School District of the City of St. Charles

9-12 Science Curriculum:

Biology I
Honors Biology
Physical Science
Chemistry
Honors Chemistry I
Physics
Honors Physics I
Environmental Science
Applied Science
Forensic Science
AP Biology
AP Chemistry/AP Chemistry Lab
AP Physics

Approved by the Board of Education

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9-12 Science Curriculum Committee

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Grades 9-12 Science Curriculum

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District Mission

The City of St. Charles School District will REACH, TEACH, and EMPOWER all students by providing a challenging, diverse, and innovative education.

District Vision

The City of St. Charles School District will be an educational leader recognized for high performance and academic excellence that prepares students to succeed in an ever-changing global society.

District Values

We, the City of St. Charles School District community of students, parents, staff, and patrons, value:

- High quality education for all students which includes:
    - Lifelong learning from early childhood through adult education
    - Rigorous learning experiences that challenge all students
    - Instruction that meets the needs of a diverse community
    - Respect for all
    - Real world, critical thinking and problem-solving skills to prepare students for the 21st Century
    - Developing caring, productive, and responsible citizens
    - Strong engagement of family and community
    - A safe, secure, and nurturing school environment

- Achievement through:
    - Celebration of individual success
    - Collaboration with parents and community stakeholders
    - Exploration, Innovation, and creativity

- High quality staff by:
    - Hiring and retaining highly qualified and invested employees
    - Providing professional development and collaboration focused on increasing student achievement
    - Empowering staff to use innovative resources and practices

- Informed decisions that are:
    - Student-centered
    - Focused on student achievement
    - Data Driven
    - Considerate of all points of view
    - Fiscally responsible

District Goals

For planning purposes, five overarching goals have been developed. These goals are statements of the key functions of the school district.

1. Student Performance
   - Develop and enhance the quality educational/instructional programs to improve student performance and enable students to meet their personal, academic, and career goals.
2. Highly qualified staff
   - Recruit, attract, develop, and retain highly qualified staff to carry out the District's mission, vision, goals, and objectives.
3. Facilities, Support, and Instructional Resource
   - Provide and maintain appropriate instructional resources, support services, and functional and safe facilities.
4. Parent and Community Involvement
   - Promote, facilitate and enhance parent, student, and community involvement in district educational programs.
5. Governance
   - Govern the district in an efficient and effective manner providing leadership and representation to benefit the students, staff, and patrons of the district.

School District Philosophical Foundations

Teachers in the School District of the City of St. Charles share in and ascribe to a philosophy that places children at the heart of the educational process. We feel that it is our professional responsibility to strive to be our best at all times and to maximize our efforts by ensuring that the following factors are present in our classrooms and our schools.

1. Learning is developed within the personal, physical, social, and intellectual contexts of the learner.
2. A strong educational program should provide developmental continuity.
3. The successful learner is motivated, strategic, knowledgeable, and interactive.
4. Children learn best when they have real purposes and can make connections to real life.
5. Effective learning is a combination of student exploration and teacher and mentor modeling.
6. Assessment is an ongoing and multidimensional process that is an integral part of instruction.
7. Making reading and writing connections across multiple sources and curricula facilitates meaning.
8. Literacy for the future means literacy in multiple technologies.
9. Education must respond to society's diverse population and serve all children.
10. Interactions among students, teachers, parents, and community form the network that supports learning.

K-12 SCIENCE SCOPE AND SEQUENCE

	Kindergarten	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	9, 10, 11
Strand 1 Matter & Energy	Properties of Matter Investigating Sound	Properties of Matter: Mass and Temperature	Properties of Rocks and Soil Forms of Energy: Sound	Investigating States of Matter Earth, Sun and Moon	Mixtures and Solutions Forms of Energy: Electrical Circuits		Physical and Chemical Properties of and Changes in Matter Forms of Energy: Heat, Electricity, Magnetism, Light and Sound Energy Transformations			Atomic Theory and Changes in Matter Energy Forms and Transfer
Strand 2 Force & Motion	Change in Position	Investigating Motion	Forces and Motion		Laws of Motion	Work and Simple Machines	Force, Motion, and Work			Interactions between Energy, Force, and Motion
Strand 3 Living Organisms	Plants and Animals Parent-Offspring Relationships	Characteristics of Plants and Animals	Life Cycles of Animals	Plants		Classification of Plants and Animals		Characteristics of Living Organisms Cells and Body Systems Disease Reproduction and Heredity		Diversity and Unity Among Organisms Cellular Processes Genetics and Heredity
Strand 4 Ecology	Weather and Seasons			Food Chains	Interactions among Organisms and their Environments			Ecosystems and Populations		Interdependence of Organisms and their Environment Matter and Energy in the Ecosystem Biological Evolution
Strand 5 Earth Systems	Weather and Seasons	Observing Water and Weather	Earth Materials: Rocks and Soil	Investigating States of Matter	Changes in the Earth's Surface	Water Cycle and Weather			Rock Cycle and Plate Tectonics Internal Processes and External Events Earth's Resources Weather and Climate	Interactions among Earth's Systems and Processes of Change Effect of Human Activity on Earth's Resources
Strand 6 Universe	Objects in the Sky			Earth, Sun, and Moon		Solar System			Objects and Their Motion in the Solar System	
Strand 7 Scientific Inquiry	Inquiry	Inquiry	Inquiry	Inquiry	Inquiry	Inquiry	Inquiry	Inquiry	Inquiry	Inquiry
Strand 8 Science, Technology, & Human Activity	Science, Technology, and Human Activity	Science, Technology, and Human Activity	Science, Technology, and Human Activity	Science, Technology, and Human Activity	Science, Technology, and Human Activity	Science, Technology, and Human Activity	Science, Technology, and Human Activity	Science, Technology, and Human Activity	Science, Technology, and Human Activity	Science, Technology, and Human Activity

K-12 Science Overview

Following the vision of Next Generation Science Standards', *A Framework for K-12 Science Education* and the Missouri Learning Standards, the City of St. Charles Science Curriculum is intended to increase coherence in our K-12 science education and embed a STEM/STEAM connected approach through an inquiry based model. The following excerpt from the *Framework* explains this methodology in more detail:

"First, it is built on the notion of learning as a developmental progression. It is designed to help children continually build on and revise their knowledge and abilities, starting from their curiosity about what they see around them and their initial conceptions about how the world works. The goal is to guide their knowledge toward a more scientifically based and coherent view of the natural sciences, as well as of the ways in which they are pursued and their results can be used.

Second, the framework focuses on a limited number of core ideas in science and engineering both within and across the disciplines allowing more time for teachers and students to explore each idea in greater depth. This gives time for students to engage in scientific investigations and argumentation and to achieve depth of understanding of the core ideas presented. Stating clearly what is to be learned about each core idea within each grade band also helps clarify what is most important to spend time on, and avoid the proliferation of detail to be learned with no conceptual grounding.

Third, the framework emphasizes that learning about science involves integration of the knowledge of scientific explanations (i.e., content knowledge) and the practices needed to engage in scientific inquiry and engineering design. Thus the framework seeks to illustrate how knowledge and practice must be intertwined in designing learning experiences in K-12 science education." – excerpted from NRC Framework for K-12 Science Education, 1-3

Strand 5: Earth Systems & Strand 6: Universe Enduring Understandings Progression

INCREASING SOPHISTICATION OF STUDENT THINKING

	K-2	3-5	6-8	9-12
The universe and its stars	Patterns of movement of the sun, moon, and stars as seen from Earth can be observed, described, and predicted	Stars range greatly in size and distance from Earth and this can explain their relative brightness	The solar system is part of the Milky Way, which is one of many billions of galaxies. Light spectra from stars are used to determine their characteristics, processes, and lifecycles. Solar activity creates the elements through nuclear fusion. The development of technologies has provided the astronomical data that provide the empirical evidence for the Big Bang theory	N/A
Earth and the solar system	N/A	The Earth's orbit and rotation, and the orbit of the moon around the Earth cause observable patterns.	The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons. Kepler's laws describe common features of the motions of orbiting objects. Observatories and space probes provide evidence for explanations of solar system formation and great distances in space.	N/A
The history of planet Earth	Some events on Earth occur very quickly; others can occur very slowly.	Certain features on Earth can be used to order events that have occurred in a landscape.	Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's early history.	N/A
Earth materials and systems	Wind and water change the shape of the land.	Four major Earth systems interact. Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around.	Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.	N/A
Plate tectonics and large-scale system interactions	Maps show where things are located. One can map the shapes and kinds of land and water in any area.	Earth's physical features occur in patterns, as do earthquakes and volcanoes. Maps can be used to locate features and determine patterns in those events.	Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history. Maps are used to display evidence of plate movement.	N/A

	K-2	3-5	6-8	9-12
The roles of water in Earth's surface processes	Water is found in many types of places and in different forms on Earth.	Most of Earth's water is in the ocean and much of the Earth's fresh water is in glaciers or underground.	Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features.	The planet's dynamics are greatly influenced by water's unique chemical and physical properties.
Weather and climate	Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region and time. People record weather patterns over time.	Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed.	Complex interactions determine local weather patterns and influence climate, including the role of the ocean.	The role of radiation from the sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. Global climate models are used to predict future changes, including changes influenced by human behavior and natural factors.
Natural resources	Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.	Energy and fuels humans use are derived from natural sources and their use affects the environment. Some resources are renewable over time, others are not.	Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes.	Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits.
Natural hazards	In a region, some kinds of severe weather are more likely than others. Forecasts allow communities to prepare for severe weather.	A variety of hazards result from natural processes; humans cannot eliminate hazards but can reduce their impacts.	Mapping the history of natural hazards in a region and understanding related geological forces.	Natural hazards and other geological events have shaped the course of human history at local, regional, and global scales.
Human impacts on Earth systems	Things people do can affect the environment but they can make choices to reduce their impacts.	Societal activities have had major effects on the land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments.	Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.	Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies.
Global climate change	N/A	N/A	Human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.	Global climate models used to predict changes continue to be improved, although discoveries about the global climate system are ongoing and continually needed.

Strand 3: Living Organisms & Strand 4: Ecology Enduring Understandings Progression

INCREASING SOPHISTICATION OF STUDENT THINKING

	K-2	3-5	6-8	9-12
Structure and function	All organisms have external parts that they use to perform everyday functions.	Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction.	All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions.	Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.
Growth and development of organisms	Parents and offspring often engage in behaviors that help the offspring survive.	Reproduction is essential to every kind of organism. Organisms have unique and diverse life cycles.	Animals engage in behaviors that increase the odds of reproduction. An organism's growth is affected by both genetic and environmental factors.	Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types.
Organization for matter and energy flow in organisms	Animals obtain food they need from plants or other animals. Plants need water and light.	Food provides animals with the materials and energy they need for body repair, growth, warmth, and motion. Plants acquire material for growth chiefly from air, water, and process matter and obtain energy from sunlight, which is used to maintain conditions necessary for survival.	Plants use the energy from light to make sugars through photosynthesis. Within individual organisms, food is broken down through a series of chemical reactions that rearrange molecules and release energy.	The hydrocarbon backbones of sugars produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy.
Information Processing	Animals sense and communicate information and respond to inputs with behaviors that help them grow and survive.	Different sense receptors are specialized for particular kinds of information; Animals use their perceptions and memories to guide their actions.	Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain; The signals are then processed in the brain, resulting in immediate behavior or memories.	N/A
Interdependent relationships in ecosystems	Plants depend on water and light to grow, and also depend on animals for pollination or to move their seeds around.	The food of almost any animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants, while decomposers restore some materials back to the soil.	Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving factors, any of which can limit their growth. Competitive, predatory, and mutually beneficial interactions vary across ecosystems but the patterns are shared.	Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem.
Cycles of matter and energy transfer in ecosystems	N/A	Matter cycles between the air and soil and among organisms as they live and die.	The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Food webs model how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.	Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem elements are combined in different ways and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle.

	K-2	3-5	6-8	9-12
Ecosystem dynamics, functioning, and resilience	N/A	When the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die.	Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.	If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.
Inheritance of traits	Young organisms are very much, but not exactly, like their parents and also resemble other organisms of the same kind.	Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops.	Genes chiefly regulate a specific protein, which affect an individual's traits.	DNA carries instructions for forming species' characteristics. Each cell in an organism has the same genetic content, but genes expressed by cells can differ
Variation of traits			In sexual reproduction, each parent contributes half of the genes acquired by the offspring resulting in variation between parent and offspring. Genetic information can be altered because of mutations, which may result in beneficial, negative, or no change to proteins in or traits of an organism.	The variation and distribution of traits in a population depend on genetic and environmental factors. Genetic variation can result from mutations caused by environmental factors or errors in DNA replication, or from chromosomes swapping sections during meiosis.
Evidence of common ancestry and diversity	N/A	Some living organisms resemble organisms that once lived on Earth. Fossils provide evidence about the types of organisms and environments that existed long ago.	The fossil record documents the existence, diversity, extinction, and change of many life forms and their environments through Earth's history. The fossil record and comparisons of anatomical similarities between organisms enables the inference of lines of evolutionary descent.	The ongoing branching that produces multiple lines of descent can be inferred by comparing DNA sequences, amino acid sequences, and anatomical and embryological evidence of different organisms.
Natural selection	N/A	Differences in characteristics between individuals of the same species provide advantages in surviving and reproducing.	Both natural and artificial selection result from certain traits giving some individuals an advantage in surviving and reproducing, leading to predominance of certain traits in a population.	Natural selection occurs only if there is variation in the genes and traits between organisms in a population. Traits that positively affect survival can become more common in a population.
Adaptation	N/A	Particular organisms can only survive in particular environments.	Species can change over time in response to changes in environmental conditions through adaptation by natural selection acting over generations. Traits that support successful survival and reproduction in the new environment become more common.	Evolution results primarily from genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. Adaptation means that the distribution of traits in a population, as well as species expansion, emergence or extinction, can change when conditions change.
Biodiversity and humans	A range of different organisms lives in different places.	Populations of organisms live in a variety of habitats. Change in those habitats affects the organisms living there.	Changes in biodiversity can influence humans' resources and ecosystem services they rely on.	Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth.

Strand 1: Matter and Energy & Strand 2: Force and Motion Enduring Understandings Progression

INCREASING SOPHISTICATION OF STUDENT THINKING

	K-2	3-5	6-8	9-12
Structure of matter	Matter exists as different substances that have observable different properties. Different properties are suited to different purposes. Objects can be built up from smaller parts.	Because matter exists as particles that are too small to see, matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials.	The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter.	The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter, including chemical reactions and nuclear processes. Repeating patterns of the periodic table reflect patterns of outer electrons. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy to take the molecule apart.
Chemical Reactions	Heating and cooling substances cause changes that are sometimes reversible and sometimes not.	Chemical reactions that occur when substances are mixed can be identified by the emergence of substances with different properties; the total mass remains the same.	Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.	Chemical processes are understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved.
Forces and motion	Pushes and pulls can have different strengths and directions, and can change the speed or direction of its motion or start or stop it.	The effect of unbalanced forces on an object results in a change of motion. Patterns of motion can be used to predict future motion. Some forces act through contact, some forces act even when the objects are not in contact. The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	The role of the mass of an object must be qualitatively accounted for in any change of motion due to the application of a force.	Newton's 2^{nd} law (F=ma) and the conservation of momentum can be used to predict changes in the motion of macroscopic objects.
Types of Interactions			Forces that act at a distance involve fields that can be mapped by their relative strength and effect on an object.	Forces at a distance are explained by fields that can transfer energy and can be described in terms of the arrangement and properties of the interacting objects and the distance between them. These forces can be used to describe the relationship between electrical and magnetic fields.
Definitions of energy	N/A	Moving objects contain energy. The faster the object moves, the more energy it has. Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents. Energy can be converted from one form to another form.	Kinetic energy can be distinguished from the various forms of potential energy. Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter.	The total energy within a system is conserved. Energy transfer within and between systems can be described and predicted in terms of energy associated with the motion or configuration of particles (objects). -- Systems move toward stable states.
Conservation of energy and energy transfer	N/A			

	K-2	3-5	6-8	9-12
Relationship between energy and forces	Bigger pushes and pulls cause bigger changes in an object's motion or shape.	When objects collide, contact forces transfer energy so as to change the objects' motions.	When two objects interact, each one exerts a force on the other, and these forces can transfer energy between them.	Fields contain energy that depends on the arrangement of the objects in the field.
Energy in chemical processes and everyday life	Sunlight warms Earth's surface.	Energy can be "produced," "used," or "released" by converting stored energy. Plants capture energy from sunlight, which can later be used as fuel or food.	Sunlight is captured by plants and used in a reaction to produce sugar molecules, which can be reversed by burning those molecules to release energy.	Photosynthesis is the primary biological means of capturing radiation from the sun; energy cannot be destroyed, it can be converted to less useful forms.
Wave properties	Sound can make matter vibrate, and vibrating matter can make sound.	Waves are regular patterns of motion, which can be made in water by disturbing the surface. Waves of the same type can differ in amplitude and wavelength. Waves can make objects move.	A simple wave model has a repeating pattern with a specific wavelength, frequency, and amplitude, and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena including sound and light. Waves can transmit energy.	The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. Waves can be used to transmit information and energy.
Electromagnetic radiation	Objects can be seen only when light is available to illuminate them.	Object can be seen when light reflected from their surface enters our eyes. -- Patterns can encode, send, receive and decode information.	The construct of a wave is used to model how light interacts with objects.	Both an electromagnetic wave model and a photon model explain features of electromagnetic radiation broadly and describe common applications of electromagnetic radiation.
Information technologies and instrumentation	People use devices to send and receive information.		Waves can be used to transmit digital information. Digitized information is comprised of a pattern of 1s and 0s.	Large amounts of information can be stored and shipped around as a result of being digitized.

Adapted from The Next Generation Science Standards and The Missouri Learning Standards

Biology I Curriculum

UNIT TITLE: Experimental Design

UNIT DURATION:

CONTENT AREA: High School Science

COURSE: Biology 9th/10th

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- Materials to come

BIG IDEA(S):

- Science understanding is developed through the use of science processes skills, scientific knowledge, scientific investigation, reasoning, and critical thinking.
- The nature of technology can advance, and is advanced by, science as it seeks to apply scientific knowledge in ways that meet human needs
- Historical and cultural perspectives of scientific explanations help to improve understanding of the nature of science and how science knowledge and technology evolve over time
- Science and technology affect, and are affected by, society

ENDURING UNDERSTANDINGS:

- Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation
- Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations
- Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings)
- The nature of science relies upon communication of results and justification of explanations
- Advances in technology often result in improved data collection and an increase in scientific information
- People of different gender and ethnicity have contributed to scientific discoveries and the invention of technological innovations
- Advances in technology often result in improved data collection and an increase in scientific information
- Scientific theories are developed based on the body of knowledge that exists at any particular time and must be rigorously questioned and tested for validity
- Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology
- Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent
- Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible

ESSENTIAL QUESTIONS:

- Can you identify the relevant parts of an experiment?
- Upon identifying a problem, can you develop an appropriate hypothesis and design an experiment to test your assumptions?
- Can you draw reasonable conclusions when analyzing collected data?
- Can you identify possible bias or significant sources of error when reflecting on an experiment?
- Are you able to format your findings, including data, into a presentable format?
- Do you understand the rationale behind retesting your results and allowing others to do so?
- Do you understand the importance of integrity in reporting your results?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 7.1.A.a	*Formulate testable questions and hypotheses*		
CLE 7.1.A.b	*Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment*		
CLE 7.1.A.c	*Design and conduct a valid experiment*		
CLE 7.1.A.d	*Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature)*		
CLE 7.1.A.e	*Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies*		
CLE 7.1.A.f	*Acknowledge there is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations*		
CLE 7.1.A.g	*Evaluate the design of an experiment and make suggestions for reasonable improvements*		

CLE 7.1.B.a	*Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)*		
CLE 7.1.B.b	*Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second*		
CLE 7.1.B.c	*Determine the appropriate tools and techniques to collect, analyze, and interpret data*		
CLE 7.1.B.d	*Judge whether measurements and computation of quantities are reasonable*		
CLE 7.1.B.e	*Calculate the range, average/mean, percent, and ratios for sets of data*		
CLE 7.1.B.f	*Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)*		
CLE 7.1.C.a	*Use quantitative and qualitative data as support for reasonable explanations (conclusions)*		
CLE 7.1.C.b	*Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable)*		
CLE 7.1.C.c	*Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions)*		
CLE 7.1.C.d	*Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)*		
CLE 7.1.D.a	*Communicate the procedures and results of investigations and explanations through: oral presentations, drawings and maps, data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities), graphs (bar, single, and multiple line), equations and writings*		
CLE 7.1.D.b	*Communicate and defend a scientific argument*		
CLE 7.1.D.c	*Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work)*		
CLE 8.1.B.a	*Recognize the relationships linking technology and science (e.g., how technological problems may create a demand for new science knowledge, how new technologies make it possible for scientists to extend research and advance science)*		
CLE 8.2.A.a	*Recognize contributions to science are not limited to the work of one particular group, but are made by a diverse group of scientists representing various ethnic and gender groups*		
CLE 8.2.A.b	*Recognize gender and ethnicity of scientists often influence the questions asked and/or the methods used in scientific research and may limit or advance science knowledge and/or technology*		
CLE 8.2.B.a	*Identify and describe how explanations (laws/principles, theories/models) of scientific phenomena have changed over time as a result of new evidence (e.g., cell theory, theories of spontaneous generation and biogenesis, theories of extinction, evolution theory, structure of the cell membrane, genetic theory of inheritance)*		
CLE 8.2.B.b	*Identify and analyze current theories that are being questioned, and compare them to new theories that have emerged to challenge older ones (e.g., theories of evolution, extinction, global warming)*		
CLE 8.3.B.a	*Analyze the roles of science and society as they interact to determine the direction of scientific and technological progress (e.g., prioritization of and funding for new scientific research and technological development is determined on the basis of individual, political and social values and needs; understanding basic concepts and principles of science and technology influences debate about the economics, policies, politics, and ethics of various scientific and technological challenges)*		
CLE 8.3.B.b	*Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research)*		
CLE 8.3.B.c	*Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, use of alternative energies for carbon fuels, use of pesticides*		
CLE 8.3.C.a	*Identify and evaluate the need for informed consent in experimentation*		
CLE 8.3.C.b	*Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment)*		
CLE 8.3.C.c	*Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)*		
CLE 8.3.D.a	*Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a scientist speaking within or outside his/her area of expertise)*		
CLE 8.3.D.b	*Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society*		

<table>
<tr><td>OBJECTIVE # 1</td><td colspan="2">Students will be able to design, conduct, and interpret the results from a valid experiment.</td></tr>
<tr><td>REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS</td><td colspan="2">7.1.A.a-g, 7.1.B.a-f, 7.1.C.a-d, 7.1.D.a-c, 8.1.B.a, 8.2.A.a-b, 8.2.B.a-b, 8.3.B.a-c, 8.3.C.a-c, 8.3.D.a-b</td></tr>
<tr><td colspan="3">WHAT SHOULD STUDENTS…</td></tr>
<tr><td>UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.</td><td>KNOW?
Facts, Names, Dates, Places, Information,
ACADEMIC VOCABULARY</td><td>BE ABLE TO DO?
Skills; Products</td></tr>
<tr><td>is able to formulate a testable question and hypothesis, with a possible explanation (If… then…) and includes the independent and dependent variables in the statement.
identifies the components, like independent variable, dependent variable, controls and constants and explains their importance to the design of a valid experiment.
interpret or predict the outcome based on information provided in a graph.</td><td>recognizes or recalls specific terminology such as:
experiment, observation, question, hypothesis, independent variable, dependent variable, constant, control group, data, results, conclusion, theory,
performs basic processes, such as:
identifies the components of a valid experiment.
defines terms such as dependent variable, independent variable, constants and control variable.
can label x and y- axis on a graph appropriately with an accurate title</td><td>designs (and or tests) a valid experiment, and can explain the importance of the components within their experiment. Must include their collected data in an appropriately labeled graph.</td></tr>
<tr><td colspan="3">FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING</td></tr>
<tr><td>TEACHER INSTRUCTIONAL ACTIVITY</td><td>STUDENT LEARNING TASK</td><td>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</td></tr>
<tr><td>present situations that require testing
present benchmark studies with historical significance
introduce applicable technologies
propose situations with breaches of scientific integrity</td><td>develop a valid experiment
identify components of the experiment
apply and identify relevant and future science testing technology based on type of test required
identify the sources of bias or error and what effect it has on experimental outcomes</td><td>2- Skill/Concept or 3- Strategic Thinking or 4- Extended Thinking
2-Skill/Concept
3- Strategic Thinking or 4- Extended Thinking
3- Strategic Thinking</td></tr>
<tr><td>INTERDISCIPLINARY CONNECTION</td><td>PRIOR KNOWLEDGE CONNECTIONS</td><td>INQUIRY CONNECTIONS</td></tr>
</table>

• historical scientists/philosophers • reading about landmark studies/findings • health industry and occupations • governmental regulations • scientific literacy	• disease • science, technology, and human activity	• identify a problem and design an original experiment
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Classic experiments • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Identify a pertinent local issue and design/develop an experiment looking for the cause • Additional resources used in Honors Biology	• Conduct research, design an experiment, collect data, analyze results, and formulate an action plan going forward • Reinforcement of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

UNIT TITLE: Cell Structure and Function **UNIT DURATION:**	**CONTENT AREA: High School Science** **COURSE: Biology 9th/10th**

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- Materials to come

BIG IDEA(S):

- **Changes in properties and states of matter provide evidence of the atomic theory of matter**
- **There is a fundamental unity underlying the diversity of all living organisms**
- **Living organisms carry out life processes in order to survive.**
- **There is a genetic basis for the transfer of biological characteristics from one generation to the next through reproductive processes**
- **Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical thinking**
- **The nature of technology can advance, and is advanced by, science as it seeks to apply scientific knowledge in ways that meet human needs**
- **Historical and cultural perspectives of scientific explanations help to improve understanding of the nature of science and how science knowledge and technology evolve over time**
- **Science and technology affect, and are affected by, society**

ENDURING UNDERSTANDINGS:

- **Mass is conserved during any physical or chemical change**
- **Organisms progress through life cycles unique to different types of organisms**
- **Cells are the fundamental units of structure and function of all living things.**
- **The cell contains a set of structures called organelles that interact to carry out life processes through physical and chemical means**
- **Photosynthesis and cellular respiration are complementary processes necessary to the survival of most organisms on Earth**
- **Cells carry out chemical transformations that use energy for the synthesis or breakdown of organic compounds**
- **Protein structure and function are coded by the DNA (Deoxyribonucleic acid) molecule**
- **Cellular activities and responses can maintain stability internally while external conditions are changing (homeostasis)**
- **Reproduction can occur asexually or sexually**
- **All living organisms have genetic material (DNA) that carries hereditary information**
- **Chromosomes are components of cells that occur in pairs and carry hereditary information from one cell to daughter cells and from parent to offspring during reproduction**
- **There is heritable variation within every species of organism**
- **The pattern of inheritance for many traits can be predicted by using the principles of Mendelian genetics**

ESSENTIAL QUESTIONS:

- How do you distinguish prokaryotes from eukaryotes?
- What organelles have essential functions in eukaryotic cells?
- What are the different mechanisms of cellular transport?
- How do different organisms get energy for cellular functions?
- How do photosynthesis and cellular respiration affect one another?
- What is the importance of DNA in living things?
- What advantages do asexual vs sexual reproduction offer?
- How are mitosis and meiosis used in multicellular organisms?
- What importance do proteins have in living things?
- How are instructions in DNA used to make proteins?
- How do changes in DNA lead to changes in an organism?
- How are traits inherited in sexual reproducers?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.e. *GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 3.1.B.a	*Recognize cells both increase in number and differentiate, becoming specialized in structure and function, during and after embryonic development*		x
CLE 3.1.B.b	*Identify factors (e.g., biochemical, temperature) that may affect the differentiation of cells and the development of an organism*		x
CLE 3.1.C.a	*Recognize all organisms are composed of cells, the fundamental units of structure and function*		x
CLE 3.1.C.b	*Describe the structure of cell parts (e.g., cell wall, cell membrane, cytoplasm, nucleus, chloroplast, mitochondrion, ribosome, vacuole) found in different types of cells (e.g., bacterial, plant, skin, nerve, blood,*		x

	muscle) and the functions they perform (e.g., structural support, transport of materials, storage of genetic information, photosynthesis and respiration, synthesis of new molecules, waste disposal) that are necessary to the survival of the cell and organism			
CLE 3.2.A.a	Compare and contrast the structure and function of mitochondria and chloroplast			x
CLE 3.2.A.b	Compare and contrast the structure and function of cell wall and cell membranes			x
CLE 3.2.A.c	Explain physical and chemical interactions that occur between organelles (e.g. nucleus, cell membrane, chloroplast, mitochondrion, ribosome) as they carry out life processes			x
CLE 3.2.B.a	Explain the interrelationship between the processes of photosynthesis and cellular respiration (e.g., recycling of oxygen and carbon dioxide), comparing and contrasting photosynthesis and cellular respiration reactions (Do NOT assess intermediate reactions)	x		
CLE 3.2.B.b	Determine what factors affect the processes of photosynthesis and cellular respiration (i.e., light intensity, availability of reactants, temperature)			x
CLE 3.2.D.a	Summarize how energy transfer occurs during photosynthesis and cellular respiration as energy is stored in and released from the bonds of chemical compounds (i.e. ATP)		x	
CLE 3.2.D.b	Relate the structure of organic compounds (e.g., proteins, nucleic acids, lipids, carbohydrates) to their role in living systems		x	
CLE 3.2.D.c	Recognize energy is absorbed or released in the breakdown and/or synthesis of organic compounds		x	
CLE 3.2.D.d	Explain how protein enzymes affect chemical reactions (e.g., the breakdown of food molecules, growth and repair, regulation)		x	
CLE 3.2.D.e	Interpret a data table showing the effects of an enzyme on a biochemical reaction		x	
CLE 3.2.E.a	Explain how the DNA code determines the sequence of amino acids necessary for protein synthesis	x		
CLE 3.2.E.b	Recognize the function of protein in cell structure and function (i.e., enzyme action, growth and repair of body parts, regulation of cell division and differentiation)		x	
CLE 3.2.F.a	Explain the significance of the selectively permeable membrane to the transport of molecules	x		
CLE 3.2.F.b	Predict the movement of molecules across a selectively permeable membrane (i.e., diffusion, osmosis, active transport) needed for a cell to maintain homeostasis given concentration gradients and different sizes of molecules	x		
CLE 3.2.F.c	Explain how water is important to cells (e.g., is a buffer for body temperature, provides soluble environment for chemical reactions, serves as a reactant in chemical reactions, provides hydration that maintains cell turgidity, maintains protein shape)		x	
CLE 3.3.A.a	Distinguish between asexual (i.e., binary fission, budding, cloning) and sexual reproduction	x		
CLE 3.3.B.a	Describe the chemical and structural properties of DNA (e.g., DNA is a large polymer formed from linked subunits of four kinds of nitrogen bases; genetic information is encoded in genes based on the sequence of subunits; each DNA molecule in a cell forms a single chromosome) (Assess the concepts – NOT memorization of nitrogen base pairs)	x		
CLE 3.3.B.b	Recognize that DNA codes for proteins, which are expressed as the heritable characteristics of an organism	x		
CLE 3.3.B.d	Explain how an error in the DNA molecule (mutation) can be transferred during replication		x	
CLE 3.3.B.e	Identify possible external causes (e.g., heat, radiation, certain chemicals) and effects of DNA mutations (e.g., altered proteins which may affect chemical reactions and structural development)		x	
CLE 3.3.C.a	Recognize the chromosomes of daughter cells, formed through the processes of asexual reproduction and mitosis, the formation of somatic (body) cells in multicellular organisms, are identical to the chromosomes of the parent cell		x	
CLE 3.3.C.b	Recognize that during meiosis, the formation of sex cells, chromosomes are reduced to half the number present in the parent cell		x	
CLE 3.3.C.c	Explain how fertilization restores the diploid number of chromosomes		x	
CLE 3.3.C.d	Identify the implications of human sex chromosomes for sex determination		x	
CLE 3.3.D.a	Describe the advantages and disadvantages of asexual and sexual reproduction with regard to variation within a population		x	
CLE 3.3.D.b	Describe how genes can be altered and combined to create genetic variation within a species (e.g., mutation, recombination of genes)		x	
CLE 3.3.E.a	Explain how genotypes (heterozygous and homozygous) contribute to phenotypic variation within a species	x		
CLE 3.3.E.b	Predict the probability of the occurrence of specific traits, including sex-linked traits, in an offspring by using a monohybrid cross		x	

CLE 3.3.E.c	*Explain how sex-linked traits may or may not result in the expression of a genetic disorder (e.g., hemophilia, muscular dystrophy, color blindness) depending on gender*		x

OBJECTIVE # 2	**Student will understand the structure, function, and importance of cells.**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.1.B.a-b, 3.1.C.a-b, 3.2.A.a-c	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• **Describes the steps of the protein export pathway** • **Distinguishes the role of different organelles in a eukaryotic or prokaryotic cell and is able to relate them to the overall function of the cell.** • **Compare and contrast plant and animal cells.**	• **(membrane-bound) organelle, nucleus, nuclear membrane (envelope), ribosome, cytoplasm, cell wall, cell (plasma) membrane, chloroplast, mitochondria** • **Differentiate between eukaryotic and prokaryotic cells**	• **Student should be able to predict how changing cell functions affect the organism.**
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Is it living? • Prokaryote/Eukaryote microscope lab • Cell Analogy • Venn Diagram of prokaryotes and eukaryotes • Animal and Plant Cell Diagrams • Cell Models • Student generated questions	• Students use criteria to determine if an object are living or non-living • Using living or prepared cells to enforce structure and function of organelles. • Students use prior knowledge of world concepts to determine the function of cell parts • Compare size and complexity of prokaryotes and eukaryotes • Compare organelles of animal and plant cells • Use their knowledge of cell structure and function of organelles to build a cell model	• 1 - Recall • 2- Skill/Concept • 3- Strategic thinking/ 4- Extended Thinking • 2- Skill/Concept • 2- Skill/Concept • 3- strategic thinking/ 4- extended thinking
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Cell City Analogy requires use of analogies, a literary device.	• Characteristics of Living Organisms • Cells and Body Systems • Inquiry • Science Technology, and Human Activity •	• Where can you find cells? bacteria culturing
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Cell City Analogy • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Formative • Summative • Summative	• 3 • 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Disease/disorder research project** • Additional resources used in Honors Biology	• **Research a disease that affects a cell organelle** • **Reinforcement of acquired knowledge**	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 3	Student will understand how cells move molecules in and out of the cell membrane.	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.2.F.a-c	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Recognizes how different substances move across the membrane • Can determine if the transport process use energy • Can identify the specific processes: • Facilitated diffusion, protein pump, exocytosis, endocytosis	• active transport, passive transport, diffusion, osmosis, concentration gradient • Can differentiate between active and passive transport • Locates the region of higher concentration for a molecule	• Determine how molecules are moving in reference to the materials provided and can describe if energy is being used.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Osmosis lab • manipulatives • practice worksheets • comparing and contrasting active and passive transport • student generated questions	• Students will set up an experiment and observe the movement of water in different concentrations • Identify the concentration gradient and kinesthetically practice the movement of molecules across a membrane • identify if each process requires energy • practice vocabulary and identifying movement of molecules	• 2- skill/concept, 3- strategic thinking • 1- Recall, 2- skill/concept • 1- Recall • 1- Recall • 3- strategic thinking/ 4- extended thinking

INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**Inquiry Connections**
•	• Cells and Body Systems • Inquiry • Science, Technology, and Human Activity	• Egg Tonicity
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 2, 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• • Additional resources used in Honors Biology	• • Reinforcement of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 4	Students will understand how organisms generate and utilize energy using cellular respiration and photosynthesis	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• CLE 1.1.I.a, 3.2.B.a-b, 3.2.D.a-e,	
	WHAT SHOULD STUDENTS…	
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Identify the products and reactants in photosynthesis and cellular respiration. • Illustrate how photosynthesis and cellular respiration form a cycle (one process uses the products of the other) • Differentiate between aerobic and anaerobic respiration • Recognize how cells recycle ATP	• recognizes or recalls specific terminology such as: glucose, oxygen, cellular respiration, mitochondria, carbohydrate, photosynthesis, anaerobic respiration, fermentation, mitochondria, chloroplast, ATP • performs basic processes, such as: understand energy is released in the breakdown of glucose.	• Produce a diagram or model describing or depicting the steps of both cellular respiration and photosynthesis. Specifically, showing the flow of products and reactants between the two energy processes. This should show a clear understanding of the interdependence between the metabolic process.
	FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING	
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Yeast digestion lab** • **Photosynthesis webquest** • **Exercise Lab** • **Elodea Lab** • **Metabolism Venn Diagram**	• Observe the respiratory pathway • Variables that affect photosynthesis • Understand the relationship between production of carbon dioxide and increased activity • Observe the photosynthetic pathway • Examine interdependence of processes	• 2-Skill/Concept • 2-Skill/Concept • 3-Strategic Thinking • 3-Strategic Thinking • 2-Skill/Concept
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	
• economic impact	• forms of Energy: Light and Sound • energy Transformation • characteristics of Living Organisms • inquiry	
	HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?	
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 2, 3 or 4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Photosynthesis and Respiration Cycle diagram • Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	• 1-recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Create your own respiration or photosynthesis experiment or video • Additional resources used in Honors Biology	• Reinforcement and expand of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 5	**Students will be able to describe the structure of DNA and understand the replication process.**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.3.B.a	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• generalize that the genetic information in DNA is determined by the order of nucleotides
• relates the importance of the sequence of DNA to the function of proteins
• explain the steps of DNA replication (unzipped and copied).
• describe that DNA is replicated during interphase to ensure each cell receives an identical copy of genes
	• recognizes or recalls specific terminology such as:
	  • adenine, thymine, guanine, cytosine, nucleotide, DNA(deoxyribonucleic acid), double helix, DNA replication, enzyme (Helicase, DNA Polymerase)
	performs basic processes, such as:
	  • identify the structure of DNA as a double helix
	  • correctly pair the bases of a DNA molecule
	  • determine the three components of a nucleotide
	  • DNA is the basic genetic information contained in every cell
	  • know the functions of all the different RNA types
		• construct their own model of a DNA molecule including a replication fork, and the enzymes involved in replication.
		• explain the roles of different enzymes in replication, and can predict the outcome of their absence.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• act out replication • build DNA model(s) • research chromosomal disorders • discuss classic DNA experiments • analyze the composition concerning the double helical nature of a DNA molecule • use a karyotype to diagnose possible disorders	• characterize the role of each component in DNA replication • study 3-dimensional structure of DNA • identify factors that lead to errors in DNA and their subsequent consequences • distinguish between theories of replication • understands fundamental principles of nucleotides (base pairing, sugar-phosphate backbone, etc.) • understand the relationship between number of chromosomes and possible diseases	• 3- Strategic thinking • 3- Strategic thinking • 4- Extended thinking • 2- Skill/Concept • 1- Recall • 2- Skill/Concept
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• basic statistical analysis	• characteristics of living organisms • disease • inquiry • science, technology, and human activity	• DNA extraction lab
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Chromosomal Research Assignment • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Formative • Summative • Summative	• 4 • 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards	• Review material at own pace with guided assistance as needed	1- Recall

• Reinforcing worksheets or activities • Corrections to previous work		

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Disease/disorder research project • Additional resources used in Honors Biology	• Research a disease that affects a cell genetic or chromosomal disorder • Reinforcement of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 6	**Students understand mechanisms of cellular reproduction**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.3.A.a, 3.3.C.a-d, 3.3.D.a-b	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• That one parent cell of a somatic cell creates two identical daughter cells
• The advantages and disadvantages of sexual and asexual reproduction
• That each somatic cell contains the same amount of chromosomes as the original cell
• That meiosis reduces the amount of chromosomes by half when gametes are formed
• That in meiosis, four non-identical daughter cells are made (crossing-over and independent assortment)
• The components of the cell cycle
	• recognizes or recalls specific terminology such as: chromosome, mitosis, cytokinesis, diploid, haploid, somatic cell, gamete cell, fertilization, zygote, meiosis
	• performs basic processes, such as:
	  ◦ differentiate between somatic(diploid) and gamete (haploid) cells
	  ◦ differentiate between sexual and asexual reproduction
	  ◦ differentiate between the processes of mitosis and meiosis
	  ◦ demonstrate that fertilization restores the diploid number of chromosomes in a zygote
		• Demonstrate microscope competency when identifying cellular samples.
		• Identify what happens in each phase of mitosis and meiosis
		• Identify the regulatory role of proofreading mechanisms during cell division in cancer cells

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Asexual vs Sexual Reproduction • Chromosome LARP • Microscope lab-onion root tip, whitefish blastula, drosophila chromosomes, etc.	• Identify mechanism of reproduction • Identify movement of genes during cell division • Visualize chromosome activity in various cells	• 2 • 3 • 2/3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**Inquiry Connections**
• Stem cell research • In-vitro fertilization	• Reproduction and Heredity • Inquiry	Why are some species more complex than others?

	• Science, Technology, and Human Activity	
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Bellringers • Exit Slips • Quick checks • Microscope competency practical • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • 2 • all levels • 2, 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Mitosis and meiosis diagram • Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	• 1-recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Diagram the phases of mitosis • Diagram the phases of meiosis • Stem cell differentiation article	• Identify and differentiate the processes of cellular division • Connect the process of cell to division to the uses of stem cells	• 2 • 3/4

OBJECTIVE # 7	Students will be able to	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.2. E. a-b, 3.3.B. a-e, 3.3.D. a-c	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Summarize the processes of transcription and translation and explain the importance of each process in the production of proteins. • Determine the order of amino acids in a protein given a strand of DNA.	• ribonucleic acid (RNA), gene expression (protein synthesis), transcription, translation, RNA polymerase, ribosome, messenger RNA (mRNA), transfer RNA (tRNA), codon, anticodon, amino acid, protein, mutation	• Discuss the significance of protein synthesis on how species might change over time. • Given a specific protein's function, predict

• Relates that a change in the order of amino acids in a protein will change the shape and function of the protein as a result of a mutation	• Compare the structure of DNA and RNA • Identify a picture/diagram of the processes of transcription translation, and label the steps	how a mutation would affect the organism.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Transcription and Translation Practice • Practice with models • Decoding Proteins Lab	• Determine mRNA and coordinating amino acids. • Manipulate the processes of Protein Synthesis and relate the importance of protein production • Act out transcription and translation in the process of creating a protien.	• 2 • 2/3 • 2/3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	
•		
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 2, 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	• 1-Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Create your own protein synthesis experiment or video • Additional resources used in Honors Biology	• Reinforcement and expand of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 8	Students will be able to predict possible outcomes based on observed patterns of heredity.	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.3.E.a-c	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• given the phenotypes or genotypes of two parents, be able to analyze the possible outcome of monohybrid genetic cross.
• upon completion of a monohybrid cross, the student can demonstrate understanding that the results of that cross are the probabilities of specific traits an organism could inherit.
	• recognizes or recalls specific terminology such as:
	  ◦ gene, trait, dominant, recessive, allele, punnett square, genetics, heredity, phenotype, genotype, homozygous, heterozygous,
	• performs basic processes, such as:
	  ◦ complete a punnett square with the parents already determined
		• create a genetic cross and then determine the possible outcomes. Explain what genotypes and phenotypes will result and be able to relate that to the parent's genotypes using key terminology.
		• given a pedigree, can determine mode of inheritance.
		• differentiate between the different modes of inheritance such as codominance and incomplete dominant and determine the probable outcome.
		• given a trait, can determine what type of dominance it represents.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• model Punnett Square • model pedigrees • Add Activities???	• observe patterns of inheritance and be able to predict probabilities amongst offspring • examine how traits can be present in different generations with varying frequency	• 3- Strategic Thinking or 4- Extended Thinking • 3- Strategic Thinking or 4- Extended Thinking
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• basic statistical analysis	• reproduction and Heredity • inquiry • disease • science, technology, and human activity	• family trait activity • blood typing lab
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Punnett Square • Pedigree • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Impact of epigenetics on gene regulation • Additional resources used in Honors Biology	• Research recent theories in the field of epigenetics and how it applies to a selected gene of their choice • Reinforcement of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

UNIT TITLE: Ecology UNIT DURATION:	CONTENT AREA: High School Science COURSE: Biology 9th/10th

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• **Materials to come**	• **Changes in properties and states of matter provide evidence of the atomic theory of matter** • **Energy had a source, can be stored, and can be transferred but is conserved within system** • **Organisms are interdependent with one another and their environment** • **Matter and energy flow through the ecosystem** • **Human activity is dependent upon and affects Earth's resources and systems** • **The universe has observable properties and structures**
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Mass is conserved during any physical or chemical change • Energy can be transferred within a system as the total amount of energy constant (i.e., The Law of Conservation of Energy) • All populations living together within a community interact with one another and with their environment in order to survive and maintain a balanced ecosystem • Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite • All organisms, including humans, and their activities cause changes in their environment that affect the ecosystem • The diversity of species within an ecosystem is affected by changes in the environment, which can be caused by other organisms or outside processes • As energy flows through the ecosystem, all organisms capture that energy and transform it to a form they can use • Matter is recycled through and ecosystem • Earth's materials limited natural resources affected by human activity • The Earth has a composition and location suitable to sustain life	• How does energy flow from the Sun through Earth's ecosystems? • How are matter and energy are recycled through ecosystems? • How are all living and nonliving parts of Earth's ecosystems interconnected? • How is the diversity of ecosystems affected by internal and external factors?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 1.1.I.a	*Compare the mass of the reactants to the mass of the products in a chemical reaction or physical change (e.g., biochemical processes, carbon dioxide-oxygen cycle, nitrogen cycle, decomposition and synthesis reactions involved in a food web) as support for the Law of Conservation of Mass*		
CLE 1.2.F.a	*Classify the different ways to store energy (i.e., chemical, nuclear, thermal, mechanical, electromagnetic) and describe the transfer of energy as it changes from kinetic to potential, while the total amount of energy remains constant, within a system (e.g., biochemical processes, carbon dioxide-oxygen cycle, nitrogen cycle, food web)*		
CLE 4.1.A.a	*Explain the nature of interactions between organisms in predator/prey relationships and different symbiotic relationships (i.e., mutualism, commensalisms, parasitism)*		
CLE 4.1.A.b	*Explain how cooperative (e.g., symbiotic) and competitive (e.g., predator/prey) relationships help maintain balance within an ecosystem*		
CLE 4.1.A.c	*Explain why no two species can occupy the same niche in a community*		
CLE 4.1.B.a	*Identify and explain the limiting factors (biotic and abiotic) that may affect the carrying capacity of a population within an ecosystem*		
CLE 4.1.B.b	*Predict how populations within an ecosystem may change in number and/or structure in response to hypothesized changes in biotic and/or abiotic factors*		
CLE 4.1.C.a	*Devise a multi-step plan to restore the stability and/or biodiversity of an ecosystem when given a scenario describing the possible adverse effects of human interactions with that ecosystem (e.g., destruction caused by direct harvesting, pollution, atmospheric changes)*		
CLE 4.1.C.b	*Predict and explain how natural or human caused changes (biological, chemical and/or physical) in one ecosystem may affect other ecosystems due to natural mechanisms (e.g., global wind patterns, water cycle, ocean currents)*		

CLE 4.1.D.a	*Predict the impact (beneficial or harmful) a natural or human caused environmental event (e.g., forest fire, flood, volcanic eruption, avalanche, acid rain, global warming, pollution, deforestation, introduction of an exotic species) may have on the diversity of different species in an ecosystem*		
CLE 4.1.D.b	*Describe possible causes of extinction of a population*		
CLE 4.2.A.a	*Illustrate and describe the flow of energy within a food web*		
CLE 4.2.A.b	*Explain why there are generally more producers than consumers in an energy pyramid*		
CLE 4.2.A.c	*Predict how the use and flow of energy will be altered due to changes in a food web*		
CLE 4.2.B.a	*Explain the processes involved in the recycling of nitrogen, oxygen, and carbon through an ecosystem*		
CLE 4.2.B.b	*Explain the importance of the recycling of nitrogen, oxygen, and carbon within an ecosystem*		
CLE 5.3.A.a	*Predict local and/or global effects of environmental changes when given a scenario describing how the composition of the geosphere, hydrosphere, or atmosphere is altered by natural phenomena or human activities*		
CLE 6.1.B.a	*Explain how Earth's environmental characteristics and location in the universe (e.g., atmosphere, temperature, orbital path, magnetic field, mass-gravity, location in solar system) provide a life-supporting environment*		

OBJECTIVE # 10	**Student will understand energy transfer within ecosystems**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 1.1.I.a, 1.2.F.a, 4.2.A.a-c, 4.2.B.a-b	
	WHAT SHOULD STUDENTS…	
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• Explain the biotic and abiotic factors that constitute an ecosystem.
• Create a food web that demonstrates all of the levels of organisms in an ecosystem.
• Analyze the energy transfer in an energy pyramid, and calculate the total energy a consumer at the top of the pyramid is consuming.
	• recognizes or recalls specific terminology such as:
	  • ecosystem, biotic factors, abiotic factors, producers, consumers, trophic level, food chain, primary producers, primary consumers, herbivores, secondary consumers, detritivores, tertiary consumers, food web, energy pyramid
	performs basic processes, such as:
	  • can list abiotic and biotic factors in an environment
	  • can make a food chain with a producer, primary consumer and secondary consumer
	  • can indicate which way energy flows on an energy pyramid and demonstrates their understanding of gain/loss of energy throughout the different levels of the pyramid
		• Students can demonstrate their understanding of food webs and energy pyramid are interrelated.

	FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING	
TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Constructing a food chain/web • Trophic levels of food pyramid • Analysis of a Missouri food web • Producer and consumer relationships (ie. herbivores, omnivores, carnivores, detritivores, scavengers)	• Students are able to appropriately depict the transfer of energy through trophic levels • Understand how energy is transferred and lost between prey and predators • Identify the interrelatedness between organisms in a food web • Understand predator/prey relationships	• 3- Strategic thinking • 2- Skill/Concept • 3- Strategic thinking • 2- Skill/Concept

<table>
<tr><td>INTERDISCIPLINARY CONNECTION</td><td>PRIOR KNOWLEDGE CONNECTIONS</td><td>INQUIRY CONNECTIONS</td></tr>
<tr><td>• Ecological geography</td><td>• Ecosystems and Populations
• Inquiry
• Science, Technology, and Human Activity</td><td>• What occurs when invasive species are introduced?</td></tr>
<tr><td colspan="3">HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?</td></tr>
<tr><td>ASSESSMENT DESCRIPTION</td><td>FORMATIVE OR SUMMATIVE?</td><td>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</td></tr>
<tr><td>• Construct a food web
• Bellringers
• Exit Slips
• Quick checks
• Objective Test
• Student Generated Assessment</td><td>• Formative
• Formative
• Formative
• Formative
• Summative
• Summative</td><td>• 2
• 1 or 2
• 1 or 2
• 1 or 2
• all levels
• 3 or 4</td></tr>
<tr><td colspan="3">HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?
Possible Interventions</td></tr>
<tr><td>TEACHER INSTRUCTIONAL ACTIVITY</td><td>STUDENT LEARNING TASK</td><td>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</td></tr>
<tr><td>• Post videos of lectures to Youtube
• Flashcards/Task cards
• Reinforcing worksheets or activities
• Corrections to previous work</td><td>• Review material at own pace with guided assistance as needed</td><td>• 1- Recall</td></tr>
<tr><td colspan="3">HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?
Possible Extensions/Enrichments</td></tr>
<tr><td>INSTRUCTIONAL ACTIVITY/METHOD</td><td>STUDENT LEARNING TASK</td><td>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</td></tr>
<tr><td>• Research an invasive species and the niche that it fills in the environment
• Additional resources used in Honors Biology</td><td>• Understand that when species fill the same niche, there is competition
• Reinforcement of acquired knowledge</td><td>• 4- extended thinking
• 3- strategic thinking/ 4- extended thinking</td></tr>
</table>

OBJECTIVE # 11	Students will understand the characteristics of different populations of living organisms and how they change.	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 4.1.A. a-c, 4.1.B. a-b, 6.1.B. a	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Predict the outcome when two species are forced to occupy the same niche • List examples of the three types of symbiosis • Identify if an environmental factor is population density dependent or independent • Describe population growth as exponential or logistic	• ecology, habitat, population, community, ecosystem, biodiversity, competitive exclusion, symbiosis, mutualism, commensalism, parasitism, ecological succession • Identify the carrying capacity for a population	• Explain how changes in the balance of populations would affect the rest of the community. (Include if those factors are density dependent or independent and how they affect the growth patterns of those populations.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Graphing population growth patterns • Concept map- density dependent and independent factors	• Visualize the effects of symbiotic relationships on changes in population size • Distinguish the different types of factors that affect populations. Make predictions on how those factors would affect population dynamics	• 2/3 • 2/3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	
•	• Inquiry • Disease • Ecosystems and Populations	
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Graphing Activity • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Formative • Summative • Summative	• 1, 2, or 3 • 1 or 2 • 1 or 2 • 1 or 2 • all levels • 2, 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?		

