WEBSTER GROVES SCHOOL DISTRICT
BOARD OF EDUCATION ITEM OF CONSIDERATION

DATE: May 11, 2015

TOPIC/PROPOSAL:
Approval of K-12 Science Curriculum

BACKGROUND INFORMATION:
Over the past year and a half, numerous staff members have worked to develop a written curriculum that aligns with the most current educational standards for music and the Marzano Teacher Evaluation Model adopted by the district. In addition and most important, teachers and leadership placed an emphasis on developing curriculum that is rigorous and relevant for students.

The K-12 Science Curriculum is attached.

INSTRUCTIONAL IMPACT/RATIONALE:
The revised K-12 Science Curriculum will better enable our students to apply the skills and understandings of science and engineering across different contents and contexts.

CSIP/DISTRICT GOAL ADDRESSED:
* WGSD will personalize learning for all students to increase engagement and rigor resulting in improved student achievement.
*WGSD will make a positive impact on the world by being a model for teaching, learning and practicing sustainability.

FISCAL NOTE:
No increase in FTE.

ADMINISTRATIVE RECOMMENDATION:
- **Action Requested: _X__**
- **Information: ____**
- **Proposed Motion for Approval (if applicable):**

I move that the Board of Education adopt the K-12 Science Curriculum with grades 9-12 initiating implementation in 15-16 and K-8 initiating implementation in 16-17.

PREPARED BY: John Simpson

Motion: _____________________ **Second: ___________________**

Board Vote: ___(yes) ___(no) ___(abstain) ___(Consent Agenda)

Standards: The science is aligned to the latest version of standards and includes the Next Generation Science Standards, Missouri Learning Standards, and College Board Standards.

Rationale: It is critical for students today to engage in learning that is relevant, rigorous, and rewarding. In addition to engaging in learning that is cognitively demanding and challenging, students need to be able to apply their knowledge and skills across contents and contexts within the school environment, and more importantly in the "real world." For it is when this application extends outside the boundaries of the school, that interest, relevance, and value are maximized.

While the curriculum is designed to support the transference of knowledge and skills, district staff working together must learn and work to provide authentic and engaging learning opportunities for students. As they engage in such learning within the science curricula, a priority will be placed on ensuring students are given learning opportunities that "reflect the interconnected nature of science as practiced and experienced in the real world" (NGSS Standards).

Course Changes: No new science courses are being added at this time.

Items of note: The following are items of note regarding the science curricula:

- While a few teachers will pilot the curricula and various resources in 15-16, the K-8 curricula will not be fully implemented district-wide until the 16-17 school year. This will provide teachers with the needed additional time to among other things select and/or create resources, develop assessments, and design learning opportunities for students. The timeline through year one of implementation may be found here: http://goo.gl/z9hXTb
- Foundational to the development of the learning goals and proficiency scales were the Next Generation Science Standards' "Cross Cutting Concepts." These core concepts bridge disciplinary boundaries, uniting core ideas throughout the fields of science and engineering. Their purpose is to help students deepen their understanding of the disciplinary core ideas, and develop a coherent and scientifically-based view of the world.
- The "content" portion of the K-8 curriculum (ie: weather and climate) is found in the "learning targets" section of the curricula. The students will demonstrate their understanding of the content through their application of the learning goals and proficiency scales. An overview of the K-8 alignment of content may be found here: http://goo.gl/j8Y5gG
- Please click on the following link to receive a brief video overview of the development and implementation of the science curricula including an explanation for how the learning goals, proficiency scales, and learning targets will function together: http://goo.gl/I4o98s
- While the curricula as a whole was aligned with the Next Generation Science Standards, the team also make sure that the curricula, where needed, aligned with the Missouri Learning Standards or science grade level expectations. This step was done to ensure students were engaged in learning that would be reflected on the MAP assessments at grades 5, 8 and high school (Biology).
- Please click here to view the main resource center for staff in support of science: hub.wgcloud.org

Webster Groves School District Est. 1868

K-12 Science Curriculum

Presented to the Board of Education on Monday, May 11, 2015

As a learning community, the Webster Groves School District will lead in purposeful innovation that challenges each of us to discover and pursue our passions and make a positive impact on the world.

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XXI. Physics A
XXII. Advanced Physics
XXIII. AP Physics 1
XXIV. AP Physics 2
XXV. Plants and People

Rationale for Curriculum

It is critical for students today to engage in learning that is relevant, rigorous, and rewarding. In addition to engaging in learning that is cognitively demanding and challenging, students need to be able to apply their knowledge and skills across contents and contexts within the school environment, and more importantly in the "real world." For it is when this application extends outside the boundaries of the school, that interest, relevance, and value are maximized.

While the curriculum is designed to support the transference of knowledge and skills, district staff working together must learn and work to provide authentic and engaging learning opportunities for students. As they engage in such learning within the science curricula, a priority will be placed on ensuring students are given learning opportunities that "reflect the interconnected nature of science as practiced and experienced in the real world" (NGSS Standards).

<u>Process of Curriculum Review Leading to Board Approval</u>

<u>Review Checklist for Draft Phase One (curriculum coordinator and/or high school designee):</u>

- The curriculum which includes learning goals and proficiency scales is written using the district template.
- Learning goals are priority, transferable understandings and skills relevant for students within and across disciplines and situations.
- Cultural relevance is evident in the learning goals and/or proficiency scales when applicable (in curriculum, always applicable in design of learning).
- Approximately 8-11 learning goals are created per semester per course or content. *There may be a good reason for more or less.*
- Learning goals are aligned to "governing" curriculum standards.
- Approximately 2-4 sample learning targets are included for each learning goal (optional).
- Proficiency scales clearly articulate a progression of learning with the learning goals and can be understood by students, staff, and families.
- On the proficiency scale:
  Level 4: Includes the statement, "Student demonstrates an in-depth inference or advanced application, or innovates with the learning goal."(Examples may be included).

  Level 3: Student demonstrates mastery with the learning goal as evidenced by…(**GRADE LEVEL/COURSE CURRICULUM EXPECTATION**)

  Level 2: Student demonstrates he/she is nearing the learning goal by…and includes identification of the "discipline- specific vocabulary" directly tied to the learning goal.
  Level 1: Student demonstrates a limited understanding or skill with the learning goal by…

- The curriculum is well-written and in the present tense.
- The content, vocabulary, and language are aligned across grade levels and/or courses (if applicable and by curriculum coordinator).

<u>Review Checklist for Draft Two (Reviewers: Gabrielle Corley or John Simpson)</u>

- The curriculum is written in a manner consistent with district expectations. The "style sheet" will be used to provide feedback.
- The curriculum is written with appropriate conventions and tense. The content and language are aligned across grade levels and/or courses. While the reviewers will examine the vertical progression of the curriculum, they will rely heavily on those developing the curriculum.

Review Checklist for Final Draft (John Simpson)

- If the curriculum is written in a manner consistent with district expectations, it's taken before the CCC for feedback and then the board of education for approval.
- The curriculum is put into digital form following board approval.

Kindergarten

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Learning Goal	Proficiency Scale
Students will be able to investigate and explain causal relationships.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • making observations of the world or in the relationships between different quantities/qualities of degrees in data. • analyzing patterns in the observations of the world around them. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: pattern, quantity, quality, data, observe, cause, effect, investigate, explain, relationship. • performing processes such as: o listing causes or effects of given situations. o experimenting with cause and effect to arrive at a given solution through trial and error. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment
• K-ESS3-3. Describing how humans impact the land, water, air, and/or other living things in the local environment. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: need, air, water, light, sun, food, shelter, temperature, living, non-living, soil, temperature, cause, effect, test, evidence, support, refute, land, water, air, reduce, reuse, recycle, environment, earth, investigate, impact, littering, soil, natural, designed, system, model, need, air, water, light, sun, food, shelter, data, experiment, investigate, observations, pattern, argument, claim, evidence, idea, evidence, obtain, evaluate, scientific ideas, model, diagram, drawing
Learning Targets - Forces and Interactions: Pushes and Pulls • K-PS2-1. Comparing the effects of different strengths or different directions of pushes and pulls on the motion of an object. • K-PS2-2. Determining if a design solution works as intended to change the speed or direction of an object with a push or a pull. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: force, object, push, pull, above, below, behind, magnetic force, straight, circular, vibrating, zigzag, falling, faster, slower, diagonal, friction, cause, effect, test, evidence, data, experiment, investigate, observation, pattern.
Learning Targets - Weather and Climate • K-PS3-2.Determining how to reduce the warming effect of sunlight on an area. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: temperature, season, rain, snow, fog, wind, cloud, thunder, lightening, hot, cold, sleet, breeze, cloudy, cloud cover, shade, precipitation, shelter, heat, light, sun, dark, hot, earth, touch, tools, materials, structure, surface, design, product, warming effect, sun, sunlight, science, engineering, technology, obtain, information, descriptive, questions, tested, observations, data, experiment, investigate, observations, pattern

1st Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Learning Goal	Proficiency Scale

Students will be able to investigate and explain causal relationships.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal.
	
	3: Student demonstrates mastery with the learning goal as evidenced by:
	• describing events as having causes.
	• identifying direct cause and effect relationships.
	• explaining phenomena such as how and why something happens.
	
	2: Student demonstrates he/she is nearing proficiency by:
	• recognizing and recalling specific vocabulary, such as: phenomena, qualities, quantities.
	• performing processes such as:
	  o making observations of the world or in the relationships between different quantities/qualities of magnitude in data.
	  o analyzing patterns in the observations of the world around them.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Waves: Light and Sound

- 1-PS4-1. Proving that vibrating materials can make sound and that sound can make materials vibrate.
- 1-PS4-2. Proving that objects can be seen only when illuminated.
- 1-PS4-3. Determining the effect of placing objects made with different materials in the path of a beam of light.
- 1-PS4-4. Using tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: communicate, light, sound, distance, source, receiver, light, sound, investigation, observation, beam, vibrate, illuminate, volume, pitch, medium, transparent, translucent, opaque, reflective

2nd Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Learning Goal	Proficiency Scale
Students will be able to investigate and explain causal relationships	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • describing events as having causes that generate observable patterns. • carrying out simple tests to gather evidence to support or refute their own ideas about causes. • explaining causation of patterns and relationships. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: describe, gather, evidence, generate, support, causation, patterns, relationships. • performing processes such as: o describing events as having causes. o identifying direct cause and effect relationships. o explaining how and why something happens 1: Student demonstrates limited understanding or skill with the learning goal.

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Learning Targets - Forces and Interactions

- 3-PS2-1 Proving the effects of balanced and unbalanced forces on the motion of an object by planning and conducting an investigation.
- 3-PS2-3. Determining cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
- 3-PS2-4. Asking questions to define a simple design problem that can be solved by applying scientific ideas about magnets.
- 3-PS2-2. Planning and conducting an investigation collaboratively to make observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: force, balanced, unbalanced, motion, speed, evidence, observation, push, pull, newton, spring scale, friction, fair test, trials, observations, gather, situation, tool, as magnetism, magnet, field, attract, repel, design, problem, investigation, testable, model, electric, magnetic, attract, repel, like, unlike, opposites, conductor, insulator, static electricity, current electricity, electricity, field, electrostatic, lightning.

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Learning Targets - Interdependent Relationships in Ecosystems

- 2-LS2-1. Determining, through investigation and evidence, if plants need sunlight and water to grow.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: grow, sunlight, leaf, photosynthesis, disperse, seed, pollination, germination, growth, development, reproduction, death, habitat, ecosystem, diversity, consumer, producer, decomposer, pollination, shelter, seed, grow, sunlight, leaf, photosynthesis, disperse, seed, fair test.

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Learning Targets - Weather and Climate

- 3-ESS3-1. Determining which solution(s) reduce the impact of a weather-related hazard.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: surface, crust, weathering, erosion, volcano, earthquake, lake, pond, river, stream, creek, ocean, sea, glacier, weather, climate, region, ecosystem, season, spring, fall, winter, summer, precipitation, temperature, rainfall, vegetation, ocean, desert, tundra, rainforest, engineering, merit, criteria, constraints, melting, vaporization, flood, tsunami, hazard, mud slide, tornado, global warming, wind, lightning, material, substance

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3rd Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Learning Goal	Proficiency Scale
Students will be able to investigate and explain causal relationships	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● designing and carrying out simple tests to gather evidence to support or refute ideas about causes. ● explaining that effects that are seen could be as a result of causes that are unseen. ● explaining how effects, resulting from factors, are beneficial or detrimental to a system or organism. ● forming questions about cause-and-effect relationships in the systems they are studying. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: quantity, quality, data, refute, observe, investigate, explain. • performing processes such as: o describing events have causes that generate observable patterns. o carrying out simple tests to gather evidence to support or refute their own ideas about causes. o explaining causation of patterns and relationships. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Learning Targets - Inheritance and Variation of Traits: Life Cycles and Traits

- 3-LS3-2. Proving that the environment influences observed traits.
- 3-LS4-2. Explaining how characteristics of the same species may provide advantages in surviving, finding mates, and reproducing.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: parent, offspring, trait, characteristic, species, survival, mate, reproduction, variation, environment, ecosystem, adaptation, natural selection, seedling, surface, crust, weathering, erosion, volcano, earthquake, lake, pond, river, stream, creek, ocean, sea, glacier, compare, similarity, difference, birth, growth, adult, reproduction, cycle, germination, pollination

Learning Targets - Structure and Properties of Matter

- 2-PS1-2. Analyzing data gathered from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- 2-PS1-4. Proving that some changes caused by heating or cooling can be reversed and some cannot.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: chemical change, chemical property, chemical reaction, physical change, matter, substance, reversible, engineering, heart, melting, vaporization, observations, ecosystem, habitat, organism, survive, thrive, migration, adaptation, properties, classify, physical property, property, hardness, flexibility, strength, malleable, ductile, texture, absorbency, structure, matter, material, substance, design, problem, investigation, testable, model

4th Grade

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<u>High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)</u>

<u>NGSS</u>

CCC Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

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Learning Goal	Proficiency Scale

Students will be able to investigate and explain causal relationships	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal.
	
	3: Student demonstrates mastery with the learning goal as evidenced by:
	• describing mechanisms that cause events to happen (e.g seeing an object, changes in landscape, interactions of objects, etc.).
	• explaining conditions that are critical in order for events to occur (e.g. erosion, climate change, process of seeing an object, etc.).
	• explaining how cause and effect events may occur immediately or over time.
	• proving how effects, resulting from factors, are beneficial or detrimental to a system or organism.
	
	2: Student demonstrates he/she is nearing proficiency by:
	• recognizing and recalling specific vocabulary, such as: mechanism, conditions, system.
	• performing processes such as:
	    o forming questions about cause-and-effect relationships in the systems they are studying.
	    o designing and carrying out simple tests to gather evidence to support or refute their own ideas about causes.
	    o explaining effects that are seen as a result of causes that are unseen.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Earth's Systems: Processes that Shape the Earth

- 4-ESS2-1. Proving the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
- 4-ESS3-2. Communicating how natural Earth processes affect humans.
- 4-ESS1-1 Explaining changes in a landscape over time.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: rock formations, fossils, rock layers, landscape, canyon, weathering, erosion, slope, vegetation, deposition, wind, freezing, thawing, volume, topographic, continental boundaries, volcano, earthquake, decomposition, crust, sedimentary, metamorphic, igneous, mountain, fault, plain, basin, flood, plateau, delta, design, solution, testable, bias, unbiased, test, quantitative, qualitative, conclusion, tsunami, volcano, hurricane, flood, typhoon, fire, tornado

Learning Targets - Waves

- 4-ESS3-1. Using cause and effect relationships to describe how the use of natural resources affects the environment.
- 4-PS3-3. Asking questions and predicting outcomes about the changes in energy that occur when objects interact.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: amplitude, wavelength, resonate, sound, energy, crest, trough, wave, mechanical wave, pitch, loudness, medium, rest position, disturbance, ear drum, renewable, non-renewable, fossil fuels, energy, resource, environment, fissile materials, habitat, dam, mining, vibration, light, sound, energy, motion, kinetic energy, potential energy, conversion, transfer, medium, collide, force, speed, transformation, temperature, balanced, unbalanced, solar energy, thermal energy, radiant energy, mechanical energy, chemical energy, circuit, design, solution, testable question, bias, unbiased, test, quantitative, qualitative, conclusion, nuclear, solar, geothermal, hydroelectric, static, conduction, convection, radiation, source, receiver, transfer, medium, Morse code, binary, smoke signal, digital, email, text, text language, Emoji, social media, blog, cell phone, portable computing devices.

Learning Targets - Structure, Function, and Information Processing

- 4-PS4-2. Using cause and effect to describe that light reflecting from objects and entering the eye allows objects to be seen.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: source, light, transferred, transparent, translucent, opaque, reflect, retina, pupil, iris, cornea, lens, optic nerve, system, system model, structure, internal, external, survival, behavior, reproduction, signal, adaptation, circulatory system, respiratory system, nervous system, stimulus, response, stem, leaves, flowers, seeds, roots, sensory organs, beaks, appendages, body covering

Learning Targets - Energy

- 4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: temperature, balanced, unbalanced, solar energy, thermal energy, radiant energy, mechanical energy, chemical energy, circuit, design, solution, testable question, bias, unbiased, test, quantitative, qualitative, conclusion, nuclear, solar, geothermal, hydroelectric, static,

conduction, convection, radiation, source, receiver, transfer, medium, Morse code, binary, smoke signal, digital, email, text, text language, Emoji, social media, blog, cell phone, portable computing devices.

5th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Learning Goal	Proficiency Scale

Students will be able to investigate and explain causal relationships	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal.
	
	3: Student demonstrates mastery with the learning goal as evidenced by:
	• identifying and testing causal relationships.
	• using cause and effect relationships to explain a change.
	• describing causal relationships.
	
	2: Student demonstrates he/she is nearing proficiency by:
	• recognizing and recalling specific vocabulary, such as generate, support, signify, causal, regularity.
	• performing processes such as:
	  o describing events that occur together as a cause and effect relationship.
	  o describing mechanisms that cause events to happen.
	  o explaining conditions that are critical in order for events to occur.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Space Systems: Stars and the Solar System
• 5-PS2-1. Determining how gravitational force (cause) exerted by Earth on objects is directed down (effect). • 5-ESS1-1. Supporting an argument that the apparent brightness of the sun and stars is due to their relative distances from Earth. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: ellipse, constellation, star, gravity, force, gravitational pull, core, sun, star, apparent brightness, relative distance, astronomical units, light year, kilometer, spring scale.
Learning Targets - Structure and Properties of Matter
• 5-PS1-4. Determining cause and effect of mixing of two or more substances. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: matter, substance, chemical change, physical change, mixture, solution, reactant, product, reaction, law of conservation of matter, experiment, heat, thermal energy, melting, freezing, condensation, properties, molecule, atom, compound, substance, particle, mass, volume, newton, milliliter, graduated cylinder, balance, gram, centimeter, luster, electrical conductivity, thermal conductivity, magnetic forces

6th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Learning Goal	Proficiency Scale
Students will be able to investigate and explain causal relationships.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● demonstrating that events that occur together with regularity might or might not signify a cause and effect relationship. ● designing mechanisms in order to test the outcomes. ● explaining effects that are seen as a result of causes that are unseen. ● proving how effects, resulting from factors, are beneficial or detrimental to a system or organism. 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary, such as: factor, organism, outcome. ● performing processes such as: o identifying and testing causal relationships. o using relationships to explain change. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Earth's Resources

- MS-ESS3-1. Determining how past and current geoscience processes (cause) have influenced the uneven distributions of Earth's mineral, energy, and groundwater resources (effect).

Learning Targets - Energy

- MS-PS3-5. Constructing, using, and presenting arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: kinetic energy, potential energy, speed, acceleration, gravity, velocity, mass, force, conservation of energy, potential energy, conservation of energy, thermal energy, heat, temperature, conductor, insulator, conservation of energy, calorie, joule

Learning Targets - Engineering Design

- MS-ETS1-1. Defining the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: deforestation, overpopulation, water and air pollution, global warming, restoration of natural environments, river bank/coastal stabilization, recycling, channelization, reintroduction of species, depletion of resources, technology, mitigate, catastrophic, solution, monitoring, design, impact, aquifer, levee, development, wetland, pollution, population, per capita, consumption, resources, society

Learning Targets - Growth, Development, and Reproduction of Organisms

- MS-LS1-4. Identifying patterns in animal behaviors and specialized plant structures that affect the probability of successful reproduction of animals and plants respectively.
- MS-LS4-5. Interpreting the way humans influence (or have influenced) the inheritance of desired traits in organisms.
- MS-LS1-5. Explaining how environmental and genetic factors influence the growth of organisms.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: characteristics, behaviors, asexual, sexual, hereditary, Punnett square, genetic modification, chromosome, gene, gene therapy, predators, prey, trait, genetic modification, chromosome, gene, gene therapy, trait, sexual, asexual, agar, code, biotic, abiotic, composition, organism, competition, genotype, phenotype

Learning Targets - Human Impact

- MS-ESS3-4. Determining how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: volcano, earthquake, interior, exterior, mass wasting, tsunami, hurricane, typhoon, tornado, flood, magnitude, hazard, technology, mitigate, catastrophic, solution, monitoring, design, impact, aquifer, levee, development, wetland, pollution, population, per capita, consumption, resources,

society, deforestation, overpopulation, water and air pollution, global warming, restoration of natural environments, river bank/coastal stabilization, recycling, channelization, reintroduction of species, depletion of resources, technology, mitigate, catastrophic, solution, monitoring, design, impact, aquifer, levee, development, wetland, pollution, population, per capita, consumption, resources, society

Learning Targets - Interdependent Relationships in Ecosystems

- MS-LS2-2. Using patterns to predict interactions among organisms across multiple ecosystems.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: ecosystem, biotic, abiotic, producer, consumer, decomposer, community, population, species, niche, habitat, photosynthesis, organism, competitive, predator, prey, symbiotic, mutually beneficial, purification, recycling, nutrient, erosion, deforestation, overpopulation, pollution, global warming, climate change, channelization, depletion, endangered, invasive species, habitat, biodiversity.

Learning Targets - Matter and Energy in Organisms and Ecosystems

- MS-LS2-1. Providing evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: photosynthesis, reactants, products, chemical reaction, chloroplast, chlorophyll, molecule, respiration, ecosystem, resource, population, influence, physical, biological, food web, law of conservation of matter, producer, consumer, decomposer, ecosystem, predator, prey, scavenger, recycle, food chain.

Learning Targets - Natural Selection and Adaptation

- MS-LS4-4. Describing how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
- MS-LS4-6. Explaining how natural selection may lead to increases and decreases of specific traits in populations over time.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: fossil, diversity, extinction, anatomy, chronological, layer, era, fossil data, natural selection, adaptation, genetic, trait, survival, reproduction, chromosome, DNA, probability, sexual, asexual, proportional reasoning.

Learning Targets - Earth's Systems

- MS-ESS3-1. Determining how past and current geoscience processes (cause) have influenced the uneven distributions of Earth's mineral, energy, and groundwater resources (effect).
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: melting, crystallization, weathering, deformation, sedimentation, minerals, metamorphic, igneous, hydrosphere, geosphere, atmosphere, evaporation, condensation, precipitation, surface run-off, groundwater flow, convection, conduction, radiation, water cycle, rock cycle, gravity, renewable, nonrenewable, geothermal, hydroelectric, fossil fuel, petroleum, sediment, ore, subduction zone, hydrothermal, resources.

7th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Learning Goal	Proficiency Scale

Students will be able to investigate and explain causal relationships.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal.
	
	3: Student demonstrates mastery with the learning goal as evidenced by:
	• identifying how various factors contribute to a cause and/or different results.
	• explaining why events have simple and multifaceted causes.
	• using relationships to predict phenomena in natural or designed systems.
	• proving that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
	• classifying relationships as causal or correlational, and recognizing that correlation does not necessarily imply causation.
	
	2: Student demonstrates he/she is nearing proficiency by:
	• recognizing and recalling specific vocabulary, such as: probability, correlation, causation, multifaceted.
	• performing processes such as:
	  o explaining causes and the results of events in familiar contexts.
	  o demonstrating that events that occur together with regularity might or might not signify a cause and effect relationship.
	  o explaining effects that are seen as a result of causes that are unseen.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

<u>Learning Targets - Universe</u>

- **Universe - Goal 2:** Student will develop and use models to describe the role of gravity.
- **Universe - Goal 3:** Student will develop and use models to describe cyclic patterns of lunar phases.
- **Universe - Goal 4:** Student will develop and use models to describe cyclic patterns of Earth's seasons.
- **Universe - Goal 5:** Student will develop and use models to describe cyclic patterns of eclipses.

<u>Learning Targets - Engineering Design</u>

- MS-ETS1-1. Defining the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: science, engineering, technology, research, climate, natural resource, economics, renewable, non-renewable.

<u>Learning Targets - Growth Development and Reproduction of Organisms</u>

- MS-LS3-2. Describing why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
- **Growth, Development, & Reproduction - Goal 2:** Student describes how environmental and genetic factors affect growth and development of organisms.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: characteristics, behaviors, asexual, sexual, hereditary, Punnett square, chromosome, gene, predators, prey, trait, genetic modification, chromosome, gene, gene therapy, trait, sexual, asexual.

<u>Learning Targets - Human Impact</u>

- MS-ESS3-3. Determining how human activities impact the environment.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: volcano, earthquake, interior, exterior, mass wasting, tsunami, hurricane, typhoon, tornado, flood, magnitude, hazard, technology, mitigate, catastrophic, solution, monitoring, design, impact, aquifer, levee, development, wetland, pollution, population, per capita, consumption, resources, society, deforestation, overpopulation, water and air pollution, global warming, restoration of natural environments, river bank/coastal stabilization, recycling, channelization, reintroduction of species, depletion of resources, technology, mitigate, catastrophic, solution, monitoring, design, impact, aquifer, levee, development.

<u>Learning Targets - Structure, Function, and Information Processing</u>

- MS-LS1-8. Explaining how sensory receptors cause a response to stimuli and how they are stored.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: brain, sensory, input, stimuli, response, nerve, receptor, memory, cell, organelle, multicellular, unicellular, nucleus, chloroplasts, mitochondria, cell membrane, cell

wall, tissue, organs, cytoplasm, system, organism, biology, biomedical, nanotechnology, centrifuge, botany, veterinarian, circulatory, excretory, digestive, respiratory, muscular.

- **Structure, Function, & Information Processing - Goal 3:** Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]

Learning Targets -Weather and Climate

- MS-ESS2-5. Demonstrating that the motions and complex interactions of air masses results in changes in weather conditions.
- MS-ESS2-5. Collecting data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
- **Weather - MS-ESS2-5. Goal 1:** Student can analyze data, including maps, and construct and use models to develop understanding of the factors that control weather.
- **Weather - MS-ESS2-6. Goal 2:** Student can analyze data, including maps, and construct and use models to develop understanding of the factors that control climate.
- **Weather - Goal 3:** Student can analyze evidence, including tables, graphs, maps to develop understanding of the natural factors and human activities that influence change in global temperature.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: weather, temperature, pressure, humidity, precipitation, wind, latitude, altitude, geographic land distribution, atmospheric circulation, oceanic circulation, climate, global temperature, natural factors, human activities

8th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Learning Goal	Proficiency Scale

Students will be able to investigate and explain causal relationships.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal.
	
	3: Student demonstrates mastery with the learning goal as evidenced by:
	• classifying correlational and causal relationships.
	• explaining that correlation does not necessarily imply causation.
	• applying cause and effect relationships to predict phenomena in natural or designed systems.
	• communicating that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
	
	2: Student demonstrates he/she is nearing proficiency by:
	• recognizing and recalling specific vocabulary, such as: predict.
	• performing processes such as:
	  o identifying how various factors contribute to a cause and/or different results.
	  o explaining why some events have simple and other events have multifaceted causes.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Structure and Properties of matter

- MS-PS1-4. Predicting and describing how adding or removing thermal energy changes particle motion, temperature, and state of a pure substance.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: temperature, thermal energy, molecule, heat, equilibrium, conduction, convection, radiation, solid, liquid, gas, kinetic molecular theory, phase change, molecule, atoms, natural resource, synthetic resource, solids, liquids, gases, physical properties, chemical properties, mixture, pure substance, matter.
- **Chemistry Learning Target 3:** Students will use the Kinetic Molecular Theory to illustrate particle arrangement and movement in each state of matter.
- **Chemistry Learning Target 4:** Students will use changes in energy to describe volume changes within various states of matter.

Learning Targets - Forces and Interactions

- MS-PS2-3. Determining the factors that affect the strength of electric and magnetic forces.
- MS-PS2-5. Proving that fields exist between objects exerting forces on each other even though the objects are not in contact.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: electric, magnetic, force, field, balanced, unbalanced, gravity, static, interaction, Newton, inertia, speed, acceleration, interaction, independent variable, dependent variable, control, tools.

3rd Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC *Energy and matter: Flows, cycles, and conservation*. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

Learning Goal	Proficiency Scale
Students will understand how changes in energy and matter help them define a system's limitations and possibilities.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • identifying examples of systems that demonstrates the principle that matter cannot be created nor destroyed, but is transferred. • predicting how objects may break into smaller pieces, be put together into larger pieces, or change shapes. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: object, pieces, shape, part, matter, conservation, particle. • performing processes such as: o illustrating that objects never "disappear" they only break into smaller pieces, be put together into larger pieces, or change shapes. o illustrating the particles that make up an item/object. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Structure and Properties of Matter

- 2-PS1-3. Proving how an object made of a small set of pieces can be disassembled and made into a new object.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: chemical change, chemical property, chemical reaction, physical change, matter, substance, reversible, engineering, heart, melting, vaporization, observations, ecosystem, habitat, organism, survive, thrive, migration, adaptation, properties, classify, physical property, property, hardness, flexibility, strength, malleable, ductile, texture, absorbency, structure, matter, material, substance, design, problem, investigation, testable, model

4th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC *Energy and matter: Flows, cycles, and conservation*. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

Learning Goal	Proficiency Scale
Students will understand how changes in energy and matter help them define a system's limitations and possibilities.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • creating a system (or systems) that demonstrates the principle that energy cannot be created nor destroyed, but is transferred. • using a model to explain matter and energy. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: energy, transfer, law, system. • performing processes such as: o identifying examples of the law of conservation of matter. o illustrating the particles that make up an item/object/event. o defining energy within a system. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Waves
• 4-PS3-2. Proving that energy can be transferred from place to place by sound, light, heat, and electric currents. • 4-PS3-4. Explaining how energy converts from one form to another. • 4-PS3-1. Relating the speed of an object to the energy of that object. • 4-PS3-3. Predicting changes in energy that occur when objects collide. • 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. • 4-ESS3-1. Obtaining and combining information to describe that energy and fuels are derived from natural resources and their uses affect the environment. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: amplitude, wavelength, resonate, sound, energy, crest, trough, wave, mechanical wave, pitch, loudness, medium, rest position, disturbance, ear drum, renewable, non-renewable, fossil fuels, energy, resource, environment, fissile materials, habitat, dam, mining, vibration, light, sound, energy, motion, kinetic energy, potential energy, conversion, transfer, medium, collide, force, speed, transformation, temperature, balanced, unbalanced, solar energy, thermal energy, radiant energy, mechanical energy, chemical energy, circuit, design, solution, testable question, bias, unbiased, test, quantitative, qualitative, conclusion, nuclear, solar, geothermal, hydroelectric, static, conduction, convection, radiation, source, receiver, transfer, medium, Morse code, binary, smoke signal, digital, email, text, text language, Emoji, social media, blog, cell phone, portable computing
Learning Targets - Energy
• 4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object. • 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. • 4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide. • 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: temperature, balanced, unbalanced, solar energy, thermal energy, radiant energy, mechanical energy, chemical energy, circuit, design, solution, testable question, bias, unbiased, test, quantitative, qualitative, conclusion, nuclear, solar, geothermal, hydroelectric, static, conduction, convection, radiation, source, receiver, transfer, medium, Morse code, binary, smoke signal, digital, email, text, text language, Emoji, social media, blog, cell phone, portable computing devices.

5th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC *Energy and matter: Flows, cycles, and conservation*. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

Learning Goal	Proficiency Scale
Students will understand how changes in energy and matter help them define a system's limitations and possibilities.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • classifying how energy can be transferred in various ways and between objects. • tracking matter as it flows and cycles before and after processes. • proving that the total weight of substances does not change when the substance may change form, shape, etc. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: tracking, flow, cycle, weight, mass. • performing processes such as: o modeling energy. o defining energy within a system. o creating a system that demonstrates the principle that energy cannot be created nor destroyed, but is transferred. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Matter and Energy in Organisms and Ecosystems

- 5-PS3-1. Using models to track that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) to the sun.
- 5-LS1-1. Tracking the materials plants need for growth is primarily air and water.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: matter, transfer, transformation, decompose, predator, prey, soil, ecosystem, Earth, herbivore, carnivore, omnivore, detritivore, organisms, food web, food chain, energy, nutrient, temperature, transfer, transformation, sun, body warmth, body repair, food (as it relates to plants and animals), properties, molecule, atom, compound, substance, particle

6th Grade

<table>
<tr><td>
<u>High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)</u>
<u>NGSS</u>
CCC <u>Energy and matter: Flows, cycles, and conservation</u>. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
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<table>
<tr><th><u>Learning Goal</u></th><th><u>Proficiency Scale</u></th></tr>
<tr><td>Students will understand how changes in energy and matter help them define a system's limitations and possibilities.</td><td>
4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:

applying the law of conservation of matter as it is displayed in a natural or designed system.
illustrating the transfer and cycling of matter and energy in a system.

2: Student demonstrates he/she is nearing proficiency by:

recognizing and recalling specific vocabulary, such as: illustrate.
performing processes such as:

recognizing energy can be transferred in various ways and between objects.
observing and illustrating energy and matter flows and cycles in systems.

1: Student demonstrates limited understanding or skill with the learning goal.
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Learning Targets - Energy • MS-PS3-5. Proving that when the kinetic energy of an object changes, energy is transferred to or from the object. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: kinetic energy, potential energy, speed, acceleration, gravity, velocity, mass, force, conservation of energy, potential energy, conservation of energy, thermal energy, heat, temperature, conductor, insulator, conservation of energy, calorie, joule
Learning Targets - Matter and Energy in Organisms and Ecosystems • MS-LS1-6. Interpreting the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. • MS-LS1-7. Showing how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. • MS-LS2-3. Describing the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: photosynthesis, reactants, products, chemical reaction, chloroplast, chlorophyll, molecule, respiration, ecosystem, resource, population, influence, physical, biological, food web, law of conservation of matter, producer, consumer, decomposer, ecosystem, predator, prey, scavenger, recycle, food chain
Learning Targets - Earth's Systems • MS-ESS2-1. Describing the cycling of Earth's materials and the flow of energy that drives this process. • MS-ESS2-4. Describing the cycling of water through Earth's systems highlighting the energy from the sun and the force of gravity. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: melting, crystallization, weathering, deformation, sedimentation, minerals, metamorphic, igneous, hydrosphere, geosphere, atmosphere, evaporation, condensation, precipitation, surface run-off, groundwater flow, convection, conduction, radiation, water cycle, rock cycle, gravity, renewable, nonrenewable, geothermal, hydroelectric, fossil fuel, petroleum, sediment, ore, subduction zone, hydrothermal, resources.

7th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

NGSS

CCC *Energy and matter: Flows, cycles, and conservation*. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

Learning Goal	Proficiency Scale
Students will understand how changes in energy and matter help them define a system's limitations and possibilities.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● demonstrating the energy or matter as it flows in a system or process. ● comparing different forms of energy or matter in a system. 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary, such as: potential energy, kinetic energy. ● performing processes such as: o applying the law of conservation of matter as it is displayed in a natural or designed system. o illustrating the matter and energy in a system. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Weather and Climate

- **Weather - MS-ESS2-5. Goal 1:** Student can analyze data, including maps, and construct and use models to develop understanding of the factors that control weather.
- **Weather - MS-ESS2-6 Goal 2:** Student can analyze data, including maps, and construct and use models to develop understanding of the factors that control climate.
- **Weather - Goal 4: MS-ESS2-4.** Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

Learning Targets - Energy

- MS-PS3-3. Applying scientific principles of thermal energy transfer.
- MS-PS3-5. Proving that when the kinetic energy of an object changes, energy is transferred to or from the object.
- **Energy - Goal 1: MS-PS2-2.** Student describes, demonstrates, or models thermal energy transfer factors.
  Energy - Goal 2: MS-PS3-4. Students will describe, demonstrate, or model energy transfer among materials and is able to explain the relationship between temperature and average kinetic energy of the particles.
- **Energy - Goal 3: MS-PS3-5.** Students are able to provide evidence to support their conclusion regarding energy transfer between objects.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: kinetic energy, speed, velocity, mass, force, conservation of energy, potential energy, thermal energy, heat, temperature, conductor, insulator, calorie, joule.

8th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC *Energy and matter: Flows, cycles, and conservation*. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

Learning Goal	Proficiency Scale
Students will understand how changes in energy and matter help them define a system's limitations and possibilities.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • proving atoms are conserved in physical and chemical processes. • analyzing the transfer of energy, within a natural or designed system, that drives the motion and/or cycling of matter. • classifying forms of energy (e.g. energy in fields, thermal energy, energy of motion). • distinguishing between mass and weight. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: system, atom, physical, chemical. • performing processes such as: o drawing conclusions from evidence about the law of conservation of matter. o demonstrating the energy as it flows into, out of, and within a system. o describing forms of energy (e.g. energy in fields, thermal energy, energy of motion). o defining the energy stored in a system. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Chemical Reactions

- MS-PS1-5. Developing and using a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
- MS-PS1-6. Demonstrating that either thermal energy is released or absorbed by chemical processes.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: chemical reaction, physical change, chemical change, law of conservation of matter, atom, molecule, mass, matter, exothermic, endothermic, temperature, atom, heat, kinetic molecular theory, conductor, insulator, law of conservation of energy, exothermic, endothermic, temperature
- **Chemistry Learning Target 6** - Student is able to classify chemical reactions and provide evidence of the law of conservation of mass.
- **Chemistry Learning target 5** - Student is able to recognize and classify changes in matter as chemical or physical.
- **Chemistry Learning Target 7-** Students will describe heat and how it is transferred

Kindergarten

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Learning Goal	Proficiency Scale
Students will understand how patterns of forms and events guide organization and classification.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● recording similarities and difference in an organized way. ● using observations of patterns in the natural and human designed world as evidence. ● using patterns and evidence in the natural world to describe phenomena. 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary such as: patterns, classify, similarity, difference, object, organize, record, events, phenomena. ● performing processes such as: o recognizing patterns in the natural and human designed world. o recognizing patterns in the classroom. o observing similarities and differences in objects and events. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment ● K-LS1-1. Using observations to describe patterns of what plants and animals (including humans) need to survive. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: need, air, water, light, sun, food, shelter, temperature, living, non-living, soil, temperature, cause, effect, test, evidence, support, refute, land, water, air, reduce, reuse, recycle, environment, earth, investigate, impact, littering, soil, natural, designed, system, model, need, air, water, light, sun, food, shelter, data, experiment, investigate, observations, pattern, argument, claim, evidence, idea, evidence, obtain, evaluate, scientific ideas, model, diagram, drawing ●
Learning Targets - Weather and Climate ● K-ESS2-1. Describing patterns in local weather conditions over time. ● K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: temperature, season, rain, snow, fog, wind, cloud, thunder, lightening, hot, cold, sleet, breeze, cloudy, cloud cover, shade, precipitation, shelter, heat, light, sun, dark, hot, earth, touch, tools, materials, structure, surface, design, product, warming effect, sun, sunlight, science, engineering, technology, obtain, information, descriptive, questions, tested, observations, data, experiment, investigate, observations, pattern,

1st Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Learning Goal	Proficiency Scale
Students will understand how patterns of forms and events guide organization and classification.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● classifying patterns in the phenomena they observe. 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary such as: classify. ● performing processes such as: o observing similarities and differences in objects. o recording the similarities and difference in an organized way. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Space Systems: Patterns and Cycles
• 1-ESS1-1. Identifying patterns of the sun, moon, and stars. • 1-ESS1-2. Identifying patterns in the amount of daylight at different times of the year. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: daylight, nighttime, sun, moon, stars, season, summer, winter, fall, autumn, spring.
Learning Targets - Structure, Function, and Information Processing
• 1-LS1-2. Determining patterns in behavior of parents and offspring that help offspring survive by reading texts and using media. • 1-LS3-1. Identifying patterns in (plant and animal) parents and offspring. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: offspring, survive, seed, life cycle, trait, seedling, behavior, hibernation, migration, hunting, internal cue, external cue, characteristic

2nd Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Learning Goal	Proficiency Scale
Students will understand how patterns of forms and events guide organization and classification.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • using patterns to describe phenomena. • using patterns to make predictions. • using patterns to make comparisons and improvements to a system. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary such as: explain, system, prediction, comparison, improvement. • performing processes such as: o recognizing, classifying, and recording patterns in the phenomena they observe 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Engineering Design
• K-2-ETS1-3. Analyzing data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: sketch, model, illustrate, shape, structure, function, observations, gather, situation, tool, test, strength, weakness, design, material
Learning Targets - Forces and Interactions

- 3-PS2-2. Using patterns to predict future motion by making observations and/or measurements of an object's motion.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: force, balanced, unbalanced, motion, speed, evidence, observation, push, pull, newton, spring scale, friction, fair test, trials, observations, gather, situation, tool, as magnetism, magnet, field, attract, repel, design, problem, investigation, testable, model, electric, magnetic, attract, repel, like, unlike, opposites, conductor, insulator, static electricity, current electricity, electricity, field, electrostatic, lightning.

Learning Targets - Interdependent Relationships in Ecosystems

- 2-LS4-1. Carrying out investigations of plants and animals to compare the diversity of life in different habitats.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: grow, sunlight, leaf, photosynthesis, disperse, seed, pollination, germination, growth, development, reproduction, death, habitat, ecosystem, diversity, consumer, producer, decomposer, pollination, shelter, seed, grow, sunlight, leaf, photosynthesis, disperse, seed, fair test

Learning Targets - Weather and Climate

- 3-ESS2-1. Identifying patterns found in data represented tables and graphical displays to describe typical weather conditions expected during a particular season.
- 3-ESS2-2. Identifying patterns found in data used to describe climates in different regions of the world.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: surface, crust, weathering, erosion, volcano, earthquake, lake, pond, river, stream, creek, ocean, sea, glacier, weather, climate, region, ecosystem, season, spring, fall, winter, summer, precipitation, temperature, rainfall, vegetation, ocean, desert, tundra, rainforest, engineering, merit, criteria, constraints, melting, vaporization, flood, tsunami, hazard, mud slide, tornado, global warming, wind, lightning, material, substance.

