

Delaware Content Standards Grade Band Extensions

Science



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Introduction

The Delaware Department of Education, in collaboration with the Center for Disabilities Studies at the University of Delaware, developed the Delaware Content Standards Grade Band Extensions to make the content standards accessible to all students.

Grade Band Extensions

The extensions are designed to assist teachers in providing access to the general education curriculum for students with significant intellectual disabilities. Students receiving instruction based on the grade band extensions (GBEs) total approximately 1% of Delaware's student population and are assessed through the Delaware Comprehensive Assessment System Alternate Assessment (DCAS-Alt1).

For the development of Science and Social Studies GBEs, Grade Level Expectations (academic skills) from the Delaware Content Standards were identified within the following grade bands: K-3, 4-5, 6-8, and High School. For each skill, three levels of extensions were created from highest to lowest complexity. Extensions are meant to provide a continuum of entry points related to the Science and Social Studies standards. Following the full text of the Grade Level Expectation, the extensions are organized as follows:

Extension 1—Most complex application of the skill

Extension 2—Less complex application of the skill

Extension 3—Least complex application of the skill

Within each grade band, Grade Level Expectations were selected from the highest grade. If a concept was not represented within the highest grade, a Grade Level Expectation that reflects the concept was included from a lower grade. Some Grade Level Expectations within specific grade bands were not extended due to the complexity of the skills and are not included in this document.

Please note, students should not be categorized according to a particular extension level. Instead, instruction should target extensions appropriate to individual strengths, which may vary by skill.

Purpose

The extensions will be used by school personnel to plan and implement lessons based on academic standards. In planning academic activities, teachers must consider incorporation of non-academic skills necessary for student success such as communication, self-determination, gross/fine motor, and social skills.

Additionally, the extensions will be the basis of the DCAS-Alt1. Test items will be aligned to the extensions. Therefore, it is imperative that students receive instruction aligned to the extensions throughout the school year.

Considerations for Use

The Delaware Content Standards Grade Band Extensions do not specify individual accommodations or supports that may be necessary for students to access the curriculum. When designing lessons based on the extensions, teachers should consider the unique learning needs of each student and employ the necessary accommodations.

In addition to considering accommodations, teachers should reference the complete Delaware Content Standards document for additional information related to implementation of the standards. The Delaware Grade Band Extensions are not meant to replace the Delaware Content Standards but to be used as a companion document. To view the Delaware Content Standards, visit the Delaware Department of Education website at www.doe.k12.de.us.

Navigating the Delaware Grade Band Extensions

The document is divided by **grade bands** as identified in the shaded bar at the top of each page: K-3, 4-5, 6-8, HS.

Standards define what students should understand and be able to do.

Enduring Understandings are statements summarizing important ideas and core processes that are central to a discipline and have lasting value beyond the classroom.

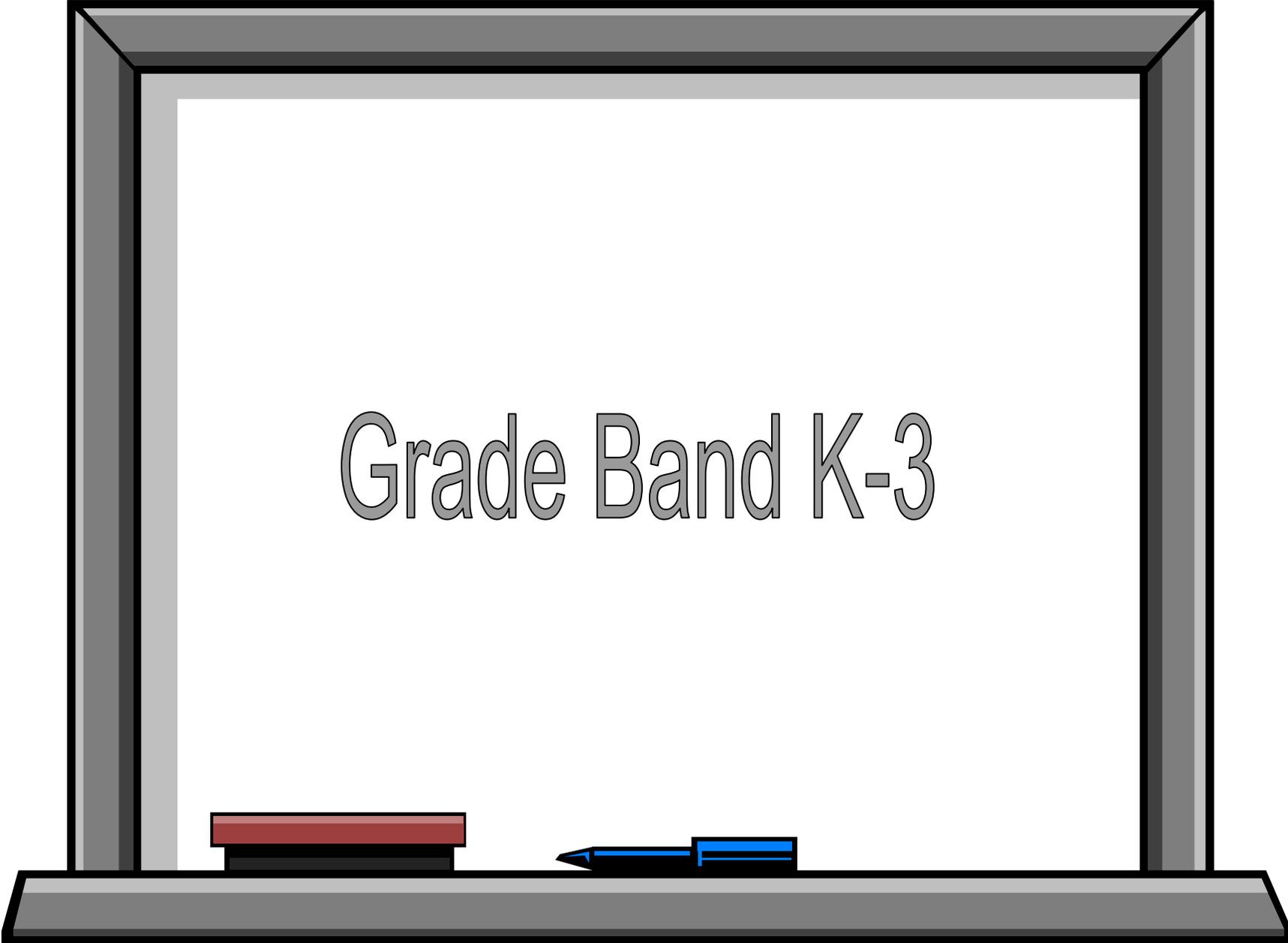
Grade Level Expectations (GLEs) are grade-specific academic skills.

Essence is the main idea of the GLE.

Extensions are entry points to the GLE.

Grade Band
↓

| | | |
|--------------------------|---|--|
| Standard → | Nature and Application of Science and Technology | 4-5 |
| Enduring Understanding → | 1 - Scientific inquiry involves asking scientifically-oriented questions, collecting evidence, forming explanations, connecting explanations to scientific knowledge and theory, and communicating and justifying the explanation. | |
| | 5.1 | Generate focused questions and informed predictions about the natural world. Essence: Questions and predictions about the natural world E1: Use observations to make specific predictions about the natural world. E2: Ask focused questions about the natural world. E3: Utilize the five senses to observe/explore the natural world. |
| GLE → | 5.2 | Design and conduct simple to multi-step investigations in order to test predictions. Keep constant all but the condition being tested. Essence: Conduct a multi-step investigation E1: Create a multi-step plan to explore a question or prediction. E2: Follow a multi-step plan to observe/investigate questions or predictions. E3: Given a multi-step plan, identify materials that are needed. |
| Essence → | 5.3 | Accurately collect data using observations, simple tools and equipment. Display and organize data in tables, charts, diagrams, and bar graphs or plots over time. Compare and question results with and from others. Essence: Collect, record, and compare data |
| Extensions → | | E1: Collect, display, and compare data from multiple sources. E2: Collect and display data in a given chart. E3: Record data in a given chart or table. |



Grade Band K-3

1 - Scientific inquiry involves asking scientifically-oriented questions, collecting evidence, forming explanations, connecting explanations to scientific knowledge and theory, and communicating and justifying the explanation.

- 3.1 Generate questions and predictions using observations and exploration about the natural world.
Essence: Questions and predictions about the natural world
E1: Use observations to make predictions about the natural world.
E2: Ask questions about the natural world.
E3: Utilize the five senses to observe/explore the natural world.
- 3.2 Generate and follow simple plans using systematic observations to explore questions and predictions.
Essence: Follow simple plans to explore questions or predictions
E1: Create a simple plan to explore a question or prediction.
E2: Follow a given plan to observe/investigate questions or predictions.
E3: Given a plan, identify materials that are needed.
- 3.3 Collect data using observations, simple tools and equipment. Record data in tables, charts, and bar graphs. Compare data with others to examine and question results.
Essence: Collect, record, and compare data
E1: Collect and compare data from multiple sources.
E2: Collect and display data in a given chart.
E3: Identify data in a given chart or table.
- 3.4 Construct a simple explanation by analyzing observational data. Revise the explanation when given new evidence or information gained from other resources or from further investigation.
Essence: Explanations based on data
E1: Based on data collected from observations construct an explanation to answer the initial question/prediction.
E2: Given additional data, determine if the initial explanation needs to be revised.
E3: Match the cause with the effect based on observations.
- 3.5 Share simple plans, data, and explanations with an audience and justify the results using the evidence from the investigation.
Essence: Report and explain observations
E1: State conclusions based on the data.
E2: Explain observations while following the plan.
E3: Select descriptive words that correspond with observations.
- 3.6 Use mathematics, reading, writing, and technology when conducting an investigation and communicating the results.
Essence: Integrate reading, writing, math, or technology into scientific investigations
No extensions available - Multiple content areas should be incorporated into scientific investigations.

1 - The structures of materials determine their properties.

- 1.2 Sort and group solids based on physical properties such as color, shape, ability to roll or stack, hardness, magnetic attraction, or whether they sink or float in water.
Essence: Attributes of solids
E1: Sort and group solids based on physical attributes.
E2: Given the attributes of a solid, match the corresponding objects.
E3: Sort and group given solids based on color, size, or shape.
- 1.4 Sort and group liquids based on physical properties such as color, odor, tendency to flow, and whether they sink or float.
Essence: Attributes of liquids
E1: Sort and group liquids based on physical properties.
E2: List attributes of liquids.
E3: Group liquids based on given properties.
- 1.7 Observe and describe changes in the physical properties of solids and liquids after exposure to various treatments (i.e., temperature, sunlight, water).
Essence: Impact of treatments on physical properties
E1: Describe changes to solids and liquids after exposure to treatments.
E2: Identify changes to solids or liquids after exposure to treatments.
E3: Match changes in physical properties (e.g., ice melting and ice cream melting).
- 2.1 Use an equal arm balance to weigh and compare a variety of objects and recognize that weighing is the process of balancing an object against a certain number of standard units.
Essence: Weigh objects
E1: Balance both sides of a scale when given an object on one side.
E2: Given an object on one side of a balancing scale, identify if more or less weight needs to be added to balance the scale.
E3: Given an object on each side of a balancing scale, identify if they are equal.
- 2.2 Predict the serial order for the weights of a variety of objects and test these predictions by weighing the objects.
Essence: Order objects by weight
E1: Predict the weight of given objects by ordering objects from lightest to heaviest or vice versa.
E2: Order a set of objects from lightest to heaviest or vice versa by weighing them.
E3: Given two objects, identify which object is heavier or lighter.
- 2.3 Recognize that equal volumes of different materials may have different weights.
Essence: Volume and weight
E1: Given equal volumes of different objects, describe the difference in weight.
E2: Given two objects of equal volume, identify which object is heavier or lighter.
E3: Given two objects of equal volume, identify if there is a difference in weight.

1 - The structures of materials determine their properties. (continued)

- 3.1 Explore evaporation and condensation. Identify the changes of state from liquid to gas in evaporation and gas to liquid in condensation using water as an example.
Essence: Evaporation and condensation
E1: Describe characteristics of condensation and evaporation.
E2: Identify changes in water as evaporation or condensation.
E3: Observe a demonstration (e.g., steam rising from a cup, ice water forming condensation on the outside of a glass) and label as condensation or evaporation.
- 3.2 Observe and describe changes in the properties of water as it changes from solid to liquid to gas.
Essence: Changes in water properties
E1: Describe the properties of water as it changes to a different state (e.g., solid to liquid to gas).
E2: When given examples, identify the state of water as solid, liquid, or gas.
E3: Categorize given examples as solid, liquid, or gas.

1 - Energy takes many forms. These forms can be grouped into types of energy that are associated with the motion of mass (kinetic energy), and types of energy associated with the position of mass and with energy fields (potential energy).

- 2.1 Identify that objects that move have energy because of their motion. Demonstrate that a hanging mobile has energy because of its motion and the mobile was given this energy by the push of moving air.
Essence: Energy of moving objects
E1: Identify what makes objects move.
E2: Match a moving object with its cause of motion.
E3: Distinguish between moving and nonmoving objects.
- 3.1 Identify heat energy as the energy that makes things warmer.
Essence: Heat energy
E1: Provide examples of heat energy.
E2: Identify objects that use heat energy.
E3: Sort given objects into groups of hot or cold.
- 3.2 Identify electrical energy as a form of energy that is used to operate many of our machines and tools.
Essence: Electrical energy
E1: Identify objects that need electricity to operate.
E2: Identify items within a given set that use electricity to operate.
E3: Sort given objects based on their use of electricity.