Possible Interventions		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Prepare a video/presentation that shows understanding of population dynamics • Additional resources used in Honors Biology	• Student-led inquiry • Reinforcement of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 12	Student will understand how humans impact the environment.	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 4.1.C.a-b, 4.1D.a-b, 5.3.A.a	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• describe the evidence of climate change and its implications for the future • relate changes in biodiversity resulting from human impact • list and expound upon the causes of habitat destruction and pollution	• understand the factual basis of climate change • identify different forms of pollution • define biodiversity, adaptation, invasive species, habitat destruction	• Using information learned from this unit, identify and describe the impact that green technologies can, and are, having on natural ecosystems
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Types of pollution-noise, oil, runoff, trash, light • Keeling curve analysis • Global warming and altered weather patterns • Alternate energy resources	• Students analyze how humans contribute to various types of pollution • Relate the data obtained from the Keeling curve to analyze trends in CO2 output • Critique trends in weather patterns and relate it to climate change • Discuss fossil fuel alternatives and possible future implications	• 1 - Recall/2- Skill/Concept • 3- Strategic thinking/ 4- Extended Thinking • 3- Strategic thinking/ 4- Extended Thinking • 2- Skill/Concept/3-Strategic thinking
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Sociology	• Ecosystems and Populations • Inquiry • Science Technology, and Human Activity	• Design an energy efficient structure.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Keeling Curve Analysis • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Formative • Summative • Summative	• 3 • 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Calculate their own carbon footprint • Design a plan for a school to become energy efficient.	• **Reflect on personal environmental impact** • **Reinforcement of acquired knowledge**	• 3=Strategic Thinking • 3=Strategic Thinking/4-Extended Thinking

UNIT TITLE: Evolution UNIT DURATION:	CONTENT AREA: High School Science COURSE: Biology

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
•	• There is a fundamental unity underlying the diversity of all living organisms. • There is a genetic basis for the transfer of biological characteristics from one generation to the next through reproductive processes. • Genetic variation sorted by the natural selection process explains evidence of biological evolution.
ENDURING UNDERSTANDINGS: • Biological classifications are based on how organisms are related. • There is heritable variation within every species of organism. • Evidence for the nature and rates of evolution can be found in anatomical and molecular characteristics of organisms and in the fossil record. • Reproduction is essential to the continuation of every species. • Natural selection is the process of sorting individuals based on their ability to survive and reproduce within their ecosystem.	**ESSENTIAL QUESTIONS:** • How does the mechanism of natural selection help drive evolution? • What are examples of evidence for evolution? • What are ways in which current populations can evolve over time?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD	
CLE 3.1.E.a.	*Explain how similiarities used to group taxa might reflect evolutionary relationships (e.g., similarities in DNA and protein structures, internal anatomical features, patterns of development*		x	
CLE 3.1.E.b.	*Explain how and why the classification of any taxon might change as more is learned about the organisms assigned to that taxon.*			x
CLE 3.3.D.c.	*Recognizes that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an orgnaism's sex cells.*			x
CLE 4.3.A.a.	*Interpret fossil evidence to explain the relatedness of organisms using the principles of superposition and fossil correlation*		x	
CLE 4.3.A.b.	*Evaluate the evidence that supports theory of biological evolution (e.g., fossil records, similarities between DNA and protein structures, similarities between developmental stages of organisms, homologous and vestigial structures)*		x	
CLE 4.3.B.a.	*Define a species in terms of the ability to mate and produce fertile offspring*			x
CLE 4.3.B.b.	*Explain the importance of reproduction to the survival of a species (i.e., the failure of a species to reproduce will lead to extinction of that species.*		x	
CLE 4.3.C.a.	*Identify examples of adaptations that may have resulted from variations favored by natural selection (e.g., long-necked giraffes, long-eared jack rabbits) and describe how that variation may have provided populations an advantage for survival*		x	
CLE 4.3.C.b.	*Explain how genetic homogeneity may cause a population to be more susceptible to extinction (e.g., succumbing to a disease for which there is no natural resistance)*		x	
CLE 4.4.C.c.	*Explain how environmental factors (e.g., habitat loss, climate change, pollution, introduction of non-native species) can be agents of natural selection*		x	
CLE 4.4.C.d.	***Given a scenario describing an environmental change, hypothesize why a given species was unable to survive***		x	

OBJECTIVE # 9	**Students will be able to understand how populations change over time.**
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.1.E.a-b, 3.3.D.c, 4.3.A.a-b, 4.3.B.a-b, 4.3.C.a-d

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Explain how natural selection could affect a specific population. • Given a specific example of evidence, describe how it supports the theory of evolution.	• selection, Darwin, variation, inheritance, adaptation, fitness, overproduction, speciation • Identify evidence of evolution (comparative anatomy, fossil record, embryology, common genetics)	• Given a scenario describing an environmental change, hypothesize why a given species was unable to survive • Using the evidence, apply it to a given population and predict how the population could change in the future.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Natural Selection Lab	• Experience how natural selection may occur by using different tools to enable survival	• 2/3
• Peppered Moth Simulation	• Understand how different physical adaptations increases an organism's chance of survivial	• 2
	• Interpret the process of natural selection given a specific example of a population with inheritable variances	
• Natural Selection Diagrams		• 2
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
•	• Characteristics of Living Organisms • Reproduction and Heredity	• Using a computer animated simulation, students can infer how species change over time.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Bellringers	• Formative	• 1 or 2
• Exit Slips	• Formative	• 1 or 2
• Quick checks	• Formative	• 1 or 2
• Objective Test	• Summative	• all levels
• Student Generated Assessment	• Summative	• 2, 3 or 4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?
Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	• 1-Recall

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Create your own protein synthesis experiment or video • Additional resources used in Honors Biology	• Reinforcement and expand of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

Honors Biology Curriculum

UNIT TITLE: Experimental Design UNIT DURATION:	CONTENT AREA: High School Science COURSE: Biology 9th/10th

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Materials to come	• Science understanding is developed through the use of science processes skills, scientific knowledge, scientific investigation, reasoning, and critical thinking. • The nature of technology can advance, and is advanced by, science as it seeks to apply scientific knowledge in ways that meet human needs • Historical and cultural perspectives of scientific explanations help to improve understanding of the nature of science and how science knowledge and technology evolve over time • Science and technology affect, and are affected by, society
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation • Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations • Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) • The nature of science relies upon communication of results and justification of explanations • Advances in technology often result in improved data collection and an increase in scientific information • People of different gender and ethnicity have contributed to scientific discoveries and the invention of technological innovations • Advances in technology often result in improved data collection and an increase in scientific information • Scientific theories are developed based on the body of knowledge that exists at any particular time and must be rigorously questioned and tested for validity • Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology • Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent • Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible	• Can you identify the relevant parts of an experiment? • Upon identifying a problem, can you develop an appropriate hypothesis and design an experiment to test your assumptions? • Can you draw reasonable conclusions when analyzing collected data? • Can you identify possible bias or significant sources of error when reflecting on an experiment? • Are you able to format your findings, including data, into a presentable format? • Do you understand the rationale behind retesting your results and allowing others to do so? • Do you understand the importance of integrity in reporting your results?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.e. *GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 7.1.A.a	*Formulate testable questions and hypotheses*		
CLE 7.1.A.b	*Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment*		
CLE 7.1.A.c	*Design and conduct a valid experiment*		
CLE 7.1.A.d	*Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature)*		
CLE 7.1.A.e	*Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies*		
CLE 7.1.A.f	*Acknowledge there is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations*		
CLE 7.1.A.g	*Evaluate the design of an experiment and make suggestions for reasonable improvements*		

CLE 7.1.B.a	*Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)*		
CLE 7.1.B.b	*Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second*		
CLE 7.1.B.c	*Determine the appropriate tools and techniques to collect, analyze, and interpret data*		
CLE 7.1.B.d	*Judge whether measurements and computation of quantities are reasonable*		
CLE 7.1.B.e	*Calculate the range, average/mean, percent, and ratios for sets of data*		
CLE 7.1.B.f	*Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)*		
CLE 7.1.C.a	*Use quantitative and qualitative data as support for reasonable explanations (conclusions)*		
CLE 7.1.C.b	*Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable)*		
CLE 7.1.C.c	*Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions)*		
CLE 7.1.C.d	*Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)*		
CLE 7.1.D.a	*Communicate the procedures and results of investigations and explanations through: oral presentations, drawings and maps, data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities), graphs (bar, single, and multiple line), equations and writings*		
CLE 7.1.D.b	*Communicate and defend a scientific argument*		
CLE 7.1.D.c	*Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work)*		
CLE 8.1.B.a	*Recognize the relationships linking technology and science (e.g., how technological problems may create a demand for new science knowledge, how new technologies make it possible for scientists to extend research and advance science)*		
CLE 8.2.A.a	*Recognize contributions to science are not limited to the work of one particular group, but are made by a diverse group of scientists representing various ethnic and gender groups*		
CLE 8.2.A.b	*Recognize gender and ethnicity of scientists often influence the questions asked and/or the methods used in scientific research and may limit or advance science knowledge and/or technology*		
CLE 8.2.B.a	*Identify and describe how explanations (laws/principles, theories/models) of scientific phenomena have changed over time as a result of new evidence (e.g., cell theory, theories of spontaneous generation and biogenesis, theories of extinction, evolution theory, structure of the cell membrane, genetic theory of inheritance)*		
CLE 8.2.B.b	*Identify and analyze current theories that are being questioned, and compare them to new theories that have emerged to challenge older ones (e.g., theories of evolution, extinction, global warming)*		
CLE 8.3.B.a	*Analyze the roles of science and society as they interact to determine the direction of scientific and technological progress (e.g., prioritization of and funding for new scientific research and technological development is determined on the basis of individual, political and social values and needs; understanding basic concepts and principles of science and technology influences debate about the economics, policies, politics, and ethics of various scientific and technological challenges)*		
CLE 8.3.B.b	*Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research)*		
CLE 8.3.B.c	*Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, use of alternative energies for carbon fuels, use of pesticides*		
CLE 8.3.C.a	*Identify and evaluate the need for informed consent in experimentation*		
CLE 8.3.C.b	*Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment)*		
CLE 8.3.C.c	*Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)*		
CLE 8.3.D.a	*Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a scientist speaking within or outside his/her area of expertise)*		
CLE 8.3.D.b	*Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society*		

OBJECTIVE # 1	**Students will be able to design, conduct, and interpret the results from a valid experiment.**
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 7.1.A.a-g, 7.1.B.a-f, 7.1.C.a-d, 7.1.D.a-c, 8.1.B.a, 8.2.A.a-b, 8.2.B.a-b, 8.3.B.a-c, 8.3.C.a-c, 8.3.D.a-b

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• is able to formulate a testable question and hypothesis, with a possible explanation (If… then…) and includes the independent and dependent variables in the statement.
• identifies the components, like independent variable, dependent variable, controls and constants and explains their importance to the design of a valid experiment.
• interpret or predict the outcome based on information provided in a graph.
	• recognizes or recalls specific terminology such as:
	  • experiment, observation, question, hypothesis, independent variable, dependent variable, constant, control group, data, results, conclusion, theory,
	performs basic processes, such as:
	  • identifies the components of a valid experiment.
	  • defines terms such as dependent variable, independent variable, constants and control variable.
	  • can label x and y- axis on a graph appropriately with an accurate title
		• designs (and or tests) a valid experiment, and can explain the importance of the components within their experiment. Must include their collected data in an appropriately labeled graph.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• present situations that require testing	• develop a valid experiment	• 2- Skill/Concept or 3- Strategic Thinking or 4- Extended Thinking • 2-Skill/Concept
• present benchmark studies with historical significance • introduce applicable technologies	• identify components of the experiment	• 3- Strategic Thinking or 4- Extended Thinking
• propose situations with breaches of scientific integrity	• apply and identify relevant and future science testing technology based on type of test required • identify the sources of bias or error and what effect it has on experimental outcomes	• 3- Strategic Thinking

INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• historical scientists/philosophers • reading about landmark studies/findings • health industry and occupations • governmental regulations • scientific literacy	• disease • science, technology, and human activity	• identify a problem and design an original experiment

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Classic experiments	• Formative	• 1 or 2
• Bellringers	• Formative	• 1 or 2
• Exit Slips	• Formative	• 1 or 2
• Quick checks	• Summative	• all levels
• Objective Test	• Summative	• 3 or 4
• Student Generated Assessment		

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Identify a pertinent local issue and design/develop an experiment looking for the cause • Additional resources used in Honors Biology	• Conduct research, design an experiment, collect data, analyze results, and formulate an action plan going forward • Reinforcement of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

CONTENT AREA: High School Science **COURSE: Biology 9th/10th**	**UNIT TITLE: Cell Structure and Function** **UNIT DURATION:**

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	**BIG IDEA(S):**
• Materials to come	• Changes in properties and states of matter provide evidence of the atomic theory of matter • There is a fundamental unity underlying the diversity of all living organisms • Living organisms carry out life processes in order to survive. • There is a genetic basis for the transfer of biological characteristics from one generation to the next through reproductive processes • Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical thinking • The nature of technology can advance, and is advanced by, science as it seeks to apply scientific knowledge in ways that meet human needs • Historical and cultural perspectives of scientific explanations help to improve understanding of the nature of science and how science knowledge and technology evolve over time • Science and technology affect, and are affected by, society
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Mass is conserved during any physical or chemical change • Organisms progress through life cycles unique to different types of organisms • Cells are the fundamental units of structure and function of all living things. • The cell contains a set of structures called organelles that interact to carry out life processes through physical and chemical means • Photosynthesis and cellular respiration are complementary processes necessary to the survival of most organisms on Earth • Cells carry out chemical transformations that use energy for the synthesis or breakdown of organic compounds • Protein structure and function are coded by the DNA (Deoxyribonucleic acid) molecule • Cellular activities and responses can maintain stability internally while external conditions are changing (homeostasis) • Reproduction can occur asexually or sexually • All living organisms have genetic material (DNA) that carries hereditary information • Chromosomes are components of cells that occur in pairs and carry hereditary information from one cell to daughter cells and from parent to offspring during reproduction • There is heritable variation within every species of organism • The pattern of inheritance for many traits can be predicted by using the principles of Mendelian genetics	• Can you distinguish between subatomic particles of a given atom? • Can you identify different types of bonds? • Are you able to classify the different classes of organic macromolecules? • How do you distinguish prokaryotes from eukaryotes? • What organelles have essential functions in eukaryotic cells? • What are the different mechanisms of cellular transport? • How do different organisms get energy for cellular functions? • How do photosynthesis and cellular respiration affect one another? • What is the importance of DNA in living things? • What advantages do asexual vs sexual reproduction offer? • How are mitosis and meiosis used in multicellular organisms? • What importance do proteins have in living things? • How are instructions in DNA used to make proteins? • How do changes in DNA lead to changes in an organism? • How are traits inherited in sexual reproducers?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 1.1.I.a	*Compare the mass of the reactants to the mass of the products in a chemical reaction or physical change (e.g., biochemical processes, carbon dioxide-oxygen cycle, nitrogen cycle, decomposition and synthesis reactions involved in a food web) as support for the Law of Conservation of Mass*	x	
CLE 3.1.B.a	*Recognize cells both increase in number and differentiate, becoming specialized in structure and function, during and after embryonic development*		x
CLE 3.1.B.b	*Identify factors (e.g., biochemical, temperature) that may affect the differentiation of cells and the development of an organism*		x
CLE 3.1.C.a	*Recognize all organisms are composed of cells, the fundamental units of structure and function*		x

CLE 3.1.C.b	*Describe the structure of cell parts (e.g., cell wall, cell membrane, cytoplasm, nucleus, chloroplast, mitochondrion, ribosome, vacuole) found in different types of cells (e.g., bacterial, plant, skin, nerve, blood, muscle) and the functions they perform (e.g., structural support, transport of materials, storage of genetic information, photosynthesis and respiration, synthesis of new molecules, waste disposal) that are necessary to the survival of the cell and organism*		x	
CLE 3.2.A.a	*Compare and contrast the structure and function of mitochondria and chloroplast*			x
CLE 3.2.A.b	*Compare and contrast the structure and function of cell wall and cell membranes*			x
CLE 3.2.A.c	*Explain physical and chemical interactions that occur between organelles (e.g. nucleus, cell membrane, chloroplast, mitochondrion, ribosome) as they carry out life processes*			x
CLE 3.2.B.a	*Explain the interrelationship between the processes of photosynthesis and cellular respiration (e.g., recycling of oxygen and carbon dioxide), comparing and contrasting photosynthesis and cellular respiration reactions (Do NOT assess intermediate reactions)*	x		
CLE 3.2.B.b	*Determine what factors affect the processes of photosynthesis and cellular respiration (i.e., light intensity, availability of reactants, temperature)*			x
CLE 3.2.D.a	*Summarize how energy transfer occurs during photosynthesis and cellular respiration as energy is stored in and released from the bonds of chemical compounds (i.e. ATP)*		x	
CLE 3.2.D.b	*Relate the structure of organic compounds (e.g., proteins, nucleic acids, lipids, carbohydrates) to their role in living systems*		x	
CLE 3.2.D.c	*Recognize energy is absorbed or released in the breakdown and/or synthesis of organic compounds*		x	
CLE 3.2.D.d	*Explain how protein enzymes affect chemical reactions (e.g., the breakdown of food molecules, growth and repair, regulation)*		x	
CLE 3.2.D.e	*Interpret a data table showing the effects of an enzyme on a biochemical reaction*		x	
CLE 3.2.E.a	*Explain how the DNA code determines the sequence of amino acids necessary for protein synthesis*	x		
CLE 3.2.E.b	*Recognize the function of protein in cell structure and function (i.e., enzyme action, growth and repair of body parts, regulation of cell division and differentiation)*		x	
CLE 3.2.F.a	*Explain the significance of the selectively permeable membrane to the transport of molecules*	x		
CLE 3.2.F.b	*Predict the movement of molecules across a selectively permeable membrane (i.e., diffusion, osmosis, active transport) needed for a cell to maintain homeostasis given concentration gradients and different sizes of molecules*	x		
CLE 3.2.F.c	*Explain how water is important to cells (e.g., is a buffer for body temperature, provides soluble environment for chemical reactions, serves as a reactant in chemical reactions, provides hydration that maintains cell turgidity, maintains protein shape)*		x	
CLE 3.3.A.a	*Distinguish between asexual (i.e., binary fission, budding, cloning) and sexual reproduction*	x		
CLE 3.3.B.a	*Describe the chemical and structural properties of DNA (e.g., DNA is a large polymer formed from linked subunits of four kinds of nitrogen bases; genetic information is encoded in genes based on the sequence of subunits; each DNA molecule in a cell forms a single chromosome) (Assess the concepts – NOT memorization of nitrogen base pairs)*	x		
CLE 3.3.B.b	*Recognize that DNA codes for proteins, which are expressed as the heritable characteristics of an organism*	x		
CLE 3.3.B.d	*Explain how an error in the DNA molecule (mutation) can be transferred during replication*		x	
CLE 3.3.B.e	*Identify possible external causes (e.g., heat, radiation, certain chemicals) and effects of DNA mutations (e.g., altered proteins which may affect chemical reactions and structural development)*		x	
CLE 3.3.C.a	*Recognize the chromosomes of daughter cells, formed through the processes of asexual reproduction and mitosis, the formation of somatic (body) cells in multicellular organisms, are identical to the chromosomes of the parent cell*		x	
CLE 3.3.C.b	*Recognize that during meiosis, the formation of sex cells, chromosomes are reduced to half the number present in the parent cell*		x	
CLE 3.3.C.c	*Explain how fertilization restores the diploid number of chromosomes*		x	
CLE 3.3.C.d	*Identify the implications of human sex chromosomes for sex determination*		x	
CLE 3.3.D.a	*Describe the advantages and disadvantages of asexual and sexual reproduction with regard to variation within a population*		x	
CLE 3.3.D.b	*Describe how genes can be altered and combined to create genetic variation within a species (e.g., mutation, recombination of genes)*		x	
CLE 3.3.E.a	*Explain how genotypes (heterozygous and homozygous) contribute to phenotypic variation within a species*	x		
CLE 3.3.E.b	*Predict the probability of the occurrence of specific traits, including sex-linked traits, in an offspring by using a monohybrid cross*		x	
CLE 3.3.E.c	*Explain how sex-linked traits may or may not result in the expression of a genetic disorder (e.g., hemophilia, muscular dystrophy, color blindness) depending on gender*		x	

OBJECTIVE # 2	Students will be able to relate basic chemistry concepts as they apply to biology.	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 1.1.I.a, 3.2.F.c	
	WHAT SHOULD STUDENTS…	
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• discern organic molecules from one another. • predict the action of water based upon its polarity.	• identify basic subatomic particles. • differentiate between major classes of organic molecules. • identify important properties of water.	• explain how organic molecules interact with each other and describe their roles in respect to protein production • discuss how atoms will form different bonds based upon their arrangement of valence electrons. • utilize the periodic table to find information regarding basic atomic structure.
	FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING	
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• introduce the Periodic Table	• based on an element's position, identify atomic structure and basic properties	• 2- Skill/Concept
• present vital organic macromolecules	• discern between carbohydrates, lipids, nucleic acids and proteins, their various properties, and their most likely cellular location	• 3- Strategic Thinking
• compare and contrast ionic and covalent bonds	• demonstrate understanding of ionic and covalent bonds using diagrams	• 3- Strategic Thinking
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• health industry • history	• Characteristics of Living Organisms • Cells and Body Systems • Inquiry • Science Technology, and Human Activity • Physical and Chemical Properties and Changes of Matter	• identify an unknown element when given its properties
	HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?	
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Alien Periodic Table	• Formative	• 2
• Element Windsocks	• Formative	• 1 or 2
• Diagraming atomic, molecular, and crystalline models	• Formative	• 2
• Labs: carbohydrates, nucleic acids, etc.	• Formative	• 2
• Bellringers	• Formative	• 1 or 2
• Exit Slips	• Formative	• 1 or 2
• Quick checks	• Summative	• all levels
• Objective Test	• Summative	• 3 or 4
• Student Generated Assessment		

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Biomedical uses for radioactive isotopes • Additional resources used in Honors Biology	• Research a biomedical method that utilizes radioactive isotopes • Reinforcement of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 3	**Student will understand the structure, function, and importance of cells.**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.1.B.a-b, 3.1.C.a-b, 3.2.A.a-c	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Describes the steps of the protein export pathway • Distinguishes the role of different organelles in a eukaryotic or prokaryotic cell and is able to relate them to the overall function of the cell. • Compare and contrast plant and animal cells.	• (membrane-bound) organelle, nucleus, nuclear membrane (envelope), ribosome, cytoplasm, cell wall, cell (plasma) membrane, chloroplast, mitochondria • Differentiate between eukaryotic and prokaryotic cells	• Student should be able to predict how changing cell functions affect the organism.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Is it living? • Prokaryote/Eukaryote microscope lab • Cell Analogy • Venn Diagram of prokaryotes and eukaryotes • Animal and Plant Cell Diagrams • Cell Models • Student generated questions	• Students use criteria to determine if an object are living or non-living • Using living or prepared cells to enforce structure and function of organelles. • Students use prior knowledge of world concepts to determine the function of cell parts • Compare size and complexity of prokaryotes and eukaryotes • Compare organelles of animal and plant cells • Use their knowledge of cell structure and function of organelles to build a cell model	• 1 - Recall • 2- Skill/Concept • 3- Strategic thinking/ 4- Extended Thinking • 2- Skill/Concept • 2- Skill/Concept • 3- strategic thinking/ 4- extended thinking
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Cell City Analogy requires use of analogies, a literary device.	• Characteristics of Living Organisms • Cells and Body Systems • Inquiry • Science Technology, and Human Activity	• Where can you find cells? bacteria culturing
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Cell City Analogy • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Formative • Summative • Summative	• 3 • 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities	• Review material at own pace with guided assistance as needed	1- Recall

• Corrections to previous work		
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Disease/disorder research project** • Additional resources used in Honors Biology	• Research a disease that affects a cell organelle • Reinforcement of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 4	Student will understand how cells move molecules in and out of the cell membrane.	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.2.F.a-c	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Recognizes how different substances move across the membrane • Can determine if the transport process use energy • Can identify the specific processes: • Facilitated diffusion, protein pump, exocytosis, endocytosis	• active transport, passive transport, diffusion, osmosis, concentration gradient • Can differentiate between active and passive transport • Locates the region of higher concentration for a molecule	• Determine how molecules are moving in reference to the materials provided and can describe if energy is being used.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Osmosis lab • manipulatives • practice worksheets • comparing and contrasting active and passive transport • student generated questions	• Students will set up an experiment and observe the movement of water in different concentrations • Identify the concentration gradient and kinesthetically practice the movement of molecules across a membrane • identify if each process requires energy • practice vocabulary and identifying movement of molecules	• 2- skill/concept, 3- strategic thinking • 1- Recall, 2- skill/concept • 1- Recall • 1- Recall • 3- strategic thinking/ 4- extended thinking
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**Inquiry Connections**
•	• Cells and Body Systems • Inquiry • Science, Technology, and Human Activity	• Egg Tonicity
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 2, 3 or 4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional resources used in Honors Biology	• Reinforcement of acquired knowledge	• 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 5	Students will understand how organisms generate and utilize energy using cellular respiration and photosynthesis	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• CLE 1.1.I.a, 3.2.B.a-b, 3.2.D.a-e	
	WHAT SHOULD STUDENTS…	
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Identify the products and reactants in photosynthesis and cellular respiration. • Illustrate how photosynthesis and cellular respiration form a cycle (one process uses the products of the other) • Differentiate between aerobic and anaerobic respiration • Recognize how cells recycle ATP	• recognizes or recalls specific terminology such as: glucose, oxygen, cellular respiration, mitochondria, carbohydrate, photosynthesis, anaerobic respiration, fermentation, mitochondria, chloroplast, ATP • performs basic processes, such as: understand energy is released in the breakdown of glucose.	• Produce a diagram or model describing or depicting the steps of both cellular respiration and photosynthesis. Specifically, showing the flow of products and reactants between the two energy processes. This should show a clear understanding of the interdependence between the metabolic process.
	FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING	
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Yeast digestion lab • Photosynthesis webquest • Exercise Lab • Elodea Lab • Metabolism Venn Diagram	• Observe the respiratory pathway • Variables that affect photosynthesis • Understand the relationship between production of carbon dioxide and increased activity • Observe the photosynthetic pathway • Examine interdependence of processes	• 2-Skill/Concept • 2-Skill/Concept • 3-Strategic Thinking • 3-Strategic Thinking • 2-Skill/Concept
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	
• economic impact	• forms of Energy: Light and Sound • energy Transformation • characteristics of Living Organisms • inquiry	
	HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?	
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 2, 3 or 4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Photosynthesis and Respiration Cycle diagram • Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	• 1-recall

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Create your own respiration or photosynthesis experiment or video • Additional resources used in Honors Biology	• Reinforcement and expand of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE #6	**Students will be able to describe the structure of DNA and understand the replication process.**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.3.B.a	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• generalize that the genetic information in DNA is determined by the order of nucleotides
• relates the importance of the sequence of DNA to the function of proteins
• explain the steps of DNA replication (unzipped and copied).
• describe that DNA is replicated during interphase to ensure each cell receives an identical copy of genes
	• recognizes or recalls specific terminology such as:
	  ◦ adenine, thymine, guanine, cytosine, nucleotide, DNA(deoxyribonucleic acid), double helix, DNA replication, enzyme (Helicase, DNA Polymerase)
	performs basic processes, such as:
	  ◦ identify the structure of DNA as a double helix
	  ◦ correctly pair the bases of a DNA molecule
	  ◦ determine the three components of a nucleotide
	  ◦ DNA is the basic genetic information contained in every cell
	  ◦ know the functions of all the different RNA types
		• construct their own model of a DNA molecule including a replication fork, and the enzymes involved in replication.
		• explain the roles of different enzymes in replication, and can predict the outcome of their absence.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• act out replication • build DNA model(s) • research chromosomal disorders • discuss classic DNA experiments • analyze the composition concerning the double helical nature of a DNA molecule • use a karyotype to diagnose possible disorders	• characterize the role of each component in DNA replication • study 3-dimensional structure of DNA • identify factors that lead to errors in DNA and their subsequent consequences • distinguish between theories of replication • understands fundamental principles of nucleotides (base pairing, sugar-phosphate backbone, etc.) • understand the relationship between number of chromosomes and possible diseases	• 3- Strategic thinking • 3- Strategic thinking • 4- Extended thinking • 2- Skill/Concept • 1- Recall • 2- Skill/Concept
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• basic statistical analysis	• characteristics of living organisms • disease • inquiry • science, technology, and human activity	• DNA extraction lab

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Chromosomal Research Assignment • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Formative • Summative • Summative	• 4 • 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Disease/disorder research project • Additional resources used in Honors Biology	• Research a disease that affects a cell genetic or chromosomal disorder • Reinforcement of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 7	**Students understand mechanisms of cellular reproduction**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.3.A.a, 3.3.C.a-d, 3.3.D.a-b	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• That one parent cell of a somatic cell creates two identical daughter cells
• The advantages and disadvantages of sexual and asexual reproduction
• That each somatic cell contains the same amount of chromosomes as the original cell
• That meiosis reduces the amount of chromosomes by half when gametes are formed
• That in meiosis, four non-identical daughter cells are made (crossing-over and independent assortment)
• The components of the cell cycle
	• recognizes or recalls specific terminology such as: chromosome, mitosis, cytokinesis, diploid, haploid, somatic cell, gamete cell, fertilization, zygote, meiosis
	• performs basic processes, such as:
	  • differentiate between somatic(diploid) and gamete (haploid) cells
	  • differentiate between sexual and asexual reproduction
	  • differentiate between the processes of mitosis and meiosis
	  • demonstrate that fertilization restores the diploid number of chromosomes in a zygote
		• Demonstrate microscope competency when identifying cellular samples.
		• Identify what happens in each phase of mitosis and meiosis
		• Identify the regulatory role of proofreading mechanisms during cell division in cancer cells

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Asexual vs Sexual Reproduction • Chromosome LARP • Microscope lab-onion root tip, whitefish blastula, drosophila chromosomes, etc.	• Identify mechanism of reproduction • Identify movement of genes during cell division • Visualize chromosome activity in various cells	• 2 • 3 • 2/3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**Inquiry Connections**
• Stem cell research • In-vitro fertilization	• Reproduction and Heredity • Inquiry • Science, Technology, and Human Activity	Why are some species more complex than others?
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking,

		4=Extended Thinking)
• Bellringers • Exit Slips • Quick checks • Microscope competency practical • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • 2 • all levels • 2, 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Mitosis and meiosis diagram • Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	• 1-recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Diagram the phases of mitosis • Diagram the phases of meiosis • Stem cell differentiation article	• Identify and differentiate the processes of cellular division • Connect the process of cell to division to the uses of stem cells	• 2 • 3/4

OBJECTIVE # 8	Students will be able to	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.2. E. a-b, 3.3.B. a-e, 3.3.D. a-c	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Summarize the processes of transcription and translation and explain the importance of each process in the production of proteins. • Determine the order of amino acids in a protein given a strand of DNA. • Relates that a change in the order of amino acids in a protein will change the shape and function of the protein as a result of a mutation	• ribonucleic acid (RNA), gene expression (protein synthesis), transcription, translation, RNA polymerase, ribosome, messenger RNA (mRNA), transfer RNA (tRNA), codon, anticodon, amino acid, protein, mutation • Compare the structure of DNA and RNA • Identify a picture/diagram of the processes of transcription translation, and label the steps	• Discuss the significance of protein synthesis on how species might change over time. • Given a specific protein's function, predict how a mutation would affect the organism.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Transcription and Translation Practice • Practice with models	• Determine mRNA and coordinating amino acids. • Manipulate the processes of Protein Synthesis and relate the importance of protein production • Act out transcription and translation in the process of creating a protien.	• 2 • 2/3

• Decoding Proteins Lab		• 2/3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	
	•	
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 2, 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	• 1-Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Create your own protein synthesis experiment or video • Additional resources used in Honors Biology	• Reinforcement and expand of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 9	**Students will be able to predict possible outcomes based on observed patterns of heredity.**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.3.E.a-c	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• given the phenotypes or genotypes of two parents, be able to analyze the possible outcome of monohybrid genetic cross. • upon completion of a monohybrid cross, the student can demonstrate understanding that the results of that cross are the	• recognizes or recalls specific terminology such as: • gene, trait, dominant, recessive, allele, punnett square, genetics, heredity, phenotype, genotype, homozygous, heterozygous,	• create a genetic cross and then determine the possible outcomes. Explain what genotypes and phenotypes will result and be able to relate that to the parent's genotypes using key terminology. • given a pedigree, can determine mode of inheritance.

probabilities of specific traits an organism could inherit.	performs basic processes, such as: • complete a punnett square with the parents already determined	• differentiate between the different modes of inheritance such as codominance and incomplete dominant and determine the probable outcome. • given a trait, can determine what type of dominance it represents.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• model Punnett Square • model pedigrees • Add Activities???	• observe patterns of inheritance and be able to predict probabilities amongst offspring • examine how traits can be present in different generations with varying frequency	• 3- Strategic Thinking or 4- Extended Thinking • 3- Strategic Thinking or 4- Extended Thinking
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• basic statistical analysis	• reproduction and Heredity • inquiry • disease • science, technology, and human activity	• family trait activity • blood typing lab
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Punnett Square • Pedigree • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Impact of epigenetics on gene regulation • Additional resources used in Honors Biology	• Research recent theories in the field of epigenetics and how it applies to a selected gene of their choice • Reinforcement of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

UNIT TITLE: Evolution UNIT DURATION:	CONTENT AREA: High School Science COURSE: Biology

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
•	• There is a fundamental unity underlying the diversity of all living organisms. • There is a genetic basis for the transfer of biological characteristics from one generation to the next through reproductive processes. • Genetic variation sorted by the natural selection process explains evidence of biological evolution.
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Biological classifications are based on how organisms are related. • There is heritable variation within every species of organism. • Evidence for the nature and rates of evolution can be found in anatomical and molecular characteristics of organisms and in the fossil record. • Reproduction is essential to the continuation of every species. • Natural selection is the process of sorting individuals based on their ability to survive and reproduce within their ecosystem.	• How does the mechanism of natural selection help drive evolution? • What are examples of evidence for evolution? • What are ways in which current populations can evolve over time?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.e. GLE/CLE/MLS/NGSS	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD	
CLE 3.1.E.a.	*Explain how similiarities used to group taxa might reflect evolutionary relationships (e.g., similarities in DNA and protein structures, internal anatomical features, patterns of development*		x	
CLE 3.1.E.b.	*Explain how and why the classification of any taxon might change as more is learned about the organisms assigned to that taxon.*			x
CLE 3.3.D.c.	*Recognizes that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an orgnaism's sex cells.*			x
CLE 4.3.A.a.	*Interpret fossil evidence to explain the relatedness of organisms using the principles of superposition and fossil correlation*		x	
CLE 4.3.A.b.	*Evaluate the evidence that supports theory of biological evolution (e.g., fossil records, similarities between DNA and protein structures, similarities between developmental stages of organisms, homologous and vestigial structures)*		x	
CLE 4.3.B.a.	*Define a species in terms of the ability to mate and produce fertile offspring*			x
CLE 4.3.B.b.	*Explain the importance of reproduction to the survival of a species (i.e., the failure of a species to reproduce will lead to extinction of that species.*		x	
CLE 4.3.C.a.	*Identify examples of adaptations that may have resulted from variations favored by natural selection (e.g., long-necked giraffes, long-eared jack rabbits) and describe how that variation may have provided populations an advantage for survival*		x	
CLE 4.3.C.b.	*Explain how genetic homogeneity may cause a population to be more susceptible to extinction (e.g., succumbing to a disease for which there is no natural resistance)*		x	
CLE 4.4.C.c.	*Explain how environmental factors (e.g., habitat loss, climate change, pollution, introduction of non-native species) can be agents of natural selection*		x	
CLE 4.4.C.d.	*Given a scenario describing an environmental change, hypothesize why a given species was unable to survive*		x	

OBJECTIVE # 10	**Students will be able to understand how populations change over time.**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.1.E.a-b, 3.3.D.c, 4.3.A.a-b, 4.3.B.a-b, 4.3.C.a-d	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Explain how natural selection could affect a specific population. • Given a specific example of evidence, describe how it supports the theory of evolution.	• selection, Darwin, variation, inheritance, adaptation, fitness, overproduction, speciation • Identify evidence of evolution (comparative anatomy, fossil record, embryology, common genetics)	• Given a scenario describing an environmental change, hypothesize why a given species was unable to survive • Using the evidence, apply it to a given population and predict how the population could change in the future.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Natural Selection Lab • Peppered Moth Simulation • Natural Selection Diagrams	• Experience how natural selection may occur by using different tools to enable survival • Understand how different physical adaptations increases an organism's chance of survivial • Interpret the process of natural selection given a specific example of a population with inheritable variances	• 2/3 • 2 • 2
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
•	• Characteristics of Living Organisms • Reproduction and Heredity	• Using a computer animated simulation, students can infer how species change over time.
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 2, 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?		

Possible Interventions		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	• 1-Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Create your own protein synthesis experiment or video • Additional resources used in Honors Biology	• Reinforcement and expand of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

CONTENT AREA: High School Science COURSE: Biology 9th/10th	UNIT TITLE: Ecology UNIT DURATION:

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• **Materials to come**	• **Changes in properties and states of matter provide evidence of the atomic theory of matter** • **Energy had a source, can be stored, and can be transferred but is conserved within system** • **Organisms are interdependent with one another and their environment** • **Matter and energy flow through the ecosystem** • **Human activity is dependent upon and affects Earth's resources and systems** • **The universe has observable properties and structures**
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Mass is conserved during any physical or chemical change • Energy can be transferred within a system as the total amount of energy constant (i.e., The Law of Conservation of Energy) • All populations living together within a community interact with one another and with their environment in order to survive and maintain a balanced ecosystem • Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite • All organisms, including humans, and their activities cause changes in their environment that affect the ecosystem • The diversity of species within an ecosystem is affected by changes in the environment, which can be caused by other organisms or outside processes • As energy flows through the ecosystem, all organisms capture that energy and transform it to a form they can use • Matter is recycled through and ecosystem • Earth's materials limited natural resources affected by human activity • The Earth has a composition and location suitable to sustain life	• How does energy flow from the Sun through Earth's ecosystems? • How are matter and energy are recycled through ecosystems? • How are all living and nonliving parts of Earth's ecosystems interconnected? • How is the diversity of ecosystems affected by internal and external factors?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.e. *GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 1.1.I.a	*Compare the mass of the reactants to the mass of the products in a chemical reaction or physical change (e.g., biochemical processes, carbon dioxide-oxygen cycle, nitrogen cycle, decomposition and synthesis reactions involved in a food web) as support for the Law of Conservation of Mass*		
CLE 1.2.F.a	*Classify the different ways to store energy (i.e., chemical, nuclear, thermal, mechanical, electromagnetic) and describe the transfer of energy as it changes from kinetic to potential, while the total amount of energy remains constant, within a system (e.g., biochemical processes, carbon dioxide-oxygen cycle, nitrogen cycle, food web)*		
CLE 4.1.A.a	*Explain the nature of interactions between organisms in predator/prey relationships and different symbiotic relationships (i.e., mutualism, commensalisms, parasitism)*		
CLE 4.1.A.b	*Explain how cooperative (e.g., symbiotic) and competitive (e.g., predator/prey) relationships help maintain balance within an ecosystem*		
CLE 4.1.A.c	*Explain why no two species can occupy the same niche in a community*		
CLE 4.1.B.a	*Identify and explain the limiting factors (biotic and abiotic) that may affect the carrying capacity of a population within an ecosystem*		
CLE 4.1.B.b	*Predict how populations within an ecosystem may change in number and/or structure in response to hypothesized changes in biotic and/or abiotic factors*		
CLE 4.1.C.a	*Devise a multi-step plan to restore the stability and/or biodiversity of an ecosystem when given a scenario describing the possible adverse effects of human interactions with that ecosystem (e.g., destruction caused by direct harvesting, pollution, atmospheric changes)*		
CLE 4.1.C.b	*Predict and explain how natural or human caused changes (biological, chemical and/or physical) in one ecosystem may affect other ecosystems due to natural mechanisms (e.g., global wind patterns,*		

	water cycle, ocean currents)		
CLE 4.1.D.a	Predict the impact (beneficial or harmful) a natural or human caused environmental event (e.g., forest fire, flood, volcanic eruption, avalanche, acid rain, global warming, pollution, deforestation, introduction of an exotic species) may have on the diversity of different species in an ecosystem		
CLE 4.1.D.b	Describe possible causes of extinction of a population		
CLE 4.2.A.a	Illustrate and describe the flow of energy within a food web		
CLE 4.2.A.b	Explain why there are generally more producers than consumers in an energy pyramid		
CLE 4.2.A.c	Predict how the use and flow of energy will be altered due to changes in a food web		
CLE 4.2.B.a	Explain the processes involved in the recycling of nitrogen, oxygen, and carbon through an ecosystem		
CLE 4.2.B.b	Explain the importance of the recycling of nitrogen, oxygen, and carbon within an ecosystem		
CLE 5.3.A.a	Predict local and/or global effects of environmental changes when given a scenario describing how the composition of the geosphere, hydrosphere, or atmosphere is altered by natural phenomena or human activities		
CLE 6.1.B.a	Explain how Earth's environmental characteristics and location in the universe (e.g., atmosphere, temperature, orbital path, magnetic field, mass-gravity, location in solar system) provide a life-supporting environment		

OBJECTIVE # 11	Student will understand energy transfer within ecosystems	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 1.1.I.a, 1.2.F.a, 4.2.A.a-c, 4.2.B.a-b	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• Explain the biotic and abiotic factors that constitute an ecosystem.
• Create a food web that demonstrates all of the levels of organisms in an ecosystem.
• Analyze the energy transfer in an energy pyramid, and calculate the total energy a consumer at the top of the pyramid is consuming.
	• recognizes or recalls specific terminology such as:
	  • ecosystem, biotic factors, abiotic factors, producers, consumers, trophic level, food chain, primary producers, primary consumers, herbivores, secondary consumers, detritivores, tertiary consumers, food web, energy pyramid
	performs basic processes, such as:
	  • can list abiotic and biotic factors in an environment
	  • can make a food chain with a producer, primary consumer and secondary consumer
	  • can indicate which way energy flows on an energy pyramid and demonstrates their understanding of gain/loss of energy throughout the different levels of the pyramid
		• Students can demonstrate their understanding of food webs and energy pyramid are interrelated.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Constructing a food chain/web • Trophic levels of food pyramid • Analysis of a Missouri food web • Producer and consumer relationships (ie. herbivores, omnivores, carnivores, detritivores, scavengers)	• Students are able to appropriately depict the transfer of energy through trophic levels • Understand how energy is transferred and lost between prey and predators • Identify the interrelatedness between organisms in a food web • Understand predator/prey relationships	• 3- Strategic thinking • 2- Skill/Concept • 3- Strategic thinking • 2- Skill/Concept
INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• Ecological geography	• Ecosystems and Populations • Inquiry • Science, Technology, and Human Activity	• What occurs when invasive species are introduced?
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Construct a food web • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Formative • Summative • Summative	• 2 • 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4

<table>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="3">HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?
Possible Interventions</td></tr>
<tr><td>TEACHER INSTRUCTIONAL ACTIVITY</td><td>STUDENT LEARNING TASK</td><td>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</td></tr>
<tr><td>• Post videos of lectures to Youtube
• Flashcards/Task cards
• Reinforcing worksheets or activities
• Corrections to previous work</td><td>• Review material at own pace with guided assistance as needed</td><td>• 1- Recall</td></tr>
<tr><td colspan="3">HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?
Possible Extensions/Enrichments</td></tr>
<tr><td>INSTRUCTIONAL ACTIVITY/METHOD</td><td>STUDENT LEARNING TASK</td><td>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</td></tr>
<tr><td>• Research an invasive species and the niche that it fills in the environment
• Additional resources used in Honors Biology</td><td>• Understand that when species fill the same niche, there is competition
• Reinforcement of acquired knowledge</td><td>• 4- extended thinking
• 3- strategic thinking/ 4- extended thinking</td></tr>
</table>

OBJECTIVE # 12	Students will understand the characteristics of different populations of living organisms and how they change.	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 4.1.A. a-c, 4.1.B. a-b, 6.1.B. a	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Predict the outcome when two species are forced to occupy the same niche • List examples of the three types of symbiosis • Identify if an environmental factor is population density dependent or independent • Describe population growth as exponential or logistic	• ecology, habitat, population, community, ecosystem, biodiversity, competitive exclusion, symbiosis, mutualism, commensalism, parasitism, ecological succession • Identify the carrying capacity for a population	• Explain how changes in the balance of populations would affect the rest of the community. (Include if those factors are density dependent or independent and how they affect the growth patterns of those populations.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Graphing population growth patterns • Concept map- density dependent and independent factors	• Visualize the effects of symbiotic relationships on changes in population size • Distinguish the different types of factors that affect populations. Make predictions on how those factors would affect population dynamics	• 2/3 • 2/3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	
•	• Inquiry • Disease • Ecosystems and Populations	
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Graphing Activity • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Formative • Summative • Summative	• 1, 2, or 3 • 1 or 2 • 1 or 2 • 1 or 2 • all levels • 2, 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards	• Review material at own pace with guided assistance as needed	1- Recall

• Reinforcing worksheets or activities • Corrections to previous work		
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Prepare a video/presentation that shows understanding of population dynamics • Additional resources used in Honors Biology	• Student-led inquiry • Reinforcement of acquired knowledge	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 13	Student will understand how humans impact the environment.	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 4.1.C.a-b, 4.1D.a-b, 5.3.A.a	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• describe the evidence of climate change and its implications for the future • relate changes in biodiversity resulting from human impact • list and expound upon the causes of habitat destruction and pollution	• understand the factual basis of climate change • identify different forms of pollution • define biodiversity, adaptation, invasive species, habitat destruction	• Using information learned from this unit, identify and describe the impact that green technologies can, and are, having on natural ecosystems
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Types of pollution-noise, oil, runoff, trash, light • Keeling curve analysis • Global warming and altered weather patterns • Alternate energy resources	• Students analyze how humans contribute to various types of pollution • Relate the data obtained from the Keeling curve to analyze trends in CO2 output • Critique trends in weather patterns and relate it to climate change • Discuss fossil fuel alternatives and possible future implications	• 1 - Recall/2- Skill/Concept • 3- Strategic thinking/ 4- Extended Thinking • 3- Strategic thinking/ 4- Extended Thinking • 2- Skill/Concept/3-Strategic thinking
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Sociology	• Ecosystems and Populations • Inquiry • Science Technology, and Human Activity	• Design an energy efficient structure.
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Keeling Curve Analysis • Bellringers • Exit Slips • Quick checks • Objective Test	• Formative • Formative • Formative • Formative • Summative	• 3 • 1 or 2 • 1 or 2 • 1 or 2 • all levels

• Student Generated Assessment	• Summative	• 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Calculate their own carbon footprint • Design a plan for a school to become energy efficient.	• **Reflect on personal environmental impact** • **Reinforcement of acquired knowledge**	• 3=Strategic Thinking • 3=Strategic Thinking/4-Extended Thinking

Physical Science Curriculum

CONTENT AREA: High School Science COURSE: Physical Science	UNIT TITLE: Experimental Design UNIT DURATION:

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Metric Equipment (Triple Beam Balance, Graduated Cylinder,metric ruler, thermometer) • Reading(s)/Handouts • Websites • Video Links/DVDs/recordings	• Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning and critical thinking.
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation • Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations. • Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understanding) • The nature of science relies upon communication of results and justification of explanations	1) How is scientific knowledge created and communicated? 2) How does science and technology affect the quality of our lives? 3) Can students use the scientific equipment effectively as well as make metric conversions? 4) Can the student set up a valid experiment including essential components?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD	STANDARDS: Scientific Inquiry	MAJOR STANDARD	SUPPORTING STANDARD
7. 1. A. a-g		**Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation**	x
7.1. B. a-f		**Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations.**	x
7.1C a-d		**Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understanding)**	x
7.1 D a-c		**The nature of science relies upon communication of results and justification of explanations**	X

OBJECTIVE # 1-4	Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical thinking	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 7.1 A-D	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information,* *ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• The student will demonstrate an understanding of how to design and implement a valid scientific experiment. • The students will be able to use scientific equipment to measure quantities using metric units. • Students will know the basic units of measurement in the metric system, the commonly used prefixes and are able to use dimensional analysis to convert between different units of measurement. • Students will be able to construct a useful data table and generate a graph form the data.	• Basic components of an experiment • Independent variable • Dependent variable • Experimental group • Control group • Constants • Theory • Law • Hypothesis/Purpose • Metric prefixes (kilo, milli, and centi) • performs basic processes, such as: converting metric to metric units • Identify lab equipment • Units of measurement	• Conduct an experiment while following safety protocol. • Be able to identify variables and constants • Associate units to quantities • Construct a data table • Create graphs to represent data (graphs should include title, labeled axis) • Write a detailed procedure and conclusion • Use dimensional analysis to effectively convert units (metric and standard)
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture/Discussion of terms • Demonstration of lab procedures • Modeling appropriate use of lab • equipment	• Examine predesigned lab procedures and identify key components • Given a prompt, design an experiment to test. • Formulate a graph from collected data in an experiment	• 2 • 3/4 • 2

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
Math- graphing skills	• 6th grade Physical Science • Basic understanding of metric units • How to write a lab procedure and hypothesis	Use the experimental method to discover, interpret, and display data in graphical and tabular form using lab equipment and materials in a safe manner.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Independent Practice • Labs- Density lab, Metric Tool Lab • Test • Practical- Students will measuring objects in the lab using correct equipment for unknown quantity. • Quizzes	• Formative • Formative • Summative • Summative	• 1 /2 • 2/3 • 2/3 • 3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP intervention • peer tutoring • additional practice/review • direct students toward helpful resources (websites, textbooks, notes, etc.)	• complete a study guide or review portfolio • retesting over objectives • performance event	• 2 • 2 • 2

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Teacher will provide materials necessary to complete developed experiment • Introduce different/advanced lab equipment • Provide challenging dimensional analysis problems • Instruction on technology to develop data tables/graphs	• Complete developed experiment • Research relative topic of interest	• 3/4 • 3

CONTENT AREA: High School Science **COURSE: Physical Science**	**Unit 2 - Mechanics (Newton's Laws of Motion)** **Duration: 4 -6 weeks**

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT: • Metric Equipment (Triple Beam Balance, Graduated Cylinder, metric ruler, thermometer, spring scales, Logger pro) • Motion Detectors • Reading(s)/Handouts • Websites • Video Links/DVDs/recordings	**BIG IDEA(S):** • The motion of an object is determined by its change in position relative to another object or point.
ENDURING UNDERSTANDINGS: • Students will understand motion relative to a frame of reference. • Students will be able to represent the motion of an object by looking at a position/acceleration vs. time graph. • Students will be able to determine net force acting on an object and whether or not the object is accelerating according to Newton's 1st Law.	**ESSENTIAL QUESTIONS:** • How can the motion of an object be described? • How does slope represent the state of motion of an object? • How is acceleration for an object represented graphically compared to constant velocity? • How can Newton's Laws be used to explain the current state of motion for an object?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD	STANDARDS: Properties and Principles of Force and Motion	**MAJOR STANDARD**	**SUPPORTING STANDARD**	
2. 1. A. a-b.	The motion of an object is described as a change in position, direction, and speed relative to another object (frame of reference)		x	
2.1 B a	An object that is accelerating is speeding up, slowing down, or changing direction			x
2.2 D a-e	Newton's Laws of Motion explain the interaction of mass and forces, and are used to predict changes in motion	X		
OBJECTIVE # 5-10	The motion of an object is described by its change in position relative to another object or point.			