3rd Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Learning Goal	Proficiency Scale
Students will understand how patterns of forms and events guide organization and classification.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● analyzing the patterns found in events or natural or designed systems. ● investigating the characteristics that allow for the classification and organization of objects, organisms or events. ● explaining change based on patterns. 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary such as: characteristics, investigate, analyze, natural, designed, classification, organization, organism. ● performing processes such as: o using patterns to describe phenomena. o using patterns to make predictions. o using patterns to make comparisons and improvements to a system. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Earth's Systems: Processes that Shape the Earth ● 2-ESS2-2. Identifying patterns found in landforms and bodies of water. ● 2-ESS2-3. Identifying patterns of where water (solid or liquid) is found on Earth. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: surface, crust, weathering, erosion, volcano, earthquake, lake, pond, river, stream, creek, ocean, sea, glacier, design, problem, investigation, testable, model, ecosystem, headings, tables of contents, glossaries, electronic menus, icons, captions, index, websites, search results, infographic.
Learning Targets - Inheritance and Variation of Traits: Life Cycles and Traits ● 3-LS1-1. Identifying patterns found by comparing life cycles. ● 3-LS3-1. Using patterns to prove that living organisms have inherited traits. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: parent, offspring, trait, characteristic, species, survival, mate, reproduction, variation, environment, ecosystem, adaptation, natural selection, seedling, surface, crust, weathering, erosion, volcano, earthquake, lake, pond, river, stream, creek, ocean, sea, glacier, compare, similarity, difference, birth, growth, adult, reproduction, cycle, germination, pollination
Learning Targets - Interdependent Relationships in Ecosystems: Environmental Impacts on Organisms ● 3-LS4-1. Analyzing and interpreting data from fossils to provide evidence of the organisms and the environments in which they lived long ago. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: ecosystem, habitat, organism, survive, thrive, migration, adaptation, inherit, fossil, geology, climate change, climate, extinction, characteristics, design, problem, investigation, testable, model, ecosystem, substance, flood, tsunami, hazard, mud slide, tornado, global warming, wind, lightning, surface,compare, similarity, difference, birth, growth, adult, reproduction, cycle, germination, pollination, parent, offspring, trait, characteristic, species, mate, reproduction
Learning Targets - Structure and Properties of Matter ● 2-PS1-1. Identifying patterns of different materials based on observable properties. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: chemical change, chemical property, chemical reaction, physical change, matter, substance, reversible, engineering, heart, melting, vaporization, observations, ecosystem, habitat, organism, survive, thrive, migration, adaptation, properties, classify, physical property, property, hardness, flexibility, strength, malleable, ductile, texture, absorbency, structure, matter, material, substance, design, problem, investigation, testable, model

4th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Learning Goal	Proficiency Scale
Students will understand how patterns of forms and events guide organization and classification.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● describing patterns found in data of events that happened long ago as well as today. ● using patterns to communicate information. ● using similarities and differences in patterns to sort, classify, and analyze simple rates of change for natural phenomena. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary such as: data, rate. • performing processes such as: o identifying patterns found in natural or designed systems or events. o investigating the characteristics that allow for the classification and organization of objects, organisms or events. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Earth's Systems: Processes that Shape the Earth • 4-ESS1-1 Identifying patterns in rock formations and fossils in rock layers. • 4-ESS2-2 Describing patterns of Earth's features found from maps. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: rock formations, fossils, rock layers, landscape, canyon, weathering, erosion, slope, vegetation, deposition, wind, freezing, thawing, volume, topographic, continental boundaries, volcano, earthquake, decomposition, crust, sedimentary, metamorphic, igneous, mountain, fault, plain, basin, flood, plateau, delta, design, solution, testable, bias, unbiased, test, quantitative, qualitative, conclusion, tsunami, volcano, hurricane, flood, typhoon, fire, tornado
Learning Targets - Waves • 4-PS4-1. Describing patterns in terms of amplitude and wavelength and that waves can cause objects to move from using a model of waves. • 4-PS4-3. Using patterns to communicate information. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: amplitude, wavelength, resonate, sound, energy, crest, trough, wave, mechanical wave, pitch, loudness, medium, rest position, disturbance, ear drum, renewable, non-renewable, fossil fuels, energy, resource, environment, fissile materials, habitat, dam, mining, vibration, light, sound, energy, motion, kinetic energy, potential energy, conversion, transfer, medium, collide, force, speed, transformation, temperature, balanced, unbalanced, solar energy, thermal energy, radiant energy, mechanical energy, chemical energy, circuit, design, solution, testable question, bias, unbiased, test, quantitative, qualitative, conclusion, nuclear, solar, geothermal, hydroelectric, static, conduction, convection, radiation, source, receiver, transfer, medium, Morse code, binary, smoke signal, digital, email, text, text language, Emoji, social media, blog, cell phone, portable computing devices.

5th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Learning Goal	Proficiency Scale
Students will understand how patterns of forms and events guide organization and classification.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • identifying patterns related to time, including simple rates of change and cycles. • developing graphic representations to communicate patterns. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary such as: cycles, predict, graphic. • performing processes such as: o describing patterns found in data of events that happened long ago as well as today. o using patterns to communicate information. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Space Systems: Stars and the Solar System
• 5-ESS1-2. Identifying patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: ellipse, constellation, star, gravity, force, gravitational pull, core, sun, star, apparent brightness, relative distance, astronomical units, light year, kilometer, spring scale.
Learning Targets - Earth Systems
• 5-ESS2-2. Describing and graphing the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: day, night, rotation, revolution, season, tilt, natural resource, glaciers, ground water, agriculture, industry, vegetation, ecosystem, wetland, reserve, geosphere, biosphere, hydrosphere, atmosphere, ecosystem, landform, climate, weather, weathering, erosion, system, salt water, reservoir, distribution, polar ice caps, melting, freezing, condensation

6th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Learning Goal	Proficiency Scale
Students will understand how patterns of forms and events guide organization and classification.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● using patterns of time, rates of change and cycles to form opinions or ideas about the natural or designed world. ● classifying information based on observed patterns. ● organizing data to reveal patterns and uncovers a solution to a natural or designed problem. ● using patterns to identify cause and effect relationships. 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary, such as: evidence, qualitative, quantitative, bias, cause and effect. ● performing processes such as: o identifying patterns related to time, including simple rates of change and cycles. o developing graphic representations to communicate patterns. 1: Student demonstrates limited understanding or skill with the learning goal.

<u>Learning Targets - Rock Cycle</u> ● identifying relevant and meaningful data to influence a conclusion.? ● identifying bias in interpretations of data.?
<u>Learning Targets - History of the Earth</u> ● MS-ESS2-3. Identifying patterns in data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: rock strata, relative, geologic, time scale, fossils, evolution, extinction, volcano, internal, external, sedimentary, igneous, weathering, erosion, volcano, earthquake, fault, expansion, contraction, decomposition, flood, mudslide, plate, tectonics.
<u>Learning Targets - Matter and Energy in Organisms and Ecosystems</u> ● MS-LS2-1. Analyzing and interpreting data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: photosynthesis, reactants, products, chemical reaction, chloroplast, chlorophyll, molecule, respiration, ecosystem, resource, population, influence, physical, biological, food web, law of conservation of matter, producer, consumer, decomposer, ecosystem, predator, prey, scavenger, recycle, food chain.
<u>Learning Targets - Natural Selection and Adaptation</u> ● MS-LS4-1. Identifying patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. ● MS-LS4-2. Identifying patterns found in anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. ● MS-LS4-3. Identifying patterns found in similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: fossil, diversity, extinction, anatomy, chronological, layer, era, fossil data, natural selection, adaptation, genetic, trait, survival, reproduction, chromosome, DNA, probability, sexual, asexual, proportional reasoning.

7th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Learning Goal	Proficiency Scale
Students will understand how patterns guide organization and classification.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • making observations using both qualitative and quantitative data. • assessing the validity of the data from the process by which it was collected. • forming conclusions based on evidence and patterns from data. • organizing data in multiple ways to uncover patterns. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: audience, influence, conclusion, relevant, validity. • performing processes such as: o organizing data to best meet the needs of the audience. o Identifying relevant and meaningful data to influence a conclusion. o identifying bias in interpretations of data. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Universe
Universe - Goal 1: Student will analyze and interpret data to compare and contrast objects in the universe. **Universe - Goal 3:** Student will develop and use models to describe cyclic patterns of lunar phases. **Universe - Goal 4:** Student will develop and use models to describe cyclic patterns of Earth's seasons.

Universe - Goal 5: Student will develop and use models to describe cyclic patterns of eclipses.
Scientific Method - Goal 2: Student will be able to make qualitative and quantitative observations and distinguish between the two.
Scientific Method - Goal 3: Student clearly communicates data using tables and graphs.

Learning Targets - Human Impact

- MS-ESS3-2. Identifying patterns in data on natural hazards to forecast future catastrophic events.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: volcano, earthquake, interior, exterior, mass wasting, tsunami, hurricane, typhoon, tornado, flood, magnitude, hazard, technology, mitigate, catastrophic, solution, monitoring, design, impact, aquifer, levee, development, wetland, pollution, population, per capita, consumption, resources, society, deforestation, overpopulation, water and air pollution, global warming, restoration of natural environments, river bank/coastal stabilization, recycling, channelization, reintroduction of species, depletion of resources, technology, mitigate, catastrophic, solution, monitoring, design, impact, aquifer, levee, development.

Learning Targets - Space Systems

- MS-ESS1-1. Describing the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: eclipse, ellipse, season, axial tilt, rotation, revolution, latitude, equator, lunar, phase, scale, proportionality, crust, atmosphere, orbital radius, telescopes, satellites, solar system, galaxy, universe, gravity, satellites, orbit, ellipse

8th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Learning Goal	Proficiency Scale
Students will understand how patterns of forms and events guide organization and classification.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● analyzing micro and macroscopic patterns in rates of change and other numerical relationships. ● analyzing graphic representations to identify patterns in data. ● differentiating patterns through various types of classification systems. ● diagnosing the patterns of failure of a designed system. 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary, such as: microscopic, macroscopic. ● performing processes such as: o making observations using both qualitative and quantitative data. o assessing the validity of the data from the process by which it was collected. o forming a conclusion based on evidence and patterns from data. o organizing data in multiple ways to uncover patterns. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Waves and Electromagnetic Radiation ● MS-PS4-1. Using mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: wave, amplitude, frequency, wavelength, crest, trough, medium, energy, compression, rarefaction, reflection, absorption, transmission, disturbance, mechanical wave, electromagnetic wave, digital, analog, signal, fiber optic, transmit, pulse, binary. ● **Wave Energy Learning Target 1**- Students will understand the properties of waves.
Learning Targets - Engineering Design ● MS-ETS1-3. Analyzing data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: model, test, modification, fair test, bias, tool, design, design solution, engineering, characteristics, solution ● **Foundations Learning Target 3**: Students will use the scientific method to design and evaluate an experiment for any testable question. ● **Foundations Learning Target 1:** Students will use correct tools to measure matter in metric units and label units correctly ● **Chemistry Learning Target 7-** Students will describe heat and how it is transferred ● **Electricity Learning Target 5**- Students will be able to demonstrate advantages and disadvantages of each wired complete circuit. ● **Wave Energy Learning Target 7:** Students will identify and explain types of reflection ● **Wave Energy Learning target 8:** Students will compare refraction of light through different materials
Learning Targets - Energy ● MS-PS3-1. Constructing and interpreting graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: kinetic energy, potential energy, speed, acceleration, gravity, velocity, mass, force, conservation of energy, potential energy, kinetic energy, thermal energy, heat, temperature, conductor, insulator, conservation of energy, calorie, joule
Learning Targets - Chemical Reactions ● Atomic structure ● MS-PS1-2. Analyzing and interpreting data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: chemical reaction, physical change, chemical change, law of conservation of matter, atom, molecule, mass, matter, exothermic, endothermic, temperature, atom, heat, kinetic molecular theory, conductor, insulator, law of conservation of energy, exothermic, endothermic, temperature
- **Chemistry Learning Target 6** - Student is able to classify chemical reactions and provide evidence of the law of conservation of mass.
- **Chemistry Learning target 5** - Student is able to recognize and classify changes in matter as chemical or physical.
- **Chemistry Learning Target 1:** Student is able to use the periodic table to identify and determine properties of Elements, Compounds, and Molecules.

Learning Targets - Forces and Interactions

- MS-PS2-2. Planning an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
- MS-PS2-5. Conducting an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: electric, magnetic, force, field, balanced, unbalanced, gravity, static, interaction, Newton, inertia, speed, acceleration, interaction, independent variable, dependent variable, control, tools.

3rd Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Learning Goal	Proficiency Scale
Students will understand how changes in scale, proportion, or quantity affect a system's structure and/or performance	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • reading a visual representation/graph to acquire information about scale and quantity. • investigating tools/instruments used to help determine scale, proportion and quantity. • using illustrations to communicate scale, proportion and quantity. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: compare, contrast, unit, metric, illustration, tool, instrument, quantity, scale, representation, graph, scale, quantity, estimate. • performing processes such as: o defining strategies to collect and display information. o recognizing units of scale. o using estimation to make determinations of quantity. o using relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Interdependent Relationships in Ecosystems: Environmental Impacts on Organisms

- 3-LS4-1. Analyzing data from fossils to provide evidence of the organisms and the environments in which they lived.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: ecosystem, habitat, organism, survive, thrive, migration, adaptation, inherit, fossil, geology, climate change, climate, extinction, characteristics, design, problem, investigation, testable, model, ecosystem, substance, flood, tsunami, hazard, mud slide, tornado, global warming, wind, lightening, surface,compare, similarity, difference, birth, growth, adult, reproduction, cycle, germination, pollination, parent, offspring, trait, characteristic, species, mate, reproduction

5th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

NGSS

CCC Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Learning Goal	Proficiency Scale
Students will understand how changes in scale, proportion, or quantity affect a system's structure and/or performance.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • measuring and describing physical quantities such as weight, time, temperature, and volume. • illustrating (through graphs, infographics, etc.) with data to communicate scale and quantity. • recognizing numerical values with powers of 10. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: quality, relative, proportion, microscopic, macroscopic, volume, power, phenomena. • performing processes such as: o identifying examples or illustrating examples of natural objects and observable phenomena exist from the very small to the immensely large. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Space Systems: Stars and the Solar System

- 5-ESS1-1. Relating the apparent brightness of the sun and stars to their relative distances from Earth.

- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: ellipse, constellation, star, gravity, force, gravitational pull, core, sun, star, apparent brightness, relative distance, astronomical units, light year, kilometer, spring scale.

Learning Targets - Earth Systems

- 5-ESS2-2. Comparing the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: day, night, rotation, revolution, season, tilt, natural resource, glaciers, ground water, agriculture, industry, vegetation, ecosystem, wetland, reserve, geosphere, biosphere, hydrosphere, atmosphere, ecosystem, landform, climate, weather, weathering, erosion, system, salt water, reservoir, distribution, polar ice caps, melting, freezing, condensation

Learning Targets - Structure and Properties of Matter

- 5-PS1-1. Developing a model to describe that matter is made of particles too small to be seen
- 5-PS1-3. Making observations and measurements to identify materials based on their properties.
- 5-PS1-2. Measuring and graphing quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: matter, substance, chemical change, physical change, mixture, solution, reactant, product, reaction, law of conservation of matter, experiment, heat, thermal energy, melting, freezing, condensation, properties, molecule, atom, compound, substance, particle, mass, volume, newton, milliliter, graduated cylinder, balance, gram, centimeter, luster, electrical conductivity, thermal conductivity, magnetic forces

6th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Learning Goal	Proficiency Scale
Students will understand how changes in scale, proportion, or quantity affect a system's structure and/or performance	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● recognizing what is relevant to a phenomena at different measures of size, time, and energy ● understanding the scale of systems too large or too small to be seen. ● comparing models to a natural or designed system in terms of scale, proportion, or quantity. ● creating a visual representation of data to communicate scale, proportion and/or quantity. 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary, such as: proportion. ● performing processes such as: o recognizing natural objects and observable phenomena exist from the very small to the immensely large. o using standard units to measure and describe physical quantities such as, but not limited to, weight, time, temperature, and volume. o creating a visual representation of data to communicate scale, proportion and/or quantity. o recognizing numerical values of powers of 10. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Energy
• MS-PS3-1. Describing the relationships of kinetic energy to the mass of an object and to the speed of an object. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: kinetic energy, potential energy, speed, acceleration, gravity, velocity, mass, force, conservation of energy, potential energy, conservation of energy, thermal energy, heat, temperature, conductor, insulator, conservation of energy, calorie, joule
Learning Targets - History of the Earth
• MS-ESS1-4. Explain, using evidence from rock strata, how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. • MS-ESS2-2. Describing how geoscience processes have changed Earth's surface at varying time and spatial scales. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: rock strata, relative, geologic, time scale, fossils, evolution, extinction, volcano, internal, external, sedimentary, igneous, weathering, erosion, volcano, earthquake, fault, expansion, contraction, decomposition, flood, mudslide, plate, tectonics

7th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Learning Goal	Proficiency Scale
Students will understand how changes in scale, proportion, or quantity affect a system's structure and/or performance	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • Relate objects or organisms using ratios and/or scales. • determining ratio or scale from data. • comparing quantities of objects or organisms using data. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: ratio, magnitude, equation, model. • performing processes such as: o using estimation to make determinations of scale, proportion and quantity. o comparing a scale model to a natural or designed system. o creating a visual representation of data to communicate scale, proportion and/or quantity. 1: Student demonstrates limited understanding or skill with the learning goal.

<u>Learning Targets - Energy</u> • MS-PS3-4. Describing the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: kinetic energy, speed, velocity, mass, force, conservation of energy, potential energy, thermal energy, heat, temperature, conductor, insulator, calorie, joule.
<u>Learning Targets - Structure, Function, and Information Processing</u> • MS-LS1-1. Providing evidence that living things are made of cells, either one cell or many different numbers and types of cells. • **Structure, Function and Information Processing - Goal 1:** Student will understand that living organisms are systems of interacting subsystems composed, on the most basic level, of cells. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: brain, sensory, input, stimuli, response, nerve, receptor, memory, cell, organelle, multicellular, unicellular, nucleus, chloroplasts, mitochondria, cell membrane, cell wall, tissue, organs, cytoplasm, system, organism, biology, biomedical, nanotechnology, centrifuge, botany, veterinarian, circulatory, excretory, digestive, respiratory, muscular.
<u>Learning Targets - Space Systems</u> · MS-ESS1-3. Determining scale properties of objects in the solar system. • MS-ESS1-3. Analyzing and interpreting data to determine scale properties of objects in the solar system. • **Universe - MS-LS1-1. Goal 1:** Student will analyze and interpret data to compare and contrast objects in the universe. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: eclipse, ellipse, season, axial tilt, rotation, revolution, latitude, equator, lunar, phase, scale, proportionality, crust, atmosphere, orbital radius, telescopes, satellites, solar system, galaxy, universe, gravity, satellites, orbit, ellipse

8th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Learning Goal	Proficiency Scale

Students will understand how changes in scale, proportion, or quantity affect a system's structure and/or performance	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal.
	
	3: Student demonstrates mastery with the learning goal as evidenced by:
	• comparing models of time, space, or energy.
	• explaining how examples observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale.
	• using proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes.
	• representing scientific relationships through the use of algebraic expressions and equations.
	
	2: Student demonstrates he/she is nearing proficiency by:
	• recognizing and recalling specific vocabulary, such as: observable, relationship, ratio, magnitude, algebraic, expression.
	• performing processes such as:
	  o using ratios or scales to relate objects or organisms.
	  o determining ratio or scale from data.
	  o comparing quantities of objects or organisms using data.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Structure and Properties of Matter
• MS-PS1-1. Developing models to describe the atomic composition of simple molecules and extended structures. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: temperature, thermal energy, molecule, heat, equilibrium, conduction, convection, radiation, solid, liquid, gas, kinetic molecular theory, phase change, molecule, atoms, natural resource, synthetic resource, solids, liquids, gases, physical properties, chemical properties, mixture, pure substance, matter.
Learning Targets - Energy
• MS-PS3-1. Describing the relationships of kinetic energy to the mass of an object and to the speed of an object. • MS-PS3-4. Describing the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. • Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: kinetic energy, potential energy, speed, acceleration, gravity, velocity, mass, force, conservation of energy, potential energy, kinetic energy, thermal energy, heat, temperature, conductor, insulator, conservation of energy, calorie, joule

3rd Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC *Stability and change*. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Learning Goal	Proficiency Scale
Students will understand conditions of stability and rates of change.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● identifying factors that influence whether a change will be slow or quick. ● predicting why some things change and why some things stay the same. ● explaining why an object, animal or landform goes through a change. ● understanding changes that can be made to a system to improve the stability. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: stability, change, influence, factor. • performing processes such as: o classifying changes as slow or quick. o identifying examples of things that may change slowly or rapidly. o measuring change. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Earth's Systems: Processes that Shape the Earth

- 2-ESS2-1. Comparing multiple solutions designed to slow or prevent wind or water from changing the shape of the land.
- 2-ESS1-1. Analyzing how Earth's events can occur quickly or slowly.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: surface, crust, weathering, erosion, volcano, earthquake, lake, pond, river, stream, creek, ocean, sea, glacier, design, problem, investigation, testable, model, ecosystem, headings, tables of contents, glossaries, electronic menus, icons, captions, index, websites, search results, infographic.

Learning Targets - Interdependent Relationships in Ecosystems: Environmental Impacts on Organisms

- 3-LS4-4. Making a claim about the merit of a solution to a problem caused when the environment changes.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: ecosystem, habitat, organism, survive, thrive, migration, adaptation, inherit, fossil, geology, climate change, climate, extinction, characteristics, design, problem, investigation, testable, model, ecosystem, substance, flood, tsunami, hazard, mud slide, tornado, global warming, wind, lightning, surface,compare, similarity, difference, birth, growth, adult, reproduction, cycle, germination, pollination, parent, offspring, trait, characteristic, species, mate, reproduction

6th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC *Stability and change*. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Learning Goal	Proficiency Scale
Students will understand conditions of stability and rates of change.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • understanding factors that influence stability and rates of change in a larger system. • identifying examples of systems in dynamic equilibrium. • measuring change (in systems, objects or organisms) in terms of differences over time. • identifying examples of systems that appear stable, but over long periods of time they will eventually, or already have, changed. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: rate, system, equilibrium, dynamic equilibrium. • performing processes such as: o recognizing that change happens over time. o identifying rates of change. o identifying examples of stability and change within a system. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Interdependent Relationships in Ecosystems

- MS-LS2-5. Evaluating ways of maintaining biodiversity and ecosystem services.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: ecosystem, biotic, abiotic, producer, consumer, decomposer, community, population, species, niche, habitat, photosynthesis, organism, competitive, predator, prey, symbiotic, mutually beneficial, purification, recycling, nutrient, erosion, deforestation, overpopulation, pollution, global warming, climate change, channelization, depletion, endangered, invasive species, habitat, biodiversity.

Learning Targets - Matter and Energy in Organisms and Ecosystems

- MS-LS2-4. Predict how changes to physical or biological components of an ecosystem affect populations.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: photosynthesis, reactants, products, chemical reaction, chloroplast, chlorophyll, molecule, respiration, ecosystem, resource, population, influence, physical, biological, food web, law of conservation of matter, producer, consumer, decomposer, ecosystem, predator, prey, scavenger, recycle, food chain.

7th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC *Stability and change*. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Learning Goal	Proficiency Scale
Students will understand conditions of stability and rates of change.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • evaluating factors that contribute to the stability or rate of change. • comparing stability and change relative to time. • proving how cyclic change patterns can be stable. • assessing the role of equilibrium in maintaining stability. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: relative, maintain. • performing processes such as: o identifying factors that influence stability and change. o measuring change (in systems, objects or organisms) in terms of differences over time. o observing that change may occur at different rates. o identifying examples of systems that appear stable, but over long periods of time they will eventually change. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Weather and Climate

- MS-ESS3-5. Assessing and citing evidence factors that have caused the rise in global temperatures over the past century.
- **Weather - MS-ESS3-5. MS-ESS3-2. MS-ESS3-3. Goal 3:** Student can analyze evidence, including tables, graphs, maps to develop understanding of the natural factors and human activities that influence change in global temperature.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: weather, temperature, pressure, humidity, precipitation, wind, latitude, altitude, geographic land distribution, atmospheric circulation, oceanic circulation, climate, global temperature, natural factors, human activities.

8th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC *Stability and change*. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Learning Goal	Proficiency Scale

Students will understand conditions of stability and rates of change.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal.
	
	3: Student demonstrates mastery with the learning goal as evidenced by:
	• critiquing stability and change in natural or designed systems by considering forces at different scales.
	• determining cause and effect of changes in one part of a system on another part.
	• proving how a system in dynamic equilibrium is stable due to a balance of feedback mechanisms.
	• connecting how the stability might be disturbed by either sudden events or gradual changes that accumulate over time.
	
	2: Student demonstrates he/she is nearing proficiency by:
	• recognizing and recalling specific vocabulary, such as: feedback mechanism, gradual, balance.
	• performing processes such as:
	    o developing an argument about how factors influence the stability or change in various systems.
	    o summarizing how forces impact the larger system.
	    o comparing systems in dynamic equilibrium.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Forces and Interactions

- MS-PS2-2. Proving an object's motion depends on the sum of the forces on the object and the mass of the object.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: electric, magnetic, force, field, balanced, unbalanced, gravity, static, interaction, Newton, inertia, speed, acceleration, interaction, independent variable, dependent variable, control, tools.

1st Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC *Structure and function*. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

Learning Goal	Proficiency Scale
Students will understand that the way in which an object or living thing is shaped determines its properties and functions.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • Comparing patterns of function in objects. • comparing the structure of objects as they relate to their function. • identifying patterns in shapes of natural and designed objects. • hypothesizing how structures can be improved to impact their function both for better or for worse. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as structure, function, shape, object, illustrate, patterns, compare, hypothesize, improve, impact. • performing processes such as: o recognizing the shapes of objects. o illustrating or building a structure designed for a specific function. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Structure, Function, and Information Processing

- 1-LS1-1. Explaining how plants and/or animals use their external parts to help them survive, grow, and meet their needs.
- 1-LS1-1. Designing a solution, with provided materials, to a human problem by using a plant or animal's solution.
- 1-LS1-2. Sharing findings of research on patterns in behavior of parents and offspring that help offspring survive.
- 1-LS3-1. Proving young plants and animals are like, but not exactly like, their parents.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: offspring, survive, seed, life cycle, trait, seedling, behavior, hibernation, migration, hunting, internal cue, external cue, characteristic

2nd Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC *Structure and function*. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

Learning Goal	Proficiency Scale
Students will understand that the way in which an object or living thing is shaped determines its properties and functions.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • describing how the shape and stability of structures of natural and designed objects are related to their function(s). 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as structure, function, stability, natural, patterns, compare, hypothesize, improve, impact. • performing processes such as: o identifying patterns of function in objects. o comparing the structure of objects as they relate to their function. o identifying patterns in shapes of natural and designed objects. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Engineering Design
● K-2-ETS1-2. Illustrating how the shape of an object helps it function as needed to solve a given problem. ● K-2-ETS1-1. Asking questions, making observations, and gathering information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: sketch, model, illustrate, shape, structure, function, observations, gather, situation, tool, test, strength, weakness, design, material

Learning Targets - Interdependent Relationships in Ecosystems

- 2-LS2-2. Describing the structure and function of characteristics of animals in dispersing seeds or pollinating plants.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: grow, sunlight, leaf, photosynthesis, disperse, seed, pollination, germination, growth, development, reproduction, death, habitat, ecosystem, diversity, consumer, producer, decomposer, pollination, shelter, seed, grow, sunlight, leaf, photosynthesis, disperse, seed, fair test

7th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC *Structure and function*. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

Learning Goal	Proficiency Scale

Students will understand the structures of an object or organism determines its properties and functions.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal.
	
	3: Student demonstrates mastery with the learning goal as evidenced by:
	• analyzing structures and system to determine how they function.
	• analyzing the function of the structure to the whole object or organism.
	• critiquing a structure's design and construction in relation to how it serves particular function.
	• critiquing a living thing's adaptations and how it serves particular functions.
	• categorizing substructures based on their shapes and the parts that serve functions.
	
	2: Student demonstrates he/she is nearing proficiency by:
	• recognizing and recalling specific vocabulary, such as structure, function, shape, composition, substructure, relationship.
	• performing processes such as:
	  o making observations about the shape, composition, and relationship among the parts in a system.
	  o investigating the different substructures of different materials.
	  o defining components that make up a system.
	  o identifying the functions of various structures.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Growth Development and Reproduction of Organisms

- MS-LS3-1. Developing and using a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
- MS-LS3-2. Developing and using a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
- **Growth, Development, & Reproduction - Goal 1:** Student describes factors that impact reproduction.
- **Growth, Development, & Reproduction - Goal 2:** Student describes how environmental and genetic factors affect growth and development of organisms.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: characteristics, behaviors, asexual, sexual, hereditary, Punnett square, chromosome, gene, predators, prey, trait, genetic modification, chromosome, gene, gene therapy, trait, sexual, asexual.

Learning Targets - Structure, Function, and Information Processing

- MS-LS1-2. Describing how the function of a cell as a whole and ways parts of cells contribute to the function.
- MS-LS1-1. Conducting an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells.
- ·MS-LS1-8. Gathering and synthesizing information to prove/demonstrate/refute that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.
- **Structure, Function and Information Processing - MS-LS1-1. Goal 1:** Student will understand that living organisms are systems of interacting subsystems composed, on the most basic level, of cells.
- **Structure, Function and Information Processing - MS-LS1-2. MS-LS1-3. Goal 2:** Student will develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
- **Structure, Function, & Information Processing - Goal 3:** Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: brain, sensory, input, stimuli, response, nerve, receptor, memory, cell, organelle, multicellular, unicellular, nucleus, chloroplasts, mitochondria, cell membrane, cell wall, tissue, organs, cytoplasm, system, organism, biology, biomedical, nanotechnology, centrifuge, botany, veterinarian, circulatory, excretory, digestive, respiratory, muscular.

8th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC *Structure and function*. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

Learning Goal	Proficiency Scale
Students will understand that the way in which an object or living thing is shaped determines its properties and functions.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • modeling complex structures and systems to visualize how their function depends on the shape, composition, and relationships among its parts. • understanding complex natural and designed structures and systems to determine how they function. • designing structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. • evaluating the composition of material to improve the function. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as structure, function, shape, composition, substructure, relationship. • performing processes such as: o modeling simple systems. o evaluating how the function depends on the shapes, composition, and relationships among its parts. o analyzing a simple structures and system to determine how they function. o designing structures to serve particular functions. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Waves and Electromagnetic Radiation

- MS-PS4-2. Describe that waves are reflected, absorbed, or transmitted through various materials.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: wave, amplitude, frequency, wavelength, crest, trough, medium, energy, compression, rarefaction, reflection, absorption, transmission, disturbance, mechanical wave, electromagnetic wave, digital, analog, signal, fiber optic, transmit, pulse, binary.

Learning Targets - Structure and Properties of Matter

- MS-PS1-3. Gathering and making sense of information to describe that synthetic materials come from natural resources.
- MS-PS1-3. Proving how synthetic materials have impacted society.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: temperature, thermal energy, molecule, heat, equilibrium, conduction, convection, radiation, solid, liquid, gas, kinetic molecular theory, phase change, molecule, atoms, natural resource, synthetic resource, solids, liquids, gases, physical properties, chemical properties, mixture, pure substance, matter.

Learning Targets - Engineering Design

- MS-ETS1-2. Evaluating competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: model, test, modification, fair test, bias, tool, design, design solution, engineering, characteristics, solution.

Learning Targets - Energy

- MS-PS3-3. Designing, constructing, and testing a device that either minimizes or maximizes thermal energy transfer.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: kinetic energy, potential energy, speed, acceleration, gravity, velocity, mass, force, conservation of energy, potential energy, kinetic energy, thermal energy, heat, temperature, conductor, insulator, conservation of energy, calorie, joule
-

Learning Targets - Chemical Reactions

- MS-PS1-6. Undertaking a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: chemical reaction, physical change, chemical change, law of conservation of matter, atom, molecule, mass, matter, exothermic, endothermic, temperature, atom, heat, kinetic molecular theory, conductor, insulator, law of conservation of energy, exothermic, endothermic, temperature

Learning Targets - Waves and Electromagnetic Radiation

- MS-PS4-3. Integrating qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: wave, amplitude, frequency, wavelength, crest, trough, medium, energy, compression, rarefaction, reflection, absorption, transmission, disturbance, mechanical wave, electromagnetic wave, digital, analog, signal, fiber optic, transmit, pulse, binary.

Kindergarten

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Learning Goal	Proficiency Scale

Students will be able to define systems they are studying.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal.
	
	3: Student demonstrates mastery with the learning goal as evidenced by:
	• illustrating a system.
	• describing objects that are living or nonliving, plants and animals in terms of its parts and function.
	
	2: Student demonstrates he/she is nearing proficiency by:
	• recognizing and recalling specific vocabulary, such as: living, non living, plants, animals, parts, functions, system, object.
	• performing processes such as:
	    ○ identifying examples of systems.
	    ○ recognizing that systems have parts.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment

- K-ESS2-2. Describing how plants and animals (including humans) can change the environment to meet their needs.
- K-ESS3-1. Using a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.
- cycle of a pumpkin
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: need, air, water, light, sun, food, shelter, temperature, living, non-living, soil, temperature, cause, effect, test, evidence, support, refute, land, water, air, reduce, reuse, recycle, environment, earth, investigate, impact, littering, soil, natural, designed, system, model, need, air, water, light, sun, food, shelter, data, experiment, investigate, observations, pattern, argument, claim, evidence, idea, evidence, obtain, evaluate, scientific ideas, model, diagram, drawing

2nd Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Learning Goal	Proficiency Scale
Students will be able to define systems they are studying.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • defining a system in terms of inputs and outputs; the flows in and out of a system. • explaining that systems in the natural and designed world have parts that work together and depend on external systems. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: input, output, contribution, role, task, job, responsibility, flow, external, contribute, relationship, whole. • performing processes such as: ○ assess how the parts of a system contribute to the whole. ○ state the relationship between the parts of a system as they relate to the whole. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Engineering Design ● K-2-ETS1-2. Developing a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: sketch, model, illustrate, shape, structure, function, observations, gather, situation, tool, test, strength, weakness, design, material
Learning Targets - Interdependent Relationships in Ecosystems ● 2-LS2-2. Developing a simple model that mimics the function of an animal in dispersing seeds or pollinating plants. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: grow, sunlight, leaf, photosynthesis, disperse, seed, pollination, germination, growth, development, reproduction, death, habitat, ecosystem, diversity, consumer, producer, decomposer, pollination, shelter, seed, grow, sunlight, leaf, photosynthesis, disperse, seed, fair test

3rd Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Learning Goal	Proficiency Scale
Students will be able to define systems they are studying.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● illustrating a system and its parts. ● classifying systems by the parts they have and are missing. ● predicting what would happen if a part was removed within a system. ● creating plans that another person can follow (ex. draw or write a set of instructions for building something) 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary, such as: classify, predict, removed, plans. ● performing processes such as: ○ define a system in terms of inputs and outputs; the flows in and out of a system. ○ explaining that systems in the natural and designed world have parts that work together and depend on external systems. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Interdependent Relationships in Ecosystems: Environmental Impacts on Organisms ● 3-LS4-4. Analyzing how an environmental change impacts the organisms in a system. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: ecosystem, habitat, organism, survive, thrive, migration, adaptation, inherit, fossil, geology, climate change, climate, extinction, characteristics, design, problem, investigation, testable, model, ecosystem, substance, flood, tsunami, hazard, mud slide, tornado, global warming, wind, lightning, surface,compare, similarity, difference, birth, growth, adult, reproduction, cycle, germination, pollination, parent, offspring, trait, characteristic, species, mate, reproduction
Learning Targets - Inheritance and Variation of Traits: Life Cycles and Traits ● 3-LS1-1. Developing models to describe that organisms have unique and diverse life cycles. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: parent, offspring, trait, characteristic, species, survival, mate, reproduction, variation, environment, ecosystem, adaptation, natural selection, seedling, surface, crust, weathering, erosion, volcano, earthquake, lake, pond, river, stream, creek, ocean, sea, glacier, compare, similarity, difference, birth, growth, adult, reproduction, cycle, germination, pollination

4th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Learning Goal	Proficiency Scale
Students will be able to define systems they are studying.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● differentiating the various functions that the parts do within the whole. ● categorizing parts of a system and how they relate to the whole. ● comparing the functions of parts of a system. ● creating a model that makes explicit the invisible features of a system, such as interactions, energy flows, or matter transfers. 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary, such as: function, explicit, transfer, invisible, model, feature, interaction, flow, energy, matter, transfers. ● performing processes such as: ○ constructing a system and identifying the parts. ○ classifying systems by the parts they have and are missing. ○ predicting what would happen if a part was removed within a system. ○ creating plans that others can follow (ex. draw or write a set of instructions for building something) 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Waves

- 4-PS4-1. Developing a model of waves to describe amplitude and wavelength and that waves can cause objects to move.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: amplitude, wavelength, resonate, sound, energy, crest, trough, wave, mechanical wave, pitch, loudness, medium, rest position, disturbance, ear drum, renewable, non-renewable, fossil fuels, energy, resource, environment, fissile materials, habitat, dam, mining, vibration, light, sound, energy, motion, kinetic energy, potential energy, conversion, transfer, medium, collide, force, speed, transformation, temperature, balanced, unbalanced, solar energy, thermal energy, radiant energy, mechanical energy, chemical energy, circuit, design, solution, testable question, bias, unbiased, test, quantitative, qualitative, conclusion, nuclear, solar, geothermal, hydroelectric, static, conduction, convection, radiation, source, receiver, transfer, medium, Morse code, binary, smoke signal, digital, email, text, text language, Emoji, social media, blog, cell phone, portable computing devices.

Learning Targets - Structure, Function, and Information Processing

- 4-LS1-1. Using systems to model that plants and animals have internal and external structures that support survival, growth, behavior, and reproduction.
- 4-LS1-2. Using a system model to describe that animals receive, process and respond to information in different ways.
- 4-PS4-2. Developing a model to describe that light reflecting from objects and entering the eye allows objects to be seen.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: source, light, transferred, transparent, translucent, opaque, reflect, retina, pupil, iris, cornea, lens, optic nerve, system, system model, structure, internal, external, survival, behavior, reproduction, signal, adaptation, circulatory system, respiratory system, nervous system, stimulus, response, stem, leaves, flowers, seeds, roots, sensory organs, beaks, appendages, body covering

5th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Learning Goal	Proficiency Scale
Students will be able to define systems they are studying.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● interpreting a system as a group of related parts that make up a whole and can carry out functions its individual parts cannot. ● describing a system in terms of its components and their interactions. ● creating a system with models that incorporate a range of mathematical relationships among variables and some analysis of the patterns of those relationships. 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary, such as: contribution, role, interaction, analysis, interpret, mathematical, relationships, variables. ● performing processes such as: ○ identifying the various functions the parts do within the whole. ○ categorizing parts of a system and how they relate to the whole. ○ comparing the functions of parts of a system. ○ creating a model that incorporates and makes explicit the invisible features of a system, such as interactions, energy flows, or matter transfers. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Earth Systems

- 5-ESS2-1. Using a system model as an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- 5-ESS3-1. Using a system model to describe ways individual communities use science ideas to protect the Earth's resources and environment.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: day, night, rotation, revolution, season, tilt, natural resource, glaciers, groundwater, agriculture, industry, vegetation, ecosystem, wetland, reserve, geosphere, biosphere, hydrosphere, atmosphere, ecosystem, landform, climate, weather, weathering, erosion, system, salt water, reservoir, distribution, polar ice caps, melting, freezing, condensation

Learning Targets - Engineering Design

- 3-5-ETS1-1. Defining a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2. Generating and comparing multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3. Planning and carrying out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: need, want, change, demands, technology, engineer, benefit, risk, demand, constraint, experiment, investigation, fair test, prototype, aspect, detail

Learning Targets - Matter and Energy in Organisms and Ecosystems

- 5-LS2-1. Using a system model to describe the movement of matter among plants, animals, decomposers, and the environment.
- 5-PS3-1. Using models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: matter, transfer, transformation, decompose, predator, prey, soil, ecosystem, Earth, herbivore, carnivore, omnivore, detritivore, organisms, food web, food chain, energy, nutrient, temperature, transfer, transformation, sun, body warmth, body repair, food (as it relates to plants and animals), properties, molecule, atom, compound, substance, particle

6th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Learning Goal	Proficiency Scale
Students will be able to define systems they are studying.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● proving a system's boundaries, conditions, inputs and outputs. ● identifying patterns of the inputs and outputs of a system. ● using models to simulate systems. ● evaluating the strengths and weaknesses of the models. 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary, such as: boundaries, conditions, model. ● performing processes such as: ○ identifying the various functions the parts do within the whole. ○ categorizing parts of a system and how they relate to the whole. 1: Student demonstrates limited understanding or skill with the learning goal.

WGSD Curriculum – Science (Systems and System Models/K-8)
DRAFT 231

Learning Targets - Energy • MS-PS3-2. Using a system or system model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: kinetic energy, potential energy, speed, acceleration, gravity, velocity, mass, force, conservation of energy, potential energy, conservation of energy, thermal energy, heat, temperature, conductor, insulator, conservation of energy, calorie, joule
Learning Targets - Matter and Energy in Organisms and Ecosystems • MS-LS1-7. Developing a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. • MS-LS2-3. Developing a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: photosynthesis, reactants, products, chemical reaction, chloroplast, chlorophyll, molecule, respiration, ecosystem, resource, population, influence, physical, biological, food web, law of conservation of matter, producer, consumer, decomposer, ecosystem, predator, prey, scavenger, recycle, food chain.
Learning Targets - Earth's Systems • MS-ESS2-1. Developing a model to describe the cycling of Earth's materials and the flow of energy that drives this process. • MS-ESS2-4. Developing a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: melting, crystallization, weathering, deformation, sedimentation, minerals, metamorphic, igneous, hydrosphere, geosphere, atmosphere, evaporation, condensation, precipitation, surface run-off, groundwater flow, convection, conduction, radiation, water cycle, rock cycle, gravity, renewable, nonrenewable, geothermal, hydroelectric, fossil fuel, petroleum, sediment, ore, subduction zone, hydrothermal, resources.