2 - Changes take place because of the transfer of energy. Energy is transferred to matter through the action of forces. Different forces are responsible for the transfer of the different forms of energy.

- K.1 Demonstrate that the position of an object can be above or below, in front of or behind, or to the left or right of another object.
Essence: Position of objects
E1: Move an object to various positions and identify the position (e.g., front, behind, below).
E2: Place an object in the specified position.
E3: Change the position of any given object.
- 2.1 Investigate how to change an object's movement by giving it a push or pull. Demonstrate that the greater the force, the greater the change in motion of the object. Summarize this understanding through the use of visuals or writing.
Essence: Movement of objects
E1: Push and pull an object with increasing force and record results.
E2: Identify if more or less force is needed to move the object closer to an ending point.
E3: Move an object by pulling or pushing.
- 3.1 Determine the effect of adding heat energy (warming) or removing heat energy (cooling) on the properties of water as it changes state (gas to liquid to solid, and vice versa).
Essence: Properties of water
E1: Describe what happens to ice when heat is added.
E2: Given examples of the properties of water, match to the corresponding state.
E3: Given water properties, identify as a solid or liquid.

2 - Changes take place because of the transfer of energy. Energy is transferred to matter through the action of forces. Different forces are responsible for the transfer of the different forms of energy. (continued)

- 3.2 Investigate and describe what happens when an object at a higher temperature is placed in direct contact with an object at a lower temperature. Record data and use the data to describe which way the heat energy is moving between the objects.
Essence: Heat energy and temperature
E1: Describe the movement of heat energy when hot and cold objects come into contact with each other.
E2: Combine hot and cold objects and identify if the objects become cooler or warmer.
E3: Given objects previously exposed to hot or cold, sort by current temperature.
- 3.3 Demonstrate that energy of motion can be transferred from one object to another (e.g., moving air transfers energy to make a pinwheel spin). Give examples of energy transfer from one object to another.
Essence: Energy transfer
E1: Demonstrate the transfer of energy through motion and give examples.
E2: Given examples of moving objects, identify the source of energy.
E3: Provide energy from different sources.
- 3.4 Simulate how bones, muscles, and joints in the human body work to transfer energy to objects, making them move.
Essence: Transfer of body energy to objects
E1: Demonstrate how the transfer of body energy can make an object move.
E2: Move a body part to make an object move.
E3: Identify a body part that can move an object.

3 - Energy readily transforms from one form to another, but these transformations are not always reversible. The details of these transformations depend upon the initial form of the energy and the properties of the materials involved. Energy may transfer into or out of a system and it may change forms, but the total energy cannot change.

- 1.1 Investigate what happens to the temperature of an object when it is placed in direct sunlight. Record data and conclude that the energy in the sunlight was changed into heat energy in the object.
Essence: Energy of the Sun
E1: Conduct an investigation on the effect sunlight has on temperature.
E2: Identify if an object becomes warmer in sunlight.
E3: Sort objects by hot and cold temperatures.
- 1.2 Compare what happens when sunlight strikes dark and light colored objects.
Essence: Energy of the Sun
E1: Describe the impact the Sun has on different colors.
E2: Given objects of different colors that have been exposed to the Sun, identify which color is warmer.
E3: Match given physical characteristics with the corresponding temperature (e.g., ice cube as cold and boiling water as hot).

4 - People utilize a variety of resources to meet the basic and specific needs of life. Some of these resources cannot be replaced. Other resources can be replenished or exist in such vast quantities they are in no danger of becoming depleted. Often the energy stored in resources must be transformed into more useful forms and transported over great distances before it can be helpful to us.

3.1 Investigate and describe how moving water and air can be used to make objects and machines, such as a waterwheel and windmill, move.

Essence: Motion of water and air

E1: Conduct an investigation to determine if air or water can make a given object move.

E2: Describe the source of energy used to make a given object move.

E3: Categorize whether an object is moved by wind or water.

1 - There are observable, predictable patterns of movement in the Earth, Moon, and Sun System that account for day and night.

- K.1 Describe the shape of the Earth as being like a sphere and describe how a globe models this shape.
Essence: Earth's shape
E1: Describe the shape of the Earth.
E2: Identify objects that are the same shape as the Earth.
E3: Sort spheres from other three-dimensional objects.
- 1.1 List objects that can be observed in the sky in the daytime and objects that can be observed in the sky at nighttime. Discuss which objects are on which lists (e.g., the Moon can be observed sometimes in the day and sometimes at night).
Essence: Objects found in the sky
E1: Identify objects that can be found in the sky according to the time of day.
E2: Sort given objects based on the time of day they can be observed.
E3: Identify if given objects are found in the sky.
- 1.2 Safely observe the location of the Sun at the same time in the morning, noon, and afternoon over several days. Describe the Sun's movement across the sky over the course of the day.
Essence: Positioning of the Sun
E1: Record the position of the Sun in the sky at different times during the day.
E2: Given a diagram, trace the movement of the Sun at different times during the day.
E3: Given an illustration, identify if the Sun has changed positions during the course of the day.
- 1.3 Observe the Moon in the day sky over several months. Draw a sequence of pictures that shows the repeating cyclic pattern of the Moon.
Essence: Cyclic patterns of the Moon
E1: Use a calendar to record the position of the Moon over the course of a month.
E2: Given pictures, sequence phases of the Moon.
E3: Identify given objects as half or whole.
- 1.4 Use simple models to demonstrate how Earth's rotation causes day and night.
Essence: Earth's rotation
E1: Match the time of day to the position of the Sun.
E2: Given a model, identify day and night.
E3: Model the rotation of the Earth.

2 - Technology expands our knowledge of the Earth, Moon, and Sun System.

- K.1 Describe how binoculars help our sense of sight by allowing us to magnify objects in the sky.
Essence: Binoculars
E1: Compare objects viewed with and without binoculars.
E2: Identify binoculars from a group of tools that magnify.
E3: Identify tools that magnify.

1 - Earth's systems can be broken down into individual components which have observable measurable properties.

- 1.1 Identify the Earth materials (i.e., rocks, soil, water, air) found in aquatic and terrestrial environments.
Essence: Earth materials
E1: Identify Earth materials.
E2: Identify an Earth material found in the ocean.
E3: Given a set of objects, identify Earth materials.
- 3.1 Examine rocks in order to observe their composition and describe the many components found in rocks.
Essence: Rock components
E1: Given various rocks, describe the similarities and differences.
E2: Identify characteristics of a rock.
E3: Distinguish rocks from other objects.
- 3.2 Identify minerals as materials that cannot be physically broken apart any further and may be a rock component.
Essence: Minerals
E1: Describe how minerals make up rocks.
E2: Identify where minerals can be found.
E3: Given a set of objects, identify a mineral.
- 3.4 Sort and group minerals based on the physical properties of hardness, color, luster, and reaction to vinegar (weak acid). Use these properties to identify common minerals (quartz, fluorite, calcite, and gypsum).
Essence: Properties of minerals
E1: Sort minerals based on physical properties.
E2: Sort given minerals based on luster.
E3: Identify if a given substance is a mineral.
- 3.5 Describe water in terms of its observable properties (transparency, shapelessness, flow).
Essence: Properties of water
E1: List physical properties of water.
E2: Identify a property of water.
E3: Distinguish water from other liquids.

2 - Earth's components form systems. These systems continually interact at different rates of time, affecting the Earth locally and globally.

- 1.2 Demonstrate that there is air all around and that the wind is moving air. Use instruments to qualitatively measure wind speed and describe this by using a simplified Beaufort scale.
Essence: Wind speed
E1: Describe wind speed using a Beaufort Scale.
E2: Use instruments to measure wind speed.
E3: Identify a source of wind.

2 - Earth's components form systems. These systems continually interact at different rates of time, affecting the Earth locally and globally. (continued)

- 1.3 Use a thermometer to measure temperature in degrees Fahrenheit. Describe how hot or cold an object or weather event feels by using a thermometer.
Essence: Thermometers
E1: Use a thermometer to determine the temperature of an object.
E2: Describe if a given temperature is hot or cold.
E3: Given an object, identify if it is hot or cold.
- 1.4 Identify three basic cloud types (cirrus, cumulus, stratus) all of which are made of water and/or ice. Conclude that wind moves clouds in the sky.
Essence: Types of clouds
E1: Identify the three types of clouds.
E2: Given descriptive words, identify characteristics of clouds.
E3: Given a set of pictures, identify a cloud.
- 1.5 Use a rain gauge to measure precipitation and describe how this measurement would change when frozen precipitation such as snow or ice melts.
Essence: Measuring precipitation
E1: Use a rain gauge to measure the amount of precipitation.
E2: Given a set of measuring tools, identify a rain gauge.
E3: Given a set of pictures, identify rain.
- 1.6 Organize weather data on graphs and on long-term data collection charts and use this data to describe typical seasonal weather patterns.
Essence: Weather patterns
E1: Record daily weather conditions on a graph or chart and identify which type of weather occurs the most.
E2: Given a graph or chart, keep a daily record of weather conditions.
E3: Given descriptive words, identify the weather.
- 1.7 Describe different weather conditions and discuss how these conditions affect plants, animals, and human activity.
Essence: Weather conditions
E1: Describe how the weather affects plants or animals.
E2: Identify how the weather affects people.
E3: Given descriptive words, identify the weather.
- 2.1 Use worms to enhance decomposition of plant material in composting. Explain how composting is an effective method to recycle plants and other discarded organic matter.
Essence: Composting
E1: Identify the benefits of composting.
E2: Identify a material that can be found in compost.
E3: Categorize materials as compostable or not compostable.

3 - Technology enables us to better understand Earth's systems. It also allows us to analyze the impact of human activities on Earth's systems and the impact of Earth's systems on human activity.

3.1 Examine an assortment of rocks and use appropriate measuring tools (balances, meter tapes, syringes) to gather data about the rocks' physical properties (length, circumference, weight).

Essence: Properties of rocks

E1: Conduct an investigation to identify physical properties of various rocks.

E2: Identify tools used to measure rocks.

E3: Given an assortment of rocks, sort by size.

3.2 Identify rocks and minerals as natural resources and list ways that humans use these resources to meet needs and wants (i.e., fluorite for toothpaste, marble for statues).

Essence: Rocks and minerals

E1: List ways humans use rocks and minerals.

E2: Identify if a given product is a natural resource.

E3: Identify given objects as a rock or a mineral.

1 - Living systems demonstrate the complementary nature of structure and function.

- K.2 Identify the five sense structures and tell which sense is associated with which structure.
Essence: Five senses
E1: Given a body part, identify the corresponding sense.
E2: Identify the five senses.
E3: Identify body parts that relate to the five senses.
- 1.3 Identify and describe structures of plants and animals that help them survive in aquatic and terrestrial environments.
Essence: Structures help living things survive
E1: Identify structures of plants and animals.
E2: Distinguish between plants and animals.
E3: Identify living and nonliving things.
- 2.4 Observe common structures of different insects (e.g., mouth parts or legs). Describe the similarities and differences among the structures. Recognize that the structure is related to the function it performs (e.g., a caterpillar mouth for chomping leaves differs from a butterfly proboscis for obtaining nectar).
Essence: Insect structures
E1: Identify similarities and differences between the structures of insects.
E2: Identify structures of insects.
E3: Distinguish insects from animals.
- 3.1 Describe how bones, muscles, and joints function together in humans to enable movement, protection and support.
Essence: Bone, muscle, and joint functions
E1: Describe how a muscle moves the bone.
E2: Identify a body part protected by a muscle or bone.
E3: Given a model, identify bones.
- 3.2 Identify the structures of different types of joints (gliding, hinged, ball and socket) and describe the movement enabled by each. Recognize the importance of each type of joint to human movement.
Essence: Types of joint movement
E1: Match joint type to the corresponding movement.
E2: List the types of joints.
E3: Locate joints on a model of the human body.
- 3.3 Compare and contrast the structure and function of the human skeleton to that of other vertebrate animals.
Essence: Skeleton's structure and function
E1: List differences and similarities between a human skeleton and an animal skeleton.
E2: Given a model of a human and animal skeleton, identify differences or similarities.
E3: Given models, distinguish a human skeleton from an animal skeleton.

2 - All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.

- 2.2 Observe a variety of plants and animals. Compare specific needs that are common to plants or animals of the same group (i.e., all fish need water but some fish need cold water to live and some need warm water to live, all plants need water but some need a humid environment and some need a dry environment).
Essence: Needs of living things
E1: Compare basic needs of plants, animals, and humans.
E2: Identify basic needs of plants and animals.
E3: Identify if given examples are basic human needs.
- 3.1 Explain that humans have basic needs for survival as do other animals. Recognize that, like other animals, these basic needs may be specific, such as range of temperature and nutrients.
Essence: Animal and human needs for survival
E1: Compare human needs to animal needs.
E2: Identify factors that affect human needs.
E3: Given a specific need, identify if it is a human need.

3 - Organisms respond to internal and external cues, which allow them to survive.