	Forces affect motion.	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 2.1 A-C • 2.2 A,B,D,E	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• Motion is compared relative to a frame of reference and can differentiate velocity from acceleration. • Perform basic calculations to find speed, distance, and acceleration. • Represent the motion of an object graphically or describe the motion of an object by looking at a position/velocity vs. time graph. • Students will be able to determine net force acting on an object and whether or not an object is accelerating according to Newton's First Law.	• **Speed** • **Constant Speed** • **Velocity** • **Vector** • **Acceleration** • **Frame of Reference** • **Equilibrium** • **Newton's First Law** • **Units For quantities** • **Displacement** • **Deceleration**	• **Calculate acceleration, speed and velocity** • **Associate units with quantities** • **Determine motion for an object graphically** • **Identify the state of equilibrium for an object** • **Determine direction of an object (positive and negative)** • **Be able to graph the motion of an object**

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Discussion of terms** • **Demonstration of lab procedures** • **Modeling appropriate use of lab** • **equipment**	• **Examine predesigned lab procedures and identify key components** • **Given a prompt, design an experiment to test.** • **Formulate a graph from collected data in an experiment**	• 2 • 3/4 • 2
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
Math- graphing skills/ algebraic skills	• 6th grade Physical Science • Basic understanding of metric units • How to write a lab procedure and hypothesis • How to correctly use lab equipment	Use the experimental method to discover, interpret, and display data in graphical and tabular form using lab equipment and materials in a safe manner.
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Independent Practice • Labs • Test • Practical	• Formative • Formative • Summative • Summative	• 1 /2 • 2/3 • 2/3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP intervention • peer tutoring • additional practice/review • direct students toward helpful resources (websites, textbooks, notes, etc.)	• complete a study guide or review portfolio • retesting over objectives	• 2 • 2 • 2

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Independent research on gravity's effect on planetary orbits	• Complete independent research • Research relative topic of interest	• 3/4 • 3

CONTENT AREA: High School Science	UNIT TITLE: Forces
COURSE: Physical Science	UNIT DURATION: 6 weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Metric Equipment (Triple Beam Balance, Graduated Cylinder,metric ruler, thermometer) • Spring scales • LoggerPro • Reading (s)/Handouts • Websites • Video Links/DVDs/recordings	• Forces affect motion
ENDURING UNDERSTANDINGS: • Forces are classified as either contact forces (pushes, pulls, friction, buoyancy) or non-contact forces (gravity, magnetism), that can be described in terms of direction and magnitude • Every object exerts a gravitational force on every other object • Newton's Laws of Motion explain the interaction of mass and forces, and are used to predict changes in motion • Perpendicular forces act independently of each other	**ESSENTIAL QUESTIONS:** 1. Can students differentiate between mass and weight? 2. How does mass and force affect the acceleration of an object? 3. What factors affect gravitational forces? 4. Can students identify forces acting on an object? 5. Can students identify direction of the forces and resulting movement of an object? 6. Can students identity action/reaction pairs

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD	STANDARDS: Forces / MAJOR STANDARD	SUPPORTING STANDARD	
2. 2 A.	Forces are classified as either contact forces (pushes, pulls, friction, buoyancy) or non-contact forces (gravity, magnetism), that can be described in terms of direction and magnitude	x	
2.2. B. a-d	Every object exerts a gravitational force on every other object	x	
2.2 D. b-e	Newton's Laws of Motion explain the interaction of mass and forces, and are used to predict changes in motion	x	
2.2 E. a	Perpendicular forces act independently of each other		x

<table>
<tr><td>OBJECTIVE # 8-10</td><td colspan="2">Forces affect motion.</td></tr>
<tr><td>REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS</td><td colspan="2">• 2.2 A,B,D,E</td></tr>
<tr><td colspan="3">WHAT SHOULD STUDENTS…</td></tr>
<tr><td>UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.</td><td>KNOW?
Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY</td><td>BE ABLE TO DO?
Skills; Products</td></tr>
<tr><td>• Students will understand the relationship between mass, net force and acceleration and can use this understanding to predict the behavior of an object under the influence of one or several forces.
• Students will identify the different types of forces that act on an object and know factors that affect those forces (e.g. coefficient of friction). Students can represent these forces in a free body diagram.
• Students will be able to analyze action/reaction pairs.</td><td>• Mass
• Weight
• Gravity
• Applied Force
• Support/Normal Force
• Friction
• Tension
• Air Drag
• Acceleration to gravity
• Coefficient of Friction
• Net Force
• Action/Reaction Pairs
• Newton's 3rd Law
• Units (mass, weight, acceleration</td><td>• Conduct an experiment while following safety protocol.
• Associate units to quantities
• Students should be able to calculate weight from mass
• Students should be able to use Newton's 2nd law equation.
• Predict the state of motion for an object
• Be able to diagram forces acting on an object
• Be able to identify action/reaction pairs</td></tr>
<tr><td colspan="3">FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING</td></tr>
<tr><td>TEACHER INSTRUCTIONAL ACTIVITY</td><td>STUDENT LEARNING TASK</td><td>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</td></tr>
<tr><td>• Lecture/Discussion of terms
• Demonstration of lab procedures
• Modeling appropriate use of lab
• equipment.</td><td>• Examine predesigned lab procedures and identify key components
• identify forces acting on objects
• be able to explain the effect forces have on objects
• Formulate a graph from collected data in an experiment</td><td>• 2
• 3/4
• 2</td></tr>
<tr><td>INTERDISCIPLINARY CONNECTION</td><td>PRIOR KNOWLEDGE CONNECTIONS</td><td>INQUIRY CONNECTIONS</td></tr>
</table>

Math- algebraic skills	• 6th grade Physical Science • Basic understanding of metric units • How to write a lab procedure and hypothesis • How to correctly use lab equipment	Use the experimental method to discover, interpret, and display data in graphical and tabular form using lab equipment and materials in a safe manner.
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Independent Practice • Labs- Type of forces lab, Mass vs Weight, Coefficient of friction • Test • Quizzes	• Formative • Formative • Summative • Summative	• 1 /2 • 2/3 • 2/3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP intervention • peer tutoring • additional practice/review • direct students toward helpful resources (websites, textbooks, notes, etc.)	• complete a study guide or review portfolio • retesting over objectives • performance event	• 2 • 2 • 2
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Teacher will supply list of possible research topics • 2 dimensional force diagrams	• Complete developed experiment • Research relative topic of interest	• 3/4 • 3

CONTENT AREA: High School Science	UNIT TITLE: Momentum
COURSE: Physical Science	UNIT DURATION:

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Metric Equipment (Triple Beam Balance, stopwatch, metric ruler, newton's cradle, cart tracks) • Reading(s)/Handouts • Websites • Video Links/DVDs/recordings	• The motion of an object is described by its change in position relative to another object or point.
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Momentum depends on the mass of the object and the velocity with which it is traveling	1. Can the students identify the factors that affect momentum? 2. How can momentum of an object be changed? 3. How is momentum conserved? 4. What are the different types of collisions? 5. Can students calculate momentum or unknown variable using the momentum equation?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD	STANDARDS: Momentum	MAJOR STANDARD	SUPPORTING STANDARD
2.1 C a-b	**Momentum depends on the mass of the object and the velocity with which it is traveling**	x	

<table>
<tr><td>OBJECTIVE # 1-4</td><td colspan="2">Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical thinking</td></tr>
<tr><td>REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS</td><td colspan="2">• 7.1 A-D</td></tr>
<tr><td colspan="3">WHAT SHOULD STUDENTS…</td></tr>
<tr><td>UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.</td><td>KNOW?
Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY</td><td>BE ABLE TO DO?
Skills; Products</td></tr>
<tr><td>• Students will understand and apply the definition of momentum and what is needed to change the momentum of an object.
• Students will demonstrate that total momentum remains constant within a system if the net force is zero. (Conservation of momentum.)</td><td>• mass
• Velocity
• Impulse
• Force
• Conservation of momentum
• elastic/inelastic collision
• momentum</td><td>• calculate momentum for an object
• describe how the factors of impulse result in momentum change
• identify a collision as elastic or inelastic
• solve for unknown variables using conservation of momentum equations
• Explain the change in velocity as a result of a collision based on the law of conservation principle</td></tr>
<tr><td colspan="3">FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING</td></tr>
<tr><td>TEACHER INSTRUCTIONAL ACTIVITY</td><td>STUDENT LEARNING TASK</td><td>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</td></tr>
<tr><td>• Lecture/Discussion of terms
• Demonstration of lab procedures
• Modeling appropriate use of lab
• equipment</td><td>• Examine predesigned lab procedures and identify key components
• design a collision problem including solution
• Discussion of scenarios involving impulse / momentum relationships
• practice problems</td><td>• 2
• 3
• 3
• 2/3</td></tr>
<tr><td>INTERDISCIPLINARY CONNECTION</td><td>PRIOR KNOWLEDGE CONNECTIONS</td><td>INQUIRY CONNECTIONS</td></tr>
<tr><td>Math- algebraic skills</td><td>• solving algebraic equations for unknown variable
• mass as a concept</td><td>• Gather evidence using qualitative and quantitative observations (Ex: automobile crash- calculating the initial velocity and the final velocity after the crash)</td></tr>
</table>

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Independent Practice • Labs- Momentum Lab, Egg drop, online lab (Phet), Bowling with different masses. • Test • Quizzes	• Formative • Formative • Summative • Summative	• 1 /2 • 2/3 • 2/3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP intervention • peer tutoring • additional practice/review • direct students toward helpful resources (websites, textbooks, notes, etc.)	• complete a study guide or review portfolio • retesting over objectives	• 2 • 2 • 2
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Teacher will provide materials necessary to complete developed experiment • Introduce factors that affect momentum/ change in momentum • Law of conservation of momentum	• Complete developed experiment • Research relative topic of interest	• 3/4 • 3

CONTENT AREA: High School Science

COURSE: Physical Science

UNIT TITLE: Work, Power and Energy

UNIT DURATION:

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	**BIG IDEA(S):**
• Metric Equipment (Triple Beam Balance, metric ruler, spring scales) • Pulley, incline plane, levers • Reading(s)/Handouts • Websites • Video Links/DVDs/recordings	• Energy has a source, can be stored, and can be transferred but is conserved within a system • Forces affect motion
ENDURING UNDERSTANDINGS: • Forms of energy have a source, a means of transfer (work and heat), and a receiver • Mechanical energy comes from the motion (kinetic energy) and/or relative position (potential energy) of an object • Energy can be transferred within a system as the total amount of energy remains constant (i.e., Law of Conservation of Energy) • Work transfers energy into and out of a mechanical system	**ESSENTIAL QUESTIONS:** 1. How can we identify when work has been done? 2. What is the relationship between work and power? 3. How do simple machines make work easier? 4. What are the various forms of energy? 5. How does energy take on various forms based on the Law of Conservation of Energy?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD	**STANDARDS:** Work, Power and Energy	**MAJOR STANDARD**	**SUPPORTING STANDARD**
1.2 A c	Forms of energy have a source, a means of transfer (work and heat), and a receiver		x
1.2 B. a-d	Mechanical energy comes from the motion (kinetic energy) and/or relative position (potential energy) of an object		x
1.2 F a-c	Energy can be transferred within a system as the total amount of energy remains constant (i.e., Law of Conservation of Energy)		x
2.2 F a-d	Work transfers energy into and out of a mechanical system		X

OBJECTIVE # 13-17	Energy has a source, and can be stored, and can be transferred but is conserved within a system Forces affect motion
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 1.2 A, B, F • 2.2 F

WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Students will be able to identify the various ways energy is stored. • Students will understand the law of conservation of energy and can apply it to make predictions about the behavior of a system. • Students will understand how work changes the energy in a system and can determine the amount of work done on an object. • Students understand the difference between work and power and can calculate the rate at which work is done. • Students will understand the functions of a simple machine	• Simple Machine • Work • Power • Efficiency • Mechanical Advantage • Work output/input • Mechanical energy • Thermal energy • Nuclear Energy • Chemical Energy • Kinetic Energy • Potential Energy • Electromagnetic Energy • Law of Conservation of Energy • Friction	• Students will design or implement a lab experiment using simple machines to calculate work done, efficiency, mechanical advantage and other ways of measuring a machine's effectiveness. • Apply the definition of work to everyday scenarios. • Determine the power output for a simple machine. • Identify the energy transformations that take place in a system. • Calculate the amount and types of energy that exist at various stages.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture/Discussion of terms • Demonstrations (Simple Machine) • Modeling appropriate use of lab • equipment	• Students can explain the principle of simple machines in which force is traded for distance. • Students knows that power is the rate at which work is done. • Students can give an example of when work is done. • Students can quantify the efficiency and mechanical advantage for a simple machine. • Students can describe how energy can be converted from one form to another.	• 2 • 2 • 2 • 3 • 2/3

INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
Math- Algebraic Skills Technical / Trades: How energy can be transformed in a vehicle How simple machines have impacted our society on a historical/cultural level.	• various types of simple machines • friction • chemical / physical changes • electromagnetic spectrum	Judge whether measurements and computations of quantities are reasonable. (Potential energy based on position, efficiency not greater than 100%)
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Independent Practice • Labs- Power, Simple Machine, Roller Coaster lab, Origami Frog lab • Test • Quizzes	• Formative • Formative • Summative • Summative	• 1 /2 • 2/3 • 2/3 • 2/3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP intervention • peer tutoring • additional practice/review • direct students toward helpful resources (websites, textbooks, notes, etc.)	• complete a study guide or review portfolio • retesting over objectives	• 2 • 2 • 2
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Design or build a machine of their choice (Robotics)	• Complete developed experiment • Research relative topic of interest	• 3/4 • 3

CONTENT AREA: High School Science	UNIT TITLE: Electricity and magnetism
COURSE: Physical Science	UNIT DURATION: 4-6 weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Metric Equipment (Triple Beam Balance, metric ruler) • Battery, wire, nails, switch, alligator clips, light bulbs • Items that can serve as a conductor/insulator • Reading(s)/Handouts • Websites • Video Links/DVDs/recordings	• Changes in properties and states of matter provide evidence of the atomic theory of matter • Forces affect motion
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• The atomic model describes the electrically neutral atom • Magnetic forces are related to electrical forces as different aspects of a single electromagnetic force	1. Which part of the atom is positively charged and which is negatively charged 2. Which particle is responsible for electric current? 3. How does static electricity happen? 4. How does resistance effect electric current? 5. How is voltage related to current? 6. How does the different circuits cause different amount of current? 7. Why are some pieces of iron magnets and others are not? 8. What factors increase the strength of an electromagnet? 9. What is the relationship between current and magnetism

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD	**STANDARDS:** Electricity	**MAJOR STANDARD**	**SUPPORTING STANDARD**
1.1 E a	Describe the atom as having a dense, positive nucleus surrounded by a cloud of negative electrons		X
1.1 E b	Calculate the number of protons, neutrons, and electrons of an element/isotopes given its mass number and atomic number	X	
1.1 E c	Describe the information provided by the atomic number and the mass number (i.e., electrical charge, chemical stability		X
2.2 C a	Recognize changing magnetic fields can produce electrical current and electric currents can produce magnetic forces	X	
2.2 C b	Predict the effects of an electromagnetic force	X	

	on the motion of objects (attract or repel)		

OBJECTIVE # 23-26	• The atomic model describes the electrically neutral atom
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 1.1 E a-c • 2.2 C a-b

WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Students will be able to describe electrical forces between objects. • Students will be able to identify and describe properties of current. • Students will be able to illustrate and describe the current in a circuit. • Students will be able to explain the effects of magnetism on electricity and magnetic material.	• Electric current • Series Circuit • Parallel Circuit • Voltage • Resistance • Polarization • ion • cation • anion • Ohms • Volts • Ampere • Magnetic Domain • Electromagnet	• Identify subatomic particles and their charges in an atom • Explain how static electricity occurs in detail • Predict if attraction or repulsion will occur between two charges • Be able to explain how an electrically charged object can be attracted to a neutral object • Understand that in order to have an electrical current an electrical potential (voltage) must be present • Use ohm's law to calculate for unknown variables in a circuit • Be able to identify characteristics of a series and parallel circuit • Be able to draw schematic diagrams of the two types of simple circuits • Find the current, voltage and resistance in a circuit • Explain why some pieces of iron can become magnetic

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture/Discussion of terms • Demonstrations	• Explain how an object becomes charged and relate that to everyday examples of static electricity • Practice using ohms' law to find unknown variables • With direction, create a series and parallel circuit using a battery, wire and light bulbs ○ Examine characteristics of both circuits	• 2 • 2 • 2 • 2/3

	• Participate in the magnet inquiry lab	
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
Math- Algebraic Skills	• subatomic particles • magnetic poles (north and south) • forces can attract and repel (experience with magnets)	Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies (atomic theory)

ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)

• Independent Practice
• Labs
  ◦ Circuit lab
  ◦ conductors/insulators static lab
  ◦ Electromagnet lab
  ◦ magnet inquiry lab
Assessment
Quizzes
	• Formative
	• Formative
	• Summative
	• Summative
		• 1 /2
		• 2/3
		• 2/3
		• 2/3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?
Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP intervention • peer tutoring • additional practice/review • direct students toward helpful resources (websites, textbooks, notes, etc.)	• complete a study guide or review portfolio • retesting over objectives	• 2 • 2 • 2

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Give them an opportunity to create more complex circuits or combination circuits • • •	• Complete developed experiment • Research relative topic of interest	• 3/4 • 3

CONTENT AREA: High School Science	UNIT TITLE: Heat and Thermal Energy
COURSE: Physical Science	UNIT DURATION: 4-6 weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- Metric Equipment (Triple Beam Balance, metric ruler, thermometer)
- Hot plate
- Tissue paper- hot air balloon
- Reading(s)/Handouts
- Websites
- Video Links/DVDs/recordings

BIG IDEA(S):

- Changes in properties and states of matter provide evidence of the atomic theory of matter
- Energy has a source, can be stored, and can be transferred but is conserved within a system

ENDURING UNDERSTANDINGS:

- Physical changes in states of matter due to thermal changes in materials can be explained by the Kinetic Theory of Matter
- Forms of energy have a source, a means of transfer (work and heat) and a receiver

ESSENTIAL QUESTIONS:

1. What is the difference between heat, temperature and thermal energy?
2. How is temperature measured? (3 scales)
3. Why do some objects heat up or cool down faster than others?
4. Why doesn't temperature change when undergoing a phase change
5. Why is evaporation a cooling process and condensation a warming process
6. What are the different types of heat transfer?
7. What is thermal equilibrium?
8. How does thermal expansion effect certain objects? How is water different than other objects?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD	STANDARDS: Heat and Thermal Energy	MAJOR STANDARD	SUPPORTING STANDARD
1.1 D a	Using the Kinetic Theory model, explain the changes that occur in the distance between atoms/molecules and temperature of a substance as energy is absorbed or released during a phase change		X
1.1 D b	Predict the effect of a temperature change on the properties (i.e., pressure, density, volume) of a material (solids, liquids, gases)	X	
1.2 A a	Differentiate between thermal energy (the total internal energy of a substance which is dependent upon mass), heat (thermal energy that transfers from one object or system to another due to a difference in temperature), and temperature (the measure of average kinetic energy of molecules or atoms in a substance)	X	
1.2 A b	Differentiate between the properties and examples of conductors and insulators		X
1.2 A f	Interpret examples of heat transfer (e.g., home heating, solar panels) as convection, conduction, or radiation	X	

OBJECTIVE # 18-22	• Changes in properties and states of matter provide evidence of the atomic theory of matter • Energy has a source, can be stored, and can be transferred but is conserved within a system
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 1.1 D a-b • 1.2 A a,b,f

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Students will be able to understand the principles of thermal energy and temperature and identify common temperature scales. • Students will be able to compare specific heat capacities of certain substances. • Students will be able to understand the behavior of objects according to the principle of thermal equilibrium. • Students will understand how heat can be transferred and can give / recognize examples of the 3 methods of heat transfer. • Students will be able to understand the behavior of particles before, during, or after a phase change.	• Absolute zero • heat • specific heat capacity • Temperature • thermal energy • thermal expansion • condensation • evaporation • conduction • convection • radiation • sublimation • thermal equilibrium	• Explain the difference between thermal energy, heat and temperature • Distinguish between a heat conductor and insulator • Use a graph to explain that when the energy of the particles making up a substance changes, either the temperature must change or the phase, but not both at the same time. • Convert between Celsius and Kelvin scales • Calculate energy using specific heat • Determine the change in temperature using the principle that heat is neither gained nor lost. • Explain water's role in climate

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

<table>
<tr><th>TEACHER INSTRUCTIONAL ACTIVITY</th><th>STUDENT LEARNING TASK</th><th>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</th></tr>
<tr><td>• Lecture/Discussion of terms
• Demonstrations</td><td>• Participate in discussion over everyday examples of temperature and thermal energy
• Practice problems over specific heat, conversion between scales and thermal equilibrium
• Complete thermal energy labs
• Use a graph to determine states of matter and identify phase changes
    ○ understanding that either temperature increases or a phase change
• Give everyday examples of heat transfer</td><td>• 2
• 2/3
• 2/3
• 3
• 2</td></tr>
<tr><th>INTERDISCIPLINARY CONNECTION</th><th>PRIOR KNOWLEDGE CONNECTIONS</th><th>INQUIRY CONNECTIONS</th></tr>
<tr><td>Math- Algebraic Skills
Geography- climate</td><td>• states of matter
• all matter is made up of moving particles
• Fahrenheit and Celsius scales
• Phase changes
• Boiling point and Freezing points on Fahrenheit and Celsius scales</td><td>Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)</td></tr>
<tr><th>ASSESSMENT DESCRIPTION</th><th>FORMATIVE OR SUMMATIVE?</th><th>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</th></tr>
<tr><td>• Independent Practice
• Labs
• Assessments
• Quizzes</td><td>• Formative
• Formative
• Summative
• Summative</td><td>• 1 /2
• 2/3
• 2/3
• 2/3</td></tr>
</table>

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP intervention • peer tutoring • additional practice/review • direct students toward helpful resources (websites, textbooks, notes, etc.)	• complete a study guide or review portfolio • retesting over objectives	• 2 • 2 • 2

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
Direct students to higher level studies in Thermodynamics	• Complete developed experiment • Research relative topic of interest	• 3/4 • 3

CONTENT AREA: High School Science COURSE: Physical Science	UNIT TITLE: Waves UNIT DURATION: 4-6 weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Metric Equipment (Triple Beam Balance, metric ruler) • slinkies/spring coils • tuning forks • Resonance boxes • Reading(s)/Handouts • Websites • Video Links/DVDs/recordings	• Energy has a source, can be stored, and can be transferred but is conserved within a system
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Forms of energy have a source, a means of transfer (work and heat) and a receiver • Electromagnetic energy from the Sun (solar radiation) is a major source of Energy on Earth	1. What are the main types of waves? 2. How does a mechanical wave compare/contrast to an electromagnetic wave? 3. What causes waves? 4. What determines the frequency of a wave? 5. How does changing the medium of a wave effect the speed? 6. How is the amplitude of a wave related to the energy in a wave? 7. What is a standing wave? 8. What are the two types of interference that occur in a wave? 9. How is frequency related to pitch in a sound wave? 10. What are overtones?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD	STANDARDS: Waves	MAJOR STANDARD	SUPPORTING STANDARD
1.2 A e	Describe the effect of different frequencies of electromagnetic waves on the Earth and living organisms (e.g., radio, infrared,visible, ultraviolet, gamma and cosmic rays		x
1.2 C a	Identify stars as producers of electromagnetic energy		X
1.2 C b	Describe how electromagnetic energy is transferred through space as electromagnetic waves of varying wavelength and frequency		X

<table>
<tr><td>OBJECTIVE # 27-29</td><td colspan="2">Energy has a source, can be stored, and can be transferred but is conserved within a system</td></tr>
<tr><td>REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS</td><td colspan="2">1.2 A e
1.2 C a-b</td></tr>
<tr><th colspan="3">WHAT SHOULD STUDENTS…</th></tr>
<tr><th>UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.</th><th>KNOW?
Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY</th><th>BE ABLE TO DO?
Skills; Products</th></tr>
<tr><td>Students should understand that waves carry energy
Students should understand that mechanical waves require a medium and that speed of the wave is dependent on that medium
If the wave’s speed is constant, then the frequency of the wave is inversely proportional to the wavelength
That Doppler effect occurs as a result of a change in frequency due to a moving source
Students should understand that waves have certain properties and behaviors (reflection, diffraction, refraction)</td><td>mechanical wave
medium
crest
trough
transverse wave
compression
rarefaction
longitudinal wave
period
frequency
hertz
wavelength
amplitude
reflection
refraction
diffraction
interference
standing waves
nodes
antinodes
resonance
ultrasonic
infrasonic
Doppler effect</td><td>Identify characteristics of a transverse wave (wavelength, amplitude, crest and trough)
Identify characteristics of a longitudinal wave (compressions and rarefactions)
Find the frequency and period in a wave
Knowing wavelength and frequency solve for speed of a wave</td></tr>
</table>

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture/Discussion of terms • Demonstrations	• Participate in discussion over types of waves • Practice problems involving finding frequency, wavelength and speed. Problems for finding wavelengths of a standing wave • Complete speed of wave labs • Use tuning forks to demonstrate wave behaviors	• 2 • 2/3 • 2/3 • 3 • 3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
Math- Algebraic Skills	• that sound is a wave	Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Independent Practice • Labs • Assessments • Quizzes	• Formative • Formative • Summative • Summative	• 1 /2 • 2/3 • 2/3 • 2/3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET**

		(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP intervention • peer tutoring • additional practice/review • direct students toward helpful resources (websites, textbooks, notes, etc.)	• complete a study guide or review portfolio • retesting over objectives	• 2 • 2 • 2
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
Direct students to higher level studies in waves Superposition problems	• Complete developed experiment • Research relative topic of interest	• 3/4 • 3

Chemistry Curriculum

CONTENT AREA: High School Science COURSE: Chemistry	UNIT TITLE: Atomic Structure UNIT DURATION: 8 Weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Reading(s)/Handouts • Manipulatives/Labs • Technology/chromebooks • Websites • Video Links/DVDs/Recordings	• The structure of atoms determines an element's properties. • The organization of the periodic table is based on properties of the elements. • Atoms are composed of smaller particles. • All elements have isotopes. • Some nuclei can change through radioactive decay.
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Students will understand that elements are made up of atoms whose properties are mainly determined by its electron arrangement. • Students will understand that an element's position on the periodic table matches its properties and electron configuration. • Students will understand that changes to the nucleus of an atom involve huge amounts of energy and a change in its identity (transmutation).	• What is the structure of an atom? • What gives an element it's properties? • How does the structure of the periodic table allow us to predict the chemical and physical properties of an element? • How can nuclei of the same element differ? • What happens when nuclei change?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.e. *GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 1.1.E.a	*Describe the atom as having a dense, positive nucleus surrounded by a cloud of negative electrons.*		x
CLE 1.1.E.b	*Calculate the number of protons, neutrons, and electrons of an isotope, given its mass number and atomic number.*		x
CLE 1.1.C.c	*Describe the information provided by the atomic number and the mass number (i.e., electrical charge, chemical stability)*		x
CLE 1.1.F.a	*Explain the structure of the periodic table in terms of the elements with common properties (groups/families) and repeating properties (periods).*		x
CLE 1.1.F.b	*Classify elements as metals, nonmetals, metalloids (semi-conductors), and noble gases according to their location on the Periodic Table.*		x
CLE 1.2.A.b	*Describe the relationship among wavelength, energy, and frequency as illustrated by the electromagnetic spectrum*		x
CLE 1.2.A.d	*Describe the effect of different frequencies of electromagnetic waves on the Earth and living organisms (e.g., radio, infrared, visible, ultraviolet, gamma, cosmic rays).*		x
CLE 1.2.E.a	*Describe how changes in the nucleus of an atom during a nuclear reaction (i.e., nuclear decay, fusion, fission)*		x

	result in emission of radiation		

Objectives 8-11		
References	CLE 1.1.A a-g; CLE 7.1.A-D	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• **That atomic number determines the identity of the atom.** • **That mass numbers must be whole numbers but atomic mass may be decimals.** • **The electron is the part of the atom that determines chemical properties.** • **That elements in the same vertical group/family on the Periodic Table have similar properties.**	• **The symbols of the most common elements.** • **The charge and relative masses of each subatomic particle.** • **The maximum number of electrons that can be contained in any energy level, sublevel or orbital.**	• **Determine the number of protons, electrons and neutrons in a particular isotope.** • **Classify elements as metals, nonmetals or metalloids according to their location on the Periodic Table.** • **Distinguish between valence and inner core electrons.** • **Draw orbital diagrams and Lewis Dot Diagram.**
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Isotopes demo** • **Videos(The History Channel: Manhatten Project)** • **Flame Test Demo** • **Spectroscope Demo**	• **Activities: Drawing "Models of Atoms"; "Isotopes of carbon".** • **History of the Atom Timeline.** • **Articles: "Isotopes of strontium-90 found in baby teeth and calculating it's atomic mass"; "Radioactivity - It's a Natural";** • **Students calculate their own body radiation levels.** • **Effects of an Atomic bomb on St. Charles.** • **Students use geiger counters to measure radiation levels in different objects.** • **Labs: "Isotopes of Pennies"; "Half-life Labs"; "Ions and Isotopes Labs"** • **Flame Tests lab** • **Periodic Table Project.**	• 2/3/4
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
CCSS M4 **CCSS E3** **CLE Strand 8.2.B**	**Basic Structure of the Atom.** **The atom is the basic unit of matter.** **Elements are represented by symbols.** **Basic familiarity with the Periodic Table.**	**CLE Strand 7**

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Flame test lab – students will identify their unknown substance based on flame test results • Other Labs • Unit Tests	• S • S • S	• 3 • 3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction • Post additional lectures via youtube/websites.	• Flashcards to revisit vocabulary. • Practice and retest	• 3
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	4

CONTENT AREA: High School Science

COURSE: Chemistry

UNIT TITLE: Chemical Reactions and Bonding

UNIT DURATION: 8 Weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- **Reading(s)/Handouts**
- **Manipulatives/Labs**
- **Technology/chromebooks**
- **Websites**
- **Video Links/DVDs/Recordings**

BIG IDEA(S):

- **Valence electron configuration determines how atoms interact and bond.**
- **The type of bonding affects the properties of a compound.**
- **Balanced chemical equations are used to derive relationships between reactions and products in a chemical change.**
- **Chemists use stoichiometry to calculate quantities of reactants and products.**

ENDURING UNDERSTANDINGS:

- **Students will be able to describe how the valence electron configuration determines how atoms interact and may bond.**
- **Students will be able to compare and contrast ionic, covalent and metallic bonding.**
- **Students will be able to write a chemical equation as a chemist's shorthand method of describing a chemical change.**
- **Students will be able to solve stoichiometry problems.**

ESSENTIAL QUESTIONS:

- **How does electron arrangement determine bonding?**
- **How do intermolecular forces determine the phase of a substance?**
- **How does the shape of the molecule affect it's polarity?**
- **How does the law of conservation of mass relate to balancing equations?**
- **How does a chemical equation give quantitative relationships between reactants and products?**

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 1.1.H.a	*Describe how the valence electron configuration determines how atoms interact and may bond*		x
CLE 1.1.H.c	*Compare and contrast the types of chemical bonds (i.e., ionic, covalent)*		x
CLE 1.1.H.d	*Predict the products of an acid/base (neutralization), oxidation (rusting), and combustion (burning) reaction*		x
CLE 1.1.I.a	*Compare the mass of the reactants to the mass of the products in a chemical reaction or physical change as support for the Law of Conservation of Mass*		x
CLE 1.1.I.b	*Recognize whether the number of atoms of the reactants and products in a chemical equation are balanced*		x

<table>
<tr><td>Objectives 12-18</td><td colspan="2"></td></tr>
<tr><td>References</td><td colspan="2">CLE 1.1.H a-g; CLE 1.1.I a-g</td></tr>
<tr><td colspan="3" align="center">WHAT SHOULD STUDENTS…</td></tr>
<tr><td align="center">UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.</td><td align="center">KNOW?
Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY</td><td align="center">BE ABLE TO DO?
Skills; Products</td></tr>
<tr><td>
That atoms can share or transfer electrons.
That bonding is a result of atoms gaining a noble gas electron configuration
There are patterns that allow chemists to classify reactions and predict products.
Only coefficients can be changed when balancing a chemical reaction.
The mole ratio allows one to convert from substance A to substance B in a factor label conversion chart.
The steps required to solve stoichimetric problems.
</td><td>
That position on the periodic table predicts the type of bonding that occurs between two atoms.
That bonds are not 100% ionic nor 100% covalent.
The difference between a coefficient and a subscript.
That reactants are on the left and products are on the right side of the arrow.
The seven diatomic elements.
That a mole ratio comes from a balanced chemical equation.
That theoretical yield is the result of a stoichiometry calculation.
</td><td>
Predict the type of bond based on the elements position on the periodic table.
Predict a substances properties based upon bond type.
Write formulas for ionic and covalent compounds.
Draw Lewis Structures.
Classify reactions.
Balance chemical equations.
Predict products of simple equations.
Write balanced equations from word equations.
Solve stoichiometric problems when the given or final answer is in mole, mass or volume units.
Identify the limiting and excess reactant in a chemical reaction.
Calculate the theoretical and percent yield for a chemical equation.
Write empirical and molecular formulas for a compound.
</td></tr>
</table>

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Properties of Ionic versus Covalent Demo** • **Formula Writing Flowchart** • **Stoichiometry Demos (S'mores, Methane Bubbles, Woosh Bottle)**	• **Formula Writing Practice** • **Making Ionic Compound Lab** • **Lab: Ionic vs Covalent** • **Structural Formula Practice using Model Kits** • **Mole Labs** • **Percent Composition Lab** • **Balancing Equations Computer Simulation** • **Classifying Reactions Activity** • **Types of Reactions Lab** • **Decomposition of Baking Soda Lab**	• 2/3/4
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
CCSS M4	**Algebraic Expressions** **Dimensional Analysis** **Atomic Structure**	**CLE Strand 7**
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs • Unit Tests	• S • S	• 3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction • Post additional lectures via youtube/websites.	• Flashcards to revisit vocabulary. • Practice and retest	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	4

UNIT TITLE: Principles of Chemistry UNIT DURATION: 8 Weeks	CONTENT AREA: High School Science COURSE: Chemistry

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Reading (s)/Handouts • Manipulatives/Lab & Safety Equipment • Technology/chromebooks • Websites • Video Links/DVDs/Recordings	• Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation,reasoning, and critical thinking • Changes in properties and states of matter provide evidence of the atomic theory of matter

ENDURING UNDERSTANDINGS:	ESSENTIAL QUESTIONS:
• Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation. • Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations. • Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) • Properties of objects and states of matter can change chemically and/or physically • Objects, and the materials they are made of, have properties that can be used to describe and classify them	• How do scientists approach solving problems? • What is the relationship between theories, laws and hypothesis? • Why can there be only one independent variable but multiple dependent variables in a controlled scientific experiment? • How does science and technology affect the quality of our lives? • How is scientific knowledge created and communicated? • How is matter classified and how does it behave? • Why can't a measurement be "exact"? • What is the difference between an accurate versus a precise measurement?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 1.1.A.a	*Compare the densities of regular and irregular objects using their respective measures of volume and mass*		x
CLE 1.1.A.b	*Classify pure substances by their physical and chemical properties (i.e., color, luster/reflectivity, hardness, conductivity, density, pH, melting point, boiling point, specific heat, solubility, phase at room temperature, chemical reactivity)*		x
CLE 1.1.A.c	*Classify a substance as being made up of one kind of atom (element) or a compound when given the molecular formula or structural formula (or electron dot diagram) for the substance*		x
CLE 7.1.A.a	*Formulate testable questions and hypotheses*		x
CLE 7.1.A.b	*Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment*		x

CLE 7.1.A.c	*Design and conduct a valid experiment*		x
CLE 7.1.A.f	*Acknowledge there is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations*		x
CLE 7.1.A.g	*Evaluate the design of an experiment and make suggestions for reasonable improvements*		x
CLE 7.1.B.a	*Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)*	x	
CLE 7.1.B.b	*Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second*	x	
CLE 7.1.B.c	*Determine the appropriate tools and techniques to collect, analyze, and interpret data*	x	
CLE 7.1.B.d	*Judge whether measurements and computation of quantities are reasonable*		x
CLE 7.1.C.a	*Use quantitative and qualitative data as support for reasonable explanations (conclusions)*	x	
CLE 7.1.C.b	*Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable)*		x
CLE 7.1.D.a	*Communicate the procedures and results of investigations and explanations through: oral presentations drawings and maps data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) graphs (bar, single, and multiple line) equations and writings*	x	
CLE 8.2.B.a	*Identify and describe how explanations (laws/principles, theories/models) of scientific phenomena have changed over time as a result of new evidence (e.g., basic structure of matter, structure of an atom)*		x

Objectives 1-7		
References	CLE 1.1.A a-g; CLE 7.1.A-D	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• **That there is no fixed procedure called the "scientific method".** • **That a control is essential in an experiment in order to make a conclusion.** • **The difference between mass, volume and density.** • **That using unit cancellation is the key to setting up problems.** • **That percent error is one method of reporting experimental error.** • **Mass is conserved during any physical or chemical change.** • **That some elements are made up of atoms; others are composed of molecules.**	• **The identity and function of basic lab equipment.** • **The difference between quantitative and qualitative data.** • **How to use conversion factors.** • **The difference between accuracy versus precision.** • **The difference between an atom and molecule.** • **The difference between intensive and extensive properties.**	• **Design and conduct a valid experiment.** • **Manipulate laboratory equipment safely.** • **Identify the experimental group, control group, dependent variable and independent variable in an experiment.** • **Solve problems using dimensional analysis** • **Round answers to the appropriate number of significant figures** • **Estimate approximate measurements in the metric system** • **Write numbers in scientific notation** • **Use their calculators to solve problems** • **Classify substances as elements, compounds or mixtures.** • **Distinguish between physical and chemical changes.** • **Use chemical and physical properties to identify an unknown substance.** • **Separate a mixture into its component substances.**
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Demonstrate safe use of lab equipment** • **Diet Coke/Mentos demonstration** • **Density demonstration** • **Videos (Rough Science, Lab Safety)** • **Demonstrate physical versus chemical changes.** • **Penny demonstrations.**	• **Student will plan and safely conduct lab experiments.** • **Measurement and significant digits lab.** • **Density lab.** • **Classification of matter activity.** • **Separation of mixtures lab.** • **CuCl and aluminum lab.** • **Penny lab.** • **Beverage density lab (How Sweet It Is)** • **Molecular models lab.**	• 3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**

CLE Strand 8.2.A/8.2.B **CCSS M4** **CCSS E4**	**Algebraic Expression** **Metric Units of Measurement**	**CLE Strand 7**
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs • Unit Tests	• S • S	• 3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction • Post additional lectures via youtube/websites.	• Flashcards to revisit vocabulary. • Practice and retest	• 3
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	4

UNIT TITLE: States of Matter UNIT DURATION: 8 Weeks	CONTENT AREA: High School Science COURSE: Chemistry

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	**BIG IDEA(S):**
• Reading (s)/Handouts • Manipulatives/Lab & Safety Equipment • Technology/chromebooks • Websites • Video Links/DVDs/Recordings	• Gas behavior can be quantitatively described using pressure, temperature, volume and mole relationships. • Kinetic molecular theory explains the difference in properties and structure of solids, liquids and gases
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Use Pressure, temperature, volume and number of moles to quantitatively describe a gas. • Use the kinetic molecular theory to explain the difference in properties and structure of solids, liquids and gases.	• What are the mathematical relationships between the quantitative values used to describe gases? • When do real gases behave like ideal gases? • How does temperature and pressure determine what phase a particular substance exists in? • Why do liquids boil at different temperatures at different atmospheric pressures?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 1.1.B.a	*Classify solutions as either dilute or concentrated; as either saturated, unsaturated, or supersaturated*		x
CLE 1.1.B.c	*Predict the effects of solvent and solute polarity on solubility ("like dissolves like"); and predict the effects of temperature, surface area, particle size, and agitation on rates of solubility*		x
CLE 1.1.D.a	*Using the Kinetic Theory model, explain the changes that occur in the distance between atoms/molecules and temperature of a substance as energy is absorbed or released during a phase change*		x
CLE 1.1.D.b	*Predict the effect of a temperature change on the properties (e.g., pressure, density) of a material (solids, liquids, gases)*		x
CLE 1.1.D.c	*Predict the effect of pressure changes on the properties (e.g., temperature, density) of a material (solids, liquids, gases)*		x

Objectives 19-20		
References	CLE 1.1.B-1.1.D	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• **That ideal gases have no volume at absolute zero.** • **Which variables (P,V & T) are inversely related and which are directly related.** • **How the kinetic molecular theory explains the behaviors of solids, liquids and gases.** • **The relationship between vapor pressure and boiling point.** • **That it is the strength of the intermolecular forces that determines what phase a substance is in.**	• **Boyle's law.** • **Charles's law.** • **Gay-Lussac's law.** • **The combined gas law equation.** • **The ideal gas law equation.** • **The value of the gas law constant, R.** • **The value of molar volume.** • **The difference between intermolecular and intramolecular forces.** • **The values of STP conditions in kPa, atm, mm of Hg, K and °C.** • **The names for all of the phase changes.**	• **Choose which equation is appropriate to use for a problem and solve for the unknown variable.** • **Solve stoichiometry problems with gas volume at STP.** • **Convert between degrees Celsius and Kelvins.** • **Relate properties such as viscosity, surface tension and capillary rise to intermolecular forces.** • **Make conversions between the different pressure units.** • **Compare the properties of real versus ideal gases.** • **Use Dalton's law of partial pressures.**
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Gas Law Demonstrations**	• **Graphical Analysis of Gas Laws** • **Boyles Law Lab** • **Charles Law Lab** • **Ideal Gas Law Lab** • **States of Matter Project**	• 3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• **CCSS M4** • **CCSS E3**	• **Algebraic Expression** • **Molar Relationships**	• **CLE Strand 7**
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs • Unit Tests	• S • S	• 3 • 3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction • Post additional lectures via youtube/websites.	• Flashcards to revisit vocabulary. • Practice and retest	• 3
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	4

Honors Chemistry Curriculum

UNIT TITLE: Atomic Structure UNIT DURATION: 8 Weeks	CONTENT AREA: High School Science COURSE: Honors Chemistry

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Reading(s)/Handouts • Manipulatives/Labs • Technology/chromebooks • Websites • Video Links/DVDs/Recordings	• The structure of atoms determines an element's properties. • The organization of the periodic table is based on properties of the elements. • Atoms are composed of smaller particles. • All elements have isotopes. • Some nuclei can change through radioactive decay.
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Students will understand that elements are made up of atoms whose properties are mainly determined by its electron configuration. • Students will understand that an element's position on the periodic table matches its properties and electron configuration. • Students will understand that changes to the nucleus of an atom involve huge amounts of energy and a change in its identity (transmutation).	• What is the structure of an atom? • What gives an element it's properties? • How does the structure of the periodic table allow us to predict the chemical and physical properties of an element? • How can nuclei of the same element differ? • What happens when nuclei change?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 1.1.E.a	*Describe the atom as having a dense, positive nucleus surrounded by a cloud of negative electrons.*		x
CLE 1.1.E.b	*Calculate the number of protons, neutrons, and electrons of an isotope, given its mass number and atomic number.*		x
CLE 1.1.C.c	*Describe the information provided by the atomic number and the mass number (i.e., electrical charge, chemical stability)*		x
CLE 1.1.F.a	*Explain the structure of the periodic table in terms of the elements with common properties (groups/families) and repeating properties (periods).*		x
CLE 1.1.F.b	*Classify elements as metals, nonmetals, metalloids (semi-conductors), and noble gases according to their location on the Periodic Table.*		x
CLE 1.2.A.b	*Describe the relationship among wavelength, energy, and frequency as illustrated by the electromagnetic spectrum*		x
CLE 1.2.A.d	*Describe the effect of different frequencies of electromagnetic waves on the Earth and living organisms (e.g., radio, infrared, visible, ultraviolet, gamma, cosmic rays).*		x
CLE 1.2.E.a	*Describe how changes in the nucleus of an atom during a nuclear reaction (i.e., nuclear decay, fusion, fission) result in emission of radiation*		x

Objectives 8-10		
References	CLE 1.1.A a-g; CLE 7.1.A-D	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• **That atomic number determines the identity of the atom.** • **That mass numbers must be whole numbers but atomic mass may be decimals.** • **The electron is the part of the atom that determines chemical properties.** • **That elements in the same vertical group/family on the Periodic Table have similar properties.**	• **The symbols of the most common elements.** • **The charge and relative masses of each subatomic particle.** • **The maximum number of electrons that can be contained in any energy level, sublevel or orbital.**	• **Determine the number of protons, electrons and neutrons in a particular isotope.** • **Classify elements as metals, nonmetals or metalloids according to their location on the Periodic Table.** • **Distinguish between valence and inner core electrons.** • **Draw orbital diagrams and Lewis Dot Diagrams.** • **Write electron configurations.**
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Isotopes demo** • **Videos(The History Channel: Manhatten Project)** • **Flame Test Demo** • **Spectroscope Demo**	• **Activities: Drawing "Models of Atoms"; "Isotopes of carbon".** • **History of the Atom Timeline.** • **Articles: "Isotopes of strontium-90 found in baby teeth and calculating it's atomic mass"; "Radioactivity - It's a Natural";** • **Students calculate their own body radiation levels.** • **Effects of an Atomic bomb on St. Charles.** • **Students use geiger counters to measure radiation levels in different objects.** • **Labs: "Isotopes of Pennies"; "Half-life Labs"; "Ions and Isotopes Labs"** • **Flame Tests lab** • **Electron Configuration Battleship.** • **Periodic Table Project.**	• 2/3/4
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**

CCSS M4 **CCSS E3** **CLE Strand 8.2.B**	**Basic Structure of the Atom.** **The atom is the basic unit of matter.** **Elements are represented by symbols.** **Basic familiarity with the Periodic Table.**	**CLE Strand 7**
	HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?	
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Flame test lab – students will identify their unknown substance based on flame test results • Other Labs • Unit Tests	• S • S • S	• 3 • 3 • 3
	HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*	
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction • Post additional lectures via youtube/websites.	• Flashcards to revisit vocabulary. • Practice and retest	• 3
	HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*	
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	4

CONTENT AREA: High School Science COURSE: Honors Chemistry	UNIT TITLE: Chemical Reactions and Bonding UNIT DURATION: 8 Weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- **Reading(s)/Handouts**
- **Manipulatives/Labs**
- **Technology/chromebooks**
- **Websites**
- **Video Links/DVDs/Recordings**

BIG IDEA(S):

- **Valence electron configuration determines how atoms interact and bond.**
- **The type of bonding affects the properties of a compound.**
- **Balanced chemical equations are used to derive relationships between reactions and products in a chemical change.**
- **Chemists use stoichiometry to calculate quantities of reactants and products.**

ENDURING UNDERSTANDINGS:

- **Students will be able to describe how the valence electron configuration determines how atoms interact and may bond.**
- **Students will be able to compare and contrast ionic, covalent and metallic bonding.**
- **Students will be able to write a chemical equation as a chemist's shorthand method of describing a chemical change.**
- **Students will be able to solve stoichiometry problems.**

ESSENTIAL QUESTIONS:

- **How does electron arrangement determine bonding?**
- **How do intermolecular forces determine the phase of a substance?**
- **How does the shape of the molecule affect it's polarity?**
- **How does the law of conservation of mass relate to balancing equations?**
- **How does a chemical equation give quantitative relationships between reactants and products?**

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 1.1.H.a	*Describe how the valence electron configuration determines how atoms interact and may bond*		x
CLE 1.1.H.c	*Compare and contrast the types of chemical bonds (i.e., ionic, covalent)*		x
CLE 1.1.H.d	*Predict the products of an acid/base (neutralization), oxidation (rusting), and combustion (burning) reaction*		x
CLE 1.1.I.a	*Compare the mass of the reactants to the mass of the products in a chemical reaction or physical change as support for the Law of Conservation of Mass*		x
CLE 1.1.I.b	*Recognize whether the number of atoms of the reactants and products in a chemical equation are balanced*		x

Objectives 11-19		
References	CLE 1.1.H a-g; CLE 1.1.I a-g	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• **That atoms can share or transfer electrons.** • **That bonding is a result of atoms gaining a noble gas electron configuration** • **There are patterns that allow chemists to classify reactions and predict products.** • **Only coefficients can be changed when balancing a chemical reaction.** • **The mole ratio allows one to convert from substance A to substance B in a factor label conversion chart.** • **The steps required to solve stoichimetric problems.**	• **That position on the periodic table predicts the type of bonding that occurs between two atoms.** • **That bonds are not 100% ionic nor 100% covalent.** • **That the polarity of a molecule if affected by the bonds and shape of the molecule.** • **The difference between a coefficient and a subscript.** • **That reactants are on the left and products are on the right side of the arrow.** • **The seven diatomic elements.** • **That a mole ratio comes from a balanced chemical equation.** • **That theoretical yield is the result of a stoichiometry calculation.**	• **Predict the type of bond based on the elements position on the periodic table.** • **Predict a substances properties based upon bond type.** • **Write formulas for ionic and covalent compounds.** • **Draw Lewis Structures.** • **Determine the shape of molecules using VSEPR theory.** • **Differentiate between a polar bond and a polar molecule.** • **Classify reactions.** • **Balance chemical equations.** • **Predict products of simple equations.** • **Write balanced equations from word equations.** • **Solve stoichiometric problems when the given or final answer is in mole, mass or volume units.** • **Identify the limiting and excess reactant in a chemical reaction.** • **Calculate the theoretical and percent yield for a chemical equation.** • **Write empirical and molecular formulas for a compound.** • **Calculate the amount of excess reactant left when a reaction is complete.**

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Properties of Ionic versus Covalent Demo** • **Formula Writing Flowchart** • **Stoichiometry Demos (S'mores, Methane Bubbles, Woosh Bottle)**	• **Formula Writing Practice** • **Making Ionic Compound Lab** • **Lab: Ionic vs Covalent** • **Structural Formula Practice using Model Kits** • **Mole Labs** • **Percent Composition Lab** • **Balancing Equations Computer Simulation** • **Classifying Reactions Activity** • **Types of Reactions Lab** • **Decomposition of Baking Soda Lab**	• 2/3/4
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
CCSS M4	**Algebraic Expressions** **Dimensional Analysis** **Atomic Structure**	**CLE Strand 7**

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs • Unit Tests	• S • S	• 3 • 3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction • Post additional lectures via youtube/websites.	• Flashcards to revisit vocabulary. • Practice and retest	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	4

UNIT TITLE: Principles of Chemistry UNIT DURATION: 8 Weeks	CONTENT AREA: High School Science COURSE: Honors Chemistry

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:
- Reading (s)/Handouts
- Manipulatives/Lab & Safety Equipment
- Technology/chromebooks
- Websites
- Video Links/DVDs/Recordings

BIG IDEA(S):
- Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation,reasoning, and critical thinking
- Changes in properties and states of matter provide evidence of the atomic theory of matter

ENDURING UNDERSTANDINGS:
- Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation.
- Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations.
- Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings)
- Properties of objects and states of matter can change chemically and/or physically
- Objects, and the materials they are made of, have properties that can be used to describe and classify them

ESSENTIAL QUESTIONS:
- How do scientists approach solving problems?
- What is the relationship between theories, laws and hypothesis?
- Why can there be only one independent variable but multiple dependent variables in a controlled scientific experiment?
- How does science and technology affect the quality of our lives?
- How is scientific knowledge created and communicated?
- How is matter classified and how does it behave?
- Why can't a measurement be "exact"?
- What is the difference between an accurate versus a precise measurement?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 1.1.A.a	*Compare the densities of regular and irregular objects using their respective measures of volume and mass*		x
CLE 1.1.A.b	*Classify pure substances by their physical and chemical properties (i.e., color, luster/reflectivity, hardness, conductivity, density, pH, melting point, boiling point, specific heat, solubility, phase at room temperature, chemical reactivity)*		x
CLE 1.1.A.c	*Classify a substance as being made up of one kind of atom (element) or a compound when given the molecular formula or structural formula (or electron dot diagram) for the substance*		x
CLE 7.1.A.a	*Formulate testable questions and hypotheses*		x
CLE 7.1.A.b	*Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and*		x

	explain their importance to the design of a valid experiment		
CLE 7.1.A.c	Design and conduct a valid experiment		x
CLE 7.1.A.f	Acknowledge there is no fixed procedure called “the scientific method”, but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations		x
CLE 7.1.A.g	Evaluate the design of an experiment and make suggestions for reasonable improvements		x
CLE 7.1.B.a	Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)	x	
CLE 7.1.B.b	Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second	x	
CLE 7.1.B.c	Determine the appropriate tools and techniques to collect, analyze, and interpret data	x	
CLE 7.1.B.d	Judge whether measurements and computation of quantities are reasonable		x
CLE 7.1.C.a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)	x	
CLE 7.1.C.b	Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable)		x
CLE 7.1.D.a	Communicate the procedures and results of investigations and explanations through: oral presentations drawings and maps data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) graphs (bar, single, and multiple line) equations and writings	x	
CLE 8.2.B.a	Identify and describe how explanations (laws/principles, theories/models) of scientific phenomena have changed over time as a result of new evidence (e.g., basic structure of matter, structure of an atom)		x

Objectives 1-7		
References	CLE 1.1.A a-g; CLE 7.1.A-D	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• **That there is no fixed procedure called the "scientific method".** • **That a control is essential in an experiment in order to make a conclusion.** • **The difference between mass, volume and density.** • **That using unit cancellation is the key to setting up problems.** • **That percent error is one method of reporting experimental error.** • **Mass is conserved during any physical or chemical change.** • **That some elements are made up of atoms; others are composed of molecules.**	• **The identity and function of basic lab equipment.** • **The difference between quantitative and qualitative data.** • **How to use conversion factors.** • **The difference between accuracy versus precision.** • **The difference between an atom and molecule.** • **The difference between intensive and extensive properties.**	• **Design and conduct a valid experiment.** • **Manipulate laboratory equipment safely.** • **Identify the experimental group, control group, dependent variable and independent variable in an experiment.** • **Solve problems using dimensional analysis** • **Round answers to the appropriate number of significant figures** • **Estimate approximate measurements in the metric system** • **Write numbers in scientific notation** • **Use their calculators to solve problems** • **Classify substances as elements, compounds or mixtures.** • **Distinguish between physical and chemical changes.** • **Use chemical and physical properties to identify an unknown substance.** • **Separate a mixture into its component substances.**
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Demonstrate safe use of lab equipment** • **Diet Coke/Mentos demonstration** • **Density demonstration** • **Videos (Rough Science, Lab Safety)** • **Demonstrate physical versus chemical changes.** • **Penny demonstrations.**	• **Student will plan and safely conduct lab experiments.** • **Measurement and significant digits lab.** • **Density lab.** • **Classification of matter activity.** • **Separation of mixtures lab.** • **CuCl and aluminum lab.** • **Penny lab.** • **Beverage density lab (How Sweet It Is)** • **Molecular models lab.**	• 3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**

CLE Strand 8.2.A/8.2.B **CCSS M4** **CCSS E4**	**Algebraic Expression** **Metric Units of Measurement**	**CLE Strand 7**
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs • Unit Tests	• S • S	• 3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction • Post additional lectures via youtube/websites.	• Flashcards to revisit vocabulary. • Practice and retest	• 3
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	4

UNIT TITLE: States of Matter

UNIT DURATION: 8 Weeks

CONTENT AREA: High School Science

COURSE: Honors Chemistry

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	**BIG IDEA(S):**
• Reading (s)/Handouts • Manipulatives/Lab & Safety Equipment • Technology/chromebooks • Websites • Video Links/DVDs/Recordings	• Gas behavior can be quantitatively described using pressure, temperature, volume and mole relationships. • Kinetic molecular theory explains the difference in properties and structure of solids, liquids and gases • Solutions can be described in both qualitative and quantitative terms.
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Use Pressure, temperature, volume and number of moles to quantitatively describe a gas. • Use the kinetic molecular theory to explain the difference in properties and structure of solids, liquids and gases. • Qualitatively and quantitatively describe a solution.	• What are the mathematical relationships between the quantitative values used to describe gases? • When do real gases behave like ideal gases? • How does temperature and pressure determine what phase a particular substance exists in? • Why do liquids boil at different temperatures at different atmospheric pressures? • What makes a mixture a "true" solution? • What is the effect of dissolved solutes on freezing and boiling points? • Why do oil and water not mix?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 1.1.B.a	*Classify solutions as either dilute or concentrated; as either saturated, unsaturated, or supersaturated*		x
CLE 1.1.B.c	*Predict the effects of solvent and solute polarity on solubility ("like dissolves like"); and predict the effects of temperature, surface area, particle size, and agitation on rates of solubility*		x
CLE 1.1.D.a	*Using the Kinetic Theory model, explain the changes that occur in the distance between atoms/molecules and temperature of a substance as energy is absorbed or released during a phase change*		x
CLE 1.1.D.b	*Predict the effect of a temperature change on the properties (e.g., pressure, density) of a material (solids, liquids, gases)*		x
CLE 1.1.D.c	*Predict the effect of pressure changes on the properties (e.g., temperature, density) of a material (solids, liquids, gases)*		x

Objectives 20-23		
References	CLE 1.1.B-1.1.D	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• **That ideal gases have no volume at absolute zero.** • **Which variables (P,V & T) are inversely related and which are directly related.** • **How the kinetic molecular theory explains the behaviors of solids, liquids and gases.** • **The relationship between vapor pressure and boiling point.** • **That it is the strength of the intermolecular forces that determines what phase a substance is in.** • **The differences between colloids, suspensions and solutions.** • **How a precipitate is formed.** • **The effect of changing temperature on solubility of both solids and gases.** • **How ionic compounds dissociate when they dissolve.** • **The phrase "like dissolves like".** • **That dilute and concentrated not synonyms with saturated and unsaturated.**	• **Boyle's law.** • **Charles's law.** • **Gay-Lussac's law.** • **The combined gas law equation.** • **The ideal gas law equation.** • **The value of the gas law constant, R.** • **The value of molar volume.** • **The difference between intermolecular and intramolecular forces.** • **The values of STP conditions in kPa, atm, mm of Hg, K and °C.** • **The names for all of the phase changes.** • **The units for molarity.** • **That water is considered the universal solvent.** • **How to make a solute dissolve faster.**	• **Choose which equation is appropriate to use for a problem and solve for the unknown variable.** • **Solve stoichiometry problems with gas volume at STP.** • **Convert between degrees Celsius and Kelvins.** • **Relate properties such as viscosity, surface tension and capillary rise to intermolecular forces.** • **Make conversions between the different pressure units.** • **Compare the properties of real versus ideal gases.** • **Use Dalton's law of partial pressures.** • **Identify the solvent and solute in a solution.** • **Calculate the molarity of a solution.** • **Solve stoichiometric problems with molarity.** • **Write the molecular, complete ionic and net ionic equations.** • **Construct a solubility curve and then analyze data from it.**
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Gas Law Demonstrations**	• **Graphical Analysis of Gas Laws** • **Boyles Law Lab** • **Charles Law Lab** • **Ideal Gas Law Lab** • **States of Matter Project** • **Solutions Lab**	• 3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• **CCSS M4** • **CCSS E3**	• **Algebraic Expression** • **Molar Relationships**	• **CLE Strand 7**

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs • Unit Tests	• S • S	• 3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction • Post additional lectures via youtube/websites.	• Flashcards to revisit vocabulary. • Practice and retest	• 3
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	4

Physics Curriculum

CONTENT AREA: Science COURSE: Physics	STRAND 1: Experimental Design UNIT DURATION: Year long

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

-

ENDURING UNDERSTANDINGS:

- Scientists use experiments to investigate the universe. They use the data collected to create mathematical models to explain and predict what they see. Scientists must be able to explain their work and defend it if it going to be accepted as "true."

BIG IDEA(S):

- Scientists use experiments to investigate the universe.

ESSENTIAL QUESTIONS:

- How do scientists design experiments?
- How do scientists determine if something is "true"?
- How and why do scientists model what happens in the real world?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
Strand 7-1- A,a-g	Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation.	x	
Strand 7-1 – B,a-f	Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations.	x	
Strand 7-1 – C,a-d	Scientific inquiry includes evaluation of explanations in light of evidence and scientific principles		x
Strand 7-1 – D, a-c	The nature of science relies upon communication of results and justification of explorations.		x

OBJECTIVE # 1-4

REFERENCES/STANDARDS
Strand 7 -1

- Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning and critical thinking.

WHAT SHOULD STUDENTS…

UNDERSTAND?

- All measurements are uncertain. In order for measurements to be useful, scientists must estimate and understand the uncertainty in their data.
- There are several types of relationships between variables and these relationships can be described verbally, graphically and mathematically.
- Once you have determined this relationship, you can use it to predict future behavior.

KNOW?

- Basic vocabulary such as
  - independent and dependent variable
  - qualitative and quantitative
  - proportional, inverse, quadratic
  - error and uncertainty

BE ABLE TO DO?