7th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Learning Goal	Proficiency Scale
Students will be able to relate parts of a system to the whole.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● use models and simulations to illustrate a system. ● critiquing how systems interact with other systems ● provinging how systems may have sub-systems and may be a part of larger complex systems. 2: Student demonstrates he/she is nearing proficiency by: ● recognizing and recalling specific vocabulary, such as: component, interaction, simulation, complex. ● performing processes such as: ○ making observations of a system created to do a task. ○ identifying patterns of the inputs and outputs of a system. ○ analyzing models used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Engineering Design

- MS-ETS1-1. Defining the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: science, engineering, technology, research, climate, natural resource, economics, renewable, non-renewable.

Learning Targets - Forces and Interactions

- MS-PS2-4. Developing or using a system to demonstrate gravitational interactions on interacting objects.

Learning Targets - Structure, Function, and Information Processing

- MS-LS1-3. Proving the body is a system of interacting subsystems composed of groups of cells.
- MS-LS1-2. Developing and using a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
- **Growth, Development, & Reproduction - Goal 1:** Student describes factors that impact reproduction.
- **Growth, Development, & Reproduction - Goal 2:** Student describes how environmental and genetic factors affect growth and development of organisms.
- **Structure, Function and Information Processing - MS-LS1-1. Goal 1:** Student will understand that living organisms are systems of interacting subsystems composed, on the most basic level, of cells.
- **Structure, Function, & Information Processing - Goal 3:** Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: brain, sensory, input, stimuli, response, nerve, receptor, memory, cell, organelle, multicellular, unicellular, nucleus, chloroplasts, mitochondria, cell membrane, cell wall, tissue, organs, cytoplasm, system, organism, biology, biomedical, nanotechnology, centrifuge, botany, veterinarian, circulatory, excretory, digestive, respiratory, muscular.

Learning Targets - Space Systems

- MS-ESS1-1. Developing and using a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
- MS-ESS1-2. Developing and using a model to describe the role of gravity in the motions within galaxies and the solar system.
- **Universe - Goal 2:** Student will develop and use models to describe the role of gravity.
- **Universe - Goal 3:** Student will develop and use models to describe cyclic patterns of lunar phases.
- **Universe - Goal 4:** Student will develop and use models to describe cyclic patterns of Earth's seasons.
- **Universe - Goal 5:** Student will develop and use models to describe cyclic patterns of eclipses.

- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: eclipse, ellipse, season, axial tilt, rotation, revolution, latitude, equator, lunar, phase, scale, proportionality, crust, atmosphere, orbital radius, telescopes, satellites, solar system, galaxy, universe, gravity, satellites, orbit, ellipse

Learning Targets -Weather and Climate

- MS-ESS2-6. Using models to describe atmospheric and oceanic circulation and their impacts.
- **Weather** - **Goal 1:** Student can analyze data, including maps, and construct and use models to develop understanding of the factors that control weather.
- **Weather - Goal 2:** Student can analyze data, including maps, and construct and use models to develop understanding of the factors that control climate.
- **Weather - Goal 4: MS-ESS2-4.** Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: weather, temperature, pressure, humidity, precipitation, wind, latitude, altitude, geographic land distribution, atmospheric circulation, oceanic circulation, climate, global temperature, natural factors, human activities

8th Grade

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS CCC Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Learning Goal	Proficiency Scale
Students will be able to define systems they are studying.	4: Student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: • investigating or analyzing a system by defining its boundaries and initial conditions, as well as its inputs and outputs. • using models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. • using models or simulations to predict the behavior of a system • recognizing that predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. • designing systems to do specific tasks. 2: Student demonstrates he/she is nearing proficiency by: • recognizing and recalling specific vocabulary, such as: scale, behavior, prediction, precision, reliability, assumption, approximation, inherent, tasks. • performing processes such as: ○ use models and simulations to illustrate a system. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets - Forces and Interactions • MS-PS2-1. Developing or using a system to apply Newton's Third Law involving the motion of two colliding objects. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: electric, magnetic, force, field, balanced, unbalanced, gravity, static, interaction, Newton, inertia, speed, acceleration, interaction, independent variable, dependent variable, control, tools
Learning Targets - Engineering Design ● MS-ETS1-4. Developing a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: model, test, modification, fair test, bias, tool, design, design solution, engineering, characteristics, solution ● Foundations Learning Target 3: Students will use the scientific method to design and evaluate an experiment for any testable question. ● Foundations Learning Target 1: Students will use correct tools to measure matter in metric units and label units correctly ● Chemistry Learning Target 7- Students will describe heat and how it is transferred ● Electricity Learning Target 5- Students will be able to demonstrate advantages and disadvantages of each wired complete circuit. ● Wave Energy Learning Target 7: Students will identify and explain types of reflection ● Wave Energy Learning target 8: Students will compare refraction of light through different materials
Learning Targets - Chemical Reactions ● MS-PS1-5. Developing and using a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: chemical reaction, physical change, chemical change, law of conservation of matter, atom, molecule, mass, matter, exothermic, endothermic, temperature, atom, heat, kinetic molecular theory, conductor, insulator, law of conservation of energy, exothermic, endothermic, temperature ● **Chemistry Learning Target 6** - Student is able to classify chemical reactions and provide evidence of the law of conservation of mass. ● **Chemistry Learning target 5** - Student is able to recognize and classify changes in matter as chemical or physical.
Learning Targets - Waves and Electromagnetic Radiation • MS-PS4-2. Developing and using a model to describe that waves are reflected, absorbed, or transmitted through various materials. ● Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: wave, amplitude, frequency, wavelength, crest, trough, medium, energy, compression, rarefaction, reflection, absorption, transmission, disturbance, mechanical wave, electromagnetic wave, digital, analog, signal, fiber optic, transmit, pulse, binary. ● Wave Energy Learning Target 8- Students will compare refraction of light through different materials ● Wave Energy Learning Target 1- Students will understand the properties of waves.
Learning Targets - Structure and Properties of Matter

- MS-PS1-1. Developing models to describe the atomic composition of simple molecules and extended structures.
- MS-PS1-4. Developing a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
- Students will be able to use/know and understand/recognize and recall domain specific vocabulary such as: temperature, thermal energy, molecule, heat, equilibrium, conduction, convection, radiation, solid, liquid, gas, kinetic molecular theory, phase change, molecule, atoms, natural resource, synthetic resource, solids, liquids, gases, physical properties, chemical properties, mixture, pure substance, matter.
- **Chemistry Learning Target 1:** Student is able to use the periodic table to identify and determine properties of Elements, Compounds, and Molecules.
- **Chemistry Learning Target 2:** Student is able to use properties to describe matter as either pure substance or mixture.
- **Chemistry Learning Target 3:** Students will use the Kinetic Molecular Theory to illustrate particle arrangement and movement in each state of matter.
- **Chemistry Learning Target 4:** Students will use changes in energy to describe volume changes within various states of matter.

WGSD Curriculum -- Anatomy & Physiology: Body Systems
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Learning Goal	Proficiency Scales
Students will be able to distinguish the principal functions of each body system: nervous, endocrine, cardiovascular, lymphatic, urinary, digestive, respiratory and reproductive.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal as evidenced by ● deducing the functions of each body system. ● recognizing disorders and diseases, including causes, effects and treatments of of each body system. ● describing the path of action throughout each body system. ● diagraming and describing the gross anatomy of each body system. ● describing the lifespan changes that occur within of each body system. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *systemic, cardiac, pulmonary, steroid, hyposecretion, hypersecretion, negative feedback, positive feedback, hypothalamus, neuron, somatic, autonomic, sympathetic, parasympathetic, and nephron.*

	• performing specific processes, such as
	  ○ identifying the major anatomy and organs of the nervous, endocrine, cardiovascular, lymphatic, urinary, digestive, respiratory and reproductive systems.
	  ○ matching nervous, endocrine, cardiovascular, lymphatic, urinary, digestive, respiratory and reproductive system disorders with general descriptions.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets
Learning Design

WGSD Curriculum -- Anatomy & Physiology Levels of Organization
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. HS-LSI-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Learning Goal	Proficiency Scales
Students will be able to summarize how homeostasis influences the human body.	4. The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3. The student demonstrates mastery of the learning goal by ● identifying and describing the function of organs included within each organ system. ● determining the relationship between Anatomy & Physiology. ● distinguishing among the epidermis, dermis, and the subcutaneous layers of the skin. ● contrasting the structure and function of the four major major tissue types (Epithelial, Connective, Nervous, Muscular). ● identifying the importance of homeostasis to health and describe homeostatic mechanisms. ● determining the organizational levels in the human body and describe the ways in which they are related. ● determining characteristics and functions of the skin and describe how each is accomplished.

	2. The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *anatomical position, homeostasis, epidermis, dermis, subcutaneous, sagittal, transverse, axial, appendicular, anterior, medial, distal, superior, lateral, inferior, superficial, posterior, cavity, receptor, effector, equilibrium, anatomy, and physiology.* ● performing specific processes, such as ○ identifying the organ systems and their primary functions. ○ listing the three layers and functions of the skin. ○ listing the four major tissue types. ○ labeling the levels of organization on a diagram. 1. The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Identify organs included in the 11 organ systems
- Describe a typical feedback loop and how that works to maintain homeostasis
- Define and identify the terms used for body regions, planes, cavities
- Define anatomy and physiology and explain their relationship
- Draw and label diagrams of tissue cells seen under a microscope
- Compile a list of the functions of the three layers of the skin

Learning Design

WGSD Curriculum -- Anatomy & Physiology: Muscular System
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Learning Goal	Proficiency Scales
Students will be able to deduce why muscles are essential for movement and posture and the structure and function of muscles.	4. The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3. The student demonstrates mastery of the learning goal as evidenced by ● formulating the functions of the muscular system. ● comparing and contrasting the three types of muscle tissue. ● researching and presenting muscular disorders and diseases, including causes, effects and treatment. ● connecting the names of the muscles of the muscular system to their origins and insertion points. ● describing how action potential is initiated in a muscle cell and the events leading up to muscle contraction. ● describing the gross and microscopic anatomy of skeletal muscle and muscle fiber. ● describing the similarities and differences in the structure and function of muscles.

	2. The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *motor neuron, motor unit, muscle fiber nucleus, neuromuscular junctions, skeletal muscle fibers, atrophy, myosin filaments, isotonic, isometric, muscle tone, antagonist, adenosinetriphosphate, glycogen, lactate, threshold, refractory period, relaxation period, cerebral palsy, muscular dystrophy, anabolic steroids.* ● performing specific processes, such as ○ identifying the major muscles of the muscular system. ○ matching muscular disorders with general descriptions. ○ listing the three types of muscular tissue. ○ explaining the main difference between skeletal muscle and muscle fiber. ○ summarizing why muscles contract. 1. The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- List and explain the functions of the muscular system
- Locate and name most of the muscles of muscular system on diagram or model
- Contrast the three types of muscular tissue
- Identify different types of muscular disorders
- List steps for the process of muscle contraction
- Categorize differences between skeletal muscle and muscle fiber

Learning Design

WGSD Curriculum -- Anatomy & Physiology: Skeletal System & Articulations

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Learning Goal	Proficiency Scales
Students will be able to describe how the skeleton is arranged to facilitate support, protection of vital organs, and movement via articulations.	4: the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal as evidences by ● formulating the functions of the skeletal system. ● comparing and contrasting the structure of compact and cancellous bone. ● investigating skeletal disorders and diseases, including causes, effects and treatment. ● describing the processes of bone formation, growth, and repair. ● identifying and naming all bones and markings of the skeletal system. ● describing the characteristics of the three major type of joints. ● comparing and contrasting the movements allowed by each type of joint. ● demonstrating and naming the different types of movements. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *major bones*

	of skeletal system (ulna, humerus, etc..), osteoporosis, osteomalacia, osteomyelitis, scoliosis, kyphosis, lordosis, flexion, extension, abduction, adduction, supination, pronation, rotation, circumduction, inversion, eversion, dorsiflexion, plantarflexion, protraction, retraction, transverse fraction, segmented fracture, comminuted fracture, oblique angle fracture, spiral curvature fracture, open fracture vs. closed, incomplete fracture, synovial joint, fibrous joint, cartilaginous joint. ● performing specific processes, such as ○ identifying major bones of the skeletal system. ○ matching bone disorders with general descriptions. ○ listing the three basic type of joints. ○ matching movements with general descriptions. ○ identifying the three types of vertebrae and the function of each. 1: The student demonstrates limited understanding or success with the learning goal.

Learning Targets

- List and explain the function of the skeletal system
- Explain the process of bone formation, growth and repair
- Locate and name all the bones and markings of the human skeleton
- Identify the different type of joints located throughout the body

Learning Design

WGSD Curriculum -- Anatomy & Physiology: Body Systems
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Learning Goal	Proficiency Scales
Students will be able to distinguish the principal functions of each body system: nervous, endocrine, cardiovascular, lymphatic, urinary, digestive, respiratory and reproductive.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal as evidenced by ● deducing the functions of each body system. ● recognizing disorders and diseases, including causes, effects and treatments of of each body system. ● describing the path of action throughout each body system. ● diagraming and describing the gross anatomy of each body system. ● describing the lifespan changes that occur within of each body system. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *systemic, cardiac, pulmonary, steroid, hyposecretion, hypersecretion, negative feedback, positive feedback, hypothalamus, neuron, somatic, autonomic, sympathetic, parasympathetic, and nephron.*

	• performing specific processes, such as
	  ○ identifying the major anatomy and organs of the nervous, endocrine, cardiovascular, lymphatic, urinary, digestive, respiratory and reproductive systems.
	  ○ matching nervous, endocrine, cardiovascular, lymphatic, urinary, digestive, respiratory and reproductive system disorders with general descriptions.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

Learning Design

WGSD Curriculum -- Animal Behavior
Aggression
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

HS-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-8: Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
HS-LS4-5: Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
CCSS.R.11-12.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
CCSS.W.11-12.7: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a question; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Learning Goal	Proficiency Scales
Students will be able to analyze patterns of aggression in the animal kingdom.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● categorizing aggressive behaviors of animals. ● hypothesizing why evolution has not led to an increasingly more aggressive individuals and societies even though aggression is adaptive. 2: The student demonstrates he/she is nearing proficiency by

	● recognizing or recalling specific vocabulary, such as: *aggression, territory, home range, core area, individual distance, lek*.
	
	● performing basic processes, such as:
	    ● comparing the types of aggression (territorial, dominance, sexual, parental, parent-offspring, anti-predatory, and extreme forms such as cannibalism and infanticide).
	    ● recognizing the internal and external factors of aggression.
	    ● understanding why animals use aggressive displays rather than fight for resources.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Define *aggression*
- Recognize the types of aggression
- Investigate the internal and external factors that affect aggression
- Design and experiment to observe aggressive displays used by male betta fish to defend their territory and to determine the conditions in which betta fish exhibit such displays

Learning Design

WGSD Curriculum -- Animal Behavior

Approaches and Methods

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-LS2-8: Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
CCSS.R.11-12.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
CCSS.W.11-12-1e: Provide a concluding statement or section that follows from or supports the argument presented.

Learning Goal	Proficiency Scales
Students will be able to judge the best use of various approaches and methods when studying animal behavior.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● demonstrating the differences between the 4 approaches to studying animal behavior (ethology, comparative psychology, behavioral ecology and sociobiology). ● drawing conclusions about the purposes of studying animal behavior. ● comparing the advantages and disadvantages of field and lab experiments. ● creating, analyzing and drawing conclusions about ethograms created in class.

	2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *behavior, stimulus, ethology, ethogram, focal sampling, scan sampling, one zero sampling, equal observability, interobserver reliability, proximate factor, ultimate factor.* ● performing basic processes, such as: ○ recognizing the difficulties with studying animal behavior. ○ identifying the four components to studying animal behavior. ○ explaining how ethograms are beneficial to scientists. ○ identifying the four approaches to studying animal behavior. ○ listing the reasons why we study animal behavior. ○ recognizing the advantages and disadvantages of field and lab studies. ○ discriminating between an instinctive behavior and a learned behavior 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Distinguish between instinctive and learned behaviors
- Create and analyze an ethogram
- Define behavior
- Determine the issues ethologist have with animal behavior studies
- Be able to recognize the four approaches of studying animal behavior
  Determine reasons why we study animal behavior.

<u>Learning Design</u>

WGSD Curriculum -- Animal Behavior

Communication

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
HS-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. **HS-LS2-8:** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. **CCSS.R.11-12.4:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics. **CCSS.R.11-12.8:** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales
Students will be able to correlate how and why communication occurs within the animal kingdom.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● classifying the different functions (in terms of survival and reproduction) of communication such as group spacing, recognition, reproduction, social status, alarm, hunting, care and soliciting play. ● comparing and contrasting the six channels of communication. 2: The student demonstrates he/she is nearing proficiency by recognizing or recalling specific vocabulary, such as: ● *communication, signal, discrete signals, continuous signals, complex communication.*

	- performing basic processes, such as:
	  - identifying the characteristics of signals used in communication.
	  - identifying examples of complex communication in the animal world.
	  - recognizing the six channels of communication.
	  - identifying the different functions of animal communication.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Recognize how communication assists animals' survival and reproduction
- List the various channels of communication and recognize the advantages and disadvantages of each channel
- Give examples of organisms that use complex communication

Learning Design

WGSD Curriculum -- Animal Behavior
Learning Mechanisms
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

HS-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-8: Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
CCSS-W.11-12.7: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
CCSS-R.11-12.4: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a question; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Learning Goal	Proficiency Scales
Students will be able to design experiments to determine the effectiveness of different mechanisms of learning.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● designing and conducting an experiment to determine whether operant conditioning occurs in mice. ● comparing and contrasting the different types of learning that can occur in the animal kingdom. 2: The student demonstrates he/she is nearing proficiency by

	● recognizing or recalling specific vocabulary, such as: *learning, habituation, sensitization, classical conditioning, operant conditioning, reinforcement, observational learning, imitation, imprinting, cognition*.
	
	● performing basic processes, such as:
	    ● identifying examples of the different types of learning.
	    ● recognizing how learning enhances survival and reproductive success.
	    ● reciting how experiences prompt learning (how memories are formed).
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Identify the different types of learning
- Investigate the effect of repeating a behavior on learning
- Investigate whether a mouse can be trained, using operant conditioning, to run a maze

Learning Design

WGSD Curriculum -- Animal Behavior
Mating Systems
DRAFT

High Priority Standard (CCSS, State, National, TILS, CREDE, etc.)
HS-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. **HS-LS2-8:** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. **HS--LS3-1:** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. **HS-LS4-2:** Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. **HS-LS4-5:** Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. **CCSS-R.11-12.9**: Synthesize information from a range of sources into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Learning Goal	Proficiency Scales
Students will be able to determine the cost and benefit of different animal mating systems.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● assessing the costs and benefits of sexual reproduction. ● explaining the reasons for sexual dimorphism. ● classifying the types of mating systems. 2: The student demonstrates mastery of the learning goal as evidenced by

	● recognizing or recalling specific vocabulary, such as: *sexual reproduction, asexual reproduction, sexual dimorphism, gametes, sexual selection, estrus, intrasexual selection, intersexual selection, monogamy, polygyny, and polyandry*.
	
	● performing basic processes, such as:
	  ● identifying the causes of reproductive behavior.
	  ● recognizing the difference between k-selected and r-selected species.
	  ● recognizing problems animals face with parenthood.
	  ● identifying the costs and benefits of sexual reproduction.
	  ● identifying the causes the of sexual dimorphism (gametes and sexual selection).
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Understand the costs and benefits of sex
- Determine the causes of reproductive behavior
- Identify the reasons for differences between the sexes of animals
- Differentiate between the types of mating systems

Learning Design

WGSD Curriculum -- Animal Behavior
Mechanisms of Animal Behavior
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. **HS-LS1-2:** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. **HS-LS2-6:** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. **HS-LS2-8:** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. **HS--LS3-1:** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. **HS-LS4-1:** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. **HS-LS4-2:** Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. **HS-LS4-4:** Construct an explanation based on evidence for how natural selection leads to adaptation of populations. **HS-LS4-5:** Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. **CCSS-R.11-12.3:** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. **CCSS-W-11-12.7:** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a question; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. **CCSS-R.11-12.4:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics. **CCSS-W.11-12.1e:** Provide a concluding statement or section that follows from or supports the argument presented.

Learning Goal	Proficiency Scales

Students will be able to differentiate the biologically determined mechanisms that control behavior and mediate the effects of evolutionary influences.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.
	
	3: The student demonstrates mastery of the learning goal by
	● hypothesizing and drawing conclusions about how genes translate into behavior by using techniques such as inbreeding, twin studies, cross fostering, selective breeding, mutations/knockout genes.
	● creating an experiment to analyze how nervous system complexity of organisms relates to behaviors seen in response to various stimuli.
	● generating and testing data about the size of the somatosensory cortex to analyze behavioral adaptations.
	● drawing conclusions about how nerve pathways constitute the structural and functional basis for behavior.
	
	2: The student demonstrates he/she is nearing proficiency by
	
	● recognizing or recalling specific vocabulary, such as: *behavior genetics, gene, allele, evolution, epigenesis, polygenic, neuron, synapse, neurotransmitter, hormone.*
	
	● performing basic processes, such as:
	    ● recognizing ways that evidence is used to show the evolution of a behavior (phylogeny, domestication and comparative studies).
	    ● recognizing the Nature/Nurture influences on behavior.
	    ● identifying the general functions of the nervous system.
	    ● labeling the parts of a neuron.
	    ● summarizing how neurons communicate.
	    ● identifying the types of neurons and types of sensory

	receptors. ● labeling the parts and functions of the human brain. ● summarizing the behavioral responses caused by hormone secretions. ● identifying techniques that are used to determine how genes are translated into behavior. ● identifying how nervous system complexity relates to complexity of behaviors. ● comparing how the nervous and endocrine system influences behaviors of animals. 1: The student demonstrates limited understanding skill with the learning goal.

Learning Targets

- Be able to debate the Nature/Nurture issue on how behaviors are influenced
- Diagram a neuron
- Explain how neurons communicate with each other
- Distinguish the types of sensory receptors
- Collect and display data on how nervous system complexity affects how animals respond to various stimuli
- Label and understand the functions of the human brain parts
- List the responses caused by hormone secretions

Learning Design

WGSD Curriculum -- Astronomy
Composition and Observation of the Universe
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. CCSS: CCSS.ELA-LITERACY.RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales

Students will be able to differentiate among the objects that comprise the universe.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the learning goal by ● critiquing and analyzing the main arguments and evidence in support of the standard cosmological model (e.g. elements, solar systems, and universe). ● comparing and contrasting the major properties of the components of our solar system. ● applying the science of comparative planetology to identify similarity and differences in planets and how to identify components of types of planets. ● analyzing the development and composition and position of objects in the universe. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *Jovian, terrestrial, moon, asteroid, accretion, albedo, cosmology.* ● performing specific processes, such as ○ outlining the arguments of the development of the universe. ○ listing properties of the objects of the universe. ○ identifying similarities and differences of planets in the solar system. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Research various theories for the origin of the universe

- Investigate the composition and origin of various components of the universe (comets, asteroids, planets, etc)
- Compare and contrast the similarities and differences of stellar objects, such as comparing terrestrial and gaseous planets

Learning Design

WGSD Curriculum -- Astronomy
Evolution and Evidence of Stellar Objects
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements. CCSS: CCSS.ELA-LITERACY.RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales

Students will be able to categorize stars and describe their life cycles.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● describing the life cycle of a star and explaining the role gravity and mass play in the brightness, life span, and end-stages of stars. ● describing how spectroscopy provides information about the inherent properties and motions of objects. ● relating nuclear fusion reactions and mass-energy equivalence to the life cycle of stars. ● explaining the relationship between the energy produced by fusion in stars to the luminosity. ● analyzing the energy relationships between the mass, power output, and lifespan of stars. ● describing energy transfers and transformations associated with the motion and interactions of celestial bodies (e.g. orbits, binary pulsars, meteors, black holes, and galaxy mergers). 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *blue giant, dwarf, HR diagram, parsec, red giant, red dwarf, spectroscopic parallax, protostar,nebulae, spectroscopy, luminosity, orbits, binary pulsars, meteors, black holes, and galaxy mergers.* ● performing specific processes, such as ○ outlining the life cycle of a star using correct sequence and terminology. ○ identifying spectrums of light related to various types of stars. ○ correlating the mass of stars to the stage in life or the type of star. 1: The student demonstrates limited understanding or skill with the

	learning goal.

<u>Learning Targets</u>

- Define the concept of atomic structure
- Identify continuous, emission, and absorption spectra
- Understand Kirchoff's rules of spectral analysis
- Describe the meaning of Wein's and Stefan-Boltzmann's laws
- Define major characteristics of stars
- Discuss steps of stellar evolution
- Identify different categories of luminous astronomical objects and describe their properties

<u>Learning Design</u>

WGSD Curriculum -- Astronomy
Exploration of the Universe
Draft

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
No applicable NGSS standards. CCSS: CCSS.ELA-LITERACY.RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales
Students will be able to articulate the challenges inherent in human exploration of	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

the universe.	3: The student demonstrates mastery of the learning goal by ● investigating space exploration through historical evidence. ● reasoning the purpose and desire of human space exploration. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *sputnik, Apollo, Gemini, Mars Rover, Hubble, Voyager.* ● performing specific processes, such as identifying the major space explorations and generalizing rationale for human space exploration. 1: The student demonstrates limited understanding or skill with the learning goal.

<u>Learning Targets</u>

- Identify different methods of the space exploration
- Describe the history of piloted space projects
- Analyze advances in astronomical instruments
- Discuss future opportunities of space exploration

<u>Learning Design</u>

WGSD Curriculum -- Astronomy
Historical Perspective
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. CCSS: CCSS.ELA-LITERACY.RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales

Students will be able to analyze the dynamic nature of astronomy.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● identifying how astronomy was integrated into ancient civilizations and then through modern astronomy. ● examining similarities and differences in cultures about what physical, cultural, and spiritual purposes were addressed through astronomical observation and prediction. ● investigating how the civilization learned about the universe. ● comparing and contrasting how celestial observation was used by ancient cultures to measure time, plant crops, and influence the fate of kingdom. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *archaeoastronomy, geocentric, heliocentric, Brahe, Copernicus, Galileo, Hubble, Ptolemaic model.* ● performing specific processes, such as: ○ listing the ancient, renaissance, and modern astronomer and their discoveries. ○ recognizing that various civilizations used astronomy and the influence on modern astronomy. 1: The student demonstrates limited understanding or skill with the learning goal.

<u>Learning Targets</u>

• Understand a historical approach when analyzing the formation of the universe • Recognize names of great astronomers and know their contribution to science (Bruno, Copernicus, Brahe, Galileo , Kepler, and, also, Hubble, Friedman, Hoyle, Tinsley, Burbidge, etc.) • Investigate other cultures beliefs and explanations of the universe
<u>Learning Design</u>

WGSD Curriculum -- Astronomy
Motion of Stellar Object
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. CCSS: CCSS.ELA-LITERACY.RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales
Students will be able to interpret how the	4: The student demonstrates an in-depth inference or advanced

organization of the solar system can be used to understand the motion of the stars, sun, moon and planets in the sky.	application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● evaluating the effects of the relative positions of the Earth, moon, and sun on observable phenomena, e.g. phases of the moon, eclipses, seasons, and diurnal cycles. ● inferring the effects of orbit, mass, and other factors on real and imaginary objects. ● describing how latitude and time of the year affect visibility of constellations. ● predicting visibility of planets (major and minor) in the solar system based on relative orbital motion. ● applying mathematically Newtonian gravity to celestial bodies to determine their masses and explain their motion (e.g. Kepler’s Laws). 2: The student demonstrates he/she is nearing proficiency by ● Recognizing or recalling specific vocabulary, such as *Azimuth, Altitude, Celestial sphere, Zenith, Polaris, Circumpolar, Celestial equator, Horizon, Meridian, Vernal equinox, Autumnal equinox, Solstice (summer/winter), phases of the moon, eclipses, seasons, diurnal cycles, orbit, mass, waxing, waning, gibbous, crescent, rotation, revolution, tilt, and constellation.* ● . ● performing specific processes, such as: ○ identifying constellations and planets in the night sky using a sky sphere. ○ listing the phases of the moon and seasons. ○ calculating orbital motions using Kepler and Newtonian laws.

	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Create sky sphere
- Analyze the causes of the seasons
- Observe and predict the moon phases
- Diagram elliptical and orbital patterns
- Manipulate Kepler’s laws of planetary motion and Newton’s gravitational laws
- Understand the celestial sphere and the system of celestial coordinates on the sky

Learning Design

WGSD Curriculum -- Fundamentals of Biology
Scientific Method
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
7.1.A: 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. 7.1.B: Scientific inquiry relies upon gathering evidence from qualitative and quantitative observation. 7.1.C: Scientific inquiry includes evaluation of explanations in light of evidence and scientific principles. 7.1.D: The nature of science relies upon communication of results and justification of explanations.

Learning Goal	Proficiency Scales
Students will be able to formulate a testable hypothesis, gather data, and draw a conclusion.	4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● Applying the steps of the scientific method. ● Designing an experiment with an independent and dependent variable, and with an experimental and control group. ● Graphing data.

	• Deciding if the hypothesis is supported or rejected by the data.
	
	2: Student demonstrates he/she is nearing proficiency by:
	
	• recognizing or recalling specific vocabulary, such as *dependent/independent variable, hypothesis, control/experimental group, and conclusion*.
	
	• performing specific processes, such as:
	   ○ Identifying the steps of the scientific method.
	   ○ Identifying the independent and dependent variables, and the experimental and control groups.
	   ○ Interpreting a line graph.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Students list the steps of the scientific method.
- Students identify the independent and dependent variables from teacher-provided scenarios.
- Students identify the experimental and control group from teacher-provided scenarios.
- Students graph data.
- Students determine if the hypothesis is supported or rejected by the data.
- Students perform and write up lab report for designated lab.

<u>Learning Design</u>

WGSD Curriculum -- Biology
Cell Growth and Reproduction
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
3.1.B: Organisms progress through life cycles unique to different types of organisms. 3.3.C: Chromosomes are components of cells that occur in pairs and carry hereditary information from one cell to daughter cells and from parents to offspring during reproduction.

Learning Goal	Proficiency Scales
The student will be able contrast the processes involved in and the end results of mitosis and meiosis.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal as evidenced by ● differentiating among the phases of mitosis. ● contrasting cytokinesis in plant and animal cells of mitosis. ● contrasting chromatids and homologous chromosomes of meiosis. ● contrasting the end products of mitosis and meiosis (number of cells and number of chromosomes) in mitosis and meiosis. ● creating a human life cycle diagram. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *mitosis, meiosis, interphase, prophase, metaphase, anaphase, telophase,*

	cytokinesis, chromosome, chromatid, homologous chromosomes, centromere, spindle fibers, diploid, haploid, gamete, zygote, sexual and *asexual reproduction.* ● performing specific processes, such as: ○ identifying the phases of mitosis. ○ contrasting cytokinesis in plant and animal cells. ○ contrasting the end products of mitosis and meiosis (# of cells and # of chromosomes). 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Students define mitosis and meiosis.
- Students identify stages of mitosis and meiosis.
- Students draw the end products of mitosis and meiosis including specific number of cells and chromosomes.
- Students create a human life cycle diagram to include meiosis, mitosis, diploid, haploid, fertilization, zygote.

Learning Design

WGSD Curriculum -- Biology
Cells
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
3.1.C: Cells are the fundamental units of structure and function of all living things. 3.2.A: The cell contains a set of structures called organelles that interact to carry out life processes through physical and chemical means. 3.2.F: Cellular activities and responses can maintain stability internally while external condition are changing (homeostasis).

Learning Goal	Proficiency Scales
The student will be able to explain how cell organelles carry out life processes and homeostasis.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal as evidenced by ● comparing and contrasting prokaryotic, eukaryotic, plant and animal cells. ● identifying functions for all cell organelles. ● labeling pictures of plant and animal cell organelles. ● predicting transport of molecules across the cell membrane based on size and polarity. 2: The student demonstrates he/she is nearing proficiency by ● recognizing and recalling specific vocabulary, such as: *cell theory,*

	prokaryote, eukaryote, cell membrane, cell wall, chloroplast, chromosomes, cytoplasm, golgi apparatus, lysosome, mitochondria, nuclear membrane, nucleolus, nucleus, ribosomes, rough endoplasmic reticulum, smooth endoplasmic reticulum, vacuole, selectively permeable, phospholipid bilayer, homeostasis, passive and active transport, concentration gradient, equilibrium, diffusion, osmosis, transport proteins, membrane pump, endocytosis, exocytosis, hypotonic, isotonic, hypertonic. ● performing specific processes, such as: ○ stating the cell theory. ○ matching cell organelles to their functions. ○ labeling pictures of plant and animal cell organelles. ○ stating the scientific name of the cell membrane and its basic characteristics. ○ providing two examples of active and passive transport. ○ drawing and labeling the cell membrane. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Students list the 3 parts of the cell theory.
- Students describe the function of 15 cell organelles.
- Students compare and contrast plant and animal cells.
- Students compare and contrast prokaryotic and eukaryotic cells.

Learning Design

WGSD Curriculum -- Biology
DNA Structure and Function
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
3.2.E: Protein structure and function are coded by the DNA. 3.3.B: All living organisms have genetic material that carries hereditary information.

Learning Goal	Proficiency Scales
The student will be able to demonstrate how the structure and function of DNA determines an organism's traits.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal as evidenced by ● modeling a strand of DNA. ● generating the end product of DNA replication if given the original strand. ● describing the steps of gene expression. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *adenine, guanine, cytosine, thymine, nucleotide, base pair, hydrogen bond, double helix, DNA, RNA, replication, transcription, translation, amino acids, codon, anticodon, protein synthesis, peptide bond, gene, trait.*

	● performing specific processes, such as: ○ identifying the base pairs in a strand of DNA. ○ Identifying the correct number of strands at the end of DNA replication. ○ ordering the steps of gene expression. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Students build and label a 3-dimensional model of DNA.
- Students complete a replicated strand of DNA.
- Students create a flowchart to show the relationships between the following concepts: DNA, RNA, protein, trait, transcription, translation.
- Students build a specific protein starting from a strand of DNA.

Learning Design

WGSD Curriculum -- Biology
Ecosystems
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
3.2.B: Photosynthesis and cellular respiration are complementary processes necessary to the survival of most organisms on Earth. 4.1.A All populations living together within a community interact with one another and with their environment in order to survive and maintain a balanced ecosystem. 4.2.A As energy flows through the ecosystems, all organisms capture a portion of that energy and transform it to a form they can use.

Learning Goal	Proficiency Scales
Students will be able to analyze the interactions between organisms and their environment.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal as evidenced by ● assessing how changes in abiotic and biotic factors affect a habitat. ● predicting the order of succession species. ● modeling a food web showing energy lost at each level. ● identifying the type of symbiotic relationship from an example. ● tracing the interactions of the products and reactants of photosynthesis and cellular respiration.

	2: The student demonstrates he/she is nearing proficiency by
	
	● recognizing or recalling specific vocabulary, such as: *ecology, ecosystem, biotic/abiotic, succession, producer, primary/secondary/tertiary consumer, omnivore/herbivore/carnivore, food chain, food web, symbiosis, parasitism, mutualism, commensalism, niche, predation, competition, carbon cycle, photosynthesis, cellular respiration.*
	
	● performing specific processes, such as:
	  ● identifying biotic and abiotic factors.
	  ● identifying the correct order of succession of species.
	  ● creating a 2-level food web showing energy lost at each level.
	  ● defining the 3 types of symbiotic relationship.
	  ● labeling the reactants of photosynthesis and cellular respiration using a teacher-provided diagram.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Students distinguish between abiotic and biotic factors of an ecosystem.
- Students sequence the process of succession from pioneer species to climax species.
- With the use of food webs, students show how energy flows and is lost in ecosystems.
- Students draw the water cycle including: condensation, evaporation, transpiration, precipitation.
- Students determine the roles of animals and plants in the carbon cycle. (Are they emitters or consumers?)

- Students explain how humans get and release nitrogen into their environment.
- Students change a simple circular diagram showing photosynthesis and respiration so it resembles reality.

Learning Design

WGSD Curriculum -- Biology
Mendelian Genetics
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
3.3.E: The pattern of inheritance for many traits can be predicted by using the principles of Mendelian genetics.

Learning Goal	Proficiency Scales
Students will be able predict the pattern of inheritance by using the principles of Mendelian genetics.	4:The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal as evidenced by ● using a Punnett square to model a monohybrid genetic cross. ● identifying mechanisms that contribute to genetic variation. ● explaining how sex chromosomes determine offspring gender for humans. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: heredity, autosomal & sex chromosomes, dominant, recessive, heterozygous, homozygous, sex-linked, hybrids, alleles, phenotype, genotype, Punnett squares. ● performing specific processes, such as: ○ identifying the results of a monohybrid genetic cross.

	○ explaining how sex chromosomes determine offspring gender for humans. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Students identify 3 mechanisms that contribute to genetic variation.
- Students complete a monohybrid cross using the 5-step process.
- Students discuss how traits are passed from parent to offspring in the Reebop Lab.
- Students demonstrate sex determination in humans using a Punnett Square.

Learning Design

WGSD Curriculum -- Biology Populations

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
CLE 4.1.B: Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite.

Learning Goal	Proficiency Scales
Students will be able to contrast population growth patterns and determine the factors that influence how populations change over time.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal as evidenced by ● contrasting population growth graphs. ● determining a population’s carrying capacity with examples of density-dependent/density-independent limiting factors. ● determining characteristics of r-strategist/k-strategist. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *population growth, exponential/boom and bust/logistic, carrying capacity, density-dependent/density-independent, and r-strategist/k-strategist*. ● performing specific processes, such as: ○ identifying the four types of population growth graphs. ○ defining r-strategist/k-strategist characteristics.

	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- The students define populations.
- The students contrast exponential, boom-and-bust, logistic and predator-prey growth rates and their graphs.
- The students determine advantages and disadvantages of r-strategist and k-strategist.
- The students define and determine a population's carrying capacity from a graph.
- The students give examples of a 4 density-dependent limiting factors.
- The students give examples of 2 density-independent limiting factors.

Learning Design

WGSD Curriculum -- Biology
Scientific Method
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
7.1.A: 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. 7.1.B: Scientific inquiry relies upon gathering evidence from qualitative and quantitative observation. 7.1.C: Scientific inquiry includes evaluation of explanations in light of evidence and scientific principles. 7.1.D: The nature of science relies upon communication of results and justification of explanations.

Learning Goal	Proficiency Scales
Students will be able to formulate a testable hypothesis, gather data, and draw a conclusion.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal as evidenced by ● identifying the steps of the scientific method. ● evaluating an experiment with an independent and dependent variable, and with an experimental and control group. ● graph data. ● decide if the hypothesis is supported or rejected by the data. 2: The student demonstrates he/she is nearing proficiency by

	● recognizing or recalling specific vocabulary, such as: *dependent/independent variable, hypothesis, control/experimental group, and conclusion*. ● performing specific processes, such as: ○ listing the steps of the scientific method. ○ Identifying from a teacher-provided lab the independent and dependent variables, the experimental and control groups. ○ constructing a line graph. ○ deciding if the hypothesis is supported or rejected by the data. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Students list the steps of the scientific method.
- Students identify the independent and dependent variables from teacher-provided scenarios.
- Students identify the experimental and control group from teacher-provided scenarios.
- Students graph data.
- Students determine if the hypothesis is supported or rejected by the data.
- Students perform and write up lab report for designated lab.

Learning Design

WGSD Curriculum -- Biology A
Cell Growth and Reproduction

<u>High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)</u>

3.1.B: Organisms progress through life cycles unique to different types of organisms.
3.3.C: Chromosomes are components of cells that occur in pairs and carry hereditary information from one cell to daughter cells and from parents to offspring during reproduction.

Essential Learning Goal	Proficiency Scales
The student will be able to contrast the processes involved in and the end results of mitosis and meiosis.	4: In addition to score 3.0 performance, the student demonstrates in-depth inferences and advanced applications that go beyond what was taught. 3: The student demonstrates mastery of the learning goal as evidenced by ● differentiating among the 6 phases of mitosis. ● describing the G1,S,G2 phases of interphase and the 3 checkpoints. ● contrasting cytokinesis in plant and animal cells of mitosis. ● contrasting chromatids and homologous chromosomes of meiosis. ● contrasting the end products of mitosis and meiosis (number of cells and number of chromosomes) in mitosis and meiosis. ● creating a human life cycle diagram (that depicts diploid, haploid, mitosis, meiosis, fertilization, and zygote). 2: The student demonstrates he/she is nearing proficiency by

	● recognizing or recalling specific vocabulary, such as *mitosis, meiosis, interphase, prophase, metaphase, anaphase, telophase, cytokinesis, chromosome, chromatid, homologous chromosomes, centomere, spindle fibers, diploid, haploid, gamete, zygote, sexual* and *asexual reproduction.* ● performing specific processes, such as ○ labeling cells in 6 phases of mitosis. ○ defining chromatids and homologous chromosomes. ○ contrasting cytokinesis in plant and animal cells. ○ contrasting the end products of mitosis and meiosis (# of cells and # of chromosomes). ○ labeling a teacher-provided human life cycle diagram. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Students define mitosis and meiosis.
- Students identify stages of mitosis and meiosis.
- Students draw the end products of mitosis and meiosis including specific number of cells and chromosomes.
- Students create a human life cycle diagram to include meiosis, mitosis, diploid, haploid, fertilization, zygote.