- 3.1 Recognize that muscles move bones in response to signals from the brain.
Essence: Brain signals and muscle responses
E1: Describe what makes bones and muscles move in the human body.
E2: Identify the organ that makes your bones and muscles move.
E3: Given a diagram of the human body, identify the brain.
- 3.2 Conduct simple investigations to determine and describe how different body parts respond to visual, auditory, and tactile stimuli.
Essence: Body's responses to external stimuli
E1: Conduct an investigation to determine how the body responds to various stimuli.
E2: Given a stimulus, identify the responding body part.
E3: Respond to a given stimulus.

4 - The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.

- 3.1 Research and report on common diseases or problems of the muscular and skeletal systems. Explain how these systems can be affected by external factors (i.e., bones can be broken and healed, good nutrition leads to strong bones).
Essence: External factors that affect the body
E1: Identify a disease or problem that can occur in the muscular or skeletal system.
E2: List external factors that can affect good bone health.
E3: Given an external factor, identify if it will affect the health of bones or muscles.

1 - Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.

- 1.3 Describe similarities and differences between parents and offspring, such as size and color.
Essence: Parents and offspring
E1: Contrast parents and offspring.
E2: Compare parents and their offspring.
E3: Match a parent to its offspring based on given characteristics.
- 2.1 Observe the life cycle of a selected organism (e.g., plant, butterfly, frog, etc.) and recognize that the stages of the life cycle are predictable and describable.
Essence: Life cycles
E1: Given a part of the life cycle, predict the next step.
E2: Sequence the given parts of the life cycle of plants or animals.
E3: Identify one part of the life cycle of a plant or animal.
- 3.1 Observe and describe similarities and differences in the skeleton of an infant to that of an adult human. Recognize that as a human grows and develops the number of bones does not change but the sizes of the bones do change.
Essence: Bone development of children to adults
E1: Compare bone sizes of an adult and infant.
E2: Given models of bones, identify as adult or infant based on size.
E3: Given a skeleton, identify a bone.

2 - The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.

- 3.1 Recognize that there are many different kinds of vertebrates in the world. One way to sort or group vertebrates is according to the structure and function of their skeletons (i.e., bird wings and human arms).
Essence: Structures and functions of skeletons
E1: Sort animals based on similar functions of their skeletal systems.
E2: Match characteristics of skeletal functions to corresponding animals.
E3: Match a given function to the corresponding body part.

3 - The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human needs and wants.

- 3.1 Recognize that technology extends the sense of sight for observing bones, muscles and joints in greater detail (i.e., X-Rays).
Essence: Use of technology in science
E1: Discuss the benefits of technology that increase visibility of the human body.
E2: Identify a device that can be used to observe muscles, joints, and bones in greater detail.
E3: Identify if a magnifying glass makes things larger or smaller.

1 - Organisms and their environments are interconnected. Changes in one part of the system will affect other parts of the system.

- 2.1 Describe the effects that result from plants, insects, and other animals changing the environment in which they live (e.g., worms make tunnels in the earth, crickets eat the grass).
Essence: Environmental changes
E1: Match organisms with how they affect the environment.
E2: Given organisms, place each in the corresponding environment.
E3: Identify living organisms.
- 2.2 Observe the plants and animals living in an environment. Identify ways in which plants and animals benefit from each other (e.g., animals use plants for food and shelter, and plants need insects to spread pollen).
Essence: Plants and animals benefit from each other
E1: Identify organisms that benefit from one another.
E2: Given organisms, match those that benefit each other.
E3: Categorize given examples as plants or animals.
- 2.3 Observe and describe the effects of plant and animal overcrowding in a given space (i.e., many guppies in an aquarium, many beetles in a habitat). Recognize that this overcrowding results in an increased need for basic resources.
Essence: Overcrowding
E1: Identify the effects of overcrowding (e.g., not enough food, water, and space).
E2: Given descriptions, identify characteristics of overcrowding.
E3: Given a model, identify the amount of a specific animal as many or few.

2 - Matter needed to sustain life is continually recycled among and between organisms and the environment. Energy from the Sun flows irreversibly through ecosystems and is conserved as organisms use and transform it.

- 2.1 Investigate how natural composting recycles plants and other discarded organic matter. Recognize the importance of this process to the environment.
Essence: Conservation of matter
E1: Identify benefits of composting.
E2: Identify if given items can be composted.
E3: Identify if given items are recyclable.

3 - Humans can alter the living and non-living factors within an ecosystem, thereby creating changes to the overall system.

- 3.1 Describe the changes to the environment that result from humans obtaining rock and mineral resources (e.g., strip mining).
Essence: Impact of human activity on the environment
E1: Identify types of human activities that can be harmful to the environment.
E2: Given materials, identify the human use.
E3: Match given materials to corresponding human use.



Grade Band 4-5

1 - Scientific inquiry involves asking scientifically-oriented questions, collecting evidence, forming explanations, connecting explanations to scientific knowledge and theory, and communicating and justifying the explanation.

- 5.1 Generate focused questions and informed predictions about the natural world.
Essence: Questions and predictions about the natural world
E1: Use observations to make specific predictions about the natural world.
E2: Ask focused questions about the natural world.
E3: Utilize the five senses to observe/explore the natural world.
- 5.2 Design and conduct simple to multi-step investigations in order to test predictions. Keep constant all but the condition being tested.
Essence: Conduct a multi-step investigation
E1: Create a multi-step plan to explore a question or prediction.
E2: Follow a multi-step plan to observe/investigate questions or predictions.
E3: Given a multi-step plan, identify materials that are needed.
- 5.3 Accurately collect data using observations, simple tools and equipment. Display and organize data in tables, charts, diagrams, and bar graphs or plots over time. Compare and question results with and from others.
Essence: Collect, record, and compare data
E1: Collect, display, and compare data from multiple sources.
E2: Collect and display data in a given chart.
E3: Record data in a given chart or table.
- 5.4 Construct a reasonable explanation by analyzing evidence from the data. Revise the explanation after comparing results with other sources or after further investigation.
Essence: Explanations based on data
E1: Based on data collected from observations, construct an explanation to answer the initial question/prediction.
E2: After comparing data from multiple sources, determine if the initial explanation needs to be revised.
E3: Match the cause with the effect based on observations.
- 5.5 Communicate procedures, data, and explanations to a variety of audiences. Justify the results by using evidence to form an argument.
Essence: Report and explain procedures and data
E1: State conclusions based on the data.
E2: Explain observations while following the procedure.
E3: Select descriptive words that correspond with observations.
- 5.6 Use mathematics, reading, writing, and technology when conducting scientific inquiries.
Essence: Integrate reading, writing, math, or technology into scientific investigations
No extensions available - Multiple content areas should be incorporated into scientific investigations.

1 - The structures of materials determine their properties.

- 4.1 Test objects for their conductivity and classify the objects based on whether they conduct electricity (conductors) or do not conduct electricity (insulators).
Essence: Conductors and insulators
E1: Test objects to determine if they are conductors or insulators.
E2: Sort given objects as conductors or insulators.
E3: Identify objects that need electricity to work.
- 4.2 Test objects for their magnetism and classify objects based on whether they are attracted to a magnet or not attracted to a magnet.
Essence: Magnetism
E1: Describe characteristics of items that are attracted to magnets.
E2: Sort given objects into magnetic or nonmagnetic groups.
E3: Identify objects that are attracted to magnets.
- 4.3 Investigate evaporation and condensation. Recognize the relationship between temperature and changes of state from liquid to gas in evaporation and gas to liquid in condensation using water as an example.
Essence: Evaporation and condensation
E1: Describe the effects temperature has on condensation and evaporation.
E2: Identify the effects temperature has on water (e.g., ice water makes condensation as it gets warmer).
E3: Given different examples, identify if change is caused by an increase or decrease in temperature.

2 - The properties of the mixture are based on the properties of its components.

- 5.1 Separate the components of a mixture by using the physical properties of the components and choosing the appropriate processes (e.g., evaporation, filtering).
Essence: Physical properties of mixtures
E1: Describe the process to separate components by using their physical properties.
E2: Identify a simple technique to separate a mixture.
E3: Create a mixture using the specified components.
- 5.2 Make and implement a plan to separate mixtures. Revise the plan based on evidence collected. Record and communicate the results.
Essence: Separation of mixtures
E1: Implement a plan to separate mixtures and record results.
E2: Given the results of separating a mixture, identify the process.
E3: Given a mixture, identify the components.
- 5.3 Combine different amounts of solid material and water. Compare the properties of these solutions (i.e., color, viscosity, clarity).
Essence: Properties of solutions
E1: Create two solutions (solid and liquid) and identify differences and similarities.
E2: Create two solutions (solid and liquid) and describe characteristics of physical properties (e.g., sticky, slimy, dark, light).
E3: Combine a solid and a liquid to create a solution.

2 - The properties of the mixture are based on the properties of its components. (continued)

5.4 Compare the mass of mixtures and solutions to the mass of their component parts.

Essence: Concept of mass

E1: Describe the changes in mass after combining or separating mixtures or solutions.

E2: Identify the changes in mass after combining or separating mixtures or solutions.

E3: Given two objects or solutions, identify which has the greater mass.

5.5 Determine the quantities of two different materials (e.g., salt and sugar) required to saturate equal volumes of water and compare the results. Recognize that some materials are more soluble in water than other materials.

Essence: Saturation and solubility

E1: Given soluble and insoluble substances, compare the differences when combined with equal amounts of water.

E2: Observe and indicate the solubility of substances when added to water.

E3: Create a solution using soluble and insoluble substances.

3 - When materials interact within a closed system, the total mass of the system remains the same.

5.1 Explain why the total amount of a material remains the same even when exposed to a variety of physical treatments (e.g., flattening or balling up clay, breaking apart a candy bar, pouring liquid into a tall, slender glass vs. a short, fat glass).

Essence: Conservation of mass

E1: Given two identical objects, identify similarities and differences before and after manipulation.

E2: Given two identical objects, record changes after manipulating one of the objects.

E3: Manipulate the physical properties of an object.

4 - People develop new materials as a response to the needs of society and the pursuit of knowledge. This development may have risks and benefits to humans and the environment.

5.1 Research and report on recycling of household materials (e.g., glass, newspaper, plastics) and how these materials are reused.

Essence: Recycling

E1: Identify reasons for recycling.

E2: Identify recyclable objects.

E3: Sort objects based on physical properties (e.g., glass, plastic, paper).

1 - Energy takes many forms. These forms can be grouped into types of energy that are associated with the motion of mass (kinetic energy), and types of energy associated with the position of mass and with energy fields (potential energy).

- 5.1 Identify sunlight as the source of energy needed for plants to make their own food. Observe that sunlight can also warm objects such as the surface of the Earth.
Essence: Energy from the Sun
E1: Describe various ways in which sunlight affects the Earth.
E2: Identify ways sunlight impacts plants and other objects.
E3: Sort given objects based on whether they use or do not use sunlight as energy.
- 5.2 Identify that sunlight has three major components; visible, infrared, and ultraviolet, and that the infrared and ultraviolet components cannot be detected by human eyes.
Essence: Components of sunlight
E1: Describe differences in the three major components of sunlight.
E2: Match given component characteristics to corresponding terms.
E3: Identify the three major components of sunlight.
- 5.3 Design and implement an investigation to show that white light coming from the Sun consists of a variety of component waves that appear to have different colors to our eyes. Record observations of the investigation and use evidence to communicate results.
Essence: Components of white light
E1: Conduct an investigation on white light and record results.
E2: Identify colors observed when given results of an investigation on white light.
E3: Identify different colors through a prism.
- 5.4 Distinguish ultraviolet from infrared light energy. Although each is invisible to the human eye without the use of technology, describe how the presence of each is detected (i.e., night vision goggles to see infrared energy, sunburn indicates ultraviolet).
Essence: Ultraviolet and Infrared light energy
E1: Identify ways infrared and ultraviolet light energy can be observed.
E2: Categorize real-life examples as ultraviolet or infrared light energy.
E3: Identify an item that uses ultraviolet or infrared light energy.
- 5.5 Observe that sound is produced by vibrating objects and give examples of vibrating objects that produce sound.
Essence: Sound as a form of energy
E1: Define sound.
E2: Identify examples of vibrating objects that produce sound.
E3: Identify the sources of sounds.
- 5.6 Observe that volume is a property of sound that determines how loud the sound is, and be able to describe what part of the vibrating object's motion determines the sound it produces.
Essence: Vibration's impact on volume
E1: Describe the change in volume of an object based on the vibrations.
E2: Identify a vibrating object that produces sound.
E3: Given a set of objects, identify if sound is produced by vibrations.