- Design a valid experiment to answer a question.
- Describe possible sources of experimental error and suggest ways to adjust the procedure to minimize this error.
- Analyze data using graphs and appropriate software.
- Students can explain the connection between their data and graphs to the overall model (mathematical, graphical, verbal) of a given system. They can describe this connection in class discussions and in written form.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture on experimental design and uncertainty in measurements. • Provide a handout explaining error and uncertainty and give students practice in finding and describing sources of error. • Facilitate student experimentation. • Provide practice using the software to graph and analyze relationships.	• Students will design an experiment to determine which features of a pendulum affect its period. They will describe their experiment and its conclusions in written form. • Students will learn about the various types of relationships by doing a suite of labs. Groups will do different labs and present/defend their results to the class.	3 3

INTERDISCIPLINARY CONNECTION

- Mathematics – graphing and equations
- Com Arts – writing skills

PRIOR KNOWLEDGE CONNECTIONS

- Finding slope, y-intercept and equation on linear graphs.
- General graphing skills.

INQUIRY CONNECTIONS

- The whole unit is focused on scientific inquiry.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Written quizzes	Formative	3
• In class practice designing and carrying out experiments	Formative	3
• Lab questions on pendulums	Summative	4
• Lab practical – students must use model to predict behavior of a pendulum.	Summative	3
• Written exam	Summative	3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching	• Re-study guide. • Additional experimentation.	3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab.	4

CONTENT AREA: Science COURSE: Physics	UNIT TITLE: Kinematics (1-D and 2-D motion) UNIT DURATION: This strand will be split into multiple units, taught over several months.

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

-

ENDURING UNDERSTANDINGS:

- Motion can only be defined relative to an arbitrary frame of reference.
- A vector is a quantity that incorporates direction.
- Graphs and equations can be used to model and predict motion.
- The vertical and horizontal components of the motion of a projectile are independent of each other. Because of this, one dimensional models can be used to analyze two dimensional projectile motion.
- Bodies in free fall have the same acceleration regardless of mass.

BIG IDEA(S):

- Graphs, equations and diagrams can be used to model and predict motion.

ESSENTIAL QUESTIONS:

- How can we model and predict the motion of an object?
- What is acceleration?
- Do heavier things fall faster?
- How can graphs be used to model and analyze motion?
- How do we model 2-dimentional motion?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
Strand 2-1A, a-b	The motion of an object is described as a change in position, direction and speed relative to a frame of reference.	x	
Strand 2-1B, a	An object that is acceleration is speeding up, slowing down, or changing directions.	x	
Strand 2-2B, d	All falling bodies accelerate at the same rate due to gravity regardless of mass		x

OBJECTIVE # 5-11

REFERENCES/STANDARDS

Strand 2-1

- The motion of an object is described by its change in position relative to another object or point.

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• Students know the difference between vector and scalar quantities.
• Students know how the directions of both one- and two-dimensional vectors are represented mathematically.
• Students can describe what features of the graph (slope, y-intercept, area under the curve) tell us about the motion, if anything.
• Student can define what is meant by free fall and understands that mass has no affect on the acceleration of an object in free fall.
• Students understand that the horizontal and vertical components of projectile motion are independent. They can use this understanding to qualitatively compare the motion of different projectiles.
	• Students know the definitions of basic vector terms, such as magnitude, resultant and component.
	• Students can explain what a reference frame is and why it is necessary to describe quantities such as position or velocity.
	• Students understand the definitions of, position, displacement, distance, velocity, acceleration.
	• Student can differentiate between average and instantaneous quantities.
	• Know what the variables in the basic kinematic equations stand for and know under what conditions they are valid.
		• Students can break a 2D vector into components, or given components can find the magnitude and direction.
		• Students can add two perpendicular or parallel vectors together.
		• Students can model 1-D motion with various graphs, equations and diagrams.
		• Given a motion graph (x vs t, v vs t, a vs t) students can
		  ▪ Sketch the other two graphs
		  ▪ Describe the motion being modeled
		• Students can correctly use the kinematic equations in problem solving, including free fall situations.
		• Students can solve problems involving projectiles launched at any angle from the ground or launched horizontally from any height. (Can predict range, launch velocity, etc.)

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture on vectors and their properties. • Presentation on motion maps (diagrams to represent motion) • Demonstrate problem solving techniques	• Students will conduct a lab to find the relationship between position and time for a car moving at a constant speed. • Lab: graph matching. Given a graph and a	3

• Facilitate discussion of lab results.	motion detector, students will move in ways to reproduce the graphs • Homework assignments – practice on interpreting graphs and motion maps • Students will conduct a lab to determine the relationship between position and time for an object undergoing constant acceleration. • Students will practice vectors skills with worksheets and a map activity. • Students will make videos of a ball dropped as well as thrown through the air. They will analyze these videos to investigate free fall and two dimensional motion. • Students will practice solving problems involving projectile motion.	3 3-4 4 3 3 3-4

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• Algebra skills • Com Arts – writing skills for reports	• Understand graphing (slope, equations, etc.)	• Students are designing experiments and interpreting results.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Given two small cars and their starting positions, students must predict the location where the cars will meet.	Formative	3
• Students will be asked to determine the straight line distance between two points that cannot be measured directly. They will need to apply vector addition.	Formative	3
• Students will be shown a ball launcher and allowed to take any measurements they need to predict the range of the ball.	Formative	3
• Periodic quizzes	Formative	3
• Written tests (2 or 3 for this strand)	Summative	3-4
• Lab Questions	Summative	4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET

		(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching	• Re-study guide. • Additional experimentation.	3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab. (e.g. design a catapult)	4

CONTENT AREA: Science **COURSE: Physics**	**UNIT TITLE: Newton's Laws** **UNIT DURATION: The strand will be split into 2 units, covered over a couple months**

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

-

BIG IDEA(S):

- A force is needed to change the motion of an object (accelerate), not to cause motion. This acceleration is related to the net force and mass of the system

ENDURING UNDERSTANDINGS:

- A force is an interaction between two objects that affects both objects equally. (Newton's 3rd)
- A force is needed to change the motion of an object, not to cause motion. (Newton's 1st)
- Acceleration occurs only when a net force act on a system. The acceleration is proportional to the force and inversely proportional to the mass of the system. (Newton's 2nd)

ESSENTIAL QUESTIONS:

- What are forces and what do they do?
- What causes acceleration?
- What factors affect this acceleration?
- What is equilibrium and how can we determine if something is in equilibrium?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
Strand 2-2A	Forces are classified as either contact or long range forces that can be described in terms of direction and magnitude	x	
Strand 2-2B, a-c	Every object exerts a gravitational force on every other object.	x	
Strand 2-2D, a-e	Newton's Laws of Motion explain the interaction of mass, and forces, and are used to predict changes in motion.	x	
Strand 2-2E, a-c	Perpendicular forces act independently of each other	x	

OBJECTIVE # 12-14
REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS

- Forces affect motion.

WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Students understand that a force is an interaction between two objects that can result in acceleration. Students understand that the net force affects the motion of an object and can use the net force to predict if the object accelerates. • Students understand that tension and normal forces occur as the result of distortions (stretches/compressions) of an object. • Students understand the concept of coefficient of friction and can differentiate between static and kinetic friction.	• Students can identify when various types of forces (gravity, friction, normal, tension) occur and the direction they act. • Students understand the difference between mass and weight and can calculate one if given the other. • Students can state Newton's 3rd Law and can use it to explain situations such as why a rocket rises or how we walk.	• They can use the expression $\lvert\vec{F_f}\rvert = \mu\lvert\vec{F_N}\rvert$ to calculate the force of friction. • Students understand Hooke's Law and can use this law to calculate tension, spring constant or distortion. • Students can use Newton's 1st and 2nd Law to predict the motion of objects or can use the motion to find the value of the forces needed to produce it. • Students can draw a force diagram to represent the individual forces that act on a system. Students can write summation statements to represent the net force acting on an object in the x and y directions. • Student can give the Newton's 3rd law pair force for any given force. • Students can apply Newton's 3rd Law to problem solving involving multiple objects.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture on types of forces and their properties. • Provide a handout describing the construction and use of force diagrams. • Demonstrate problem solving with Newton's Laws. • Facilitate student discussion of lab design and results.	• Students will collect data on the stretch/compression of spring to derive Hooke's Law.	3-4
	• Students will conduct a lab, measuring both mass and weight to derive the relationship between the two for objects on Earth.	3
	• Students will collect data on the normal force and friction acting on a block to investigate coefficient of friction.	3
	• Students will collect data about the net force, mass and acceleration of a system in order to derive Newton's 2nd Law.	4
	• Students will practice problem solving involving Newton's Laws.	3-4
	• Students will observe objects moving with and without friction in order to derive/understand Newton's 1st Law.	3
	• Students will practice drawing force diagrams for a variety of situations. Students will practice writing summation statements of forces based on a force diagram and using them in problem solving.	3-4
	• Students will investigate Newton's 3rd by comparing the forces objects exert on each other in a variety of situations.	3

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• Algebra skills	• Understand graphing (slope, equations, etc.)	• Students are designing experiments and interpreting results.

- Com Arts – writing skills for reports

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Given a lab setup where two forces act on a block, students will determine the third force needed to put the block into equilibrium and test their prediction by releasing the block to see if it accelerates.	Formative	3
• Students will conduct a lab to determine to relationship between force, mass and acceleration.	Summative	3-4
• Given a car on an inclined plane, students will be asked to predict the time for the car to travel a set distance on the plane.	Formative	3
• Periodic quizzes	Formative	3
• Written tests (1 for each unit)	Summative	3-4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching	• Re-study guide. • Additional experimentation.	3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab. (e.g. investigate air resistance)	4

CONTENT AREA: Science COURSE: Physics	UNIT TITLE: Work and Energy UNIT DURATION: 6-8 weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

-

ENDURING UNDERSTANDINGS:

- Energy can be stored in various ways and can be transferred from system to system, but the total amount always remains the same.
- Work is the transfer of energy from system to system via a force.

BIG IDEA(S):

- Energy cannot be created or destroyed, only transferred.

ESSENTIAL QUESTIONS:

- How can energy be stored and what does it do?
- How can energy be moved from place to place?
- What characteristics of a system show energy is stored there?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
Strand 1-2B, a-d	Mechanical energy comes from the motion and/or position of an object.	x	
Strand 1-2F, a-c	Energy can be transferred within a system as the total amount of energy remain constant.	x	
Strand 2-2F a-d	Work transfers energy into and out of a system.	x	

OBJECTIVE # 15-17

REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS

- Energy has a source, can be stored, and can be transferred, but is never created or destroyed.

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Students understand that motion is the indicator of kinetic energy in a system and that the amount of E_k is related to the mass and velocity of the system. • Students understand that elevation is the indicator of gravitational energy in a system and that the amount of E_g is related to the mass, height and gravitational field. • Students understand that distortion is the indicator of stored elastic energy and that the amount of E_{el} is related to stretch/compression and spring constant. • Students understand that heat and sound are indicators of dissipated energy and that energy is dissipated most often by friction/drag and collision. • Students can explain why work is only done if the system is displaced in a direction that is parallel to a component of the force.	• Students understand that work is the transfer of energy into or out of a system by means of a force and can identify situations in which work is done. • Students can state the Law of Conservation of Energy. • Students can distinguish open and closed systems and when work is/is not done.	• Students can identify energy storage and changes within a system and represent this change with a diagram (pie chart or bar graph.) • Students can use formulae to correctly calculate the amount of energy stored. • Students can calculate the work done by a using the relation $W = F\,\Delta x \cos\theta$ or by using the area under a force vs. position graph. • Students can use the law of conservation of energy, and the concept of work to predict the behavior/characteristics of objects in an open or closed system.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide reading materials on the ways energy can be stored. • Lecture on work and conservation of energy. • Facilitate student discussion of lab design and results.	• Students will use area under force vs. position graphs to derive the formulae for various forms of energy.	3-4
	• Students will practice identifying where energy is stored and model the energy flow with pie charts and bar graphs.	3
	• Students will conduct a lab to determine what factors affect the amount of energy stored in a spring.	4
	• Lab: Determining formulas for kinetic and gravitational energy. Students will use	

	springs (with known spring constant) to launch cars up a ramp. Students will use the conservation of energy to determine the relationship between energy and height and energy and speed.	4
	• Various worksheets to practice energy conservation problems.	3-4
	• Students practice calculations of work with constant and non-constant forces.	3-4
	• Lab: Determining your power. Students will determine the power they can generate and compare that to the amount of power needed for various household appliances.	3

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• Algebra skills • Com Arts – writing skills for reports	• Understand graphing (slope, equations, etc.)	• Students are designing experiments and interpreting results.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Presented with a spring and a stuffed animal “bungee jumper” they will determine a safe, but exciting jump height.	Formative	3
• Periodic quizzes.	Formative	3
• Lab report over spring/elastic energy experiment.	Summative	3-4
• Written test.	Summative	3-4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching	• Re-study guide.	3

- Additional experimentation.

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab. (e.g. investigate energy in simple harmonic oscillators/sound)	4

Honors Physics Curriculum

CONTENT AREA: Science COURSE: Honors Physics	STRAND 1: Experimental Design UNIT DURATION: Year long

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

-

ENDURING UNDERSTANDINGS:

- Scientists use experiments to investigate the universe. They use the data collected to create mathematical models to explain and predict what they see. Scientists must be able to explain their work and defend it if it going to be accepted as “true.”

BIG IDEA(S):

- Scientists use experiments to investigate the universe.

ESSENTIAL QUESTIONS:

- How do scientists design experiments?
- How do scientists determine if something is “true”?
- How and why do scientists model what happens in the real world?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
Strand 7-1- A,a-g	Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation.	x	
Strand 7-1 – B,a-f	Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations.	x	
Strand 7-1 – C,a-d	Scientific inquiry includes evaluation of explanations in light of evidence and scientific principles		x
Strand 7-1 – D, a-c	The nature of science relies upon communication of results and justification of explorations.		x

OBJECTIVE # 1-4

REFERENCES/STANDARDS

Strand 7 -1

- Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning and critical thinking.

WHAT SHOULD STUDENTS…

UNDERSTAND?

- All measurements are uncertain. In order for measurements to be useful, scientists must estimate and understand the uncertainty in their data.
- There are several types of relationships between variables and these relationships can be described verbally, graphically and mathematically.
- Once you have determined this relationship, you can use it to predict future behavior.

KNOW?

- Basic vocabulary such as
  - independent and dependent variable
  - qualitative and quantitative
  - proportional, inverse, quadratic
  - error and uncertainty

BE ABLE TO DO?

- Design a valid experiment to answer a question.
- Assess the sources of experimental error and to explain the affect of this error on the conclusions.
- Students should be able to estimate the uncertainty in their measurements.
- Analyze data using graphs and appropriate software.
- Students can use their data and analysis to build a model (mathematical, graphical, verbal) of a given system. They can present and defend their conclusions to the class in oral and written form.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY

- Lecture on experimental design and uncertainty in measurements.
- Provide a handout explaining error and uncertainty and give students practice in calculating and estimating these values.
- Facilitate student experimentation.
- Provide practice using the software to graph and analyze relationships.

STUDENT LEARNING TASK

- Students will design an experiment to determine which features of a pendulum affect its period. They will write a report describing their experiment and defending their conclusions.
- Students will learn about the various types of relationships by doing a suite of labs. Groups will do different labs and present/defend their conclusions to the class.

DOK TARGET

(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)

4

3

INTERDISCIPLINARY CONNECTION

- Mathematics – graphing and equations
- Com Arts – writing skills

PRIOR KNOWLEDGE CONNECTIONS

- Finding slope, y-intercept and equation on linear graphs.
- General graphing skills.

INQUIRY CONNECTIONS

- The whole unit is focused on scientific inquiry.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Written quizzes	Formative	3
• In class practice designing and carrying out experiments	Formative	3
• Lab Report on pendulums	Summative	4
• Lab practical – students must use model to predict behavior of a pendulum.	Summative	3
• Written exam	Summative	3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching	• Re-study guide. • Additional experimentation.	3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab.	4

CONTENT AREA: Science COURSE: Honors Physics	UNIT TITLE: Kinematics (1-D and 2-D motion) UNIT DURATION: This strand will be split into multiple units, taught over several months.

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

-

ENDURING UNDERSTANDINGS:

- Motion can only be defined relative to an arbitrary frame of reference.
- A vector is a quantity that incorporates direction.
- Graphs and equations can be used to model and predict motion.
- The vertical and horizontal components of the motion of a projectile are independent of each other. Because of this, one dimensional models can be used to analyze two dimensional projectile motion.
- Bodies in free fall have the same acceleration regardless of mass.

BIG IDEA(S):

- Graphs, equations and diagrams can be used to model and predict motion.

ESSENTIAL QUESTIONS:

- How can we model and predict the motion of an object?
- What is acceleration?
- Do heavier things fall faster?
- How can graphs be used to model and analyze motion?
- How do we model 2-dimentional motion?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
Strand 2-1A, a-b	The motion of an object is described as a change in position, direction and speed relative to a frame of reference.	x	
Strand 2-1B, a	An object that is acceleration is speeding up, slowing down, or changing directions.	x	
Strand 2-2B, d	All falling bodies accelerate at the same rate due to gravity regardless of mass		x

OBJECTIVE # 5-11

REFERENCES/STANDARDS

Strand 2-1

- The motion of an object is described by its change in position relative to another object or point.

WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• Students know the difference between vector and scalar quantities.
• Students know how the directions of both one- and two-dimensional vectors are represented mathematically.
• Students can describe what features of the graph (slope, y-intercept, area under the curve) tell us about the motion, if anything.
• Student can define what is meant by free fall and understands that mass has no affect on the acceleration of an object in free fall.
• Students understand that the horizontal and vertical components of projectile motion are independent. They can use this understanding to qualitatively compare the motion of different projectiles.
	• Students know the definitions of basic vector terms, such as magnitude, resultant and component.
	• Students can explain what a reference frame is and why it is necessary to describe quantities such as position or velocity.
	• Students understand the definitions of, position, displacement, distance, velocity, acceleration.
	• Student can differentiate between average and instantaneous quantities.
	• Know what the variables in the basic kinematic equations stand for and know under what conditions they are valid.
		• Students can break a 2D vector into components, or given components can find the magnitude and direction.
		• Students can add any two vectors together.
		• Students can model 1-D motion with various graphs, equations and diagrams.
		• Given a motion graph (x vs t, v vs t, a vs t) students can
		  ▪ Sketch the other two graphs
		  ▪ Describe the motion being modeled
		• Students can correctly use the kinematic equations in problem solving, including free fall situations.
		• Students can solve problems involving projectiles launched at any angle from any height. (Can predict range, max height, launch velocity, etc.)

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture on vectors and their properties. • Presentation on motion maps (diagrams to represent motion) • Demonstrate problem solving techniques • Facilitate discussion of lab results.	• Students will design a lab to find the relationship between position and time for a car moving at a constant speed. They will present and defend their model in a written report.	4
	• Lab: graph matching. Given a graph and a motion detector, students will move in ways to reproduce the graphs	3

	• Homework assignments – practice on interpreting graphs and motion maps • Students will design a lab to determine the relationship between position and time for an object undergoing constant acceleration. They will present and defend their model in a written report. • Students will practice vectors skills with worksheets and a map activity. • Students will make videos of a ball dropped as well as thrown through the air. They will analyze these videos to investigate free fall and two dimensional motion. They will write a report describing and defending their results. • Students will practice solving problems involving projectile motion.	3-4 4 3 4 3-4
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Algebra skills • Com Arts – writing skills for reports	• Understand graphing (slope, equations, etc.)	• Students are designing experiments and interpreting results.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Given two small cars and their starting positions, students must predict the location where the cars will meet.	Formative	3
• Students will be asked to determine the straight line distance between two points that cannot be measured directly. They will need to apply vector addition.	Formative	3
• Students will be shown a ball launcher and allowed to take any measurements they need to predict the range of the ball.	Formative	3
• Periodic quizzes	Formative	3
• Written tests (2 or 3 for this strand)	Summative	3-4
• Lab Reports	Summative	4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?
Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic

		Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching	• Re-study guide. • Additional experimentation.	3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab. (e.g. design a catapult)	4

CONTENT AREA: Science COURSE: Honors Physics	UNIT TITLE: Newton's Laws UNIT DURATION: The strand will be split into 2 units, covered over a couple months

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

-

BIG IDEA(S):

- A force is needed to change the motion of an object (accelerate), not to cause motion. This acceleration is related to the net force and mass of the system

ENDURING UNDERSTANDINGS:

- A force is an interaction between two objects that affects both objects equally. (Newton's 3rd)
- A force is needed to change the motion of an object, not to cause motion. (Newton's 1st)
- Acceleration occurs only when a net force act on a system. The acceleration is proportional to the force and inversely proportional to the mass of the system. (Newton's 2nd)

ESSENTIAL QUESTIONS:

- What are forces and what do they do?
- What causes acceleration?
- What factors affect this acceleration?
- What is equilibrium and how can we determine if something is in equilibrium?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
Strand 2-2A	Forces are classified as either contact or long range forces that can be described in terms of direction and magnitude	x	
Strand 2-2B, a-c	Every object exerts a gravitational force on every other object.	x	
Strand 2-2D, a-e	Newton's Laws of Motion explain the interaction of mass, and forces, and are used to predict changes in motion.	x	
Strand 2-2E, a-c	Perpendicular forces act independently of each other	x	

OBJECTIVE # 12-14
REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS

- Forces affect motion.

WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Students understand that a force is an interaction between two objects that can result in acceleration. Students understand that the net force affects the motion of an object and can use the net force to predict if the object accelerates. • Students understand that tension and normal forces occur as the result of distortions (stretches/compressions) of an object. • Students understand the concept of coefficient of friction and can differentiate between static and kinetic friction. •	• Students can identify when various types of forces (gravity, friction, normal, tension) occur and the direction they act. • Students understand the difference between mass and weight and can calculate one if given the other. • Students can state Newton's 3rd Law and can use it to explain situations such as why a rocket rises or how we walk. •	• They can use the expression $\lvert\overrightarrow{F_f}\rvert \le \mu\lvert\overrightarrow{F_N}\rvert$ to calculate the force of friction, understanding when to use the inequality/equality. • Students understand Hooke's Law and can use this law to calculate tension, spring constant or distortion. • Students can use Newton's 1st and 2nd Law to predict the motion of objects or can use the motion to find the value of the forces needed to produce it. • Students can draw a force diagram to represent the individual forces that act on a system. Students can write summation statements to represent the net force acting on an object in the x and y directions. • Student can give the Newton's 3rd law pair force for any given force. • Students can apply Newton's 3rd Law to problem solving involving multiple objects.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture on types of forces and their properties. • Provide a handout describing the construction and use of force diagrams. • Demonstrate problem sovling with Newton's Laws. • Facilitate student discussion of lab design and results.	• Students will collect data on the stretch/compression of spring to derive Hooke's Law.	3-4
	• Students will conduct a lab, measuring both mass and weight to derive the relationship between the two for objects on Earth.	3
	• Students will collect data on the normal force and friction acting on a block to investigate coefficient of friction for both static and kinetic cases.	3
	• Students will collect data about the net force, mass and acceleration of a system in order to derive Newton's 2nd Law.	4
	• Students will practice problem solving involving Newton's Laws.	3-4
	• Students will observe objects moving with and without friction in order to derive/understand Newton's 1st Law.	3
	• Students will practice drawing force diagrams for a variety of situations. Students will practice writing summation statements of forces based on a force diagram and using them in problem solving.	3-4
	• Students will investigate Newton's 3rd by comparing the forces objects exert on each other in a variety of situations.	3

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• Algebra skills • Com Arts – writing skills for reports	• Understand graphing (slope, equations, etc.)	• Students are designing experiments and interpreting results.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Given a lab setup where two forces act on a block, students will determine the third force needed to put the block into equilibrium and test their prediction by releasing the block to see if it accelerates.	Formative	3
• Students will design a lab to determine to relationship between force, mass and acceleration. Students will write a report explaining and defending their model.	Summative	3-4
• Given a car on an inclined plane that is accelerated by a hanging mass, students will be asked to adjust the mass of car and hanging mass to hit a target acceleration.	Formative	3
• Periodic quizzes	Formative	3
• Written tests (1 for each unit)	Summative	3-4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching	• Re-study guide. • Additional experimentation.	3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab. (e.g. investigate air resistance)	4

CONTENT AREA: Science COURSE: Honors Physics	UNIT TITLE: Work and Energy UNIT DURATION: 6-8 weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

-

ENDURING UNDERSTANDINGS:

- Energy can be stored in various ways and can be transferred from system to system, but the total amount always remains the same.
- Work is the transfer of energy from system to system via a force.

BIG IDEA(S):

- Energy cannot be created or destroyed, only transferred.

ESSENTIAL QUESTIONS:

- How can energy be stored and what does it do?
- How can energy be moved from place to place?
- What characteristics of a system show energy is stored there?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
Strand 1-2B, a-d	Mechanical energy comes from the motion and/or position of an object.	x	
Strand 1-2F, a-c	Energy can be transferred within a system as the total amount of energy remain constant.	x	
Strand 2-2F a-d	Work transfers energy into and out of a system.	x	

OBJECTIVE # 15-17
REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS

- Energy has a source, can be stored, and can be transferred, but is never created or destroyed.

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Students understand that motion is the indicator of kinetic energy in a system and that the amount of E_k is related to the mass and velocity of the system. • Students understand that elevation is the indicator of gravitational energy in a system and that the amount of E_g is related to the mass, height and gravitational field. • Students understand that distortion is the indicator of stored elastic energy and that the amount of E_{el} is related to stretch/compression and spring constant. • Students understand that heat and sound are indicators of dissipated energy and that energy is dissipated most often by friction/drag and collision. • Students can explain why work is only done if the system is displaced in a direction that is parallel to a component of the force.	• Students understand that work is the transfer of energy into or out of a system by means of a force and can identify situations in which work is done. • Students can state the Law of Conservation of Energy. • Students can distinguish open and closed systems and when work is/is not done.	• Students can identify energy storage and changes within a system and represent this change with a diagram (pie chart or bar graph.) • Students can use formulae to correctly calculate the amount of energy stored. • Students can calculate the work done by a using the relation $W = F\,\Delta x \cos\theta$ or by using the area under a force vs. position graph. • Students can use the law of conservation of energy, and the concept of work to predict the behavior/characteristics of objects in an open or closed system.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide reading materials on the ways energy can be stored. • Lecture on work and conservation of energy. • Facilitate student discussion of lab design and results.	• Students will use area under force vs. position graphs to derive the formulae for various forms of energy.	3-4
	• Students will practice identifying where energy is stored and model the energy flow with pie charts and bar graphs.	3
	• Students will design a lab to determine what factors affect the amount of energy stored in a spring. They will write a report that describes their experiment and that explains and defends the model they have created.	4

	• Lab: Determining formulas for kinetic and gravitational energy. Students will use springs (with known spring constant) to launch cars up a ramp. Students will use the conservation of energy to determine the relationship between energy and height and energy and speed.	4
	• Various worksheets to practice energy conservation problems.	3-4
	• Students practice calculations of work with constant and non-constant forces.	3-4
	• Lab: Determining your power. Students will determine the power they can generate and compare that to the amount of power needed for various household appliances.	3

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• Algebra skills • Com Arts – writing skills for reports	• Understand graphing (slope, equations, etc.)	• Students are designing experiments and interpreting results.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Presented with a spring and a stuffed animal “bungee jumper” they will determine a safe, but exciting jump height.	Formative	3
• Periodic quizzes.	Formative	3
• Lab report over spring/elastic energy experiment.	Summative	3-4
• Written test.	Summative	3-4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching	• Re-study guide.	3

- Additional experimentation.

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab. (e.g. investigate energy in simple harmonic oscillators/sound)	4

Environmental Science Curriculum

CONTENT AREA: High School Science COURSE: Environmental Science	UNIT TITLE: Aquatics UNIT DURATION:

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Dissolved Oxygen kits • Nitrate kits • TDS and pH meters • visual/chemical/ macro survey sheets • nets • macroinvertebrate ID sheet • Reading(s)/Handouts • Websites • Video Links/DVDs/recordings	• Organisms are interdependent with one another and with their environment • Earth's Systems (geosphere, atmosphere, and hydrosphere) have common components and unique structures • Earth's Systems (geosphere, atmosphere, and hydrosphere) interact with one another as they undergo change by common processes • Human activity is dependent upon and affects Earth's resources and systems
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• All organisms, including humans, and their activities cause changes in their environment that affect the ecosystem • The hydrosphere is composed of water (a material with unique properties) and other materials • The Earth's materials and surface features are changed through a variety of external processes • Earth's materials are limited natural resources affected by human activity	1) How can we use fresh water more sustainably? 2) What are some ways that we can reduce pollution? 3) How can we reduce the threat of flooding? 4) How can we protect our watershed? 5)What do invertebrates tell about the quality of a stream or pond? 6) How can we determine if waterways are healthy?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD	STANDARDS: Aquatics	MAJOR STANDARD	SUPPORTING STANDARD
4.1 C	*Predict and explain how natural or human caused changes (biological, chemical and/or physical) in one ecosystem may affect other ecosystems due to natural mechanisms (e.g., global wind patterns, water cycle, ocean currents)*	x	
5.1 B a	*Recognize the importance of water as a solvent in the environment as it relates to karst geology (dissolution and mineralization), acid rain, water pollution, erosion and deposition of rock and soil materials*		X
5.2 A a	*Explain the external processes (i.e., weathering, erosion, deposition of sediment) that result in the formation and modification of landforms*		X
5.2 A b	*Describe the factors that affect rates of weathering and erosion of landforms (e.g., soil/rock type, amount and force of run-off, slope)*	X	
5.3 A b	*Identify human activities that may adversely affect the composition of the atmosphere, hydrosphere, or geosphere*	X	
5.3 A c	*Predict local and/or global effects of environmental changes when given a scenario describing how the composition of the geosphere, hydrosphere, or atmosphere is altered by natural phenomena or human activities*	X	

<table>
<tr><td>OBJECTIVE # 2</td><td colspan="2">Students should identify ways to manage and sustain freshwater ecosystems</td></tr>
<tr><td>REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS</td><td colspan="2">• 4.1 C, 5.1 B a, 5.2 A a-b, 5.3 A b-c</td></tr>
<tr><td colspan="3">WHAT SHOULD STUDENTS…</td></tr>
<tr><td>UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.</td><td>KNOW?
Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY</td><td>BE ABLE TO DO?
Skills; Products</td></tr>
<tr><td>• There are sustainable ways to reduce and prevent water pollution
• That we can lessen the threat of flooding by protecting wetlands and not developing on Flood plains
Students will understand the value of a riparian corridor
• That our everyday habits can have detrimental effects on water quality</td><td>• watershed
• dissolved oxygen
• macroinvertebrates
• point source pollution
• nonpoint source pollution
• turbidity
• nitrates
• runoff
• riparian corridor</td><td>• Students will visit a stream or pond, run tests to determine chemical contamination, and evaluate the water quality based on the chemical tests and their observations of the invertebrates that populate the stream or pond.
• Explain the value of floodplains and watersheds.</td></tr>
<tr><td colspan="3">FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING</td></tr>
<tr><td>TEACHER INSTRUCTIONAL ACTIVITY</td><td>STUDENT LEARNING TASK</td><td>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</td></tr>
<tr><td>• Lecture/Discussion of terms
• Demonstration of lab procedures
• Modeling appropriate use of lab
• equipment</td><td>• Field study of a neighboring creek. Students will test the creek to determine health of the water.
• Students will visit the creek to collect macroinvertebrates to determine health of the stream
• Students will look at their own watershed and look at how development can affect our water</td><td>• 2
• 3/4
• 2</td></tr>
<tr><td>INTERDISCIPLINARY CONNECTION</td><td>PRIOR KNOWLEDGE CONNECTIONS</td><td>INQUIRY CONNECTIONS</td></tr>
<tr><td>Geology/Geography- GIS</td><td>• 6th grade Physical Science
• knowledge of the water cycle</td><td>Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)</td></tr>
<tr><td colspan="3">HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?</td></tr>
<tr><td>ASSESSMENT DESCRIPTION</td><td>FORMATIVE OR SUMMATIVE?</td><td>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</td></tr>
</table>

• Independent Practice • Labs • Test • Practical • Quizzes	• Formative • Formative • Summative • Summative	• 1 /2 • 2/3 • 2/3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP intervention • peer tutoring • additional practice/review • direct students toward helpful resources (websites, textbooks, notes, etc.)	• complete a study guide or review portfolio • retesting over objectives • performance event	• 2 • 2 • 2
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Teacher will provide materials necessary to complete developed experiment • Introduce different/advanced lab equipment • Work on GIS activity on mapping watersheds	• Complete developed experiment • Research relative topic of interest	• 3/4 • 3

CONTENT AREA: High School Science

COURSE: Environmental Science

UNIT TITLE: Forestry

UNIT DURATION:

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- Meter sticks
- Tree Field guides
- Reading(s)/Handouts
- Websites
- Video Links/DVDs/recordings

BIG IDEA(S):

- Organisms are interdependent with one another and with their environment
- There is a fundamental unity underlying the diversity of all living organisms
- Living organisms carry out life processes in order to survive

ENDURING UNDERSTANDINGS:

- Life processes can be disrupted by disease (intrinsic failures of the organ systems or by infection due to other organisms)
- The diversity of species within an ecosystem is affected by changes in the environment, which can be caused by other organisms or outside processes
- Organisms progress through life cycles unique to different types of organisms
- Biological classifications are based on how organisms are related

ESSENTIAL QUESTIONS:

1. **Why should we study forestry? Why are trees important?**
2. **What physical abnormalities indicate a diseased or dying tree?**
3. **What does the diameter at breast height (DBH) tell us about the health of the tree?**
4. **What are the different species of Missouri trees?**
5. **Are there specific characteristics that can help identify trees (leaves, seed, flower)?**
6. **Why are some trees better to plant in certain locations than others (landscaping)?**
7. **How can trees help save energy?**

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD	**STANDARDS:** Forestry	**MAJOR STANDARD**	**SUPPORTING STANDARD**	
3.2 G	Life processes can be disrupted by disease (intrinsic failures of the organ systems or by infection due to other organisms)		x	
4.1 D	The diversity of species within an ecosystem is affected by changes in the environment, which can be caused by other organisms or outside processes		X	
3.1 B	Organisms progress through life cycles unique to different types of organisms			X
3.1. A	Biological classifications are based on how organisms are related			X

OBJECTIVE # 1	Students should understand the importance of forestry in the world
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.1 A,B 3.2 G

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Trees can be classified as coniferous or deciduous trees • steps/procedures to protect and care for trees • Certain trees thrive in different environments/situations • certain trees have characteristics that allow them to be easily identified	• Compound leaf • simple leaf • deciduous • coniferous • trunk • crown • foliage • witch's broom • woody gall • diebacks • girdling	• Identify 25 of Missouri's common trees • Evaluate the crown, trunk and foliage for damage and disease • determine the best tree to plant to optimize energy savings

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture/Discussion of terms • Demonstration of lab procedures • Modeling appropriate use of lab • equipment	• Evaluate trees for disease or injury • Create a field guide that will help in tree identification • design a landscape using trees providing reasons for planting a tree in that locale	• 2 • 2/3 •

INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
Geography	• 6th grade Physical Science • basic structure of trees • common names for trees- maple, oaks..	Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Independent Practice • Labs- • Test • Practice tree identification • Quizzes • Tree practical • Landscaping project	• Formative • Formative • Summative • Summative • Summative • Summative	• 1 /2 • 2/3 • 2/3 • 3 • 3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP intervention • peer tutoring • additional practice/review • direct students toward helpful resources (websites, textbooks, notes, etc.)	• complete a study guide or review portfolio • retesting over objectives • performance event	• 2 • 2 • 2
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Teacher will provide materials necessary to complete developed experiment • Introduce different/advanced lab equipment • Provide enrichment topics	• Complete developed experiment • Research relative topic of interest	• 3/4 • 3

CONTENT AREA: High School Science COURSE: Environmental Science	UNIT TITLE: Current Issues (human activity) UNIT DURATION:

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT: • magazine articles • video clips • water testing kit (activity related pollutants) • handouts • graphing paper • microscopes • beakers, slides, slide covers	**BIG IDEA(S):** • Energy has a source, can be stored or transferred, but is always conserved in a system • Matter and energy flow through an ecosystem • Organisms are interpendent with one another and their environment • Human activity is dependent upon and affects Earth's resources and systems • Earth's systems (geosphere, atmosphere, hydrosphere) interact and undergo change by common processes • The nature of technology can advance via science and new knowledge is utilized to meet human needs • The evolution of science can be traced through history, evident in cultural and historical perspectives for various periods • Science and technology affect, and are affected by society
ENDURING UNDERSTANDINGS: • Forms of energy have a source and a means of transfer • Energy can be transferred within a system as the total amount remains constant • All organisms, including human activity cause changes in the environment which affects the ecosystem • Matter is recycled through an ecosystem • Earth's materials are limited natural resources affected by human activity • Climate is a description of the average weather conditions in a given area due to the transfer of energy and matter through the system (Earth) • Advances in technology often result in improved data collection an increased scientific understanding • Scientific theories are developed based on current information and must be rigorously tested for validity • Scientific ethics require that scientists avoid subjecting people to health or property risks without their previous knowledge and consent • The progress of science and technology greatly affects the current social, political, economic, ethical, and environmental ideals of a society	**ESSENTIAL QUESTIONS:** • Are students aware of their impact on the environment through daily activities? • How are resources made available through refinery and processing? • What are the differences between reusable and recylable materials? • How have theories such as global warming changed or been enhanced with new information? • Can students calculate their carbon footprint as well as offer solutions to reducing it?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.** *Be sure to include connections to strands 7 & 8 as supporting standards*	**MAJOR STANDARD**	**SUPPORTING STANDARD**
1.2 A (b,c)	Energy can be transferred within a system as the		x

	total energy remains constant.		
1.2 F (a)	Energy has a source, can be stored, and transferred, but is always conserved.		x
4.1 C (a)	Organisms are interdependent with one another and their environment.	x	
4.2 B (a,b)	Matter and energy flow through an ecosystem.		x
5.2 F (c-e)	Common processes can lead to changes in the Earth's systems (geo., hydro., atmos.)	x	
5.3 A (a-e)	Human activity is dependent upon and affects Earth's resources and systems.	x	
8.1 B (a) / 8.2 B (a,b)/ 8.3 C (b,c)	Science and technology are affected by as well as influence societal, cultural, and economic perspectives.	x	

OBJECTIVE # 1	Students should understand that they are a part of a system, highly influential as well as subject to the consequences as well as benefits of their actions.		
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 1.2 A (b,c) • 1.2 F (a)	4.1 C (a) 4.2 B (a,b)	5.2 F (c-e) 5.3 A (a-e)	8.1 B (a) / 8.2 B (a,b)/ 8.3 C (b,c)

WHAT SHOULD STUDENTS…		
Understand? *Concepts; essential truths, encompassing ideas*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Energy transfers through a system- we are part of that system • Human activities play an enormous role in environmental stability as well availability of resources • Science and technology are influenced by society and culture, as well as economics; the same is true in reverse • Science and technology must be pursued with the well being of society and the planet in mind.	• energy conservation • interdependence • ecosystem • oceanic gyres • oceanic acidification • "Mini- Ice Age" • Recycling / Reusing • Composting techniques • Geothermal H/AC • Global Warming • alternative energy examples • cycles (oxygen, nitrogen, carbon) • greenhouse effect (methane) • thermohaline circulation • Maunder Minimal	• Calculate a carbon footprint • design a "green" home and produce a scalar model • Predict the annual amount of waste produced per person, as well as offer valid option to minimize waste • Evaluate the quality of water and parallel it's relative quality to causes • Connect microbes to overall quality of air, water, soil, etc… • Calculate population growth in humans • Describe how Earth's climate has been altered in recent history (mechanisms) • Argue both sides to controversial theories such as global warming • Develop and /or ***implement*** green techniques at home • Be a conscientious consumer

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY ***Such as:Teacher will…(provide possible examples of teacher)***	**STUDENT LEARNING TASK** ***Such as: Students will…(provide possible examples)***	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **videos, discussion, current event articles** • **modeling examples of green homes** • **help in gathering of samples for study**	• **Design a green home** • **investigate water samples (quality)** • **Discuss various factors involved in climate shift** • **Take accountability for their role in these systems and**	• 3+ • 3 • 2

• **provide notes and foundational info.**	**offer solutions.** • **Determine which organisms to target in habitat rehabilitation due to cost, reproductive fecundity, influence on the food web (ecosystem) etc...**	• 3+ • 3+
INTERDISCIPLINARY CONNECTION **economics, history, mathematics**	**PRIOR KNOWLEDGE CONNECTIONS** • general ecology • theories (global warming, greenhouse effect)	**Inquiry Connections:** **Make qualitative and quantitative observations using the appropriate senses, tools, and data.**
	•	•

ASSESSMENT DESCRIPTION	ASSESSMENT TYPE? (i.e. formative, summative, obstrusive, unobtrusive, etc.)	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• green home design • water testing /microbe observation • quizzes • labs • current events / summaries • Short answer essays	summative summative both formative summative summative	3 + 3 2 / 3 2/3 2 / 3 2 / 3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?
Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP intervention • tutoring • additional practice/review • direct students to sources	• study guide / review portfolio • retesting • performance event	2 2 / 3 3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?
Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• suggested list of research topics • internship opportunities	• complete developed experiment /task • research relative topic of interest	3 /4 3

UNIT TITLE: Wildlife	CONTENT AREA: High School Science
UNIT DURATION:	COURSE: Environmental Science

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- videos
- models
- field trip
- handouts
- magazine articles

BIG IDEA(S):

- There is a fundamental unity underlying diversity of all living organisms
- Living organisms carry out life processes to survive
- There is a genetic basis for the transfer of bio. characteristics from one generation to the next
- Organisms are interdependent with each other and connected to their environment
- Matter and energy flow through a system
- Biological evolution is explained by natural selection and genetic variation

ENDURING UNDERSTANDINGS:

- Organisms progress through their own unique life cycle
- Biological classifications are based on relation of organisms to each other
- Photos. and resp. are complementary processes necessary for life
- All organisms have DNA (hereditary material)
- Every species of organism has inheritable variation
- Balanced ecosystems rely on interaction between all organisms and the resources available in the ecosystem
- Living organisms will reach a carrying capacity due to the limited resources that are available
- All activities (including human) cause change in ecosystems
- Species diversity is influenced by external factors as well

ESSENTIAL QUESTIONS:

- How are various species connected?
- What affects do each organism have on the overall food web or ecosystem they reside in?
- How are survival of the fittest and predation beneficial to the prey species as well as the ecosystem?
- How has the change (evolution) of a species been affected or selected by the surrounding environment?
- What factors determine the type of biome an area is considered to be?
- How does biomass affect population density?
- What types of succession are there and when/where can they be found?
- How is matter cycled through an ecosystem?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
3.1 E (a,b) / 3.1 E (a,b)	Explain how similarities used to group taxa might reflect evolutionary relationships		x
3.2 B (a,b)	Understand that photo. and resp. are complementary processes, as well as the factors which affect these processes		x
3.3 B (a-e) D (a-c)	Recognize that there is heritable information (DNA) passed along through various forms of reproduction		x
4.1 /4.2/ 4.3	Explain the interactions of organisms and how those	x	

(all)	affect populations, biomes, diversity, and available resources		

a

OBJECTIVE # 1	Wildlife			
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 3.1 E (a,b) / 3.1 E (a,b)	3.2 B (a,b)3.3 B (a-e) D (a-c)	4.1 /4.2/ 4.3 (all)	

WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• organisms are interdependent • ecosystems have a delicate balance that must be maintained • heredity plays a crucial role in survival of the fittest • Both species density and diversity are limited by available abiotic factors	• biotic / abiotic factors • biomass • food web / chain • trophic levels • symbiosis (mutualism, parasitism, commensalism) • niche • biological magnification • "10% Rule" • succession • tertiary predator • Invasive • Chronic Hemhorraging Disease (CWD) • Chytrid	• Create a balanced food web • predict the overall affect on an ecosystem when one component is removed • Explain the value of a food web compared to a food chain • After analyzing a hypothetical ecosystem, prescribe solutions for remedying it of imbalances or issues • Cite examples of common issues faced by organisms (bio. magnification, overcompetition, bottlenecking) • identify mammals based on bone characteristics •

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **lecture** • **video** • **reading samples (MO Dept. of Cons.)** • **labs, field trips, outdoor observation and data collection**	• **Identify the strengths and weaknesses of an authentic food web** • **Parallel water quality with diversity in an ecosystem**	2 / 3 3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
•	•	•

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• practice quizzes • tests • written reports • Field Trip Journal / Reflection	formative summative summative summative	2 / 3 3 2 /3 2 / 3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP Intervention • peer tutoring • additional assignments (reinforcements) • supplementary materials	• study guides / notebooks • retesting • performance events	2 2/ 3 3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Enrichment through advanced research • conducting field studies	• complete research (experiment) • testing / journal observations	3 3

Applied Science Curriculum

CONTENT AREA: High School Science COURSE: Applied Science	UNIT TITLE: Atomic Structure UNIT DURATION: 8 Weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:
- **Reading(s)/Handouts**
- **Manipulatives/Labs**
- **Technology/chromebooks**
- **Websites**
- **Video Links/DVDs/Recordings**

BIG IDEA(S):
- **The structure of atoms determines an element's properties.**
- **The organization of the periodic table is based on properties of the elements.**
- **Atoms are composed of smaller particles.**
- **All elements have isotopes.**
- **Some nuclei can change through radioactive decay.**

ENDURING UNDERSTANDINGS:
- **Students will understand that elements are made up of atoms whose properties are mainly determined by its electron configuration.**
- **Students will understand that an element's position on the periodic table matches its properties and electron configuration.**

ESSENTIAL QUESTIONS:
- **What is the structure of an atom?**
- **What gives an element it's properties?**
- **How does the structure of the periodic table allow us to predict the chemical and physical properties of an element?**
- **How can nuclei of the same element differ?**
- **What happens when nuclei change?**

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 1.1.E.a	*Describe the atom as having a dense, positive nucleus surrounded by a cloud of negative electrons.*		x
CLE 1.1.E.b	*Calculate the number of protons, neutrons, and electrons of an isotope, given its mass number and atomic number.*		x
CLE 1.1.C.c	*Describe the information provided by the atomic number and the mass number (i.e., electrical charge, chemical stability)*		x
CLE 1.1.F.a	*Explain the structure of the periodic table in terms of the elements with common properties (groups/families) and repeating properties (periods).*		x
CLE 1.1.F.b	*Classify elements as metals, nonmetals, metalloids (semi-conductors), and noble gases according to their location on the Periodic Table.*		x
CLE 1.2.A.b	*Describe the relationship among wavelength, energy, and frequency as illustrated by the electromagnetic spectrum*		x
CLE 1.2.A.d	*Describe the effect of different frequencies of electromagnetic waves on the Earth and living organisms (e.g., radio, infrared, visible, ultraviolet, gamma, cosmic rays).*		x
CLE 1.2.E.a	*Describe how changes in the nucleus of an atom during a nuclear reaction (i.e., nuclear decay, fusion, fission) result in emission of radiation*		x

Objectives 8-10		
References	CLE 1.1.A a-g; CLE 7.1.A-D	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• **That atomic number determines the identity of the atom.** • **That mass numbers must be whole numbers but atomic mass may be decimals.** • **The electron is the part of the atom that determines chemical properties.** • **That elements in the same vertical group/family on the Periodic Table have similar properties.**	• **The symbols of the most common elements.** • **The charge and relative masses of each subatomic particle.** • **The maximum number of electrons that can be contained in any energy level, sublevel or orbital.**	• **Determine the number of protons, electrons and neutrons in a particular isotope.** • **Classify elements as metals, nonmetals or metalloids according to their location on the Periodic Table.** • **Distinguish between valence and inner core electrons.** • **Draw orbital diagrams and Lewis Dot Diagrams.**
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Isotopes demo** • **Videos(The History Channel: Manhatten Project)** • **Flame Test Demo** • **Spectroscope Demo**	• **Activities: Drawing “Models of Atoms”; “Isotopes of carbon”.** • **History of the Atom Timeline.** • **Articles: “Isotopes of strontium-90 found in baby teeth; “Radioactivity - It’s a Natural”;** • **Students calculate their own body radiation levels.** • **Effects of an Atomic bomb on St. Charles.** • **Students use geiger counters to measure radiation levels in different objects.** • **Labs: “Half-life Labs”; “Ions and Isotopes Labs”** • **Flame Tests lab** • **Periodic Table Project.**	• 2/3/4
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
CCSS M4 **CCSS E3** **CLE Strand 8.2.B**	**Basic Structure of the Atom.** **The atom is the basic unit of matter.** **Elements are represented by symbols.** **Basic familiarity with the Periodic Table.**	**CLE Strand 7**
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET**

		(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Flame test lab – students will identify their unknown substance based on flame test results • Other Labs • Unit Tests	• S • S • S	• 3 • 3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction • Post additional lectures via youtube/websites.	• Flashcards to revisit vocabulary. • Practice and retest	• 3
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	4

UNIT TITLE: Chemical Reactions and Bonding

UNIT DURATION: 4 Weeks

CONTENT AREA: High School Science

COURSE: Chemistry

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:
- **Reading(s)/Handouts**
- **Manipulatives/Labs**
- **Technology/chromebooks**
- **Websites**
- **Video Links/DVDs/Recordings**

BIG IDEA(S):
- **Valence electron configuration determines how atoms interact and bond.**
- **The type of bonding affects the properties of a compound.**
- **Balanced chemical equations are used to derive relationships between reactions and products in a chemical change.**

ENDURING UNDERSTANDINGS:
- **Students will be able to describe how the valence electron configuration determines how atoms interact and may bond.**
- **Students will be able to compare and contrast ionic and covalent bonding.**

ESSENTIAL QUESTIONS:
- **How does electron arrangement determine bonding?**
- **How do intermolecular forces determine the phase of a substance?**
- **How does the law of conservation of mass relate to balancing equations?**
- **How does a chemical equation give quantitative relationships between reactants and products?**

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 1.1.H.a	*Describe how the valence electron configuration determines how atoms interact and may bond*		x
CLE 1.1.H.c	*Compare and contrast the types of chemical bonds (i.e., ionic, covalent)*		x
CLE 1.1.H.d	*Predict the products of an acid/base (neutralization), oxidation (rusting), and combustion (burning) reaction*		x
CLE 1.1.I.a	*Compare the mass of the reactants to the mass of the products in a chemical reaction or physical change as support for the Law of Conservation of Mass*		x
CLE 1.1.I.b	*Recognize whether the number of atoms of the reactants and products in a chemical equation are balanced*		x

Objectives 12-18		
References	CLE 1.1.H a-g; CLE 1.1.I a-g	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• **That atoms can share or transfer electrons.** • **That bonding is a result of atoms gaining a noble gas electron configuration** • **Only coefficients can be changed when balancing a chemical reaction.**	• **That position on the periodic table predicts the type of bonding that occurs between two atoms.** • **The difference between a coefficient and a subscript.** • **That reactants are on the left and products are on the right side of the arrow.**	• **Predict the type of bond based on the elements position on the periodic table.** • **Predict a substances properties based upon bond type.** • **Write formulas for ionic and covalent compounds.** • **Draw Lewis Structures.** • **Balance chemical equations.**
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Properties of Ionic versus Covalent Demo**	• **Making Ionic Compound Lab** • **Lab: Ionic vs Covalent** • **Structural Formula Practice using Model Kits** • **Balancing Equations Computer Simulation** • **Types of Reactions Lab**	• 2/3/4
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
CCSS M4	**Atomic Structure**	**CLE Strand 7**
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs • Unit Tests	• S • S	• 3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to	• Flashcards to revisit vocabulary.	• 3

needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction • Post additional lectures via youtube/websites.	• Practice and retest	
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	4

UNIT TITLE: Principles of Chemistry UNIT DURATION: 12 Weeks	CONTENT AREA: High School Science COURSE: Applied Science

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Reading(s)/Handouts • Manipulatives/Lab & Safety Equipment • Technology/chromebooks • Websites • Video Links/DVDs/Recordings	• Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation,reasoning, and critical thinking • Changes in properties and states of matter provide evidence of the atomic theory of matter
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation. • Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations. • Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) • Properties of objects and states of matter can change chemically and/or physically • Objects, and the materials they are made of, have properties that can be used to describe and classify them	• How do scientists approach solving problems? • What is the relationship between theories, laws and hypothesis? • Why can there be only one independent variable but multiple dependent variables in a controlled scientific experiment? • How does science and technology affect the quality of our lives? • How is scientific knowledge created and communicated? • How is matter classified and how does it behave? • Why can't a measurement be "exact"? • What is the difference between an accurate versus a precise measurement?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 1.1.A.a	*Compare the densities of regular and irregular objects using their respective measures of volume and mass*		x
CLE 1.1.A.b	*Classify pure substances by their physical and chemical properties (i.e., color, luster/reflectivity, hardness, conductivity, density, pH, melting point, boiling point, specific heat, solubility, phase at room temperature, chemical reactivity)*		x
CLE 1.1.A.c	*Classify a substance as being made up of one kind of atom (element) or a compound when given the molecular formula or structural formula (or electron dot diagram) for the substance*		x
CLE 7.1.A.a	*Formulate testable questions and hypotheses*		x
CLE 7.1.A.b	*Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment*		x
CLE 7.1.A.c	*Design and conduct a valid experiment*		x

CLE 7.1.A.f	*Acknowledge there is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations*		x
CLE 7.1.A.g	*Evaluate the design of an experiment and make suggestions for reasonable improvements*		x
CLE 7.1.B.a	*Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)*	x	
CLE 7.1.B.b	*Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second*	x	
CLE 7.1.B.c	*Determine the appropriate tools and techniques to collect, analyze, and interpret data*	x	
CLE 7.1.B.d	*Judge whether measurements and computation of quantities are reasonable*		x
CLE 7.1.C.a	*Use quantitative and qualitative data as support for reasonable explanations (conclusions)*	x	
CLE 7.1.C.b	*Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable)*		x
CLE 7.1.D.a	*Communicate the procedures and results of investigations and explanations through: oral presentations drawings and maps data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) graphs (bar, single, and multiple line) equations and writings*	x	
CLE 8.2.B.a	*Identify and describe how explanations (laws/principles, theories/models) of scientific phenomena have changed over time as a result of new evidence (e.g., basic structure of matter, structure of an atom)*		x

Objectives 1-7		
References	CLE 1.1.A a-g; CLE 7.1.A-D	

WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• **That there is no fixed procedure called the "scientific method".** • **That a control is essential in an experiment in order to make a conclusion.** • **The difference between mass, volume and density.** • **Mass is conserved during any physical or chemical change.** • **That some elements are made up of atoms; others are composed of molecules.**	• **The identity and function of basic lab equipment.** • **The difference between quantitative and qualitative data.** • **The difference between accuracy versus precision.** • **The difference between an atom and molecule.** • **The difference between intensive and extensive properties.**	• **Design and conduct a valid experiment.** • **Manipulate laboratory equipment safely.** • **Identify the experimental group, control group, dependent variable and independent variable in an experiment.** • **Estimate approximate measurements in the metric system** • **Write numbers in scientific notation** • **Use their calculators to solve problems** • **Classify substances as elements, compounds or mixtures.** • **Distinguish between physical and chemical changes.** • **Use chemical and physical properties to identify an unknown substance.** • **Separate a mixture into its component substances.**