Learning Design

WGSD Curriculum -- Biology A
Cells
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
3.1.C: Cells are the fundamental units of structure and function of all living things. 3.2.A: The cell contains a set of structures called organelles that interact to carry out life processes through physical and chemical means. 3.2.F: Cellular activities and responses can maintain stability internally while external condition are changing (homeostasis).

Learning Goal	Proficiency Scales
The student will be able to explain how cell organelles carry out life processes and homeostasis.	4: In addition to score 3.0 performance, the student demonstrates in-depth inferences and advanced applications that go beyond what was taught. 3: The student demonstrates mastery of the learning goal as evidenced by ● stating the 3 parts of the cell theory ● comparing and contrasting prokaryotic, eukaryotic, plant and animal cells. ● identifying functions for all cell organelles. ● labeling pictures of plant and animal cell organelles. ● drawing and labeling the cell membrane. ● predicting transport of molecules across the cell membrane based on size and polarity.

	2: The student demonstrates he/she is nearing proficiency by ● recognizing and recalling specific vocabulary, such as *cell theory, prokaryote, eukaryote, cell membrane, cell wall, chloroplast, chromosomes, cytoplasm, golgi apparatus, lysosome, mitochondria, nuclear membrane, nucleolus, nucleus, ribosomes, rough endoplasmic reticulum, smooth endoplasmic reticulum, vacuole, selectively permeable, phospholipid bilayer, homeostasis, passive and active transport, concentration gradient, equilibrium, diffusion, osmosis, transport proteins, membrane pump, endocytosis, exocytosis, hypotonic, isotonic, hypertonic.* ● performing specific processes, such as ○ recognizing the 3 parts of the cell theory. ○ identifying prokaryotic, eukaryotic, plant and animal cells. ○ matching cell organelles to their functions. ○ labeling pictures of plant and animal cell organelles. ○ stating the scientific name of the cell membrane and its basic characteristics. ○ providing two examples of active and passive transport. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Students list the 3 parts of the cell theory.
- Students identify the scientists responsible for developing cell theory.
- Students describe the function of 15 cell organelles.
- Students compare and contrast plant and animal cells.

• Students compare and contrast prokaryotic and eukaryotic cells.
Learning Design

WGSD Curriculum -- Biology A
DNA Structure and Function
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
3.2.E: Protein structure and function are coded by the DNA. 3.3.B: All living organisms have genetic material that carries hereditary information.

Learning Goal	Proficiency Scales
The student will be able to demonstrate how the structure and function of DNA determines an organism’s traits.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal 3: The student demonstrates mastery of the learning goal as evidenced by ● tracing the contributions of Watson, Crick and Franklin to the discovery of DNA’s function. ● identifying major parts on a strand of DNA. ● generating the end product of DNA replication if given the original strand. ● describing the steps of gene expression. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *adenine, guanine, cytosine, thymine, nucleotide, base pair, hydrogen bond, double helix, DNA, RNA, replication, transcription, translation, amino acids, codon, anticodon, protein synthesis, peptide bond,*

	gene, trait. ● performing specific processes, such as ○ labeling the base pairs in a strand of DNA. ○ Identifying the correct number of strands at the end of DNA replication. ○ ordering the steps of gene expression. 1: Student demonstrates limited understanding or skill with the learning goal.

<u>Learning Targets</u>
<u>Learning Design</u>

WGSD Curriculum -- Biology A
Ecosystems
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
3.2.B: Photosynthesis and cellular respiration are complementary processes necessary to the survival of most organisms on Earth. 4.1.A All populations living together within a community interact with one another and with their environment in order to survive and maintain a balanced ecosystem. 4.2.A As energy flows through the ecosystems, all organisms capture a portion of that energy and transform it to a form they can use.

Learning Goal	Proficiency Scales
Students will be able to analyze the interactions between organisms and their environment.	4: In addition to score 3.0 performance, the student demonstrates in-depth inferences and advanced applications that go beyond what was taught. 3: The student demonstrates mastery of the learning goal as evidenced by ● assessing how changes in abiotic and biotic factors affect a habitat. ● identifying and mapping the biotic and abiotic factors with specific a ecosystem and show the influences that humans have on that site. ● predicting the order of succession species.

	● creating 3-level food web showing energy lost at each level.
	● tracing the interactions of the products and reactants of photosynthesis and cellular respiration.
	
	2: The student demonstrates he/she is nearing proficiency by
	
	● recognizing or recalling specific vocabulary, such as *ecology, ecosystem, biotic/abiotic, succession, producer, primary/secondary/tertiary consumer, omnivore/herbivore/carnivore, food chain, food web, symbiosis, parasitism, mutualism, commensalism, niche, predation, competition, carbon cycle, photosynthesis, cellular respiration.*
	
	● performing specific processes, such as
	    ● identifying biotic and abiotic factors.
	    ● identifying the correct order of succession of species.
	    ● creating a 2-level food web showing energy lost at each level.
	    ● defining the 3 types of symbiotic relationship.
	    ● labeling the reactants of photosynthesis and cellular respiration using a teacher-provided diagram.
	    ● identifying the type of symbiotic relationship from an example.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Students distinguish between abiotic and biotic factors of an ecosystem.
- Students sequence the process of succession from pioneer species to climax species.
- With the use of food webs, students show how energy flows and is lost in ecosystems.
- Students draw the water cycle including: condensation, evaporation, transpiration, precipitation.
- Students determine the roles of animals and plants in the carbon cycle. (Are they emitters or consumers?)
- Students explain how humans get and release nitrogen into their environment.
- Students change a simple circular diagram showing photosynthesis and respiration so it resembles reality.

Learning Design

WGSD Curriculum -- Biology A
Mendelian Genetics
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
3.3.E: The pattern of inheritance for many traits can be predicted by using the principles of Mendelian genetics.

Learning Goal	Proficiency Scales
Students will be able to apply the principles of Mendelian genetics to patterns of inheritance.	4: In addition to score 3.0 performance, the student demonstrates in-depth inferences and advanced applications that go beyond what was taught. 3: The student demonstrates mastery of the learning goal as evidenced by ● completing a dihybrid genetic cross using a Punnett square. ● identifying 3 mechanisms that contribute to genetic variation. ● explaining how sex chromosomes determine offspring gender for humans. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *heredity, autosomal & sex chromosomes, dominant, recessive, heterozygous, homozygous, sex-linked, hybrids, alleles, phenotype, genotype, Punnett squares.*

	● performing specific processes, such as ○ completing a monohybrid genetic cross using a Punnett square. ○ explaining how sex chromosomes determine offspring gender for humans. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Students identify 3 mechanisms that contribute to genetic variation.
- Students complete a monohybrid cross using the 5-step process.
- Students discuss how traits are passed from parent to offspring in the Reebop Lab.
- Students demonstrate sex determination in humans using a Punnett Square.

Learning Design

WGSD Curriculum -- Biology A
Populations
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
CLE 4.1.B: Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite.

Learning Goal	Proficiency Scales
Students will relate population growth patterns to population change.	4. In addition to score 3.0 performance, the student demonstrates in-depth inferences and advanced applications that go beyond what was taught. 3. The student demonstrates mastery of the learning goal as evidenced by ● contrasting population growth graphs. ● determining a population's carrying capacity with examples of density-dependent/density-independent limiting factors. ● determining characteristics of r-strategist/k-strategist 2. The student demonstrates he/she is nearing proficiency by ● recognizing and recalling specific vocabulary, such as *population growth, exponential/boom and bust/logistic, carrying capacity, density-dependent/density-independent, and r-strategist/k-strategist.* ● performing specific processes, such as

	○ identifying the four types of population growth graphs. ○ defining r-strategist/k-strategist characteristics. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- The students define populations.
- The students contrast exponential, boom-and-bust, logistic and predator-prey growth rates and their graphs.
- The students determine advantages and disadvantages of r-strategist and k-strategist.
- The students define and determine a population's carrying capacity from a graph.
- The students give examples of a 4 density-dependent limiting factors.
- The students give examples of 2 density-independent limiting factors.

Learning Design

WGSD Curriculum -- Biology A
Scientific Method
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
7.1.A: 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. 7.1.B: Scientific inquiry relies upon gathering evidence from qualitative and quantitative observation. 7.1.C: Scientific inquiry includes evaluation of explanations in light of evidence and scientific principles. 7.1.D: The nature of science relies upon communication of results and justification of explanations.

Learning Goal	Proficiency Scales
Students will be able to formulate a testable hypothesis, gather data, and draw a conclusion.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery with the learning goal by ● applying the steps of the scientific method. ● designing an experiment with an independent and dependent variable, and with an experimental and control group. ● graphing data. ● analyzing how the hypothesis is supported or rejected by the data. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *dependent/independent variable, hypothesis, control/experimental*

	group, and conclusion.
	
	● performing specific processes, such as
	  ○ listing the steps of the scientific method.
	  ○ Identifying from a teacher-provided lab the independent and dependent variables, the experimental and control groups.
	  ○ constructing a line graph.
	  ○ deciding if the hypothesis is supported or rejected by the data.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Students list the steps of the scientific method.
- Students identify the independent and dependent variables from teacher-provided scenarios.
- Students identify the experimental and control group from teacher-provided scenarios.
- Students graph data.
- Students determine if the hypothesis is supported or rejected by the data.
- Students perform and write up lab report for designated lab.

Learning Design

WGSD Curriculum -- Conceptual Chemistry
Interaction of Geospheres
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-ESS 2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. NGSS-HS-ESS 3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. NGSS-HS-ESS 3-6: Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Learning Goal	Proficiency Scales
The student will be able to develop a logical argument about about how the interaction of geospheres affects, and is affected by, earth populations.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● analyzing the interaction of the chemical properties of pollution with air and water to assess their effects. ● showing and discussing evidence illustrating the effects of humans on a particular resource scarcity and purity. ● assessing the impact of chemistry on the environment. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *geosphere, population, pollution, acid rain, deposition.*

	● performing specific processes, such as: ● summarizing the properties of air and water. ● summarizing the major sources of pollution of air and water. ● giving examples of the interactions of properties and human behavior. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets
● Properties of water -- molecular shape, MP/FP, BP, solvation ● Properties of air -- mixture, composition, movement ● Pollution -- types, causes, solutions ● Acid Rain -- types, causes, solutions
Learning Design

WGSD Curriculum -- Conceptual Chemistry
Nuclear
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS 1-8: Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission fusion, and radioactive decay. NGSS-HS-PS 4-4: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. NGSS-HS-ESS 1-1: Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in sun's core to release energy that eventually reaches Earth in the form of radiation. NGSS-HS-ESS 1-3: Communicate scientific ideas about the way stars, over their life cycle, produce elements. (fusion)

Learning Goal	Proficiency Scales
Students will be able to evaluate the composition and interactions of the atomic nucleus.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● modeling the process by which energy and particles are released from an atomic nucleus. ● comparing energy released through nuclear processes. ● evaluating the validity and reliability of claims of effects of EMR on living organisms. 2: The student demonstrates he/she is nearing proficiency by: ● recognizing or recalling specific vocabulary, such as: *radiation, decay, half-life, exposure, alpha particle, beta particle, gamma radiation, fission, fusion, isotope, ionizing, and EMR.*

	- performing basic processes, such as: - completing a nuclear decay series. - describing the process by which stars produce/release energy. - comparing and contrasting the processes of fission and fusion. - describing three ways we may limit radiation exposure. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe the particles that make up a nucleus and their relative masses
- Discuss the characteristics of alpha particles, beta particles, and gamma radiation
- Discuss the ways that we may limit radiation exposure -- time, distance, shielding
- Fission
- Fusion

Learning Design

WGSD Curriculum -- Conceptual Chemistry
Classify Matter
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS 1-1: Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. NGSS-HS-PS 1-3: Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. NGSS-HS-PS 2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Learning Goal	Proficiency Scales
Students will be able to describe and classify matter.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● differentiating matter as pure substances or mixtures. ● describing physical and chemical properties and changes of matter. ● classifying chemical change based on experimental evidence. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *matter, density, solubility, mixture, pure substance, phases of matter, homogeneous, heterogeneous, precipitate.*

	● performing basic processes, such as: ● classifying an object based on its physical and chemical properties. ● classifying matter as a pure substance, mixture, element, compound and type of mixture. ● identifying types of mixtures. ● recognizing evidence of a chemical change. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Classify matter based on its physical and chemical properties
- Contrast physical and chemical changes
- Arrange Matter (pure substance, mixture, element, compound, homogeneous mixture, heterogeneous mixture, and solution) into a tree
- Differentiate mixtures and pure substances
- Evidence of Chemical change -- gas evolved, precipitate formed, energy change, color change (odd change)

Learning Design

WGSD Curriculum -- Conceptual Chemistry

Composition and Interaction of Atoms

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS 1-1: Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. NGSS-HS-PS 1-3: Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. NGSS-HS-PS 1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. NGSS-HS-PS 2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Learning Goal	Proficiency Scales
Students will be able to create models and predict interactions of atoms.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● drawing a sketch showing the relative position of subatomic particles in an atom. ● interpreting the development of the modern model of the atom. ● constructing chemical formulas using outermost electron energy levels. ● developing a model of interaction of subatomic particles. ● constructing simple chemical reaction equations showing conservation of atoms and mass.

	2: The student demonstrates he/she is nearing proficiency by
	
	• recognizing or recalling specific vocabulary, such as: *period, group, nucleus, electron cloud, isotope, ion, formula, molecule, valence electrons.*
	
	• performing specific processes, such as
	    ○ matching the development of the modern model of the atom with the correct scientist.
	    ○ describing the structure of the periodic table.
	    ○ balancing simple chemical equations.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe the development of the models of the atom
- Draw a representation of an atom showing the position of the particles and their correct number
- Calculate the number of each subatomic particle present in an isotope
- Show how atoms gain, lose or share electrons to reduce their energy
- Describe the subatomic particles found in an atom -- position, charge, size
- Discuss the development of the modern model of the atom
- Discuss the development of the periodic table
- Discuss periodicity and how it helps us to classify atoms
- Describe the arrangement of the periodic table as it relates to electron arrangement
- Discuss why the periodic table has the current arrangement
- Join ions to make ionic formulas
- Name formulas and binary molecules

Learning Design

WGSD Curriculum -- Conceptual Chemistry

Energy Transferred

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS 3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other components(s) and energy flows in and out of the system are known. NGSS-HS-PS 3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields. NGSS-HS-PS 3-4: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

Learning Goal	Proficiency Scales
Students will be able to apply the Law of Conservation of Energy.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● demonstrating experimentally the conservation of energy in a system. ● creating a computational model relating a system to its surroundings. ● evaluating the transfer of thermal energy. ● discussing the behavior of particles that creates the observed temperature, pressure and volume changes. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *pressure,*

	temperature, volume, kinetic, heat, specific heat capacity, endothermic, exothermic, and insulator.
	
	● performing specific processes, such as:
	    ● describing the movement of heat energy.
	    ● discussing the Law of Conservation of Energy and its affect on systems.
	    ● evaluating an experiment to determine the system studied and the surroundings present.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- heat movement from hot to cold
- heat lost = heat gained
- Assumptions of Kinetic Molecular Theory
- Pressure = collisions
- Temperature = motion
- Volume = space used
- Boyle's Law, Charles' Law, and Gay-Lussac's Law

Learning Design

WGSD Curriculum -- Conceptual Chemistry - Role of Energy

DRAFT

Standard (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS 1-2: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. NGSS-HS-PS 1-4: Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. NGSS-HS-PS 1-5: Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. NGSS-HS-PS 1-6: Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Learning Goal	Proficiency Scales
Students will be able to show the role of energy in chemical reactions (ie. rates of reactions).	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● explaining how changing the conditions of a reaction will affect the rate of that reaction. ● modifying an explanation of rate change based on experimental data. ● interpreting a phase change graph using heat energy and temperature. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *endothermic, melting, boiling, condensing, freezing, temperature.*

	• performing specific processes, such as:
	  ◦ identifying actions that will affect the rate of a reaction: stirring, particle size, temperature.
	  ◦ describing why temperature doesn't change during a phase change.
	  ◦ identifying melting, boiling, condensing, and freezing on a phase change graph.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- endothermic vs exothermic processes
- phase change diagrams
- temperature-energy diagrams and their related calculations
- discuss how energy changes affect temperature changes

Learning Design

WGSD Curriculum -- Chemistry A
Nuclear
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS 1-8: Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission fusion, and radioactive decay. NGSS-HS-PS 4-4: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. NGSS-HS-ESS 1-1: Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in sun's core to release energy that eventually reaches Earth in the form of radiation. NGSS-HS-ESS 1-3: Communicate scientific ideas about the way stars, over their life cycle, produce elements. (fusion)

Learning Goal	Proficiency Scales
Students will be able to evaluate the composition and interactions of the atomic nucleus.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● modeling the process by which energy and particles are released from an atomic nucleus. ● comparing energy released through nuclear processes. ● evaluating the validity and reliability of claims of effects of EMR on living organisms. 2: The student demonstrates he/she is nearing proficiency by: ● recognizing or recalling specific vocabulary, such as: *radiation, decay, half-life, exposure, alpha particle, beta particle, gamma radiation, fission, fusion, isotope, ionizing.*

	• performing basic processes, such as: ◦ completing a nuclear decay series. ◦ describing the process by which stars produce/release energy. ◦ comparing and contrasting the processes of fission and fusion. ◦ describing three ways we may limit radiation exposure. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe the particles that make up a nucleus and their relative masses
- Discuss the characteristics of alpha particles, beta particles, and gamma radiation
- Discuss the ways that we may limit radiation exposure -- time, distance, shielding
- Units for measuring radiation and radiation exposure
- Compare and contrast ionizing and nonionizing radiation and describe where each is found on the Electromagnetic Spectrum
- Fission
- Fusion

Learning Design

WGSD Curriculum -- Chemistry A
Classify Matter
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS 1-1: Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. NGSS-HS-PS 1-3: Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. NGSS-HS-PS 2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Learning Goal	Proficiency Scales
Students will be able to describe and classify matter.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● predicting physical and chemical properties of matter based on their position on the periodic table. ● differentiating matter as pure substances or mixtures. ● describing physical and chemical properties and changes of matter. ● classifying chemical change based on experimental evidence. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *matter, density, solubility, mixture, pure substance, phases of matter, homogeneous, heterogeneous, precipitate.* ● performing basic processes, such as:

	- classifying an object based on its physical and chemical properties. - describing the relationships among matter, pure substances, mixtures, elements, compounds and types of mixtures. - identifying types of mixtures. - recognizing evidence of a chemical change. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Classify matter based on its physical and chemical properties
- Contrast physical and chemical changes
- Arrange Matter (pure substance, mixture, element, compound, homogeneous mixture, heterogeneous mixture, and solution) into a tree
- Differentiate mixtures and pure substances
- Evidence of Chemical change -- gas evolved, precipitate formed, energy change, color change (odd change)

Learning Design

WGSD Curriculum -- Chemistry A
Composition and Interaction of Atoms
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS 1-1: Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. NGSS-HS-PS 1-3: Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. NGSS-HS-PS 1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. NGSS-HS-PS 2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Learning Goal	Proficiency Scales
Students will be able to identify the composition and model the interactions of atoms.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● drawing a sketch showing the relative position of subatomic particles in an atom and their relative numbers for a given isotope. ● drawing conclusions on how the characteristics used to identify atoms relate to the periodicity of the periodic table. ● interpreting the development of the modern model of the atom. ● constructing chemical formulas using outermost electron energy levels. ● developing a model of interaction of subatomic particles. ● constructing simple chemical reaction equations showing

	conservation of atoms and mass. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *period, group, nucleus, electron cloud, isotope, ion, formula, molecule.* ● performing specific processes, such as ○ creating a timeline depicting the development of the modern model of the atom. ○ describing the structure of the periodic table and how that structure was developed. ○ balancing simple chemical equations. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe the development of the models of the atom
- Draw a representation of an atom showing the position of the particles and their correct number
- Calculate the number of each subatomic particle present in an isotope
- Show how atoms gain, lose or share electrons to reduce their energy
- Describe the subatomic particles found in an atom -- position, charge, size
- Discuss the development of the modern model of the atom
- Discuss the development of the periodic table
- Discuss periodicity and how it helps us to classify atoms
- Describe the arrangement of the periodic table as it relates to electron arrangement
- Discuss why the periodic table has the current arrangement.
- Join ions to make ionic formulas
- Name formulas and binary molecules

Learning Design

WGSD Curriculum -- Chemistry A
Energy Transferred
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS 3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other components(s) and energy flows in and out of the system are known. NGSS-HS-PS 3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields. NGSS-HS-PS 3-4: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

Learning Goal	Proficiency Scales
Students will be able to model energy transfer within chemical systems as the total energy remains constant (i.e., Law of Conservation of Energy).	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● demonstrating mathematically and experimentally the conservation of energy in a system. ● creating a computational model relating a system to its surroundings. ● evaluating the transfer of thermal energy. ● discussing the behavior of particles that creates the observed temperature, pressure and volume changes. 2: The student demonstrates he/she is nearing proficiency by

	● recognizing or recalling specific vocabulary, such as: *pressure, temperature, volume, kinetic, heat, specific heat capacity.*
	
	● performing specific processes, such as:
	
	  ● describing the movement of heat energy.
	  ● discussing the Law of Conservation of Energy and its affect on systems.
	  ● evaluating an experiment to determine the system studied and the surroundings present.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- $Q = mCp\Delta T$
- heat movement from hot to cold
- heat lost = heat gained
- Assumptions of Kinetic Molecular Theory
- Pressure = collisions
- Temperature = motion
- Volume = space used
- Boyle's Law, Charles' Law, and Gay-Lussac's Law

Learning Design

WGSD Curriculum -- Chemistry A
Interaction of Geospheres
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-ESS 2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. NGSS-HS-ESS 3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. NGSS-HS-ESS 3-6: Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Learning Goal	Proficiency Scales
The student will be able to develop a logical argument about about how the interaction of geospheres affects, and is affected by, earth populations.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● analyzing the interaction of the chemical properties of pollution with air and water to assess their effects. ● showing and discussing evidence illustrating the effects of humans on a particular resource scarcity and purity. ● discussing how colligative properties are affected by the hydrogen bonding in water. ● assessing the impact of chemistry on the environment. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *geosphere,*

	population, pollution, acid rain, deposition. ● performing specific processes, such as: ● summarizing the properties of air and water. ● summarizing the major sources of pollution of air and water. ● analyzing the interaction of the properties and human behavior with teacher help. 1: The student demonstrates limited understanding or skill with the learning goal.

Targets

- Properties of water -- molecular shape, MP/FP, BP, solvation
- Properties of air -- mixture, composition, movement
- Pollution -- types, causes, solutions
- Acid Rain -- types, causes, solutions

Learning Design

WGSD Curriculum -- Chemistry A

Role of Energy

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS 1-2: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. NGSS-HS-PS 1-4: Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. NGSS-HS-PS 1-5: Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. NGSS-HS-PS 1-6: Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Learning Goal	Proficiency Scales
Students will be able to show the role of energy in chemical reactions (ie. rates of reactions).	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● explaining how changing the conditions of a reaction will affect the rate of that reaction. ● give evidentiary support how changing conditions affect the amount of product. ● calculating the total energy change required to change the temperature of a substance a given amount. ● modifying an explanation of rate change based on experimental data. 2: The student demonstrates he/she is nearing proficiency by

	• recognizing or recalling specific vocabulary, such as: *endothermic, exothermic, entropy, heat of vaporization, heat of fusion, enthalpy.*
	
	• performing specific processes, such as:
	  • identifying actions that will affect the rate of a reaction: stirring, particle size, temperature.
	  • explaining what changing conditions might affect the amount of product.
	  • describing why temperature doesn’t change during a phase change.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- endothermic vs exothermic processes
- phase change diagrams
- temperature-energy diagrams and their related calculations
- discuss how energy changes affect temperature changes
- LeChatelier’s principle

Learning Design

WGSD Curriculum -- Advanced Chemistry -- Changes in Matter

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

College Board Advanced Placement Chemistry

Big Idea 3: Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.

Learning Goal	Proficiency Scales
Students will be able to use models to predict or explain changes in matter involving the rearrangement and/or reorganization of atoms and/or the transfer of electrons during chemical reactions.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● representing chemical changes with a balanced chemical equation that identifies the ratios with which reactants react and products form. ● classifying chemical reactions by considering what the reactants are, what the products are, or how they change from one into the other; classes of chemical reactions include precipitation, acid-base, and oxidation-reduction reactions. ● identifying chemical and physical transformations that involve a change in energy. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *redox reactions, acid-base reactions, precipitate reactions, solubility rules, limiting reactant, stoichiometric ratio, actual ratio, excess reactants, molarity, percent yield, spectator ions, net ionic reactions, complete ionic reactions, complete formula reactions.*

	• performing specific processes, such as balancing chemical equations in terms of reactants, products, and change of energy. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Learning objective 3.1 Students can translate among macroscopic observations of change, chemical equations, and particle views. [See SP 1.5, 7.1; Essential knowledge components of 3.A–3.C]
- Learning objective 3.2 The student can translate an observed chemical change into a balanced chemical equation and justify the choice of equation type (molecular, ionic, or net ionic) in terms of utility for the given circumstances. [See SP 1.5, 7.1; Essential knowledge 3.A.1]
- Learning objective 3.3 The student is able to use stoichiometric calculations to predict the results of performing a reaction in the laboratory and/or to analyze deviations from the expected results. [See SP 2.2, 5.1; Essential knowledge 3.A.2]
- Learning objective 3.4 The student is able to relate quantities (measured mass of substances, volumes of solutions, or volumes and pressures of gases) to identify stoichiometric relationships for a reaction, including situations involving limiting reactants and situations in which the reaction has not gone to completion. [See SP 2.2, 5.1, 6.4; Essential knowledge 3.A.2]
- Learning objective 3.5 The student is able to design a plan in order to collect data on the synthesis or decomposition of a compound to confirm the conservation of matter and the law of definite proportions. [See SP 2.1, 4.2, 6.4; Essential knowledge 3.B.1]
- Learning objective 3.6 The student is able to use data from synthesis or decomposition of a compound to confirm the conservation of matter and the law of definite proportions. [See SP 2.2, 6.1; Essential knowledge 3.B.1]

- Learning objective 3.7 The student is able to identify compounds as Brønsted-Lowry acids, bases, and/or conjugate acid-base pairs, using proton-transfer reactions to justify the identification. [See SP 6.1; Essential knowledge 3.B.2]
- Learning objective 3.8 The student is able to identify redox reactions and justify the identification in terms of electron transfer. [See SP 6.1; Essential knowledge 3.B.3]
- Learning objective 3.9 The student is able to design and/or interpret the results of an experiment involving a redox titration. [See SP 4.2, 5.1; Essential knowledge 3.B.3]
- Learning objective 3.10 The student is able to evaluate the classification of a process as a physical change, chemical change, or ambiguous change based on both macroscopic observations and the distinction between rearrangement of covalent interactions and noncovalent interactions. [See SP 1.4, 6.1; Essential knowledge 3.C.1, connects to 5.D.2]
- Learning objective 3.11 The student is able to interpret observations regarding macroscopic energy changes associated with a reaction or process to generate a relevant symbolic and/or graphical representation of the energy changes. [See SP 1.5, 4.4; Essential knowledge 3.C.2]
- Learning objective 3.12 The student can make qualitative or quantitative predictions about galvanic or electrolytic reactions based on half-cell reactions and potentials and/or Faraday's laws. [See SP 2.2, 2.3, 6.4; Essential knowledge 3.C.3]
- Learning objective 3.13 The student can analyze data regarding galvanic or electrolytic cells to identify properties of the underlying redox reactions. [See SP 5.1; Essential knowledge 3.C.3]

Learning Design

WGSD Curriculum -- Advanced Chemistry - Chemical and physical properties of materials
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Chemistry Big Idea 2: 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.

Learning Goal	Proficiency Scales
Students will be able to prove that chemical and physical properties of materials are derived from the structure and the arrangement of atoms, ions, or molecules and the forces between them.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by: ● describing matter according to its physical properties with the understanding that the physical properties of a substance generally depend on the spacing between the particles (atoms, molecules, ions) that make up the substance and the forces of attraction among them. ● demonstrating that forces of attraction between particles (including the noble gases and also different parts of some large molecules) are important in determining many macroscopic properties of a substance, including how the observable physical state changes with temperature. ● understanding that the strong electrostatic forces of attraction

	holding atoms together in a unit are called chemical bonds. ● deducing the type of bonding in the solid state from the properties of the solid state. 2: The student demonstrates he/she is nearing proficiency: ● by recognizing or recalling specific vocabulary, such as *ionic bonds, covalent bonds, metallic bonds, intermolecular forces of attraction, dipole-dipole attractions, hydrogen bonding, london dispersion forces, vapor pressure.* ● by performing specific processes, such as ○ identifying types of matter given the physical properties. ○ identifying the effect of the attraction between particles on macroscopic properties of matter. ○ describing the purpose of chemical bonds. ○ performing calculations with scaffolding under limited circumstances. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Learning objective 2.1 Students can predict properties of substances based on their chemical formulas, and provide explanations of their properties based on particle views. [See SP 6.4, 7.1; Essential knowledge components of 2.A–2.D]

- Learning objective 2.2 The student is able to explain the relative strengths of acids and bases based on molecular structure, interparticle forces, and solution equilibrium. [See SP 7.2, connects to Big Idea 5, Big Idea 6; Essential knowledge components of 2.A–2.D]

- Learning objective 2.3 The student is able to use aspects of particulate models (i.e., particle spacing, motion, and forces of attraction) to reason about observed differences between solid and liquid phases and among solid and liquid materials. [See SP 6.4, 7.1; Essential knowledge 2.A.1]

- Learning objective 2.4 The student is able to use KMT and concepts of intermolecular forces to make predictions about the macroscopic properties of gases, including both ideal and nonideal behaviors. [See SP 1.4, 6.4; Essential knowledge 2.A.2]

- Learning objective 2.5 The student is able to refine multiple representations of a sample of matter in the gas phase to accurately represent the effect of changes in macroscopic properties on the sample. [See SP 1.3, 6.4, 7.2; Essential knowledge 2.A.2]

- Learning objective 2.6 The student can apply mathematical relationships or estimation to determine macroscopic variables for ideal gases. [See SP 2.2, 2.3; Essential knowledge 2.A.2]

- Learning objective 2.7 The student is able to explain how solutes can be separated by chromatography based on intermolecular interactions. [See SP 6.2; Essential knowledge 2.A.3]

- Learning objective 2.8 The student can draw and/or interpret representations of solutions that show the interactions between the solute and solvent. [See SP 1.1, 1.2, 6.4; Essential knowledge 2.A.3]

- Learning objective 2.9 The student is able to create or interpret representations that link the concept of molarity with partical views of solutions. [See SP 1.1, 1.4; Essential knowledge 2.A.3]

- Learning objective 2.10 The student can design and/or interpret the results of a separation experiment (filtration, paper chromatography, column chromatography, or distillation) in terms of the relative strength of interactions among and between the components. [See SP 4.2, 5.1, 6.4; Essential knowledge 2.A.3]

- Learning objective 2.11 The student is able to explain the trends in properties and/or predict properties of samples consisting of particles with no permanent dipole on the basis of London dispersion forces. [See SP 6.2, 6.4; Essential knowledge 2.B.1]

- Learning objective 2.12 The student can qualitatively analyze data regarding real gases to identify deviations from ideal behavior and relate these to molecular interactions. [See SP 5.1, 6.5; Essential knowledge 2.B.2, connects to 2.A.2]

- Learning objective 2.13 The student is able to describe the relationships between the structural features of polar molecules and the forces of attraction between the particles. [See SP 1.4, 6.4; Essential knowledge 2.B.2]

- Learning objective 2.14 The student is able to apply Coulomb's law qualitatively (including using representations) to describe the interactions of ions, and the attractions between ions and solvents to explain the factors that contribute to the solubility of ionic compounds. [See SP 1.4, 6.4; Essential knowledge 2.B.2]

- Learning objective 2.15 The student is able to explain observations regarding the solubility of ionic solids and molecules in water and other solvents on the basis of particle views that include intermolecular interactions and entropic effects. [See SP 1.4, 6.2; Essential knowledge 2.B.3, connects to 5.E.1]

- Learning objective 2.16 The student is able to explain the properties (phase, vapor pressure, viscosity, etc.) of small and large molecular compounds in terms of the strengths and types of intermolecular forces. [See SP 6.2; Essential knowledge 2.B.3]

- Learning objective 2.17 The student can predict the type of bonding present between two atoms in a binary compound based on position in the periodic table and the electronegativity of the elements. [See SP 6.4; Essential knowledge components of 2.C]

- Learning objective 2.18 The student is able to rank and justify the ranking of bond polarity on the basis of the locations of the bonded atoms in the periodic table. [See SP 6.1; Essential knowledge 2.C.1]

- Learning objective 2.19 The student can create visual representations of ionic substances that connect the microscopic structure to macroscopic properties, and/or use representations to connect the microscopic structure to macroscopic properties (e.g., boiling point, solubility, hardness, brittleness, low volatility, lack of malleability, ductility, or conductivity). [See SP 1.1, 1.4, 7.1; Essential knowledge 2.C.2, connects to 2.D.1, 2.D.2]

- Learning objective 2.20 The student is able to explain how a bonding model involving delocalized electrons is consistent with macroscopic properties of metals (e.g., conductivity, malleability, ductility, and low volatility) and the shell model of the atom. [See SP 6.2, 7.1; Essential knowledge 2.C.3, connects to 2.D.2]

- Learning objective 2.21 The student is able to use Lewis diagrams and VSEPR to predict the geometry of molecules, identify hybridization, and make predictions about polarity. [See SP 1.4; Essential knowledge 2.C.4]
- Learning objective 2.22 The student is able to design or evaluate a plan to collect and/or interpret data needed to deduce the type of bonding in a sample of a solid. [See SP 4.2, 6.4; Essential knowledge components of 2.D]
- Learning objective 2.23 The student can create a representation of an ionic solid that shows essential characteristics of the structure and interactions present in the substance. [See SP 1.1; Essential knowledge 2.D.1]
- Learning objective 2.24 The student is able to explain a representation that connects properties of an ionic solid to its structural attributes and to the interactions present at the atomic level. [See SP 1.1, 6.2, 7.1; Essential knowledge 2.D.1]
- Learning objective 2.25 The student is able to compare the properties of metal alloys with their constituent elements to determine if an alloy has formed, identify the type of alloy formed, and explain the differences in properties using particulate level reasoning. [See SP 1.4, 7.2; Essential knowledge 2.D.2]
- Learning objective 2.26 Students can use the electron sea model of metallic bonding to predict or make claims about the macroscopic properties of metals or alloys. [See SP 6.4, 7.1; Essential knowledge 2.D.2]
- Learning objective 2.27 The student can create a representation of a metallic solid that shows essential characteristics of the structure and interactions present in the substance. [See SP 1.1; Essential knowledge 2.D.2]
- Learning objective 2.28 The student is able to explain a representation that connects properties of a metallic solid to its structural attributes and to the interactions present at the atomic level. [See SP 1.1, 6.2, 7.1; Essential knowledge 2.D.2]
- Learning objective 2.29 The student can create a representation of a covalent solid that shows essential characteristics of the structure and interactions present in the substance. [See SP 1.1; Essential knowledge

2.D.3]

- Learning objective 2.30 The student is able to explain a representation that connects properties of a covalent solid to its structural attributes and to the interactions present at the atomic level. [See SP 1.1, 6.2, 7.1; Essential knowledge 2.D.3]
- Learning objective 2.31 The student can create a representation of a molecular solid that shows essential characteristics of the structure and interactions present in the substance. [See SP 1.1; Essential knowledge 2.D.4]
- Learning objective 2.32 The student is able to explain a representation that connects properties of a molecular solid to its structural attributes and to the interactions present at the atomic level. [See SP 1.1, 6.2, 7.1; Essential knowledge 2.D.4]

Learning Design

WGSD Curriculum -- Advanced Chemistry - Chemical Elements are Fundamental Building Materials of Matter
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Chemistry Big Idea 1. 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. **CCSS** **Reading Standard (11-12)** #3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. #8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales
Students will be able to prove that chemical elements are fundamental building materials of matter and that all matter can be understood in terms of arrangement and	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by

rearrangement of atoms.	- conducting experiments and solving chemical problems that demonstrate that - all matter is made of atoms; there are a limited number of types of atoms; these are the elements. - 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; this periodicity can be explained by the regular variations that occur in the electronic structures of atoms; periodicity is a useful principle for understanding properties and predicting trends in properties; its modern-day uses range from examining the composition of materials to generating ideas for designing new materials. - 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. 2: The student demonstrates he/she is nearing proficiency by - recognizing and recalling specific vocabulary, such as *atomic number, mass number, atomic mass, ionization energy and trends, electron affinity and trends, electronegativity and trends, atomic size trends, ion size trends, PES data.* - performing specific processes, such as - describing the properties of atoms. - explaining the functions of the periodic table. - performing calculations with scaffolding in limited cases.

	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Learning objective 1.1 The student can justify the observation that the ratio of the masses of the constituent elements in any pure sample of that compound is always identical on the basis of the atomic molecular theory. [See SP 6.1; Essential knowledge 1.A.1]
- Learning objective 1.2 The student is able to select and apply mathematical routines to mass data to identify or infer the composition of pure substances and/or mixtures. [See SP 2.2; Essential knowledge 1.A.2]
- Learning objective 1.3 The student is able to select and apply mathematical relationships to mass data in order to justify a claim regarding the identity and/or estimated purity of a substance. [See SP 2.2, 6.1; Essential knowledge 1.A.2]
- Learning objective 1.4 The student is able to connect the number of particles, moles, mass, and volume of substances to one another, both qualitatively and quantitatively. [See SP 7.1; Essential knowledge 1.A.3]
- Learning objective 1.5 The student is able to explain the distribution of electrons in an atom or ion based upon data. [See SP 1.5, 6.2; Essential knowledge 1.B.1]
- Learning objective 1.6 The student is able to analyze data relating to electron energies for patterns and relationships. [See SP 5.1; Essential knowledge 1.B.1]
- Learning objective 1.7 The student is able to describe the electronic structure of the atom, ionization energy data, and/or Coulomb's law to construct explanations of how the energies of electrons within shells in atoms vary. [See SP 5.1, 6.2; Essential knowledge 1.B.2]
- Learning objective 1.8 The student is able to explain the distribution of electrons using Coulomb's law to analyze

measured energies. [See SP 6.2; Essential knowledge 1.B.2]

- Learning objective 1.9 The student is able to predict and/or justify trends in atomic properties based on location on the periodic table and/or the shell model. [See SP 6.4; Essential knowledge 1.C.1]
- Learning objective 1.10 Students can justify with evidence the arrangement of the periodic table and can apply periodic properties to chemical reactivity. [See SP 6.1; Essential knowledge 1.C.1]
- Learning objective 1.11 The student can analyze data, based on periodicity and the properties of binary compounds, to identify patterns and generate hypotheses related to the molecular design of compounds for which data are not supplied. [See SP 3.1, 5.1; Essential knowledge 1.C.1]
- Learning objective 1.13 Given information about a particular model of the atom, the student is able to determine if the model is consistent with specified evidence. [See SP 5.3; Essential knowledge 1.D.1]
- Learning objective 1.17 The student is able to express the law of conservation of mass quantitatively and qualitatively using symbolic representations and particulate drawings. [See SP 1.5; Essential knowledge 1.E.1]
- Learning objective 1.18 The student is able to apply conservation of atoms to the rearrangement of atoms in various processes. [See SP 1.4; Essential knowledge 1.E.2]
- Learning objective 1.19 The student can design, and/or interpret data from, an experiment that uses gravimetric analysis to determine the concentration of an analyte in a solution. [See SP 4.2, 5.1, 6.4; Essential knowledge1.E.2]
- Learning objective 1.20 The student can design, and/or interpret data from, an experiment that uses titration to determine the concentration of an analyte in a solution. [See SP 4.2, 5.1, 6.4; Essential knowledge 1.E.2]

Learning Design

WGSD Curriculum -- Advanced Chemistry -- Laws of Thermodynamics DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Chemistry Big Idea 5: The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter

Learning Goal	Proficiency Scales
Students will be able to apply the laws of thermodynamics.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● quantifying the exchange of thermal energy (heat). ● applying the Law of Conservation of Energy. ● calculating the release of energy caused by the breaking of chemical bonds. ● calculating the energy changes when the electrostatic forces that exist between molecules as well as between atoms or ions are broken. ● predicting how chemical or physical processes are driven by a decrease in enthalpy or an increase in entropy, or both. 2: The student demonstrates he/she is nearing proficiency by

	- recognizing or recalling specific vocabulary, such as *Internal Energy, calorimetry, enthalpy, heat, work, system, surroundings,specific heat, exothermic, endothermic, heat of reaction, heat of solution, Hess's law, bond energy, heat of formation.* - by performing specific processes, such as - generating explanations about the transfer of thermal energy between systems based on this transfer being due to a kinetic energy transfer between systems arising from molecular collisions. - identifying when chemical or physical processes are driven by enthalpy or entropy. - determining whether a reaction is thermodynamically favored. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Learning objective 5.1 The student is able to create or use graphical representations in order to connect the dependence of potential energy to the distance between atoms and factors, such as bond order (for covalent interactions) and polarity (for intermolecular interactions), which influence the interaction strength. [See SP 1.1, 1.4, 7.2, connects to Big Idea 2; Essential knowledge components of 5.A–5.E]

- Learning objective 5.2 The student is able to relate temperature to the motions of particles, either via particulate representations, such as drawings of particles with arrows indicating velocities, and/or via representations of average kinetic energy and distribution of kinetic energies of the particles, such as plots of the Maxwell-Boltzmann distribution. [See SP 1.1, 1.4, 7.1; Essential knowledge 5.A.1]

- Learning objective 5.3 The student can generate explanations or make predictions about the transfer of thermal energy between systems based on this transfer being due to a kinetic energy transfer between systems arising from molecular collisions. [See SP 7.1; Essential knowledge 5.A.2]

- Learning objective 5.4 The student is able to use conservation of energy to relate the magnitudes of the energy changes occurring in two or more interacting systems, including identification of the systems, the type (heat versus work), or the direction of energy flow. [See SP 1.4, 2.2, connects to Essential knowledge 5.B.1, 5.B.2]

- Learning objective 5.5 The student is able to use conservation of energy to relate the magnitudes of the energy changes when two nonreacting substances are mixed or brought into contact with one another. [See SP 2.2, connects to Essential knowledge 5.B.1, 5.B.2]

- Learning objective 5.6 The student is able to use calculations or estimations 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/vaporization, relate energy changes associated with a chemical reaction to the enthalpy of the reaction, and relate energy changes to $P\Delta V$ work. [See SP 2.2, 2.3; Essential knowledge 5.B.3]

- Learning objective 5.7 The student is able to design and/or interpret the results of an experiment in which calorimetry is used to determine the change in enthalpy of a chemical process (heating/cooling, phase transition, or chemical reaction) at constant pressure. [See SP 4.2, 5.1, 6.4; Essential knowledge 5.B.4]

- Learning objective 5.8 The student is able to draw qualitative and quantitative connections between the reaction enthalpy and the energies involved in the breaking and formation of chemical bonds. [See SP 2.3, 7.1, 7.2; Essential knowledge 5.C.2]

- Learning objective 5.9 The student is able to make claims and/or predictions regarding 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. [See SP 6.4; Essential knowledge 5.D.1]

- Learning objective 5.10 The student can support the claim about whether a process is a chemical or physical change (or may be classified as both) based on whether the process involves changes in intramolecular versus intermolecular interactions. [See SP 5.1; Essential knowledge 5.D.2]

- Learning objective 5.11 The student is able to identify the noncovalent interactions within and between large molecules, and/or connect the shape and function of the large molecule to the presence and magnitude of these interactions. [See SP 7.2; Essential knowledge 5.D.3]

- Learning objective 5.12 The student is able to use representations and models to predict the sign and relative magnitude of the entropy change associated with chemical or physical processes. [See SP 1.4; Essential knowledge 5.E.1]

- Learning objective 5.13 The student is able to predict whether or not a physical or chemical process is thermodynamically favored by determination of (either quantitatively or qualitatively) the signs of both $\Delta H°$ and $\Delta S°$, and calculation or estimation of $\Delta G°$ when needed. [See SP 2.2, 2.3, 6.4; Essential knowledge 5.E.2, connects to 5.E.3]

- Learning objective 5.14 The student is able to determine whether a chemical or physical process is thermodynamically favorable by calculating the change in standard Gibbs free energy. [See SP 2.2; Essential knowledge 5.E.3, connects to 5.E.2]

- Learning objective 5.15 The student is able to explain how the application of external energy sources or the coupling of favorable with unfavorable reactions can be used to cause processes that are not thermodynamically favorable to become favorable. [See SP 6.2; Essential knowledge 5.E.4]

- Learning objective 5.16 The student can use Le Chatelier's principle to make qualitative predictions for systems in which coupled reactions that share a common intermediate drive formation of a product. [See SP 6.4; Essential knowledge 5.E.4, connects to 6.B.1]

- Learning objective 5.17 The student can make quantitative predictions for systems involving coupled reactions that share a common intermediate, based on the equilibrium constant for the combined reaction. [See SP 6.4; Essential knowledge 5.E.4, connects to 6.A.2]

- Learning objective 5.18 The student can explain why a thermodynamically favored chemical reaction may not produce large amounts of product (based on consideration of both initial conditions and kinetic effects), or why a thermodynamically unfavored chemical reaction can produce large amounts of product for certain sets of initial conditions. [See SP 1.3, 7.2; Essential knowledge 5.E.5, connects to 6.D.1]

<u>Learning Design</u>

WGSD Curriculum -- AP Chemistry -- Bonds and Intermolecular Attractions DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Chemistry Big Idea 6: 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.