1 - Energy takes many forms. These forms can be grouped into types of energy that are associated with the motion of mass (kinetic energy), and types of energy associated with the position of mass and with energy fields (potential energy). (continued)

- 5.7 Describe the relationship between the pitch of a sound and the physical properties of the sound source (i.e., length of vibrating object, frequency of vibrations, and tension of vibrating string). Describe how the pitch of sound is different from the volume.
Essence: Pitch and volume
E1: Describe the pitch of different objects.
E2: Identify differences between pitch and volume.
E3: Match given definitions of volume and pitch to their terms.
- 5.8 Identify that sound energy needs a medium through which to travel. Compare how effectively sound travels through solids, liquids, and air. Demonstrate that vibrations in materials set up wavelike disturbances that spread away from the source. Construct a method to direct sound from the source to the receiver.
Essence: Motion of sound energy
E1: Investigate sound energy through different sources and record results.
E2: Given results of an investigation on sound energy through different sources, identify characteristics of each source.
E3: Identify sources that sound can travel through.
- 5.9 Identify that the energy of a moving object depends upon its speed. Give examples of how an object's energy of motion increases when the object's speed increases.
Essence: Speed's impact on energy
E1: Describe the effects increasing speeds have on energy (e.g., the faster a car goes the harder it crashes).
E2: Given the speed of various objects, identify the level of impact (e.g., high impact or low impact).
E3: Identify if the motion of an object increases or decreases with speed.
- 5.10 Describe how energy can be stored in an elastic object or material by stretching it. Use diagrams to describe ways that the energy stored in a stretched object can be used to make objects move.
Essence: Storing energy
E1: Describe how objects that stretch can store energy.
E2: Sort given objects into groups by their ability to stretch.
E3: Identify given objects that stretch.

2 - Changes take place because of the transfer of energy. Energy is transferred to matter through the action of forces. Different forces are responsible for the transfer of the different forms of energy.

- 4.1 Identify the basic components (i.e., battery, wires, bulbs, switch) of an electric circuit and understand their function. Draw an example circuit and label the important parts. Relate that circuits must take the form of complete (closed) loops before electrical energy can pass.
Essence: Electrical circuits
E1: Identify components of an electrical circuit.
E2: Given a diagram of a circuit, label the important parts.
E3: Match given circuits to corresponding components (e.g., flashlight to batteries, light bulb to lamp).

2 - Changes take place because of the transfer of energy. Energy is transferred to matter through the action of forces. Different forces are responsible for the transfer of the different forms of energy. (continued)

- 4.3 Test objects for their conductivity and classify the materials based on whether they conduct electricity (conductors) or do not conduct electricity (insulators). Choose which materials would be used to construct a circuit and justify your choices.
Essence: Conductivity of electricity
E1: Test objects to determine if they are conductors of electricity.
E2: Given a set of objects, identify objects as conductors or insulators.
E3: Given a set of objects, identify if they can conduct electricity.
- 5.1 Use rulers, meter sticks, tapes, and watches to measure the distance objects travel in a given period of time, and how much time it takes for an object to travel a certain distance. Organize the measurements in tables, and construct graphs based on the measurements. Reach qualitative conclusions about the speeds of the objects (faster versus slower).
Essence: Measurement of speed
E1: Measure the distance an object travels in a fixed time and record results.
E2: Use a unit of measurement to verify the distance an object has traveled.
E3: Given objects in motion, identify which object travels the farthest.
- 5.2 Demonstrate and explain how forces of different sizes and directions can produce different kinds of changes in the motion of an object.
Essence: Force and motion
E1: Investigate the change in motion of an object based on size and direction.
E2: Given a set of objects, predict which objects will have the most force based on size.
E3: Sort given objects based on their ability to move fast or slow.
- 5.3 Explain how the flow of heat energy contributes to the melting and freezing processes. Describe which way heat energy must flow for liquid water to boil.
Essence: Heat energy
E1: Describe how heat energy contributes to the melting process.
E2: Identify characteristics of increasing heat energy on a frozen substance.
E3: Identify the state of a substance after heat energy is applied (e.g., melted, boiled).

3 - Energy readily transforms from one form to another, but these transformations are not always reversible. The details of these transformations depend upon the initial form of the energy and the properties of the materials involved. Energy may transfer into or out of a system and it may change forms, but the total energy cannot change.

- 5.1 Observe that light travels in a straight line away from its source until it strikes an object. Observe that when light strikes an object, it can reflect off the object, transmit through the object, be absorbed within the object, or a combination of these phenomena. Give examples of light being reflected, transmitted, and/or absorbed by objects.
Essence: Interaction of light and objects
E1: Identify the different ways light interacts with objects.
E2: Sort given materials based on absorption or reflection of light.
E3: Manipulate light on different objects.

3 - Energy readily transforms from one form to another, but these transformations are not always reversible. The details of these transformations depend upon the initial form of the energy and the properties of the materials involved. Energy may transfer into or out of a system and it may change forms, but the total energy cannot change. (continued)

5.2 Using the physical properties of objects, make predictions about how light will behave when it strikes the object. Categorize materials as transparent, translucent, absorbent or reflective based on how they interact with light.

Essence: Interaction of light and objects

E1: Given properties of an object, predict how light will interact.

E2: Sort given materials based on transparency.

E3: Identify if light shines through an object.

4 - People utilize a variety of resources to meet the basic and specific needs of life. Some of these resources cannot be replaced. Other resources can be replenished or exist in such vast quantities they are in no danger of becoming depleted. Often the energy stored in resources must be transformed into more useful forms and transported over great distances before it can be helpful to us.

5.1 Recognize that solar energy, an inexhaustible source, is an alternative energy source to fossil fuels, an exhaustible source. Using books, computers and other resources, search for ways that we can use sunlight to heat and light our homes, and generate electrical energy. Report your results by making a poster, a written report or an oral presentation.

Essence: Solar energy

E1: Find examples of solar energy in given research.

E2: List benefits of solar energy.

E3: Identify the source of solar energy.

1 - There are observable, predictable patterns of movement in the Earth, Moon, and Sun System that account for day and night.

- 4.1 Observe and describe the path of the Sun as it appears to move across the sky from east to west during the course of a day.
Essence: Sun's path
E1: Describe the path of the Sun during the course of a day.
E2: Trace the east to west pattern of the sun's position in the sky.
E3: Given a diagram, identify east and west.
- 4.2 Use models to describe how the Earth's rotation on its axis causes one half of the Earth to always be illuminated by the Sun (day) and one half to not be illuminated by the Sun (night). Apply this model of the rotating Earth to explain why the Sun appears to move across the sky each day from east to west.
Essence: Earth's rotation
E1: Describe the pattern of Earth's rotation.
E2: Demonstrate that the rotation of the Earth causes the change from day to night.
E3: Identify that the Sun first appears in the east and sets in the west.
- 4.3 Using newspapers, the internet, and actual sky observations when possible, chart the appearance of the Moon in the night sky over the course of at least two months. Identify the basic pattern of the Moon's appearance. Classify the Moon's appearance by using the terms new, first quarter, full, last (third) quarter.
Essence: Phases of the Moon
E1: Use various resources to record the phases of the Moon over the course of two months.
E2: Sequence the phases of the Moon.
E3: Match pictures of the Moon to the corresponding phase.
- 4.4 Observe the size of the Sun and Moon in the sky. Use models to illustrate the approximate size and distance relationship between the Sun and Moon. Explain why the Sun and Moon appear to be similar in size when observed in the sky.
Essence: Relationship between size and distance
E1: Describe why the Sun appears the same size as the Moon when observed from Earth.
E2: Observe apparent size of objects from different distances and compare.
E3: Sort given objects based on size.

2 - Most objects in the Solar System orbit the Sun.

- 4.1 Identify and order the major planets and describe how they all revolve around the Sun.
Essence: Planets
E1: Identify and order the planets that revolve around the Sun.
E2: Order the planets by distance from the Sun.
E3: Given a picture/model of the Solar System, identify planets based on a given location from the Sun.
- 4.2 Research and develop a short report on one of the planets in the Solar System. Compare the information learned in the reports.
Essence: Solar System
E1: Report the characteristics of a planet.
E2: Identify the characteristics of a given planet.
E3: Given pictures, identify a planet.

2 - Most objects in the Solar System orbit the Sun. (continued)

- 4.3 Describe our Sun as a star that is similar to other stars that are seen in the night sky. Explain why our Sun appears to be larger in size than other stars.

Essence: Sun is a star

- E1: Explain why the Sun appears larger than other stars.
E2: Identify the closest star to Earth.
E3: Given a picture/model, identify the Sun.

3 - Technology expands our knowledge of the Earth, Moon, and Sun System.

- 4.1 Use photos gathered from terrestrial telescopes, robot probes, the Hubble telescope, and manned exploration of the Moon to examine pictures of the planets and Moon.

Essence: Technology and the solar system

- E1: List technologies that allow the planets and Moon to be observed.
E2: Examine photos of the planets or moon and identify what is pictured.
E3: Sort given pictures by planet or moon.

1 - Earth's systems can be broken down into individual components which have observable measurable properties.

- 4.1 Examine materials that compose soil (i.e., sand, clay, humus, gravel, and water) and describe these on the basis of their properties (i.e., color, luster, granularity, texture, mass relative to size, particle size, ability to absorb water, pore space, ability to compact). Describe how certain soil properties affect the way in which soil is eroded and deposited by water.
- Essence: Properties of soil**
- E1: Given a sample of soil, list the components.
 - E2: Given soil components, identify physical properties.
 - E3: Categorize given Earth materials (e.g., sand, soil, and clay) based on physical properties.

2 - Earth's components form systems. These systems continually interact at different rates of time, affecting the Earth locally and globally.

- 4.1 Create a model that can be used to describe how water moves from one place on Earth to another in a continuous cycle through the processes of evaporation, condensation, and precipitation.
- Essence: Water cycles**
- E1: Identify the stages of the water cycle.
 - E2: Given a diagram of the water cycle, label evaporation, condensation, and precipitation.
 - E3: Identify forms of precipitation.
- 4.2 Use stream tables to observe the creation of landforms as water flows over and through the land. Describe changes that result from the flowing of water, using correct geographic terminology (i.e., canyon, delta, tributary). Describe changes to the water as it flows over land (i.e., color, transparency).
- Essence: Water flow**
- E1: Describe the change in water color as it flows over land.
 - E2: Identify a landform that water flows over.
 - E3: Identify if a given object is visible through water.
- 4.3 Describe how fast-moving water and slow-moving water over the land affect erosion and deposition.
- Essence: Water flow**
- E1: Identify if water flowing at different speeds changes the land.
 - E2: Recognize that water flows at different speeds.
 - E3: Differentiate water from land on a map.
- 4.4 Use stream tables to model and describe the effects of slope. Describe how the flow of water (fast or slow) is affected by the slope of the land, the amount and type of vegetation, and the landforms.
- Essence: Water flow**
- E1: List factors that can slow the flow of water.
 - E2: Identify if water flows faster or slower down various slopes.
 - E3: Identify if an object placed in water is moving fast or slow.
- 4.5 Use stream tables to model the effect of human activity on erosion and deposition. Describe how human activity (i.e., building a dam, clear cutting a forest, bulldozing a roadway) affects the amount of erosion and deposition and changes the environment.
- Essence: Environmental modifications**
- E1: Identify human activities that affect erosion and deposition.
 - E2: Use a stream table to observe the effects of human activity on erosion and deposition.
 - E3: Match erosion and deposition to their corresponding definitions.

2 - Earth's components form systems. These systems continually interact at different rates of time, affecting the Earth locally and globally. (continued)

- 4.6 Research and report on a specific landform created by the interaction of land and water (i.e., Cape Henlopen, Delaware Bay, Mississippi Delta, Appalachian Mountains).
Essence: Types of landforms
E1: Research a specific landform and answer questions.
E2: Given research on a specific landform, identify key attributes.
E3: Identify a type of landform.
- 4.7 Keep daily records of weather conditions (wind speed and direction, type and amount of precipitation, cloud cover and type, temperature) and use these records to identify short term and seasonal patterns in Delaware.
Essence: Weather patterns
E1: Keep a daily record using the weather conditions on a graph or chart and identify which type of weather occurs the most.
E2: Keep a daily record using wind speed and precipitation type.
E3: Given descriptive words, identify the weather condition.
- 4.8 Identify and describe different types of storm systems that occur in Delaware (i.e., tornadoes, hurricanes, thunderstorms, blizzards). From observed and gathered historical data, identify times of the year when these storms are most likely to occur.
Essence: Storm systems
E1: Identify and describe types of storm systems that occur in Delaware.
E2: Identify types of storm systems.
E3: Match given descriptions to the type of storm system.
- 4.9 Using newspapers, computer internet sites, and other information resources, identify weather conditions in different parts of the world. Compare this with the local weather in Delaware and discuss how weather conditions for a specific day may vary around the USA and world.
Essence: Weather
E1: Identify similarities and differences in the weather between Delaware and another state.
E2: Identify a weather condition in a different part of the world.
E3: Given descriptive words, identify the weather in Delaware.

3 - Technology enables us to better understand Earth's systems. It also allows us to analyze the impact of human activities on Earth's systems and the impact of Earth's systems on human activity.

- 4.1 Observe satellite photos showing change over time of landforms (i.e., Chesapeake Bay, Cape Henlopen, Delaware coastline) and predict future changes that may occur. Describe how these predictions may affect human activities (i.e., locations for building).
Essence: Landform changes
E1: Observe satellite photos and describe the changes of landforms over time.
E2: Identify a specific landform from satellite photos.
E3: Given before and after images from a satellite, identify if there has been a change.

3 - Technology enables us to better understand Earth's systems. It also allows us to analyze the impact of human activities on Earth's systems and the impact of Earth's systems on human activity. (continued)

- 4.2 Select and use a variety of appropriate instruments (i.e., graduated cylinders, stream tables, hand lens, ruler, balances) for collecting, recording, and analyzing data obtained from stream table investigations. Communicate the results of stream table investigations through record sheets, oral and written observations, and drawings.