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Demonstrate safe use of lab equipment** • **Diet Coke/Mentos demonstration** • **Density demonstration** • **Videos (Rough Science, Lab Safety)** • **Demonstrate physical versus chemical changes.** • **Penny demonstrations.**	• **Student will plan and safely conduct lab experiments.** • **Measurement and significant digits lab.** • **Density lab.** • **Classification of matter activity.** • **Separation of mixtures lab.** • **Penny lab.** • **Molecular models lab.**	• 3
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
CLE Strand 8.2.A/8.2.B **CCSS M4** **CCSS E4**	**Algebraic Expression** **Metric Units of Measurement**	**CLE Strand 7**

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)

• Labs • Unit Tests	• S • S	• 3 • 3
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction • Post additional lectures via youtube/websites.	• Flashcards to revisit vocabulary. • Practice and retest	• 3
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	4

UNIT TITLE: States of Matter UNIT DURATION: 8 Weeks	CONTENT AREA: High School Science COURSE: Applied Science

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Reading (s)/Handouts • Manipulatives/Lab & Safety Equipment • Technology/chromebooks • Websites • Video Links/DVDs/Recordings	• Gas behavior can be quantitatively described using pressure, temperature, volume and mole relationships. • Kinetic molecular theory explains the difference in properties and structure of solids, liquids and gases • Solutions can be described in both qualitative and quantitative terms.
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• Use the concepts of Pressure, temperature, volume to describe the behavior of a gas. • Use the kinetic molecular theory to explain the difference in properties and structure of solids, liquids and gases.	• What are the relationships between the measurable properties used to describe gases? • What is the historical timeline for the development of the gas laws? • How do these concepts apply to real world problems? • How does temperature and pressure determine what phase a particular substance exists in? • Why do liquids boil at different temperatures at different atmospheric pressures? • What does temperature measure and what is the significance of absolute zero?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 1.1.B.c	*Predict the effects of solvent and solute polarity on solubility ("like dissolves like"); and predict the effects of temperature, surface area, particle size, and agitation on rates of solubility*		x
CLE 1.1.D.a	*Using the Kinetic Theory model, explain the changes that occur in the distance between atoms/molecules and temperature of a substance as energy is absorbed or released during a phase change*		x
CLE 1.1.D.b	*Predict the effect of a temperature change on the properties (e.g., pressure, density) of a material (solids, liquids, gases)*		x
CLE 1.1.D.c	*Predict the effect of pressure changes on the properties (e.g., temperature, density) of a material (solids, liquids, gases)*		x

<table>
<tr><td>Objectives 20-23</td><td colspan="2"></td></tr>
<tr><td>References</td><td colspan="2">CLE 1.1.B-1.1.D</td></tr>
<tr><th colspan="3">WHAT SHOULD STUDENTS…</th></tr>
<tr><th>UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.</th><th>KNOW?
Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY</th><th>BE ABLE TO DO?
Skills; Products</th></tr>
<tr><td>That ideal gases have no volume at absolute zero.
That temperature measures the kinetic molecular motion of atoms and molecules.
That at absolute zero all motion stops.
Which variables (P,V & T) are inversely related and which are directly related.
How the kinetic molecular theory explains the behaviors of solids, liquids and gases.
The relationship between vapor pressure and boiling point.
That it is the strength of the intermolecular forces that determines what phase a substance is in.
The phrase “like dissolves like”.</td><td>Boyle’s law.
Charles’s law.
Gay-Lussac’s law.
The values of STP conditions in kPa, atm, mm of Hg, K and ◦C.
The names for all of the phase changes.</td><td>Convert between degrees Celsius and Kelvins.
Relate properties such as viscosity, surface tension and capillary rise to intermolecular forces.
Recognize which gas laws apply in real world situations.
Predict what would happen in a real world problem using their knowledge of the gas laws.
Understand how hot air balloons are relate to the gas laws.
Construct a solubility curve and then analyze data from it.</td></tr>
<tr><th colspan="3">FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING</th></tr>
<tr><th>TEACHER INSTRUCTIONAL ACTIVITY</th><th>STUDENT LEARNING TASK</th><th>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</th></tr>
<tr><td>Lecture/Notes
Gas Law Demonstrations</td><td>Graphical Analysis of Gas Laws
Boyles Law Lab
Charles Law Lab
Construct and Fly a Hot Air Balloon
States of Matter Project</td><td>3</td></tr>
<tr><th>INTERDISCIPLINARY CONNECTION</th><th>PRIOR KNOWLEDGE CONNECTIONS</th><th>INQUIRY CONNECTIONS</th></tr>
<tr><td>CCSS M4
CCSS E3</td><td>Understand the properties of solids, liquids, and gases.</td><td>CLE Strand 7</td></tr>
<tr><th colspan="3">HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?</th></tr>
<tr><th>ASSESSMENT DESCRIPTION</th><th>FORMATIVE OR SUMMATIVE?</th><th>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</th></tr>
<tr><td>Labs
Unit Tests</td><td>S
S</td><td>3
3</td></tr>
</table>

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction • Post additional lectures via youtube/websites.	• Flashcards to revisit vocabulary. • Practice and retest	• 3
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	4

Forensic Science Curriculum

CONTENT AREA: High School Science COURSE: Forensic Science	UNIT TITLE: N/A UNIT DURATION: N/A

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- Reading(s)/Handouts
- Websites
- Video Links/DVDs/recordings
- Hair from different species (cat, dog, human)
- Synthetic and natural fibers
- Microscope and slides
- Bunsen burner

BIG IDEA(S):

- **Science understanding is developed through the use of science processes skills, scientific knowledge, scientific investigation, reasoning, and critical thinking.**
- **The nature of technology can advance, and is advanced by, science as it seeks to apply scientific knowledge in ways that meet human needs**
- **Historical and cultural perspectives of scientific explanations help to improve understanding of the nature of science and how science knowledge and technology evolve over time**
- **Science and technology affect, and are affected by, society**

ENDURING UNDERSTANDINGS:

- **Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation**
- **Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations**
- **The nature of science relies upon communication of results and justification of explanations**
- **Advances in technology often result in improved data collection and an increase in scientific information**
- **Advances in technology often result in improved data collection and an increase in scientific information**

ESSENTIAL QUESTIONS:

- **What are the different ways that science is used to help investigate and try legal matters?**
- **How has forensic science changed criminal investigation?**
- **How does the U.S. Bill of Rights protect people from certain types of investigation?**
- **What characteristics make fingerprints unique?**
- **How are fingerprints collected and used in investigations?**
- **How is DNA matched between samples?**
- **How are bloodstains used to recreate crimes?**
- **What differentiates hairs between individuals and species?**
- **What differentiates different natural and man-made fibers?**
- **What is the value of hair and fiber analysis to an investigation?**
- **How are handwriting and ink samples used to match documents?**
- **What are the best practices for processing a crime scene?**

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	**STANDARDS: Hair and Fiber**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 7.1.B.a	*Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)*	X	
CLE 7.1.B.c	*Determine the appropriate tools and techniques to collect, analyze, and interpret data*	X	
CLE 7.1.C.a	*Use quantitative and qualitative data as support for reasonable explanations (conclusions)*	X	

CLE 7.1.D.a	*Communicate the procedures and results of investigations and explanations through: oral presentations, drawings and maps, data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities), graphs (bar, single, and multiple line), equations and writings*	X	
CLE 7.1.D.b	*Communicate and defend a scientific argument*		X
CLE 8.1.B.b	*Advances in technology often result in improved data collection and an increase in scientific information*		X
CLE 8.3.D.a	*Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a scientist speaking within or outside his/her area of expertise)*		X
CLE 8.3.D.b	*Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society*		X

OBJECTIVE # 1	**Students will be able to evaluate the importance of forensic evidence in criminal investigation.**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 7.1.A.a-g, 7.1.B.a-f, 7.1.C.a-d, 7.1.D.a-c, 8.1.B.a, 8.2.A.a-b, 8.2.B.a-b, 8.3.B.a-c, 8.3.C.a-c, 8.3.D.a-b	
	WHAT SHOULD STUDENTS…	
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• Student can understand and explain why scientific evidence is prefered to eyewitness testimony.
• can differentiate between types of evidence
• Predict whether evidence would be admissible
	• recognizes or recalls specific terminology such as:
	  • Locard's Principle, forensic science, physical/indirect evidence, Direct/Testimonial evidence, Means, Motive, Opportunity, Manner/Cause/Mechanism of death, due process
	performs basic processes, such as:
	  • identifies the area of forensic study
	  • identify pertinent parts of the Bill of Rights
		• Student can explain the difference in the justice system pre and post the introduction of forensic science
		• Students can evaluate case studies of criminal cases through the lens of good science

	FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING	
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Forensic Discipline Presentations • Powers of Observation http://goo.gl/OBLdSG • Class or Individual Evidence Lab • CSI Effect Discussion http://goo.gl/rxS4R4	• Describe various disciplines and their importance to investigating crimes • Determine reliability of sensory information • Evaluate pieces of evidence and provide reasoning • Evaluate effects of CSI television shows on jurors	• 3 • 3 • 2 • 4
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• U.S. Bill of Rights • Criminal Justice System	• Nature of science • U.S. Bill of Rights	• Identify a problem and design an original experiment
	HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?	
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Classic experiments • Bellringers • Exit Slips • Quick checks	• Formative • Formative • Formative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels

• Objective Test • Student Generated Assessment	• Summative	• 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1 or 2
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Identify how forensic investigation affected a real case (*eg* OJ Simpson)	• Analyze importance of forensic investigation	• 4- extended thinking

OBJECTIVE # 2	**Students can find fingerprints and match them to known samples**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 7.1.A d,f 7.1.B.a,c,f, 7.1.C.c, 7.1.D-c, 8.1.B.b, 8.2.A.a	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• students can use various methods to develop prints • students can compare two like fingerprints and match minutiae points • students can create a clear, complete inked print	• recognizes or recalls specific terminology such as: • fingerprints, loops, whorls, and arches, minutiae points, latent/plastic/ visible prints performs basic processes, such as: • differentiate between fingerprint patterns • determine if a print is latent, plastic, or visible	• Research a high profile crime the involves the use of fingerprints

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Notes/Lecture • Practice inking prints http://goo.gl/oeX3JW • Demonstrate correct technique on lifting of fingerprints • Practice dusting and lifting for prints http://goo.gl/FEkSwM	• Practice taking prints from self/classmates • Try all methods provided to master lifting prints • Try to lift prints from different surfaces • complete homework associated with learning target • Lift prints and identify the source	• 2- Skill/Concept or 3- Strategic Thinking or 4- Extended Thinking • 2-Skill/Concept 2- Skill/concept 2-Skill/concept • 3- Strategic Thinking
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• History of fingerprints • Link between integumentary system and ridge formations	• All individuals possess fingerprints/footprints	• **Science understanding is developed through the use of science processes skills, scientific knowledge, scientific investigation, reasoning, and critical thinking.** • **The nature of technology can advance, and is advanced by, science as it seeks to apply scientific knowledge in ways that meet human needs** • **Historical and cultural perspectives of scientific explanations help to improve understanding of the nature of science and how science knowledge and technology evolve over time**
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lifting and matching unknown prints correctly • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment • Student created portfolio	• Formative • Formative • Formative • Summative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4 • 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide appropriate enrichment activity	• Students can research advances in fingerprinting • Look at case studies that involve fingerprinting	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 3	**Students can use information from DNA analysis and blood stains to recreate a crime**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 7.1.A d,f 7.1.B.a,c,f, 7.1.C.c, 7.1.D-c, 8.1.B.b, 8.2.A.a	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*

• Can predict the relationship between distance fallen and size of drop
• Can calculate angle of impact
• Uses various methods to identify blood
• Describe how DNA is fragmented and separated to match samples
• Differentiate between PCR and RFLP DNA analysis
	• recognizes or recalls specific terminology such as:
	  • serology, presumptive tests, passive patterns, impact patterns, void, projected stains, spines, satellites, DNA, electrophoresis
	performs basic processes, such as:
	  • Identify blood as human or other
	  • Find area of convergence of blood stains
	  • Recognize basic DNA structure
		• Student can summarize activity at a crime scene based on types and placement of blood stains

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Notes/Lecture • DNA Analysis WebQuest	• Introduction to background and basic information • Review various processes involved in DNA analysis	• 1 • 2-Skill/Concept

http://goo.gl/KQz5Ep • Presumptive blood test demo • Demonstrate various bloodstain patterns	• Experience various blood presumptive blood tests • Experience how various patterns are made	• 2-Skill/concept • 2-Skill/concept
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• History of fingerprints • Link between integumentary system and ridge formations	• All individuals possess fingerprints/footprints	• **Science understanding is developed through the use of science processes skills, scientific knowledge, scientific investigation, reasoning, and critical thinking.** • **The nature of technology can advance, and is advanced by, science as it seeks to apply scientific knowledge in ways that meet human needs** • **Historical and cultural perspectives of scientific explanations help to improve understanding of the nature of science and how science knowledge and technology evolve over time**
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Recreate crime based on bloodstain patterns • Classic experiments • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment • Student created portfolio	• Formative • Formative • Formative • Formative • Summative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4 • 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide appropriate enrichment activity	• Students can research advances in DNA analysis • Look at case studies that involve bloodstain pattern analysis	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

OBJECTIVE # 4	**Students will be able to match hairs and fibers from the crime scene to known samples**	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• 7.1.B.a,c, 7.1.C.a, 7.1.D.a-b, 8.1.B.b, 8.3.D.a-b	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Hair is class evidence that can be individual evidence if removed in the anagen phase • Hair has different characteristics for different species • Hair has three phases of growth • Fibers are class evidence • that statistics are important in solving crimes • There are two categories of fibers (natural and synthetic) • there are different weave patterns of textiles	• cortex • cuticle • medulla • follicle • polymer • anagen phase • catagen phase • telogen phase • follicular tag • morphology • cortical fusi • warp • weft	• Use a compound microscope to identify hair morphology • Describe the structure of hair • tell the difference between human and animal hair • distinguish and identify fibers based on properties(chemical and heat test) • explain the proper collection of hair and fiber •
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture/Discussion of terms • Demonstration of lab procedures	• complete performance tasks • Look at hair morphology through	• 2- Skill/Concept or 3- Strategic Thinking or 4- Extended Thinking • 2-Skill/Concept

• Modeling appropriate use of lab equipment.	a compound microscope • Make a cast of hair • identify whether the hair is human or animal • identify different fibers using chemical or flame test	• 2- Skill/Concept • 3- Strategic Thinking or 4- Extended Thinking • 3- Strategic Thinking
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• historical scientists/philosophers • reading about landmark studies/findings • scientific literacy	• different types of fibers (Cotton, polyester...)	• **Science understanding is developed through the use of science processes skills, scientific knowledge, scientific investigation, reasoning, and critical thinking.**
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Classic experiments • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Information on the chemistry of different fibers • lab materials to make polyester	• Create a synthetic fiber	• 4- extended thinking

<table>
<tr><td>OBJECTIVE # 5</td><td colspan="2">Students evaluate questioned documents to detect forgeries and trace document origin.</td></tr>
<tr><td>REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS</td><td colspan="2">• 7.1.A d,f 7.1.B.a,c,f, 7.1.C.c, 7.1.D-c, 8.1.B.b, 8.2.A.a</td></tr>
<tr><td colspan="3">WHAT SHOULD STUDENTS…</td></tr>
<tr><td>UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.</td><td>KNOW?
Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY</td><td>BE ABLE TO DO?
Skills; Products</td></tr>
<tr><td>• Match handwriting samples based on 12 characteristics
• Compare black ink samples based on chromatography results</td><td>• recognizes or recalls specific terminology such as:
  • chromatography, forgery, diacritics, watermark, counterfeit, exemplar
performs basic processes, such as:
  • Identify handwriting characteristics</td><td>• Identify a forged document based on ink and handwriting samples</td></tr>
<tr><td colspan="3">FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING</td></tr>
<tr><td>TEACHER INSTRUCTIONAL ACTIVITY</td><td>STUDENT LEARNING TASK</td><td>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</td></tr>
<tr><td>• Notes/Lecture
• Evaluation of Zodiac and BTK letters http://goo.gl/dPOFd
• Ink chromatography to evaluate differences in ink composition http://goo.gl/QkjZ9l</td><td>• Introduction to background, terminology, and processes
• Recognize handwriting characteristics in unfamiliar writing
• Students learn and use chromatography</td><td>• 1
• 2
• 2</td></tr>
<tr><td>INTERDISCIPLINARY CONNECTION</td><td>PRIOR KNOWLEDGE CONNECTIONS</td><td>INQUIRY CONNECTIONS</td></tr>
<tr><td>• Recognizing unique grammar
• History of cases
• Chemistry of chromatography</td><td>• Effect of molecular weight on chromatogrtaphy</td><td>• Science understanding is developed through the use of science processes skills, scientific knowledge, scientific investigation, reasoning, and critical thinking.
• The nature of technology can advance, and is advanced by, science as it seeks to apply scientific knowledge in ways that meet human needs
• Historical and cultural perspectives of scientific explanations help to improve understanding of the nature of science and how science knowledge and technology evolve over time</td></tr>
</table>

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Classic experiments • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment • Student created portfolio	• Formative • Formative • Formative • Summative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4 • 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide appropriate enrichment activity	• Students can research advances in chromatogrpahy • Look at case studies that involve questioned documents	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

<table>
<tr><td>OBJECTIVE # 6</td><td colspan="2">Students understand how to properly process a crime scene.</td></tr>
<tr><td>REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS</td><td colspan="2">• 7.1.A.f, 7.1.B.a,c, 7.1.C.a-c, 7.1.D.a-c, 8.2.A.a-b, 8.3B.a, 8.3.D.a-b</td></tr>
<tr><td colspan="3">WHAT SHOULD STUDENTS…</td></tr>
<tr><td>UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.</td><td>KNOW?
Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY</td><td>BE ABLE TO DO?
Skills; Products</td></tr>
<tr><td>• Basic components of crime scene documentation, and collection of evidence
• there are different search patterns that are applicable to different circumstances
• evidence must be collected based on the type of evidence
• the importance of securing a crime scene
• that individual evidence is preferred but that class evidence may be probative
• that eyewitness testimony can have unintentional errors present in the evidence
• problems associated with the CSI effect</td><td>• Chain of custody
• class evidence
• direct evidence
• individual evidence
• algor mortis
• livor mortis
• rigor mortis
• manner of death
• mechanism of death
• probative value</td><td>• define physical evidence and testimony
• list the responsibilities of the first officer on the scene (APAPT)
• thoroughly process a crime scene including taking notes, sketching the scene, and collecting evidence
• start a chain of custody and understand the importance in regards to collection of evidence
• search a crime scene using one of the four methods.
• define and contrast individual and class evidence
• properly collect evidence depending on the type of evidence</td></tr>
<tr><td colspan="3">FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING</td></tr>
<tr><td>TEACHER INSTRUCTIONAL ACTIVITY</td><td>STUDENT LEARNING TASK</td><td>DOK TARGET
(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)</td></tr>
<tr><td>• Lecture/Discussion of terms
• Demonstration of lab procedures
• Modeling appropriate use of lab
• equipment.</td><td>• properly collect evidence according to protocol
• identify whether evidence is class or individual evidence
• accurately sketch a crime scene
• documentation of a crime scene
• complete all other lab activities</td><td>• 2- Skill/Concept or 3- Strategic Thinking or 4- Extended Thinking
• 2-Skill/Concept
• 3- Strategic Thinking or 4- Extended Thinking
• 3- Strategic Thinking
• 2/ 3 - concept/extended thinking</td></tr>
<tr><td>INTERDISCIPLINARY CONNECTION</td><td>PRIOR KNOWLEDGE CONNECTIONS</td><td>INQUIRY CONNECTIONS</td></tr>
<tr><td>• historical scientists/philosophers
• reading about landmark studies/findings
• governmental regulations
• scientific literacy</td><td>• science, technology, and human activity</td><td>• Science understanding is developed through the use of science processes skills, scientific knowledge, scientific investigation, reasoning, and critical thinking.</td></tr>
</table>

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Classic experiments • Bellringers • Exit Slips • Quick checks • Objective Test • Student Generated Assessment	• Formative • Formative • Formative • Summative • Summative	• 1 or 2 • 1 or 2 • 1 or 2 • all levels • 3 or 4
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Post videos of lectures to Youtube • Flashcards/Task cards • Reinforcing worksheets or activities • Corrections to previous work	• Review material at own pace with guided assistance as needed	1- Recall
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• introduce more advanced components to the crime scene such entailing studies in anthropology and entomology	• Create a crime scene to use in the class setting	• 4- extended thinking • 3- strategic thinking/ 4- extended thinking

AP Biology Curriculum

UNIT TITLE: Ecology UNIT DURATION:	CONTENT AREA: Science COURSE: AP Biology

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• **Campbell/Reece AP Edition Biology** • **AP Biology Investigative Labs: An Inquiry-Based Approach**	**Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.** **Big Idea 3: Living systems store, retrieve, transmit, and respond to information essential to life processes.** **Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.**

ENDURING UNDERSTANDINGS:

- All living systems require constant input of free energy. **(2.A.1)**
- All biological systems from cells and organisms to populations, communities and ecosystems are affected by complex biotic and abiotic interactions involving exchange of matter and free energy. **(2.D.1)**
- Biological systems are affected by disruptions to their dynamic homeostasis. **(2.D.3)**
- Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection. **(2.E.3)**
- Individuals can act on information and communicate it to others. **(3.E.1)**
- Communities are composed of populations of organisms that interact in complex ways. **(4.A.5)**
- Interactions among living systems and with their environment result in the movement of matter and energy. **(4.A.6)**
- Interactions between and within populations influence patterns of species distribution and abundance. **(4.B.3)**
- Distribution of local and global ecosystems changes over time. **(4.B.4)**
- The diversity of species within an ecosystem may influence the stability of the ecosystem. **(4.C.4)**

ESSENTIAL QUESTIONS:

- Why are natural and artificial ecosystems with fewer component parts and with little diversity among the parts are often less resilient to changes in the environment?
- How do keystone species, producers, and essential abiotic and biotic factors contribute to maintaining the diversity of an ecosystem?
- How are the activities of organisms affected by interactions with biotic and abiotic factors?
- How is the stability of populations, communities and ecosystems affected by interactions with biotic and abiotic factors?
- Why do disruptions to ecosystems impact the dynamic homeostasis or balance of the ecosystem?
- How do organisms act on information and communicate it to others?
- How are responses to information and communication of information vital to natural selection?
- In what ways do organisms behave and exchange information with each other in response to internal changes and external cues?
- What mechanisms of communication occur in nature?
- How is a community measured and described in terms of species composition and species diversity?
- What role do mathematical or computer models play in investigating population interactions within and environmental impacts on a community.
- What mathematical models and graphical representations are used to illustrate population growth patterns and interactions?
- How are energy flow and matter recycling related?
- How do changes in regional and global climates and in atmospheric composition influence patterns of primary productivity?
- What relationships do organisms within food webs and food chains have with one another?

	• How does primary productivity affect food webs and food chains? • How do human activities impact ecosystems on a local, regional, and global scale? • Why are many adaptations of organisms related to obtaining and using energy and matter in a particular environment? • In what ways do interactions between populations affect the distributions and abundance of populations? • How does completion influence the characteristics and variation found within individuals of a population? • How does species-specific and environmental catastrophes; such as geological events, the sudden influx/depletion of abiotic resources or increased human activities affect species distribution and abundance? • What role does human impact have on the acceleration of change at local and global levels? • Geological and meteorological events impact ecosystem distribution in what ways? • How can changes in free energy availability result in changes in population size? • How can changes in free energy availability result in disruptions to an ecosystem?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 1.1.C	***Properties of matter can be explained in terms of moving particles too small to be seen without tremendous magnification***		**x**
CLE 1.2.F.a	***Energy can be transferred within a system as the total amount of energy remains constant (i.e., Law of Conservation of Energy)*** ***a.* Classify the different ways to store energy (i.e., chemical, nuclear, thermal, mechanical, electromagnetic) and describe the transfer of energy as it changes from kinetic to potential, while the total amount of energy remains constant, within a system (e.g., biochemical processes, carbon dioxide-oxygen cycle, nitrogen cycle, food web)***		**x**
CLE 3.1.A	***Organisms have basic needs for survival***	**x**	
CLE 3.2.C	***Complex multicellular organisms have systems that interact to carry out life processes through physical and chemical means***	**x**	
CLE 3.2.G	***Life processes can be disrupted by disease (intrinsic failures of the organ systems or by infection due to other organisms)***		**x**
CLE 4.1.A.a-c.	***All populations living together within a community interact with one another and with their environment in order to survive and maintain a balanced ecosystem*** ***a. Explain the nature of interactions between organisms in predator/prey relationships and different symbiotic relationships (i.e., mutualism, commensalisms, parasitism)*** ***b. Explain how cooperative (e.g., symbiotic) and competitive (e.g., predator/prey)***	**x**	

	relationships help maintain balance within an ecosystem *c. * Explain why no two species can occupy the same niche in a community* *(The functional role of a species is not limited to its placement along a food pyramid; it also includes the interactions of a species with other organisms while obtaining food. For example, the methods used to tolerate the physical factors of its environment, such as climate, water, nutrients, soils, and parasites, are all part of its functional role. In other words, the ecological niche of an organism is its natural history: all the interactions and interrelationships of the species with other organisms and the environment.)*		
CLE 4.1.B.a-b.	*Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite* *a. Identify and explain the limiting factors (biotic and abiotic) that may affect the carrying capacity of a population within an ecosystem* *b.*Predict how populations within an ecosystem may change in number and/or structure in response to hypothesized changes in biotic and/or abiotic factors*	x	
CLE 4.1.C.a-b.	*All organisms, including humans, and their activities cause changes in their environment that affect the ecosystem* *a. *Devise a multi-step plan to restore the stability and/or biodiversity of an ecosystem when given a scenario describing the possible adverse effects of human interactions with that ecosystem (e.g., destruction caused by direct harvesting, pollution, atmospheric changes)* *b. *Predict and explain how natural or human caused changes (biological, chemical and/or physical) in one ecosystem may affect other ecosystems due to natural mechanisms (e.g., global wind patterns, water cycle, ocean currents)*	x	
CLE 4.1.D.a-b.	*The diversity of species within an ecosystem is affected by changes in the environment, which can be caused by other organisms or outside processes* *a. Predict the impact (beneficial or harmful) a natural or human caused environmental event (e.g., forest fire, flood, volcanic eruption, avalanche, acid rain, global warming, pollution, deforestation, introduction of an exotic species) may have on the diversity of different species in an ecosystem* *b. *Describe possible causes of extinction of a population*	x	
CLE 4.2.A.a-c.	**As energy flows through the ecosystem, all organisms capture a portion of that energy and transform it to a form they can use** **a. *Illustrate and describe the flow of energy within a food web** **b. *Explain why there are generally more producers than consumers in an energy pyramid** **c. Predict how the use and flow of energy will be altered due to changes in a food web**	x	
CLE 4.2.B.a-b	**Matter is recycled through an ecosystem** **a. *Explain the processes involved in the recycling of nitrogen, oxygen, and carbon through an ecosystem** **b. * Explain the importance of the recycling of nitrogen, oxygen, and carbon within an eco**	x	
CLE 4.3.C.c-d.	**Natural selection is the process of sorting individuals based on their ability to survive and reproduce within their ecosystem** **c. Explain how environmental factors (e.g., habitat loss, climate change, pollution, introduction of non-native species) can be agents of natural selection** **d. *Given a scenario describing an environmental change, hypothesize why a given species was unable to survive**	x	
CLE 5.2.E	**Changes in the form of water as it moves through Earth's systems are described as the water cycle**		x
CLE 5.2.F	**Climate is a description of average weather conditions in a given area due to the transfer of energy and matter through Earth's systems**		x

CLE 5.3.A.a-b	**Earth's materials are limited natural resources affected by human activity** **a. *Predict local and/or global effects of environmental changes when given a scenario describing how the composition of the geosphere, hydrosphere, or atmosphere is altered by natural phenomena or human activities** **b. *Recognize how the geomorphology of Missouri (i.e., different types of Missouri soil and rock materials such as limestone, granite, clay, loam; land formations such as Karst (cave) formations, glaciated plains, river channels) affects the survival of organisms**		**x**
CLE 6.1.A	**The Earth, Sun, and moon are part of a larger system that includes other planets and smaller celestial bodies**		**x**
CLE 6.1.B.a	**The Earth has a composition and location suitable to sustain life** **a. * Explain how Earth's environmental characteristics and location in the universe (e.g., atmosphere, temperature, orbital path, magnetic field, mass-gravity, location in solar system) provide a life-supporting environment**		**x**
CLE 6.2.C	**The regular and predictable motions of a planet and moon relative to the Sun explain natural phenomena, such as day, month, year, shadows, moon phases, eclipses, tides, and seasons**		**x**
CLE 8.2.B.b	**Scientific theories are developed based on the body of knowledge that exists at any particular time and must be rigorously questioned and tested for validity** **b. *Identify and analyze current theories that are being questioned, and compare them to new theories that have emerged to challenge older ones (e.g., theories of evolution, extinction, global warming)**		**x**
CLE 8.3.B.b-c.	**Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology** **b. *Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research)** **c. *Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, use of alternative energies for carbon fuels, use of pesticides**		**x**
CLE 7.1.A.a-g.	**Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation** **a. Formulate testable questions and hypotheses** **b. Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment** **c. Design and conduct a valid experiment** **d. Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature)** **e. *Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies** **f. *Acknowledge there is no fixed procedure called "the scientific method", but**		**x**

	that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations Evaluate the design of an experiment and make suggestions for reasonable improvements		
CLE 7.1.B.a-f.	Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations a. *Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) b. Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second c. Determine the appropriate tools and techniques to collect, analyze, and interpret data d. Judge whether measurements and computation of quantities are reasonable e. Calculate the range, average/mean, percent, and ratios for sets of data *Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)		x
CLE 7.1.C.a-d.	Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) a. Use quantitative and qualitative data as support for reasonable explanations (conclusions) b. Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable) c. Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)		x
CLE 7.1.D.a-c.	The nature of science relies upon communication of results and justification of explanations a. Communicate the procedures and results of investigations and explanations through: ¨ oral presentations ¨ drawings and maps ¨ data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ¨ graphs (bar, single, and multiple line) ¨ equations and writings b. * Communicate and defend a scientific argument Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work)		x
CLE 8.3.C.a-c.	Scientific ethics require that scientists must not knowingly subject people or the		x

	community to health or property risks without their knowledge and consent **a. *Identify and evaluate the need for informed consent in experimentation** **b. *Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment)** **c. *Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)**		
CLE 8.3.D.a-b.	**Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible** **a. *Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a scientist speaking within or outside his/her area of expertise)** *** Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society**		**x**

OBJECTIVE # 1	Ecology
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• Missouri State Course Level Expectations

WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
***Evidence of student learning** is a demonstrated understanding of the following:* • Innate behaviors are behaviors that are inherited. • Learning occurs through interactions with the environment and other organisms. • Behaviors in animals are triggered by environmental cues and are vital to reproduction, natural selection and survival. • Cooperative behavior within or between populations contributes to the survival of the populations. • Living systems have a variety of signal behaviors or cues that produce changes in the behavior of other organisms and can result in differential reproductive success. • Animals use visual, audible, tactile, electrical and chemical signals to indicate dominance, find food, establish territory and ensure reproductive success. • Natural selection favors innate and learned behaviors that increase survival and reproductive fitness. • Cooperative behavior tends to increase the fitness of the individual and the survival of the population. • Reproduction without constraints results in the exponential growth of a population. • A population can produce a density of individuals that exceeds	• Abiotic Factor • Abundance • Accuracy • Adaptation • Age Structure • Biodiversity • Biome • Biotic Factor • Carbon Cycle • Carrying Capacity • Chi-Square • Climate Change • Community • Conservation • Constant • Control • Decomposer • Deductive Reasoning • Demography • Density-Dependent Factor • Dependent Variable	Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems. 1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain. 1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain. 1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain. 1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively. 1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain. Science Practice 2: The student can use mathematics appropriately. 2.1 The student can justify the selection of a

the system's resource availability. • As limits to growth due to density-dependent and density-independent factors are imposed, a logistic growth model generally ensues. • Demographics data with respect to age distributions and fecundity can be used to study human populations. • Competition, parasitism, predation, mutualism and commensalism can affect population dynamics. • Relationships among interacting populations can be characterized by positive and negative effects, and can be modeled mathematically (predator/prey, epidemiological models, invasive species). • Many complex symbiotic relationships exist in an ecosystem, and feedback control systems play a role in the functioning of these ecosystems. • Biogeographical studies illustrate these changes.	• Detritovore • Distribution • Ecological Pyramid • Ecological Succession • Ecosystem • Endangered Species • Exponential Growth • Food Chain • Food Web • Global Warming • Graph • Greenhouse Effect • Greenhouse Gas • Gross Primary Productivity • Habitat • Hydrologic Cycle • Hypothesis • Imprinting • Independent Variable • Inductive Reasoning • Interspecific Competition • Intraspecific Competition • Invasive Species • Keystone Species • K-Selection • Life Table • Limiting Factor • Logistic Growth • Mark and Recapture • Mean • Median • Migration • Model • Mortality • Mutualism • Net Primary Productivity • Niche • Nitrogen Cycle • Nutrient Cycle • Observation • Parasite	mathematical routine to solve problems. 2.2 The student can apply mathematical routines to quantities that describe natural phenomena. 2.3 The student can estimate numerically quantities that describe natural phenomena. Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course. 3.1 The student can pose scientific questions. 3.2 The student can refine scientific questions. 3.3 The student can evaluate scientific questions. Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question. 4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question. 4.2 The student can design a plan for collecting data to answer a particular scientific question. 4.3 The student can collect data to answer a particular scientific question. 4.4 The student can evaluate sources of data to answer a particular scientific question Science Practice 5: The student can perform data analysis and evaluation of evidence. 5.1 The student can analyze data to identify patterns or relationships. 5.2 The student can refine observations and measurements based on data analysis. 5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question. Science Practice 6: The student can work with scientific explanations and theories. 6.1 The student can justify claims with evidence. 6.2 The student can construct explanations of phenomena based on evidence produced

	• Photoautotrophs • Pollution • Population • Population Growth • Precision • Predator • Prediction • Primary Consumer • Quadrat • Rate • Rate of Increase • R-Selection • Saprophyte • Scientific Method • Secondary Consumer • Species Diversity • Survivorship Curve • Symbiosis • Table • Threatened Species • Trend • Trophic Level • Urbanization • Variable	through scientific practices. 6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced. 6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models. 6.5 The student can evaluate alternative scientific explanations. Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains. 7.1 The student can connect phenomena and models across spatial and temporal scales. 7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)

• **Presentations**
• **Video Presentations**
• **Chapter Outlines**
• **Guided Readings**
• **Virtual Labs**
• **Inquiry Labs**
    • **Mark and Recapture Lab**
    • **Random Quadrat Sampling Lab**
	• **Exposure to relevant material**
	• **Exposure to relevant material**
	• **Synthesis of relevant material**
	• **Synthesis of relevant material**
	• **Application of relevant material**
	• **Application of relevant material**
		2=Skill/Concept
		2=Skill/Concept
		2=Skill/Concept, 3=Strategic Thinking
		2=Skill/Concept, 3=Strategic Thinking
		3=Strategic Thinking, 4=Extended Thinking
		3=Strategic Thinking, 4=Extended Thinking

INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Civics, History, Psychology, Mathematics, English	• Builds upon a general understanding of Biology I and Critical Thinking Strategies	• Conducting and Designing Inquiry Lab Investigations

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Section Quizzes** • **Virtual Labs** • **Inquiry Labs** • **Unit Tests**	Form Form/Summ Form/Summ Summ	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP • Test Corrections with written explanations • Lab Corrections with written explanations • Retesting on Unit Tests • Writing their own test questions • Grading their own essays	• Students are presented information using different instructional strategies • Gathering an understanding of why their answers were incorrect • Students need a thorough understanding of the concepts to write or grade their own tests and essays	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AP Exam Multiple Choice Questions • AP Exam Free Response Questions • Designing Their Own Experiments • Conducting Additional Lab Investigations • Supplemental Research	• Be able to answer questions of an AP Exam • Apply knowledge toward extending on labs conducted in class • Apply knowledge toward conducting additional labs • Research additional ideas on applicable, relevant topics	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think**

UNIT TITLE: Chemistry	CONTENT AREA: Science
UNIT DURATION:	COURSE: AP Biology

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- **Campbell/Reece AP Edition Biology**
- **AP Biology Investigative Labs: An Inquiry-Based Approach**

BIG IDEA(S):

Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.

Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

ENDURING UNDERSTANDINGS:

- All living systems require constant input of free energy. **(2.A.1)**
- Organisms must exchange matter with the environment to grow, reproduce, and maintain organization. **(2.A.3)**
- The subcomponents of biological molecules and their sequence determine the properties of that molecule. **(4.A.1)**
- Interactions between molecules affect their structure and function. **(4.B.1)**
- Variation in molecular units provides cells with a wider range of functions. **(4.C.1)**

ESSENTIAL QUESTIONS:

- How does entropy apply to the 2nd Law of thermodynamics?
- Why are molecules and atoms from the environment necessary to build new molecules?
- What determines polymer form and function?
- What is meant by form determines function of atoms and molecules?
- How is the shape of enzymes, active sites and interaction with specific molecules essential for basic functioning of the enzyme?
- In what ways do molecules and the environment influence how enzymes act or enhance or inhibit enzyme activity?
- What determines whether molecules can bind reversibly or irreversibly to the active or allosteric sites, changing the activity of the enzyme?
- What information can be interpreted about enzymatic activity from data regarding the concentrations of product or substrate as a function of time?
- What are the characteristics of the different classes of molecules?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.e. GLE/CLE/MLS/NGSS	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 1.1.A	Objects, and the materials they are made of, have properties that can be used to describe and classify them		x
CLE 1.1.B	Properties of mixtures depend upon the concentrations, properties, and interactions of particles		x
CLE 1.1.C	Properties of matter can be explained in terms of moving particles too small to be seen without tremendous magnification		x
CLE 1.1.D	Physical changes in states of matter due to thermal changes in materials can be explained by the Kinetic Theory of Matter		x
CLE 1.1.E	The atomic model describes the electrically neutral atom	x	
CLE 1.1.F	The periodic table organizes the elements according to their atomic structure and chemical reactivity	x	
CLE 1.1.G	Properties of objects and states of matter can change chemically and/or physically	x	
CLE 1.1.H	Chemical bonding is the combining of different pure substances (elements, compounds) to form new substances with different properties	x	

CLE 1.1.I.a	**Mass is conserved during any physical or chemical change** **a. * Compare the mass of the reactants to the mass of the products in a chemical reaction or physical change (e.g., biochemical processes, carbon dioxide-oxygen cycle, nitrogen cycle, decomposition and synthesis reactions involved in a food web) as support for the Law of Conservation of Mass**	X	
CLE 1.2.A	**Forms of energy have a source, a means of transfer (work and heat), and a receiver**		X
CLE 1.2.D	**Chemical reactions involve changes in the bonding of atoms with the release or absorption of energy**	X	
CLE 1.2.E	**Nuclear energy is a major source of energy throughout the universe**		X
CLE 3.2.D.a-e.	**Cells carry out chemical transformations that use energy for the synthesis or breakdown of organic compounds** **a. Summarize how energy transfer occurs during photosynthesis and cellular respiration as energy is stored in and released from the bonds of chemical compounds (i.e. ATP)** **b. * Relate the structure of organic compounds (e.g., proteins, nucleic acids, lipids, carbohydrates) to their role in living systems** **c. * Recognize energy is absorbed or released in the breakdown and/or synthesis of organic compounds** **d. * Explain how protein enzymes affect chemical reactions (e.g., the breakdown of food molecules, growth and repair, regulation)** **e. * Interpret a data table showing the effects of an enzyme on a biochemical reaction**	X	
CLE 3.2.F.a-c.	**Cellular activities and responses can maintain stability internally while external conditions are changing (homeostasis)** **a. Explain the significance of the selectively permeable membrane to the transport of molecules** **b. Predict the movement of molecules across a selectively permeable membrane (i.e., diffusion, osmosis, active transport) needed for a cell to maintain homeostasis given concentration gradients and different sizes of molecules** **c. Explain how water is important to cells (e.g., is a buffer for body temperature, provides soluble environment for chemical reactions, serves as a reactant in chemical reactions, provides hydration that maintains cell turgidity, maintains protein shape)**	X	
CLE 3.3.B.a	**All living organisms have genetic material (DNA) that carries hereditary information** **a. Describe the chemical and structural properties of DNA (e.g., DNA is a large polymer formed from linked subunits of four kinds of nitrogen bases; genetic information is encoded in genes based on the sequence of subunits; each DNA molecule in a cell forms a single chromosome) (Assess the concepts – NOT memorization of nitrogen base pairs)**	X	
CLE 7.1.A.a-g.	**Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation** **a. Formulate testable questions and hypotheses** **b. Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment** **c. Design and conduct a valid experiment** **d. Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature)** **e. *Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies** **f. *Acknowledge there is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant**		x

	evidence, logical reasoning, and some imagination in developing hypotheses and other explanations Evaluate the design of an experiment and make suggestions for reasonable improvements		
CLE 7.1.B.a-f.	Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations a. *Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) b. Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second c. Determine the appropriate tools and techniques to collect, analyze, and interpret data d. Judge whether measurements and computation of quantities are reasonable e. Calculate the range, average/mean, percent, and ratios for sets of data *Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)		x
7.1.C.a-d.	Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) a. Use quantitative and qualitative data as support for reasonable explanations (conclusions) b. Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable) c. Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)		x
CLE 7.1.D.a-c.	The nature of science relies upon communication of results and justification of explanations a. Communicate the procedures and results of investigations and explanations through: ¨ oral presentations ¨ drawings and maps ¨ data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ¨ graphs (bar, single, and multiple line) ¨ equations and writings b. * Communicate and defend a scientific argument Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work)		x
CLE 8.3.C.a-c.	Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent a. *Identify and evaluate the need for informed consent in experimentation b. *Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment) c. *Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)		x

OBJECTIVE # 2		
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• Missouri State Course Level Expectations	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
***Evidence of student learning** is a demonstrated understanding of the following:* • Order is maintained by constant free energy input into the system. • Loss of order or free energy flow results in death. • Increased disorder and entropy are offset by biological processes that maintain or increase order. • Order is maintained by coupling cellular processes that increase entropy (and so have negative changes in free energy) with those that decrease entropy (and so have positive changes in free energy). • Energy input must exceed free energy lost to entropy to maintain order and power cellular processes. • Energetically favorable exergonic reactions, such as ATP→ADP, that have a negative change in free energy can be used to maintain or increase order in a system by being coupled with reactions that have a positive free energy change. • Carbon moves from the environment to organisms where it is used to build carbohydrates, proteins, lipids, or nucleic acids. Carbon is used in storage compounds and cell formation in all organisms. • Nitrogen moves from the environment to organisms where it is used in building proteins and nucleic acids. Phosphorus moves from the environment to organisms where it is used in nucleic acids and certain lipids. • Living systems depend on properties of water that result from its polarity and hydrogen bonding. • In nucleic acids, biological information is encoded in sequences of nucleotide monomers. Each nucleotide has structural components: a five-carbon sugar (deoxyribose or ribose), a phosphate and a nitrogen base (adenine, thymine, guanine, cytosine or uracil). DNA and RNA differ in function and differ slightly in structure, and these structural differences account for the differing functions. • In proteins, the specific order of amino acids in a polypeptide (primary structure) interacts with the environment to determine the overall shape of the protein, which also involves secondary tertiary and quaternary structure and, thus, its function. The R group of an amino acid can be categorized by chemical properties (hydrophobic, hydrophilic and ionic), and the interactions of these R groups determine structure and function of that region of the protein. • In general, lipids are nonpolar; however, phospholipids exhibit structural properties, with polar regions that interact with other polar molecules such as water, and with nonpolar regions where differences in saturation determine the structure and	• Accuracy • Amino Acid • Carbohydrate • Carbon • Characteristics of the Periodic Table • Chi-Square • Constant • Control • Covalent Bond • Deductive Reasoning • Denaturation • Dependent Variable • Disaccharide • Functional Group • Graph • Hydrogen Bond • Hydrophilic • Hydrophobic • Hypothesis • Independent Variable • Inductive Reasoning • Ion • Lipid • Macromolecule • Mean • Median • Model • Monomer • Monosaccharide • Nonpolar • Nucleic Acid • Nucleotide • Observation	Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems. 1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain. 1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain. 1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain. 1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively. 1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain. Science Practice 2: The student can use mathematics appropriately. 2.1 The student can justify the selection of a mathematical routine to solve problems. 2.2 The student can apply mathematical routines to quantities that describe natural phenomena. 2.3 The student can estimate numerically quantities that describe natural phenomena.

function of lipids. • Carbohydrates are composed of sugar monomers whose structures and bonding with each other by dehydration synthesis determine the properties and functions of the molecules. Illustrative examples include: cellulose versus starch. • Nucleic acids have ends, defined by the 3' and 5' carbons of the sugar in the nucleotide, that determine the direction in which complementary nucleotides are added during DNA synthesis and the direction in which transcription occurs (from 5' to 3'). • Proteins have an amino (NH_2) end and a carboxyl (COOH) end, and consist of a linear sequence of amino acids connected by the formation of peptide bonds by dehydration synthesis between the amino and carboxyl groups of adjacent monomers. • The nature of the bonding between carbohydrate subunits determines their relative orientation in the carbohydrate, which then determines the secondary structure of the carbohydrate. • For an enzyme-mediated chemical reaction to occur, the substrate must be complementary to the surface properties (shape and charge) of the active site. In other words, the substrate must fit into the enzyme's active site. • Cofactors and coenzymes affect enzyme function; this interaction relates to a structural change that alters the activity rate of the enzyme. The enzyme may only become active when all the appropriate cofactors or coenzymes are present and bind to the appropriate sites on the enzyme.	• Organic Molecule • Peptide Bond • Phospholipid • Polar • Polymer • Precision • Prediction • Properties of Water • Protein • Rate • Scientific Method • Table • Trend • Variable	Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course. 3.1 The student can pose scientific questions. 3.2 The student can refine scientific questions. 3.3 The student can evaluate scientific questions. Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question. 4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question. 4.2 The student can design a plan for collecting data to answer a particular scientific question. 4.3 The student can collect data to answer a particular scientific question. 4.4 The student can evaluate sources of data to answer a particular scientific question Science Practice 5: The student can perform data analysis and evaluation of evidence. 5.1 The student can analyze data to identify patterns or relationships. 5.2 The student can refine observations and measurements based on data analysis. 5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question. Science Practice 6: The student can

		work with scientific explanations and theories. 6.1 The student can justify claims with evidence. 6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices. 6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced. 6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models. 6.5 The student can evaluate alternative scientific explanations. Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains. 7.1 The student can connect phenomena and models across spatial and temporal scales. 7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Presentations** • **Video Presentations** • **Chapter Outlines** • **Guided Readings** • **Virtual Labs** • **Inquiry Labs**	• **Exposure to relevant material** • **Exposure to relevant material** • **Synthesis of relevant material** • **Synthesis of relevant material** • **Application of relevant material** • **Application of relevant material**	**2=Skill/Concept** **2=Skill/Concept** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **3=Strategic Thinking, 4=Extended Thinking** **3=Strategic Thinking, 4=Extended**

• **Enzyme Activity Lab** • **Osmosis and DIffusion Lab**		**Thinking**
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Civics, History, Psychology, Mathematics, English	• Builds upon a general understanding of Biology I and Critical Thinking Strategies	• Conducting and Designing Inquiry Lab Investigations
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Section Quizzes** • **Virtual Labs** • **Inquiry Labs** • **Unit Tests**	Form Form/Summ Form/Summ Summ	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP • Test Corrections with written explanations • Lab Corrections with written explanations • Retesting on Unit Tests • Writing their own test questions • Grading their own essays	• Students are presented information using different instructional strategies • Gathering an understanding of why their answers were incorrect • Students need a thorough understanding of the concepts to write or grade their own tests and essays	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AP Exam Multiple Choice Questions • AP Exam Free Response Questions • Designing Their Own Experiments • Conducting Additional Lab Investigations	• Be able to answer questions of an AP Exam • Apply knowledge toward extending on labs conducted in class	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking,**

• Supplemental Research	• Apply knowledge toward conducting additional labs • Research additional ideas on applicable, relevant topics	**4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think**

UNIT TITLE: Cellular Biology UNIT DURATION:	CONTENT AREA: Science COURSE: AP Biology

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT: • **Campbell/Reece AP Edition Biology** • **AP Biology Investigative Labs: An Inquiry-Based Approach**	**BIG IDEA(S):** **Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.** **Big Idea 3: Living systems store, retrieve, transmit, and respond to information essential to life processes.** **Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.**
ENDURING UNDERSTANDINGS: • Organisms must exchange matter with the environment to grow, reproduce and maintain organization. **(2.A.3)** • Cell membranes are selectively permeable due to their structure. **(2.B.1)** • Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes. **(2.B.2)** • Eukaryotic cells maintain internal membranes that partition the cell into specialized regions. **(2.B.3)** • Timing and coordination of physiological events are regulated by multiple mechanisms. **(2.E.2)** • A variety of intercellular and intracellular signal transmissions mediate gene expression. **(3.B.2)** • Cell communication processes share common features that reflect a shared evolutionary history. **(3.D.1)** • Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling. **(3.D.2)** • Signal transduction pathways link signal reception with cellular response. **(3.D.3)** • Changes in signal transduction pathways can alter cellular response. **(3.D.4)** • The structure and function of subcellular components, and their interactions, provide essential cellular processes. **(4.A.2)** • Cooperative interactions within organisms promote efficiency in the use of energy and matter. **(4.B.2)**	**ESSENTIAL QUESTIONS:** • How does surface area-to-volume ratio affect a biological system's ability to obtain necessary resources or eliminate waste products? • What properties of the cell membrane separate the internal environment of the cell from the external environment? • How does selective permeability relate to membrane structure, as described by the fluid mosaic model? • What are the differences between the cell wall and cell membrane? • What are the primary differences between active and passive transport? • What are the differences between endocytosis and exocytosis? • What is the significance of the internal and external cellular membranes having the same composition? • What are the similarities between eubacteria and arachaebacteria? • In fungi, protists and bacteria, how do internal and external signals regulate a variety of physiological responses? • What role does signal transmission have on gene expression? • What role does signal transmission have on cell function? • How does transduction of stimulatory or inhibitory signals from other cells, organisms or the environment affect communication? • How do signal transduction pathways influence how unicellular organisms respond to its environment? • How do signal transduction pathways coordinate the activities within individual cells that support the function of the organism as a whole? • What are the mechanisms of cellular communication? • How can conditions where signal transduction is blocked or defective be deleterious, preventative or prophylactic? • What are the roles of the following organelles in cellular physiology? • Ribosomes • Endoplasmic Reticulum (Smooth and Rough) • Golgi Complex • Mitochondria • Lysosomes • Vacuole

	• Chloroplasts		
WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?			
Standards, Concepts, Content, Skills, Products, Vocabulary			
REFERENCE/STANDARD i.*e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 3.1.B.a-b.	**Organisms progress through life cycles unique to different types of organisms** **a. Recognize cells both increase in number and differentiate, becoming specialized in structure and function, during and after embryonic development** **b. * Identify factors (e.g., biochemical, temperature) that may affect the differentiation of cells and the development of an organism**	x	
CLE *3.1.C.a-b.*	**Cells are the fundamental units of structure and function of all living things** **a. * Recognize all organisms are composed of cells, the fundamental units of structure and function** **b. Describe the structure of cell parts (e.g., cell wall, cell membrane, cytoplasm, nucleus, chloroplast, mitochondrion, ribosome, vacuole) found in different types of cells (e.g., bacterial, plant, skin, nerve, blood, muscle) and the functions they perform (e.g., structural support, transport of materials, storage of genetic information, photosynthesis and respiration, synthesis of new molecules, waste disposal) that are necessary to the survival of the cell and organism**	x	
CLE *3.1.D*	**Plants and animals have different structures that serve similar functions necessary for the survival of the organism**		x
CLE *3.2.A.a-c.*	**The cell contains a set of structures called organelles that interact to carry out life processes through physical and chemical means** **a. *Compare and contrast the structure and function of mitochondria and chloroplasts** **b. *Compare and contrast the structure and function of cell wall and cell membranes** **c. Explain physical and chemical interactions that occur between organelles (e.g. nucleus, cell membrane, chloroplast, mitochondrion, ribosome) as they carry out life processes**	x	
CLE *3.2.B.a-b.*	**Photosynthesis and cellular respiration are complementary processes necessary to the survival of most organisms on Earth** **a. Explain the interrelationship between the processes of photosynthesis and cellular respiration (e.g., recycling of oxygen and carbon dioxide), comparing and contrasting photosynthesis and cellular respiration reactions (Do NOT assess intermediate reactions)** **b Determine what factors affect the processes of photosynthesis and cellular respiration (i.e., light intensity, availability of reactants, temperature)**	x	
CLE *3.2.D.a-e.*	**Cells carry out chemical transformations that use energy for the synthesis or breakdown of organic compounds** **a. Summarize how energy transfer occurs during photosynthesis and cellular respiration as energy is stored in and released from the bonds of chemical compounds (i.e. ATP)** **b. * Relate the structure of organic compounds (e.g., proteins, nucleic acids, lipids, carbohydrates) to their role in living systems** **c. * Recognize energy is absorbed or released in the breakdown and/or synthesis of organic compounds** **d. * Explain how protein enzymes affect chemical reactions (e.g., the breakdown of food molecules, growth and repair, regulation)** **e. * Interpret a data table showing the effects of an enzyme on a biochemical reaction**	x	
CLE *3.2.E.a-b.*	**Protein structure and function are coded by the DNA (Deoxyribonucleic acid) molecule**	x	

	a. Explain how the DNA code determines the sequence of amino acids necessary for protein synthesis b. * Recognize the function of protein in cell structure and function (i.e., enzyme action, growth and repair of body parts, regulation of cell division and differentiation)		
CLE 3.*2.F.a-c.*	Cellular activities and responses can maintain stability internally while external conditions are changing (homeostasis) a. Explain the significance of the selectively permeable membrane to the transport of molecules b. Predict the movement of molecules across a selectively permeable membrane (i.e., diffusion, osmosis, active transport) needed for a cell to maintain homeostasis given concentration gradients and different sizes of molecules c. Explain how water is important to cells (e.g., is a buffer for body temperature, provides soluble environment for chemical reactions, serves as a reactant in chemical reactions, provides hydration that maintains cell turgidity, maintains protein shape)	x	
CLE *3.3.B.a*	All living organisms have genetic material (DNA) that carries hereditary information a. Describe the chemical and structural properties of DNA (e.g., DNA is a large polymer formed from linked subunits of four kinds of nitrogen bases; genetic information is encoded in genes based on the sequence of subunits; each DNA molecule in a cell forms a single chromosome) (Assess the concepts – NOT memorization of nitrogen base pairs)	x	
CLE *3.3.D.a*	There is heritable variation within every species of organism a. Describe the advantages and disadvantages of asexual and sexual reproduction with regard to variation within a population	x	
CLE *8.2.B.b*	Scientific theories are developed based on the body of knowledge that exists at any particular time and must be rigorously questioned and tested for validity a. *Identify and analyze current theories that are being questioned, and compare them to new theories that have emerged to challenge older ones (e.g., theories of evolution, extinction, global warming)		x
CLE *8.3.B.c*	Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology *Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, use of alternative energies for carbon fuels, use of pesticides		x
CLE 7.1.A.a-g.	Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation a. Formulate testable questions and hypotheses b. Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment c. Design and conduct a valid experiment d. Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature) e. *Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources,		x

	and/or technologies f. *Acknowledge there is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations Evaluate the design of an experiment and make suggestions for reasonable improvements		
CLE 7.1.B.a-f.	**Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations** a. *Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) b. Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second c. Determine the appropriate tools and techniques to collect, analyze, and interpret data d. Judge whether measurements and computation of quantities are reasonable e. Calculate the range, average/mean, percent, and ratios for sets of data *Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)		x
7.1.C.a-d.	**Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings)** a. Use quantitative and qualitative data as support for reasonable explanations (conclusions) b. Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable) c. Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)		x
CLE 7.1.D.a-c.	**The nature of science relies upon communication of results and justification of explanations** a. Communicate the procedures and results of investigations and explanations through: ¨ oral presentations ¨ drawings and maps ¨ data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ¨ graphs (bar, single, and multiple line) ¨ equations and writings b. * Communicate and defend a scientific argument Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can		x

	influence the decisions regarding future scientific work)		
CLE 8.3.C.a-c.	**Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent** **a. *Identify and evaluate the need for informed consent in experimentation** **b. *Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment)** **c. *Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)**		x
CLE 8.3.D.a-b.	**Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible** **a. *Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a scientist speaking within or outside his/her area of expertise)** *** Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society**		x