Learning Goal	Proficiency Scales
The student will be able to analyze factors that influence bonding, intermolecular attraction and chemical equilibrium.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● solving problems in which chemical equilibrium is a dynamic, reversible state in which rates of opposing processes are equal. ● calculating changes in the response due to external perturbations that lead to a change in the composition of a system systems at equilibrium. ● calculating chemical equilibrium in acid-base chemistry and in solubility. ● expressing the equilibrium constant in relation to temperature and

	the difference in Gibbs free energy between reactants and products. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *dynamic equilibrium, reversible reactions, equilibrium constants: k, ka, kb, ksp, pka, pkb, pH, kw, Q (law of mass action), le chatelier's principle, strong vs weak acid or base, monoprotic, diprotic, polyprotic, protonated, deprotonated thermodynamically favorable, ΔG°.* ● performing specific processes, such as solving simple problems in which chemical equilibrium is dynamic. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Learning objective 6.1 The student gives an explanation that connects the observations to the reversibility of the underlying chemical reactions or processes, given a set of experimental observations regarding physical, chemical, biological, or environmental processes that are reversible, [SP 6.2; Essential knowledge 6.A.1]
- Learning objective 6.2 The student determines the effects of that manipulation on Q or K, given a manipulation of a chemical reaction or set of reactions (e.g., reversal of reaction or addition of two reactions), [SP 2.2; Essential knowledge 6.A.2]

- Learning objective 6.3 The student can connect kinetics to equilibrium by using reasoning about equilibrium, such as Le Chatelier's principle, to infer the relative rates of the forward and reverse reactions. [See SP 7.2; Essential knowledge 6.A.3]

- Learning objective 6.4 The student can, given a set of initial conditions (concentrations or partial pressures) and the equilibrium constant, K, use the tendency of Q to approach K to predict and justify the prediction as to whether the reaction will proceed toward products or reactants as equilibrium is approached. [See SP 2.2, 6.4; Essential knowledge 6.A.3]

- Learning objective 6.5 The student can, given data (tabular, graphical, etc.) from which the state of a system at equilibrium can be obtained, calculate the equilibrium constant, K. [See SP 2.2; Essential knowledge 6.A.3]

- Learning objective 6.6 The student can, given a set of initial conditions (concentrations or partial pressures) and the equilibrium constant, K, use stoichiometric relationships and the law of mass action (Q equals K at equilibrium) to determine qualitatively and/or quantitatively the conditions at equilibrium for a system involving a single reversible reaction. [See SP 2.2, 6.4; Essential knowledge 6.A.3]

- Learning objective 6.7 The student is able, for a reversible reaction that has a large or small K, to determine which chemical species will have very large versus very small concentrations at equilibrium. [See SP 2.2, 2.3; Essential knowledge 6.A.4]

- Learning objective 6.8 The student is able to use Le Chatelier's principle to predict the direction of the shift resulting from various possible stresses on a system at chemical equilibrium. [See SP 1.4, 6.4; Essential knowledge 6.B.1]

- Learning objective 6.9 The student is able to use Le Chatelier's principle to design a set of conditions that will optimize a desired outcome, such as product yield. [See SP 4.2; Essential knowledge 6.B.1]

- Learning objective 6.10 The student is able to connect Le Chatelier's principle to the comparison of Q to K by explaining the effects of the stress on Q and K. [See SP 1.4, 7.2; Essential knowledge 6.B.2]

- Learning objective 6.11 The student can generate or use a particulate representation of an acid (strong or weak or polyprotic) and a strong base to explain the species that will have large versus small concentrations at equilibrium. [See SP 1.1, 1.4, 2.3; Essential knowledge 6.C.1]

- Learning objective 6.12 The student can reason about the distinction between strong and weak acid solutions with similar values of pH, including the percent ionization of the acids, the concentrations needed to achieve the same pH, and the amount of base needed to reach the equivalence point in a titration. [See SP 1.4, 6.4; Essential knowledge 6.C.1, connects to 1.E.2]

- Learning objective 6.13 The student can interpret titration data for monoprotic or polyprotic acids involving titration of a weak or strong acid by a strong base (or a weak or strong base by a strong acid) to determine the concentration of the titrant and the pKa for a weak acid, or the pKb for a weak base. [See SP 5.1, 6.4; Essential knowledge 6.C.1, connects to I.E.2]

- Learning objective 6.14 The student can, based on the dependence of Kw on temperature, reason that neutrality requires [H+] = [OH–] as opposed to requiring pH = 7, including especially the applications to biological systems. [See SP 2.2, 6.2; Essential knowledge 6.C.1]

- Learning objective 6.15 The student can identify a given solution as containing a mixture of strong acids and/or bases and calculate or estimate the pH (and concentrations of all chemical species) in the resulting solution. [See SP 2.2, 2.3, 6.4; Essential knowledge 6.C.1]

- Learning objective 6.16 The student can identify a given solution as being the solution of a monoprotic weak acid or base (including salts in which one ion is a weak acid or base), calculate the pH and concentration of all species in the solution, and/or infer the relative strengths of the weak acids or bases from given equilibrium concentrations. [See SP 2.2, 6.4; Essential knowledge 6.C.1]

- Learning objective 6.17 The student can, given an arbitrary mixture of weak and strong acids and bases (including polyprotic systems), determine which species will react strongly with one another (i.e., with K >1) and what species will be present in large concentrations at equilibrium. [See SP 6.4; Essential knowledge 6.C.1]

- Learning objective 6.18 The student can design a buffer solution with a target pH and buffer capacity by selecting an appropriate conjugate acid-base pair and estimating the concentrations needed to achieve the desired capacity. [See SP 2.3, 4.2, 6.4; Essential knowledge 6.C.2]

- Learning objective 6.19 The student can relate the predominant form of a chemical species involving a labile proton (i.e., protonated/deprotonated form of a weak acid) to the pH of a solution and the pKa associated with the labile proton. [See SP 2.3, 5.1, 6.4; Essential knowledge 6.C.2]

- Learning objective 6.20 The student can identify a solution as being a buffer solution and explain the buffer mechanism in terms of the reactions that would occur on addition of acid or base. [See SP 6.4; Essential knowledge 6.C.2]Learning objective 6.21 The student can predict the solubility of a salt, or rank the solubility of salts, given the relevant Ksp values. [See SP 2.2, 2.3, 6.4; Essential knowledge 6.C.3]

- Learning objective 6.22 The student can interpret data regarding solubility of salts to determine, or rank, the relevant Ksp values. [See SP 2.2, 2.3, 6.4; Essential knowledge 6.C.3]

- Learning objective 6.23 The student can interpret data regarding the relative solubility of salts in terms of factors (common ions, pH) that influence the solubility. [See SP 5.1, 6.4; Essential knowledge 6.C.3]

- Learning objective 6.24 The student can analyze the enthalpic and entropic changes associated with the dissolution of a salt, using particulate level interactions and representations. [See SP 1.4, 7.1; Essential knowledge 6.C.3, connects to 5.E]

- Learning objective 6.25 The student is able to express the equilibrium constant in terms of $\Delta G°$ and RT and use this relationship to estimate the magnitude of K and, consequently, the thermodynamic favorability of the process. [See SP 2.3; Essential knowledge 6.D.1]

<u>Learning Design</u>

WGSD Curriculum -- AP Chemistry -- Changes in Matter

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Chemistry Big Idea 3: Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.

Learning Goal	Proficiency Scales
Students will be able to use models to predict or explain changes in matter involving the rearrangement and/or reorganization of atoms and/or the transfer of electrons during chemical reactions.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● representing chemical changes with a balanced chemical equation that identifies the ratios with which reactants react and products form. ● classifying chemical reactions by considering what the reactants are, what the products are, or how they change from one into the other; classes of chemical reactions include precipitation, acid-base, and oxidation-reduction reactions. ● identifying chemical and physical transformations that involve a change in energy. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *redox reactions, acid-base reactions, precipitate reactions, solubility rules, limiting reactant, stoichiometric ratio, actual ratio, excess reactants, molarity, percent yield, spectator ions, net ionic reactions, complete ionic reactions, complete formula reactions.*

	• performing specific processes, such as balancing chemical equations in terms of reactants, products, and change of energy. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Learning objective 3.1 Students can translate among macroscopic observations of change, chemical equations, and particle views. [See SP 1.5, 7.1; Essential knowledge components of 3.A–3.C]
- Learning objective 3.2 The student can translate an observed chemical change into a balanced chemical equation and justify the choice of equation type (molecular, ionic, or net ionic) in terms of utility for the given circumstances. [See SP 1.5, 7.1; Essential knowledge 3.A.1]
- Learning objective 3.3 The student is able to use stoichiometric calculations to predict the results of performing a reaction in the laboratory and/or to analyze deviations from the expected results. [See SP 2.2, 5.1; Essential knowledge 3.A.2]
- Learning objective 3.4 The student is able to relate quantities (measured mass of substances, volumes of solutions, or volumes and pressures of gases) to identify stoichiometric relationships for a reaction, including situations involving limiting reactants and situations in which the reaction has not gone to completion. [See SP 2.2, 5.1, 6.4; Essential knowledge 3.A.2]
- Learning objective 3.5 The student is able to design a plan in order to collect data on the synthesis or decomposition of a compound to confirm the conservation of matter and the law of definite proportions. [See SP 2.1, 4.2, 6.4; Essential knowledge 3.B.1]
- Learning objective 3.6 The student is able to use data from synthesis or decomposition of a compound to confirm the conservation of matter and the law of definite proportions. [See SP 2.2, 6.1; Essential knowledge 3.B.1]

- Learning objective 3.7 The student is able to identify compounds as Brønsted-Lowry acids, bases, and/or conjugate acid-base pairs, using proton-transfer reactions to justify the identification. [See SP 6.1; Essential knowledge 3.B.2]

- Learning objective 3.8 The student is able to identify redox reactions and justify the identification in terms of electron transfer. [See SP 6.1; Essential knowledge 3.B.3]

- Learning objective 3.9 The student is able to design and/or interpret the results of an experiment involving a redox titration. [See SP 4.2, 5.1; Essential knowledge 3.B.3]

- Learning objective 3.10 The student is able to evaluate the classification of a process as a physical change, chemical change, or ambiguous change based on both macroscopic observations and the distinction between rearrangement of covalent interactions and noncovalent interactions. [See SP 1.4, 6.1; Essential knowledge 3.C.1, connects to 5.D.2]

- Learning objective 3.11 The student is able to interpret observations regarding macroscopic energy changes associated with a reaction or process to generate a relevant symbolic and/or graphical representation of the energy changes. [See SP 1.5, 4.4; Essential knowledge 3.C.2]

- Learning objective 3.12 The student can make qualitative or quantitative predictions about galvanic or electrolytic reactions based on half-cell reactions and potentials and/or Faraday's laws. [See SP 2.2, 2.3, 6.4; Essential knowledge 3.C.3]

- Learning objective 3.13 The student can analyze data regarding galvanic or electrolytic cells to identify properties of the underlying redox reactions. [See SP 5.1; Essential knowledge 3.C.3]

Learning Design

WGSD Curriculum -- AP Chemistry - Chemical and physical properties of materials
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Chemistry Big Idea 2: 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.

Learning Goal	Proficiency Scales
Students will be able to prove that chemical and physical properties of materials are derived from the structure and the arrangement of atoms, ions, or molecules and the forces between them.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by: ● describing matter according to its physical properties with the understanding that the physical properties of a substance generally depend on the spacing between the particles (atoms, molecules, ions) that make up the substance and the forces of attraction among them. ● demonstrating that forces of attraction between particles (including the noble gases and also different parts of some large molecules) are important in determining many macroscopic properties of a substance, including how the observable physical state changes with temperature. ● understanding that the strong electrostatic forces of attraction

holding atoms together in a unit are called chemical bonds.

- deducing the type of bonding in the solid state from the properties of the solid state.

2: The student demonstrates he/she is nearing proficiency:

- by recognizing or recalling specific vocabulary, such as *ionic bonds, covalent bonds, metallic bonds, intermolecular forces of attraction, dipole-dipole attractions, hydrogen bonding, london dispersion forces, vapor pressure.*

- by performing specific processes, such as

    - identifying types of matter given the physical properties.
    - identifying the effect of the attraction between particles on macroscopic properties of matter.
    - describing the purpose of chemical bonds.
    - performing calculations with scaffolding under limited circumstances.

1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Learning objective 2.1 Students can predict properties of substances based on their chemical formulas, and provide explanations of their properties based on particle views. [See SP 6.4, 7.1; Essential knowledge components of 2.A–2.D]

- Learning objective 2.2 The student is able to explain the relative strengths of acids and bases based on molecular structure, interparticle forces, and solution equilibrium. [See SP 7.2, connects to Big Idea 5, Big Idea 6; Essential knowledge components of 2.A–2.D]

- Learning objective 2.3 The student is able to use aspects of particulate models (i.e., particle spacing, motion, and forces of attraction) to reason about observed differences between solid and liquid phases and among solid and liquid materials. [See SP 6.4, 7.1; Essential knowledge 2.A.1]

- Learning objective 2.4 The student is able to use KMT and concepts of intermolecular forces to make predictions about the macroscopic properties of gases, including both ideal and nonideal behaviors. [See SP 1.4, 6.4; Essential knowledge 2.A.2]

- Learning objective 2.5 The student is able to refine multiple representations of a sample of matter in the gas phase to accurately represent the effect of changes in macroscopic properties on the sample. [See SP 1.3, 6.4, 7.2; Essential knowledge 2.A.2]

- Learning objective 2.6 The student can apply mathematical relationships or estimation to determine macroscopic variables for ideal gases. [See SP 2.2, 2.3; Essential knowledge 2.A.2]

- Learning objective 2.7 The student is able to explain how solutes can be separated by chromatography based on intermolecular interactions. [See SP 6.2; Essential knowledge 2.A.3]

- Learning objective 2.8 The student can draw and/or interpret representations of solutions that show the interactions between the solute and solvent. [See SP 1.1, 1.2, 6.4; Essential knowledge 2.A.3]

- Learning objective 2.9 The student is able to create or interpret representations that link the concept of molarity with partical views of solutions. [See SP 1.1, 1.4; Essential knowledge 2.A.3]

- Learning objective 2.10 The student can design and/or interpret the results of a separation experiment (filtration, paper chromatography, column chromatography, or distillation) in terms of the relative strength of interactions among and between the components. [See SP 4.2, 5.1, 6.4; Essential knowledge 2.A.3]

- Learning objective 2.11 The student is able to explain the trends in properties and/or predict properties of samples consisting of particles with no permanent dipole on the basis of London dispersion forces. [See SP 6.2, 6.4; Essential knowledge 2.B.1]

- Learning objective 2.12 The student can qualitatively analyze data regarding real gases to identify deviations from ideal behavior and relate these to molecular interactions. [See SP 5.1, 6.5; Essential knowledge 2.B.2, connects to 2.A.2]

- Learning objective 2.13 The student is able to describe the relationships between the structural features of polar molecules and the forces of attraction between the particles. [See SP 1.4, 6.4; Essential knowledge 2.B.2]

- Learning objective 2.14 The student is able to apply Coulomb's law qualitatively (including using representations) to describe the interactions of ions, and the attractions between ions and solvents to explain the factors that contribute to the solubility of ionic compounds. [See SP 1.4, 6.4; Essential knowledge 2.B.2]

- Learning objective 2.15 The student is able to explain observations regarding the solubility of ionic solids and molecules in water and other solvents on the basis of particle views that include intermolecular interactions and entropic effects. [See SP 1.4, 6.2; Essential knowledge 2.B.3, connects to 5.E.1]

- Learning objective 2.16 The student is able to explain the properties (phase, vapor pressure, viscosity, etc.) of small and large molecular compounds in terms of the strengths and types of intermolecular forces. [See SP 6.2; Essential knowledge 2.B.3]

- Learning objective 2.17 The student can predict the type of bonding present between two atoms in a binary compound based on position in the periodic table and the electronegativity of the elements. [See SP 6.4; Essential knowledge components of 2.C]

- Learning objective 2.18 The student is able to rank and justify the ranking of bond polarity on the basis of the locations of the bonded atoms in the periodic table. [See SP 6.1; Essential knowledge 2.C.1]

- Learning objective 2.19 The student can create visual representations of ionic substances that connect the microscopic structure to macroscopic properties, and/or use representations to connect the microscopic structure to macroscopic properties (e.g., boiling point, solubility, hardness, brittleness, low volatility, lack of malleability, ductility, or conductivity). [See SP 1.1, 1.4, 7.1; Essential knowledge 2.C.2, connects to 2.D.1, 2.D.2]

- Learning objective 2.20 The student is able to explain how a bonding model involving delocalized electrons is consistent with macroscopic properties of metals (e.g., conductivity, malleability, ductility, and low volatility) and the shell model of the atom. [See SP 6.2, 7.1; Essential knowledge 2.C.3, connects to 2.D.2]

- Learning objective 2.21 The student is able to use Lewis diagrams and VSEPR to predict the geometry of
- molecules, identify hybridization, and make predictions about polarity. [See SP 1.4; Essential knowledge 2.C.4]

- Learning objective 2.22 The student is able to design or evaluate a plan to collect and/or interpret data needed to deduce the type of bonding in a sample of a solid. [See SP 4.2, 6.4; Essential knowledge components of 2.D]

- Learning objective 2.23 The student can create a representation of an ionic solid that shows essential characteristics of the structure and interactions present in the substance. [See SP 1.1; Essential knowledge 2.D.1]

- Learning objective 2.24 The student is able to explain a representation that connects properties of an ionic solid to its structural attributes and to the interactions present at the atomic level. [See SP 1.1, 6.2, 7.1; Essential knowledge 2.D.1]

- Learning objective 2.25 The student is able to compare the properties of metal alloys with their constituent elements to determine if an alloy has formed, identify the type of alloy formed, and explain the differences in properties using particulate level reasoning. [See SP 1.4, 7.2; Essential knowledge 2.D.2]

- Learning objective 2.26 Students can use the electron sea model of metallic bonding to predict or make claims about the macroscopic properties of metals or alloys. [See SP 6.4, 7.1; Essential knowledge 2.D.2]

- Learning objective 2.27 The student can create a representation of a metallic solid that shows essential characteristics of the structure and interactions present in the substance. [See SP 1.1; Essential knowledge 2.D.2]

- Learning objective 2.28 The student is able to explain a representation that connects properties of a metallic solid to its structural attributes and to the interactions present at the atomic level. [See SP 1.1, 6.2, 7.1; Essential knowledge 2.D.2]

- Learning objective 2.29 The student can create a representation of a covalent solid that shows essential characteristics of the structure and interactions present in the substance. [See SP 1.1; Essential knowledge

2.D.3]

- Learning objective 2.30 The student is able to explain a representation that connects properties of a covalent solid to its structural attributes and to the interactions present at the atomic level. [See SP 1.1, 6.2, 7.1; Essential knowledge 2.D.3]
- Learning objective 2.31 The student can create a representation of a molecular solid that shows essential characteristics of the structure and interactions present in the substance. [See SP 1.1; Essential knowledge 2.D.4]
- Learning objective 2.32 The student is able to explain a representation that connects properties of a molecular solid to its structural attributes and to the interactions present at the atomic level. [See SP 1.1, 6.2, 7.1; Essential knowledge 2.D.4]

Learning Design

WGSD Curriculum -- AP Chemistry - Chemical Elements are Fundamental Building Materials of Matter
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

College Board Advanced Placement Chemistry

Big Idea 1. 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.

CCSS
Reading Standard (11-12)

#3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

#8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales
Students will be able to prove that chemical elements are fundamental building materials of matter and that all matter can be understood in terms of arrangement and	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by conducting

rearrangement of atoms.	experiments and solving chemical problems that demonstrate that ● all matter is made of atoms; there are a limited number of types of atoms; these are the elements. ● 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; this periodicity can be explained by the regular variations that occur in the electronic structures of atoms; periodicity is a useful principle for understanding properties and predicting trends in properties; its modern-day uses range from examining the composition of materials to generating ideas for designing new materials. ● 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. 2: The student demonstrates he/she is nearing proficiency by ● recognizing and recalling specific vocabulary, such as *atomic number, mass number, atomic mass, ionization energy and trends, electron affinity and trends, electronegativity and trends, atomic size trends, ion size trends, PES data.* ● performing specific processes, such as ○ describing with accuracy the properties of atoms. ○ explaining the functions of the periodic table. ○ performing calculations with scaffolding in limited cases. 1: The student demonstrates limited understanding or skill with the

	learning goal.

Learning Targets

- Learning objective 1.1 The student can justify the observation that the ratio of the masses of the constituent elements in any pure sample of that compound is always identical on the basis of the atomic molecular theory. [See SP 6.1; Essential knowledge 1.A.1]
- Learning objective 1.2 The student is able to select and apply mathematical routines to mass data to identify or infer the composition of pure substances and/or mixtures. [See SP 2.2; Essential knowledge 1.A.2]
- Learning objective 1.3 The student is able to select and apply mathematical relationships to mass data in order to justify a claim regarding the identity and/or estimated purity of a substance. [See SP 2.2, 6.1; Essential knowledge 1.A.2]
- Learning objective 1.4 The student is able to connect the number of particles, moles, mass, and volume of substances to one another, both qualitatively and quantitatively. [See SP 7.1; Essential knowledge 1.A.3]
- Learning objective 1.5 The student is able to explain the distribution of electrons in an atom or ion based upon data. [See SP 1.5, 6.2; Essential knowledge 1.B.1]
- Learning objective 1.6 The student is able to analyze data relating to electron energies for patterns and relationships. [See SP 5.1; Essential knowledge 1.B.1]
- Learning objective 1.7 The student is able to describe the electronic structure of the atom, ionization energy data, and/or Coulomb’s law to construct explanations of how the energies of electrons within shells in atoms vary. [See SP 5.1, 6.2; Essential knowledge 1.B.2]
- Learning objective 1.8 The student is able to explain the distribution of electrons using Coulomb’s law to analyze measured energies. [See SP 6.2; Essential knowledge 1.B.2]

- Learning objective 1.9 The student is able to predict and/or justify trends in atomic properties based on location on the periodic table and/or the shell model. [See SP 6.4; Essential knowledge 1.C.1]

- Learning objective 1.10 Students can justify with evidence the arrangement of the periodic table and can apply periodic properties to chemical reactivity. [See SP 6.1; Essential knowledge 1.C.1]

- Learning objective 1.11 The student can analyze data, based on periodicity and the properties of binary compounds, to identify patterns and generate hypotheses related to the molecular design of compounds for which data are not supplied. [See SP 3.1, 5.1; Essential knowledge 1.C.1]

- Learning objective 1.13 Given information about a particular model of the atom, the student is able to determine if the model is consistent with specified evidence. [See SP 5.3; Essential knowledge 1.D.1]

- Learning objective 1.17 The student is able to express the law of conservation of mass quantitatively and qualitatively using symbolic representations and particulate drawings. [See SP 1.5; Essential knowledge 1.E.1]

- Learning objective 1.18 The student is able to apply conservation of atoms to the rearrangement of atoms in various processes. [See SP 1.4; Essential knowledge 1.E.2]

- Learning objective 1.19 The student can design, and/or interpret data from, an experiment that uses gravimetric analysis to determine the concentration of an analyte in a solution. [See SP 4.2, 5.1, 6.4; Essential knowledge1.E.2]

- Learning objective 1.20 The student can design, and/or interpret data from, an experiment that uses titration to determine the concentration of an analyte in a solution. [See SP 4.2, 5.1, 6.4; Essential knowledge 1.E.2]

Learning Design

WGSD Curriculum -- AP Chemistry -- Laws of Thermodynamics
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

College Board Advanced Placement Chemistry

Big Idea 5: The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter

Learning Goal	Proficiency Scales
Students will be able to apply the laws of thermodynamics.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● quantifying the exchange of thermal energy (heat). ● applying the Law of Conservation of Energy. ● calculating the release of energy caused by the breaking of chemical bonds. ● calculating the energy changes when the electrostatic forces that exist between molecules as well as between atoms or ions are broken. ● predicting how chemical or physical processes are driven by a decrease in enthalpy or an increase in entropy, or both. 2: The student demonstrates he/she is nearing proficiency by

	● recognizing or recalling specific vocabulary, such as *Internal Energy, calorimetry, enthalpy, heat, work, system, surroundings,specific heat, exothermic, endothermic, heat of reaction, heat of solution, Hess's law, bond energy, heat of formation.* ● by performing specific processes, such as ○ generating explanations about the transfer of thermal energy between systems based on this transfer being due to a kinetic energy transfer between systems arising from molecular collisions. ○ identifying when chemical or physical processes are driven by enthalpy or entropy. ○ determining whether a reaction is thermodynamically favored. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Learning objective 5.1 The student is able to create or use graphical representations in order to connect the dependence of potential energy to the distance between atoms and factors, such as bond order (for covalent interactions) and polarity (for intermolecular interactions), which influence the interaction strength. [See SP 1.1, 1.4, 7.2, connects to Big Idea 2; Essential knowledge components of 5.A–5.E]

- Learning objective 5.2 The student is able to relate temperature to the motions of particles, either via particulate representations, such as drawings of particles with arrows indicating velocities, and/or via representations of average kinetic energy and distribution of kinetic energies of the particles, such as plots of the Maxwell-Boltzmann distribution. [See SP 1.1, 1.4, 7.1; Essential knowledge 5.A.1]

- Learning objective 5.3 The student can generate explanations or make predictions about the transfer of thermal energy between systems based on this transfer being due to a kinetic energy transfer between systems arising from molecular collisions. [See SP 7.1; Essential knowledge 5.A.2]

- Learning objective 5.4 The student is able to use conservation of energy to relate the magnitudes of the energy changes occurring in two or more interacting systems, including identification of the systems, the type (heat versus work), or the direction of energy flow. [See SP 1.4, 2.2, connects to Essential knowledge 5.B.1, 5.B.2]

- Learning objective 5.5 The student is able to use conservation of energy to relate the magnitudes of the energy changes when two nonreacting substances are mixed or brought into contact with one another. [See SP 2.2, connects to Essential knowledge 5.B.1, 5.B.2]

- Learning objective 5.6 The student is able to use calculations or estimations 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/vaporization, relate energy changes associated with a chemical reaction to the enthalpy of the reaction, and relate energy changes to $P\Delta V$ work. [See SP 2.2, 2.3; Essential knowledge 5.B.3]

- Learning objective 5.7 The student is able to design and/or interpret the results of an experiment in which calorimetry is used to determine the change in enthalpy of a chemical process (heating/cooling, phase transition, or chemical reaction) at constant pressure. [See SP 4.2, 5.1, 6.4; Essential knowledge 5.B.4]

- Learning objective 5.8 The student is able to draw qualitative and quantitative connections between the reaction enthalpy and the energies involved in the breaking and formation of chemical bonds. [See SP 2.3, 7.1, 7.2; Essential knowledge 5.C.2]

- Learning objective 5.9 The student is able to make claims and/or predictions regarding 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. [See SP 6.4; Essential knowledge 5.D.1]

- Learning objective 5.10 The student can support the claim about whether a process is a chemical or physical change (or may be classified as both) based on whether the process involves changes in intramolecular versus intermolecular interactions. [See SP 5.1; Essential knowledge 5.D.2]

- Learning objective 5.11 The student is able to identify the noncovalent interactions within and between large molecules, and/or connect the shape and function of the large molecule to the presence and magnitude of these interactions. [See SP 7.2; Essential knowledge 5.D.3]

- Learning objective 5.12 The student is able to use representations and models to predict the sign and relative magnitude of the entropy change associated with chemical or physical processes. [See SP 1.4; Essential knowledge 5.E.1]

- Learning objective 5.13 The student is able to predict whether or not a physical or chemical process is thermodynamically favored by determination of (either quantitatively or qualitatively) the signs of both $\Delta H°$ and $\Delta S°$, and calculation or estimation of $\Delta G°$ when needed. [See SP 2.2, 2.3, 6.4; Essential knowledge 5.E.2, connects to 5.E.3]

- Learning objective 5.14 The student is able to determine whether a chemical or physical process is thermodynamically favorable by calculating the change in standard Gibbs free energy. [See SP 2.2; Essential knowledge 5.E.3, connects to 5.E.2]

- Learning objective 5.15 The student is able to explain how the application of external energy sources or the coupling of favorable with unfavorable reactions can be used to cause processes that are not thermodynamically favorable to become favorable. [See SP 6.2; Essential knowledge 5.E.4]

- Learning objective 5.16 The student can use Le Chatelier's principle to make qualitative predictions for systems in which coupled reactions that share a common intermediate drive formation of a product. [See SP 6.4; Essential knowledge 5.E.4, connects to 6.B.1]

- Learning objective 5.17 The student can make quantitative predictions for systems involving coupled reactions that share a common intermediate, based on the equilibrium constant for the combined reaction. [See SP 6.4; Essential knowledge 5.E.4, connects to 6.A.2]

- Learning objective 5.18 The student can explain why a thermodynamically favored chemical reaction may not produce large amounts of product (based on consideration of both initial conditions and kinetic effects), or why a thermodynamically unfavored chemical reaction can produce large amounts of product for certain sets of initial conditions. [See SP 1.3, 7.2; Essential knowledge 5.E.5, connects to 6.D.1]

Learning Design

WGSD Curriculum -- AP Chemistry -- Rates of Chemical Reactions
DRAFT

<table>
<tr><td>

<u>High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)</u>

College Board Advanced Placement Chemistry

Big Idea 4: Rates of chemical reactions are determined by details of the molecular collisions.

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<u>Learning Goal</u>	<u>Proficiency Scales</u>
Students will be able to prove that rates of reactions are influenced or explained by variables such as molecular collisions and catalysts.	4:The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by: ● calculating reaction rates that depend on temperature and other environmental factors by measuring changes in concentrations of reactants or products over time. ● determining that elementary reactions are mediated by collisions between molecules, and only collisions having sufficient energy and proper relative orientation of reactants lead to products. ● determining which reactions proceed via a series of elementary reactions. ● calculating reaction rates increased by the presence of a catalyst. 2: The student demonstrates he/she is nearing proficiency: ● by recognizing or recalling specific vocabulary, such as *reaction*

	rate, rate law, zero-order, first-order, second order, half-life, molecularity, slow step, reaction mechanism, elementary reaction, reaction intermediate, catalyst, energy profile.
	
	• by performing specific processes, such as
	    ○ measuring changes in concentrations of reactants or products over time.
	    ○ identifying elementary reactions and series of elementary reactions.
	    ○ determining when a reaction rate is determined by the presence of a catalyst.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Learning objective 4.1 The student is able to design and/or interpret the results of an experiment regarding the factors (i.e., temperature, concentration, surface area) that may influence the rate of a reaction. [See SP 4.2, 5.1; Essential knowledge 4.A.1]

- Learning objective 4.2 The student is able to analyze concentration vs. time data to determine the rate law for a zeroth-, first-, or second-order reaction. [See SP 5.1, 6.4; Essential knowledge 4.A.2, connects to 4.A.3]

- Learning objective 4.3 The student is able to connect the half-life of a reaction to the rate constant of a first-order reaction and justify the use of this relation in terms of the reaction being a first-order reaction. [See SP 2.1, 2.2; Essential knowledge 4.A.3]

- Learning objective 4.4 The student is able to connect the rate law for an elementary reaction to the frequency and success of molecular collisions, including connecting the frequency and success to the order and rate constant, respectively. [See SP 7.1; Essential knowledge 4.B.1, connects to 4.A.3, 4.B.2]

- Learning objective 4.5 The student is able to explain the difference between collisions that convert reactants to products and those that do not in terms of energy distributions and molecular orientation. [See SP 6.2; Essential knowledge 4.B.2]
- Learning objective 4.6 The student is able to use representations of the energy profile for an elementary reaction (from the reactants, through the transition state, to the products) to make qualitative predictions regarding the relative temperature dependence of the reaction rate. [See SP 1.4, 6.4; Essential knowledge 4.B.3]
- Learning objective 4.7 The student is able to evaluate alternative explanations, as expressed by reaction mechanisms, to determine which are consistent with data regarding the overall rate of a reaction, and data that can be used to infer the presence of a reaction intermediate. [See SP 6.5; connects to Essential knowledge 4.C.1, 4.C.2, 4.C.3]
- Learning objective 4.8 The student can translate among reaction energy profile representations, particulate representations, and symbolic representations (chemical equations) of a chemical reaction occurring in the presence and absence of a catalyst. [See SP 1.5; Essential knowledge 4.D.1]
- Learning objective 4.9 The student is able to explain changes in reaction rates arising from the use of acid-base catalysts, surface catalysts, or enzyme catalysts, including selecting appropriate mechanisms with or without the catalyst present. [See SP 6.2, 7.2; Essential knowledge 4.D.2]

Learning Design

WGSD Curriculum -- Environmental Science
Ecology
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS LS2-4: Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

Learning Goal	Proficiency Scales
Students will be able to describe how ecosystems interact and change over time.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● graphing the biomass collected in the field and relating the graph to human biomass adjusted to the same scale. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *producer, consumer, microscopic, macroscopic, herbivore, carnivore*, and *biomass*. ● performing specific processes, such as ○ classifying organisms in their correct trophic level. ○ describing types of relationships in an ecosystem.

	○ describing the components of an ecosystem. 1: The student demonstrates limited understanding or skill with the learning goal.

<u>Learning Targets</u> ● Define the components of ecosystems ● Define and relate the major trophic levels in an ecosystem ● Create food chains and webs ● Explain what happens to energy in an ecosystem ● Define and give examples of niches ● Describe relationships between organisms in an ecosystem ● Explain how ecosystems change over time
<u>Learning Design</u>

WGSD Curriculum -- Environmental Science
Biodiversity
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. NGSS-HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

Learning Goal	Proficiency Scales
The student will be able to analyze the ways human activities affect biodiversity of the environment.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● describing the political, economic, and social of loss of biodiversity and evaluating measures employed to protect endangered species. ● evaluating the potential values (medicinal, aesthetic, recreational, moral, and ethical) that endangered plants might have against the costs/benefits of conservation efforts. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary such as *endangered, threatened, extirpated, extinct, extant*, *biodiversity*, and *rare*.

	● performing processes, such as listing the major human-caused activities that most negatively impact biodiversity. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Use the internet to learn the status, habitat requirements, threats, and conservation efforts of a species of conservation concern in Missouri
- Classify and rate the various threats faced by endangered and threatened species globally as well as specifically in Missouri
- Predict possible future impacts to human well-being by continued loss of biodiversity
- Distinguish the terms used to describe organisms of conservation concern
- Discuss the causes and possible effects of plant extinction
- Explain who the key players are in the field of conservation in the United States

Learning Design

WGSD Curriculum -- Environmental Science

Energy Resources

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. NGSS-HS-ETS-1: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural and environmental impacts.

Learning Goal	Proficiency Scales
Students will be able to evaluate renewable and nonrenewable energy sources.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrate mastery of the learning goal by ● ranking the feasibility and limits of various renewable energy sources (solar, tidal, wind, etc.) based on costs, current technology, location, and environmental impacts. ● comparing fossil fuel derived energy production, nuclear power plants, and renewable energy systems. ● developing scenarios about future energy directions based on various cost/benefit criteria. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary such as: *non-renewable*, and *renewable*, and categorize types of fossil fuels. ● performing processes, such as listing advantages and

	disadvantages of a variety of energy resources. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- List factors that influence the value of a fuel
- Explain how a power plant generates electricity
- Explain how fossil fuels form
- Compare the advantages and disadvantages of fossil-fuel use
- Describe a variety of renewable energy types and list their features, advantages, disadvantages, obstacles to be overcome, and future potential
- Describe nuclear fission and nuclear fusion
- Describe the advantages and disadvantages of nuclear energy
- Describe various renewable energy technologies and outline their advantages, obstacles, present use and future potential

Learning Design

WGSD Curriculum -- Environmental Science
Natural Resources
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity NGSS-HS-ESS3-5: Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. NGSS-HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

Learning Goal	Proficiency Scales
Students will be able to critique resource use and abuse.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● describing how human activity leads to ozone depletion, acid rain and climate change. ● outlining how federal laws have impacted pollution. ● describing ways the "urban crisis" can be avoided or mitigated. ● Students will be able to describe water, air, and soil resources as they relate to environmental, legal, and economic issues. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as primary and

	secondary pollutants, VOCs, CFCs, ozone, erosion, desertification, salinization, point and non-point pollution, aquifer, and groundwater. ● performing processes such as, ○ describing soil structure and profile, air composition, and water quality. ○ describing the aquatic cycle. 1: Student demonstrates limited proficiency with the objectives and essential vocabulary with help achieving partial success.