Essence: Stream table investigations

E1: Conduct a stream table investigation and collect and record data.

E2: Identify tools used to collect or record data from a stream table investigation.

E3: Given a set of objects, identify a tool used in scientific investigations about streams.

1 - Living systems demonstrate the complementary nature of structure and function.

- 5.2 Describe how to promote healthy digestion and recognize some symptoms that indicate disturbances associated with the normal functioning of the digestive system (i.e., stomach ache, flatulence).
Essence: Healthy digestive systems
E1: Identify symptoms that may indicate problems with the digestive system.
E2: Given examples of foods, identify if they will help digestion.
E3: Sort given examples of food into healthy and unhealthy foods.
- 5.3 Identify, label the parts, and describe the basic functions of the human digestive tract including the mouth, esophagus, stomach, small intestine, large intestine (colon), rectum, and anus.
Essence: Digestive systems
E1: Describe functions of the parts of the digestive system.
E2: Given a model, label the parts of the digestive system.
E3: Match a given characteristic to the corresponding part of the digestive system.
- 5.4 Compare and contrast the human body digestive system with that of other animals (e.g., earthworm, chicken, fish, crayfish, snail, cow).
Essence: Animal and human digestive systems
E1: Compare the human digestive system to other animals' digestive systems.
E2: Identify differences or similarities between the digestive systems of humans and animals.
E3: Given models, identify the human digestive system.

2 - All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.

- 5.1 Explain that all organisms require a form of energy to survive and that humans and other animals obtain energy and materials from food.
Essence: Living things get energy from food
E1: Describe what happens to food after it is eaten.
E2: Explain why the body needs food to survive.
E3: Identify a source of energy for the body.

3 - Organisms respond to internal and external cues, which allow them to survive.

- 5.1 Identify external structures (i.e., legs) and behaviors (i.e., walking) of organisms that enable them to survive in their particular ecosystem and describe how these structures enable the organisms to respond to internal (i.e., hunger) and external (i.e., temperature, danger) cues.
Essence: Structures and behaviors of organisms
E1: Identify external structures that help organisms survive.
E2: Identify behaviors that animals exhibit in order to survive.
E3: Given an organism's behavior, match to the corresponding external structure.

3 - Organisms respond to internal and external cues, which allow them to survive. (continued)

- 5.2 Research the ways that a variety of organisms respond to internal (i.e., need for food and shelter) and external (i.e., presence of predators) cues. Describe the similarities and differences among the organisms.

Essence: Organisms' responses to the environment

- E1: Match internal/external cues to appropriate organism responses.
E2: Categorize cues as internal or external.
E3: Given examples, identify an internal cue.

4 - The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.

- 5.1 Identify safety equipment (e.g., goggles, gloves) and procedures (e.g., washing hands, wafting, not eating) used in classroom science investigations. Explain how these promote healthy living and prevent injuries.

Essence: Injury prevention

- E1: Identify ways to maintain a healthy living and prevent injuries.
E2: Identify the purpose of given safety equipment.
E3: Match the safety equipment to the corresponding purpose (e.g., helmet to bike, goggles to eyes).

- 5.2 Identify and discuss how short-term and long-term alterations in the environment affect the health of organisms found in that ecosystem.

Essence: Alterations of environment

- E1: Identify effects of environmental change on organisms.
E2: Identify changes that can occur in the environment.
E3: Match a given organism to the corresponding environment.

1 - Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.

- 4.1 Compare the similarities and differences of offspring to their parents (e.g., crayfish, bean sprouts). Know that offspring receive characteristics from both parents.
Essence: Passing traits from parents to offspring
E1: Contrast characteristics of parents with offspring.
E2: Compare given characteristics of parents to offspring.
E3: Match a parent to its offspring based on given characteristics.
- 4.2 Recognize that some characteristics acquired by the parents are not inherited by the offspring (i.e., a lost claw does not mean offspring are born with only one claw).
Essence: Non-inherited characteristics
E1: Describe differences between parents and offspring.
E2: Identify a non-inherited characteristic that may be different between a parent and offspring.
E3: Given examples of parents and offspring, identify if there is a difference.
- 5.1 Identify plants and animals in an ecosystem (i.e., beach, woodland, marsh, meadow). Examine the life cycles of the plants and animals and identify factors in the ecosystem that are beneficial or harmful to the organism at various stages in its life cycle (i.e., young fish are small which makes them able to hide in plants, but this characteristic also makes them more vulnerable to predators).
Essence: Ecosystems
E1: Identify factors of an ecosystem that could be harmful or beneficial to plants and animals.
E2: Identify animals and plants that live in a given ecosystem.
E3: Match an animal to its corresponding ecosystem.

2 - The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.

- 5.1 Recognize that there are many different kinds of vertebrates and invertebrates in the world's ecosystem with a diverse variety of organisms in each group.
Essence: Vertebrates and invertebrates
E1: Describe the differences between invertebrates and vertebrates.
E2: Identify examples of animals that are invertebrates or vertebrates.
E3: Identify if given animals are invertebrates or vertebrates.

1 - Organisms and their environments are interconnected. Changes in one part of the system will affect other parts of the system.

- 5.1 Examine a variety of ecosystems such as marsh, pond, field, forest. Compare how the organisms, the habitat, and the food chains are similar and different in these ecosystems.
Essence: Ecosystem comparisons
E1: List similarities and differences between ecosystems.
E2: Identify different types of ecosystems.
E3: Match given animals or plants to the corresponding ecosystem.
- 5.2 Differentiate between an organism's "habitat" (where an animal lives) and its "territory" (an area claimed as its own space). Select an organism and describe its habitat and territory.
Essence: Habitat
E1: Identify differences between habitat and territory of an organism.
E2: Identify animals and corresponding habitats.
E3: Match given organisms to their habitats.
- 5.3 Predict and describe how a dramatic increase or decrease in the population size of a single species within an ecosystem affects the entire ecosystem.
Essence: Impact of population size on ecosystems
E1: Predict the effects that increasing or decreasing the population of a certain species will have on an ecosystem.
E2: Identify effects an increase or decrease of a population will have on a given ecosystem.
E3: Identify which group of animals has a larger population based on given scenarios.
- 5.4 Identify environmental factors that affect the growth and reproduction of organisms in an ecosystem (e.g., temperature can affect germination and soil moisture).
Essence: Growth and reproduction of environment
E1: List factors that affect growth and reproduction in an ecosystem.
E2: Identify if given factors will affect reproduction or growth in an ecosystem.
E3: Match an environmental factor with affects on growth and reproduction.

2 - Matter needed to sustain life is continually recycled among and between organisms and the environment. Energy from the Sun flows irreversibly through ecosystems and is conserved as organisms use and transform it.

- 5.1 Conduct investigations to simulate terrestrial and aquatic ecosystems and their interdependence. Demonstrate and describe how alteration of one part of the ecosystem (i.e., change in pH, over fertilization, addition of salt) may cause changes throughout the entire ecosystem.
Essence: Interdependence of ecosystems
E1: Conduct an investigation on the interdependence between ecosystems and record results.
E2: Identify alterations that can be made to an ecosystem.
E3: Sort given parts of an ecosystem based on physical characteristics.
- 5.2 Categorize the organisms within an ecosystem according to the function they serve as producers, consumers, or decomposers. Explain why the organism was categorized this way.
Essence: Role of organisms in an ecosystem
E1: Identify the roles organisms play in a given ecosystem.
E2: Match given organisms to their corresponding roles in an ecosystem.
E3: Identify if given organisms are producers of food or consumers of food.

2 - Matter needed to sustain life is continually recycled among and between organisms and the environment. Energy from the Sun flows irreversibly through ecosystems and is conserved as organisms use and transform it. (continued)

- 5.3 Identify the Sun as a source of energy that drives an ecosystem. Describe the path of energy from the Sun to the producers then to the consumer in the food chain. Recognize that an organism has dependent and independent relationships in an ecosystem.

Essence: Energy in a food chain

E1: Describe the path of energy from the Sun through the ecosystem.

E2: Identify the main source of energy in a food chain.

E3: Given a diagram or model, trace the path of energy from the Sun through the ecosystem.

3 - Humans can alter the living and non-living factors within an ecosystem, thereby creating changes to the overall system.

- 5.1 Identify natural (i.e., wildfire, flood, drought) and man-made changes (forest clear cutting, input of pollutants, filling in of marshland) to an ecosystem. Discuss how these changes affect the balance of an ecosystem.

Essence: Man-made and natural changes

E1: Identify man-made and natural changes to an ecosystem.

E2: Identify man-made effects on an ecosystem.

E3: Sort given changes as man-made or natural.

- 5.2 Explain why moving organisms from their ecosystem to a new ecosystem may upset the balance of the new ecosystem, for example, by introduction of diseases or depletion of resources.

Essence: Movement of organisms from one ecosystem to another

E1: Predict what effect a new species has on an ecosystem.

E2: Identify ways an ecosystem becomes unbalanced.

E3: Match a given organism to the corresponding ecosystem.

Grade Band 6-8



1 - Scientific inquiry involves asking scientifically-oriented questions, collecting evidence, forming explanations, connecting explanations to scientific knowledge and theory, and communicating and justifying the explanation.

- 8.1 Frame and refine questions that can be investigated scientifically, and generate testable hypotheses.
Essence: Generate hypotheses
E1: Use questions or predictions to generate a hypothesis.
E2: Given a hypothesis, identify related questions or predictions.
E3: Match scientific questions or predictions with the corresponding topic.
- 8.2 Design and conduct investigations with controlled variables to test hypotheses.
Essence: Conduct an investigation on a hypothesis
E1: Create a multi-step investigation to explore a hypothesis.
E2: Follow a multi-step investigation to explore a hypothesis.
E3: Given a multi-step investigation, identify materials that are needed.
- 8.3 Accurately collect data through the selection and use of tools and techniques appropriate to the investigation. Construct tables, diagrams and graphs, showing relationships between two variables, to display and facilitate analysis of data. Compare and question results with and from other students.
Essence: Collect, record, and compare data
E1: Collect, display, and compare data related to an investigation.
E2: Collect and display data from multiple sources.
E3: Record data in a given chart or table.
- 8.4 Form explanations based on accurate and logical analysis of evidence. Revise the explanation using alternative descriptions, predictions, models and knowledge from other sources as well as results of further investigation.
Essence: Explanations based on data
E1: Based on data collected from observations construct an explanation to answer the initial question/prediction.
E2: Identify additional predictions to further the investigation based on comparison of data.
E3: Identify a conclusion based on the results of the investigation.
- 8.5 Communicate scientific procedures, data, and explanations to enable the replication of results. Use computer technology to assist in communicating these results. Critical review is important in the analysis of these results.
Essence: Report and explain scientific procedures and data
E1: Summarize scientific procedures used.
E2: Sequence the scientific procedure used.
E3: Match associated pictures or objects with steps in the procedure.
- 8.6 Use mathematics, reading, writing, and technology in conducting scientific inquiries.
Essence: Integrate reading, writing, math, or technology into scientific investigations
No extensions available - Multiple content areas should be incorporated into scientific investigations.

1 - The structures of materials determine their properties.

- 7.1 Recognize that all matter consists of particles and how the particles are arranged determines the physical state. Use the particle model to describe solids, liquids, and gases in terms of the packing and motion of particles.
Essence: Particle arrangement
E1: Given a particle model, identify given characteristics of particle motion as solids, liquids, or gases.
E2: Match states of matter with given characteristics of particle models.
E3: Given particle models, identify if the particles are close together or far apart.
- 8.1 Conduct simple investigations in which a variety of materials (sand, water, light colored materials, dark colored materials) are exposed to light and heat energy. Measure the change in temperature of the material and describe any changes that occur in terms of the physical properties of the material.
Essence: Effects of temperature on physical properties
E1: Observe and describe changes to materials that are exposed to light and heat.
E2: Observe and identify changes to materials that are exposed to light and heat.
E3: Given materials exposed to heat or light, identify if there is a change in physical properties.
- 8.2 Conduct investigations, using a variety of materials, to show that some materials conduct heat more readily than others. Identify these materials as conductors or insulators.
Essence: Insulators and conductors
E1: Conduct an investigation on materials to determine if they are conductors or insulators.
E2: Given results from an investigation on heat conduction, identify materials as conductors or insulators.
E3: Sort given objects of an investigation on heat conduction into conductors and insulators.
- 8.3 Explain why insulators may be used to slow the change of temperature of hot or cold materials.
Essence: Insulators impact on temperature
E1: Describe characteristics of an insulator.
E2: Given characteristics, identify given objects as insulators.
E3: Identify given objects as insulated or non-insulated.

2 - The properties of the mixture are based on the properties of its components.

- 7.1 Distinguish between homogenous and heterogeneous mixtures. Using their physical properties, design and conduct an investigation to separate the components of a homogenous or heterogeneous mixture. Recognize that a homogenous mixture is a solution.
Essence: Homogenous and heterogeneous mixtures
E1: Conduct an investigation to separate the components of heterogeneous or homogeneous mixtures and record results.
E2: Identify the similarities or differences between heterogeneous and homogeneous mixtures.
E3: Classify given mixtures into heterogeneous and homogeneous categories.
- 7.2 Prepare solutions of different concentrations recognizing that the properties of the solution (color, density, boiling point) depend on the nature and concentration of the solute and solvent.
Essence: Properties of a solution
E1: Create the same solutions in different concentrations and record the differences.
E2: Given the same solutions in different concentrations, describe similarities or differences.
E3: Observe a solution and identify physical properties (e.g., color, texture).