<table>
<tr><td colspan="2">OBJECTIVE # 3</td><td></td></tr>
<tr><td colspan="2">REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS</td><td>• Missouri State Course Level Expectations</td></tr>
<tr><td colspan="3">WHAT SHOULD STUDENTS…</td></tr>
<tr><td>UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.</td><td>KNOW?
Facts, Names, Dates, Places, Information,
ACADEMIC VOCABULARY</td><td>BE ABLE TO DO?
Skills; Products</td></tr>
<tr><td>Evidence of student learning is a demonstrated understanding of the following:
• As cells increase in volume, the relative surface area decreases and demand for material resources increases; more cellular structures are necessary to adequately exchange materials and energy with the environment. These limitations restrict cell size.
• The surface area of the plasma membrane must be large enough to adequately exchange materials; smaller cells have a more favorable surface area-to-volume ratio for exchange of materials with the environment.
• Cell membranes consist of a structural framework of phospholipid molecules, embedded proteins, cholesterol, glycoproteins and glycolipids.
• Phospholipids give the membrane both hydrophilic and hydrophobic properties. The hydrophilic phosphate portions of the phospholipids are oriented toward the aqueous external or internal environments, while the hydrophobic fatty acid portions face each other within the interior of the membrane itself.
• Embedded proteins can be hydrophilic, with charged and polar side groups, or hydrophobic, with nonpolar side groups.
• Small, uncharged polar molecules and small nonpolar molecules, such as N_2, freely pass across the membrane. Hydrophilic substances such as large polar molecules and ions move across the membrane through embedded channel and transport proteins. Water moves across membranes and through channel proteins called aquaporins.</td><td>• Accuracy
• Active Transport
• Amphipathic
• Apoptosis
• Aquaporin
• Carrier Protein
• Cell Wall
• Central Vacuole
• Centrioles
• Channel Protein
• Chi-Square
• Chloroplast
• Communication
• Concentration Gradient
• Constant
• Control
• Cyclic AMP
• Cytoplasm
• Cytoskeleton</td><td>Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems.
1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain.
1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain.
1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain.
1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively.</td></tr>
</table>

• Plant cell walls are made of cellulose and are external to the cell membrane. • Other examples are cells walls of prokaryotes and fungi. • Passive transport plays a primary role in the import of resources and the export of wastes. • Membrane proteins play a role in facilitated diffusion of charged and polar molecules through a membrane. • External environments can be hypotonic, hypertonic or isotonic to internal environments of cells. • Active transport is a process where free energy (often provided by ATP) is used by proteins embedded in the membrane to "move" molecules and/or ions across the membrane and to establish and maintain concentration gradients. • Membrane proteins are necessary for active transport. • In exocytosis, internal vesicles fuse with the plasma membrane to secrete large macromolecules out of the cell. • In endocytosis, the cell takes in macromolecules and particulate matter by forming new vesicles derived from the plasma membrane. • Endocrine signals are produced by endocrine cells that release signaling molecules, which are specific and can travel long distances through the blood to reach all parts of the body. • Different receptors recognize different chemical messengers, which can be peptides, small chemicals or proteins, in a specific one-to-one relationship. • A receptor protein recognizes signal molecules, causing the receptor protein's shape to change, which initiates transduction of the signal. • Signaling cascades relay signals from receptors to cell targets, often amplifying the incoming signals, with the result of appropriate responses by the cell. • Second messengers are often essential to the function of the cascade. • Many signal transduction pathways include: • Protein modifications (an illustrative example could be how methylation changes the signaling process) • Phosphorylation cascades in which a series of protein kinases add a phosphate group to the next protein in the cascade sequence. • Rough endoplasmic reticulum functions to compartmentalize the cell, serves as mechanical support, provides site-specific protein synthesis with membrane-bound ribosomes and plays a role in intracellular transport. • In most cases, smooth ER synthesizes lipids. • Functions of the Golgi include synthesis and packaging of materials (small molecules) for transport (in vesicles), and production of lysosomes. • Mitochondria have a double membrane that allows compartmentalization within the mitochondria and is important to its function. • The outer membrane is smooth, but the inner membrane is highly convoluted, forming folds called cristae.	• Deductive Reasoning • Dependent Variable • Diffusion • Electron Microscope • Endocytosis • Endoplasmic Reticulum • Eukaryotic Cell • Exocytosis • Facilitated Diffusion • Flagella • Fluid Mosaic Model • Glycolipid • Glycoprotein • Golgi Apparatus • G-Protein Linked Receptor • Graph • Hormone • Hypertonic • Hypothesis • Independent Variable • Inductive Reasoning • Ion Pump • Isotonic • Ligand • Light Microscope • Lysosome • Magnification • Mean • Median • Membrane • Mitochondrion • Model • Necrosis • Nuclear Envelope • Nuclear Pore • Nucleus • Observation • Organelles • Osmosis • Passive Tansport • Phagocytosis	1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain. Science Practice 2: The student can use mathematics appropriately. 2.1 The student can justify the selection of a mathematical routine to solve problems. 2.2 The student can apply mathematical routines to quantities that describe natural phenomena. 2.3 The student can estimate numerically quantities that describe natural phenomena. Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course. 3.1 The student can pose scientific questions. 3.2 The student can refine scientific questions. 3.3 The student can evaluate scientific questions. Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question. 4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question. 4.2 The student can design a plan for collecting data to answer a particular scientific question. 4.3 The student can collect data to answer a particular scientific question. 4.4 The student can evaluate sources of data to answer a

• Cristae contain enzymes important to ATP production; cristae also increase the surface area for ATP production. • The structure and function relationship in the chloroplast allows cells to capture the energy available in sunlight and convert it to chemical bond energy via photosynthesis. • Chloroplasts contain chlorophylls, which are responsible for the green color of a plant and are the key light-trapping molecules in photosynthesis. There are several types of chlorophyll, but the predominant form in plants is chlorophyll *a*. • Chloroplasts have a double outer membrane that creates a compartmentalized structure, which supports its function. Within the chloroplasts are membrane-bound structures called thylakoids. Energy capturing reactions housed in the thylakoids are organized in stacks, called “grana,” to produce ATP and $NADPH_2$, which fuel carbon-fixing reactions in the Calvin-Benson cycle. Carbon fixation occurs in the stroma, where molecules of CO_2 are converted to carbohydrates. • At the cellular level, the plasma membrane, cytoplasm and, for eukaryotes, the organelles contribute to the overall specialization and functioning of the cell. • Interactions among cells of a population of unicellular organisms can be similar to those of multicellular organisms, and these interactions lead to increased efficiency and utilization of energy and matter.	• Phospholipid • Phosphorylation Cascade • Pinocytosis • Plasma Membrane • Plasmolysis • Precision • Prediction • Prokaryotic Cell • Protein Kinase • Quorum Sensing • Rate • Receptor • Resolution • Ribosome • Rough ER • Scientific Method • Secondary Messenger • Selectively Permeable • Signal Cascade • Signal Tranduction • Smooth ER • Surface Area to Volume Ratio • Table • Transmembrane Protein • Trend • Turgor Pressure • Variable	particular scientific question Science Practice 5: The student can perform data analysis and evaluation of evidence. 5.1 The student can analyze data to identify patterns or relationships. 5.2 The student can refine observations and measurements based on data analysis. 5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question. Science Practice 6: The student can work with scientific explanations and theories. 6.1 The student can justify claims with evidence. 6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices. 6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced. 6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models. 6.5 The student can evaluate alternative scientific explanations. Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains. 7.1 The student can connect phenomena and models across spatial and temporal scales. 7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or

		across enduring understandings and/or big ideas.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Presentations** • **Video Presentations** • **Chapter Outlines** • **Guided Readings** • **Virtual Labs** • **Inquiry Labs** • **Microscope Lab**	• **Exposure to relevant material** • **Exposure to relevant material** • **Synthesis of relevant material** • **Synthesis of relevant material** • **Application of relevant material** • **Application of relevant material**	**2=Skill/Concept** **2=Skill/Concept** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **3=Strategic Thinking, 4=Extended Thinking** **3=Strategic Thinking, 4=Extended Thinking**
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Civics, History, Psychology, Mathematics, English	• Builds upon a general understanding of Biology I and Critical Thinking Strategies	• Conducting and Designing Inquiry Lab Investigations
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Section Quizzes** • **Virtual Labs** • **Inquiry Labs** • **Unit Tests**	Form Form/Summ Form/Summ Summ	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP • Test Corrections with written explanations • Lab Corrections with written explanations • Retesting on Unit Tests	• Students are presented information using different instructional strategies • Gathering an understanding of why their answers were incorrect	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking,**

• Writing their own test questions • Grading their own essays	• Students need a thorough understanding of the concepts to write or gade their own tests and essays	**4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AP Exam Multiple Choice Questions • AP Exam Free Response Questions • Designing Their Own Experiments • Conducting Additional Lab Investigations • Supplemental Research	• Be able to answer questions of an AP Exam • Apply knowledge toward extending on labs conducted in class • Apply knowledge toward conducting additional labs • Research additional ideas on applicable, relevant topics	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think**

UNIT TITLE: Evolution UNIT DURATION:	CONTENT AREA: Science COURSE: AP Biology

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• **Campbell/Reece AP Edition Biology** • **AP Biology Investigative Labs: An Inquiry-Based Approach**	**Big Idea 1: The process of evolution drives the diversity and unity of life.**
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**

• Natural selection is a major mechanism of evolution. **(1.A.1)**
• Natural selection acts on phenotypic variations in populations. **(1.A.2)**
• Evolutionary change is also driven by random processes. **(1.A.3)**
• Biological evolution is supported by scientific evidence from many disciplines, including mathematics. **(1.A.4)**
• Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today. **(1.B.1)**
• Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested. **(1.B.2)**
• Speciation and extinction have occurred throughout the Earth's history. **(1.C.1)**
• Speciation may occur when two populations become reproductively isolated from each other. **(1.C.2)**
• Populations of organisms continue to evolve. **(1.C.3)**
• There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence. **(1.D.1)**
• Scientific evidence from many different disciplines supports models of the origin of life. **(1.D.2)**
	• What is Darwin's theory of natural selection?
	• What determines evolutionary fitness?
	• What roles do genetic variation and mutation play roll in natural selection?
	• Why is a diverse gene pool important for the survival of a species in a changing environment?
	• How does environmental stability affect evolutionary rate and direction?
	• What is an adaptation and how does it manifest itself?
	• In addition to natural selection, chance and random events can influence the evolutionary process, especially for small populations.
	• What are the conditions for a population or an allele to be in Hardy-Weinberg equilibrium?
	• What mathematical approaches are used to calculate changes in allele frequency?
	• What drives phenotypic variation?
	• How do phenotypic variations significantly increase or decrease fitness of the organism and the population?
	• What role do humans play in variation of other species?
	• Why does genetic drift tend to occur in small populations?
	    • What evidence supports the relatedness of all domains?
	    • What information is used to construct phylogenetic trees and cladograms, and what information can be deciphered from them?
	• What affects rates of speciation?
	• How does ecological stress affect extinction rates?
	• What pre and post-zygotic mechanisms maintain reproductive isolation and prevent gene flow?
	• What evidence is there supporting evolution?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.e. *GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 3.1.E.a-b.	**Biological classifications are based on how organisms are related** **a. * Explain how similarities used to group taxa might reflect evolutionary relationships (e.g., similarities in DNA and protein structures, internal anatomical features, patterns of development)**	x	

	b. * Explain how and why the classification of any taxon might change as more is learned about the organisms assigned to that taxon		
CLE 3.2.A.a-c.	The cell contains a set of structures called organelles that interact to carry out life processes through physical and chemical means a. *Compare and contrast the structure and function of mitochondria and chloroplasts b. *Compare and contrast the structure and function of cell wall and cell membranes c. Explain physical and chemical interactions that occur between organelles (e.g. nucleus, cell membrane, chloroplast, mitochondrion, ribosome) as they carry out life processes		X
CLE 3.2.B.a-b.	Photosynthesis and cellular respiration are complementary processes necessary to the survival of most organisms on Earth a. Explain the interrelationship between the processes of photosynthesis and cellular respiration (e.g., recycling of oxygen and carbon dioxide), comparing and contrasting photosynthesis and cellular respiration reactions (Do NOT assess intermediate reactions) b. Determine what factors affect the processes of photosynthesis and cellular respiration (i.e., light intensity, availability of reactants, temperature)		X
CLE 3.3.D.a	There is heritable variation within every species of organism a. Describe the advantages and disadvantages of asexual and sexual reproduction with regard to variation within a population		X
CLE 4.1.B.b	Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite a *Predict how populations within an ecosystem may change in number and/or structure in response to hypothesized changes in biotic and/or abiotic factors		X
CLE 4.3.A.a-b.	Evidence for the nature and rates of evolution can be found in anatomical and molecular characteristics of organisms and in the fossil record a. *Interpret fossil evidence to explain the relatedness of organisms using the principles of superposition and fossil correlation b *Evaluate the evidence that supports the theory of biological evolution (e.g., fossil records, similarities between DNA and protein structures, similarities between developmental stages of organisms, homologous and vestigial structures)		X
CLE 4.3.C.a-d.	Natural selection is the process of sorting individuals based on their ability to survive and reproduce within their ecosystem a. Identify examples of adaptations that may have resulted from variations favored by natural selection (e.g., long-necked giraffes, long-eared jack rabbits) and describe how that variation may have provided populations an advantage for survival b. *Explain how genetic homogeneity may cause a population to be more susceptible to extinction (e.g., succumbing to a disease for which there is no natural resistance) c. Explain how environmental factors (e.g., habitat loss, climate change, pollution, introduction of non-native species) can be agents of natural selection d. *Given a scenario describing an environmental change, hypothesize why a given species was unable to survive	X	
CLE 5.2.D	Changes in the Earth over time can be inferred through rock and fossil evidence	X	
CLE 8.2.B.b	Scientific theories are developed based on the body of knowledge that exists at any particular time and must be rigorously questioned and tested for validity b. *Identify and analyze current theories that are being questioned, and compare them to new theories that have emerged to challenge older ones (e.g., theories of evolution, extinction, global warming)		X
CLE 8.3.B.b-c.	Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology a. *Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research) b. *Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, use of alternative energies for carbon fuels, use of pesticides		X
CLE 7.1.A.a-g.	Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation a. Formulate testable questions and hypotheses b. Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment		x

	c. Design and conduct a valid experiment d. Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature) e. *Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies f. *Acknowledge there is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations Evaluate the design of an experiment and make suggestions for reasonable improvements		
CLE 7.1.B.a-f.	Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations a. *Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) b. Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second c. Determine the appropriate tools and techniques to collect, analyze, and interpret data d. Judge whether measurements and computation of quantities are reasonable e. Calculate the range, average/mean, percent, and ratios for sets of data *Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)		x
7.1.C.a-d.	Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) a. Use quantitative and qualitative data as support for reasonable explanations (conclusions) b. Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable) c. Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)		x
CLE 7.1.D.a-c.	The nature of science relies upon communication of results and justification of explanations a. Communicate the procedures and results of investigations and explanations through: ¨ oral presentations ¨ drawings and maps ¨ data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ¨ graphs (bar, single, and multiple line) ¨ equations and writings b. * Communicate and defend a scientific argument Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work)		x
CLE 8.3.C.a-c.	Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent a. *Identify and evaluate the need for informed consent in experimentation b. *Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment) c. *Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)		x
CLE 8.3.D.a-b.	Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible a. *Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a		x

	scientist speaking within or outside his/her area of expertise) *** Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society**		

OBJECTIVE # 4		
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• Missouri State Course Level Expectations	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
***Evidence of student learning** is a demonstrated understanding of the following:* • Fossils can be dated by a variety of methods that provide evidence for evolution. These include the age of the rocks where a fossil is found, the rate of decay of isotopes including carbon-14, the relationships within phylogenetic trees, and the mathematical calculations that take into account information from chemical properties and/or geographical data. • Morphological homologies represent features shared by common ancestry. Vestigial structures are remnants of functional structures, which can be compared to fossils and provide evidence for evolution. • Biochemical and genetic similarities, in particular DNA nucleotide and protein sequences, provide evidence for evolution and ancestry. • Mathematical models and simulations can be used to illustrate and support evolutionary concepts. • Phenotypic variations are not directed by the environment but occur through random changes in the DNA and through new gene combinations. • Some phenotypic variations significantly increase or decrease fitness of the organism and the population. • DNA and RNA are carriers of genetic information through transcription, translation and replication. • Major features of the genetic code are shared by all modern living systems. • Metabolic pathways are conserved across all currently recognized domains. • Primitive Earth provided inorganic precursors from which organic molecules could have been synthesized due to the presence of available free energy and the absence of a significant quantity of oxygen. • In turn, these molecules served as monomers or building blocks for the formation of more complex molecules, including amino acids and nucleotides. • The joining of these monomers produced polymers with the ability to replicate, store and transfer information. • These complex reaction sets could have occurred in solution (organic soup model) or as reactions on solid reactive surfaces.	• Accuracy • Adaptation • Allele • Allopatric • Analogous Structure • Artificial Selection • Biogeography • Biological Species • Chi-Square • Cladogensis • Coevolution • Common Ancestor • Constant • Control • Convergent Evolution • Darwin • Deductive Reasoning • Dependent Variable • Directional Selection • Disruptive Selection • Divergent Evolution • Endosymbiosis • Epoch • Evolution • Extinction • Fitness	Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems. 1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain. 1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain. 1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain. 1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively. 1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain. Science Practice 2: The student can use mathematics appropriately. 2.1 The student can justify the selection of a mathematical routine to solve problems. 2.2 The student can apply mathematical routines to quantities

• The RNA World hypothesis proposes that RNA could have been the earliest genetic material. • The Earth formed approximately 4.6 billion years ago (bya), and the environment was too hostile for life until 3.9 bya, while the earliest fossil evidence for life dates to 3.5 bya. Taken together, this evidence provides a plausible range of dates when the origin of life could have occurred. • Chemical experiments have shown that it is possible to form complex organic molecules from inorganic molecules in the absence of life. • Scientific evidence includes molecular building blocks that are common to all life forms. • Scientific evidence includes a common genetic code.	• Fossils • Founder Effect • Gene Flow • Gene Pool • Genetic Bottleneck • Genetic Drift • Genetic Equilibrium • Genetic Variation • Genotype • Geologic Time • Geology • Gradualism • Graph • Hardy-Weinberg Equation • Homologous Structures • Homology • Hybrid • Hypothesis • Independent Variable • Inductive Reasoning • Mean • Median • Migration • Miller-Urey • Model • Mutation • Natural Selection • Observation • Paleontology • Phenotype • Phylogeny • Polymorphism • Polyploidy • Population • Postzygotic Isolating Mechanism	that describe natural phenomena. 2.3 The student can estimate numerically quantities that describe natural phenomena. Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course. 3.1 The student can pose scientific questions. 3.2 The student can refine scientific questions. 3.3 The student can evaluate scientific questions. Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question. 4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question. 4.2 The student can design a plan for collecting data to answer a particular scientific question. 4.3 The student can collect data to answer a particular scientific question. 4.4 The student can evaluate sources of data to answer a particular scientific question Science Practice 5: The student can perform data analysis and evaluation of evidence. 5.1 The student can analyze data to identify patterns or relationships. 5.2 The student can refine observations and measurements based on data analysis. 5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question.

	• Precision • Prediction • Prezygotic Isolating Mechanism • Primordial • Radiometric Dating • Random Mating • Rate • Relative Dating • Reproductive Isolation • Scientific Method • Speciation • Species • Stabilizing Selection • Strata • Sympatric • Table • Transitional Fossil • Trend • Variable • Vestigial Structure	Science Practice 6: The student can work with scientific explanations and theories. 6.1 The student can justify claims with evidence. 6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices. 6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced. 6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models. 6.5 The student can evaluate alternative scientific explanations. Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains. 7.1 The student can connect phenomena and models across spatial and temporal scales. 7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.

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INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AP Exam Multiple Choice Questions • AP Exam Free Response Questions • Designing Their Own Experiments • Conducting Additional Lab Investigations • Supplemental Research	• Be able to answer questions of an AP Exam • Apply knowledge toward extending on labs conducted in class • Apply knowledge toward conducting additional labs • Research additional ideas on applicable, relevant topics	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think**

UNIT TITLE: Cellular Energy UNIT DURATION:	CONTENT AREA: Science COURSE: AP Biology

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT: • **Campbell/Reece AP Edition Biology** • **AP Biology Investigative Labs: An Inquiry-Based Approach**	**BIG IDEA(S):** **Big Idea 1: The process of evolution drives the diversity and unity of life.** **Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.** **Big Idea 3: Living systems store, retrieve, transmit, and respond to information essential to life processes.** **Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.**
ENDURING UNDERSTANDINGS: Organisms capture and store free energy for use in biological processes. **(2.A.2)** All living systems require constant input of free energy. **(2.A.1)**	**ESSENTIAL QUESTIONS:** • What are the differences between entropy and enthalpy? • How do organisms utilize free energy? • What are the differences between energy-harvesting mechanisms between autotrophs and heterotrophs? • What is the role of electron acceptors in the energy harvesting process? • What are the roles of light-dependent and light-independent reactions in photosynthesis? • What evidence is there to support that photosynthesis first evolved in prokaryotes? • What are the steps of cellular respiration in eukaryotes? • What is the role of the electron transport chain in establishing an electrochemical gradient across membranes? • How is free energy from ATP utilized in metabolic processes?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 1.1.A	**Objects, and the materials they are made of, have properties that can be used to describe and classify them**	X	
CLE 1.1.D	**Physical changes in states of matter due to thermal changes in materials can be explained by the Kinetic Theory of Matter**	X	
CLE 1.1.I.a	**Mass is conserved during any physical or chemical change** *** Compare the mass of the reactants to the mass of the products in a chemical reaction or physical change (e.g., biochemical processes, carbon dioxide-oxygen cycle, nitrogen cycle, decomposition and synthesis reactions involved in a food web) as support for the Law of Conservation of Mass**	X	
CLE 1.2.B	**Mechanical energy comes from the motion (kinetic energy) and/or relative position (potential energy) of an object**		X
CLE 1.2.F.a	**Energy can be transferred within a system as the total amount of energy remains constant (i.e., Law of Conservation of Energy)** **a. * Classify the different ways to store energy (i.e., chemical, nuclear, thermal, mechanical, electromagnetic) and describe the transfer of energy as it changes from kinetic to potential, while the total amount of energy remains constant, within a system (e.g., biochemical processes, carbon dioxide-oxygen cycle, nitrogen cycle, food web)**		X
CLE 2.2.F	**Work transfers energy into and out of a mechanical system**	X	
CLE 3.1.C.a-b.	**Cells are the fundamental units of structure and function of all living things** **a. * Recognize all organisms are composed of cells, the fundamental units of structure and function** **b. Describe the structure of cell parts (e.g., cell wall, cell membrane, cytoplasm, nucleus, chloroplast, mitochondrion, ribosome, vacuole) found in different types of cells (e.g., bacterial, plant, skin, nerve, blood,**	X	

	muscle) and the functions they perform (e.g., structural support, transport of materials, storage of genetic information, photosynthesis and respiration, synthesis of new molecules, waste disposal) that are necessary to the survival of the cell and organism		
CLE 3.2.A.a-c.	The cell contains a set of structures called organelles that interact to carry out life processes through physical and chemical means a. *Compare and contrast the structure and function of mitochondria and chloroplasts b. *Compare and contrast the structure and function of cell wall and cell membranes c. Explain physical and chemical interactions that occur between organelles (e.g. nucleus, cell membrane, chloroplast, mitochondrion, ribosome) as they carry out life processes	X	
CLE 3.2.B.a-b.	Photosynthesis and cellular respiration are complementary processes necessary to the survival of most organisms on Earth a. Explain the interrelationship between the processes of photosynthesis and cellular respiration (e.g., recycling of oxygen and carbon dioxide), comparing and contrasting photosynthesis and cellular respiration reactions (Do NOT assess intermediate reactions) Determine what factors affect the processes of photosynthesis and cellular respiration (i.e., light intensity, availability of reactants, temperature)	X	
CLE 3.2.C	Complex multicellular organisms have systems that interact to carry out life processes through physical and chemical means	X	
CLE 3.2.D.a-e.	Cells carry out chemical transformations that use energy for the synthesis or breakdown of organic compounds a. Summarize how energy transfer occurs during photosynthesis and cellular respiration as energy is stored in and released from the bonds of chemical compounds (i.e. ATP) b. * Relate the structure of organic compounds (e.g., proteins, nucleic acids, lipids, carbohydrates) to their role in living systems c. * Recognize energy is absorbed or released in the breakdown and/or synthesis of organic compounds d. * Explain how protein enzymes affect chemical reactions (e.g., the breakdown of food molecules, growth and repair, regulation) e. * Interpret a data table showing the effects of an enzyme on a biochemical reaction	X	
CLE 3.2.F.a-c.	Cellular activities and responses can maintain stability internally while external conditions are changing (homeostasis) a. Explain the significance of the selectively permeable membrane to the transport of molecules b. Predict the movement of molecules across a selectively permeable membrane (i.e., diffusion, osmosis, active transport) needed for a cell to maintain homeostasis given concentration gradients and different sizes of molecules c. Explain how water is important to cells (e.g., is a buffer for body temperature, provides soluble environment for chemical reactions, serves as a reactant in chemical reactions, provides hydration that maintains cell turgidity, maintains protein shape)	X	
CLE 5.2.F	Climate is a description of average weather conditions in a given area due to the transfer of energy and matter through Earth's systems		X
CLE 6.1.A	The Earth, Sun, and moon are part of a larger system that includes other planets and smaller celestial bodies		X
CLE 6.1.C	Most of the information we know about the universe comes from the electromagnetic spectrum		X
CLE 7.1.A.a-g.	Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation a. Formulate testable questions and hypotheses b. Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment c. Design and conduct a valid experiment d. Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature) e. *Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies f. *Acknowledge there is no fixed procedure called "the scientific method", but that some investigations involve		x

	systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations g. Evaluate the design of an experiment and make suggestions for reasonable improvements		
CLE 7.1.B.a-f.	Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations a. *Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) b. Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second c. Determine the appropriate tools and techniques to collect, analyze, and interpret data d. Judge whether measurements and computation of quantities are reasonable e. Calculate the range, average/mean, percent, and ratios for sets of data f. *Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)		x
7.1.C.a-d.	Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) a. Use quantitative and qualitative data as support for reasonable explanations (conclusions) b. Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable) c. Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) d. Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)		x
CLE 7.1.D.a-c.	The nature of science relies upon communication of results and justification of explanations a. Communicate the procedures and results of investigations and explanations through: ¨ oral presentations ¨ drawings and maps ¨ data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ¨ graphs (bar, single, and multiple line) ¨ equations and writings b. * Communicate and defend a scientific argument c. Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work)		x
CLE 8.3.C.a-c.	Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent a. *Identify and evaluate the need for informed consent in experimentation b. *Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment) c. *Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)		x
CLE 8.3.D.a-b.	Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible a. *Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a scientist speaking within or outside his/her area of expertise) b. * Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society		x

OBJECTIVE # 5		
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• Missouri State Course Level Expectations	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information,* *ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
***Evidence of student learning** is a demonstrated understanding of the following:* • Order is maintained by constant free energy input into the system. • Loss of order or free energy results in death. • Increased disorder and entropy are offset by biological processes that maintain or increase order. • Order is maintained by coupling cellular processes that increase entropy (and so have negative changes in free energy) with those that decrease entropy (and so have positive changes in free energy). • Energy input must exceed free energy lost to entropy to maintain order and power cellular processes. • Energetically favorable exergonic reactions, such as ATP → ADP, that have a negative change in free energy can be used to maintain or increase order in a system by being coupled with reactions that have a positive free energy change. • Reproduction and rearing of offspring require free energy beyond that used for maintenance and growth. Different organisms use various reproductive strategies in response to energy availability. • There is a relationship between metabolic rate per unit body mass and the size of multicellular organisms — generally, the smaller the organism, the higher the metabolic rate. • Excess acquired free energy versus required free energy expenditure results in energy storage or growth. • Insufficient acquired free energy versus required free energy expenditure results in loss of mass and, ultimately, the death of an organism. • Photosynthetic organisms capture free energy present in sunlight. • Chemosynthetic organisms capture free energy from small inorganic molecules present in their environment, and this process can occur in the absence of oxygen. • Heterotrophs may metabolize carbohydrates, lipids and proteins by hydrolysis as sources of free energy. • Fermentation produces organic molecules, including alcohol and lactic acid, and it occurs in the absence of oxygen. • During photosynthesis, chlorophylls absorb free energy from light, boosting electrons to a higher energy level in Photosystems I and II. • Photosystems I and II are embedded in the internal membranes of chloroplasts (thylakoids) and are connected by the transfer of higher free energy electrons through an	• Absorption Spectrum • Accessory Pigment • Accuracy • Acetyl CoA • Action Spectrum • Activation Energy • Active Site • Allosteric Regulation • Anabolism • Anaerobic Respiration • ATP • Autotroph • Calvin Cycle • Catabolism • Catalyst • Cellular Respiration • Chemiosmosis • Chemoautotroph • Chi-Square • Chlorophyll • Chloroplast • Coenzyme • Cofactor • Compartmentalization • Constant • Consumer • Control • Deductive Reasoning	Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems. 1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain. 1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain. 1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain. 1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively. 1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain. Science Practice 2: The student can use mathematics appropriately. 2.1 The student can justify the selection of a mathematical routine to solve problems. 2.2 The student can apply mathematical routines to quantities that describe natural phenomena. 2.3 The student can estimate numerically quantities that describe

electron transport chain (ETC). • When electrons are transferred between molecules in a sequence of reactions as they pass through the ETC, an electrochemical gradient of hydrogen ions (protons) across the thykaloid membrane is established. • The formation of the proton gradient is a separate process, but it is linked to the synthesis of ATP from ADP and inorganic phosphate via ATP synthase. • The energy captured in the light reactions as ATP and NADPH powers the production of carbohydrates from carbon dioxide in the Calvin cycle, which occurs in the stroma of the chloroplast. • Glycolysis rearranges the bonds in glucose molecules, releasing free energy to form ATP from ADP and inorganic phosphate, and resulting in the production of pyruvate. • Pyruvate is transported from the cytoplasm to the mitochondrion, where further oxidation occurs. • In the Krebs cycle, carbon dioxide is released from organic intermediates ATP is synthesized from ADP and inorganic phosphate via substrate level phosphorylation and electrons are captured by coenzymes. • Electrons that are extracted in the series of Krebs cycle reactions are carried by NADH and FADH2 to the electron transport chain. • Electron transport chain reactions occur in chloroplasts (photosynthesis), mitochondria (cellular respiration) and prokaryotic plasma membranes. • In cellular respiration, electrons delivered by NADH and FADH2 are passed to a series of electron acceptors as they move toward the terminal electron acceptor, oxygen. In photosynthesis, the terminal electron acceptor is NADP+. • The passage of electrons is accompanied by the formation of a proton gradient across the inner mitochondrial membrane or the thylakoid membrane of chloroplasts, with the membrane(s) separating a region of high proton concentration from a region of low proton concentration. In prokaryotes, the passage of electrons is accompanied by the outward movement of protons across the plasma membrane. • The flow of protons back through membrane-bound ATP synthase by chemiosmosis generates ATP from ADP and inorganic phosphate. • In cellular respiration, decoupling oxidative phosphorylation from electron transport is involved in thermoregulation.	• Denaturation • Dependent Variable • Electron Flow • Electron Transport Chain • Endergonic Reaction • Entropy • Exergonic Reaction • Feedback Inhibition • Fermentation • Glycolysis • Graph • Heterotroph • Hypothesis • Independent Variable • Inductive Reasoning • Kreb's Cycle • Light-Dependent Reaction • Light-Independent Reaction • Mean • Median • Metabolic Pathway • Mitochondrion • Model • NAD • NADP • Negative Feedback • Observation • Oxidative Phosphorylation • Photolysis • Photosynthesis • Positive Feedback • Precision • Prediction • Rate • RUBISCO	natural phenomena. Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course. 3.1 The student can pose scientific questions. 3.2 The student can refine scientific questions. 3.3 The student can evaluate scientific questions. Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question. 4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question. 4.2 The student can design a plan for collecting data to answer a particular scientific question. 4.3 The student can collect data to answer a particular scientific question. 4.4 The student can evaluate sources of data to answer a particular scientific question Science Practice 5: The student can perform data analysis and evaluation of evidence. 5.1 The student can analyze data to identify patterns or relationships. 5.2 The student can refine observations and measurements based on data analysis. 5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question. Science Practice 6: The student can work with scientific explanations and theories.

	• Scientific Method • Substrate-Level Phosphorylation • Table • Thylakoid Membrane • Trend • Variable	6.1 The student can justify claims with evidence. 6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices. 6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced. 6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models. 6.5 The student can evaluate alternative scientific explanations. Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains. 7.1 The student can connect phenomena and models across spatial and temporal scales. 7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)

• **Presentations**
• **Video Presentations**
• **Chapter Outlines**
• **Guided Readings**
• **Virtual Labs**
• **Inquiry Labs**
    • **Energy Dynamics**
    • **Cellular Respiration Lab**
    • **Root Beer Lab**
	• **Exposure to relevant material**
	• **Exposure to relevant material**
	• **Synthesis of relevant material**
	• **Synthesis of relevant material**
	• **Application of relevant material**
	• **Application of relevant material**
		2=Skill/Concept
		2=Skill/Concept
		2=Skill/Concept, 3=Strategic Thinking
		2=Skill/Concept, 3=Strategic Thinking
		3=Strategic Thinking, 4=Extended Thinking
		3=Strategic Thinking, 4=Extended Thinking

• **Plant Pigment and Photosynthesis**		
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Civics, History, Psychology, Mathematics, English	• Builds upon a general understanding of Biology I and Critical Thinking Strategies	• Conducting and Designing Inquiry Lab Investigations
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Section Quizzes** • **Virtual Labs** • **Inquiry Labs** • **Unit Tests**	Form Form/Summ Form/Summ Summ	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP • Test Corrections with written explanations • Lab Corrections with written explanations • Retesting on Unit Tests • Writing their own test questions • Grading their own essays	• Students are presented information using different instructional strategies • Gathering an understanding of why their answers were incorrect • Students need a thorough understanding of the concepts to write or gade their own tests and essays	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic

		Thinking, 4=Extended Thinking)
• AP Exam Multiple Choice Questions • AP Exam Free Response Questions • Designing Their Own Experiments • Conducting Additional Lab Investigations • Supplemental Research	• Be able to answer questions of an AP Exam • Apply knowledge toward extending on labs conducted in class • Apply knowledge toward conducting additional labs • Research additional ideas on applicable, relevant topics	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think**

UNIT TITLE: Cell Cycle, Mitosis, and Meiosis UNIT DURATION:	CONTENT AREA: Science COURSE: AP Biology

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• Campbell/Reece AP Edition Biology • AP Biology Investigative Labs: An Inquiry-Based Approach	Big Idea 3: Living systems store, retrieve, transmit, and respond to information essential to life processes. Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.
ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
• In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis or meiosis plus fertilization. (3.A.2) • The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring. (3.A.3) • Biological systems have multiple processes that increase genetic variation. (3.C.2) • Viral replication results in genetic variation, and viral infection can introduce genetic variation into the hosts. (3.C.3) • The level of variation in a population affects population dynamics. (4.C.3)	• What regulatory factors are part of the cell cycle? • What are the major differences between mitosis and meiosis? • What processes influence genetic variation during meiosis? • What genetic disorders can be attributed to the inheritance of single gene traits or specific chromosomal changes, such as nondisjunction? • What types of ethical, social, and medical issues surround human genetic disorders? • How does viral replication differ from other reproductive strategies? • How do the reproductive cycles of viruses facilitate transfer of genetic information? • How does genetic diversity allow individuals in a population to respond differently to the same changes in environmental conditions? • How is the Hardy-Weinberg equation a good model for determining allelic variation?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD i.e. GLE/CLE/MLS/NGSS	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 3.1.C.a-b.	Cells are the fundamental units of structure and function of all living things a. * Recognize all organisms are composed of cells, the fundamental units of structure and function b. Describe the structure of cell parts (e.g., cell wall, cell membrane, cytoplasm, nucleus, chloroplast, mitochondrion, ribosome, vacuole) found in different types of cells (e.g., bacterial, plant, skin, nerve, blood, muscle) and the functions they perform (e.g., structural support, transport of materials, storage of genetic information, photosynthesis and respiration, synthesis of new molecules, waste disposal) that are necessary to the survival of the cell and organism	x	
CLE 3.2.C	Complex multicellular organisms have systems that interact to carry out life processes through physical and chemical means	x	
CLE 3.2.E.a-b.	Protein structure and function are coded by the DNA (Deoxyribonucleic acid) molecule a. Explain how the DNA code determines the sequence of amino acids necessary for protein synthesis b. * Recognize the function of protein in cell structure and function (i.e., enzyme action, growth and repair of body parts, regulation of cell division and differentiation)	x	
CLE 3.3.A.a	Reproduction can occur asexually or sexually a. * Distinguish between asexual (i.e., binary fission, budding, cloning) and sexual reproduction	x	
CLE 3.3.B.a, c-e.	All living organisms have genetic material (DNA) that carries hereditary information a. Describe the chemical and structural properties of DNA (e.g., DNA is a large polymer formed from linked subunits of four kinds of nitrogen bases; genetic information is encoded in genes based on the sequence of subunits; each DNA molecule in a cell forms a single chromosome) (Assess the concepts – NOT memorization of nitrogen base pairs) c. * Recognize that degree of relatedness can be determined by comparing DNA sequences d. * Explain how an error in the DNA molecule (mutation) can be transferred during replication e. Identify possible external causes (e.g., heat, radiation, certain chemicals) and effects of DNA	x	

	mutations (e.g., altered proteins which may affect chemical reactions and structural development)		
CLE 3.3.C.a-d.	Chromosomes are components of cells that occur in pairs and carry hereditary information from one cell to daughter cells and from parent to offspring during reproduction a. Recognize the chromosomes of daughter cells, formed through the processes of asexual reproduction and mitosis, the formation of somatic (body) cells in multicellular organisms, are identical to the chromosomes of the parent cell b. Recognize that during meiosis, the formation of sex cells, chromosomes are reduced to half the number present in the parent cell c. Explain how fertilization restores the diploid number of chromosomes *Identify the implications of human sex chromosomes for sex determination	x	
CLE 3.3.D.a-c.	There is heritable variation within every species of organism a. Describe the advantages and disadvantages of asexual and sexual reproduction with regard to variation within a population b. * Describe how genes can be altered and combined to create genetic variation within a species (e.g., mutation, recombination of genes) * Recognize that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism’s sex cells	x	
CLE 8.3.B.c	Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology c. *Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, use of alternative energies for carbon fuels, use of pesticides		x
CLE 7.1.A.a-g.	Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation a. Formulate testable questions and hypotheses b. Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment c. Design and conduct a valid experiment d. Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature) e. *Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies f. *Acknowledge there is no fixed procedure called “the scientific method”, but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations Evaluate the design of an experiment and make suggestions for reasonable improvements		x
CLE 7.1.B.a-f.	Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations a. *Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) b. Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second c. Determine the appropriate tools and techniques to collect, analyze, and interpret data d. Judge whether measurements and computation of quantities are reasonable e. Calculate the range, average/mean, percent, and ratios for sets of data		x

	*Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)		
7.1.C.a-d.	Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) a. Use quantitative and qualitative data as support for reasonable explanations (conclusions) b. Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable) c. Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)		x
CLE 7.1.D.a-c.	The nature of science relies upon communication of results and justification of explanations a. Communicate the procedures and results of investigations and explanations through: ¨ oral presentations ¨ drawings and maps ¨ data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ¨ graphs (bar, single, and multiple line) ¨ equations and writings b. * Communicate and defend a scientific argument Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work)		x
CLE 8.3.C.a-c.	Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent a. *Identify and evaluate the need for informed consent in experimentation b. *Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment) c. *Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)		x
CLE 8.3.D.a-b.	Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible a. *Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an “eye witness”, a scientist speaking within or outside his/her area of expertise) b. * Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator’s credibility with other scientists and society		x

OBJECTIVE # 6		
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• Missouri State Course Level Expectations	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information,* *ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
***Evidence of student learning** is a demonstrated understanding of the following:* • Viruses have highly efficient replicative capabilities that allow for rapid evolution and acquisition of new phenotypes. • Viruses replicate via a component assembly model allowing one virus to produce many progeny simultaneously via the lytic cycle. • Virus replication allows for mutations to occur through usual host pathways. • RNA viruses lack replication error-checking mechanisms, and thus have higher rates of mutation. • Related viruses can combine/recombine information if they infect the same host cell. • HIV is a well-studied system where the rapid evolution of a virus within the host contributes to the pathogenicity of viral infection. • Viruses transmit DNA or RNA when they infect a host cell. • Some viruses are able to integrate into the host DNA and establish a latent (lysogenic) infection. These latent viral genomes can result in new properties for the host such as increased pathogenicity in bacteria. • Segregation and independent assortment can be applied to genes that are on different chromosomes. • Genes that are adjacent and close to each other on the same chromosome tend to move as a unit; the probability that they will segregate as a unit is a function of the distance between them. • Interphase consists of three phases: growth, synthesis of DNA, preparation for mitosis. • The cell cycle is directed by internal controls or checkpoints. Internal and external signals provide stop-and-go signs at the checkpoints. • Cyclins and cyclin-dependent kinases control the cell cycle. • Mitosis alternates with interphase in the cell cycle. • When a cell specializes, it often enters into a stage where it no longer divides, but it can reenter the cell cycle when given appropriate cues. Nondividing cells may exit the cell cycle; or hold at a particular stage in the cell cycle. • Mitosis occurs after DNA replication. • Mitosis followed by cytokinesis produces two genetically identical daughter	• Accuracy • Anaphase • Cancer • Cell Cycle • Cell Division • Cellular Differentiation • Centrioles • Chi-Square • Chromosome • Constant • Control • Crossing-Over • Crossing-Over Frequency • Cyclin-Dependent Kinase • Cytokinesis • Deductive Reasoning • Dependent Variable • Differentiation • Diploid • DNA Replication • Fertilization • Gamete • Graph • Haploid • Homologous Chromosomes • Hypothesis • Independent Assortment	Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems. 1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain. 1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain. 1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain. 1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively. 1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain. Science Practice 2: The student can use mathematics appropriately. 2.1 The student can justify the selection of a mathematical routine to solve problems. 2.2 The student can apply mathematical routines to quantities that describe natural phenomena. 2.3 The student can estimate numerically quantities that describe natural phenomena. Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course. 3.1 The student can pose scientific questions. 3.2 The student can refine scientific questions.

cells. • Mitosis plays a role in growth, repair, and asexual reproduction. • Mitosis is a continuous process with observable structural features along the mitotic process. Evidence of student learning is demonstrated by knowing the order of the processes (replication, alignment, separation). • Meiosis ensures that each gamete receives one complete haploid (1n) set of chromosomes. • During meiosis, homologous chromosomes are paired, with one homologue originating from the maternal parent and the other from the paternal parent. Orientation of the chromosome pairs is random with respect to the cell poles. • Separation of the homologous chromosomes ensures that each gamete receives a haploid (1n) set of chromosomes composed of both maternal and paternal chromosomes. • During meiosis, homologous chromatids exchange genetic material via a process called "crossing over," which increases genetic variation in the resultant gametes. • Fertilization involves the fusion of two gametes, increases genetic variation in populations by providing for new combinations of genetic information in the zygote, and restores the diploid number of chromosomes.	• Independent Variable • Inductive Reasoning • Interphase • Maternal Chromosome • Mean • Median • Meiosis • Metaphase • Mitosis • Model • Nuclear Division • Observation • p53 Gene • Paternal Chromosome • Potency • Precision • Prediction • Prophase • Rate • Recombination • Scientific Method • Sex Chromosome • Somatic Cell • Synapsis • Table • Telophase • Trend • Variable	3.3 The student can evaluate scientific questions. Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question. 4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question. 4.2 The student can design a plan for collecting data to answer a particular scientific question. 4.3 The student can collect data to answer a particular scientific question. 4.4 The student can evaluate sources of data to answer a particular scientific question Science Practice 5: The student can perform data analysis and evaluation of evidence. 5.1 The student can analyze data to identify patterns or relationships. 5.2 The student can refine observations and measurements based on data analysis. 5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question. Science Practice 6: The student can work with scientific explanations and theories. 6.1 The student can justify claims with evidence. 6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices. 6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced. 6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models. 6.5 The student can evaluate alternative scientific explanations. Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains. 7.1 The student can connect phenomena and models across spatial and temporal scales.

		7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Presentations** • **Video Presentations** • **Chapter Outlines** • **Guided Readings** • **Virtual Labs** • **Inquiry Labs** • **Cell Division: Mitosis and Meiosis Lab**	• **Exposure to relevant material** • **Exposure to relevant material** • **Synthesis of relevant material** • **Synthesis of relevant material** • **Application of relevant material** • **Application of relevant material**	**2=Skill/Concept** **2=Skill/Concept** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **3=Strategic Thinking, 4=Extended Thinking** **3=Strategic Thinking, 4=Extended Thinking**
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Civics, History, Psychology, Mathematics, English	• Builds upon a general understanding of Biology I and Critical Thinking Strategies	• Conducting and Designing Inquiry Lab Investigations
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Section Quizzes** • **Virtual Labs** • **Inquiry Labs** • **Unit Tests**	Form Form/Summ Form/Summ Summ	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP • Test Corrections with written explanations • Lab Corrections with written explanations • Retesting on Unit Tests • Writing their own test questions	• Students are presented information using different instructional strategies • Gathering an understanding of why their answers were incorrect • Students need a thorough	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**

• Grading their own essays	understanding of the concepts to write or gade their own tests and essays	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AP Exam Multiple Choice Questions • AP Exam Free Response Questions • Designing Their Own Experiments • Conducting Additional Lab Investigations • Supplemental Research	• Be able to answer questions of an AP Exam • Apply knowledge toward extending on labs conducted in class • Apply knowledge toward conducting additional labs • Research additional ideas on applicable, relevant topics	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think**

UNIT TITLE: Genetics (Chromosomal Inheritance) UNIT DURATION:	CONTENT AREA: Science COURSE: AP Biology

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• **Campbell/Reece AP Edition Biology** • **AP Biology Investigative Labs: An Inquiry-Based Approach**	**Big Idea 3: Living systems store, retrieve, transmit, and respond to information essential to life processes.**

ENDURING UNDERSTANDINGS:	ESSENTIAL QUESTIONS:
• Changes in genotype can result in changes in phenotype. **(3.C.1)** • The inheritance pattern of many traits cannot be explained by simple Mendelian genetics. **(3.A.4)** • The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring. **(3.A.3)**	• How can the rules of probability be applied to analyze passage of single gene traits from parent to offspring? • What processes lead to genetic variation in offspring? • What human genetic disorders can be attributed to the inheritance of single gene traits or specific chromosomal changes, such as nondisjunction? • What are some ethical, social, and medical issues surrounding human genetic disorders? • What are the various mechanisms of genetic inheritance? • How does inheritance of sex-linked genes differ from autosomal inheritance? • How are some traits a result of nonnuclear inheritance? • How can errors (mutations) in mitosis or meiosis result in changes in phenotype?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 3.1.B.a-b.	**Organisms progress through life cycles unique to different types of organisms** **a. Recognize cells both increase in number and differentiate, becoming specialized in structure and function, during and after embryonic development** *** Identify factors (e.g., biochemical, temperature) that may affect the differentiation of cells and the development of an organism**	x	
CLE 3.1.E.a-b.	**Biological classifications are based on how organisms are related** **a. * Explain how similarities used to group taxa might reflect evolutionary relationships (e.g., similarities in DNA and protein structures, internal anatomical features, patterns of development)** **b. * Explain how and why the classification of any taxon might change as more is learned about the organisms assigned to that taxon**	x	
CLE 3.2.C	**Complex multicellular organisms have systems that interact to carry out life processes through physical and chemical means**	x	
CLE 3.2.E.a-b.	**Protein structure and function are coded by the DNA (Deoxyribonucleic acid) molecule** **a. Explain how the DNA code determines the sequence of amino acids necessary for protein synthesis** **b. * Recognize the function of protein in cell structure and function (i.e., enzyme action, growth and repair of body parts, regulation of cell division and differentiation)**	x	

CLE 3.3.B.b-e.	**All living organisms have genetic material (DNA) that carries hereditary information** **b. Recognize that DNA codes for proteins, which are expressed as the heritable characteristics of an organism** **c. * Recognize that degree of relatedness can be determined by comparing DNA sequences** **d. * Explain how an error in the DNA molecule (mutation) can be transferred during replication** **e. Identify possible external causes (e.g., heat, radiation, certain chemicals) and effects of DNA mutations (e.g., altered proteins which may affect chemical reactions and structural development)**	**x**	
CLE 3.3.D.b-c.	**There is heritable variation within every species of organism** **a. * Describe how genes can be altered and combined to create genetic variation within a species (e.g., mutation, recombination of genes)** **b. * Recognize that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism's sex cells**	**x**	
CLE 3.3.E.a-c.	**The pattern of inheritance for many traits can be predicted by using the principles of Mendelian genetics** **a. Describe the advantages and disadvantages of asexual and sexual reproduction with regard to variation within a population** **b. * Describe how genes can be altered and combined to create genetic variation within a species (e.g., mutation, recombination of genes)** **c. * Recognize that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism's sex cells**	**x**	
CLE 4.3.B.a	**Reproduction is essential to the continuation of every species** **a. *Define a species in terms of the ability to mate and produce fertile offspring**	**x**	
CLE 4.3.C.b	**Natural selection is the process of sorting individuals based on their ability to survive and reproduce within their ecosystem** **b. *Explain how genetic homogeneity may cause a population to be more susceptible to extinction (e.g., succumbing to a disease for which there is no natural resistance)**	**x**	
CLE 8.3.B.b-c.	**Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology** **b. *Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research)** **c. *Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, use of alternative energies for carbon fuels, use of pesticides**		**x**
CLE 7.1.A.a-g.	**Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation** **a. Formulate testable questions and hypotheses** **b. Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment** **c. Design and conduct a valid experiment** **d. Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature)**		**x**

	e. *Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies f. *Acknowledge there is no fixed procedure called “the scientific method”, but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations Evaluate the design of an experiment and make suggestions for reasonable improvements		
CLE 7.1.B.a-f.	**Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations** a. *Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) b. Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second c. Determine the appropriate tools and techniques to collect, analyze, and interpret data d. Judge whether measurements and computation of quantities are reasonable e. Calculate the range, average/mean, percent, and ratios for sets of data *Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)		x
7.1.C.a-d.	Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) a. Use quantitative and qualitative data as support for reasonable explanations (conclusions) b. Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable) c. Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)		x
CLE 7.1.D.a-c.	The nature of science relies upon communication of results and justification of explanations a. Communicate the procedures and results of investigations and explanations through: ¨ oral presentations ¨ drawings and maps ¨ data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ¨ graphs (bar, single, and multiple line) ¨ equations and writings b. * Communicate and defend a scientific argument Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work)		x
CLE 8.3.C.a-c.	Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent a. *Identify and evaluate the need for informed consent in experimentation b. *Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment)		x

	c. *Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)		
CLE 8.3.D.a-b.	**Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible** **a. *Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a scientist speaking within or outside his/her area of expertise)** *** Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society**		**x**

OBJECTIVE # 7	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• Missouri State Course Level Expectations

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
***Evidence of student learning** is a demonstrated understanding of the following:* • Segregation and independent assortment can be applied to genes that are on different chromosomes. • Genes that are adjacent and close to each other on the same chromosome tend to move as a unit; the probability that they will segregate as a unit is a function of the distance between them. • The pattern of inheritance (monohybrid, dihybrid, sex-linked, and genes linked on the same homologous chromosome) can often be predicted from data that gives the parent genotype/phenotype and/or the offspring phenotypes/genotypes. • Patterns of inheritance of many traits do not follow ratios predicted by Mendel's laws and can be identified by quantitative analysis, where observed phenotypic ratios statistically differ from the predicted ratios. • Chloroplasts and mitochondria are randomly assorted to gametes and daughter cells; thus, traits determined by chloroplast and mitochondrial DNA do not follow simple Mendelian rules. • In animals, mitochondrial DNA is transmitted by the egg and not by sperm; as such, mitochondrial-determined traits are maternally inherited. • Changes in chromosome number often result in new phenotypes, including sterility caused by triploidy and increased vigor of other polyploids. • Changes in chromosome number often result in human disorders with developmental limitations, including Trisomy 21 (Down syndrome) and	• Accuracy • Allele • Autosome • Chi-Square • Codominance • Constant • Control • Deductive Reasoning • Dependent Variable • Dihybrid Cross • Dominant • F1 Generation • F2 Generation • Genetic Counseling • Genomic Imprinting • Genotype • Graph • Heterozygous • Homozygous • Hypothesis • Incomplete Dominance	Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems. 1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain. 1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain. 1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain. 1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively. 1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain. Science Practice 2: The student can use mathematics appropriately.