Targets

- Explain why water is essential to life
- Describe the distribution of Earth's water resources
- Describe the relationship between groundwater and surface water in a watershed
- Identify how water is used in homes, in industry, and in agriculture
- Classify water pollution
- Describe how water resources are regulated and distributed in the U.S.
- Describe legislation designed to protect water quality
- Describe how a typical water treatment plant works
- Describe how a typical sewage treatment plant works
- Describe how freshwater resources are managed
- Identify ways that water can be conserved
- Describe the composition and importance of air
- Distinguish between primary and secondary air pollutants and name two major sources of air pollution in urban areas
- Describe the way in which smog forms
- Describe the formation, destruction, and consequences of ozone
- Explain the way in which a thermal inversion traps air pollution
- Describe three possible short-term effects and long-term effects of air pollution on human health
- Explain what causes indoor air pollution and how it can be prevented
- Explain the causes, problems and issues related to acid precipitation

- Describe ways air pollution is being managed
- Describe how soil is formed from organic and inorganic materials
- Evaluate how soil layers and soil composition affect soil's ability to support life
- Identify major soil-related problems and their causes
- Describe ways to conserve soil and reduce erosion
- Distinguish between urban and rural land
- Describe the urban crisis and explain what people are doing to deal with it
- Explain how urban sprawl affects the environment
- Explain how open spaces provide urban areas with environmental and other benefits
- Explain the function of parks and of wilderness areas

Learning Design

WGSD Curriculum -- Forensic Science
Body Fluid Evidence
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

This course is aligned to St. Louis University 1818
SOC 260 Introduction to Forensic Science

Learning Goal	Proficiency Scales
Students will be able to draw conclusions about the source of body fluids from the analysis of stains collected from a crime scene.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● differentiating between mitochondrial and nuclear DNA. ● identifying all parts of the body containing mtDNA and those containing nuclear DNA. ● differentiating between PCR and STR DNA testing. ● collecting and storing DNA evidence properly. ● explaining what CODIS is and where the data in it comes from. ● drawing conclusions about the events that occurred to create a blood stain or set of bloodstain patterns. ● concluding which circumstances are best for the application of luminol and which are best for kastle-meyer reagents. 2: The student demonstrates he/she is nearing proficiency by

	● recognizing or recalling specific vocabulary, such as: *mitochondrial DNA, nuclear DNA, PCR, STR, CODIS, angle of impact, direction, speed/velocity, distance, kastle-meyer, and luminol.* ● performing specific processes, such as ○ investigating the patterns from blood drops resulting from movements in various directions. ○ use context cues to deduce information about an interactive online crime scene scenario. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Know the basic differences between mtDNA and nuclear DNA
- Know parts of the body DNA is found in
- Know the name of the tests used for DNA
- For theses test, understand
  - Their strengths and weaknesses
  - How they work
- Describe how to collect and store DNA evidence
- Explain what CODIS is
- Understand how to determine the direction, speed, and distance blood falls from
- Determine the difference between the application of luminol and Kastle-Meyer in detecting blood
- Know how to detect acid phosphatase enzyme

Learning Design

WGSD Curriculum -- Forensic Science
Drug Evidence
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned to St. Louis University 1818 SOC 260 Introduction to Forensic Science

Learning Goal	Proficiency Scales
Students will be able to evaluate a specific set of drugs for purposes of identification, physiological and psychological effects on humans, and legal penalties for illegal possession of each drug.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● determining the family, short-term effects, long-term effects, presumptive test, conclusive test, schedule and penalty for illegal possession for each of the following: morphine, heroin, codeine, oxycontin, fentanyl, marijuana, ketamine, LSD, PCP, alcohol, barbiturates, inhalants,methamphetamine, ecstasy, GHB, Cocaine, Crack Cocaine, and anabolic steroids. ● determining the presumptive test used to identify each of the above drugs. ● determining the confirmatory test for all of the drugs listed above ● identifying the schedule and penalty for illegal possession for each of the drugs listed above. 2: The student demonstrates he/she is nearing proficiency

	• by recognizing or recalling specific vocabulary, such as: *family, short-term effects, long-term effects, presumptive test. confirmatory test, index, schedules, morphine, heroin, codeine, oxycontin, fentanyl, methamphetamine, ketamine, ecstasy, marijuana, alcohol, GHB, inhalants and anabolic steroids.* • performing specific processes, such as: ○ drawing conclusions about an unknown drug sample from procedures in a color test. ○ recalling physiological and psychological effects of drug on humans ○ Identifying legal penalties for illegal possession of a drug 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Be able to determine the family, short-term effects, long-term effects, presumptive test, conclusive test, schedule and penalty for illegal possession for each of the following:
    - Morphine, heroin, codeine, oxycontin, fentanyl, marijuana, ketamine, LSD, PCP, alcohol, barbiturates, inhalants, methamphetamine, ecstasy, GHB, Cocaine, Crack Cocaine, and anabolic steroids
- Know the five standard presumptive tests used to identify unknown drugs:
    - Duquesnois-Levine, Scott, Van Urk, Marquis, Dillie-Koppanyi
- Know the confirmatory tests used to give final identity to unknown drugs
- Know the 5 schedules and their penalties

- Determine when the above types of physical evidence have class characteristics only and when they also have individual characteristics

Learning Design

WGSD Curriculum -- Forensic Science
Fingerprints and Physical Evidence
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned to St. Louis University 1818 SOC 260 Introduction to Forensic Science

Learning Goal	Proficiency Scales
Students will be able to analyze fingerprints and physical evidence.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by performing fingerprint analysis by: ● differentiating between the types of fingerprint patterns; ● identifying the seven types of ridge characteristics; ● locating and identifying 4 points on a fingerprint; ● differentiating between a latent, visible and plastic print; ● differentiating between chemical and physical development of a print; ● differentiating between class and individual characteristics; ● and identifying the two steps in testing physical evidence. 2: The student demonstrates he/she is nearing proficiency by recognizing or recalling specific vocabulary, such as: *loop, whorl, arch, ridge characteristic, bifurcation, enclosure, latent print, plastic print,*

	visible print, class characteristic and individual characteristic. ● performing specific processes, such as ○ lifting and correctly labeling a latent fingerprint. ○ rolling fingerprints and identifying the type of print. ○ identifying ridge characteristics on a single fingerprint. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Identify the specific type of fingerprint from the pattern visible in a fingerprint
- Locate and identify 4 points in a single fingerprint
- Discuss the standard types of chemical developments used for fingerprint enhancement
- Lift and label a fingerprint using various techniques from a nonporous surface
- Identify a single minutiae in a lifted print
- know the difference between a latent, visible and plastic print
- Know the 2 steps performed at crime labs to examine all types of evidence
- Define class and individual characteristics and identify examples of each
- Discuss the 2 steps for testing crime scene and control evidence in a crime lab

Learning Design

WGSD Curriculum -- Forensic Science
Introduction and Crime Scenes
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned to St. Louis University 1818 SOC 260 Introduction to Forensic Science

Learning Goal	Proficiency Scales
Students will be able to explain and perform some of the basic functions of a crime laboratory.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● comparing and contrasting Frye vs. US and Daubert vs Merrell Dow Pharmaceutical. ● identifying sections of the crime lab that perform specific functions. ● drawing conclusions about the time of death from information about rigor, livor and/or algor mortis of a cadaver. ● organizing the information from a crime scene into a record of notes, sketch and evidence properly collected from the scene with a chain of custody log completed. ● explaining chain of custody in terms of its importance for use of evidence in the courts. 2: The student demonstrates he/she is nearing proficiency by recognizing or recalling specific vocabulary, such as: *Miranda Rights,*

	fourth amendment, fifth amendment, warrant, Frye vs. US, Daubert vs. Merrell Dow, crime scene search, crime scene sketch, rigor mortis, livor mortis, and algor mortis notes, evidence container, labeling evidence, sealing evidence, chain of custody ● performing specific processes, such as ○ evaluating types of containers to correctly collecting evidence. ○ sketching a crime scene. ○ note taking during the processing of a crime scene. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Discuss the relevance of Frye v. US and Daubert v. Merrell Dow Pharmaceutical
- Explain divisions of a crime lab and their responsibilities
- Explain Voir Dire examination and the requirements for expert witness
- Explain what rigor, livor and algor mortis are and the information they tell about a death.
- Discuss how to:
  - Secure a crime scene
  - Search and record the scene
  - Properly collect and label evidence
- Explain Chain of Custody and its importance to law enforcement
- Summarize the essential evidence from a case reading assigned for this unit

Learning Design

WGSD Curriculum -- Forensic Science

Trace Evidence

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned to St. Louis University 1818 SOC 260 Introduction to Forensic Science

Learning Goal	Proficiency Scales
Students will be able to identify the major types of trace evidence, and determine how to collect and examine each.	4: The student demonstrates in in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● explaining how type of glass is determined. ● citing evidence for determination of specie and whether or not death has occurred using hair. ● citing evidence for determination of fiber type. ● explaining the technique used to determine dye/pigment type. ● describing the technique used to examine soil evidence. ● explaining how type of paint is determined. ● identifying the correct procedures for collection of glass, hair, fiber, soil and paint. ● differentiating between class and individual characteristics for all types of trace evidence. 2: The student demonstrates he/she is nearing proficiency by

	recognizing or recalling specific vocabulary, such as: *refractive index, fracturing, first shot, medulla, medullary index, cuticle, cortex, distal, proximal, natural fiber, synthetic fiber, optical properties, polarized light, gas pyrolysis, pigment, layering, soil and density gradient tubes.* ● performing specific processes, such as ○ examining fiber to determine type. ○ examining hair to determine if human or not. ○ identifying the fracture that occurred first in a pane of glass. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Be able to identify the parts of a hair
- Describe the techniques used to examine and identify
    - Type of glass
    - Species of hair
    - Type of fiber
    - Type of dye in fibers and pigment in paints
    - Type of soil
    - Type of glass
- Know the components of paint and explain how they are identified
- Know the standard procedures for collection of crime scene and control samples for glass, soil, fiber, hair and paint
- Determine when the above types of physical evidence have class characteristics only and when they also have individual characteristics

Learning Design

WGSD Curriculum -- Advanced Forensic Science ACC
Crime Scene Investigation
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

This course is aligned to St. Louis University 1818
SOC 260 Introduction to Forensic Science

- High School TILS Strand II: Information Literacy: Students will be able to research and synthesize information; use a variety of digital resources; retrieve and evaluate reliability and accuracy from appropriately cited sources; draw evidence-based conclusions in order to prove comprehension of course objectives.
- High School TILS Strand IV: Tools of the Trade: Students will be able to use appropriate digital tools within and across content areas in preparation for post-secondary experiences.

Learning Goal	Proficiency Scales
Students will be able to draw conclusions about the historical development of crime scene processing.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by • researching and interpreting the information from multiple sources about the events that lead to a crime in a famous case in forensic science prior to 1989. • evaluating the information from resources about the famous case. • explaining thoroughly and concisely the details of the case and how the case would be investigated differently today. 2: The student demonstrates he/she is nearing proficiency by

	• recognizing or recalling specific vocabulary, such as: *chain of custody, digital evidence, investigators, crime scene, database, IAFIS, NIBIN, and CODIS.*
	• performing specific processes, such as
	    ○ researching information about a famous case
	    ○ outlining the information for the case
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Discuss cause and manner of death
- Describe the behavior of a fire using the burn patterns and structure of the building
- Explain the requirements for a fire to be self-sustaining
- Explain the cause for the difference in heat transfer in different materials
- Explain the cause for different heat capacity in fires with different fuels

Learning Design

WGSD Curriculum -- Advanced Forensic Science ACC
Death Investigation
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

This course is aligned to St. Louis University 1818
SOC 260 Introduction to Forensic Science

High School TILS Strand IV: Tools of the Trade: Students will be able to use appropriate digital tools within and across content areas in preparation for post-secondary experiences.

Learning Goal	Proficiency Scales
Students will be able to compare and contrast the work of a medical examiner, forensic anthropologist, forensic artist, and footwear examiner.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● differentiating among manner, cause and mechanisms of death. ● identifying responsibilities of a forensic pathologists. ● explaining the cause of rigor, livor and algor mortis and drawing conclusions from their stages about the time of death of a cadaver. ● analyzing a corpse to establish its identity by ○ determining the bones necessary to determine age, sex and race of a person; ○ determining how to uniquely identify a person from bones; ○ determining the race of a person from a skull; ○ determining the sex of a person from the pelvis or skull;

	○ identifying the types of bones required to determine the approximate height of a person from skeletal remains; ○ identifying the areas of the bones necessary to determine the age of a person from skeletal remains; ○ and explaining how to use a 2-dimensional image of a skull to identify a person. ● drawing correct conclusions about the source of an unknown footwear impression. ● determining the characteristics required to make an outsole unique. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *forensic pathologist, manner, cause and mechanism of death, rigor, livor and algor mortis, forensic anthropologist, forensic art, 2-d and 3-d facial reconstruction, footwear impression, wear patterns, accidental marks, crepe and calendared outsoles.* ● performing specific processes, such as ○ identifying the bones needed to determine age, sex, and race of a person. ○ explaining 2-dimensional facial reconstruction. ○ drawing conclusions about the source unknown footwear impressions. 1: The student demonstrates limited understanding or skill with the learning goal.

Targets

- Describe the basic responsibilities of a medical examiner

• Know the 5 Manners of Death • Know what cause of death and mechanism of death are • Distinguish between cause and mechanism of death • Determine the race, sex, height and approximate age of a set of bones • know how a person may be uniquely identified from their nuclear DNA in skeletal remains • Understand how a skeletal remains can be identified using forensic art techniques • Know the difference between 2-D and 3-D facial reconstruction • Identify the types of outsoles that have individual characteristics when brand new • Determine the characteristics required to make an outsole unique • Know the different types of outsoles • Be able to compare points on two outsole impressions • Be able to collect controls of outsoles
Learning Design

WGSD Curriculum -- Advanced Forensic Science ACC
Firearm Evidence Analysis
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned to St. Louis University 1818 SOC 260 Introduction to Forensic Science

Learning Goal	Proficiency Scales
Students will be able to explain the collection, examination and comparison of firearms and toolmark evidence.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● differentiating between caliber and gauge. ● identifying the areas of a bullet and cartridge case that will have toolmarks on them from a firearm. ● identifying the parts of a firearm that will leave marks on specific places on a bullet or cartridge case. ● explaining how a barrel is rifled and what occurs to make the striations from rifling unique. ● identifying which types of toolmarks are unique. ● determining identity of a toolmark from a set of possible tools. ● explaining how to collect firearms evidence. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *caliber,*

	gauge, firing pin, extractor, ejector, primer cup, cartridge, cartridge case, breechface, striations and toolmark. ● performing specific processes, such as ○ identifying a specific tool that made a specific toolmark from a set of possible tools. ○ restoring the legibility of a damaged serial number using a metal block. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Explain caliber and gauge and understand the differences
- Know the areas on firearms evidence where toolmarks can be and what part of the firearm created the mark
- Know which toolmarks from a firearm have individual characteristics
- Understand why the striations from a barrel on a bullet are unique to each rifled firearm
- Explain how a toolmark is created
- Understand how serial numbers can be restored after being damaged

Learning Design

WGSD Curriculum -- Advanced Forensic Science ACC
Questioned Documents and Crime Scenes
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned to St. Louis University 1818 SOC 260 Introduction to Forensic Science

Learning Goal	Proficiency Scales
Students will be able to analyze basic crime scene and examine and identify sources of questioned documents.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● comparing and contrasting Frye vs. US and Daubert vs Merrell Dow Pharmaceutical. ● explaining Miranda rights and their application to forensic science. ● describing fourth and fifth amendment rights as they apply to forensic science. ● analyzing information about a crime scene to determine if it is primary or secondary scene. ● evaluating information about evidence to determine if it is primary or secondary transfer, transient, pattern, conditional or associative evidence. ● examining a document to determine if it is possible for parts of it to be forged. ● determining the source of a writing by examining the formation of

	the text. ● drawing conclusions about the authenticity of a document by examining the paper, print and application of the print to the document. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *miranda rights, fourth and fifth amendment, primary and secondary crime scenes, primary or secondary transfer, transient, pattern, conditional or associative evidence, questioned document, and exemplar* ● performing specific processes, such as ○ identifying the source of a handwriting. ○ examining the pages of a document for print, text and paper type. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Understand why Frye and Daubert cases are an important part of forensics
- Understand the rights US citizens have with respect to an arrest, search and seizure.
- Understand the types of crime scenes, search techniques, transfer of evidence, and types of evidence
- Identify parts of a document that can be forged, ways they can be forged and how to detect the forgeries

Learning Design

WGSD Curriculum -- Genetics
Biotechnology
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS Science and Engineering Practices 3. Planning and carrying out investigations 4. Analyzing and interpreting data

Learning Goal	Proficiency Scales
Students will be able to apply the concepts of biotechnology.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery with the learning goal as evidenced by ● analyzing DNA restriction fragments, including use of restriction enzymes, and electrophoresis. ● simulating DNA sequencing. ● analyzing gene expression by use of microarrays. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *cloning,*

	plasmids, ligase, sticky ends, restriction enzymes, DNA restriction fragments, antibiotic resistance, polymerase chain reaction, electrophoresis, DNA fingerprinting, DNA microarray, transgenic organisms, GMO.
	
	● performing specific processes, such as:
	  ● performing a restriction digest experiment.
	  ● analyzing a DNA fingerprint.
	  ● modeling restriction enzyme activity.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- DNA cloning yields multiple copies of a gene or other DNA segment, and can be accomplished using bacteria, yeast, or PCR.
- DNA technology allows us to study the sequence, expression, and function of genes.
- Cloning organisms may lead to production of stems cells for research and other applications.
- The practical applications of DNA technology affect our lives in many ways.

Learning Design

WGSD Curriculum -- Genetics
Cells Reproduction
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. High School TILS Strand IV: Tools of the Trade: Students will be able to use appropriate digital tools within and across content areas in preparation for post-secondary experiences.

Learning Goal	Proficiency Scales
Students will be able to explain how cells reproduce and replace themselves by a process known as the cell cycle, including understanding the role the cell cycle plays in growth, repair, and cancer.	4:The student demonstrates in in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● diagramming cell reproduction. ● explaining the regulation of cell reproduction. ● explaining how regulation goes awry to cause cancer. 2: The student demonstrates he/she is nearing the learning goal by ● recognizing or recalling specific vocabulary, such as: c*ell cycle, chromosome, chromatid, interphase, mitosis, cell plate, cleavage furrow, checkpoints, cyclin, cyclin dependent kinases, MPF,*

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density dependent inhibition, cancer, HeLa, metastasis.

performing specific processes, such as:

describing cell reproduction
discussing the regulation of cell division.
describing the development of cancerous cells.

1: The student demonstrates limited understanding or skill with the learning goal.
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Learning Targets

- DNA stores genetic information in a circular chromosome in prokaryotes and in chromosomes in eukaryotes.
- The DNA of chromosomes is replicated during interphase.
- DNA is passed into new cells by the process of mitosis, which consists of prophase, metaphase, anaphase, and telophase.
- Cell division has checkpoints and is regulated by chemicals called cyclins and enzymes known as kinases.
- Loss of regulation of cell division results in cancer.

Learning Design

WGSD Curriculum -- Genetics
Chromosomes
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits from parents to offspring. HS-LS-3: Apply concepts of statistics and probability to explain the variation in distribution of expressed traits in a population.

Learning Goal	Proficiency Scales
Students will be able to model the chromosomes relationship to genes and impact on traits.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by: ● analyzing crossing over events to create gene maps. ● solving sex-linked genetic problems. ● analyzing pedigrees. ● analyzing karyotypes. ● tracing mitochondrial inheritance patterns. ● tracing non-Mendelian epigenetic inheritance patterns. 2: The student demonstrates he/she is nearing the learning goal by ● recognizing or recalling specific vocabulary, such as: *chromosome*

	theory of inheritance, Morgan, linked genes, sex-linked genes, recombinants, cytological maps, sex determination, Barr body, nondisjunction, aneuploidy, genomic imprinting, mitochondrial inheritance.
	
	● performing specific processes, such as:
	  ● solving sex-linked problems.
	  ● describing chromosomal inheritance.
	  ● determining pedigrees.
	  ● analyzing karyotypes.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Mendelian inheritance has its physical basis in the behavior of chromosomes.
- Sex-linked genes exhibit unique patterns of inheritance.
- Linked genes tend to be inherited together because they are located near each other on the same chromosome.
- Alterations of chromosome number or structure cause some genetic disorders.
- Some inheritance patterns are exceptions to standard Mendelian inheritance (for example, imprinting and mitochondrial inheritance.)
- The Hardy-Weinberg equation can be used to test whether a population is evolving.

Learning Design

WGSD Curriculum -- Genetics
DNA
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS: HS-LS-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

Learning Goal	Proficiency Scales
Students will be able to analyze key scientific experiments to trace the discovery of DNA as the molecular basis of inheritance, the structure of DNA, and the method of DNA replication.	4: The student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal as evidenced by ● labeling the components of the DNA molecule ● modeling DNA replication. ● evaluating the results of key scientific experiments. ● predicting the results of key scientific experiments or alterations of key scientific experiments. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *transformation, Hershey-Chase experiment, X-ray crystallography, Watson-Crick model of DNA, DNA replication, origin of replication, polymerases, leading strand, lagging strand, ligase, primer,*

	primase, Okazaki fragments, nuclease, telomerase, histones, nucleosomes.
	
	● performing specific processes, such as:
	  ● outlining the history of the discovery of DNA.
	  ● describing the outcome of key scientific experiments.
	
	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- DNA is the genetic material; an understanding of this is of historical significance in the field of biology.
- DNA structure.
- DNA replication and repair involves many proteins working together.
- A eukaryotic chromosome consists of a DNA molecule packed together with proteins known as histones.

Learning Design

WGSD Curriculum -- Genetics
DNA to RNA of Protein
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS: HS-LS-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. HS-LS3-2: Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurred during replication, and/or (3) mutations caused by environmental factors.

Learning Goal	Proficiency Scales
Students will be able to model the flow of genetic information from DNA to RNA to the protein.	4: The student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: The student demonstrates mastery with the learning goal by ● applying the flow of genetic information to the synthesis of a protein. ● contrasting and comparing the processes of transcription and translation in prokaryotic and eukaryotic organisms. ● analyzing mutations to genetic material. 2: The student demonstrates he/she is nearing proficiency by ● recognizing and recalling specific vocabulary, such as: *Beadle-Tatum experiment, RNA, mRNA, template strand, transcription,*

	translation, codon, genetic code, tRNA, transcription factors, promoter, TATA box, introns, exons, spliceosome complex, anticodon, APE sites, mutations, mutagens.
	
	● performing specific processes, such as:
	    ● transcribing DNA into RNA.
	    ● translating RNA into protein by use of an mRNA codon chart.
	    ● recognizing mutations.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Genes specify proteins via transcription and translation.
- Transcription is the DNA-directed synthesis of RNA.
- Eukaryotic cells modify RNA after transcription.
- Translation is the RNA-directed synthesis of a polypeptide (protein).
- Mutations of one or a few nucleotides can affect protein structure and function.
- While gene expression differs among the domains of life, the concept of a gene is universal among life forms.

Learning Design

WGSD Curriculum -- Genetics
Gene Expression
DRAFT

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<u>High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)</u>

NGSS Science and Engineering Practices

2. Developing and using models

<u>High School TILS Strand IV:</u> Tools of the Trade: Students will be able to use appropriate digital tools within and across content areas in preparation for post-secondary experiences.

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Learning Goal	Proficiency Scales
Students will be able to model gene expression.	4: The student demonstrates an in-depth inference, advanced application or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● describing the regulation of gene expression in prokaryotic and eukaryotic organisms. ● building models that illustrate how bacterial operons work. ● performing bacterial gene transformation experimentally. ● demonstrating the regulation of gene expression.

	2: The student demonstrates he/she is nearing proficiency by: ● recognizing or recalling specific vocabulary, such as: *prokaryotic gene regulation, operon, promoter, operator, repressor, inducible, repressible, eukaryotic gene regulation, histones, methylation, acetylation, epigenetics, transposons, proto-oncogenes, oncogenes, tumor suppressor genes, differentiation, cytoplasmic determinants, homeotic genes, gene families*. ● performing specific processes, such as: ○ labeling models that illustrate bacterial operons. ○ conducting bacterial gene transformation with limited success. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Bacteria often respond to environmental change by regulating transcription.
- Eukaryotic gene expression is regulated at many stages.
- Noncoding RNAs play multiple roles in controlling gene expression.
- A program of differential gene expression leads to the different cell types in a multicellular organism.
- Cancer results from genetic changes that affect cell cycle control.

Learning Design

WGSD Curriculum -- Genetics

Inheritance

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Learning Goal	Proficiency Scales
Students will be able to mathematically demonstrate the inheritance of traits._	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● applying advanced, discipline-specific vocabulary in describing Mendelian genetics. ● solving genetics problems using Punnett Squares. ● making mathematical predictions about phenotypes in future generations. 2: The student demonstrates he/she is nearing the learning goal by ● recognizing or recall specific vocabulary, such as: *Gregor Mendel, dominant, recessive,independent assortment, law of segregation, Punnett square, probability, incomplete dominance, codominance, multiple alleles, epistasis, polygenic inheritance, pedigree.* ● performing specific processes, such as:

	◦ demonstrating independent assortment during gamete formation. ◦ completing a Punnett square. ◦ analyzing genotype and phenotype probabilities. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Mendel used a scientific approach to identify two laws of inheritance: law of segregation and law of independent assortment.
- The laws of probability govern and explain Mendelian inheritance; outcomes of genetic crosses can be predicted using Punnett squares.
- Over time, geneticists have discovered that inheritance patterns are often more complex than simple Mendelian genetics.
- Many human traits follow Mendelian patterns of inheritance.
- Genetic testing and counseling can provide information regarding genetic disorders to prospective parents.

Learning Design

WGSD Curriculum -- Genetics
Large Biological Molecules
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS: HS-LSI-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. HS-LS1-6: Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

Learning Goal	Proficiency Scales
Students will be able to explain the processes regulated by large biological molecules.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● explaining the role of macromolecules in regulating chemical reactions in cells. ● explaining the storage of genetic information. 2: The student demonstrates he/she is nearing the learning goal by ● recognizing or recalling specific vocabulary, such as: *protein, amino acid, peptide bond, 4 levels of protein structure,chaperonin,nucleic acids, DNA, RNA, nucleotide, purine,*

	pyrimidine, and antiparallel. ● performing specific processes, such as ○ labeling major macromolecules in the cell. ○ explaining the Central Dogma of Protein Synthesis. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Distinguish general chemical structure of carbohydrates, lipids, proteins, and nucleic acids
- Identify and label the parts of an amino acid (which is the building block of a protein)
- Investigate the four levels of protein structure (primary, secondary, tertiary, quaternary)
- Give examples of the structure and function of various types of proteins
- Identify and label the parts of a nucleotide (which is the building block of a nucleic acid)
- Compare and contrast the structure of DNA and RNA
- Summarize the Central Dogma of Protein Synthesis

Learning Design

WGSD Curriculum -- Genetics
Meiosis
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS HS LS3-2: Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

Learning Goal	Proficiency Scales
Students will be able to model sexual reproduction at a cellular level.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● diagramming the process of meiosis. ● diagramming the process of crossing over. 2: The student demonstrates he/she is nearing the learning goal by ● recognizing or recalling specific vocabulary, such as: *gametes, variation, karyotype, homologous chromosomes, zygote, meiosis I, meiosis II, crossing over, synapsis, independent assortment.* ● performing specific processes, such as: ○ describing the process of meiosis.

	○ defining the process of crossing over. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Offspring acquire genes from parents by inheriting chromosomes.
- Fertilization and meiosis alternate in sexual life cycles.
- Meiosis reduces the number of chromosome sets from diploid to haploid.
- Genetic variation produced in sexual life cycles contributes to evolution.

Learning Design

WGSD Curriculum -- Meteorology-Severe Weather
DRAFT

Standard (CCSS, State, National, TILS, CREDE, etc.)
NG Standards:HS-ESS 3-1-Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. CCSS: CCSS.ELA-LITERACY.RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales
Students will be able to identify the	4: In addition to score 3.0 performance, the student demonstrates in-

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<td>conditions under which severe weather is likely to occur and will develop specific safety measures for different types of severe weather.</td>
<td>depth inferences and advanced applications that go beyond what was taught.

3: The student demonstrates mastery of the learning goal by

developing an early warning system and safety plan for a major weather event.
demonstrating proficiency in evaluating the severe weather potential associated with a given storm environment, and the subsequent forecasting of severe local weather.
analyzing the similarities and differences of major weather events such as hurricanes, tornados, floods, and thunderstorms.
examining and discussing the human impact of severe weather events.

2: The student demonstrates he/she is nearing proficiency by

recognizing or recalling specific vocabulary, such as: cyclone, hurricane, tornado, supercell, mesocyclone, Saffir-Simpson, Fujita, updraft, downdraft, wind sheer, eye wall, watch, warning.
performing specific processes, such as:

identifying the difference in the various types of severe weather and distinguishing the levels of severity of each (hurricane versus depression).
developing an early warning system and plan with prompting from the teacher.
identifying the human impact of storms.

1: Student demonstrates limited understanding or skill with the learning goal.</td>
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Targets
- Identify factors that create storms like blizzards, tornadoes, cyclones, and thunderstorms   - Create a safety plan for specific storms   - Identify historical times of success and failure in the wake of severe storms   - Examine and debate the occurrences from Hurricane Katrina, Sandy, and other severe storms and the reaction of officials and populations
Learning Design

WGSD Curriculum -- Meteorology -Weather Forecasting
DRAFT

Standard (CCSS, State, National, TILS, CREDE, etc.)
NG Standards:HS-ESS 2-4-Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. 3-5-Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. CCSS: CCSS.ELA-LITERACY.RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales

Students will be able to identify and interpret the multiple ways in which different factors influence weather forecasting.	4: In addition to score 3.0 performance, the student demonstrates in-depth inferences and advanced applications that go beyond what was taught. 3: The student demonstrates mastery of the learning goal by ● synthesizing and making detailed predictions of current and future weather based on station models, humidity, temperature, pressure, and movement of fronts. 2: The student demonstrates he/she is nearing the learning goal by ● recognizing or recalling specific vocabulary, such as: *troposphere, stratosphere, mesosphere, thermosphere, humidity, pressure, temperature, weather, climate, station model.* ● performing basic processes, such as ○ Identifying patterns in humidity, pressure, temperature. ○ Predicting current weather and making a general forecast based on information provided. 1: Student demonstrates limited understanding or skill with the learning goal.

Targets

- Describe the composition and layers of the atmosphere
- Describe the difference between weather and climate
- Interpret a weather map and describe present weather conditions and predict changes in weather over 24 hours Describe conditions associated with frontal boundaries (cold, warm, stationary, and occluded)

Learning Design

Complete Layers of the Atmosphere labeling and identification
Read Chapter 1 and complete questions
Interpreting Weather forecasting online and by hand

WGSD Curriculum -- Meteorology -Weather Patterns
DRAFT

Standard (CCSS, State, National, TILS, CREDE, etc.)
NG Standards:HS-ESS 3-1-Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. 3-6-Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. CCSS: CCSS.ELA-LITERACY.RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales

Students will be able to compare and contrast the effect of solar and terrestrial controls on temperature and wind movement on Earth and predict weather for specific areas.	4: In addition to score 3.0 performance, the student demonstrates in-depth inferences and advanced applications that go beyond what was taught. 3: The student demonstrates mastery of the learning goal by ● using solar and terrestrial controls to predict and explain weather patterns in various regions and cities. ● discussing similarities and differences in climate based on: ○ temperatures in various latitude zones; ○ effects of various air masses; ○ temperature differences at different locations; ○ physical and topographic features of various cities; and ○ wind types for the various cities. 2: The student demonstrates he/she is nearing the learning goal by ● recognizing or recalling specific vocabulary, such as: *global winds and types, movement of winds, Coriolis effect, radiation, convection, conduction, air masses.* ● performing specific processes, such as: ○ Explaining seasons, air mass effects, heating of the earth, effect of topography on climate. ○ Recognizing temperatures vary in different latitude zones. ○ Identifying air masses related to specific areas. ○ Identifying temperature patterns throughout the world. ○ Identifying physical and topographic features in different areas.

	1: Student demonstrates limited understanding or skill with the learning goal.

Targets

- Describe the characteristics and movement across North America of the major air masses and the jet stream
- Explain the primary causes of seasons
- Identify major global wind belts (trade winds, prevailing westerlies, and polar easterlies) and that their vertical components control the global distribution of rainforests and deserts
- Describe the various ways to heat the Earth
- Explain how temperature changes due to topography.

Learning Design

WGSD Curriculum -- Meteorology -Global Warming
DRAFT

Standard (CCSS, State, National, TILS, CREDE, etc.)

NGSS: HS-ESS

2-4-Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
3-1-Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
3-5-Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
3-6-Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
CCSS:
CCSS.ELA-LITERACY.RST.11-12.1
Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
CCSS.ELA-LITERACY.RST.11-12.3
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
CCSS.ELA-LITERACY.RST.11-12.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*.
CCSS.ELA-LITERACY.RST.11-12.7
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
CCSS.ELA-LITERACY.RST.11-12.8

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales
Students will be able to cite evidence of how the climate has changed over time and what factors have influenced these changes.	4: In addition to score 3.0 performance, the student demonstrates in-depth inferences and advanced applications that go beyond what was taught. 3: Student demonstrates mastery of the learning goal by ● evaluating global warming, its effects, and how it is related to the greenhouse effect and human activity. ● describing factors that change climates on long periods. ● evaluating evidence presented by various sources on the causes of climate change. ● analyzing the possible futures of the Earth due to climate change. 2: The student demonstrates he/she is nearing proficiency in the learning goal by ● recognizing or recalling specific vocabulary, such as: *CO2, climate change, emissions, fossil fuels, global warming, greenhouse effect.* ● performing basic processes, such as: ○ describing the changes occurring in the climate and giving simple reasoning for the changes. 1: The student demonstrates limited understanding or skill with the learning goal.

Targets

- Evaluate the validity and reliability in published materials of the effects of global warming
- Use various sources to develop and defend an opinion of global warming
- Understand natural and man- made influences of global warming
- Discuss and analyze similarities and causes of the Greenhouse effect and global warming

Learning Design

WGSD Curriculum -- Meteorology-- Ocean Currents
DRAFT

Standard (CCSS, State, National, TILS, CREDE, etc.)
NG Standards: HS-ESS 2-4-Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. 3-1-Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. CCSS: CCSS.ELA-LITERACY.RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales

Students will be able to analyze the positive and negative global impact of oceanic currents in reference to climate patterns and human impacts.	4: In addition to score 3.0 performance, the student demonstrates in-depth inferences and advanced applications that go beyond what was taught. 3: The student demonstrates mastery of the learning goal by ● connecting the movements of oceanic current to global climate patterns. ● describing in detail the motion of upwelling and the effects on climate. ● understanding the impact of ocean currents on human events (slave trade, hurricane landfall, population settling). 2: The student demonstrates he/she is nearing the learning goal by ● recognizing or recalling specific vocabulary, such as: *Gulf Stream, upwelling, El Nino, current, convection current, gyre, ocean temperature, ocean salinity.* ● performing specific processes, such as: ○ explaining the layered structure of the oceans. ○ explaining the generation of horizontal and vertical ocean currents. ○ explaining how currents distribute heat around the globe. ○ explaining how currents interact with climate and weather. 1: Student demonstrates limited understanding or skill with the learning goal.

Targets
• Identify the various oceanic currents • How do the currents affect the climates/weather • Understand how the currents can be changed and the effects on global climate
Learning Design

WGSD Curriculum -- Microbiology -- Bacterial Cell Structure
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS Science and Engineering Practices 5. Using mathematics and computational thinking

Learning Goal	Proficiency Scales
Students will be able to describe bacterial cell structure and reproduction.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates evidence mastery of the learning goal by ● contrasting Gram positive and Gram negative bacterial cells. ● tracing the three types of gene transfer in bacteria. ● diagramming spore formation. 2: The student demonstrates he/she is nearing the learning goal by: ● recognizing or recalling specific vocabulary,such as *surface area/volume ratio, plasma membrane, cytoplasm, phospholipid bilayer, diffusion, osmosis, plasmolysis, plasmoptysis, endocytosis, exocytosis, peptidoglycan, Gram positive, Gram negative, capsule, slime layer, glycocalyx, pili, flagella, genome, transformation, transduction, conjugation, spore.* ● performing specific processes, such as

	○ calculating surface area/volume ratio. ○ labeling a bacterial cell. ○ describing bacterial cell structure and reproduction. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Calculate surface area to volume ratio and discuss why a high SA/Vol ratio in bacteria is important
- Discuss and diagram methods of transport of materials into and out of bacteria cells
- Label the components of and contrast the cell wall in Gram + and Gram – bacteria
- Compare the various coatings on bacteria (capsule, slime layer, glycocalyx)
- Diagram and explain how a flagellum works
- Diagram and explain binary fission
- Diagram and explain gene transfer in bacteria by conjugation, transformation, and transduction
- Diagram and explain spore formation and how it aids in survival of bacteria

Learning Design

WGSD Curriculum -- Microbiology -- Control of Microbial Growth
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS Science and Engineering Practices 1. Asking questions (for science) and defining problems (for engineering)

Learning Goal	Proficiency Scales
Students will be able to manipulate microbial growth.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the goal by ● differentiating means in the control of microbial growth: physically, chemically, and radiological methods. ● comparing the effectiveness of various antibiotics. 2: Student demonstrates he/she is nearing the learning goal by ● recognizing or recalling specific vocabulary, such as: *filtration, HEPA filter, Pasteurization, incineration, canning, desiccation, radiation, chemical food preservatives, halogens, chlorine, bromine, heavy metals, phenolics, antibiotics, antibiotic resistance*. ● performing specific processes, such as: ○ listing the physical and chemical means of microbe control. 1: Student demonstrates limited understanding or skill with the learning

	goal.

Learning Targets
• Describe the control of bacteria by various physical means (filtration, heat, cold, desiccation, radiation) • Describe the control of bacteria by various chemical antimicrobial agents (salt, sugar, acids, nitrates, disinfectants, antiseptics) and antibiotics)
Learning Design

WGSD Curriculum -- Microbiology -- Factors Affecting Bacterial Growth DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS Science and Engineering Practices 3. Planning and carrying out investigations

Learning Goal	Proficiency Scales
Students will be able to analyze factors affecting bacterial growth.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the goal by ● diagramming a bacterial growth curve. ● performing a serial dilution. ● predicting the reaction of bacteria to being placed in hypertonic, hypotonic, and isotonic solutions. 2: Student demonstrates he/she is nearing the learning goal by ● recognizing specific vocabulary, such as: *enumeration or doubling time, lag, log, stationary, decline, batch culture, continuous culture, viable plate count method, serial dilution, psychrophiles, thermophiles, mesophiles, catalase, halophiles, neutrophiles, acidophiles, alkalophiles, hypertonic, hypotonic.*

	• performing specific processes, such as
	  ○ listing various environmental situations in which bacteria may live.
	  ○ describing factors affecting bacterial growth.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Diagram and label the bacterial growth curve
- Discuss various methods of enumerating bacteria, with special emphasis on the serial dilution
- Discuss factors such as temperature, oxygen, salinity, pH that affect bacterial growth

Learning Design

WGSD Curriculum -- Microbiology -- Individual Discoveries
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS Science and Engineering Practices 8. Obtaining, evaluating, and communicating information

Learning Goal	Proficiency Scales
Students will be able to evaluate the contribution of individuals' discoveries in the field of microbiology.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the goal by: ● applying discipline-specific vocabulary to describe the history of major microbiological discoveries. ● evaluating the contributions of major microbiologists to the field of microbiology. ● tracing the classification of microorganisms using the 6-kingdom system and domains. 2: Student demonstrates he/she is nearing the learning goal by: ● recognizing or recalling specific vocabulary, such as: *classification, domain, kingdoms, spontaneous generation, biogenesis, endosymbiont theory, bacillus, coccus, spirilla, mycoplasma, anaerobic, aerobic, cilia, species, type, Bergey's manual.* ● identifying the contributions of major microbiologists to the field of microbiology.

	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe the contributions to the field of microbiology of these microbiologists: Leewenhoek, Hooke, Needham, Spallanzani, Pasteur, Koch, Lister, Jenner
- Diagram and explain the 3 biological domains, emphasizing recent rRNA evidence used to establish domains
- Diagram and explain the 6 biological kingdoms
- Diagram and explain the evolution of multicellular organisms by endosymbiosis

Learning Design

WGSD Curriculum -- Microbiology -- Infection and Immune Response
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS Science and Engineering Practices 1. Asking questions (for science) and defining problems (for engineering)

Learning Goal	Proficiency Scales
Students will be able to predict how the human body responds to infection.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the goal by: ● applying Koch's postulates to analyze disease transmission. ● identifying virulence factors. ● mapping and tracing the orchestration of the immune response with various participating cells. 2: Student demonstrates he/she is nearing the learning goal by: ● recognizing or recalling specific vocabulary, such as: *Koch's postulates, virulence factors, adhesion factors, disease progression, routes of disease transmission, sign, symptom, vector, nosocomial infection, endemic, epidemic, pandemic, morbidity, mortality, quarantine, antigen, antibody, T-cells, B-cells, antigen presenting cells, macrophages.* ● performing specific processes, such as

	○ identifying portals of entry for various pathogens. ○ comparing the terms epidemic, pandemic, and endemic. ○ distinguishing between an antigen and antibody. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- List and explain Koch's postulates
- Explain how virulence factors enable pathogens to enter a host
- Explain the stages of disease in a host
- List and describe 5 portals of entry into the human body for diseases
- Contrast various ways that epidemiologists track and monitor diseases
- Trace the development of various types of white blood cells that are involved in the immune response
- Explain the role of the following cells in the the immune response: antigen presenting cells, B-cells, T-cells, memory cells

Learning Design

WGSD Curriculum -- Microbiology -- Microorganisms
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS Science and Engineering Practices 8. Obtaining, evaluating, and communicating information.

Learning Goal	Proficiency Scales
Students will be able to differentiate microorganisms: bacteria, fungi, algae, protozoans, and viruses.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates an understanding of various type of microorganisms and viruses by: ● analyzing the lytic and lysogenic cycles of a bacteriophage. ● contrasting vertical and horizontal transmission of viral disease. 2: Student demonstrates he/she is nearing the learning goal by: ● recognizing or recalling specific vocabulary, such as: *virus, capsid, envelope, host, lytic cycle, lysogenic cycle, bacteriophage, restriction enzymes, prophage, pathogen, horizontal transmission, vertical transmission, viroid, prion, vaccination, eubacteria, archaebacteria, algae, fungi, protozoans, micrometer.* ● performing specific processes, such as: ○ recognizing several viral and representative microbe-caused diseases.

	○ describing the characteristics of various microorganisms. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe the characteristics of bacteria, fungi, algae, protozoans, and viruses
- Diagram and explain the lytic and lysogenic cycles of a bacteriophage
- Explain the transmission, symptoms, and treatment of various viral infections

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Learning Design

WGSD Curriculum -- Microbiology -- Microorganisms and Human Disease
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

High School TILS Strand II: Information Literacy: Students will be able to research and synthesize information; use a variety of digital resources; retrieve and evaluate reliability and accuracy from appropriately cited sources; draw evidence-based conclusions in order to prove comprehension of course objectives.

NGSS Science and Engineering Practices
1. Asking questions (for science) and defining problems (for engineering.

8. Obtaining, evaluating, and communicating information.

Learning Goal	Proficiency Scales
Students will be able to cite evidence supporting the relationship of microorganisms to human disease.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the goal by: ● describing the causative agent, symptoms, transmission, treatment, and prevention of various bacterial and viral diseases. 2: Student demonstrates he/she is nearing the learning goal by: ● recognizing or recalling specific vocab, such as: *Flu, HIV, typhoid, bubonic plague, peptic ulcers, syphilis, Ebola, meningococcal disease, tuberculosis, tetanus, rabies, diphtheria, pertussis, tetanus.* ● performing specific processes, such as: ○ identifying and describing specific human diseases. ○

	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe the stages of a disease
- Describe the transmission, symptoms, prevention, and treatment of various viral and bacterial diseases

Learning Design

WGSD Curriculum -- Microbiology -- Safe Lab Techniques
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS Science and Engineering Practices 3. Planning and carrying out investigations

Learning Goal	Proficiency Scales
Students will be able to utilize specialized equipment and techniques to study bacteria.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the goal by ● modeling specific behaviors relevant to safe microbiological techniques. 2: Student demonstrates he/she is nearing the learning goal by ● recognizing or recalling specific vocabulary, such as: *aseptic technique, antiseptics, disinfectants, agar, pour plate method, culture media, autoclave, pipette, inoculating loop, Petri dish, pure culture.* ● performing specific processes, such as: ○ identifying safe and appropriate lab techniques. ○ demonstrating proper care and use of the microscope in the lab setting. 1: Student demonstrates limited understanding of skill with the learning

	goal.