2 - The properties of the mixture are based on the properties of its components. (continued)

- 7.3 Conduct investigations to determine the effect of temperature and surface area of the solute on the rate of solubility. Describe the rate of solubility using the particle model.
Essence: Rate of solubility
E1: Describe changes to a solute at various temperatures.
E2: Measure the rate at which a solute dissolves at various temperatures.
E3: Sequence solubility rates by arranging from least to most amount of time.
- 7.4 Conduct investigations to determine the effect of temperature on saturation point. Construct a solubility curve based on data collected. Describe solubility and saturation point using the particle model.
Essence: Solubility and saturation
E1: Record results of an investigation on the saturation point of a solvent.
E2: Match the terms saturation and solubility to the corresponding definition.
E3: Create a saturated solution.
- 7.5 Conduct investigations to demonstrate the process of diffusion. Use the particle model to describe the movement of materials from an area of higher concentration to an area of lower concentration.
Essence: Diffusion
E1: Conduct a given experiment to determine the effects of diffusion.
E2: Describe the difference between low and high concentration.
E3: Identify examples of diffusion.

3 - When materials interact within a closed system, the total mass of the system remains the same.

- 7.1 Show that mass is conserved when adding a solute to a solvent (mass of solvent + mass of solute = total mass of solution).
Essence: Conservation of mass
E1: Conduct an investigation of mass by combining solvents and solutes and record changes.
E2: Identify changes in mass after combining solutions.
E3: Combine a solvent and solute to create a solution.

4 - People develop new materials as a response to the needs of society and the pursuit of knowledge. This development may have risks and benefits to humans and the environment.

- 7.1 Select a manufactured item and identify its component materials. Explain how the physical properties of the materials contribute to the function of the item.
Essence: Functions of materials
E1: Describe connections between component materials and their function.
E2: Classify given materials based on functions.
E3: Given functions, identify corresponding objects.
- 7.2 Discuss the social, economic, and/or environmental consequences of the production of new materials to meet human wants and needs.
Essence: Human effects on the environment
E1: Choose a product and identify environmental impact (e.g., fertilizer effects water runoff, cars effect ozone).
E2: Given products and their impact, identify consequences as social, environmental, or economic.
E3: Identify a product that has environmental consequences.

- 1 - Energy takes many forms. These forms can be grouped into types of energy that are associated with the motion of mass (kinetic energy), and types of energy associated with the position of mass and energy fields (potential energy).**
- 8.2 Design and carry out investigations to determine how changing the mass of an object or changing its speed changes its kinetic energy.
Essence: Kinetic energy
E1: Conduct an investigation on the effects that mass and speed have on kinetic energy.
E2: Given results of an investigation on kinetic energy, identify how increasing mass and/or speed affects kinetic energy.
E3: Given objects, identify which will go faster based on speed.
- 8.3 Explain that gravitational potential energy (GPE) is the energy of position (above the Earth's surface) and that it depends on the object's mass and height above the ground. Relate that lifted objects have GPE and that the size of an object's GPE depends on its mass and the vertical distance it was lifted. Make a graph to demonstrate and describe how the GPE changes as the height of an object is increased or decreased.
Essence: Gravitational potential energy (GPE)
E1: Conduct an investigation to determine the effect mass and height have on gravitational potential energy and graph results.
E2: Given the mass and the vertical distance an object was lifted, identify which object will have the greatest gravitational potential energy.
E3: Given various scenarios, identify which objects have the most gravitational potential energy.
- 8.4 Explain that the mechanical energy of an object is the sum of its kinetic energy and its potential energy at any point in time. Identify the mechanical energy of objects in different circumstances and identify whether the mechanical energy consists of KE, PE or both (i.e., a ball at rest at the top of an incline and in its motion part of the way down the incline, or a model plane driven by a "rubber band" motor, etc.).
Essence: Mechanical energy
E1: Use the definition of mechanical energy to determine if an object has kinetic energy, potential energy, or both.
E2: Identify objects that have kinetic and potential energy at various points of motion.
E3: Categorize real life scenarios as demonstrating kinetic energy or potential energy.
- 8.6 Explain that the mechanical energy of an object is a measure of how much the object can change the motion of other objects or materials (e.g., a ball (or air) having a large kinetic energy can do more damage than a ball (or air) with less kinetic energy).
Essence: Mechanical energy of an object
E1: Given various objects, compare the change in motion based on mechanical energy.
E2: Order a given set of objects from least to greatest based on the amount of kinetic energy.
E3: Identify the amount of kinetic energy a given object has based on weight.
- 8.7 Use the particle model to explain heat energy as the combined random kinetic energy of particles that make up an object and while the heat energy and temperature of an object are related, they are different quantities.
Essence: Heat energy
E1: Describe the relationship between heat energy and temperature.
E2: Identify the relationship between particle movement and heat energy.
E3: Identify objects that use heat energy.
- 8.8 Describe how the motion of water particles in a glass of cold water is different from the motion of water particles in a glass of hot water.
Essence: Temperature's relationship to particle motion
E1: Describe how the temperature of water affects the motion of particles.
E2: Given a description of particles in motion, identify if they are in hot or cold water.
E3: Given water temperature, identify the movement of particles as fast or slow.

1 - Energy takes many forms. These forms can be grouped into types of energy that are associated with the motion of mass (kinetic energy), and types of energy associated with the position of mass and energy fields (potential energy). (continued)

- 8.9 Explain that sound energy is mechanical energy that travels in the form of waves. Use the particle model to explain why sound waves must travel through matter, and that sound travels more effectively through solids and liquids than through gases. Model and describe how sound energy travels through solids, liquids, and gases.
- Essence: Mechanical energy of sounds**
E1: Draw conclusions about sound energy by investigating the way sound waves travel through solids, liquids, and gases.
E2: Given results of an investigation on the motion of sound, identify if sound waves would travel best through a solid, liquid, or gas.
E3: Given examples, identify the state of matter that produces the most sound.
- 8.10 Use the properties of sound waves and the particle model to describe how the pitch of two waves can be different and how the loudness of two waves can be different.
- Essence: Pitch and loudness**
E1: Use the particle model to describe how the sound waves of pitch and loudness vary.
E2: Identify the difference between pitch and volume.
E3: Identify the properties of sound.
- 8.11 Explain that heat energy and sound energy both make the particles of a substance move. Use models to explain how the particles respond differently to these types of energy. Use models to explain why sound travels much faster through substances than heat energy does.
- Essence: Heat energy and sound energy**
E1: Describe differences in the way particles respond to heat and sound energy.
E2: Given particle models, identify the form of energy used.
E3: Given particle models, match to corresponding energy source.
- 8.12 Relate that the Sun is the source of almost all of the Earth's energy and that this energy travels to the Earth in the form of electromagnetic waves.
- Essence: Energy of the Sun**
E1: Explain how electromagnetic waves travel to Earth.
E2: Identify forms of electromagnetic waves that come from the Sun.
E3: Identify products that use electromagnetic waves for energy.
- 8.13 Explain that the electromagnetic waves from the Sun consist of a range of wavelengths and associated energies. Explain that the majority of the energy from the Sun reaches Earth in the form of infrared, visible, and ultraviolet waves. Use diagrams to demonstrate the differences in different types of electromagnetic waves.
- Essence: Electromagnetic wavelengths**
E1: Use a diagram to compare and contrast infrared, ultraviolet, and visible wavelengths.
E2: Order electromagnetic waves (i.e., infrared, ultraviolet, visible wavelength) from longest to shortest wavelength.
E3: Given a diagram, identify an infrared, ultraviolet, or visible wavelength.
- 8.14 Plan and conduct an experiment to identify the presence of UV and IR waves in sunlight or other sources of electromagnetic waves. Use evidence to explain the presence of each.
- Essence: UV and IR waves**
E1: Use evidence from an investigation to explain the presence of UV and IR waves.
E2: Identify a source of UV or IR waves.
E3: Categorize real life examples as UV or IR waves.

2 - Changes take place because of the transfer of energy. Energy is transferred to matter through the action of forces. Different forces are responsible for the different forms of energy.

- 8.1 The force of gravity can act across very large distances of space. Through the force of gravity planets pull on their moons, and pull on each other. The Sun pulls on all planets, moons and other celestial bodies in the Solar System. Use an understanding of how forces change the motion of objects to explain how gravity is responsible for creating the orbital motion of planets and moons.
- Essence: Force of gravity**
E1: Describe how the force of gravity affects the planets and their moons.
E2: Given a set of objects varying in mass, order from strongest to weakest gravitational force.
E3: Given a set of objects, demonstrate the force of gravity.
- 8.2 Explain that the transfer of energy from one object to another is caused by the exertion of a force. Create an energy chain to show how forces can change the mechanical energy of an object. Describe how the distance over which the forces act will influence the amount of energy transferred (and when appropriate, the amount of energy transformed).
- Essence: Transfer of energy**
E1: Produce an energy chain and describe the transfer of mechanical energy when force is applied.
E2: Given results of an investigation on energy chains, identify if a change occurs in mechanical energy.
E3: Identify if more or less force is needed to continue an energy chain.
- 8.3 Give examples of how mechanical energy can be transferred to (or away from) an object, and describe the changes that can take place in the motion of the object because of this energy transfer, (e.g., pulling on a trailer to start it moving or using friction to slow an object and bring it to rest).
- Essence: Energy transfer and motion**
E1: Describe the relationship between the transfer of mechanical energy and motion.
E2: Identify if given examples demonstrate transfer of mechanical energy to an object.
E3: Identify what type of energy transfer is needed to continue or stop a given motion.
- 8.4 Use diagrams to trace and describe the transfer of energy through a physical system (for example, the erosion effects of water flowing down an unprotected slope).
- Essence: Transfer of energy**
E1: Describe the transfer of energy through a physical system.
E2: Given a diagram, identify points of energy transfer.
E3: Identify if given examples describe a transfer of energy.
- 8.5 Use the particle model to explain how mechanical waves can transport energy without transporting mass. Give examples that support the transfer of energy without any net transfer of matter.
- Essence: Mechanical waves**
E1: Describe how mechanical waves transport energy.
E2: Identify characteristics of mechanical waves.
E3: Identify examples of mechanical waves.

2 - Changes take place because of the transfer of energy. Energy is transferred to matter through the action of forces. Different forces are responsible for the different forms of energy. (continued)

- 8.6 Explain that the frequency and amplitude are two characteristics of waves that determine the mechanical energy carried and delivered by a sound wave per unit of time. Use diagrams to explain how each of these properties will influence the KE of the particles in the substance when a sound wave passes through the substance.
Essence: Amplitude and frequency
E1: Explain how frequency and amplitude affect the kinetic energy of particles in a sound wave.
E2: Identify characteristics of amplitude and frequency.
E3: Identify objects that use sound waves to function.
- 8.7 The energy delivered by a wave depends on more than just the frequency. Give an example of a high frequency sound wave that delivers small quantities of energy every second and explain how this is possible. Give an example of a low frequency sound wave that delivers large quantities of energy every second and explain how this is possible.
Essence: High and low frequencies
E1: Describe the differences between high and low frequencies.
E2: Give examples of high and low frequency sound waves.
E3: Identify a sound as high or low frequency.
- 8.8 Use the particle model to explain how heat energy is transferred through solid materials (conduction). Give examples of materials that are good “conductors” of heat energy and examples of materials that are poor conductors of heat energy, and how both types of materials are used in typical homes.
Essence: Conductors of heat
E1: Use the particle model to explain how heat is conducted through solid material.
E2: Identify given materials as good or poor conductors of heat.
E3: Given a set of objects, identify conductors of heat.
- 8.9 Use the particle model to describe the difference between heat energy transfer in solids and heat energy transfer in liquids and gases (i.e., the differences between conduction and convection).
Essence: Conduction and convection
E1: Describe the differences between convection and conduction.
E2: Match the definitions of convection and conduction to the corresponding terms.
E3: Given examples of heat energy transfer, identify as convection or conduction.
- 8.11 Conduct simple investigations to demonstrate that heat energy is transferred from one material to another in predictable ways (from materials at higher temperatures to materials at lower temperatures), until both materials reach the same temperature.
Essence: Transfer of heat energy
E1: Predict the direction of heat flow between two materials and conduct an investigation.
E2: Identify if heat energy will be transferred between given materials.
E3: Identify if a transfer of heat energy took place after combining materials.
- 8.12 Explain how the addition or removal of heat energy can change an object's temperature or its physical state. Conduct simple investigations involving changes of physical state and temperature. Relate that there is no change in temperature when a substance is changing state.
Essence: Heat energy
E1: Conduct an investigation on the addition and removal of heat energy and record results.
E2: Identify if heat was added or removed from the initial material when given the results of an investigation on heat energy.
E3: Identify if the physical state of material has changed after the addition or removal of heat.

3 - Energy readily transforms from one form to another, but these transformations are not always reversible. The details of these transformations depend upon the initial form of the energy and the properties of the materials involved. Energy may transfer into or out of a system and it may change forms, but the total energy cannot change.