XO (Turner syndrome).	• Independent Assortment • Independent Variable • Inductive Reasoning • Lethal Allele • Linkage • Mean • Median • Model • Monohybrid Cross • Multiple Alleles • Non-disjunction • Non-nuclear Inheritance • Observation • P Generation • Pedigree Analysis • Phenotype • Phenotypic Plasticity • Polygenic Inheritance • Precision • Prediction • Punnett Square • Pure-Breeding • Rate • Recessive • Scientific Method • Segregation • Selfing • Sex Chromosome • Sex-Linked Traits • Table • Test-Cross • Trait • Trend • Variable • Variation	2.1 The student can justify the selection of a mathematical routine to solve problems. 2.2 The student can apply mathematical routines to quantities that describe natural phenomena. 2.3 The student can estimate numerically quantities that describe natural phenomena. Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course. 3.1 The student can pose scientific questions. 3.2 The student can refine scientific questions. 3.3 The student can evaluate scientific questions. Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question. 4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question. 4.2 The student can design a plan for collecting data to answer a particular scientific question. 4.3 The student can collect data to answer a particular scientific question. 4.4 The student can evaluate sources of data to answer a particular scientific question Science Practice 5: The student can perform data analysis and evaluation of evidence. 5.1 The student can analyze data to identify patterns or relationships. 5.2 The student can refine observations and measurements based on data

		analysis. 5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question. Science Practice 6: The student can work with scientific explanations and theories. 6.1 The student can justify claims with evidence. 6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices. 6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced. 6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models. 6.5 The student can evaluate alternative scientific explanations. Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains. 7.1 The student can connect phenomena and models across spatial and temporal scales. 7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Presentations** • **Video Presentations** • **Chapter Outlines** • **Guided Readings**	• **Exposure to relevant material** • **Exposure to relevant material** • **Synthesis of relevant material**	**2=Skill/Concept** **2=Skill/Concept** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking**

• **Virtual Labs**
• **Inquiry Labs**
  • **Mathematical Selection: HWE Lab**
  • **RFLP of DNA Lab**
  • **Genetics of Organisms Lab**
  • **Candy Chi-Square Lab**
	• **Synthesis of relevant material**
	• **Application of relevant material**
	• **Application of relevant material**
		3=Strategic Thinking, 4=Extended Thinking
		3=Strategic Thinking, 4=Extended Thinking

INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Civics, History, Psychology, Mathematics, English	• Builds upon a general understanding of Biology I and Critical Thinking Strategies	• Conducting and Designing Inquiry Lab Investigations
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Section Quizzes** • **Virtual Labs** • **Inquiry Labs** • **Unit Tests**	Form Form/Summ Form/Summ Summ	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP • Test Corrections with written explanations • Lab Corrections with written explanations • Retesting on Unit Tests • Writing their own test questions • Grading their own essays	• Students are presented information using different instructional strategies • Gathering an understanding of why their answers were incorrect • Students need a thorough understanding of the concepts to write or gade their own tests and essays	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?		

Possible Extensions/Enrichments		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AP Exam Multiple Choice Questions • AP Exam Free Response Questions • Designing Their Own Experiments • Conducting Additional Lab Investigations • Supplemental Research	• Be able to answer questions of an AP Exam • Apply knowledge toward extending on labs conducted in class • Apply knowledge toward conducting additional labs • Research additional ideas on applicable, relevant topics	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think**

UNIT TITLE: Molecular Genetics UNIT DURATION:	CONTENT AREA: Science COURSE: AP Biology

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:	BIG IDEA(S):
• **Campbell/Reece AP Edition Biology** • **AP Biology Investigative Labs: An Inquiry-Based Approach**	**Big Idea 3: Living systems store, retrieve, transmit, and respond to information essential to life processes.** **Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.**

ENDURING UNDERSTANDINGS:	ESSENTIAL QUESTIONS:
• DNA, and in some cases RNA, is the primary source of heritable information. **(3.A.1)** • Changes in genotype can result in changes in phenotype. **(3.C.1)** • Biological systems have multiple processes that increase genetic variation. **(3.C.2)** • Viral replication results in genetic variation, and viral infection can introduce genetic variation into the hosts. **(3.C.3)** • Variation in molecular units provides cells with a wider range of function. **(4.C.1)**	• How is genetic information transmitted from one generation to the next? • How do structural differences between DNA and RNA determine function? • What is the central dogma of modern biology? • What types of genetic engineering techniques manipulate the heritable information of DNA and, in special cases, RNA? • What internal and external mechanisms can lead to genetic mutation? • Is it possible for a genotypic change to positively affect individual fitness? • How does the process of DNA replication lead to increased variation? • What mechanisms of genetic acquisition lead to increased variation in prokaryotic cells? • What are the mechanisms of viral replication? • How does the reproductive cycle of viruses facilitate the transfer of genetic information?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 3.1.B.a-b.	Organisms progress through life cycles unique to different types of organisms a. Recognize cells both increase in number and differentiate, becoming specialized in structure and function, during and after embryonic development b. * Identify factors (e.g., biochemical, temperature) that may affect the differentiation of cells and the development of an organism	x	
CLE 3.1.E.a-b.	Biological classifications are based on how organisms are related a. * Explain how similarities used to group taxa might reflect evolutionary relationships (e.g., similarities in DNA and protein structures, internal anatomical features, patterns of development) b. * Explain how and why the classification of any taxon might change as more is learned about the organisms assigned to that taxon	x	
CLE 3.2.C	Complex multicellular organisms have systems that interact to carry out life processes through physical and chemical means	x	
CLE 3.2.E.a-b.	Protein structure and function are coded by the DNA (Deoxyribonucleic acid) molecule a. Explain how the DNA code determines the sequence of amino acids necessary for protein synthesis b. * Recognize the function of protein in cell structure and function (i.e., enzyme action, growth and repair of body parts, regulation of cell division and differentiation)	x	
CLE 3.3.B.b-e.	All living organisms have genetic material (DNA) that carries hereditary information b. Recognize that DNA codes for proteins, which are expressed as the heritable characteristics of an organism c. * Recognize that degree of relatedness can be determined by comparing DNA sequences	x	

	d. * Explain how an error in the DNA molecule (mutation) can be transferred during replication e. Identify possible external causes (e.g., heat, radiation, certain chemicals) and effects of DNA mutations (e.g., altered proteins which may affect chemical reactions and structural development)		
CLE 3.3.D.b-c.	There is heritable variation within every species of organism b. * Describe how genes can be altered and combined to create genetic variation within a species (e.g., mutation, recombination of genes) c. * Recognize that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism's sex cells	x	
CLE 3.3.E.a-c.	The pattern of inheritance for many traits can be predicted by using the principles of Mendelian genetics a. Explain how genotypes (heterozygous and homozygous) contribute to phenotypic variation within a species b. Predict the probability of the occurrence of specific traits, including sex-linked traits, in an offspring by using a monohybrid cross *Explain how sex-linked traits may or may not result in the expression of a genetic disorder (e.g., hemophilia, muscular dystrophy, color blindness) depending on gender	x	
CLE 4.3.B.a	Reproduction is essential to the continuation of every species a. *Define a species in terms of the ability to mate and produce fertile offspring	x	
CLE 4.3.C.b	Natural selection is the process of sorting individuals based on their ability to survive and reproduce within their ecosystem b. *Explain how genetic homogeneity may cause a population to be more susceptible to extinction (e.g., succumbing to a disease for which there is no natural resistance)	x	
CLE 8.3.B.b-c.	Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology b. *Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research) c. *Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, use of alternative energies for carbon fuels, use of pesticides		x
CLE 7.1.A.a-g.	Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation a. Formulate testable questions and hypotheses b. Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment c. Design and conduct a valid experiment d. Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature) e. *Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies f. *Acknowledge there is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant evidence, logical		x

	reasoning, and some imagination in developing hypotheses and other explanations Evaluate the design of an experiment and make suggestions for reasonable improvements		
CLE 7.1.B.a-f.	Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations a. *Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) b. Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second c. Determine the appropriate tools and techniques to collect, analyze, and interpret data d. Judge whether measurements and computation of quantities are reasonable e. Calculate the range, average/mean, percent, and ratios for sets of data *Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)		x
7.1.C.a-d.	Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) a. Use quantitative and qualitative data as support for reasonable explanations (conclusions) b. Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable) c. Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)		x
CLE 7.1.D.a-c.	The nature of science relies upon communication of results and justification of explanations a. Communicate the procedures and results of investigations and explanations through: ¨ oral presentations ¨ drawings and maps ¨ data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ¨ graphs (bar, single, and multiple line) ¨ equations and writings b. * Communicate and defend a scientific argument Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work)		x
CLE 8.3.C.a-c.	Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent a. *Identify and evaluate the need for informed consent in experimentation b. *Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment) c. *Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)		x
CLE 8.3.D.a-b.	Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible a. *Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an “eye witness”, a scientist speaking within or outside his/her area of expertise)		x

	*** Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator’s credibility with other scientists and society**		

OBJECTIVE # 8		
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• Missouri State Course Level Expectations	
WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information,* *ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
***Evidence of student learning** is a demonstrated understanding of the following:* • Genetic information is stored in and passed to subsequent generations through DNA molecules and, in some cases, RNA molecules. • Noneukaryotic organisms have circular chromosomes, while eukaryotic organisms have multiple linear chromosomes, although in biology there are exceptions to this rule. • Prokaryotes, viruses and eukaryotes can contain plasmids, which are small extra-chromosomal, double-stranded circular DNA molecules. • The proof that DNA is the carrier of genetic information involved a number of important historical experiments. These include: i. Contributions of Watson, Crick, Wilkins, and Franklin on the structure of DNA i. Avery-MacLeod-McCarty experiments i. Hershey-Chase experiment • DNA replication ensures continuity of hereditary information. i. Replication is a semiconservative process; that is, one strand serves as the template for a new, complementary strand. i. Replication requires DNA polymerase plus many other essential cellular enzymes, occurs bidirectionally, and differs in the production of the leading and lagging strands. • Genetic information in retroviruses is a special case and has an alternate flow of information: from RNA to DNA, made possible by reverse transcriptase, an enzyme that copies the viral RNA genome into DNA. This DNA integrates into the host genome and becomes transcribed and translated for the assembly of new viral progeny. • Both have three components — sugar, phosphate and a nitrogenous base — which form nucleotide units that are connected by covalent bonds to form a linear molecule with 3' and 5' ends, with the nitrogenous bases perpendicular to the sugar-phosphate backbone. • The basic structural differences include: i. DNA contains deoxyribose (RNA contains ribose). i. RNA contains uracil in lieu of thymine in DNA. i. DNA is usually double stranded, RNA is usually single stranded. v. The two DNA strands in double-stranded DNA are antiparallel in directionality. • Both DNA and RNA exhibit specific nucleotide base pairing that is conserved through	• Accuracy • Activator • Amino Acids • Anticodon • Base Pairing Rules • Cell Differentiation • Chi-Square • Coding Strand • Codon • Constant • Control • Deductive Reasoning • Dependent Variable • DNA • DNA Ligase • DNA Polymerase • DNA Replication • Embryonic Stem Cells • Exons • Gel Electrophoresis • Gene Expression • Gene Induction • Gene Repression • Genetic Code • Genetic Engineering	Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems. 1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain. 1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain. 1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain. 1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively. 1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain. Science Practice 2: The student can use mathematics appropriately. 2.1 The student can justify the selection of a mathematical routine to solve problems. 2.2 The student can apply mathematical routines to quantities that describe

evolution: adenine pairs with thymine or uracil (A-T or A-U) and cytosine pairs with guanine (C-G). i. Purines (G and A) have a double ring structure. i. Pyrimidines (C, T and U) have a single ring structure. • The sequence of the RNA bases, together with the structure of the RNA molecule, determines RNA function. i. mRNA carries information from the DNA to the ribosome. i. tRNA molecules bind specific amino acids and allow information in the mRNA to be translated to a linear peptide sequence. i. rRNA molecules are functional building blocks of ribosomes. /. The role of RNAi includes regulation of gene expression at the level of mRNA transcription. • The enzyme RNA-polymerase reads the DNA molecule in the 3' to 5' direction and synthesizes complementary mRNA molecules that determine the order of amino acids in the polypeptide. • In eukaryotic cells the mRNA transcript undergoes a series of enzyme-regulated modifications. • Translation of the mRNA occurs in the cytoplasm on the ribosome. • In prokaryotic organisms, transcription is coupled to translation of the message. Translation involves energy and many steps, including initiation, elongation and termination. The salient features include: i. The mRNA interacts with the rRNA of the ribosome to initiate translation at the (start) codon. ii. The sequence of nucleotides on the mRNA is read in triplets called codons. iii. Each codon encodes a specific amino acid, which can be deduced by using a genetic code chart. Many amino acids have more than one codon. iv. tRNA brings the correct amino acid to the correct place on the mRNA. v. The amino acid is transferred to the growing peptide chain. vi. The process continues along the mRNA until a “stop” codon is reached. vii. The process terminates by release of the newly synthesized peptide/protein. • DNA mutations can be positive, negative or neutral based on the effect or the lack of effect they have on the resulting nucleic acid or protein and the phenotypes that are conferred by the protein. • Whether or not a mutation is detrimental, beneficial or neutral depends on the environmental context. Mutations are the primary source of genetic variation. • Selection results in evolutionary change. • Viruses have highly efficient replicative capabilities that allow for rapid evolution and acquisition of new phenotypes.	• Genetic Modification • Graph • Helicase • Homeotic Genes • HOX Genes • Hydrogen Bonding • Hypothesis • Independent Variable • Inducible Genes • Inductive Reasoning • Introns • Lac Operon • Lagging Strand • Leading Strand • Mean • Median • Messenger RNA • Micro RNA • Model • Morphogenesis • Morphogens • Mutation • Nucleic Acids • Nucleotides • Observation • Okazaki Fragments • Polymerase Chain Reaction • Precision • Prediction • Protein • Rate • Regulatory Sequence • Replication Fork • Repressor • Restriction Enzyme	natural phenomena. 2.3 The student can estimate numerically quantities that describe natural phenomena. Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course. 3.1 The student can pose scientific questions. 3.2 The student can refine scientific questions. 3.3 The student can evaluate scientific questions. Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question. 4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question. 4.2 The student can design a plan for collecting data to answer a particular scientific question. 4.3 The student can collect data to answer a particular scientific question. 4.4 The student can evaluate sources of data to answer a particular scientific question Science Practice 5: The student can perform data analysis and evaluation of evidence. 5.1 The student can analyze data to identify patterns or relationships. 5.2 The student can refine observations and measurements based on data analysis. 5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question.

• Viruses replicate via a component assembly model allowing one virus to produce many progeny simultaneously via the lytic cycle. • Virus replication allows for mutations to occur through usual host pathways. • RNA viruses lack replication error-checking mechanisms, and thus have higher rates of mutation. • Related viruses can combine/recombine information if they infect the same host cell. • HIV is a well-studied system where the rapid evolution of a virus within the host contributes to the pathogenicity of viral infection. • Viruses transmit DNA or RNA when they infect a host cell. • Some viruses are able to integrate into the host DNA and establish a latent (lysogenic) infection. These latent viral genomes can result in new properties for the host such as increased pathogenicity in bacteria. • A heterozygote may be a more advantageous genotype than a homozygote under particular conditions, since with two different alleles, the organism has two forms of proteins that may provide functional resilience in response to environmental stresses. • Gene duplication creates a situation in which one copy of the gene maintains its original function, while the duplicate may evolve a new function.	• Reverse Transcriptase • Ribosomal RNA • Scientific Method • Small Regulatory RNA • Start Codon • Stop Codon • Table • Template Strand • Transcription • Transcription Factors • Transfer RNA • Transgenic Organism • Translation • Trend • Variable	Science Practice 6: The student can work with scientific explanations and theories. 6.1 The student can justify claims with evidence. 6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices. 6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced. 6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models. 6.5 The student can evaluate alternative scientific explanations. Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains. 7.1 The student can connect phenomena and models across spatial and temporal scales. 7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)

• **Presentations**
• **Video Presentations**
• **Chapter Outlines**
• **Guided Readings**
• **Virtual Labs**
• **Inquiry Labs**
    • **Comparing DNA Using BLAST**
    • **Virtual Fly Lab**
	• **Exposure to relevant material**
	• **Exposure to relevant material**
	• **Synthesis of relevant material**
	• **Synthesis of relevant material**
	• **Application of relevant material**
	• **Application of relevant material**
		2=Skill/Concept
		2=Skill/Concept
		2=Skill/Concept, 3=Strategic Thinking
		2=Skill/Concept, 3=Strategic Thinking
		3=Strategic Thinking, 4=Extended Thinking
		3=Strategic Thinking, 4=Extended Thinking

INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE**	**INQUIRY CONNECTIONS**

	CONNECTIONS	
• Civics, History, Psychology, Mathematics, English	• Builds upon a general understanding of Biology I and Critical Thinking Strategies	• Conducting and Designing Inquiry Lab Investigations
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Section Quizzes** • **Virtual Labs** • **Inquiry Labs** • **Unit Tests**	Form Form/Summ Form/Summ Summ	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP • Test Corrections with written explanations • Lab Corrections with written explanations • Retesting on Unit Tests • Writing their own test questions • Grading their own essays	• Students are presented information using different instructional strategies • Gathering an understanding of why their answers were incorrect • Students need a thorough understanding of the concepts to write or gade their own tests and essays	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AP Exam Multiple Choice Questions • AP Exam Free Response Questions • Designing Their Own Experiments • Conducting Additional Lab Investigations	• Be able to answer questions of an AP Exam • Apply knowledge toward extending on labs conducted in	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**

• Supplemental Research	class • Apply knowledge toward conducting additional labs • Research additional ideas on applicable, relevant topics	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think**

UNIT TITLE: Genetics-Genomes, Gene Expression, and Biotechnology	CONTENT AREA: Science
UNIT DURATION:	COURSE: AP Biology

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- **Campbell/Reece AP Edition Biology**
- **AP Biology Investigative Labs: An Inquiry-Based Approach**

BIG IDEA(S):

Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.
Big Idea 3: Living systems store, retrieve, transmit, and respond to information essential to life processes.
Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

ENDURING UNDERSTANDINGS:

- Environmental factors influence the expression of the genotype in an organism. **(4.C.2)**
- Gene regulation results in differential gene expression, leading to cell specialization. **(3.B.1)**
- A variety of intercellular and intracellular signal transmissions mediate gene expression. **(3.B.2)**
- Interactions between external stimuli and regulated gene expression result in specialization of cells, tissues and organs. **(4.A.3)**
- Timing and coordination of specific events are necessary for the normal development of an organism, and these events are regulated by a variety of mechanisms. **(2.E.1)**

ESSENTIAL QUESTIONS:

- What factors lead to cellular differentiation?
- How can gene expression be altered by inducing transcription factors?
- What is programmed cell death (apoptosis) and its role in normal development and differentiation?
- How are DNA regulatory sequences, regulatory genes, and small regulatory RNAs involved in gene expression?
- What are the control mechanisms that regulate gene expression in bacteria and viruses?
- How do eukaryotic organisms regulate gene expression?
- How does gene regulation influence phenotypic expression between closely related species?
- How does signal transmission within and between cells mediate gene expression and cell function?
- How do environmental factors influence phenotypes?
- What is meant by saying an organism has a flexible response of its genome?
- What external and internal cues trigger gene regulation and developmental differentiation?
- How does expression of genes lead to structural and functional divergence of cells?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 3.1.B.a-b.	**Organisms progress through life cycles unique to different types of organisms** **a. Recognize cells both increase in number and differentiate, becoming specialized in structure and function, during and after embryonic development** *** Identify factors (e.g., biochemical, temperature) that may affect the differentiation of cells and the development of an organism**		**x**
CLE 3.1.E.a-b.	**Biological classifications are based on how organisms are related**		**x**

	a. * Recognize all organisms are composed of cells, the fundamental units of structure and function b. Describe the structure of cell parts (e.g., cell wall, cell membrane, cytoplasm, nucleus, chloroplast, mitochondrion, ribosome, vacuole) found in different types of cells (e.g., bacterial, plant, skin, nerve, blood, muscle) and the functions they perform (e.g., structural support, transport of materials, storage of genetic information, photosynthesis and respiration, synthesis of new molecules, waste disposal) that are necessary to the survival of the cell and organism		
CLE 3.2.C	Complex multicellular organisms have systems that interact to carry out life processes through physical and chemical means		x
CLE 3.2.D.a-e.	Cells carry out chemical transformations that use energy for the synthesis or breakdown of organic compounds a. Summarize how energy transfer occurs during photosynthesis and cellular respiration as energy is stored in and released from the bonds of chemical compounds (i.e. ATP) b. * Relate the structure of organic compounds (e.g., proteins, nucleic acids, lipids, carbohydrates) to their role in living systems c. * Recognize energy is absorbed or released in the breakdown and/or synthesis of organic compounds d. * Explain how protein enzymes affect chemical reactions (e.g., the breakdown of food molecules, growth and repair, regulation) * Interpret a data table showing the effects of an enzyme on a biochemical reaction	x	
CLE 3.2.E.a-b.	Protein structure and function are coded by the DNA (Deoxyribonucleic acid) molecule a. Explain how the DNA code determines the sequence of amino acids necessary for protein synthesis b. * Recognize the function of protein in cell structure and function (i.e., enzyme action, growth and repair of body parts, regulation of cell division and differentiation)	x	
CLE 3.2.G	Life processes can be disrupted by disease (intrinsic failures of the organ systems or by infection due to other organisms)	x	
CLE 3.3.B.c-e.	All living organisms have genetic material (DNA) that carries hereditary information c. * Recognize that degree of relatedness can be determined by comparing DNA sequences d. * Explain how an error in the DNA molecule (mutation) can be transferred during replication e. Identify possible external causes (e.g., heat, radiation, certain chemicals) and effects of DNA mutations (e.g., altered proteins which may affect chemical reactions and structural development)	x	
CLE 3.3.D.b-c.	There is heritable variation within every species of organism b. * Describe how genes can be altered and combined to create genetic variation within a species (e.g., mutation, recombination of genes) c. * Recognize that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism's sex cells	x	
CLE 3.3.E.a-c.	The pattern of inheritance for many traits can be predicted by using the principles of Mendelian genetics a. Explain how genotypes (heterozygous and homozygous) contribute to phenotypic variation within a species b. Predict the probability of the occurrence of specific traits, including sex-linked traits, in an offspring by using a monohybrid cross c. *Explain how sex-linked traits may or may not result in the expression of a genetic disorder (e.g., hemophilia, muscular dystrophy, color blindness) depending on gender	x	
CLE 4.3.B.a	Reproduction is essential to the continuation of every species a. *Define a species in terms of the ability to mate and produce fertile offspring	x	
CLE 4.3.C.b	Natural selection is the process of sorting individuals based on their ability to survive and reproduce within their ecosystem b. *Explain how genetic homogeneity may cause a population to be more susceptible to extinction (e.g., succumbing to a disease for which there is no natural resistance)	x	
CLE 8.1.A	Designed objects are used to do things better or more easily and to do some things that could not		x

	otherwise be done at all		
CLE 8.1.B.a	Advances in technology often result in improved data collection and an increase in scientific information a. * Recognize the relationships linking technology and science (e.g., how technological problems may create a demand for new science knowledge, how new technologies make it possible for scientists to extend research and advance science)		x
CLE 8.2.A.a-b.	People of different gender and ethnicity have contributed to scientific discoveries and the invention of technological innovations a. *Recognize contributions to science are not limited to the work of one particular group, but are made by a diverse group of scientists representing various ethnic and gender groups b. *Recognize gender and ethnicity of scientists often influence the questions asked and/or the methods used in scientific research and may limit or advance science knowledge and/or technology		x
CLE 8.2.B.a-b.	Scientific theories are developed based on the body of knowledge that exists at any particular time and must be rigorously questioned and tested for validity a. *Identify and describe how explanations (laws/principles, theories/models) of scientific phenomena have changed over time as a result of new evidence (e.g., cell theory, theories of spontaneous generation and biogenesis, theories of extinction, evolution theory, structure of the cell membrane, genetic theory of inheritance) b. *Identify and analyze current theories that are being questioned, and compare them to new theories that have emerged to challenge older ones (e.g., theories of evolution, extinction, global warming)		x
CLE 8.3.A	People, alone or in groups, are always making discoveries about nature and inventing new ways to solve problems and get work done		x
CLE 8.3.B.a-c.	Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology a. *Analyze the roles of science and society as they interact to determine the direction of scientific and technological progress (e.g., prioritization of and funding for new scientific research and technological development is determined on the basis of individual, political and social values and needs; understanding basic concepts and principles of science and technology influences debate about the economics, policies, politics, and ethics of various scientific and technological challenges) b. *Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research) c. *Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, use of alternative energies for carbon fuels, use of pesticides		x
CLE 7.1.A.a-g.	Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation a. Formulate testable questions and hypotheses b. Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment c. Design and conduct a valid experiment d. Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature) e. *Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies f. *Acknowledge there is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant evidence, logical		x

	reasoning, and some imagination in developing hypotheses and other explanations g. Evaluate the design of an experiment and make suggestions for reasonable improvements		
CLE 7.1.B.a-f.	Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations a. *Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) b. Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second c. Determine the appropriate tools and techniques to collect, analyze, and interpret data d. Judge whether measurements and computation of quantities are reasonable e. Calculate the range, average/mean, percent, and ratios for sets of data f. *Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)		x
CLE 7.1.C.a-d.	Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) a. Use quantitative and qualitative data as support for reasonable explanations (conclusions) b. Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable) c. Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) d. Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)		x
CLE 7.1.D.a-c.	The nature of science relies upon communication of results and justification of explanations a. Communicate the procedures and results of investigations and explanations through: ¨ oral presentations ¨ drawings and maps ¨ data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ¨ graphs (bar, single, and multiple line) ¨ equations and writings b. * Communicate and defend a scientific argument Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work)		x
CLE 8.3.C.a-c.	Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent a. *Identify and evaluate the need for informed consent in experimentation b. *Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment) c. *Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)		x
CLE 8.3.D.a-b.	Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible a. *Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a scientist speaking within or outside his/her area of expertise) b. * Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society		x

OBJECTIVE # 9	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• Missouri State Course Level Expectations

<table>
<tr><th colspan="3">WHAT SHOULD STUDENTS…</th></tr>
<tr><th>UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.</th><th>KNOW?
Facts, Names, Dates, Places, Information,
ACADEMIC VOCABULARY</th><th>BE ABLE TO DO?
Skills; Products</th></tr>
<tr><td>Evidence of student learning is a demonstrated understanding of the following:
• Homeotic genes are involved in developmental patterns and sequences.
• Embryonic induction in development results in the correct timing of events.
• Temperature and the availability of water determine seed germination in most plants.
• Genetic mutations can result in abnormal development.
• Genetic transplantation experiments support the link between gene expression and normal development.
• Genetic regulation by microRNAs plays an important role in the development of organisms and the control of cellular functions.
• Regulatory sequences are stretches of DNA that interact with regulatory proteins to control transcription.
• The expression of specific genes can be turned on by the presence of an inducer.
• The expression of specific genes can be inhibited by the presence of a repressor.
• Inducers and repressors are small molecules that interact with regulatory proteins and/or regulatory sequences.
• Regulatory proteins inhibit gene expression by binding to DNA and blocking transcription (negative control).
• Regulatory proteins stimulate gene expression by binding to DNA and stimulating transcription (positive control) or binding to repressors to inactivate repressor function.
• Certain genes are continuously expressed; that is, they are always turned “on,” e.g., the ribosomal genes.
• Transcription factors bind to specific DNA sequences and/or other regulatory proteins.
• Some of these transcription factors are activators (increase expression), while others are repressors (decrease expression).</td><td>• Accuracy
• Activator
• Amino Acids
• Anticodon
• Base Pairing Rules
• Cell Differentiation
• Chi-Square
• Coding Strand
• Codon
• Constant
• Control
• Deductive Reasoning
• Dependent Variable
• DNA
• DNA Ligase
• DNA Polymerase
• DNA Replication
• Embryonic Stem Cells
• Exons
• Gel Electrophoresis
• Gene Expression
• Gene Induction
• Gene Repression
• Genetic Code
• Genetic Engineering</td><td>Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems.
1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain.
1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain.
1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain.
1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively.
1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain.
Science Practice 2: The student can use mathematics appropriately.
2.1 The student can justify the selection of a mathematical routine to solve problems.
2.2 The student can apply mathematical routines to quantities that describe natural phenomena.
2.3 The student can estimate numerically quantities that describe natural phenomena.
Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.
3.1 The student can pose scientific questions.
3.2 The student can refine scientific questions.</td></tr>
</table>

• The combination of transcription factors binding to the regulatory regions at any one time determines how much, if any, of the gene product will be produced.	• Genetic Modification • Graph • Helicase • Homeotic Genes • HOX Genes • Hydrogen Bonding • Hypothesis • Independent Variable • Inducible Genes • Inductive Reasoning • Introns • Lac Operon • Lagging Strand • Leading Strand • Mean • Median • Messenger RNA • Micro RNA • Model • Morphogenesis • Morphogens • Mutation • Nucleic Acids • Nucleotides • Observation • Okazaki Fragments • Polymerase Chain Reaction • Precision • Prediction • Protein • Rate • Regulatory Sequence • Replication Fork • Repressor • Restriction Enzyme	3.3 The student can evaluate scientific questions. Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question. 4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question. 4.2 The student can design a plan for collecting data to answer a particular scientific question. 4.3 The student can collect data to answer a particular scientific question. 4.4 The student can evaluate sources of data to answer a particular scientific question Science Practice 5: The student can perform data analysis and evaluation of evidence. 5.1 The student can analyze data to identify patterns or relationships. 5.2 The student can refine observations and measurements based on data analysis. 5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question. Science Practice 6: The student can work with scientific explanations and theories. 6.1 The student can justify claims with evidence. 6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices. 6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced. 6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models. 6.5 The student can evaluate alternative scientific explanations. Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains. 7.1 The student can connect phenomena and models across spatial and temporal scales.

	• Reverse Transcriptase • Ribosomal RNA • Scientific Method • Small Regulatory RNA • Start Codon • Stop Codon • Table • Template Strand • Transcription • Transcription Factors • Transfer RNA • Transgenic Organism • Translation • Trend • Variable	7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Presentations** • **Video Presentations** • **Chapter Outlines** • **Guided Readings** • **Virtual Labs** • **Inquiry Labs** • **Biotechnology: Bacterial Transformation**	• **Exposure to relevant material** • **Exposure to relevant material** • **Synthesis of relevant material** • **Synthesis of relevant material** • **Application of relevant material** • **Application of relevant material**	**2=Skill/Concept** **2=Skill/Concept** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **3=Strategic Thinking, 4=Extended Thinking** **3=Strategic Thinking, 4=Extended Thinking**
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Civics, History, Psychology, Mathematics, English	• Builds upon a general understanding of Biology I and Critical Thinking Strategies	• Conducting and Designing Inquiry Lab Investigations
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Section Quizzes** • **Virtual Labs** • **Inquiry Labs**	Form Form/Summ Form/Summ	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext.**

• **Unit Tests**	Summ	**Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP • Test Corrections with written explanations • Lab Corrections with written explanations • Retesting on Unit Tests • Writing their own test questions • Grading their own essays	• Students are presented information using different instructional strategies • Gathering an understanding of why their answers were incorrect • Students need a thorough understanding of the concepts to write or gade their own tests and essays	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AP Exam Multiple Choice Questions • AP Exam Free Response Questions • Designing Their Own Experiments • Conducting Additional Lab Investigations • Supplemental Research	• Be able to answer questions of an AP Exam • Apply knowledge toward extending on labs conducted in class • Apply knowledge toward conducting additional labs • Research additional ideas on applicable, relevant topics	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think**

UNIT TITLE: Organism Form and Function **UNIT DURATION:**	**CONTENT AREA: Science** **COURSE: AP Biology**

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:
- **Campbell/Reece AP Edition Biology**
- **AP Biology Investigative Labs: An Inquiry-Based Approach**

BIG IDEA(S):
Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.
Big Idea 3: Living systems store, retrieve, transmit, and respond to information essential to life processes.

ENDURING UNDERSTANDINGS:
- Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes. **(2.C.1)**
- Organisms respond to changes in their external environments. **(2.C.2)**
- Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments. **(2.D.2)**
- Biological systems are affected by disruptions to their dynamic homeostasis. **(2.D.3)**
- Timing and coordination of physiological events are regulated by multiple mechanisms. **(2.E.2)**
- Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection. **(2.E.3)**
- Cell communication processes share common features that reflect a shared evolutionary history. **(3.D.1)**
- Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling. **(3.D.2)**
- Signal transduction pathways link signal reception with cellular response. **(3.D.3)**
- Changes in signal transduction pathways can alter cellular response. **(3.D.4)**

ESSENTIAL QUESTIONS:
- What is the role of negative feedback mechanisms on organism function?
- What is the role of positive feedback mechanisms on organism function?
- How does amplification apply to positive feedback?
- What are the possible repercussions of altering a feedback mechanism?
- How do organisms respond to changes in their environment?
- What does conserved homeostatic mechanisms in animals, plants, and microbes suggest?
- What are the homeostatic mechanisms in plants?
- What are the homeostatic mechanisms in animals?
- What are the homeostatic mechanisms in microbes?
- What are the homeostatic mechanisms in fungi?
- How is communication influenced by transduction of stimulatory or inhibitory signals from other cells, organisms or the environment?
- How do signal transduction pathways influence how single-celled organisms respond to the environment?
- How do signal transduction pathways influence how multi-cellular organisms respond to the environment?
- How do cells communicate with each other?
- What is the role of a ligand at the cell membrane?
- What is signal transduction, and how does it function at the cellular level?
- What occurs if signal transduction is blocked or defective?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
CLE 3.1.A	Organisms have basic needs for survival	X	
CLE 3.1.B.a-b.	Organisms progress through life cycles unique to different types of organisms a. Recognize cells both increase in number and differentiate, becoming specialized in structure and function, during and after embryonic development b. * Identify factors (e.g., biochemical, temperature) that may affect the differentiation of cells and the development of an organism	X	

CLE 3.1.C.a-b.	Cells are the fundamental units of structure and function of all living things a. * Recognize all organisms are composed of cells, the fundamental units of structure and function b. Describe the structure of cell parts (e.g., cell wall, cell membrane, cytoplasm, nucleus, chloroplast, mitochondrion, ribosome, vacuole) found in different types of cells (e.g., bacterial, plant, skin, nerve, blood, muscle) and the functions they perform (e.g., structural support, transport of materials, storage of genetic information, photosynthesis and respiration, synthesis of new molecules, waste disposal) that are necessary to the survival of the cell and organism	X	
CLE 3.1.D	Plants and animals have different structures that serve similar functions necessary for the survival of the organism		X
CLE 3.1.E.a-b.	Biological classifications are based on how organisms are related a. * Explain how similarities used to group taxa might reflect evolutionary relationships (e.g., similarities in DNA and protein structures, internal anatomical features, patterns of development) b. * Explain how and why the classification of any taxon might change as more is learned about the organisms assigned to that taxon	X	
CLE 3.2.A.a-c.	The cell contains a set of structures called organelles that interact to carry out life processes through physical and chemical means a. *Compare and contrast the structure and function of mitochondria and chloroplasts b. *Compare and contrast the structure and function of cell wall and cell membranes c. Explain physical and chemical interactions that occur between organelles (e.g. nucleus, cell membrane, chloroplast, mitochondrion, ribosome) as they carry out life processes	X	
CLE 3.2.C	Complex multicellular organisms have systems that interact to carry out life processes through physical and chemical means	X	
CLE 3.2.F.a-c.	Cellular activities and responses can maintain stability internally while external conditions are changing (homeostasis) a. Explain the significance of the selectively permeable membrane to the transport of molecules b. Predict the movement of molecules across a selectively permeable membrane (i.e., diffusion, osmosis, active transport) needed for a cell to maintain homeostasis given concentration gradients and different sizes of molecules c. Explain how water is important to cells (e.g., is a buffer for body temperature, provides soluble environment for chemical reactions, serves as a reactant in chemical reactions, provides hydration that maintains cell turgidity, maintains protein shape)	X	
CLE 3.2.G	Life processes can be disrupted by disease (intrinsic failures of the organ systems or by infection due to other organisms)	X	
CLE 3.3.B.d-e	All living organisms have genetic material (DNA) that carries hereditary information d. * Explain how an error in the DNA molecule (mutation) can be transferred during replication e. Identify possible external causes (e.g., heat, radiation, certain chemicals) and effects of DNA mutations (e.g., altered proteins which may affect chemical reactions and structural development)	X	
CLE 3.3.D.c	There is heritable variation within every species of organism c. * Recognize that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism's sex cells	X	
CLE 4.3.B.b	Reproduction is essential to the continuation of every species b. Explain the importance of reproduction to the survival of a species (i.e., the failure of a species to reproduce will lead to extinction of that species)	X	
CLE 5.2.F	Climate is a description of average weather conditions in a given area due to the transfer of energy and matter through Earth's systems		X
CLE 6.1.B.a	The Earth has a composition and location suitable to sustain life a. * Explain how Earth's environmental characteristics and location in the universe (e.g., atmosphere, temperature, orbital path, magnetic field, mass-gravity, location in solar system) provide a life-supporting environment		X
CLE 8.3.B.c	Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology		X

	c. *Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, use of alternative energies for carbon fuels, use of pesticides		
CLE 7.1.A.a-g.	Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation a. Formulate testable questions and hypotheses b. Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment c. Design and conduct a valid experiment d. Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature) e. *Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies f. *Acknowledge there is no fixed procedure called “the scientific method”, but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations g. Evaluate the design of an experiment and make suggestions for reasonable improvements		x
CLE 7.1.B.a-f.	Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations a. *Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) b. Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second c. Determine the appropriate tools and techniques to collect, analyze, and interpret data d. Judge whether measurements and computation of quantities are reasonable e. Calculate the range, average/mean, percent, and ratios for sets of data f. *Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)		x
7.1.C.a-d.	Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) a. Use quantitative and qualitative data as support for reasonable explanations (conclusions) b. Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable) c. Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) d. Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)		x
CLE 7.1.D.a-c.	The nature of science relies upon communication of results and justification of explanations a. Communicate the procedures and results of investigations and explanations through: ¨ oral presentations ¨ drawings and maps ¨ data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ¨ graphs (bar, single, and multiple line) ¨ equations and writings b. * Communicate and defend a scientific argument c. Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed		x

	for subsequent investigations by peers; results can influence the decisions regarding future scientific work)		
CLE 8.3.C.a-c.	**Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent** **a. *Identify and evaluate the need for informed consent in experimentation** **b. *Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment)** **c. *Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)**		x
CLE 8.3.D.a-b.	**Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible** **a. *Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a scientist speaking within or outside his/her area of expertise)** **b. * Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society**		x

OBJECTIVE # 10	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• Missouri State Course Level Expectations

WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
***Evidence of student learning** is a demonstrated understanding of the following:* • Phototropism, or the response to the presence of light. • Photoperiodism, or the response to change in length of the night, that results in flowering in long-day and short-day plants. • In phototropism in plants, changes in the light source lead to differential growth, resulting in maximum exposure of leaves to light for photosynthesis. • In photoperiodism in plants, changes in the length of night regulate flowering and preparation for winter. • Behaviors in animals are triggered by environmental cues and are vital to reproduction, natural selection and survival. • Cooperative behavior within or between populations contributes to the survival of the populations • Endocrine signals are produced by endocrine cells that release signaling molecules, which are specific and can travel long distances through the blood to reach all parts	• Accuracy • Analogous Structure • Archaea • Bacteria • Binomial Nomenclature • Chi-Square • Cladistics • Cladogram • Class • Classification and Biological Diversity • Constant • Control • Deductive Reasoning • Dependent Variable • Eukarya • Family • Genus • Graph	Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems. 1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain. 1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain. 1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain. 1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively. 1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain. Science Practice 2: The student can use mathematics

of the body. • Different receptors recognize different chemical messengers, which can be peptides, small chemicals or proteins, in a specific one-to-one relationship. • A receptor protein recognizes signal molecules, causing the receptor protein's shape to change, which initiates transduction of the signal. • Signaling cascades relay signals from receptors to cell targets, often amplifying the incoming signals, with the result of appropriate responses by the cell. • Second messengers are often essential to the function of the cascade. • Many signal transduction pathways include: i. Protein modifications (an illustrative example could be how methylation changes the signaling process) i. Phosphorylation cascades in which a series of protein kinases add a phosphate group to the next protein in the cascade sequence.	• Homologous Structure • Hypothesis • Independent Variable • Inductive Reasoning • Kingdom • Mean • Median • Model • Observation • Order • Phylogenetic Tree • Phylogeny • Phylum • Precision • Prediction • Rate • Scientific Method • Species • Table • Taxon • Trend • Variable	appropriately. 2.1 The student can justify the selection of a mathematical routine to solve problems. 2.2 The student can apply mathematical routines to quantities that describe natural phenomena. 2.3 The student can estimate numerically quantities that describe natural phenomena. Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course. 3.1 The student can pose scientific questions. 3.2 The student can refine scientific questions. 3.3 The student can evaluate scientific questions. Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question. 4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question. 4.2 The student can design a plan for collecting data to answer a particular scientific question. 4.3 The student can collect data to answer a particular scientific question. 4.4 The student can evaluate sources of data to answer a particular scientific question Science Practice 5: The student can perform data analysis and evaluation of evidence. 5.1 The student can analyze data to identify patterns or relationships. 5.2 The student can refine observations and measurements based on data analysis. 5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question. Science Practice 6: The student can work with scientific explanations and theories. 6.1 The student can justify claims with evidence. 6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices. 6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced. 6.4 The student can make claims and predictions about natural phenomena based on scientific theories and

		models. 6.5 The student can evaluate alternative scientific explanations. Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains. 7.1 The student can connect phenomena and models across spatial and temporal scales. 7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)

• **Presentations**
• **Video Presentations**
• **Chapter Outlines**
• **Guided Readings**
• **Virtual Labs**
• **Inquiry Labs**
  • **Fruit Fly Behavior**
  • **Worm Environment Lab**
  • **Roly Poly Lab**
	• **Exposure to relevant material**
	• **Exposure to relevant material**
	• **Synthesis of relevant material**
	• **Synthesis of relevant material**
	• **Application of relevant material**
	• **Application of relevant material**
		2=Skill/Concept
		2=Skill/Concept
		2=Skill/Concept, 3=Strategic Thinking
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INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Civics, History, Psychology, Mathematics, English	• Builds upon a general understanding of Biology I and Critical Thinking Strategies	• Conducting and Designing Inquiry Lab Investigations
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Section Quizzes** • **Virtual Labs** • **Inquiry Labs** • **Unit Tests**	Form Form/Summ Form/Summ Summ	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP • Test Corrections with written explanations • Lab Corrections with written explanations • Retesting on Unit Tests • Writing their own test questions • Grading their own essays	• Students are presented information using different instructional strategies • Gathering an understanding of why their answers were incorrect • Students need a thorough understanding of the concepts to write or gade their own tests and essays	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AP Exam Multiple Choice Questions • AP Exam Free Response Questions • Designing Their Own Experiments • Conducting Additional Lab Investigations • Supplemental Research	• Be able to answer questions of an AP Exam • Apply knowledge toward extending on labs conducted in class • Apply knowledge toward conducting additional labs • Research additional ideas on applicable, relevant topics	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think**

UNIT TITLE: Organism Form and Function-Immune and Nervous Systems UNIT DURATION:	CONTENT AREA: Science COURSE: AP Biology

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT: • **Campbell/Reece AP Edition Biology** • **AP Biology Investigative Labs: An Inquiry-Based Approach**	**BIG IDEA(S):** **Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.** **Big Idea 3: Living systems store, retrieve, transmit, and respond to information essential to life processes.** **Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.**
ENDURING UNDERSTANDINGS: • Organisms respond to changes in their external environments. **(2.C.2)** • Biological systems are affected by disruptions to their dynamic homeostasis. **(2.D.3)** • Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis. **(2.D.4)** • Cell communication processes share common features that reflect a shared evolutionary history. **(3.D.1)** • Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling. **(3.D.2)** • Changes in signal transduction pathways can alter cellular response. **(3.D.4)** • Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses. **(3.E.2)** • Organisms exhibit complex properties due to interactions between their constituent parts. **(4.A.4)** • Cooperative interactions within organisms promote efficiency in the use of energy and matter. **(4.B.2)**	**ESSENTIAL QUESTIONS:** Organisms respond to changes in their environment through behavioral and physiological mechanisms. • How do disruptions at the molecular and cellular levels affect the health of an organism? • What nonspecific immune responses do plants, invertebrates, and vertebrates have? • What specific immune responses do mammals have, and what causes them? • How does communication involving transduction influence cells, tissues, organs, systems, etc.? • What is the basic structural unit of the nervous system? • What is an action potential and how does it propagate along a neuron? • How is an action potential propagated across synapses? • What are the major regions of the vertebrate brain and what do they control? • How does interaction and coordination between organs and systems provide essential biological activities?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE 3.1.A	**Organisms have basic needs for survival**	X	
CLE 3.1.B.a-b.	**Organisms progress through life cycles unique to different types of organisms** **a. Recognize cells both increase in number and differentiate, becoming specialized in structure and function, during and after embryonic development** **b. * Identify factors (e.g., biochemical, temperature) that may affect the differentiation of cells and the development of an organism**	X	
CLE 3.1.C.a-b.	**Cells are the fundamental units of structure and function of all living things** **a. * Recognize all organisms are composed of cells, the fundamental units of structure and function**	X	

	b. Describe the structure of cell parts (e.g., cell wall, cell membrane, cytoplasm, nucleus, chloroplast, mitochondrion, ribosome, vacuole) found in different types of cells (e.g., bacterial, plant, skin, nerve, blood, muscle) and the functions they perform (e.g., structural support, transport of materials, storage of genetic information, photosynthesis and respiration, synthesis of new molecules, waste disposal) that are necessary to the survival of the cell and organism		
CLE 3.1.E.a-b.	Biological classifications are based on how organisms are related a. * Explain how similarities used to group taxa might reflect evolutionary relationships (e.g., similarities in DNA and protein structures, internal anatomical features, patterns of development) b. * Explain how and why the classification of any taxon might change as more is learned about the organisms assigned to that taxon	X	
CLE 3.2.C	Complex multicellular organisms have systems that interact to carry out life processes through physical and chemical means	X	
CLE 3.2.F.a-c.	Cellular activities and responses can maintain stability internally while external conditions are changing (homeostasis) a. Explain the significance of the selectively permeable membrane to the transport of molecules b. Predict the movement of molecules across a selectively permeable membrane (i.e., diffusion, osmosis, active transport) needed for a cell to maintain homeostasis given concentration gradients and different sizes of molecules c. Explain how water is important to cells (e.g., is a buffer for body temperature, provides soluble environment for chemical reactions, serves as a reactant in chemical reactions, provides hydration that maintains cell turgidity, maintains protein shape)	X	
CLE 3.2.G	Life processes can be disrupted by disease (intrinsic failures of the organ systems or by infection due to other organisms)	X	
CLE 3.3.B.d-e	All living organisms have genetic material (DNA) that carries hereditary information d. * Explain how an error in the DNA molecule (mutation) can be transferred during replication e. Identify possible external causes (e.g., heat, radiation, certain chemicals) and effects of DNA mutations (e.g., altered proteins which may affect chemical reactions and structural development)	X	
CLE 4.3.B.b	Reproduction is essential to the continuation of every species b. Explain the importance of reproduction to the survival of a species (i.e., the failure of a species to reproduce will lead to extinction of that species)	X	
CLE 5.2.F	Climate is a description of average weather conditions in a given area due to the transfer of energy and matter through Earth's systems	X	
CLE 6.1.B.a	The Earth has a composition and location suitable to sustain life a. * Explain how Earth's environmental characteristics and location in the universe (e.g., atmosphere, temperature, orbital path, magnetic field, mass-gravity, location in solar system) provide a life-supporting environment	X	
CLE 8.3.B.c	Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology c. *Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, use of alternative energies for carbon fuels, use of pesticides		X
CLE 8.3.C.a-c.	Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent a. *Identify and evaluate the need for informed consent in experimentation b. *Identify the ethical issues involved in experimentation (i.e., risks to organisms or		X

	environment) **c. *Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)**		
CLE 8.3.D.a-b.	**Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible** **a. *Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a scientist speaking within or outside his/her area of expertise)** **b. * Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society**		x

OBJECTIVE # 11	
REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*	• Missouri State Course Level Expectations

WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
***Evidence of student learning** is a demonstrated understanding of the following:* • The mammalian immune system includes two types of specific responses: cell mediated and humoral. • In the cell-mediated response, cytotoxic T cells, a type of lymphocytic white blood cell, "target" intracellular pathogens when antigens are displayed on the outside of the cells. • In the humoral response, B cells, a type of lymphocytic white blood cell, produce antibodies against specific antigens. • Antigens are recognized by antibodies to the antigen. • Antibodies are proteins produced by B cells, and each antibody is specific to a particular antigen. • A second exposure to an antigen results in a more rapid and enhanced immune response. • Endocrine signals are produced by endocrine cells that release signaling molecules, which are specific and can travel long distances through the blood to reach all parts of the body. • A typical neuron has a cell body, axon and dendrites. Many axons have a myelin sheath that acts as an electrical insulator. • The structure of the neuron allows for the detection, generation, transmission and integration of signal information. • Schwann cells, which form the myelin sheath, are separated by gaps of unsheathed axon over which the impulse travels as the signal propagates along the neuron. • Membranes of neurons are polarized by the establishment of	• Accuracy • Action Potential • Active Immunity • Allergens • Antibody • Antigen • Artificial Immunity • Autoimmune • B-Cells • Benign • Cerebellum • Cerebrum • Chi-Square • Clonal Selection • Constant • Control • Cortex • Deductive Reasoning • Dependent Variable • Disease • Endothermic	Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems. 1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain. 1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain. 1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain. 1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively. 1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain. Science Practice 2: The student can use mathematics appropriately.

electrical potentials across the membranes. • In response to a stimulus, Na^+ and K^+ gated channels sequentially open and cause the membrane to become locally depolarized. • Na^+/K^+ pumps, powered by ATP, work to maintain membrane potential. • In most animals, transmission across synapses involves chemical messengers called neurotransmitters. • Transmission of information along neurons and synapses results in a response. • The response can be stimulatory or inhibitory. • Within multicellular organisms, specialization of organs contributes to the overall functioning of the organism. • Interactions among cells of a population of unicellular organisms can be similar to those of multicellular organisms, and these interactions lead to increased efficiency and utilization of energy and matter.	• Excretion • Exothermic • Graph • Homeostasis • Hormone • Hypothalamus • Hypothesis • Immunity • Independent Variable • Inductive Reasoning • Inflammation • Inhibition • Interstitial • Lymphocytes • Macrophage • Malignant • Mean • Median • Medulla Oblongata • Model • Motor Neuron • Myelin • Natual Immunity • Neuromuscular Junction • Neuron • Neurotransmitter • Observation • Passive Immunity • Pathogen • Pathology • Phagocyte • Precision • Prediction • Rate • Scientific Method	2.1 The student can justify the selection of a mathematical routine to solve problems. 2.2 The student can apply mathematical routines to quantities that describe natural phenomena. 2.3 The student can estimate numerically quantities that describe natural phenomena. Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course. 3.1 The student can pose scientific questions. 3.2 The student can refine scientific questions. 3.3 The student can evaluate scientific questions. Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question. 4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question. 4.2 The student can design a plan for collecting data to answer a particular scientific question. 4.3 The student can collect data to answer a particular scientific question. 4.4 The student can evaluate sources of data to answer a particular scientific question Science Practice 5: The student can perform data analysis and evaluation of evidence. 5.1 The student can analyze data to identify patterns or relationships. 5.2 The student can refine observations and measurements based on data analysis.

	• Sensory Neuron • Spinal Cord • Synapse • Table • T-Cells • Trend • Vaccination • Variable	5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question. Science Practice 6: The student can work with scientific explanations and theories. 6.1 The student can justify claims with evidence. 6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices. 6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced. 6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models. 6.5 The student can evaluate alternative scientific explanations. Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains. 7.1 The student can connect phenomena and models across spatial and temporal scales. 7.2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.
FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Presentations** • **Video Presentations** • **Chapter Outlines** • **Guided Readings** • **Virtual Labs** • **Inquiry Labs**	• **Exposure to relevant material** • **Exposure to relevant material** • **Synthesis of relevant material** • **Synthesis of relevant material** • **Application of relevant material**	**2=Skill/Concept** **2=Skill/Concept** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **3=Strategic Thinking, 4=Extended Thinking** **3=Strategic Thinking, 4=Extended Thinking**

• **Fatigue Lab** • **Systems Physiology Lab**	• **Application of relevant material**	
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• Civics, History, Psychology, Mathematics, English	• Builds upon a general understanding of Biology I and Critical Thinking Strategies	• Conducting and Designing Inquiry Lab Investigations
HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Section Quizzes** • **Virtual Labs** • **Inquiry Labs** • **Unit Tests**	Form Form/Summ Form/Summ Summ	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**
HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED? *Possible Interventions*		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AIP • Test Corrections with written explanations • Lab Corrections with written explanations • Retesting on Unit Tests • Writing their own test questions • Grading their own essays	• Students are presented information using different instructional strategies • Gathering an understanding of why their answers were incorrect • Students need a thorough understanding of the concepts to write or gade their own tests and essays	**2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think**

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• AP Exam Multiple Choice Questions • AP Exam Free Response Questions • Designing Their Own Experiments • Conducting Additional Lab Investigations • Supplemental Research	• Be able to answer questions of an AP Exam • Apply knowledge toward extending on labs conducted in class • Apply knowledge toward conducting additional labs • Research additional ideas on applicable, relevant topics	**2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **2=Skill/Concept, 3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think** **3=Strategic Thinking, 4=Ext. Think**

AP Chemistry/Chemistry Lab Curriculum

CONTENT AREA: High School Science COURSE: AP Chemistry	UNIT TITLE: Structure of Matter UNIT DURATION: 6 Weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- **Reading (s)/Handouts**
- **Manipulatives/Lab & Safety Equipment**
- **Technology**
- **Websites**
- **Video Links/DVDs/Recordings**

BIG IDEA(S):

- **The chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms. These atoms retain their identity in chemical reactions.**

ENDURING UNDERSTANDINGS:

- **All matter is made of atoms.**
- **The atoms of each element have unique structures arising from interactions between electrons and nuclei.**
- **Elements display periodicity in their properties when the elements are organized according to increasing atomic number.**
- **Atoms are so small that they are difficult to study directly; atomic models are constructed to explain experimental data on collections of atoms.**
- **Atoms are conserved in physical and chemical processes.**

ESSENTIAL QUESTIONS:

- **What are molecules composed of?**
- **How do chemists identify a substance?**
- **How is the mole used?**
- **What is the structure of an atom?**
- **How do chemists describe the electron structure of an atom?**
- **How are periodic trends related to the electronic structure of an atom?**
- **How does the quantum mechanical model describe an atom?**
- **How are atomic models used?**
- **How is mass spectrometry data used to provide evidence for atomic models?**
- **How are physical and chemical processes depicted?**
- **How is the law of conservation of mass utilized?**

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT? Standards, Concepts, Content, Skills, Products, Vocabulary			
REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
AP LO 1.1 – 1.20	*Specific learning objectives provided in the AP Chemistry Curriculum Framework*	*x*	
CLE 1.2.C.a	*Describe how electromagnetic energy is transferred through space as electromagnetic waves of varying wavelength and frequency*	*x*	
AP SP 1	*The student can use representations and models to communicate scientific phenomena and solve scientific problems.*		
AP SP 2	*The student can use mathematics appropriately*	*x*	
AP SP 3	*The student can engage in scientific questions to extend thinking or to guide investigations within the context of the AP course.*	*x*	
AP SP 4	*The student can plan and implement data collections strategies in relation to a particular scientific question.*	*x*	
AP SP 5	*The student can perform data analysis and evaluation of evidence.*	*x*	
AP SP 6	*The student can work with scientific explanations and theories.*	*X*	
AP SP 7	*The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.*	*X*	

OBJECTIVE REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS

- CLE Strand 1

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• All matter is made up of atoms. • Chemical analysis provides a method for determining the relative number of atoms in a substance. • The unique structure of an element arises from interactions between electrons and nuclei. • Periodicity is a useful principle for understanding properties and predicting trends in properties. • Atomic models are constructed to explain experimental data on collections of atoms. • Atoms are conserved in chemical and physical changes.	• How to apply mathematical routines to mass data to identify the composition of a pure substance. • How to use mathematical relationships to quantitatively connect substances to one another. • How Coulomb's law is used to explain the distribution of electrons. • How spectroscopy is used to determine the concentration of a solution.	• Design and conduct a valid experiment. • Manipulate laboratory equipment safely. • Interpret data from scientific experiments. • Predict and justify trends in atomic properties. • Explain the distribution of electrons in an atom or ion based upon data. • Describe the electronic structure of the atom. • Apply the law of conservation of mass to the rearrangement of atoms in various processes.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Model Problem Solving Strategies** • **Demos**	• Representing Chemical Equations and Stoichiometry Activity • Periodic Table Graphing Activity • Formula of a Hydrate **Lab** • Stoichiometry Lab • Spectrum and Spectroscopy Lab • Determining Solution Concentration Using a Spectrophotometer Lab	• 3 and 4
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• **CLE Strand 8.2.A/8.2.B** • **CCSS M4** • **CCSS E4**	• **Algebraic Expression** • **Basic Atomic Structure** • **Element Symbols** • **Basic Laboratory Skills** • **Periodic Table Structure**	• **CLE Strand 7**

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?		
ASSESSMENT DESCRIPTION	**FORMATIVE OR SUMMATIVE?**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs	• S	• 3 /4
• Unit Tests	• S	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction	• Practice and retest	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	• 4

CONTENT AREA: High School Science COURSE: AP Chemistry	UNIT TITLE: Properties of Matter-Characteristics, States, and Forces of Attraction UNIT DURATION: 5 weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- **Reading (s)/Handouts**
- **Manipulatives/Lab & Safety Equipment**
- **Technology**
- **Websites**
- **Video Links/DVDs/Recordings**

BIG IDEA(S):

- **Chemical and physical properties of materials can be explained by the structure and the arrangement of atoms, ions, or molecules and the forces between them.**

ENDURING UNDERSTANDINGS:

- **Matter can be described by its physical properties.**
- **Forces of attraction between particles are important in determining many macroscopic properties of a substance.**
- **The strong electrostatic forces of attraction holding atoms together in a unit are called chemical bonds.**
- **The types of bonding in the solid state can be deduced from the properties of the solid state.**

ESSENTIAL QUESTIONS:

- **How can differences in structure account for the different properties of solids and liquids?**
- **How can the gaseous state be modeled using mathematical equations?**
- **What are solutions and what determines the physical properties of solutions?**
- **What are London dispersion forces?**
- **What determines a dipole-dipole force?**
- **How do intermolecular forces contribute to the properties of a substance?**
- **What determines the distribution of electrons and the polarity of a covalent bond?**
- **What is an ionic bond?**
- **How are Lewis diagrams and the VSEPR model used to describe bonding?**
- **What are the properties of ionic solids?**
- **What are the properties of metallic solids?**
- **What are the properties of covalent network solids?**
- **What are the properties of molecular solids?**

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR	SUPPORTING

i.e. GLE/CLE/MLS/NGSS		**STANDARD**	**STANDARD**
AP LO 2.1-2.32	*Specific learning objectives provided in the AP Chemistry Curriculum Framework*	*x*	
AP SP 1	*The student can use representations and models to communicate scientific phenomena and solve scientific problems.*	*x*	
AP SP 2	*The student can use mathematics appropriately*	*x*	
AP SP 5	*The student can perform data analysis and evaluation of evidence.*	*x*	
AP SP 6	*The student can work with scientific explanations and theories.*	*x*	
AP SP 7	*The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.*	*x*	

OBJECTIVE
REFERENCES/STANDARDS •
i.e. GLE/CLE/MLS/NGSS

WHAT SHOULD STUDENTS…

UNDERSTAND?

Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.

- The physical properties of a substance generally depend on the spacing between the particles that make up the substance and the forces of attraction among them.
- The gaseous state can be effectively modeled with a mathematical equation.
- Solutions are homogeneous mixtures in which the physical properties are dependent on the concentration of the solute and the strengths of all interactions among the particles of the solute and the solvent.
- London dispersion forces are attractive forces present between all atoms and molecules.
- Dipole forces result from the attraction among the positive ends and negative ends of polar molecules.
- Intermolecular forces play a key role in determining the properties of substances.
- In covalent bonding, electrons are shared between the nuclei of two atoms.
- The localized bonding models describes and predicts molecular geometry using Lewis diagrams and the VSEPR model.
- Type of bonding can be used to predict the properties of a substance.

KNOW?

Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY

- Different properties of solids and liquids can be explained by differences in their structures.
- The mathematical relationships among the number of particles present, the temperature, the pressure and volume for ideal gases.
- How to express solution composition.
- How solution components are separated by chromatography.
- London dispersion forces are often the strongest net intermolecular force between large molecules.
- Hydrogen bonding is a strong type of dipole-dipole force.
- Electronegativity differences between two atoms account for the distribution of shared electrons and polarity of the bond.
- Ionic bonding results from the net attraction between oppositely charged ions.
- Metallic bonding describes an array of positively charged metal cores surrounded by a sea of mobile valence electrons.

BE ABLE TO DO?

Skills; Products

- Predict properties of substances based on their chemical formulas.
- Explain the relative strengths of acids and bases based on molecular structure and solution equilibrium.
- Use particulate models to reason about observed differences between solid and liquids.
- Use KMT and concepts of intermolecular forces to make predictions about the macroscopic properties of gases.
- Apply mathematical relationships to determine macroscopic variables for ideal gases.
- Prepare solutions of specified molarity.
- Draw representations of solutions that show interactions between the solute and solvent.
- Explain trends in properties of samples on the basis of London dispersion forces.
- Describe the relationships between the structural features of polar molecules and the forces of attraction between the particles.
- Explain the properties of small and large molecular compounds in terms of strengths and types of intermolecular forces.
- Rank bond polarity on the basis of the locations of the bonded atoms in the periodic table.
- Create visual representations of ionic

		substances. • Explain how a bonding model involving delocalized electrons is consistent with macroscopic properties of metals. • Use Lewis diagrams and VSEPR to predict the geometry of molecules. • Explain a representation that connects properties of a solid to the interactions present at the atomic level.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Model Problem Solving Strategies** • **Demos**	• Molecular Geormetry Activity • Molar Volume of a Gas Lab • Pressure-Temperature Relationship in Gases Lab • Bonding Lab • Vapor Pressure of Liquids	• 3/4

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• **CLE Strand 8.2.A/8.2.B** • **CCSS M4** • **CCSS E4**	• **Algebraic Expression**	• **CLE Strand 7**

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs	• S	• 4
• Unit Tests	• S	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction •	• Practice and retest •	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	• 4

CONTENT AREA: High School Science COURSE: AP Chemistry	UNIT TITLE: Chemical Reactions UNIT DURATION: 6 Weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- **Reading (s)/Handouts**
- **Manipulatives/Lab & Safety Equipment**
- **Technology**
- **Websites**
- **Video Links/DVDs/Recordings**

BIG IDEA(S):

- **Changes in matter involve the rearrangement and/or reorganization of atoms and/or transfer of electrons.**

ENDURING UNDERSTANDINGS:

- **Chemical changes are represented by a balanced chemical equation that identifies the ratios with which reactants react and products form.**
- **Chemical reactions can be classified by considering what the reactants are, what the products are or how they change from one into the other.**
- **Chemical and physical transformations may be observed in several ways and typically involve a change in energy.**

ESSENTIAL QUESTIONS:

- **How are chemical changes represented by molecular, ionic or net ionic equations?**
- **How can quantitative information be derived from stoichiometric calculations?**
- **What are synthesis reactions?**
- **How are decomposition reactions different than synthesis reactions?**
- **What occurs in a neutralization reaction?**
- **What is an oxidation-reduction reaction?**
- **What are evidences that a chemical change has occurred?**
- **What distinguishes an endothermic reaction from an exothermic reaction?**
- **How is chemical energy converted to electrical energy?**

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT? Standards, Concepts, Content, Skills, Products, Vocabulary			
REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
AP LO 3.1-3.13	*Specific learning objectives provided in the AP Chemistry Curriculum Framework*	*x*	
AP SP 1	*The student can use representations and models to communicate scientific phenomena and solve scientific problems.*	*x*	
AP SP 2	*The student can use mathematics appropriately*	*x*	
AP SP 4	*The student can plan and implement data collection strategies in relation to a particular scientific question.*	*x*	
AP SP 5	*The student can perform data analysis and evaluation of evidence.*	*x*	
AP SP 6	*The student can work with scientific explanations and theories.*	*x*	
AP SP 7	*The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.*	*x*	

OBJECTIVE
REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• A chemical change may be represented by a molecular, ionic or net ionic equation. • Quantitative information can be derived from stoichiometric calculations. • Classes of chemical reactions include synthesis, decomposition, acid-base, and oxidation-reduction reactions. • Production of heat or light, formation of a gas, and formation of a precipitate and/or a color change are possible evidences that a chemical change has occurred. • Electrochemistry encompasses the study of redox reactions that occur with electrochemical cells.	• Chemical equations represent chemical changes. • Coefficients of balanced chemical equations contain information regarding the proportionality of the amounts of substances involved in the reaction. • Synthesis reactions are those in which atoms or molecules combine to form a new compound. • Decomposition is the reverse of synthesis. • In a neutralization reaction, protons are transferred from an acid to a base. • In oxidation-reduction reactions, there is a net transfer of electrons. • Net changes in energy for a chemical reaction can be endothermic or exothermic. • Electrochemistry shows the interconversion between chemical and electrical energy in galvanic and electrolytic cells.	• Translate an observed chemical change into a balanced chemical equation. • Use stoichiometric calculations to predict the results of performing a reaction in the laboratory. • Design a plan to collect data on the synthesis or decomposition of a compound to confirm the conservation of matter and the law of definite proportions. • Identify compounds as Bronsted-Lowry acids, bases and/or conjugate acid-base pairs. • Identify redox reactions and justify the identification in terms of electron transfer. • Classify a process as a chemical or physical change. • Interpret observations regarding macroscopic energy changes associate with a reaction. • Made qualitative or quantitative predictions about galvanic or electrolytic reactions base on half-cell reactions and potentials and/or Faraday's laws.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET**

		(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Model Problem Solving Strategies** • **Demos**	• Acid-Base Neutralization Activity • pH Titration Lab • Stoichiometry Lab • Voltaic Cell Lab	• **3/4**

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• **CLE Strand 8.2.A/8.2.B** • **CCSS M4** • **CCSS E4**	• **Algebraic Expression**	• **CLE Strand 7**

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs	• S	• 4
• Unit Tests	• S	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction •	• Practice and retest	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET

		(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	• 4

CONTENT AREA: High School Science **COURSE: AP Chemistry**	**UNIT TITLE: Rates of Chemical Reactions** **UNIT DURATION: 6 Weeks**

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- **Reading (s)/Handouts**
- **Manipulatives/Lab & Safety Equipment**
- **Technology**
- **Websites**
- **Video Links/DVDs/Recordings**

BIG IDEA(S):

- **Rates of chemical reactions are determined by details of the molecular collisions.**

ENDURING UNDERSTANDINGS:

- **Reaction rates that depend on temperature and other environmental factors are determined by measuring changes in concentrations of reactants and products over time.**
- **Elementary reactions are mediated by collisions between molecules.**
- **Many reactions proceed via a series of elementary reactions.**
- **‘Reaction rates may be increased by the presence of a catalyst.**

ESSENTIAL QUESTIONS:

- **What influences the rate of a reaction?**
- **What does a rate law indicate?**
- **What does the rate constant contain?**
- **What are elementary reactions?**
- **What do collisions need to be successful?**
- **How can a successful collision be viewed?**
- **What does the mechanism of a multistep reactions consist of?**
- **What is a rate-limiting step?**
- **What are reaction intermediates?**
- **How do catalysts work?**
- **What are the important classifications of catalysts?**

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT? Standards, Concepts, Content, Skills, Products, Vocabulary			
REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
AP LO 4.1 – 4.9	*Specific learning objectives provided in the AP Chemistry Curriculum Framework*	*x*	
AP SP 1	*The student can use representations and models to communicate scientific phenomena and solve scientific problems.*	*x*	
AP SP 4	*The student can plan and implement data collection strategies in relation to a particular scientific question.*	*x*	
AP SP 5	*The student can perform data analysis and evaluation of evidence.*	*x*	
AP SP 6	*The student can work with scientific explanations and theories.*	*x*	
AP SP 7	*The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.*	*x*	
CLE 1.1.H.b	*Predict the reaction rates of different substances based on their properties (i.e., concentrations of reactants, pressure, temperature, state of matter, surface area, type of reactant material)*	*x*	

OBJECTIVE
REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• The rate of a reaction is influenced by the concentration or pressure of reactants, the phase of the reactants and products, and environmental factors such as temperature and solvent. • The rate law shows how the rate depends on reactant concentrations. • The magnitude and temperature dependence of the rate of reaction is contained quantitatively in the rate constant. • Elementary reactions can be unimolecular or involve collisions between two or more molecules. • A successful collision can be viewed as following a reaction path with an associated energy profile. • The mechanism of a multistep reaction consists of a series of elementary reactions that add up to the overall reaction.	• The rate of a reaction is measured by the amount of reactants converted to products per unit of time. • The rate law expresses the rate of a reaction as proportional to the concentration of each reactant raised to a power. • The proportionality constant in the rate law is called the rate constant. • The order of an elementary reaction can be inferred from the number of molecules participating in a collision. • Not all collisions are successful. • In many reactions, the rate is set by the slowest elementary reaction. • Catalysts function by lowering the activation energy of an elementary step in a reaction mechanism.	• Design and/or interpret the results of an experiment regarding the factors that may influence the rate of a reaction. • Analyze concentration versus time data to determine the rate law for zeroth-, first-, or second-order reactions. • Connect the half-life of a reaction to the rate constant of a first-order reaction. • Connect the rate law for an elementary reaction to the frequency and success of molecular collisions. • Explain the difference between collisions that convert reactants to products and those that do not in terms of energy and molecular orientations. • Use representations of the energy profile fo an elementary reaction to make qualitative predictions regarding the relative temperature dependence of the reaction rate. • Translate among reaction energy profile representations, particulate representations and symbolic representations of a chemical reaction occurring in the presence and absence of a catalyst.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Model Problem Solving Strategies** • **Demos**	• Online Kinetics Activity • POGIL - Kinetics • Determining the Rate Law of a Crystal Violet Reaction Lab	• 3/4
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• **CLE Strand 8.2.A/8.2.B** • **CCSS M4** • **CCSS E4**	• Algebraic Expression	• **CLE Strand 7**

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs	• S	• 4
• Unit Tests	• S	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?
Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction	• Practice and retest	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?
Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic

		Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	• 4

CONTENT AREA: High School Science COURSE: AP Chemistry	UNIT TITLE: Thermodynamics UNIT DURATION: 6 Weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- **Reading (s)/Handouts**
- **Manipulatives/Lab & Safety Equipment**
- **Technology**
- **Websites**
- **Video Links/DVDs/Recordings**

BIG IDEA(S):

- **The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.**

ENDURING UNDERSTANDINGS:

- **Two systems with different temperatures that are in thermal contact will exchange energy.**
- **Energy is neither created nor destroyed, but only transformed from one form to another.**
- **Breaking bonds required energy, and making bonds releases energy.**
- **Electrostatic forces exist between molecules as well as between atoms or ions, and breaking the resultant intermolecular interactions requires energy.**
- **Chemical or physical processes are driven by a decrease in enthalpy or an increase in entropy, or both.**

ESSENTIAL QUESTIONS:

- **What is temperature?**
- **What is heat?**
- **What is heat transfer and in which direction is it spontaneous?**
- **How is energy transferred between systems?**
- **How does the energy that comes out of one system compare to the energy that goes into the other system?**
- **What are the three main processes that change the energy of a chemical system?**
- **What is calorimetry?**
- **How is potential energy related to the geometric arrangement of atoms or ions?**
- **How is the net energy change of a chemical reaction determined?**
- **How is potential energy related to the interaction of molecules?**
- **How can chemical processes be distinguished from physical processes at the particulate scale?**
- **What is the role of noncovalent and intermolduclar interactions in biological systems?**
- **What is entropy?**
- **When is a process “thermodynamically favored”?**
- **How is Gibbs free energy used to determine whether a process is thermodynamically favored?**
- **Do thermodynamically favored processes always occur?**

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary			
REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
AP LO 5.1 – 5.18	*Specific learning objectives provided in the AP Chemistry Curriculum Framework*	*x*	
AP SP 1	*The student can use representations and models to communicate scientific phenomena and solve scientific problems.*	*x*	
AP SP 2	*The student can use mathematics appropriately*		
AP SP 4	*The student can plan and implement data collection strategies in relation to a particular scientific question.*	*x*	
AP SP 5	*The student can perform data analysis and evaluation of evidence.*	*x*	
AP SP 6	*The student can work with scientific explanations and theories.*	*x*	
AP SP 7	*The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.*	*x*	
CLE 1.2.A.c	*Describe sources and common uses of different forms of energy: chemical (the energy stored in the electrical fields between atoms in a compound), nuclear, thermal, mechanical, electromagnetic*	*x*	
CLE 1.2.B.a	*Relate kinetic energy to an object's mass and its velocity*	*x*	

OBJECTIVE REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS

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WHAT SHOULD STUDENTS…

UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.

- Temperature is a measure of the average kinetic energy of atoms and molecules.
- The process of kinetic energy transfer at the particulate scale is referred to as heat transfer.
- Energy is transferred between systems either through heat transfer or through one system doing work of the other system.
- Chemical systems undergo three main processes that change their energy: heating/cooling, phase transitions, and chemical reactions.
- Potential energy is associated with a particular geometric arrangement of atoms or ions and the electrostatic interactions between them.
- Entropy is a measure of the dispersal of matter and energy.
- Processes are thermodynamically favored when they involve both a decrease in the internal energy of the components and an increase in the entropy of those components.

KNOW?
Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY

- All molecules in a sample are in motion.
- The spontaneous direction of the transfer of heat is always form a hot to a cold body.
- When two systems are in contact with each other and are otherwise isolated, the energy that comes out of one system is equal to the energy that goes into the other system.
- Heating a system increases the energy of the system, while cooling a system decreases the energy.
- Calorimetry is an experimental technique that is used to determine the heat exchanged/transferred in a chemical system.
- The net energy change during a reaction is the sum of the energy required to break the bonds in the reactant molecules and the energy released in forming the bonds of the product molecules.
- Entropy is increased when matter is dispersed.
- The Gibbs free energy change can be used to determine whether a process is thermodynamically favored.

BE ABLE TO DO?
Skills; Products

- Relate temperature to the motions of particles.
- Make predictions about the transfer of thermal energy between systems.
- Use conservation of energy to relate the magnitudes of the energy changes occurring in two or more interacting systems.
- Use calculations to relate energy changes associated with heating/cooling a substance to the heat capacity, relate energy changes associated with a phase transition to the enthalpy of fusion/vaporizations, related energy changes associated with a chemical reaction to the enthalpy of the reaction, and relate energy changes to $P\Delta V$ work.
- Design and/or interpret the results of an experiment in which calorimetry is used to determine the change in enthalpy of a chemical process.
- Draw qualitative and quantitative connections between the reaction enthalpy and the energies involved in the breaking and formation of chemical bonds.
- Make predictions regarding the relative magnitudes of the forces acting within collections of interacting molecules based on the distribution of electrons within the molecules and the types of intermolecular forces through which the molecules interact.

- Use representations and models to predict the sign and relative magnitude of the entropy change associated with chemical or physical processes.
- Determine whether or not a process is thermodynamically favored by calculating the change in standard Gibbs free energy.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Model Problem Solving Strategies** • **Demos**	• Online Heating and Cooling Curve Simulations • Heat of Formation of a Compound Lab • Solubility and Determination of $\Delta H°$, $\Delta S°$, $\Delta G°$ of Calcium Hydroxide L a b • Voltaic Cell Lab	• 3/4
INTERDISCIPLINARY CONNECTION	**PRIOR KNOWLEDGE CONNECTIONS**	**INQUIRY CONNECTIONS**
• **CLE Strand 8.2.A/8.2.B** • **CCSS M4** • **CCSS E4**	• Algebraic Expression	• **CLE Strand 7**

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs	• S	• 4
• Unit Tests	• S	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction	• Practice and retest	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	• 4

CONTENT AREA: High School Science COURSE: AP Chemistry	UNIT TITLE: Equilibrium UNIT DURATION: 6 Weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- **Reading (s)/Handouts**
- **Manipulatives/Lab & Safety Equipment**
- **Technology**
- **Websites**
- **Video Links/DVDs/Recordings**

BIG IDEA(S):

- **Any bond or intermolecular attraction that can be formed can be broken. These two processes are in a dynamic competition, sensitive to initial conditions and external perturbations.**

ENDURING UNDERSTANDINGS:

- **Chemical equilibrium is a dynamic, reversible state in which rates of opposing processes are equal.**
- **Systems at equilibrium are responsive to external perturbations, with the response leading to a change in the composition of the system.**
- **Chemical equilibrium plays an important role in acid-base chemistry and in solubility.**
- **The equilibrium constant is related to temperature and the difference in Gibbs free energy between reactants and products.**

ESSENTIAL QUESTIONS:

- **How are reversible reactions characterized?**
- **What is equilibrium?**
- **What does the magnitude of the equilibrium constant indicate?**
- **How can LeChatelier's principle be used to predict the response of a system to stresses?**
- **How does a system respond when Q differs from K?**
- **How can chemical equilibrium reasoning be used to describe the proton-transfer reactions of acid-base chemistry?**
- **What is pH?**
- **How can pH be controlled by buffers?**
- **How does equilibrium relate to the solubility of a substance?**
- **How is the difference in Gibbs free energy between reactants and products related to the equilibrium constant?**

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary			
REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
AP LO 6.1 – 6.25	*Specific learning objectives provided in the AP Chemistry Curriculum Framework*	*x*	
AP SP 1	*The student can use representations and models to communicate scientific phenomena and solve scientific problems.*	*x*	
AP SP 2	*The student can use mathematics appropriately*		
AP SP 4	*The student can plan and implement data collection strategies in relation to a particular scientific question.*	*x*	
AP SP 5	*The student can perform data analysis and evaluation of evidence.*	*x*	
AP SP 6	*The student can work with scientific explanations and theories.*	*x*	
AP SP 7	*The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.*	*x*	
CLE 1.2.A.c	*Describe sources and common uses of different forms of energy: chemical (the energy stored in the electrical fields between atoms in a compound), nuclear, thermal, mechanical, electromagnetic*	*x*	
CLE 1.2.B.a	*Relate kinetic energy to an object's mass and its velocity*	*x*	

OBJECTIVE REFERENCES/STANDARDS •
i.e. GLE/CLE/MLS/NGSS

WHAT SHOULD STUDENTS…		
UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• IN many classes of reactions, it is important to consider both the forward and reverse reaction. • The current state of a system undergoing a reversible reaction can be characterized by the extent to which reactants have been converted to products. • When a system is at equilibrium, all macroscopic variables do not change over time. • Systems at equilibrium respond to disturbance by partially countering the effect of the disturbance. • Chemical equilibrium plays an important role in acid-base chemistry and in solubility.	• The relative quantities of reaction components are quantitatively describe by the reaction quotient Q. • Equilibrium results from an equality between the rates of the forward and reverse reactions. • The magnitude of the equilibrium constant can be used to determine whether the equilibrium lies toward the reactant or product side. • Le Chatelier's principle can be used to predict the response of a system to stresses. • Chemical equilibrium reasoning can be used to describe the proton transfer reactions of acid-base chemistry. • pH is an important characteristic of aqueous solutions that can be controlled with buffers. • The solubility of a substance can be understood in terms of chemical equilibrium.	• Determine the effects of a given manipulation of a chemical reaction on Q or K. • Connect kinetics to equilibrium by using reasoning (Le Chatelier's principle) to infer the relative rates of the forward and reverse reactions. • Given a set of initial conditions and the equilibrium constant predict whether the reaction will proceed toward the reactants or products as equilibrium is approached. • Given data, calculate the equilibrium constant. • Given a set of initial conditions, and the equilibrium constant, determine quantitatively the conditions at equilibrium. • Use Le Chatelier's principle to predict the direction of the shift resulting from stresses on a system. • Given a mixture of weak and strong acids and bases, determine which species will react strongly with one another and what species will be present in large concentrations at equilibrium. • Design a buffer solution with a target pH and buffer capacity. • Predict the solubility of a salt given the relative Ksp value. • Express the equilibrium constant in terms of ΔG^0 and RT and use this relationship to estimate the magnitude of K.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• **Lecture/Notes** • **Model Problem Solving Strategies** • **Demos**	• Online Gas Phase Equilibrium Activity • Application of Le Chatelier's Principle Lab • Determining K_a by Half Titration • Preparation of a Buffer • Determination of the Solubility Product of an Ionic Compound	• 3/4

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• **CLE Strand 8.2.A/8.2.B** • **CCSS M4** • **CCSS E4**	• Algebraic Expression	• **CLE Strand 7**

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Labs	• S	• 4
• Unit Tests	• S	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Consider the data and group students according to needs to focus on filling the gaps. • Use supplemental material that supports core instruction. • Reteach core instruction	• Practice and retest	• 3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Additional study/project opportunities at higher level .	• Formulate and complete an independent study.	• 4

AP Physics Curriculum

CONTENT AREA: Science **COURSE: AP Physics**	**UNIT TITLE: Strand 1: Kinematics (1 and 2 dimensional)** **UNIT DURATION: 6 weeks (revisiting throughout year)**

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- Virtual Textbook: Physics for Scientists and Engineers by Knight
- Various lab equipment

ENDURING UNDERSTANDINGS:

- Motion can only be defined relative to an arbitrary frame of reference. Reference frames can be inertial or non-inertial.
- Graphs and equations can be used to model and predict motion. Calculus gives us tools for analyzing non-linear graphs.
- Two-dimensional motion can be broken into perpendicular components that are independent of each other. Because of this, one dimensional models can be used to analyze any two dimensional motion, such as circular or projectile motion.

BIG IDEA(S):

- Graphs, equations and diagrams can be used to model and predict motion. Calculus provides tools to analyze complex motion.

ESSENTIAL QUESTIONS:

- How can we model and predict the motion of an object?
- How can calculus be used to model and analyze complex motion?
- How do we model two-dimensional motion, such as circular motion?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
CLE: Strand 2-1A, a-b	The motion of an object is described as a change in position, direction and speed relative to a frame of reference.		x
CLE: Strand 2-1B, a	An object that is acceleration is speeding up, slowing down, or changing directions.		x
CLE: Strand 2-2B, d	All falling bodies accelerate at the same rate due to gravity regardless of mass		x
AP: Strand A, 1 and 2	Kinematics – Motion in One and Two Dimensions	x	

OBJECTIVE # ??
REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS

- AP Physics C: Mechanics Course Standards: all of Strand A

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Students should understand the general relationships among position, velocity and acceleration for the motion of a particle along a straight line. • Students should understand the general motion of a particle in two dimensions so that, given functions of components (x and y or radial and tangential) which describe this motion, they can determine the components, magnitude, and direction of the particle's velocity and acceleration as functions of time.	• Definitions of vector terminology, such as magnitude, component, resolve, and resultant. • Definitions of common kinematics terms such as position, displacement, velocity, and acceleration. • Definitions of terms involving circular motion, such as centripetal, tangential, radial, and period.	• Given a graph of one of the kinematic quantities, position, velocity or acceleration, as a function of time, they can identify or sketch a graph of the others as a function of time. (Special attention to max/min, and intercept values.) • Given an expression for one of the kinematic quantities, position, velocity or acceleration, as a function of time, they can determine the other two as a function of time, and find when these quantities are zero or achieve their maximum and minimum values. • Use the equations $\vec{x} = \vec{x}_0 + \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$, $\vec{v} = \vec{v}_0 + \vec{a}t$ and $v^2 = v_0^2 + 2\vec{a}\overrightarrow{\Delta x}$ to solve problems involving one-dimensional motion with constant acceleration. Also, apply these same equations to problems involving two-dimensional projectile motion. • Students should know how to deal with situations in which acceleration is a specified function of velocity and time so they can write an appropriate differential equation and solve it for *v(t)* by separation of variables, incorporating correctly a given initial value of *v* . (e.g. air resistance) • Students should be able to add, subtract, and resolve displacement, velocity and acceleration vectors.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture on calculus (basic derivatives and integrals) and its relation to kinematics. • Lecture on centripetal/tangential reference frames and relation to circular motion. • Demonstrate problem solving techniques. • Provide concept questions for students to discuss in groups. (Interpreting graphs, diagrams, etc.) • Facilitate discussion of lab results.	• Interaction with videos and simulations available from virtual textbook.	2-3
	• Various homework assignments to practice problems solving skills.	2-4
	• Lab: Car on incline. Using photogates, students will determine the acceleration of a car rolling down a ramp.	3
	• Lab: Video analysis of Projectile Motion: students will analyze a round of Angry Birds to determine the rules of projectile motion within the game.	3
	• Lab: Circular motion: Student will determine the relationship between speed, radius and centripetal acceleration.	4

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• Mathematics - algebra and calculus skills • Com Arts – writing skills for lab reports.	• Kinematics knowledge from Honor's Physics course, such as an understanding of constant acceleration and free fall. • Understand how to create and interpret graphs.	• Students are designing experiments and interpreting results.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Students will be shown a ball launcher and allowed to take any measurements they need to predict the position of the ball at various time. Test by placing shooting the ball through hoops the students place.	Formative	3
• Periodic quizzes	Formative	3
• Written tests (2 or 3 for this strand)	Summative	3-4
• Lab Reports	Summative	4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET

		(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching • Create restudy guide from virtual text.	• Re-study guide. • Additional experimentation.	3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab.	4

CONTENT AREA: Science COURSE: AP Physics	UNIT TITLE: Strand 2: Newton's Laws of Motion UNIT DURATION: 4 weeks (revisiting throughout year)

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:
- Virtual Textbook: Physics for Scientists and Engineers by Knight
- Various lab equipment

ENDURING UNDERSTANDINGS:
- An object's acceleration is proportional to the net force acting on it and inversely proportional to the mass of the object.
- For every action there is an equal and opposite reaction.

BIG IDEA(S):
- Newton's Laws describe the relation between forces and motion.

ESSENTIAL QUESTIONS:
- What are forces?
- What factors affect acceleration?
- How do systems affect each other?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?
Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
Strand 2-2A	Forces are classified as either contact or long range forces that can be described in terms of direction and magnitude	x	
Strand 2-2B, a-c	Every object exerts a gravitational force on every other object.	x	
Strand 2-2D, a-e	Newton's Laws of Motion explain the interaction of mass, and forces, and are used to predict changes in motion.	x	
Strand 2-2E, a-c	Perpendicular forces act independently of each other	x	
AP: Strand B, 1, 2 and 3	Newton's Law of Motion: Static Equilibrium, Dynamics of Single Particle, Systems of two or more objects	x	

OBJECTIVE # ???

REFERENCES/STANDARDS

i.e. GLE/CLE/MLS/NGSS

- AP Physics C Mechanics Course Standards: all of Strand B

WHAT SHOULD STUDENTS…

UNDERSTAND?

Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.

- Students should understand the relation between the force that acts on an object and the resulting change in the object's velocity.
- Students should understand how Newton's Second Law, $\overrightarrow{\Sigma F} = m\vec{a}$, applies to an object subject to forces such as gravity, the pull of strings, or contact forces.
- Students should understand the significance of the coefficient of friction in both the kinetic and static cases.
- Students should understand the effect of drag forces (air resistance) on the motion of an object.
- Students should understand Newton's Third Law so that, for a given system, they can identify the force pairs and the objects on which they act, and state the magnitude and direction of each force.

KNOW?

Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY

- Students should be able to state Newton's 3 Laws.
- Know vocabulary associated with forces, e.g. inertia, coefficient of friction, spring constant, drag coefficient.

BE ABLE TO DO?

Skills; Products

- Calculate, for an object moving in one or two dimensions, the velocity change that results when a constant force *F,* or a varying force *F(t)* acts over a specified time interval.
- Draw a well-labeled, free-body diagram showing all real forces that act on the object, so that they can write the summation statements for the net force in each component. Use those summation statements to solve for unknown forces or accelerations. Also, problems involving multiple objects requiring a system of equations.
- Write down the relationship between the normal and frictional forces on a surface, so they might analyze situations in which an object moves along a rough surface or under what circumstances an object will start to slip, or to calculate the magnitude of the force of static friction.
- Find the terminal velocity of an object moving vertically under the influence of a drag force dependent on velocity. Or use Newton's 2^{nd} to write and solve the differential equation for the velocity of a function of time.
- Describe qualitatively, with the aid of graphs, the acceleration, velocity, and displacement of such a particle when it is released from rest or is projected vertically with specified initial velocity under the influence of drag.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture dealing with systems containing multiple objects. • Lecture on centripetal forces and the use of centrifugal force in non-inertial reference frames. • Demonstrate problem solving techniques. • Provide concept questions for students to discuss in groups. (Interpreting graphs, diagrams, etc.) • Facilitate discussion of lab results.	• Interaction with videos and simulations available from virtual textbook.	2-3
	• Various homework assignments to practice problems solving skills.	2-4
	• Lab: Atwood's Machine: students will investigate the relationship between the acceleration and masses on an Atwood's machine.	3
	• Lab: Air resistance. Students will investigate the relation between the mass and terminal velocity of coffee filters to model air resistance.	3
	• Lab: Spring constants: students will investigate how to determine the spring constant of various combinations of spring.	4

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• Mathematics - algebra and calculus skills • Com Arts – writing skills for lab reports.	• Dynamics knowledge from Honor's Physics course, such as an understanding of types of forces. • Graphing skills.	• Students are designing experiments and interpreting results.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Given an Atwood's Machine students must place mass on each side to produce a target acceleration.	Formative	3
• Shown a toy helicopter of given mass flying in a circular path, students must use the length and angle the string makes with the ceiling to predict the time for 10 circuits.	Formative	3
• Periodic quizzes		
• Written tests (2 or 3 for this strand)	Formative	3
• Lab Reports	Summative	3-4
	Summative	4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching • Create restudy guide from virtual text.	• Re-study guide. • Additional experimentation.	3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?
Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab.	4

CONTENT AREA: Science COURSE: AP Physics	UNIT TITLE: Strand 3 – Work, Energy and Power UNIT DURATION: 6 weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:
- Virtual Textbook: Physics for Scientists and Engineers by Knight
- Various lab equipment

ENDURING UNDERSTANDINGS:
- Energy cannot be created or destroyed, only transferred from one form or system to another.
- Work is the process of transferring energy using a force.

BIG IDEA(S):
- Energy can be transferred or stored in a variety of ways, but never created or destroyed.

ESSENTIAL QUESTIONS:
- What is energy and how is it stored and transferred?
- What does it mean for a machine to be powerful?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?
Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
Strand 1-2B, a-d	Mechanical energy comes from the motion and/or position of an object.	x	
Strand 1-2F, a-c	Energy can be transferred within a system as the total amount of energy remains constant.	x	
Strand 2-2F a-d	Work transfers energy into and out of a system.	x	
AP: Strand C, 1, 2, 3 & 4	Work, Energy Power: Work-Energy Theorem, Forces and Potential Energy, Conservation of Energy, Power	x	

OBJECTIVE # ???

REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS

- AP Physics C Mechanics Course Standards: all of Strand C

WHAT SHOULD STUDENTS…

UNDERSTAND?

Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.

- Students should understand conservation of energy and can identify how energy is being stored within a given system. (kinetic, gravitational, elastic, chemical, dissipated, etc.)
- Students should understand the definition of work, including when it is positive, negative, or zero.
- State the general relation between force and potential energy, and explain why potential energy can be associated only with conservative forces.

KNOW?

Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY

- The Law of Conservation of Energy
- The formal definition of work and under what conditions more simplified definitions can be used.
- The definitions of kinetic and potential energy (elastic, gravitation, etc.)
- The distinction between conservative and non-conservative forces.
- Power is the rate at which work is done.

BE ABLE TO DO?

Skills; Products

- Use diagrams (bar graphs, pie charts) to model the transfer and storage of energy in a system.
- Apply conservation of energy to analyze systems involving multiple bodies or systems under the influence of constant and/or non-constant forces.
- Calculate the work done using the dot product of force and displacement for a constant force, or using the area under a force vs. position graph (integral of $F(x)$) for a varying force.
- Calculate a potential energy function associated with a specified one-dimensional force $F(x)$. (Or the reverse.)
- Calculate the power needed to produce specified motion or use power to calculate the quantity of work being done.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY

- Lecture concerning ways energy can be stored and transferred (work).
- Lecture on conservative forces and their relation to potential energy.
- Demonstrate problem solving techniques.
- Provide concept questions for students to discuss in groups. (Interpreting graphs, diagrams, etc.)
- Facilitate discussion of lab results.

STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
Interaction with videos and simulations available from virtual textbook.	2-3
Various homework assignments to practice problems solving skills.	2-4
Lab: Analysis of videos showing various situations in which energy changes form.	2-4
Lab: Interrupted Pendulum.	4

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• Mathematics - algebra and calculus skills • Com Arts – writing skills for lab reports.	• Energy knowledge from Honor's Physics course, such as an understanding of ways to store energy. • Graphing skills.	• Students are designing experiments and interpreting results.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Students determine the maximum height a bar that interrupts a pendulum can be set to allow the string to wrap around the bar.	Formative	3
• Periodic quizzes	Formative	3
• Written test	Summative	3-4
• Lab Reports	Summative	4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching • Create restudy guide from virtual text.	• Re-study guide. • Additional experimentation.	3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab.	4

CONTENT AREA: Science COURSE: AP Physics	UNIT TITLE: Strand 4 – Momentum and Impulse UNIT DURATION: 4 weeks

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- Virtual Textbook: Physics for Scientists and Engineers by Knight
- Various lab equipment

BIG IDEA(S):

- Momentum is a conserved quantity that is useful in analyzing collisions and explosions.

ENDURING UNDERSTANDINGS:

- The total momentum in a closed system is conserved.
- The linear motion of an extended body can be approximated by treating the body as a point particle located at the center of mass.
- Impulse is the change in momentum caused by a force.

ESSENTIAL QUESTIONS:

- How do accident investigators determine the speed of cars before a collision?
- How can we analyze the motion of groups of particles?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
Strand 2-1C (all)	Momentum depends on the mass of the object and the velocity with which it is traveling.	x	
AP: Strand D 1,2 and 3	System of Particles, Linear Momentum: Center of Mass, Impulse and Momentum, Conservation of Linear Momentum, Collisions	x	

OBJECTIVE # ???

REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*

- AP Physics C Mechanics Course Standards: all of Strand D

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Students should be able to understand and apply the relation between center-of-mass velocity and linear momentum, and between center-of-mass acceleration and net external force for a system of particles. • Students should understand impulse and linear momentum. • Explain how linear momentum conservation follows as a consequence of Newton's Third Law for an isolated system. • Understand under what conditions momentum is conserved.	• Definition of center of mass. • Relate mass, velocity, and linear momentum for a moving object, and calculate the total linear momentum of a system of objects. • The complete form of Newton's 2nd Law in terms of momentum instead of acceleration and when the two forms are equivalent.	• Students should understand the technique for finding center of mass, so they can, by inspection, find the center of mass of a symmetrical object or, by formula, locate the center of mass of a system consisting of two or more objects or use integration to find the center of mass of a thin rod of non-uniform density • Determine the impulse on a system by determining the change in momentum, by multiplying the average force by time, by determining the area under a force vs. time graph or by integrating a function *F(t)*. • Apply linear momentum conservation to one-or two-dimensional elastic and inelastic collisions or explosions.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture concerning the complete form of Newton's 2nd based on momentum. • Lecture on impulse. • Demonstrate problem solving techniques. • Provide concept questions for students to discuss in groups. (Interpreting graphs, diagrams, etc.) • Facilitate discussion of lab results.	• Interaction with videos and simulations available from virtual textbook.	2-3
	• Various homework assignments to practice problems solving skills.	2-4
	• Lab: students will measure the velocity of carts before and after collisions/explosions to determine how initial and final momentums are related.	4
	• Lab: Analysis of videos showing various	3-4

	collisions and explosions to investigate conservation of momentum and impulse. • Lab: Analysis of videos to investigate center of mass.	3-4

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• Mathematics - algebra and calculus skills • Com Arts – writing skills for lab reports.	• Honor's Physics course, vectors and motion. • Graphing skills.	• Students are designing experiments and interpreting results.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Students will determine the "muzzle velocity" of a launcher using a ballistic pendulum.	Formative	3
• Periodic quizzes	Formative	3
• Written test	Summative	3-4
• Lab Reports	Summative	4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching • Create restudy guide from virtual text.	• Re-study guide. • Additional experimentation.	3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab.	4

CONTENT AREA: Science **COURSE: AP Physics**	**UNIT TITLE: Strand 5 – Circular Motion and Rotation** **UNIT DURATION: 6 weeks (revisiting throughout year)**

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- Virtual Textbook: Physics for Scientists and Engineers by Knight
- Various lab equipment

BIG IDEA(S):

- Rotation can analyzed using quantities that are analogous to translational quantities. Most rotational equations have the same form as their translational counterparts.

ENDURING UNDERSTANDINGS:

- For rotating bodies, the angle is analogous to position for a translating body. Other linear quantities have rotational analogs.
- Angular momentum is conserved in a closed system.
- A rotating object has kinetic energy even if it is not translating.

ESSENTIAL QUESTIONS:

- How can we model objects that spin or move in circles?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
AP: Strand E, 1, 2,3 & 4	Circular Motion and Rotation: Uniform Circular Motion, Torque and Rotational Statics, Rotational Kinematics and Dynamics, Angular Momentum and its Conservation	x	

OBJECTIVE # ???
REFERENCES/STANDARDS
i.e. GLE/CLE/MLS/NGSS

- AP Physics C Mechanics Course Standards: all of Strand E

WHAT SHOULD STUDENTS…

UNDERSTAND?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.

- Students should understand the uniform circular motion of a particle and distinguish between circular motion and rotation.
- Students should develop a qualitative understanding of rotational inertia so they can determine which of a set of symmetrical objects of equal mass has the greatest rotational inertia or by what factor an object's rotational inertia changes if all its dimensions are increased by the same factor.
- Students should understand the analogy between translational and rotational kinematics so they can write and apply relations among the angular acceleration, angular velocity, and angular displacement of an object that rotates about a fixed axis with constant angular acceleration.
- Write down, justify, and apply the relation between linear and angular velocity, or between linear and angular acceleration, for an object of circular cross-section that rolls with or without slipping along a fixed plane, and determine the velocity and acceleration of an arbitrary point on such an object.
- Students should understand angular momentum conservation, so they can recognize the conditions under which this law is applicable and relate this law to one- and two-particle systems such as satellite orbits.

KNOW?
Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY

- Relate the radius of the circle and the speed of the particle to the magnitude of the centripetal acceleration. Be able to sketch the direction of the velocity and acceleration vectors.
- Students should be able to define torque and calculate the magnitude and direction of the torque associated with a given force or net torque due to multiple forces.
- State the conditions for translational and rotational equilibrium of a rigid object.
- Students should be able to use the right-hand rule to determine the direction of angular vector quantities.
- State the relation between net external torque and angular momentum, and identify situations in which angular momentum is conserved.

BE ABLE TO DO?
Skills; Products

- Analyze situations in which an object moves with specified acceleration under the influence of one or more forces so they can determine the net force or of one of the forces that makes up the net force.
- Analyze the equilibrium of a rigid object under the combined influence of a number of coplanar forces applied at different locations.
- Compute the rotational inertia of a collection of point masses lying in a plane, or of any uniform bodies or collection of uniform bodies (i.e. rod, sphere, hoop, etc.). Understand and apply the parallel axis theorem when needed.
- Determine the angular acceleration for a rigid object when subjected to a specified external torque or force. Also, determine the centripetal and tangential acceleration of any point on that body.
- Apply conservation of energy to problems of fixed-axis rotation or the problems involving a rolling body.
- Calculate the angular momentum vector for a moving particle and for a rotating rigid object about a fixed axis.
- Use conservation of angular momentum to analyze problems in which the moment of inertia of an object is changed as it rotates and a collision between a moving particle and a rigid object that can rotate about a fixed axis.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture on rotational analogs to translational quantities (e.g. position/angle, force/ torque). • Lecture on determining moment of inertia using integration. • Demonstrate problem solving techniques. • Demonstrations of conservation of momentum (spinning bicycle wheel, e.g.) • Provide concept questions for students to discuss in groups. (Interpreting graphs, diagrams, etc.) • Facilitate discussion of lab results.	• Interaction with videos and simulations available from virtual textbook.	2-3
	• Various homework assignments to practice problems solving skills.	2-4
	• Lab: Moment of Inertia, students will apply known torques to various bodies and measure the angular acceleration, in order to determine the moment of inertia.	4
	• Lab: Video Analysis. Students will analyze videos of collisions in rotating systems to investigate the conservation of angular momentum.	3-4
	• Lab: Video Analysis: Students will analyze videos to investigate conservation of energy involving rotational kinetic energy.	3-4

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• Mathematics - algebra and calculus skills • Com Arts – writing skills for lab reports.	• Dynamics knowledge from Honor's Physics course, such as an understanding of types of forces. • Graphing skills.	• Students are designing experiments and interpreting results.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Students determine the moment of inertia for various shapes experimentally.	Formative	3
• Shown a toy helicopter of given mass flying in a circular path, students must use the length and angle the string makes with the ceiling to predict the time for 10 circuits.	Formative	3
• Periodic quizzes		
• Written tests (2 for this strand)	Formative	3
• Lab Reports	Summative	3-4
	Summative	4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions		
TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching • Create restudy guide from virtual text.	• Re-study guide. • Additional experimentation.	3
HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab.	4

CONTENT AREA: Science COURSE: AP Physics	UNIT TITLE: Strand 6 – Oscillation and Gravitation UNIT DURATION: 6 weeks (as part of 2 units)

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:

- Virtual Textbook: Physics for Scientists and Engineers by Knight
- Various lab equipment

BIG IDEA(S):

- The period of an object in Simple Harmonic Motion can be determined from the physical characteristics of the system.
- The characteristics of a stable orbit are based on the mass of the central body and the velocity and radius of the orbiting body.

ENDURING UNDERSTANDINGS:

- Simple Harmonic Motion (SHM) occurs when the force on a particle is proportional to its displacement, but acts in the opposite direction.
- SHM can be modeled with a sine function.
- The force of gravity exists between any two masses, and is proportional to these masses and inversely proportional to the square of the distance between them.

ESSENTIAL QUESTIONS:

- How do we analyze systems with repeating motion, such as orbits and swinging pendulums?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?

Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	STANDARDS: Content specific standards that will be addressed in this unit.	MAJOR STANDARD	SUPPORTING STANDARD
Strand 2-2B a-d	Every object exerts a gravitational force on every other object		x
AP: Strand F, 1, 2, 3, 4 & 5	Oscillation and Gravitation: Simple Harmonic Motion, Mass on a spring, Pendulum and other Oscillations, Newton's Law of Gravity, Orbits of Planets and Satellites (circular and general)	x	

OBJECTIVE # ??

REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*

- AP Physics C Mechanics Course Standards: all of Strand F

WHAT SHOULD STUDENTS…

UNDERSTAND? *Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.*	**KNOW?** *Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	**BE ABLE TO DO?** *Skills; Products*
• Recognize that a system that obeys a differential equation of the form $\frac{d^2x}{dt^2} = -\omega^2 x$ must execute simple harmonic motion, and determine the frequency and period of such motion. • Develop a qualitative understanding of resonance so they can identify situations in which a system will resonate in response to a sinusoidal external force. • Students should be able to apply their knowledge of simple harmonic motion to the case of a mass on a spring and to simple, physical, or torsional pendulums. • Describe the gravitational force inside and outside a uniform sphere, and calculate how the field at the surface depends on the radius and density of the sphere. • For circular orbits, recognize that the motion does not depend on the object's mass; describe qualitatively how the velocity, period of revolution, and centripetal acceleration depend upon the radius of the orbit; and derive expressions for the velocity and period of revolution in such an orbit.	• State and apply the relation between frequency and period. • State how the total energy of an oscillating system depends on the amplitude of the motion, sketch or identify a graph of kinetic or potential energy as a function of time, and identify points in the motion where this energy is all potential or all kinetic. • Students should know Newton's Law of Universal Gravitation and be able to use it to determine the force of gravity between any two objects. • State Kepler's three laws of planetary motion and use them to describe in qualitative terms the motion of an object in an elliptical orbit.	• Sketch or identify a graph of displacement as a function of time, and determine from such a graph the amplitude, period, and frequency of the motion. Be able to write an equation that models such a graph. • State the relations between acceleration, velocity, and displacement, and identify points in the motion where these quantities are zero or achieve their greatest positive and negative values. Use this relation to write functions for velocity and acceleration. • Calculate the kinetic and potential energies of an oscillating system as functions of time, sketch or identify graphs of these functions, and prove that the sum of kinetic and potential energy is constant. Use these graphs or functions to determine the maximum displacement or velocity. • Use the physical characteristics of the system to derive and apply the expressions for the period of a mass on a spring, and for various types of pendulums (simple, torsional, physical). Understand the approximations that must be made to write these expressions. • Derive Kepler's 3rd Law for circular orbits and understand how to apply it to elliptical orbits. • Apply conservation of angular momentum to determine the velocity and radial distance at any point in the orbit.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	**STUDENT LEARNING TASK**	**DOK TARGET**

		(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Lecture on the differential equations that govern simple harmonic motion • Lecture on Newton's Law of gravitation and orbits. • Demonstrate problem solving techniques. • Provide concept questions for students to discuss in groups. (Interpreting graphs, diagrams, etc.) • Facilitate discussion of lab results.	• Interaction with videos and simulations available from virtual textbook. • Various homework assignments to practice problems solving skills. • Lab: Pendulum: students determine experimentally the factors that affect the period of a pendulum. • Lab: Mass on spring: Students determine the factors that affect the period of a mass hanging from a spring • Lab: Video Analysis: Students will analyze videos of other types of oscillations.	2-3 2-4 3-4 3-4 3

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS
• Mathematics - algebra and calculus skills, from trigonometry: graphs and period of sine function. • Com Arts – writing skills for lab reports.	• Dynamics knowledge from Honor's Physics course, such as an understanding of gravitational force. • Graphing skills.	• Students are designing experiments and interpreting results.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Given a target period, students construct a physical pendulum that has that period. • In a computer simulation, students determine factors to put a satellite into stable orbits. • Periodic quizzes • Written tests (2 for this strand) • Lab Reports	Formative Formative Formative Summative Summative	3 3 3 3-4 4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET

		(1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching • Create restudy guide from virtual text.	• Re-study guide. • Additional experimentation.	3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED? *Possible Extensions/Enrichments*		
INSTRUCTIONAL ACTIVITY/METHOD	**STUDENT LEARNING TASK**	**DOK TARGET** (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab.	4

CONTENT AREA: Science COURSE: AP Physics	UNIT TITLE: Lab Standard UNIT DURATION: Ongoing, throughout all units

MATERIALS / INSTRUCTIONAL RESOURCES FOR THIS UNIT:
- Virtual Textbook: Physics for Scientists and Engineers by Knight
- Various lab equipment

ENDURING UNDERSTANDINGS:
- All models and theories in science must be based on and supported by data.
- All experimental measurements contain error. Scientists must identify and minimize this error in order for results to be useful.
- Graphs and mathematics make results easier to display and apply.

BIG IDEA(S):
- Scientists construct and test models by experimentation.

ESSENTIAL QUESTIONS:
- How do we develop models and test their usefulness?

WHAT SHOULD STUDENTS KNOW, UNDERSTAND, AND BE ABLE TO DO AT THE END OF THIS UNIT?
Standards, Concepts, Content, Skills, Products, Vocabulary

REFERENCE/STANDARD *i.e. GLE/CLE/MLS/NGSS*	**STANDARDS: Content specific standards that will be addressed in this unit.**	**MAJOR STANDARD**	**SUPPORTING STANDARD**
Strand 7-1- A,a-g	Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation.	x	
Strand 7-1 – B,a-f	Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations.	x	
Strand 7-1 – C,a-d	Scientific inquiry includes evaluation of explanations in light of evidence and scientific principles		x
Strand 7-1 – D, a-c	The nature of science relies upon communication of results and justification of explorations.		x
AP: Lab Standards 1-5	Laboratory and Experimental Situations: Design experiments, Observe and Measure real phenomena, Analyze Data, Analyze Errors, Communicate Results	x	

OBJECTIVE # ??

REFERENCES/STANDARDS *i.e. GLE/CLE/MLS/NGSS*

- AP Physics C Mechanics Course Standards: Laboratory and Experimental Situations

WHAT SHOULD STUDENTS…

UNDERSTAND?	KNOW?	BE ABLE TO DO?
Concepts; essential truths that give meaning to the topic; ideas that transfer across situations.	*Facts, Names, Dates, Places, Information, ACADEMIC VOCABULARY*	*Skills; Products*
• Students should understand how to analyze data, including interpreting graphs. • Students should understand that all measurements contain experimental error, and be able to identify sources of that error and how they propagate, estimate magnitude and direction of errors and identify ways to reduce error. • How to design an experiment.	• Basic vocabulary: independent and dependent variable control, etc. • Difference between error and uncertainty. Terms such as systematic and random error.	• Describe the purpose of an experiment or a problem to be investigated and identify equipment needed and describe how it is to be used. Including, draw a diagram or provide a description of an experimental setup and the procedures to be used, including controls and measurements to be taken. • Graph data and analyze this graph by finding best fit lines and curves to data points in graphs. Perform calculations with data and make extrapolations and interpolations from data. • Students should understand how to summarize and communicate results, so they can draw inferences and conclusions from experimental data, suggest ways to improve experiment and propose questions for further study.

FACILITATING ACTIVITIES – STRATEGIES AND METHODS FOR TEACHING AND LEARNING

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide guidance on error analysis.	• Complete experiments in various units	3-4
• Provide a variety of lab experiences, both actual and in computer simulation, as appropriate.	• Discuss and defend lab results in small groups and in class.	3-4
• Facilitate discussion of lab results.	• Write lab reports and/or answer questions about lab results.	3-4

INTERDISCIPLINARY CONNECTION	PRIOR KNOWLEDGE CONNECTIONS	INQUIRY CONNECTIONS

• Mathematics - algebra and calculus skills. • Com Arts – writing skills for lab reports.	• Lab report standards from Honor's Physics. • Graphing and curve fitting skills.	• Students are designing experiments and interpreting results.

HOW DO WE KNOW WHAT STUDENTS HAVE LEARNED?

ASSESSMENT DESCRIPTION	FORMATIVE OR SUMMATIVE?	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Discussion of Lab results in groups.	Formative	3-4
• Lab Reports	Summative	4

HOW WILL WE RESPOND IF STUDENTS HAVE NOT LEARNED?

Possible Interventions

TEACHER INSTRUCTIONAL ACTIVITY	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Use of AIP time for re-teaching • Provide additional lab experiences	• Revise Lab Reports. • Additional experimentation.	3

HOW WILL WE RESPOND IF STUDENTS HAVE ALREADY LEARNED?

Possible Extensions/Enrichments

INSTRUCTIONAL ACTIVITY/METHOD	STUDENT LEARNING TASK	DOK TARGET (1=Recall, 2=Skill/Concept, 3=Strategic Thinking, 4=Extended Thinking)
• Provide additional reading materials/content that address specific student interests	• Student can design an experiment independently using equipment available in our lab.	4

Grades 9-12 Science

Appendix