Learning Targets

- Identify and explain safe/unsafe lab techniques
- Explain the use of the autoclave in the sterilization of media and equipment
- Prepare agar, Petri dishes, and bacterial stock culture tubes using aseptic technique
- Describe how the scientific method was used in early discoveries of microorganisms
- Compare/contrast the types of microscopes that are used to study microorganisms
- Describe the procedure and perform four types of staining techniques used to visualize bacteria: simple stain, Gram stain, negative stain, endospore stain

Learning Design

WGSD Curriculum -- Microbiology -- Water Safety
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS Science and Engineering Practices 6. Constructing explanations (for science) and designing solutions (for engineering). 7. Engaging in argument from evidence

Learning Goal	Proficiency Scales
Students will be able to develop a logical argument supporting the use of water testing and treatment to reduce bacterial numbers in water, making the water potable or safe for recreational use.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the goal by: ● modeling drinking water treatment and sewage treatment techniques. ● analyzing costs and benefits of water and sewage treatment. ● developing arguments for public health policy. 2: Student demonstrates he/she is nearing the learning goal by: ● recognizing or recalling specific vocabulary, such as: *potable water, water treatment plant, sewage, sewage treatment plant, fecal coliforms, indicator organism, E.coli, septic tank, water-borne diseases, water standards*. ● listing sources of water pollution. ● identifying appropriate water testing strategies.

	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe sources of microbial water pollution
- Describe and explain a water treatment protocol used by a municipal a water treatment plant
- Describe several sewage treatment protocols
- Define the phrase “indicator organism” with respect to water treatment
- Explain the consequences of inadequately treated water

Learning Design

WGSD Curriculum -- Physics-Conceptual
Electricity and Magnetism
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS: 2-4:Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. 2-5: Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. 3-5:Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. CCSS: CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales
Students will be able to analyze the interaction of electrical and magnetic forces.	4: Student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

	3: Student demonstrates mastery of the learning goal by
	● using Coulomb's law to mathematically demonstrate electrostatic forces between particles.
	● using Ohm's law to explain the relationship between voltage, resistance, and current.
	● discriminating among the types of charges, ways to charge materials, and factors that affect charges, such as resistance etc.
	● demonstrating the essential relationship between electric current and magnetic fields
	● demonstrating that an electric current can produce an electric field and a changing magnetic field can produce an electric current.
	
	2: Student demonstrates he/she is nearing proficiency by
	
	● recognizing or recalling specific vocabulary, such as *domains, poles, charge, conservation, excess, field, Coulomb's Law, inverse square, attraction, repulsion, electrons, protons, neutrons, nucleus, Ohm's Law, resistance, current, voltage, electric potential energy, power, circuit, conductor, insulator, generator, compass, induction, and mass.*
	
	● performing processes, such as:
	    ● explaining the essentials of the effects of the inverse square law on two charged particles.
	    ● representing electric and magnetic fields using field lines.
	    ● explaining how electrons flow through a circuit and how series and parallel circuit differ.
	    ● describing magnetic and electric fields.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe the fundamental rule at the base of all electrical phenomena
- Explain how an object becomes electrically charged
- Use Coulomb’s law to understand the relationship among force, charge and distance
- Describe two ways electric charges can be transferred
- Describe what happens when a charged object is placed near a conducting surface
- Describe how to measure the strength of an electric field at different points
- Illustrate electric fields with vectors and by electric field lines
- Describe the flow of electric charge, magnetic field, and a current-carrying wire
- Give examples of voltage sources
- Analyze the relationship among the factors that affect the resistance of a wire
- Describe Ohm’s law
- Distinguish between DC and AC and how AC is converted to DC
- Explain how current can be turned on or off in a circuit, and how electrical devices can be connected in a circuit
- Describe the characteristics of a series and parallel circuit
- Explain how magnetic poles affect each other
- Describe the magnetic field in the space around a magnet
- Describe how a magnetic field exerts a force on a charged particle in the field
- Describe how current is affected by a magnetic field
- Create a motor

Learning Design

WGSD Curriculum -- Physics-Conceptual
Energy
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

NGSS-HS-PS:
3-1:Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
3-3:Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*
CCSS:
CCSS.ELA-LITERACY.RST.11-12.3
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
CCSS.ELA-LITERACY.RST.11-12.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*.
CCSS.ELA-LITERACY.RST.11-12.8
Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales
Students will be able to categorize energy sources and demonstrate an understanding of the Law of Conservation of Energy	4: Student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the learning goal by

	• modeling multiple sources of energy.
	• modeling the Law of Conservation of Energy.
	• calculating the conservation of potential and kinetic energy in a given system.
	• demonstrating energy transfer.
	
	2: Student demonstrates he/she is nearing proficiency by
	
	• recognizing or recalling specific vocabulary, such as: *conservation, potential, kinetic, height, mechanical, nonmechanical, gravitational, efficiency, work, heat, sound, friction, static, and power.*
	
	• performing basic processes, such as:
	    ○ listing and describing sources and transfers of energy.
	    ○ describing Law of Conservation of Energy with teacher supplying terms.
	    ○ planning and building a device that demonstrates some energy transfer with some success.
	
	1. Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Define and describe work
- Define and describe power
- State the two forms of mechanical energy and explain how energy is changed in a closed system
- State three forms of potential energy
- Describe how work and potential and kinetic energy are related verbally and mathematically
- State the law of conservation of energy and describe the transfer of energy in a system
- Build a model that demonstrates energy transfer

Learning Design

WGSD Curriculum -- Physics-Conceptual
Forces and Interaction
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS: 2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. 2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. 2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.* 2-4 Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. CCSS: CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales
Students will be able to model the motion	4: Student demonstrates an in-depth inference or advanced application, or

of an object.	innovates with the learning goal. 3: Student demonstrates mastery of the learning goal by ● describing and manipulating mathematically the relationships among acceleration, mass, velocity, and force using ○ v=d/t ○ $d=1/2at^2$ ○ $a= v_i-v_f/t$ ○ F=ma ○ p=mv ○ Conservation of momentum, and ○ Law of Gravitation. ● designing, evaluating, and refining a model that minimizes the force of a collision between objects. 2: Student demonstrates he/she is nearing proficiency in the learning goal by ● recognizing or recalling specific vocabulary, such as: *velocity*, *inertia, mass, newton, weight, force, acceleration, origin, equilibrium, conservation, momentum, impulse, change in momentum.* ● performing basic processes, such as: ● exhibiting an understanding of Newton's 3 laws of motion. ● constructing free-body diagrams. ● conceptualizing and categorizing collisions including conservation of momentum but are unsuccessful at analyzing the success or failure of the model. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe the relationship between mass and inertia
- Explain how the law of inertia applies to objects in motion
- State the relationship between acceleration and net force and mass in terms of Newton’s 2nd law
- List the factors that affect the movement of an object, such as friction and air resistance
- Analyze the role of mass and force along with velocity in momentum through collisions
- Explain why an impulse is greater when an object bounces than when the same object comes to a sudden stop
- Describe and calculate how the conservation of momentum applies to collisions

Learning Design

WGSD Curriculum -- Physics-Conceptual
Space Systems
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-ESS: 1-1: Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. 1-2 Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. 1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements. 1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. CCSS: CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales
Students will be able to demonstrate the distinct properties, composition, structure, and interactions of the bodies that comprise	4: Student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the learning goal by

our universe.	- developing a model of the life span of a star that includes the role of nuclear fusion, production of elements, and the effects on the Earth. - explaining light shift, movement of galaxies, and the similarities and differences of matter in the universe. - using mathematical representations (Kepler and Newtonian) to predict motion of orbiting objects. 2: Student demonstrates he/she is nearing proficiency by - recognizing or recalling specific vocabulary, such as: *orbit, field, centripetal, force, acceleration, radius, circumference, fusion, fission, star, spectroscopy, light shift, Kepler, Newtonian, and period.* - performing basic processes, such as: - describing the life span of stars in general, rather than specific terms. - defining the Big Bang Theory. - describing the motion and causes of orbiting objects without using mathematical representations. 1: Student demonstrates limited understanding or skill with the learning goal.

Objectives

- Describe current efforts and technologies used to study the universe explain how their research impacts human activity
- Apply Kepler's Laws and Newton's Universal Law of Gravitation to planetary motion

- Describe the life cycle of stars(nebulae, protostar, red giants, white dwarfs, neutron stars, pulsars, supernovas, black holes), and the role of gravity in their stellar evolution
- Explain the relationship between absolute magnitude and surface temperature of stars using the Hertzsprung-Russell diagram
- Use bright and dark line spectra to determine the movement and elemental composition of stars
- Describe the structure and evolution of galaxies using their visible characteristics
- Explain how the Doppler effect supports the concept of an expanding universe and the Big Bang Theory

Learning Design

WGSD Curriculum -- Physics-Conceptual
Waves
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS: 4-1:Use mathematical representations to support a claim regarding relationships among the frequency, wavelength,and speed of waves traveling in various media. 4-2: Evaluate questions about the advantages of using a digital transmission and storage of information. 4-3: Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. 4-4:Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. 4-5: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.* CCSS: CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. CCSS.ELA-LITERACY.RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Learning Goal	Proficiency Scales

Students will be able to deduce the function and purpose of a wave based on its physical characteristics and behavior.	4: Student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the learning goal by ● representing waves mathematically ($v=f\lambda$) and explaining the relationship of the variables. ● relating the frequency to the wavelength on the electromagnetic spectrum. ● describing the process by which energy (digital information) is transferred from source to receiver. 2: Student demonstrates he/she is nearing proficiency by ● recognizing and recalling specific vocabulary, such as: *reflection, refraction, diffraction, interference, crest, trough, medium, frequency, period, velocity, hertz, Doppler shift, electromagnetic, spectrum, wavelength, wave speed, longitudinal, tranverse, stationary, and amplitude.* ● performing basic processes, such as ○ labeling and defining all parts of a wave. ○ describing the order of EM spectrum. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe the characteristics and properties of waves
- Describe how to calculate the speed of a wave
- Distinguish between the two types of waves

- Discriminate between sound waves and electromagnetic waves
- Explain the Doppler Effect
- Manipulate the electromagnetic spectrum based on frequency and wavelength
- Investigate waves as a means of digital storage and transmission and contrast with other means
- Summarize various types of interference

Learning Design

WGSD Curriculum -- Physics A
Dynamics
DRAFT

<u>High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)</u>

NGSS: HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object its mass, and its acceleration.
NGSS: HS-PS2-2: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

Learning Goal	Proficiency Scales
Students will be able to relate acceleration to mass, velocity, and the forces that affect motion.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● analyzing situations in which an object remains at rest or moves with a constant velocity and momentum (p=mv). ● describing the relationship between the net force that acts on an object and the resulting change in the object's velocity and momentum. ● Identifying the action and reaction pairs of forces (impulses) on objects that are interacting. 2: The student demonstrates he/she is nearing proficiency in the learning goal by

	● recognizing or recalling specific vocabulary, such as: *inertia, mass, force, net force, acceleration, momentum, equilibrium, conservation, momentum, impulse, change in momentum, free-body diagram, Newton's Laws of Motion.* ● performing basic processes, such as ○ constructing free-body diagrams. ○ exhibiting an understanding of Newton's Three Laws of Motion. ○ calculating the impulse applied to an object as it relates to the change in momentum. ○ conceptualizing and categorizing collisions including conservation of momentum but are unsuccessful at analyzing the success or failure of the model. 1: The student demonstrates limited understanding or skill with the learning goal.

<u>Learning Targets</u>

- Calculate momentum of objects in motion (p=mv)
- Calculate the Impulse acting on objects while an object is undergoing a change in momentum (J=
- Describe the relationship between mass and inertia
- State the relationship between acceleration and net force and mass in terms of Newton's 2nd law
- List the factors that affect the movement of an object, such as friction and air resistance
- Analyze the role of mass and force along with velocity in momentum through collisions
- Explain why an impulse is greater when an object bounces than when the same object comes to a sudden stop
- Describe and calculate how the conservation of momentum applies to collisions
- draw a well-labeled, free-body diagram showing all forces that act on the object;
- determine a state of equilibrium as the absence of a net force or impulse;
- describe state of motion in terms of constant momentum and zero acceleration; and

- apply Newton's 1st Law of Motion (Law of Inertia).
- draw a well-labeled, free-body diagram showing an imbalance of forces that act on the object;
- understand how Newton's Second Law of motion($\Sigma F = ma$) applies to an object subject to forces such as gravity, the pull of strings, or contact forces;
- calculate the acceleration and the change in momentum that results when a constant net force acts over a specified time interval resulting from a impulse;
- determine the size and direction of the net force, or of one of the forces that makes up the net force, from kinematic measurements of an object in motion; and
- apply Newton's 2nd Law of Motion (Law of Force).
- explain the resulting changes in velocity and momentum of the objects interacting or involved in collisions;
- calculate the acceleration and momentum change of objects interacting or involved in collisions;
- apply linear momentum conservation to one-dimensional elastic, inelastic and perfectly inelastic collisions; and
- apply Newton's Third Law of Motion.

Learning Design

WGSD Curriculum -- Physics A

Electrostatics

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS: HS-PS2-4: Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. **NGSS: HS-PS2-5:** Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. **NGSS: HS-PS3-5:** Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

Learning Goal	Proficiency Scales
Students will be able to analyze the electrostatic interaction of electrical charges through electrical fields.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The students demonstrates mastery of the learning goal by: ● describing the types of charge and the attraction and repulsion of charges. ● using Coulomb's law to calculate the size and direction of the electrical force on a positive or negative charge due to other specified point charges. ● analyzing the motion of a specified charge and mass under the influence of an electrostatic force. ● modeling the concept of an electric field. ● modeling the concept of electric potential.

	2: Student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *electric charge, electric force , Coulomb's Law, attraction, repulsion, electrons, protons, neutrons, electric potential, electric potential energy, potential difference, voltage.* ● performing specific processes, such as ○ explaining the essentials of the effects of the inverse square law on two charged particles. ○ demonstrating the essential relationship between electric charge, electric field strength and electrostatic forces. ○ representing electric fields using field lines. 1: The student demonstrates limited understanding or skill with the learning goal.

<u>Learning Targets</u>

- Describe the fundamental rule at the base of all electrical phenomena
- Explain how an object becomes electrically charged
- Use Coulomb's law to understand the relationship among force, charge and distance
- Describe two ways electric charges can be transferred
- Describe what happens when a charged object is placed near a conducting surface
- Describe how to measure the strength of an electric field at different points
- Illustrate electric fields with vectors and by electric field lines
- define it in terms of the force on a test charge;
- describe and calculate the electric field of a single point charge;
- calculate the size and direction of the electric field produced by two or more point charges;
- calculate the size and direction of the force on a positive or negative charge placed in a specified field;

- interpret an electric field diagram; and
- analyze the motion of a specified charge and mass in a uniform electric field.
- understanding the concept of electric potential, so that they can
- determine the electric potential (in volts) in the vicinity of one or more electric charges;
- calculate the electrical work done on a charge or use conservation of energy to determine the speed of a charge that moves through a specified potential difference;
- determine the direction and approximate magnitude of the electric field at various positions given a sketch of equipotentials;
- calculate the potential difference between two points in a uniform electric field, and state which point is at the higher potential;
- calculate how much work is required to move a test charge from one location to another in the field of fixed point charges; and
- calculate the electrostatic potential energy of a system of two or more point charges, and calculate how much work is required to establish the charge system.

Learning Design

WGSD Curriculum -- Physics A

Work, Energy, Power

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS: HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. **NGSS: HS-PS3-2:** Develop and use ;models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.

Learning Goal	Proficiency Scales
Students will be able to relate an object's energy to the amount of work performed on or by the object.	4:The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Students demonstrate mastery of the learning goal by: ● calculating the work performed by a specified constant force on an object that undergoes a specified displacement and relate the amount of work to energy transferred; ● determining the amount of mechanical energy transferred during work, when non-conservative forces are absent (The Principle of Conservation of Mechanical Energy). ● calculating the potential and kinetic forms of mechanical energy that an object has by virtue of its mass, speed and position; and ● calculate the power required to maintain the motion of an object. ● calculating the work performed by a force. ● applying the Law of Conservation of Energy to situations where change is occurring.

	2: The student demonstrates he/she is nearing proficiency by
	
	• recognizing or recalling specific vocabulary, such as: *conservation, potential, kinetic, height, mechanical, nonmechanical, gravitational, efficiency, work, heat, sound, friction, static, and power.*
	
	• performing basic processes, such as:
	    ○ listing and partially describing sources and transfers of energy.
	    ○ describing LOCOE with teacher supplying terms.
	    ○ planning and building a device that demonstrates some energy transfer with some success.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Define and describe work
- Define and describe energy
- Define and describe power
- State the two forms of mechanical energy and explain how energy is changed in a closed system
- State three forms of potential energy
- Describe how work and potential and kinetic energy are related verbally and mathematically
- State the law of conservation of energy and describe the transfer of energy in a system
- Build model that demonstrates energy transfer

Learning Design

WGSD Curriculum -- Physics A
Kinematics
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS: HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object its mass, and its acceleration.

Learning Goal	Proficiency Scales
Students will be able to model motion of an object as it relates to its position, velocity, and acceleration.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● describing the relationships among position, velocity and acceleration. ● analyzing displacement, velocity and acceleration vectors. ● understanding the motion in a uniform gravitational field. 2: The student demonstrates he/she is nearing proficiency in the learning goal by ● recognizing or recalling specific vocabulary, such as *displacement, velocity, acceleration, vector, components, resultant, frame of reference.* ● Performing basic processes, such as ○ producing and extrapolating data from graphs of position vs.

	time and velocity vs. time. ○ illustrating an understanding of motion with reference to kinematic equations. ○ understanding the motion in a uniform gravitational field for projectiles launched horizontally as well as at angles regarding the horizontal and vertical components of position, velocity and acceleration. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Calculate displacement, velocity and acceleration of objects moving in one and two dimensions
    - graphically represent a moving object's position, velocity and acceleration as functions of time, and identify or sketch graphs of these motions;
    - use the kinematic equations to solve problems involving motion with constant velocity and constant acceleration; and
    - describe in words the motion, and subsequent changes in motion, for objects moving with a constant velocity or with constant acceleration.
    - add and subtract displacement, velocity and acceleration vectors in one and two dimensions to find the resultant vector; and
    - determine the components of a given displacement, velocity and acceleration vector along a specified, mutually perpendicular axes.
    - write down expressions for the horizontal and vertical components of position, velocity and acceleration as functions of time, and sketch or identify graphs of these components; and
    - use kinematic equations in analyzing the motion of a projectile that is projected with an arbitrary initial velocity.

Learning Design

WGSD Curriculum -- Physics A

Current Electricity

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS: Science and Engineering Practices: Analyze data using tools, technologies, and/or models (eg.computational, mathematical) in order to make valid and reliable scientific claims or create an optimal design decision.

Learning Goal	Proficiency Scales
The student will be able to analyze the movement of electrical charges and the resulting energy transferred by the current.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● predicting the rate and flow of positive and negative charges when given the size and direction of the electric current. ● relating electric current and voltage for a resistor. ● describing how the resistance of a resistor depends upon its length and cross-sectional area and applying this result in comparing current flow in resistors of different material or different geometry. ● deriving expressions that relate the electric current, voltage, and resistance to the rate at which heat is produced when current passes through a resistor. ● determining the ratio of the voltages across resistors connected in series or the ratio of the currents through resistors connected in parallel. ● calculating the voltage, current, and power dissipation for any

	resistor with a single power supply. ● showing correct methods of connecting voltmeters and ammeters into circuits. 2: Student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *electric current, electric resistance, electric power, voltage difference, amp, volt, ohm, Ohm's Law, circuit, series, parallel, watts.* ● performing specific processes, such as ○ building electrical circuits where the resistors are attached to a power source in both series and parallel configurations. ○ measuring the voltage drops and electrical current using meters placed in an electrical circuit. ○ calculating the electrical power used in running various resistors connected in both series and parallel configurations. ○ applying Ohm's law. ○ identifying on a circuit diagram whether resistors are in series or in parallel. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe the flow of electric charge in a current-carrying wire

- Give examples of voltage sources
- Analyze the relationship among the factors that affect the resistance of a wire
- Describe Ohm's law
- Distinguish between DC and AC and how AC is converted to DC
- Explain how current can be turned on or off in a circuit, and how electrical devices can be connected in a circuit
- Describe the characteristics of a series and parallel circuit

Learning Design

WGSD Curriculum -- Physics A
Conceptual-Space Systems
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

NGSS: HS-PS2-4: Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
NGSS: HS-ESS1-4: Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

Learning Goal	Proficiency Scales
Students will be able to prove relational properties of objects in our solar system.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● demonstrating an understanding of Newton's Law of Universal Gravitation. ● explaining the motion of an object in orbit under the influence of gravitational forces. ● using mathematical representations (Kepler and Newtonian) to predict motion of orbiting objects. 2: Student demonstrates he/she is nearing proficiency by ● Recognizing or recalling specific vocabulary, such as: *orbit, field, centripetal, force, acceleration, radius, circumference, Kepler, Newtonian, and period* ● Performing basic processes, such as:

	○ describing the motion and causes of orbiting objects without using mathematical representations. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Applying Kepler's Laws and Newton's Universal Law of Gravitation to planetary motion
- determining the gravitational force that one spherically symmetrical mass exerts on another; and
- determining the strength of the gravitational field at a specified point outside a spherically symmetrical mass.
- recognizing 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; and
- deriving and applying the relations among kinetic energy, potential energy, and total energy for such an orbit.

Learning Design

WGSD Curriculum -- Physics A
Waves
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-PS: 4-1:Use mathematical representations to support a claim regarding relationships among the frequency, wavelength,and speed of waves traveling in various media. 4-2: Evaluate questions about the advantages of using a digital transmission and storage of information. 4-3: Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. 4-4:Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. 4-5: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*

Learning Goal	Proficiency Scales
Students will be able to deduce the function and purpose of a wave based on its physical characteristics and behavior.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● modeling the physical characteristics of a traveling wave. ● describing the behavioral characteristics of a traveling wave. ● describing the conditions under which the waves reaching an observation point from two or more sources will all interfere. ● relating the amplitude produced by two or more sources that

	interfere to the amplitude produced by a single source.
	2: The student demonstrates he/she is nearing proficiency by
	
	● recognizing and recalling specific vocabulary, such as: *reflection, refraction, diffraction, interference, frequency, period, velocity, Doppler shift, and amplitude.*
	
	● Performing basic processes, such as
	    ● labeling and define all parts of a wave.
	    ● describing the order of EM spectrum.
	    ● summarizing various types of interference.
	    ● describing the interaction of waves in terms of reflection, refraction and diffraction of a wave at a boundary between two media.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describing the characteristics and properties of waves
- Describing how to calculate the speed of a wave
- Distinguishing between the two types of waves
- Discriminating between sound waves and electromagnetic waves
- Explaining the Doppler Effect
- Manipulating the electromagnetic spectrum based on frequency and wavelength
- Investigating waves as a means of digital storage and transmission and contrast with other means
- Identifying graphs that represent traveling waves and determine the amplitude, wavelength, and frequency of a wave from such a graph;
- Applying the relationship ($v=f\lambda$) among velocity, frequency, and wavelength for a traveling wave; and
- Describing qualitatively what factors determine the speed of waves through space in both longitudinal and transverse types.

• Understanding qualitatively the Doppler effect for waves in order to explain why there is a frequency shift in both the moving-source and moving-observer case; and
<u>Learning Design</u>

WGSD Curriculum -- Physics A

Magnetism

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS: HS-PS2-5: Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

Learning Goal	Proficiency Scales
Students will be able to analyze the interaction of magnets and magnetic fields.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by: ● determining the force experienced by a charged particle in a magnetic field. ● understanding the force exerted on a current-carrying wire in a magnetic field. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *domains, poles, magnetic field, magnetic force, attraction, repulsion, electrons, protons, right-hand rule.* ● performing specific processes, such as ○ demonstrating the essential relationship between electric current and magnetic fields. ○ representing magnetic fields using field lines.

	○ demonstrating that an electric current can produce an electric field and a changing magnetic field can produce an electric current. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets
○ calculate the size and direction of the force in terms of q, v, and, B, and explain why the magnetic force can perform no work; ○ calculate the size and direction of a magnetic field from information about the forces experienced by charged particles moving through that field; and ○ describe the paths of charged particles moving in uniform magnetic fields. ○ calculate the magnitude and direction of the field at a point in the vicinity of such a wire; ○ use superposition to determine the magnetic field produced by two long wires; and ○ calculate the force of attraction or repulsion between two long current-carrying wires.
Learning Design

WGSD Curriculum -- Adv Physics
Electric Charges, Forces and Fields
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned with Saint Louis University 1818 Phys 122 & Phys 124. CCSS.ELA-LITERACY.RST.11-12.8 -- Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. CCSS.ELA-LITERACY.W.11-12.1 -- Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. CCSS.ELA-LITERACY.W.11-12.2 -- Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Learning Goal	Proficiency Scales
Students will be able to investigate and analyze the relationships among Electric Charge, Electric Fields, Gauss's Law, and Electric Flux.	4: The student demonstrates in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by: ● interpreting how application of electrostatic shielding and the application of Gauss's Law reveal an electric field. ● applying Coulomb's Law to situations involving multiple charges. 2: The student demonstrates he/she is nearing proficiency by: ● recognizing or recalling specific vocabulary, such as *electron, coulomb, Gauss, field lines, and electric flux.* ● performing basic processes, such as

	○ identifying types of electric charge and the magnitude of the small available charge. ○ defining and drawing electric field lines. ○ applying Coulomb's Law to situations with limited charges. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Explain electric properties of materials -- insulators and conductors
- Describe and state Coulomb's Law
- Describe an electric field
- Describe a potential gradient
- Solve electric field and potential gradient problems
- Draw electric field lines
- Define electric field and solve problem applications
- Define induction and solve problem applications
- Define electric flux and solve problem applications

Learning Design

WGSD Curriculum -- Adv Physics
Electric Potential and Electric Potential Energy
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned with Saint Louis University 1818 Phys 122 & Phys 124.

Learning Goal	Proficiency Scales
Students will be able to draw conclusions about the relationship and interaction of Electric Potential and Electric Potential Energy.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by: ● differentiating between electric potential and electric potential energy. ● defining equipotential surfaces and electric fields. ● solving problems that demonstrate how electric potential and electric potential energy relate to electric fields. ● applying the Law of Conservation of Energy to problems involving charged particles moving in an electric field. ● calculating the capacitance of an electric field and energy stored in a capacitor. 2: The student demonstrates he/she is nearing proficiency by: ● recognizing or recalling specific vocabulary, such as *capacitor, capacitance, electric field, electric potential, and electric potential energy.* ● performing basic processes, such as ○ comparing electric potential and electric potential energy.

	○ solving basic calculation problems with assistance. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Define electric potential
- Define electric potential energy
- Apply formulas to mathematical solution for electric potential and electric potential energy
- Calculate the electric energy stored in capacitors

Learning Design

WGSD Curriculum -- Adv Physics
Laws of Thermodynamics
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)

This course is aligned with Saint Louis University 1818 Phys 122 & Phys 124.

CCSS.ELA-LITERACY.RST.11-12.10 -- By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

CCSS.ELA-LITERACY.W.11-12.1 -- Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

CCSS.ELA-LITERACY.W.11-12.2 -- Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

<table>
<tr><th>Learning Goal</th><th>Proficiency Scales</th></tr>
<tr><td>The students will be able to apply their understanding of Entropy and the Zeroth, First, Second and Third Laws of Thermodynamics to problems.</td><td>4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: The student demonstrates mastery of the learning goal by
● solving thermodynamics problems.
● drawing conclusions about the relationships of the laws of thermodynamics from their mathematical calculations on thermodynamic application problems.

2: The student demonstrates he/she is nearing proficiency by:
● recognizing or recalling specific vocabulary, such as: heat, work, specific heat , and heat engines.
● performing basic processes, such as:
○ making connections between Q, W, ΔU, specific heat at</td></tr>
</table>

	constant pressure, specific heat at constant volume. ○ describing how heat engines, refrigerators, and heat pumps work. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Explain the Zeroth Law of Thermodynamics
- Explain the First Law of Thermodynamics, including the definitions of Q, W, and U
- Explain the Second Law of Thermodynamics; describing heat engines, and the Carnot's Theorem
- Discuss Entropy
- Explain the Third Law of Thermodynamics

Learning Design

WGSD Curriculum -- Adv Physics
Rotational Dynamics
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned with Saint Louis University 1818 Phys 122 & Phys 124.

Learning Goal	Proficiency Scales
Students will be able to distinguish experimentally between the effects of torque and force in terms of linear motion versus circular motion.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by: ● applying the equations for torque, force, and rotational motion to problems and lab activities. ● conducting an investigation to show the relationships among torque, angular momentum and rotational work. 2: The student demonstrates he/she is nearing proficiency by: ● recognizing or recalling specific vocabulary, such as *torque, static equilibrium, angular momentum, and rotational work.* ● performing basic processes, such as solving basic application problems with teacher prompting. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe torque and force
- Explain static equilibrium
- Demonstrate the use of equations for angular momentum and conservation of angular momentum
- Demonstrate the use of equation for rotational work

Learning Design

WGSD Curriculum -- Adv Physics
Rotational Kinematics and Energy
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned with Saint Louis University 1818 Phys 122 & Phys 124. CCSS.ELA-LITERACY.RST.11-12.4 -- Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics* CCSS.ELA-LITERACY.RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. CCSS.ELA-LITERACY.RST.11-12.10 -- By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently. CCSS.ELA-LITERACY.W.11-12.1 -- Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. CCSS.ELA-LITERACY.W.11-12.2 -- Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Learning Goal	Proficiency Scales
Students will be able to demonstrate the relationship between the mathematical representation of rotational kinematics to its linear counterpart.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by: ● solving problems that require the application of kinematics. ● conducting an investigation which describes rolling, moment of inertia and rotational kinetic energy .

	2: The student demonstrates he/she is nearing proficiency by: ● recognizing or recalling specific vocabulary, such as *moment of inertia, radian measure, angular velocity, and angular acceleration.* ● performing basic processes, such as solving basic application problems with prompts 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

1. Define angular position, Θ
2. Define angular velocity, ω
3. Define angular acceleration, α
4. Demonstrate the use of the equations for rotational kinematics
5. Demonstrate the connection between rotational kinematic equations and the linear kinematic equations
6. Explain rolling
7. Calculate the moment of inertia for various solids
8. Explain the conservation of mechanical energy

Learning Design

WGSD Curriculum -- Adv Physics

Thermal Physics

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned with Saint Louis University 1818 Phys 122 & Phys 124. CCSS.ELA-LITERACY.RST.11-12.4 -- Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics* CCSS.ELA-LITERACY.RST.11-12.10 -- By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently. CCSS.ELA-LITERACY.W.11-12.1 -- Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. CCSS.ELA-LITERACY.W.11-12.2 -- Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Learning Goal	Proficiency Scales
Students will be able to solve problems that demonstrate the applications of the Law of Conservation of Energy, including calorimetry and the connections between mechanical work and heat.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by: applying his/her understanding of the applications of the Law of Conservation of Energy by successfully solving mathematical problems. 2: The student demonstrates he/she is nearing proficiency by: ● recognizing or recalling specific vocabulary, such as *temperature,*

	heat, and mechanical heat exchange in terms of the Law of Conservation of Energy. ● performing specific processes, such as solving some mathematical problems with guidance. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Convert readings on temperature scales (°C, °F, K)
- Describe constant volume thermometer and measurement of absolute zero
- Calculate energy transfer, specific heat
- Describe mechanism of heat exchange: conduction, convection and radiation
- Demonstrate in problems application of the kinetic theory of gases -- molecular speed distributions
- Explain latent heat
- Explain phase change and energy

Learning Design

WGSD Curriculum -- Adv Physics

Electricity and Magnetism

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned with Saint Louis University 1818 Phys 122 & Phys 124. CCSS.ELA-LITERACY.RST.11-12.3 -- Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 -- Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics* CCSS.ELA-LITERACY.RST.11-12.10 -- By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently. CCSS.ELA-LITERACY.W.11-12.1 -- Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. CCSS.ELA-LITERACY.W.11-12.2 -- Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Learning Goal	Proficiency Scales
Students will be able to analyze the interaction of electrical and magnetic forces between individual particles and through electrical and magnetic fields.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the learning goal by ● using Coulomb's law to mathematically demonstrate electrostatic forces between particles. ● using Ohm's law to explain the relationship between voltage,

	resistance, and current.
	● discriminating among the types of charges, ways to charge materials, and factors that affect charges, such as resistance, etc.
	● explaining how electrons flow through a circuit and how series and parallel circuit differ.
	● describing magnetic and electric fields.
	● preparing a transformer to demonstrate that an electric current can produce an electric field and a changing magnetic field can produce an electric current.
	● experimenting with e/m and $F_B = BI\ell$.
	
	2: Student demonstrates he/she is nearing proficiency by
	
	● recognizing or recalling specific vocabulary, such as *domains, poles, charge, conservation, excess, field, Coulomb's Law, inverse square, attraction, repulsion, electrons, protons, neutrons, nucleus, Ohm's Law, resistance, current, voltage, electric potential energy, power, circuit, conductor, insulator, generator, compass, induction, and mass.*
	
	● performing processes, such as:
	    ● explaining the essentials of the effects of the inverse square law on two charged particles.
	    ● demonstrating the essential relationship between electric current and magnetic fields.
	    ● representing electric and magnetic fields using field lines.
	
	1: Student demonstrates limited understanding or skill with the learning goal.

<u>Learning Targets</u>

- Illustrate electric fields with vectors and by electric field lines
- Describe the flow of electric charge, magnetic field, and a current-carrying wire
- Describe Ohm's law
- Distinguish between DC and AC and how AC is converted to DC
- Explain how current can be turned on or off in a circuit, and how electrical devices can be connected in a circuit
- Describe the characteristics of a series and parallel circuit
- Explain how magnetic poles affect each other
- Describe the magnetic field in the space around a magnet
- Describe how a magnetic field exerts a force on a moving charged particle in the field
- Describe how current is affected by a magnetic field
- Describe how a magnetic field exerts a torque on a current-carrying loop
- Explain the magnetic field right-hand rule
- Describe magnetic flux
- Explain induced emf using Faraday's Law, Lenz's Law and motional emf
- Describe the mechanical work and electrical energy associated with generators and transformers

Learning Design

WGSD Curriculum -- Adv Physics
Electromagnetic Waves and Physical Optics
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
This course is aligned with Saint Louis University 1818 Phys 122 & Phys 124. CCSS.ELA-LITERACY.RST.11-12.2 -- Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. CCSS.ELA-LITERACY.RST.11-12.3 -- Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 -- Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics* CCSS.ELA-LITERACY.RST.11-12.10 -- By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently. CCSS.ELA-LITERACY.W.11-12.1 -- Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. CCSS.ELA-LITERACY.W.11-12.2 -- Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Learning Goal	Proficiency Scales
Students will be able to deduce the function and purpose of a wave based on its physical characteristics and behavior.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

	3: The student demonstrates mastery of the learning goal by ● mathematically representing waves ($v=f\lambda$) and explaining the relationship of the variables. ● ordering the electromagnetic spectrum by frequency or wavelength. ● describing the process by which energy (digital information) is transferred from source to receiver. 2: Student demonstrates he/she is nearing proficiency by ● recognizing and recalling specific vocabulary, such as: *reflection, refraction, diffraction, interference, frequency, period, velocity, Doppler shift, and amplitude.* ● performing basic processes, such as ○ labeling and defining all parts of a wave. ○ describing the order of EM spectrum. 1: Student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe the characteristics and properties of waves
- Describe how to calculate the speed of a wave
- Distinguish between the two types of waves
- Discriminate between sound waves and electromagnetic waves
- Explain the Doppler Effect
- Manipulate the electromagnetic spectrum based on frequency and wavelength
- Summarize various types of superposition and interference

• Explain Young's two slit experiment • Explain single-slit diffraction and diffraction gratings
<u>Learning Design</u>

WGSD Curriculum -- AP Physics 1 and 2
Conservation Laws
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Physics 1 & 2 Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.

Learning Goal	Proficiency Scales
Students will be able to understand and apply the systemic constraints of conservation laws.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the learning goal by ● modeling and solving mathematical problems that apply the

	following conservation concepts: ● the total mass-energy of a system is conserved; ● the electric charge of a system is conserved; ● the linear momentum of a system is conserved; ● the angular momentum of a system is conserved; ● nucleon number is conserved. 2: Student demonstrates that he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *fusion, fission, isolated, system, alpha particle, beta particle, gamma decay, continuity equation, constrained, rotational inertia, elliptical, elastic, inelastic, potential difference, node, junction, Kirchhoff, diarrhea, Bernoulli's Equation, absorption spectra, isobaric, isothermal, isovolumetric, adiabatic.* ● performing specific processes, such as ○ identifying these characteristics of isolated systems: ■ certain quantities are conserved, in the sense that the changes of those quantities in a given system are always equal to the transfer of that quantity to or from the system by all possible interactions with other systems; ■ classically, the the mass of a system is conserved; and ■ classically, the energy of a system is conserved. 1: The student demonstrates a limited understanding or skill with the learning goal.

<u>Learning Targets</u>

- The student is able to define open and closed systems for everyday situations and apply conservation concepts for energy, charge, and linear momentum to those situations.
- The student is able to set up a representation or model showing that a single object can only have kinetic energy and use information about that object to calculate its kinetic energy.
- The student is able to translate between a representation of a single object, which can only have kinetic energy, and a system that includes the object, which may have both kinetic and potential energies.
- The student is able to calculate the expected behavior of a system using the object model (i.e., by ignoring changes in internal structure) to analyze a situation. Then, when the model fails, the student can justify the use of conservation of energy principles to calculate the change in internal energy due to changes in internal structure because the object is actually a system.
- The student is able to describe and make qualitative and/or quantitative predictions about everyday examples of systems with internal potential energy.
- The student is able to make quantitative calculations of the internal potential energy of a system from a description or diagram of that system.
- The student is able to apply mathematical reasoning to create a description of the internal potential energy of a system from a description or diagram of the objects and interactions in that system.
- The student is able to describe and make predictions about the internal energy of systems.
- The student is able to calculate changes in kinetic energy and potential energy of a system, using information from representations of that system.
- The student is able to design an experiment and analyze data to examine how a force exerted on an object or system does work on the object or system as it moves through a distance.
- The student is able to design an experiment and analyze graphical data in which interpretations of the area under a force-distance curve are needed to determine the work done on or by the object or system.
- The student is able to predict and calculate from graphical data the energy transfer to or work done on an object or system from information about a force exerted on the object or system through a distance.
- The student is able to make claims about the interaction between a system and its environment in which the environment exerts a force on the system, thus doing work on the system and changing the energy of the system (kinetic energy plus potential energy).
- The student is able to predict and calculate the energy transfer to (i.e., the work done on) an object or system from information about a force exerted on the object or system through a distance.
- The student is able to design an experiment and analyze graphical data in which interpretations of the area under a pressure-volume curve are needed to determine the work done on or by the object or system.
- The student is able to describe the models that represent processes by which energy can be transferred between

a system and its environment because of differences in temperature: conduction, convection, and radiation.

- The student is able to predict qualitative changes in the internal energy of a thermodynamic system involving transfer of energy due to heat or work done and justify those predictions in terms of conservation of energy principles.
- The student is able to create a plot of pressure versus volume for a thermodynamic process from given data.
- The student is able to use a plot of pressure versus volume for a thermodynamic process to make calculations of internal energy changes, heat, or work, based upon conservation of energy principles (i.e., the first law of thermodynamics).
- The student is able to describe emission or absorption spectra associated with electronic or nuclear transitions as transitions between allowed energy states of the atom in terms of the principle of energy conservation, including characterization of the frequency of radiation emitted or absorbed.
- The student is able to construct or interpret a graph of the energy changes within an electrical circuit with only a single battery and resistors in series and/or in, at most, one parallel branch as an application of the conservation of energy (Kirchhoff's loop rule).
- The student is able to apply conservation of energy concepts to the design of an experiment that will demonstrate the validity of Kirchhoff's loop rule ($\Delta V = \sum 0$) in a circuit with only a battery and resistors either in series or in, at most, one pair of parallel branches.
- The student is able to apply conservation of energy (Kirchhoff's loop rule) in calculations involving the total electric potential difference for complete circuit loops with only a single battery and resistors in series and/or in, at most, one parallel branch.
- The student is able to analyze experimental data including an analysis of experimental uncertainty that will demonstrate the validity of Kirchhoff's loop rule ($\Delta V = \sum 0$).
- The student is able to use conservation of energy principles (Kirchhoff's loop rule) to describe and make predictions regarding electrical potential difference, charge, and current in steady-state circuits composed of various combinations of resistors and capacitors.
- The student is able to mathematically express the changes in electric potential energy of a loop in a multiloop electrical circuit and justify this expression using the principle of the conservation of energy.
- The student is able to refine and analyze a scientific question for an experiment using Kirchhoff's Loop rule for circuits that includes determination of internal resistance of the battery and analysis of a non-ohmic resistor.
- The student is able to translate between graphical and symbolic representations of experimental data describing relationships among power, current, and potential difference across a resistor.
- The student is able to use Bernoulli's equation to make calculations related to a moving fluid.
- The student is able to use Bernoulli's equation and/or the relationship between force and pressure to make

calculations related to a moving fluid.