- 8.1 Identify that energy can exist in several forms, and when it changes from one form into another the process is called energy transformation.
Essence: Energy transformation
E1: Describe energy transformation.
E2: Identify examples of energy changing from one form to another.
E3: Identify a form of energy.
- 8.2 Explain that energy transformation and energy transfer are different processes, and that energy transformations can take place during an energy transfer. Give examples of energy transformations that take place during an energy transfer.
Essence: Energy transfer and transformation
E1: Compare and contrast energy transformation and energy transfer.
E2: Identify differences between energy transformation and energy transfer.
E3: Match examples of energy to their corresponding terms.
- 8.4 Use energy chains to trace the flow of energy through physical systems. Indicate the energy transfers and the energy transformations that are involved in the processes (e.g., the lighting of an electric lamp in a region serviced by a hydroelectric (or coal fueled) electric power plant, or the sediment that clouds a stream after a heavy rainfall).
Essence: Energy flow
E1: Describe the transfer of energy through a physical system.
E2: Given an energy chain, identify specific points of energy transfer or transformation.
E3: Given an energy chain, trace the transfer of energy through a physical system.
- 8.5 Recognize that when light enters an eye, the energy carried by the light waves carries information and allows living things to see.
Essence: Light energy
E1: Describe how light impacts sight.
E2: Classify given activities based on the ability to perform with or without light.
E3: Categorize scenarios as occurring in light or dark environments.
- 8.6 Trace the flow of the energy carried by the light when the light strikes a material and is reflected from, transmitted through, and/or absorbed by the material. Describe the energy transfers and transformations that take place when light energy is absorbed by a material.
Essence: Light energy
E1: Describe ways light energy interacts with different materials.
E2: Identify if energy was transferred by light.
E3: Given a diagram, trace the transfer of light energy.
- 8.7 Conduct investigations to show that materials can absorb some frequencies of electromagnetic waves, but reflect others or allow them to transmit through the material. Use this selective absorption process to explain how objects obtain their color, how materials like sunscreen can serve to protect us from harmful electromagnetic waves, and how selective absorption contributes to the Greenhouse Effect.
Essence: Absorption of electromagnetic waves
E1: Conduct an investigation to determine how electromagnetic waves interact with various materials.
E2: Given results of an investigation, identify the interaction between electromagnetic waves and various materials.
E3: Identify if objects can absorb a given substance.

3 - Energy readily transforms from one form to another, but these transformations are not always reversible. The details of these transformations depend upon the initial form of the energy and the properties of the materials involved. Energy may transfer into or out of a system and it may change forms, but the total energy cannot change. (continued)

- 8.8 Trace what happens to the energy from the Sun when it reaches Earth and encounters various materials, such as, atmosphere, oceans, soil, rocks, plants, and animals. Recognize that these materials absorb, reflect and transmit the electromagnetic waves coming from the Sun differently.
Essence: Properties of light
E1: Describe the relationship between the Sun and the Earth.
E2: List examples of how light from the Sun interacts with the Earth.
E3: Given a diagram, trace the transfer of energy from the Sun to the Earth.
- 8.9 Conduct investigations to determine how the physical properties of materials (e.g., size, shape, color, texture, hardness) can account for the effect the materials have on sunlight and the degree of change observed in the materials (e.g., dark cloth absorbs more heat than light cloth, clear water transmits more light than murky water, and polished materials reflect more light than dull materials).
Essence: Properties of light
E1: Conduct an investigation to determine how sunlight affects the physical properties of various materials.
E2: Identify the physical properties of materials most affected by sunlight.
E3: Given a set of objects exposed to sunlight, identify which objects absorbed the most heat.
- 8.10 Use the properties of water and soil to explain how uneven heating of Earth's surface can occur. Conduct an investigation that shows how water and soil are heated unequally by sunlight. Describe how this can be used to explain unequal heating of the Earth's surface, producing atmospheric movements that influence weather.
Essence: Earth's absorption of energy
E1: Conduct an investigation to determine if water or soil heats up faster in the sunlight.
E2: Identify the temperature of water and soil after being exposed to sunlight.
E3: Given a set of objects exposed to sunlight, identify which has the highest temperature.
- 8.11 Use the particle model to explain why a material expands (takes up more space) as its temperature increases. Recognize that this expansion is due to the increase in the motion of the particles, and that the particles themselves remain the same size.
Essence: Particle expansion
E1: Describe particle motion in hot and cold temperatures.
E2: Given characteristics of particle motion, identify temperature as hot or cold.
E3: Given the same object in different forms, identify which is expanded.

4 - People utilize a variety of resources to meet the basic and specific needs of life. Some of these resources cannot be replaced. Other resources can be replenished or exist in such vast quantities they are in no danger of becoming depleted. Often the energy stored in resources must be transformed into more useful forms and transported over great distances before it can be helpful to us.

- 8.1 Identify different forms of alternative energy (i.e., solar, wind, ocean waves, tidal and hydroelectric systems). Research and report on the use of this alternative form of energy. Discuss and compare findings to describe the advantages and disadvantages of different kinds of alternative energy.
Essence: Alternative energy
E1: Research and report on a form of alternative energy.
E2: Identify different forms of alternative energy.
E3: Identify if a given example is a form of alternative energy.

1 - Observable, predictable patterns of movement in the Earth, Moon, and Sun System occur because of gravitational interaction and energy from the Sun.

- 8.1 Describe how scientists have historically confirmed that the Earth is round, not flat.
Essence: Earth is round
E1: Discuss the historical evidence that supports the Earth is round.
E2: Identify facts that support the Earth is round.
E3: Identify if given objects are round.
- 8.2 Analyze data on sunrise and sunset times (in terms of length of daylight) and describe patterns. Explain the reason for the patterns by using models or computer simulations of the Earth and Sun.
Essence: Length of daylight
E1: Compare the amount of daylight in relation to the position of the Earth.
E2: Identify patterns in length of day.
E3: Match the terms sunrise and sunset to the time of day they occur.
- 8.3 Using internet, newspaper, and actual observations of the night sky for at least two months, collect data on the Moon's appearance, and moonrise and moonset times. Analyze the data to describe the observable patterns (phases). Explain why the Moon's appearance changes in a repeating cyclical pattern.
Essence: Patterns of the Moon
E1: Use various resources to record the phases of the Moon over the course of two months.
E2: Sequence the phases of the Moon and note the changes in appearance.
E3: Identify representations of the Moon in various phases.
- 8.4 Use models to describe how the relative positions of the Sun, Moon, and Earth account for Moon phases, eclipses, and tides.
Essence: Positional relationship between the Sun, Earth, Moon
E1: Explain how the positions of the Sun, Moon, and Earth affect the phases of the Moon.
E2: Identify the differences in Moon phases.
E3: Model the rotation of the Earth.
- 8.5 Describe how the relative positions of the Earth, Moon, and Sun can cause high and low tides, and unusually high or low tides.
Essence: Tides
E1: Explain how tides are affected by the phases of the Moon.
E2: Identify differences between high and low tides.
E3: Identify the position of an object as high or low.

2 - All objects in the Solar System orbit the Sun and have distinctive physical characteristics and orderly motion.

- 8.1 Demonstrate an understanding of the components of our Solar System and their characteristics, including the Moon, the Sun, the planets and their moons, extra-solar planets, and smaller objects such as asteroids and comets. Construct scale models of the Solar System in order to describe the relative sizes of planets and their distances from the Sun.
Essence: Components of the Solar System
E1: Construct a model of the planets and the Sun.
E2: Order the planets according to distance from the Sun.
E3: Identify components (e.g., planets, moons) of our Solar System.

2 - All objects in the Solar System orbit the Sun and have distinctive physical characteristics and orderly motion. (continued)

- 8.2 Use a variety of resources (e.g., NASA photographs, computer simulations) to compare and contrast the physical properties (i.e., temperature, size, composition, surface features) of planets.
Essence: Physical properties of planets
E1: Compare physical properties of other planets to the earth.
E2: Identify physical properties of planets.
E3: Match physical properties to the corresponding planet.
- 8.3 Demonstrate an understanding of the motion of the bodies in our Solar System. Use models, charts, illustrations, and other suitable representations to predict and describe regular patterns of motion for most objects in the Solar System.
Essence: Motion of objects in the Solar System
E1: Describe patterns of motion between the Earth, Moon, and Sun.
E2: Identify the part of our Solar System that does not move.
E3: Identify if an object is in motion.
- 8.4 Explain how the Sun is the central and largest body in our Solar System and the source of the light energy that hits our planet. Use models to explain how variations in the amount of the Sun's energy hitting the Earth's surface results in seasons.
Essence: Light energy results in seasons
E1: Compare the seasons to the position of the Earth as it orbits the Sun.
E2: Describe the seasons in terms of daylight and temperature.
E3: Identify the four seasons.
- 8.5 Recognize that the force of gravity keeps planets in orbit around the Sun and influences objects on Earth and other planets (i.e., tides, ability of humans to move and function). Differentiate between an object's mass and weight.
Essence: Force of gravity
E1: Describe how mass influences the force of gravity.
E2: Compare the mass of objects using a balance.
E3: Sort given objects by weight.

3 - Technology expands our knowledge of the Solar System.

- 8.1 Describe how scientists have acquired knowledge about components of our Solar System. Recognize the importance of people and technologies that have led to our current understanding of space.
Essence: Technology and scientific knowledge
E1: List types of technology that have enhanced scientific knowledge of space.
E2: Identify ways scientists have learned about the Solar System.
E3: Identify types of technology that help increase knowledge.
- 8.2 Recognize that spin-offs are products which have undergone a technology transfer process from research to public use. Research and report on spin-offs from the space program that have affected our everyday lives (i.e., Velcro, smoke detectors, cordless tools).
Essence: Everyday applications of scientific technology
E1: Identify benefits of a given spin-off.
E2: Identify products that have originated from space technology.
E3: Match technological products with their function.

1 - Earth's systems can be broken down into individual components which have observable measurable properties.

- 7.1 Create models that simulate the amount of salt, frozen, fresh, and potable water available on Earth's surface. Compare total water supply on Earth to the amount of potable water available for human use.
Essence: Types of water
 E1: Using a water supply map, identify the type of water that is most abundant.
 E2: Identify types of water.
 E3: Identify a source of water.
- 7.2 Calculate the ratio/percent of water generally found in solid, liquid and gaseous form on or within the Earth's surface and use this ratio to compare the amounts of water stored in different states.
Essence: States of water
 E1: Identify the percentage of water on Earth.
 E2: Identify the differences between water as a solid, liquid, and gas.
 E3: Identify the differences between water as a solid and liquid.

2 - Earth's components form systems. These systems continually interact at different rates of time, affecting the Earth locally and globally.

- 6.2 Investigate how weathered materials are transported (i.e., mass movement and wind, water, and ice processes) in the process of erosion. Explain how erosion shapes rock particles.
Essence: Erosion processes
 E1: Identify how weathered materials are transported.
 E2: Identify weathered materials.
 E3: Distinguish between water and wind.
- 7.1 Use diagrams of the hydrologic cycle to show and describe the circulation of water through the Earth's crust, oceans, and atmosphere.
Essence: Water circulation
 E1: Given a diagram of the water cycle, label evaporation, condensation, and precipitation.
 E2: Identify the Earth's crust, ocean, and atmosphere using a diagram.
 E3: Distinguish between the Earth's crust and the ocean.
- 8.1 Observe, measure, and predict changes in weather using atmospheric properties (wind speed and direction, cloud cover and type, temperature, dew point, air pressure, and relative humidity). Describe how air pressure and temperature change with increasing altitude and/or latitude.
Essence: Weather
 E1: Observe and measure changes in weather using atmospheric properties.
 E2: Measure weather changes over time.
 E3: Given descriptive words, identify wind speed.
- 8.2 Explain how uneven heating of Earth's components - water, land, air - produce local and global atmospheric and oceanic movement. Describe how these local and global patterns of movement influence weather and climate.
Essence: Earth's components and weather patterns
 E1: Identify how the heating of the Earth's components affects weather and climate.
 E2: Identify which will heat faster, water or land.
 E3: Distinguish between land and the ocean.