- The student is able to use Bernoulli's equation and the continuity equation to make calculations related to a moving fluid.
- The student is able to construct an explanation of Bernoulli's equation in terms of the conservation of energy.
- The student is able to apply conservation of mass and conservation of energy concepts to a natural phenomenon and use the equation Emc =2 to make a related calculation.
- The student is able to analyze electric charge conservation for nuclear and elementary particle reactions and make predictions related to such reactions based upon conservation of charge.
- The student is able to predict electric charges on objects within a system by application of the principle of charge conservation within a system.
- The student is able to design a plan to collect data on the electrical charging of objects and electric charge induction on neutral objects and qualitatively analyze that data.
- The student is able to justify the selection of data relevant to an investigation of the electrical charging of objects and electric charge induction on neutral objects.
- The student is able to apply conservation of electric charge (Kirchhoff's junction rule) to the comparison of electric current in various segments of an electrical circuit with a single battery and resistors in series and in, at most, one parallel branch and predict how those values would change if configurations of the circuit are changed.
- The student is able to design an investigation of an electrical circuit with one or more resistors in which evidence of conservation of electric charge can be collected and analyzed.
- The student is able to use a description or schematic diagram of an electrical circuit to calculate unknown values of current in various segments or branches of the circuit.
- The student is able to predict or explain current values in series and parallel arrangements of resistors and other branching circuits using Kirchhoff's junction rule and relate the rule to the law of charge conservation.
- The student is able to determine missing values and direction of electric current in branches of a circuit with resistors and NO capacitors from values and directions of current in other branches of the circuit through appropriate selection of nodes and application of the junction rule.
- The student is able to determine missing values and direction of electric current in branches of a circuit with both resistors and capacitors from values and directions of current in other branches of the circuit through appropriate selection of nodes and application of the junction rule.
- The student is able to determine missing values, direction of electric current, charge of capacitors at steady state, and potential differences within a circuit with resistors and capacitors from values and directions of current in other branches of the circuit.
- The student is able to make qualitative predictions about natural phenomena based on conservation of linear

momentum and restoration of kinetic energy in elastic collisions.

- The student is able to apply the principles of conservation of momentum and restoration of kinetic energy to reconcile a situation that appears to be isolated and elastic, but in which data indicate that linear momentum and kinetic energy are not the same after the interaction, by refining a scientific question to identify interactions that have not been considered. Students will be expected to solve qualitatively and/or quantitatively for one-dimensional situations and only qualitatively in two-dimensional situations.
- The student is able to apply mathematical routines appropriately to problems involving elastic collisions in one dimension and justify the selection of those mathematical routines based on conservation of momentum and restoration of kinetic energy.
- The student is able to design an experimental test of an application of the principle of the conservation of linear momentum, predict an outcome of the experiment using the principle, analyze data generated by that experiment whose uncertainties are expressed numerically, and evaluate the match between the prediction and the outcome.
- The student is able to classify a given collision situation as elastic or inelastic, justify the selection of conservation of linear momentum and restoration of kinetic energy as the appropriate principles for analyzing an elastic collision, solve for missing variables, and calculate their values.
- The student is able to make predictions of the dynamical properties of a system undergoing a collision by application of the principle of linear momentum conservation and the principle of the conservation of energy in situations in which an elastic collision may also be assumed.
- The student is able to classify a given collision situation as elastic or inelastic, justify the selection of conservation of linear momentum and restoration of kinetic energy as the appropriate principles for analyzing an elastic collision, solve for missing variables, and calculate their values.
- The student is able to qualitatively predict, in terms of linear momentum and kinetic energy, how the outcome of a collision between two objects changes depending on whether the collision is elastic or inelastic.
- The student is able to plan data collection strategies to test the law of conservation of momentum in a two-object collision that is elastic or inelastic and analyze the resulting data graphically.
- The student is able to apply the conservation of linear momentum to a closed system of objects involved in an inelastic collision to predict the change in kinetic energy.
- The student is able to analyze data that verify conservation of momentum in collisions with and without an external friction force.
- The student is able to classify a given collision situation as elastic or inelastic, justify the selection of conservation of linear momentum as the appropriate solution method for an inelastic collision, recognize that there is a common final velocity for the colliding objects in the totally inelastic case, solve for missing variables, and calculate their values.

- The student is able to apply the conservation of linear momentum to a closed system of objects involved in an inelastic collision to predict the change in kinetic energy.
- The student is able to predict the velocity of the center of mass of a system when there is no interaction outside of the system but there is an interaction within the system (i.e., the student imply recognizes that interactions within a system do not affect the center of mass motion of the system and is able to determine that there is no external force).
- The student is able to make predictions about the velocity of the center of mass for interactions within a defined one-dimensional system.
- The student is able to make predictions about the velocity of the center of mass for interactions within a defined two-dimensional system.
- The student is able to make qualitative predictions about the angular momentum of a system for a situation in which there is no net external torque.
- The student is able to make calculations of quantities related to the angular momentum of a system when the net external torque on the system is zero.
- The student is able to describe or calculate the angular momentum and rotational inertia of a system in terms of the locations and velocities of objects that make up the system. Students are expected to do qualitative reasoning with compound objects. Students are expected to do calculations with a fixed set of extended objects and point masses.
- The student is able to make calculations of quantities related to flow of a fluid, using mass conservation principles (the continuity equation).
- The student is able to apply conservation of nucleon number and conservation of electric charge to make predictions about nuclear reactions and decays such as fission, fusion, alpha decay, beta decay, or gamma decay.

Learning Design

WGSD Curriculum -- AP Physics 1 and 2
Fields can Explain Interactions
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Physics 1 & 2 Big Idea 2: Fields existing in space can be used to explain interactions.

Learning Goal	Proficiency Scales
Students will be able to explain and predict physical interactions based on the properties of fields.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● modeling and/or calculating problems that require applying the following concepts: ○ a field associates a value of some physical quantity with every point in space; ○ field models are useful for describing interactions that occur at a distance (long-range forces) as well as a variety of other physical phenomena; ○ physicists often construct a map of isolines connecting points of equal value for some quantity related to a field and use these maps to help visualize the field; and ○ magnetic monopoles have not yet been observed in nature, so all measured magnetic fields form closed loops.

	2: The student demonstrates that he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as *isoline, electric potential, vector field map, scalar, equipotential, spherically symmetric, domain, compass, monopole, magnitude, point charge, qualitatively, quantitatively.* ● performing specific processes, such as ○ identifying that a gravitational field is caused by an object with mass. ○ determining the shape of an electric field caused by an object with a charge or combinations of charges. ○ demonstrating that a magnetic field is caused by a magnet or a moving electrically charged object. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Goals

- The student is able to apply to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems.
- The student is able to apply to calculate the gravitational field due to an object with mass M, where the field is a vector directed toward the center of the object of mass M.
- The student is able to approximate a numerical value of the gravitational field (g) near the surface of an object from its radius and mass relative to those of the Earth or other reference objects.
- The student is able to predict the direction and the magnitude of the force exerted on an object with an electric charge q placed in an electric field E using the mathematical model of the relation between an electric force and an electric field: a vector relation.
- The student is able to calculate any one of the variables — electric force, electric charge, and electric field — at a point given the values and sign or direction of the other two quantities.

- The student is able to qualitatively and semiquantitatively apply the vector relationship between the electric field and the net electric charge creating that field.
- The student is able to explain the inverse square dependence of the electric field surrounding a spherically symmetric electrically charged object.
- The student is able to distinguish the characteristics that differ between monopole fields (gravitational field of spherical mass and electrical field due to single point charge) and dipole fields (electric dipole field and magnetic field) and make claims about the spatial behavior of the fields using qualitative or semi-quantitative arguments based on vector addition of fields due to each point source, including identifying the locations and signs of sources from a vector diagram of the field.
- The student is able to apply mathematical routines to determine the magnitude and direction of the electric field at specified points in the vicinity of a small set (2–4) of point charges, and express the results in terms of magnitude and direction of the field in a visual representation by drawing field vectors of appropriate length and direction at the specified points.
- The student is able to create representations of the magnitude and direction of the electric field at various distances (small compared to plate size) from two electrically charged plates of equal magnitude and opposite signs, and is able to recognize that the assumption of uniform field is not appropriate near edges of plates.
- The student is able to calculate the magnitude and determine the direction of the electric field between two electrically charged parallel plates, given the charge of each plate, or the electric potential difference and plate separation.
- The student is able to represent the motion of an electrically charged particle in the uniform field between two oppositely charged plates and express the connection of this motion to projectile motion of an object with mass in the Earth's gravitational field.
- The student is able to apply mathematical routines to express the force exerted on a moving charged object by a magnetic field.
- The student is able to create a verbal or visual representation of a magnetic field around a long straight wire or a pair of parallel wires.
- The student is able to describe the orientation of a magnetic dipole placed in a magnetic field in general and the particular cases of a compass in the magnetic field of the Earth and iron filings surrounding a bar magnet.
- The student is able to use the representation of magnetic domains to qualitatively analyze the magnetic behavior of a bar magnet composed of ferromagnetic material.
- The student is able to construct or interpret visual representations of the isolines of equal gravitational potential energy per unit mass and refer to each line as a gravitational equipotential.
- The student is able to determine the structure of isolines of electric potential by constructing them in a given

electric field.

- The student is able to predict the structure of isolines of electric potential by constructing them in a given electric field and make connections between these isolines and those found in a gravitational field.
- The student is able to qualitatively use the concept of isolines to construct isolines of electric potential in an electric field and determine the effect of that field on electrically charged objects.
- The student is able to apply mathematical routines to calculate the average value of the magnitude of the electric field in a region from a description of the electric potential in that region using the displacement along the line on which the difference in potential is evaluated.
- The student is able to apply the concept of the isoline representation of electric potential for a given electric charge distribution to predict the average value of the electric field in the region.

Learning Design

WGSD Curriculum -- AP Physics 1 and 2
Forces Cause Interactions
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Physics 1 & 2 Big Idea 3: The interactions of an object with other objects can be described by forces.

Learning Goal	Proficiency Scales

The student will be able to mathematically model and predict the consequences of forces between objects.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.
	
	3: Student demonstrates mastery of the learning goal by
	● solving fabricated and real-world problems that require an application of the following concepts:
	    ● at the macroscopic level, forces can be categorized as either long-range (action-at-a-distance) forces or contact forces;
	    ● all forces share certain common characteristics when considered by observers in inertial reference frames;
	    ● a force exerted on an object can change the momentum of the object;
	    ● a force exerted on an object can change the kinetic energy of the object;
	    ● a force exerted on an object can cause a torque on that

	object; and ● certain types of forces are considered fundamental. 2: The student demonstrates that he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *dominant, electromagnetic, repulsive, rotational, torque, angular momentum, moment of inertia, axis of rotation, angular velocity, static equilibrium, lever arm, kinetic energy, impulse, tension, buoyant, friction, interatomic, dipole moment, inverse square, harmonic oscillator, macroscopic, vector, phasor.* ● performing specific processes, such as ○ recognizing distinctions between field and contact forces. ○ calculating momentum and kinetic energy of objects. ○ predicting the acceleration of an object interacting with other objects using Newton's Second Law. ○ modeling forces, torques, momenta, fields, etc. with vectors and phasors. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- The student is able to express the motion of an object using narrative, mathematical, and graphical representations.
- The student is able to design an experimental investigation of the motion of an object.
- The student is able to analyze experimental data describing the motion of an object and is able to express the results of the analysis using narrative, mathematical, and graphical representations.
- The student is able to analyze a scenario and make claims (develop arguments, justify assertions) about the forces exerted on an object by other objects for different types of forces or components of forces.

- The student is able to challenge a claim that an object can exert a force on itself.
- The student is able to describe a force as an interaction between two objects and identify both objects for any force.
- The student is able to make claims about the force on an object due to the presence of other objects with the same property: mass, electric charge.
- The student is able to construct explanations of physical situations involving the interaction of bodies using Newton’s third law and the representation of action-reaction pairs of forces.
- The student is able to use Newton’s third law to make claims and predictions about the action-reaction pairs of forces when two objects interact.
- The student is able to analyze situations involving interactions among several objects by using free-body diagrams that include the application of Newton’s third law to identify forces.
- The student is able to predict the motion of an object subject to forces exerted by several objects using an application of Newton’s second law in a variety of physical situations with acceleration in one dimension.
- The student is able to design a plan to collect and analyze data for motion (static, constant, or accelerating) from force measurements and carry out an analysis to determine the relationship between the net force and the vector sum of the individual forces.
- The student is able to reexpress a free-body diagram representation into a mathematical representation and solve the mathematical representation for the acceleration of the object.
- The student is able to predict the motion of an object subject to forces exerted by several objects using an application of Newton’s second law in a variety of physical situations.
- The student is able to create and use free-body diagrams to analyze physical situations to solve problems with motion qualitatively and quantitatively.
- The student is able to predict which properties determine the motion of a simple harmonic oscillator and what the dependence of the motion is on those properties.
- The student is able to design a plan and collect data in order to ascertain the characteristics of the motion of a system undergoing oscillatory motion caused by a restoring force.
- The student can analyze data to identify qualitative or quantitative relationships between given values and variables (i.e., force, displacement, acceleration, velocity, period of motion, frequency, spring constant, string length, mass) associated with objects in oscillatory motion to use that data to determine the value of an unknown.
- The student is able to construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force.
- The student is able to use Newton’s law of gravitation to calculate the gravitational force the two objects exert on each other and use that force in contexts other than orbital motion.

- The student is able to use Newton's law of gravitation to calculate the gravitational force between two objects and use that force in contexts involving orbital motion (for circular orbital motion only in Physics 1).
- The student is able to use Coulomb's law qualitatively and quantitatively to make predictions about the interaction between two electric point charges (interactions between collections of electric point charges are not covered in Physics 1 and instead are restricted to Physics 2).

The student is able to connect the concepts of gravitational force and electric force to compare similarities and differences between the forces.

- The student is able to use mathematics to describe the electric force that results from the interaction of several separated point charges (generally 2 to 4 point charges, though more are permitted in situations of high symmetry).
- The student is able to use right-hand rules to analyze a situation involving a current-carrying conductor and a moving electrically charged object to determine the direction of the magnetic force exerted on the charged object due to the magnetic field created by the current-carrying conductor.
- The student is able to plan a data collection strategy appropriate to an investigation of the direction of the force on a moving electrically charged object caused by a current in a wire in the context of a specific set of equipment and instruments and analyze the resulting data to arrive at a conclusion.
- The student is able to make claims about various contact forces between objects based on the microscopic cause of those forces.
- The student is able to explain contact forces (tension, friction, normal, buoyant, spring) as arising from interatomic electric forces and that they therefore have certain directions.
- The student is able to justify the selection of data needed to determine the relationship between the direction of the force acting on an object and the change in momentum caused by that force.
- The student is able to justify the selection of routines for the calculation of the relationships between changes in momentum of an object, average force, impulse, and time of interaction.
- The student is able to predict the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted.
- The student is able to analyze data to characterize the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted.
- The student is able to design a plan for collecting data to investigate the relationship between changes in momentum and the average force exerted on an object over time.
- The student is able to make predictions about the changes in kinetic energy of an object based on considerations of the direction of the net force on the object as the object moves.
- The student is able to use net force and velocity vectors to determine qualitatively whether kinetic energy of an

object would increase, decrease, or remain unchanged.

- The student is able to use force and velocity vectors to determine qualitatively or quantitatively the net force exerted on an object and qualitatively whether kinetic energy of that object would increase, decrease, or remain unchanged.
- The student is able to apply mathematical routines to determine the change in kinetic energy of an object given the forces on the object and the displacement of the object.
- The student is able to use representations of the relationship between force and torque.
- The student is able to compare the torques on an object caused by various forces.
- The student is able to estimate the torque on an object caused by various forces in comparison to other situations.
- The student is able to design an experiment and analyze data testing a question about torques in a balanced rigid system.
- The student is able to calculate torques on a two-dimensional system in static equilibrium, by examining a representation or model (such as a diagram or physical construction).
- The student is able to make predictions about the change in the angular velocity about an axis for an object when forces exerted on the object cause a torque about that axis.
- The student is able to plan data collection and analysis strategies designed to test the relationship between a torque exerted on an object and the change in angular velocity of that object about an axis.
- The student is able to predict the behavior of rotational collision situations by the same processes that are used to analyze linear collision situations using an analogy between impulse and change of linear momentum and angular impulse and change of angular momentum.
- In an unfamiliar context or using representations beyond equations, the student is able to justify the selection of a mathematical routine to solve for the change in angular momentum of an object caused by torques exerted on the object.
- The student is able to plan data collection and analysis strategies designed to test the relationship between torques exerted on an object and the change in angular momentum of that object.
- The student is able to articulate situations when the gravitational force is the dominant force and when the electromagnetic, weak, and strong forces can be ignored.
- The student is able to connect the strength of the gravitational force between two objects to the spatial scale of the situation and the masses of the objects involved and compare that strength to other types of forces.
- The student is able to connect the strength of electromagnetic forces with the spatial scale of the situation, the magnitude of the electric charges, and the motion of the electrically charged objects involved.
- The student is able to identify the strong force as the force that is responsible for holding the nucleus together.

Learning Design

WGSD Curriculum -- AP Physics 1 and 2
Interactions Cause Changes
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Physics 1 & 2 Big Idea 4: Interactions between systems can result in changes in those systems.

Learning Goal	Proficiency Scales

The student will be able to experimentally and mathematically predict and model certain changes in interactive systems.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.
	
	3: Student demonstrates mastery of the learning goal by
	
	● making predictions and creating models that apply the following concepts:
	    ● interactions with other objects or systems can change the total linear momentum of a system;
	    ● interactions with other objects or systems can change the total energy of a system; and
	    ● a net torque exerted on a system by other objects or systems will change the angular momentum of the system.
	
	2: The student demonstrates that he/she is nearing proficiency by
	● recognizing or recalling specific vocabulary, such as *emf, capacitor, series, parallel, constant of proportionality, dielectric,*

	anomaly, induction, insulator, conductor, polarized, flux, convection, radiation, antiparallel. ● performing specific processes, such as ○ calculating the acceleration of the center of mass of a system, as it is related to the net force exerted on the system, where is a vector equation. ○ predicting how the electric and magnetic properties of a system can change in response to the presence of, or changes in, other objects or systems. ○ mathematically modeling the momentum and energy of a system in the absence of interactions. 1: The student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

- The student is able to use representations of the center of mass of an isolated two-object system to analyze the motion of the system qualitatively and semiquantitatively.
- The student is able to make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity per unit time, and velocity is equal to the change in position per unit time.
- The student is able to evaluate using given data whether all the forces on a system or whether all the parts of a system have been identified.
- The student is able to create mathematical models and analyze graphical relationships for acceleration, velocity, and position of the center of mass of a system and use them to calculate properties of the motion of the center of mass of a system.
- The student is able to apply Newton's second law to systems to calculate the change in the center-of-mass velocity when an external force is exerted on the system.
- The student is able to use visual or mathematical representations of the forces between objects in a system to predict whether or not there will be a change in the center-of-mass velocity of that system.

- The student is able to calculate the change in linear momentum of a two-object system with constant mass in linear motion from a representation of the system (data, graphs, etc.).
- The student is able to analyze data to find the change in linear momentum for a constant-mass system using the product of the mass and the change in velocity of the center of mass.
- The student is able to apply mathematical routines to calculate the change in momentum of a system by analyzing the average force exerted over a certain time on the system.
- The student is able to perform analysis on data presented as a force-time graph and predict the change in momentum of a system.
- The student is able to calculate the total energy of a system and justify the mathematical routines used in the calculation of component types of energy within the system whose sum is the total energy.
- The student is able to predict changes in the total energy of a system due to changes in position and speed of objects or frictional interactions within the system.
- The student is able to make predictions about the changes in the mechanical energy of a system when a component of an external force acts parallel or antiparallel to the direction of the displacement of the center of mass.
- The student is able to apply the concepts of Conservation of Energy and the Work-Energy theorem to determine qualitatively and/or quantitatively that work done on a two-object system in linear motion will change the kinetic energy of the center of mass of the system, the potential energy of the systems, and/or the internal energy of the system.
- The student is able to make predictions about the direction of energy transfer due to temperature differences based on interactions at the microscopic level.
- The student is able to apply mathematical routines to describe the relationship between mass and energy and apply this concept across domains of scale.
- The student is able to describe a representation and use it to analyze a situation in which several forces exerted on a rotating system of rigidly connected objects change the angular velocity and angular momentum of the system.
- The student is able to plan data collection strategies designed to establish that torque, angular velocity, angular acceleration, and angular momentum can be predicted accurately when the variables are treated as being clockwise or counterclockwise with respect to a well-defined axis of rotation, and refine the research question based on the examination of data.
- The student is able to describe a model of a rotational system and use that model to analyze a situation in which angular momentum changes due to interaction with other objects or systems.
- The student is able to plan a data collection and analysis strategy to determine the change in angular momentum

of a system and relate it to interactions with other objects and systems.

- The student is able to use appropriate mathematical routines to calculate values for initial or final angular momentum, or change in angular momentum of a system, or average torque or time during which the torque is exerted in analyzing a situation involving torque and angular momentum.
- The student is able to plan a data collection strategy designed to test the relationship between the change in angular momentum of a system and the product of the average torque applied to the system and the time interval during which the torque is exerted.
- The student is able to use representations and models to qualitatively describe the magnetic properties of some materials that can be affected by magnetic properties of other objects in the system.
- The student is able to construct an explanation of the function of a simple electromagnetic device in which an induced emf is produced by a changing magnetic flux through an area defined by a current loop (i.e., a simple microphone or generator) or of the effect on behavior of a device in which an induced emf is produced by a constant magnetic field through a changing area.
- The student is able to make predictions about the redistribution of charge during charging by friction, conduction, and induction.
- The student is able to make predictions about the redistribution of charge caused by the electric field due to other systems, resulting in charged or polarized objects.
- The student is able to construct a representation of the distribution of fixed and mobile charge in insulators and conductors.
- The student is able to construct a representation of the distribution of fixed and mobile charge in insulators and conductors that predicts charge distribution in processes involving induction or conduction.
- The student is able to plan and/or analyze the results of experiments in which electric charge rearrangement occurs by electrostatic induction, or is able to refine a scientific question relating to such an experiment by identifying anomalies in a data set or procedure.
- The student is able to make predictions about the properties of resistors and/or capacitors when placed in a simple circuit, based on the geometry of the circuit element and supported by scientific theories and mathematical relationships.
- The student is able to design a plan for the collection of data to determine the effect of changing the geometry and/or materials on the resistance or capacitance of a circuit element and relate results to the basic properties of resistors and capacitors.
- The student is able to analyze data to determine the effect of changing the geometry and/or materials on the resistance or capacitance of a circuit element and relate results to the basic properties of resistors and capacitors.

Learning Design

WGSD Curriculum -- AP Physics 1 and 2
Probability
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Physics 1 & 2 Big Idea 7: The mathematics of probability can be used to describe the behavior of complex systems and to interpret the behavior of quantum mechanical systems.

Learning Goal	Proficiency Scales
Student will be able to apply concepts of probability to describe the behavior of complex systems and to interpret quantum mechanical systems.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery of the learning goal by interpreting the behavior of certain systems by applying these concepts: ● the properties of an ideal gas can be explained in terms of a small number of macroscopic variables including temperature and pressure; ● the tendency of isolated systems to move toward states with higher disorder is described by probability; and ● at the quantum scale, matter is described by a wave function, which leads to a probabilistic description of the microscopic world. 2: The student demonstrates that he/she is nearing proficiency by

	● recognizing or recalling specific vocabulary, such as *probability, integer, allowed energy states, reversible, irreversible, entropy, disorder, probability distribution.* ● performing specific processes, such as ○ describing thermal and fluid interaction. ○ using statistical analysis to explain thermal and fluid interactions. ○ constructing models of quantum systems are often small and seldom observed in everyday life. ○ recognizing that systems containing more than a few particles are more easily treated using statistics. ○ justifying the use of statistical methods in physics by experiment. 1: The student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

- The student is able to make claims about how the pressure of an ideal gas is connected to the force exerted by molecules on the walls of the container, and how changes in pressure affect the thermal equilibrium of the system.
- Treating a gas molecule as an object (i.e., ignoring its internal structure), the student is able to analyze qualitatively the collisions with a container wall and determine the cause of pressure, and at thermal equilibrium, to quantitatively calculate the pressure, force, or area for a thermodynamic problem given two of the variables.
- The student is able to qualitatively connect the average of all kinetic energies of molecules in a system to the temperature of the system.
- The student is able to connect the statistical distribution of microscopic kinetic energies of molecules to the macroscopic temperature of the system and to relate this to thermodynamic processes.
- The student is able to extrapolate from pressure and temperature or volume and temperature data to make the prediction that there is a temperature at which the pressure or volume extrapolates to zero.

- The student is able to design a plan for collecting data to determine the relationships between pressure, volume, and temperature, and amount of an ideal gas, and to refine a scientific question concerning a proposed incorrect relationship between the variables.
- The student is able to analyze graphical representations of macroscopic variables for an ideal gas to determine the relationships between these variables and to ultimately determine the ideal gas law $PV = nRT$.
- The student is able to construct an explanation, based on atomic scale interactions and probability, of how a system approaches thermal equilibrium when energy is transferred to it or from it in a thermal process.
- The student is able to connect qualitatively the second law of thermodynamics in terms of the state function called entropy and how it (entropy) behaves in reversible and irreversible processes.
- The student is able to use a graphical wave function representation of a particle to predict qualitatively the probability of finding a particle in a specific spatial region.
- The student is able to use a standing wave model in which an electron orbit circumference is an integer multiple of the de Broglie wavelength to give a qualitative explanation that accounts for the existence of specific allowed energy states of an electron in an atom.
- The student is able to predict the number of radioactive nuclei remaining in a sample after a certain period of time, and also predict the missing species (alpha, beta, gamma) in a radioactive decay.
- The student is able to construct or interpret representations of transitions between atomic energy states involving the emission and absorption of photons. [For questions addressing stimulated emission, students will not be expected to recall the details of the process, such as the fact that the emitted photons have the same frequency and phase as the incident photon; but given a representation of the process, students are expected to make inferences such as figuring out from energy conservation that since the atom loses energy in the process, the emitted photons taken together must carry more energy than the incident photon.]

Learning Design

WGSD Curriculum -- AP Physics 1 and 2 - Properties and Structure of Objects and Systems

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Physics 1 & 2 Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.

Learning Goal	Proficiency Scales

Students will be able to explain the properties of objects (mass and charge) and demonstrate that some systems have internal structure while others do not.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.
	
	3: The student demonstrates mastery of the learning goal by
	● applying the following concepts:
	  ● classical mechanics cannot describe all properties of objects; and
	  ● materials have many macroscopic properties that result from the arrangement and interactions of the atoms and molecules that make up the material.
	
	2: Student demonstrates that he/she is nearing proficiency by
	● recognizing or recalling specific vocabulary, such as: *charge, magnetic moment, quantized parameters, energy states, transitions, ground state, neutrons, protons, quarks, elementary,*

	fundamental, radioactive isotope, discrete, spectrum, Bohr Model, compositions, emission, half-life, nucleus, constituent, neutral, electrostatics, current, Coulombs, derivation, special relativity, dimensions, double-slit experiment, photon, relativistic mass/energy equivalence, microscopic/macroscopic, thermodynamics, vacuum, density, permittivity of free space, permeability of free space, intrinsic, resistance, resistivity. ● performing specific processes, such as: ○ determining the properties of a system given the internal structure. ○ explaining that electric charge is a property of an object or system that affects its interactions with other objects or systems containing charge. ○ explaining that bjects and systems have properties of inertial mass and gravitational mass that are experimentally verified to be the same and that satisfy conservation principles. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- The student is able to construct representations of the differences between a fundamental particle and a system composed of fundamental particles and to relate this to the properties and scales of the systems being investigated.
- The student is able to model verbally or visually the properties of a system based on its substructure and to relate this to changes in the system properties over time as external variables are changed.
- The student is able to construct representations of how the properties of a system are determined by the

interactions of its constituent substructures.

- The student is able to make claims about natural phenomena based on conservation of electric charge.
- The student is able to make predictions, using the conservation of electric charge, about the sign and relative quantity of net charge of objects or systems after various charging processes, including conservation of charge in simple circuits.
- The student is able to construct an explanation of the two-charge model of electric charge based on evidence produced through scientific practices.
- The student is able to make a qualitative prediction about the distribution of positive and negative electric charges within neutral systems as they undergo various processes.
- The student is able to challenge claims that polarization of electric charge or separation of charge must result in a net charge on the object.
- The student is able to challenge the claim that an electric charge smaller than the elementary charge has been isolated.
- The student is able to design an experiment for collecting data to determine the relationship between the net force exerted on an object, its inertial mass, and its acceleration.
- The student is able to design a plan for collecting data to measure gravitational mass and to measure inertial mass, and to distinguish between the two experiments.
- The student is able to articulate the reasons that the theory of conservation of mass was replaced by the theory of conservation of mass-energy.
- The student is able to explain why classical mechanics cannot describe all properties of objects by articulating the reasons that classical mechanics must be refined and an alternative explanation developed when classical particles display wave properties.
- The student is able to articulate the reasons that classical mechanics must be replaced by special relativity to describe the experimental results and theoretical predictions that show that the properties of space and time are not absolute.
- The student is able to predict the densities, differences in densities, or changes in densities under different conditions for natural phenomena and design an investigation to verify the prediction.
- The student is able to select from experimental data the information necessary to determine the density of an object and/or compare densities of several objects.
- The student is able to choose and justify the selection of data needed to determine resistivity for a given material.

Learning Design

WGSD Curriculum -- AP Physics 1 and 2

Waves

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
College Board Advanced Placement Physics 1 & 2 Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Learning Goal	Proficiency Scales

Students will be able to prove that waves can transfer energy and momentum from one location to another.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.
	
	3: The student demonstrates mastery of the learning goal by
	
	● making graphic representations and claims that apply the following key concepts:
	    ● only waves exhibit interference and diffraction;
	    ● interference and superposition lead to standing waves and beats; and
	    ● the direction of propagation of a wave such as light may be changed when the wave encounters an interface between two media.
	
	2: The student demonstrates that he/she is nearing proficiency by

	● recognizing or recalling specific vocabulary, such as *de Broglie wavelength, maxima, minima, constructive, destructive, diffraction, polarization, Davisson, Germer, Thomson, quantum mechanics, photoelectric effect, h, x-rays, ultraviolet, infrared, microwave, radio, critical angle, normal, transparent, refraction, propagation, index of refraction, specular, diffuse, antinode, standing wave, travelling wave, wavelength, frequency, period, amplitude, medium, transverse, longitudinal.* ● performing specific processes, such as ○ explaining the following concepts: ■ a wave is a traveling disturbance that transfers energy and momentum; ■ a periodic wave is one that repeats as a function of both time and position and can be described by its amplitude, frequency, wavelength, speed, and energy; ■ electromagnetic radiation can be modeled as waves or as fundamental particles; and ■ all matter can be modeled as waves or particles. 1: The student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

- The student is able to use a visual representation to construct an explanation of the distinction between transverse and longitudinal waves by focusing on the vibration that generates the wave.
- The student is able to describe representations of transverse and longitudinal waves.
- The student is able to analyze data (or a visual representation) to identify patterns that indicate that a particular mechanical wave is polarized and construct an explanation of the fact that the wave must have a vibration

perpendicular to the direction of energy propagation.
- The student is able to describe sound in terms of transfer of energy and momentum in a medium and relate the concepts to everyday examples.
- The student is able to contrast mechanical and electromagnetic waves in terms of the need for a medium in wave propagation.
- The student is able to use graphical representation of a periodic mechanical wave to determine the amplitude of the wave.
- The student is able to explain and/or predict qualitatively how the energy carried by a sound wave relates to the amplitude of the wave, and/or apply this concept to a real-world example.
- The student is able to use a graphical representation of a periodic mechanical wave (position versus time) to determine the period and frequency of the wave and describe how a change in the frequency would modify features of the representation.
- The student is able to use a visual representation of a periodic mechanical wave to determine wavelength of the wave.
- The student is able to construct an equation relating the wavelength and amplitude of a wave from a graphical representation of the electric or magnetic field value as a function of position at a given time instant and vice versa, or construct an equation relating the frequency or period and amplitude of a wave from a graphical representation of the electric or magnetic field value at a given position as a function of time and vice versa.
- The student is able to design an experiment to determine the relationship between periodic wave speed, wavelength, and frequency and relate these concepts to everyday examples.
- The student is able to create or use a wave front diagram to demonstrate or interpret qualitatively the observed frequency of a wave, dependent upon relative motions of source and observer.
- The student is able to make claims and predictions about the net disturbance that occurs when two waves overlap. Examples should include standing waves.
- The student is able to construct representations to graphically analyze situations in which two waves overlap over time using the principle of superposition.
- The student is able to make claims about the diffraction pattern produced when a wave passes through a small opening, and to qualitatively apply the wave model to quantities that describe the generation of a diffraction pattern when a wave passes through an opening whose dimensions are comparable to the wavelength of the wave.
- The student is able to qualitatively apply the wave model to quantities that describe the generation of interference patterns to make predictions about interference patterns that form when waves pass through a set of openings whose spacing and widths are small compared to the wavelength of the waves.

- The student is able to predict and explain, using representations and models, the ability or inability of waves to transfer energy around corners and behind obstacles in terms of the diffraction property of waves in situations involving various kinds of wave phenomena, including sound and light.
- The student is able to use representations of individual pulses and construct representations to model the interaction of two wave pulses to analyze the superposition of two pulses.
- The student is able to design a suitable experiment and analyze data illustrating the superposition of mechanical waves (only for wave pulses or standing waves).
- The student is able to design a plan for collecting data to quantify the amplitude variations when two or more traveling waves or wave pulses interact in a given medium.
- The student is able to analyze data or observations or evaluate evidence of the interaction of two or more traveling waves in one or two dimensions (i.e., circular wave fronts) to evaluate the variations in resultant amplitudes.
- The student is able to refine a scientific question related to standing waves and design a detailed plan for the experiment that can be conducted to examine the phenomenon qualitatively or quantitatively.
- The student is able to predict properties of standing waves that result from the addition of incident and reflected waves that are confined to a region and have nodes and antinodes.
- The student is able to plan data collection strategies, predict the outcome based on the relationship under test, perform data analysis, evaluate evidence compared to the prediction, explain any discrepancy and, if necessary, revise the relationship among variables responsible for establishing standing waves on a string or in a column of air.
- The student is able to describe representations and models of situations in which standing waves result from the addition of incident and reflected waves confined to a region.
- The student is able to challenge with evidence the claim that the wavelengths of standing waves are determined by the frequency of the source regardless of the size of the region.
- The student is able to calculate wavelengths and frequencies (if given wave speed) of standing waves based on boundary conditions and length of region within which the wave is confined, and calculate numerical values of wavelengths and frequencies. Examples should include musical instruments.
- The student is able to use a visual representation to explain how waves of slightly different frequency give rise to the phenomenon of beats.
- The student is able to make claims using connections across concepts about the behavior of light as the wave travels from one medium into another, as some is transmitted, some is reflected, and some is absorbed.
- The student is able to make predictions about the locations of object and image relative to the location of a reflecting surface. The prediction should be based on the model of specular reflection with all angles measured

relative to the normal to the surface.

- The student is able to describe models of light traveling across a boundary from one transparent material to another when the speed of propagation changes, causing a change in the path of the light ray at the boundary of the two media.
- The student is able to plan data collection strategies as well as perform data analysis and evaluation of the evidence for finding the relationship between the angle of incidence and the angle of refraction for light crossing boundaries from one transparent material to another (Snell's law).
- The student is able to make claims and predictions about path changes for light traveling across a boundary from one transparent material to another at non-normal angles resulting from changes in the speed of propagation.
- The student is able to plan data collection strategies, and perform data analysis and evaluation of evidence about the formation of images due to reflection of light from curved spherical mirrors.
- The student is able to use quantitative and qualitative representations and models to analyze situations and solve problems about image formation occurring due to the reflection of light from surfaces.
- The student is able to use quantitative and qualitative representations and models to analyze situations and solve problems about image formation occurring due to the refraction of light through thin lenses.
- The student is able to plan data collection strategies, perform data analysis and evaluation of evidence, and refine scientific questions about the formation of images due to refraction for thin lenses.
- The student is able to make qualitative comparisons of the wavelengths of types of electromagnetic radiation.
- The student is able to describe representations and models of electromagnetic waves that explain the transmission of energy when no medium is present.
- The student is able to support the photon model of radiant energy with evidence provided by the photoelectric effect.
- The student is able to select a model of radiant energy that is appropriate to the spatial or temporal scale of an interaction with matter.
- The student is able to make predictions about using the scale of the problem to determine at what regimes a particle or wave model is more appropriate.
- The student is able to articulate the evidence supporting the claim that a wave model of matter is appropriate to explain the diffraction of matter interacting with a crystal, given conditions where a particle of matter has momentum corresponding to a de Broglie wavelength smaller than the separation between adjacent atoms in the crystal.
- The student is able to predict the dependence of major features of a diffraction pattern (e.g., spacing between interference maxima), based upon the particle speed and de Broglie wavelength of electrons in an electron beam interacting with a crystal. (de Broglie wavelength need not be given, so students may need to obtain it.)

Learning Design

WGSD Curriculum -- Plants and People

Garden Design

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS Science and Engineering Practices: **6.Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. ● Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS2-3) ● Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-LS2-7)

Learning Goal	Proficiency Scales

Students will be able to apply the key design components of different styles of gardens.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● incorporating learned principles in their dream garden designs. (HS-LS2-3, HS-LS2-7) ● considering light exposure and other factors in their designs.(HS-LS2-3, HS-LS2-7) ○ proficiency scale missing information about researching or investigating garden types, soil composition, temperature regulation, water and nutrient reliance, etc. ○ The level 3 needs more detail about what exactly students will be demonstrating. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *analogous* vs *complementary color schemes, line, form, texture, balance, transition, rhythm,* and *focalization.* ● performing specific processes, such as designing a garden with appropriate plants and to an appropriate scale. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Describe and use basic landscaping principles
- Design their “dream garden” using the bubble site plot method

• Define, describe, and understand the concepts of a particular type of garden (eg. Japanese, vegetable, roof-top, perennial border, and xeriscape)
Learning Design

WGSD Curriculum -- Plants and People

Photosynthesis

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

Learning Goal	Proficiency Scales
Students will be able to describe the process of photosynthesis.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● dividing the photosynthetic process into the light and dark reactions. ● describing the structures of chloroplasts and their roles in photosynthesis. ● comparing various carbon-fixing pathways (C_3,C_4, CAM). 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary such as: *photosynthesis, ATP, chlorophyll,* and *chloroplast*. ● performing specific processes, such as listing the reactant and products of photosynthesis.

	1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets
- Explain the role of energy in life.   - Describe the structure of ATP and its role in life processes.   - Provide the chemical reaction that describes photosynthesis.   - Identify the importance of pigments and light to photosynthesis.   - Describe the structure of a chloroplast.   - List the reactants and products of the light and dark reaction of photosynthesis.
Learning Design

WGSD Curriculum -- Plants and People

Plant Anatomy

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

Learning Goal	Proficiency Scales
Students will be able to recognize and name the anatomical features and functions of plants.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● modeling the form and function of different plans. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary related to flower, leaf, stem, root and seed anatomy. ● performing specific processes, such as contrasting monocots and dicots. ● labelling plant parts of dissected specimens. ● describing functions of plant parts. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Identify and describe parts of a flower
- Identify parts of a leaf and ways of describing them
- Describe the structure of angiosperm stems and distinguish them from monocot stems
- Distinguish types of roots and their basic structures

Learning Design

WGSD Curriculum -- Plants and People

Plant Endangerment

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. NGSS-HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

Learning Goal	Proficiency Scales
Students will be able to analyze the ways human activities affect the habitats and populations of plants.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● describing the political, economic, and social causes of loss of biodiversity and measures employed to protect endangered plants. ● evaluating the potential values (medicinal, aesthetic, recreational, moral, and ethical) that endangered plants might have against the costs/benefits of conservation efforts. ● describing the effects of genetic modification on plant populations. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary such as *endangered, threatened, extirpated, extinct, extant*, *biodiversity, aesthetic,*

	endangered, conservation, and rare. ● performing specific processes, such as list the major human-caused activities that most negatively impact biodiversity. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Use the internet to learn the status, habitat requirements, threats, and conservation efforts of a plants of conservation concern in Missouri
- Classify and rate the various threats faced by endangered and threatened species globally as well as specifically in Missouri
- Predict possible future impacts to human well-being by continued loss of biodiversity
- Compare the extent of the endangerment problem, it's impact, and the allocation of funds, of plants with other types of organisms
- Distinguish between the terms extant, extirpated and extinct
- Distinguish the terms used to describe organisms of conservation concern
- Discuss the causes and possible effects of plant extinction
- Explain who the key players are in the field of conservation in the United States

Learning Design

WGSD Curriculum -- Plants and People
Plant Propagation
DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

Learning Goal	Proficiency Scales
Students will be able to apply different methodologies to start new plants.	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● analyzing factors affecting seed storage and germination. ● applying specific techniques to initiate germination of seeds of plants with inhibitory hormones. ● modeling how humans and other animals impact plant propagation. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *stratification, germination, scarification, Auxin, recalcitrant seed* and *orthodox seed.* ● performing specific processes, such as: ○ propagating plants by seed and by cuttings. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets
• Stratify (cold treatment) or scarify (nick) seeds that need pretreatment for germination • Take cuttings, apply rooting hormone, and propagate a variety of plants by cutting • Describe basic horticultural practices like plant seeds at the right depth, potting and repotting, using fertilizers, and pruning
Learning Design

WGSD Curriculum -- Plants and People

Plant Physiology

DRAFT

High Priority Standards (CCSS, State, National, TILS, CREDE, etc.)
NGSS-HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms NGSS-HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

Learning Goal	Proficiency Scales
Students will be able to categorize various plant hormones."	4: The student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: The student demonstrates mastery of the learning goal by ● explaining the source, path, destination, and effect of various hormones. ● comparing the relative importance of hormones in plants and animals. ● describing plant homeostasis and environmental adaptation based on various plant hormones. 2: The student demonstrates he/she is nearing proficiency by ● recognizing or recalling specific vocabulary, such as: *hormones,*

	source and sink, photoperiodism, geotropism, thigmotropism, adventitious root, apical dominance, and herbicidal. ● performing specific processes, such as connecting hormone activity to plant growth, development and senescence. 1: The student demonstrates limited understanding or skill with the learning goal.

Learning Targets

- Explain how water, minerals and plant products move into, through, and out of plants
- Describe the role of hormones in plant tropisms
- Know the important plant hormones and their roles
- Use auxin to promote the rooting of plant cuttings

Learning Design

WGSD Curriculum
Science Department

Course: Science Independent Research
Grade Level: 11-12

LG 1: The curriculum for this course is co-developed with the student and teacher.