2 - Earth's components form systems. These systems continually interact at different rates of time, affecting the Earth locally and globally. (continued)

- 8.4 Use a variety of models, charts, diagrams, or simple investigations to explain how the Sun's energy drives the cycling of water through the Earth's crust, oceans, and atmosphere.
Essence: Sun energy and water cycles
E1: Explain how the Sun affects the water cycle.
E2: Given a diagram of the water cycle, label evaporation, condensation, and precipitation, and identify the Sun as the main source of energy.
E3: Given a diagram, identify a layer of the Earth's crust.
- 8.5 Examine maps of ocean currents and trace the origin and flow of such currents to explain the transfer of heat energy. Identify which currents have dominant influence on the Delaware coast.
Essence: Heat transfer in the ocean
E1: Given a map with ocean currents, identify the origin of a current.
E2: Identify a water current using a map.
E3: Given a map, trace the flow of a water current.
- 8.6 Differentiate between weather, which is the condition of the atmosphere at a given time, and climate, which is the weather averaged over a long period of time.
Essence: Weather and climate
E1: Compare and contrast climate and weather.
E2: Identify differences between climate and weather.
E3: Match the terms climate and weather to the corresponding definition or examples.
- 8.7 Discuss the origin and identify characteristics (i.e., air circulation pattern, wind speed, temperature and dew point, and air pressure) of storm systems including hurricanes, Nor'easters, tornadoes, thunderstorms, and mid-latitude cyclones. Explain how these weather events can transfer heat. Describe the environmental, economic, and human impact of these storms.
Essence: Storm system characteristics and heat transfer
E1: Describe the environmental impact of a storm system.
E2: Identify different types of storm systems.
E3: Match given characteristics with the corresponding storm system.
- 8.8 Compare and contrast different storm systems in terms of size, formation, and associated weather.
Essence: Characteristics of storm systems
E1: Compare and contrast two different storm systems.
E2: Identify the characteristics of a storm system.
E3: Match given characteristics with the corresponding storm system.
- 8.9 Describe how origin affects the temperature and moisture content of an air mass. Describe how the interaction of air masses produces different fronts (warm, cold, and stationary) that influence our weather.
Essence: Origin of storm formation
E1: Describe how fronts are produced.
E2: Identify the types of weather fronts.
E3: Match real life examples of different fronts with corresponding terms.

2 - Earth's components form systems. These systems continually interact at different rates of time, affecting the Earth locally and globally. (continued)

- 8.10 Describe how the formation of clouds is influenced by the dew point, environmental temperature and amount of particles in the air. Explain how various lifting mechanisms affect cloud formation.
Essence: Cloud formation
 E1: Explain how clouds are influenced by dew point, temperature, and amount of particles in the air.
 E2: Describe cloud formation.
 E3: Identify what substances form clouds.
- 8.11 Use cloud characteristics (altitude, composition, and form) to predict the weather. Discuss how different cloud types are indicators of weather and weather systems such as frontal systems and hurricanes.
Essence: Cloud characteristics
 E1: Predict the weather based on cloud type.
 E2: Identify characteristics of clouds.
 E3: Match given characteristics to corresponding cloud type.

3 - Technology enables us to better understand Earth's systems. It also allows us to analyze the impact of human activities on Earth's systems and the impact of Earth's systems on human activity.

- 7.1 Use topographic maps to locate Delaware watersheds and to identify the bodies of water into which they drain. Analyze and describe the relationship between elevation of land and the flow rate of water in a watershed.
Essence: Watersheds and land elevation
 E1: Given a topographic map of Delaware, identify the watersheds.
 E2: Given a topographic map, identify bodies of water.
 E3: Given a topographic map, distinguish between water and land.
- 7.4 Explain the impact of human activities (e.g., building roads, fertilizing golf courses, etc.) on the quality of Delaware's waters.
Essence: Impact of human activity on watersheds
 E1: Provide examples of human activities that affect the water quality of Delaware.
 E2: Given human activities, determine if it impacts the quality of water in Delaware.
 E3: Distinguish clean water from dirty water.
- 8.1 Examine isobars on weather maps to describe how wind (moving air) travels from a region of high pressure to a region of low pressure. Apply this knowledge to explain the cause of wind.
Essence: Isobars and wind
 E1: Given a completed weather map, identify high pressure and low pressure regions.
 E2: Given a completed weather map, identify isobars.
 E3: Identify if wind travels from high to low pressure regions.
- 8.2 Record and interpret daily weather measurements over an extended period of time using a variety of instruments (i.e., barometer, anemometer, sling psychrometer, rain gauge, and thermometer) in order to predict and to identify weather patterns.
Essence: Measuring weather properties
 E1: Collect weather data over a period of time and note changes.
 E2: Use weather instruments to collect weather data.
 E3: Given a set of objects, identify a weather instrument.

3 - Technology enables us to better understand Earth's systems. It also allows us to analyze the impact of human activities on Earth's systems and the impact of Earth's systems on human activity. (continued)

8.3 Construct and use surface station models to represent local atmospheric data and interpret weather patterns on meteorological maps.

Essence: Weather maps

E1: Construct a basic station model.

E2: Complete a partially constructed station model.

E3: Distinguish between a meteorological map and another type of map.

8.4 Examine satellite imagery pictures and use these images to identify cloud patterns and storm systems.

Essence: Satellite imagery and weather patterns

E1: Identify how technology can be used to identify cloud patterns and storms.

E2: Locate a storm system on a satellite image.

E3: Given pictures, identify a satellite image.

8.5 Use weather maps to describe the movement of fronts and storms and to predict their influence on local weather.

Essence: Weather patterns

E1: Explain how fronts are produced.

E2: Locate a warm and cold front on a map.

E3: Distinguish between a meteorological map and another type of map.

1 - Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.

- 7.1 Identify and apply criteria for determining whether specimens or samples are living, dead, dormant or nonliving.
Essence: Living versus nonliving
E1: Compare and contrast living and nonliving things.
E2: Identify the criteria for living and nonliving things.
E3: Identify given examples as living or nonliving.
- 7.2 Classify organisms based on shared characteristics into currently recognized kingdoms and justify their placement. Give examples of organisms from each kingdom.
Essence: Kingdoms
E1: Sort organisms into kingdoms by their characteristics.
E2: Identify characteristics of a given kingdom.
E3: Match characteristics to a given kingdom.
- 7.3 Explain that individual cells are able to carry out basic life functions that are similar in organisms; however, explain that in multi-cellular organisms, cells become specialized, interdependent upon one another, and unable to survive independently.
Essence: Cells and organisms
E1: Explain what happens to cells in multi-cellular organisms.
E2: Identify the function of individual cells.
E3: Identify if given examples are multi-cellular organisms.
- 7.4 Describe the hierarchical organization of multi-cellular organisms. Recognize that multi-celled organisms are organized as specialized cells within tissues that make up organs within organ systems, which work together to carry out life processes for the entire organism.
Essence: Multi-cellular organisms
E1: Describe how multi-cellular organisms are organized.
E2: List examples of multi-cellular organisms.
E3: Match a given organ to the corresponding function.
- 7.5 Observe and sketch cells using microscopes and other appropriate tools. Compare and contrast plant, animal, protist, and bacterial cells by noting the presence or absence of major organelles (i.e., cell membrane, cell wall, nucleus, chloroplasts, mitochondria and vacuoles) using the sketches and other resources.
Essence: Cell types
E1: Compare and contrast different cell types.
E2: Label the parts of a given cell.
E3: Identify given cells as plant or animal.
- 7.6 Research the sequence of events that led to the formation of the cell theory and correlate these events with technological advancements (e.g., hand lens, microscopes, and staining techniques).
Essence: Technology improves understanding of cells
E1: Explain how tools allow us to understand cells.
E2: List tools or procedures used to view cells.
E3: Identify if a given instrument will magnify an object.

2 - All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.

- 7.1 Recognize that the process of photosynthesis occurs in the chloroplasts of producers. Summarize the basic process in which energy from sunlight is used to make sugars from carbon dioxide and water (photosynthesis). Indicate that this food can be used immediately, stored for later use, or used by other organisms.
Essence: Plants use energy to make food
E1: Discuss how plants make food through photosynthesis.
E2: Locate where the process of making food takes place in a plant.
E3: Identify the resources needed for plants to make food.
- 7.2 Recognize that the process of cellular respiration in the mitochondria of both plants and animals releases energy from food. Indicate that this food provides the energy and materials for repair and growth of cells. Explain the complementary nature between photosynthesis and cellular respiration.
Essence: Food provides energy to organisms
E1: Explain how organisms use energy.
E2: Identify organisms that depend on plants for food.
E3: Identify a source of energy for the body.

3 - Organisms respond to internal and external cues, which allow them to survive.

- 8.1 Understand and describe how the maintenance of a relatively stable internal environment is required for the continuation of life and explain how stability is challenged by changing physical, chemical, and environmental conditions.
Essence: Maintenance of a stable internal environment
E1: Differentiate between stable and unstable environments.
E2: Given environmental condition, identify as stable or unstable.
E3: Identify the typical characteristics of a given environment.
- 8.2 Explain that the regulatory and behavioral responses of an organism to external stimuli occur in order to maintain both short and long term equilibrium (e.g., migrating shorebirds behave differently along the migration path in order to support their life cycle).
Essence: Regulatory and behavioral responses of organisms
E1: Explain how survival of an organism is dependent upon responses to internal and external stimuli.
E2: Give an example of internal or external stimuli to which organisms respond.
E3: Identify if given stimuli are located inside or outside of the body.

4 - The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.

- 6.2 Research and report on how body systems are affected by lifestyle choices such as diet or exercise, for example lack of exercise leads to cardiovascular disease.
Essence: Effects of diet and exercise
E1: Identify ways to keep the body systems healthy.
E2: Identify healthy activities.
E3: Given food choices, identify healthy foods.

1 - Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.

- 7.6 Describe the relationship between genes, chromosomes, and DNA in terms of location and relative size.
Essence: Genetics
E1: Describe the similarities and differences between genes, chromosomes, and DNA.
E2: Identify a difference between genes, chromosomes, and DNA.
E3: Sequence genes, chromosomes, and DNA based on size.
- 7.9 Use single trait Punnett squares to examine the genotypes of individuals and indicate which individuals will express dominant or recessive traits. Justify the indication by relating that dominant alleles appearing heterozygously or homozygously are expressed or that two recessive alleles (homozygous) are required for an offspring to express a recessive trait phenotypically.
Essence: Punnett squares and dominant and recessive genes
E1: Create a simple Punnett Square.
E2: Identify if given characteristics are recessive or dominant genes.
E3: Sort given characteristics as recessive or dominant genes (e.g., blond hair to recessive, brown eyes to dominant).
- 8.1 Relate the advantages and disadvantages of different reproductive strategies in terms of energy expenditure per offspring and survival rates of that offspring.
Essence: Offspring's life span
E1: Compare and contrast advantages of reproductive strategies.
E2: Identify reproductive strategies (e.g., asexual, sexual).
E3: Match given species with their offspring.
- 8.2 Research and report on reproductive strategies of different organisms (i.e., broadcast spawning versus nurturing parenting) that allow them to be successful.
Essence: Offspring's life span
E1: Research reproductive strategies.
E2: Research an animal's life span and offspring.
E3: Sort given species with their form of birth (e.g., live birth, hatching from eggs).

2 - The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.

- 8.1 Recognize that species acquire many of their unique characteristics through biological adaptations, which involve the selection of naturally occurring variations in populations.
Essence: Acquired traits
E1: Describe how biological adaptations occur.
E2: Identify similar traits across generations.
E3: Match characteristics from offspring to parent.
- 8.2 Observe a variety of organisms and explain how a specific trait could increase an organism's chances of survival.
Essence: Traits influence on survival
E1: Describe traits that can increase survival.
E2: Given the environment, identify the survival traits needed.
E3: Match given needs with corresponding traits.

2 - The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring. (continued)

- 8.3 Explain how the extinction of a species occurs when the environment changes and the adaptation of a species is insufficient to allow for its survival.
Essence: Extinction
E1: Discuss reasons animals become extinct.
E2: Identify animals that have been extinct.
E3: Identify if given animals are extinct.
- 8.4 Conduct a natural selection simulation to demonstrate how physical adaptations (i.e., protective camouflage, long neck for food gathering, muscular legs for running, heavy beak for nut cracking, etc.) have selective advantages for an organism. Research and report on beneficial physical adaptations of a variety of organisms.
Essence: Physical adaptations
E1: Describe how physical adaptations help species to survive.
E2: Given the environment, identify physical adaptations needed.
E3: Match an animal to an environment based on physical adaptations.
- 8.5 Investigate and discuss how short-term physiological changes of an organism (e.g., skin tanning, muscle development, formation of calluses) differ from long-term evolutionary adaptations (e.g., white coloration of polar bears, seed formation in plants) that occur in populations of organisms over generations.
Essence: Short versus long term physiological changes
E1: Describe the difference between short and long term physiological changes.
E2: Identify short or long term physiological changes.
E3: Match an animal to an environment based on physical adaptations.
- 8.6 Conduct simulations to investigate how organisms fulfill basic needs (i.e., food, shelter, air, space, light/dark, and water) in a competitive environment. Relate how competition for resources can determine survival.
Essence: Competition for basic needs
E1: Describe ways in which humans or animals compete for basic needs.
E2: Match food or shelter with corresponding animal.
E3: Identify if given examples are basic needs.
- 8.7 Examine an assortment of plants and animals and use simple classification keys, based on observable features, to sort and group the organisms.
Essence: Species classifications
E1: Classify animals and plants using physical features.
E2: Identify a given species as a plant or animal.
E3: Sort animals based on physical characteristics.

3 - The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human wants and needs.

- 7.1 Research and report on selective breeding. Select an organism (e.g., race horses, pedigree dogs, drought resistant plants) and trace its history of development and the traits of the plant or animal that were enhanced by selective breeding.
Essence: Selective breeding
E1: Discuss reasons for selective breeding.
E2: Research animals or plants that have been selectively bred.
E3: Identify if given examples are traits of an organism.
- 7.2 Recognize that the health profession uses pedigree charts to trace genetic disorders in past generations to make predictions for future generations. Research and report on a chromosomal disorder. Complete a simulated pedigree for a fictional family based on your research.
Essence: Genetic disorders in families
E1: Research and report genetic disorders.
E2: Create a simple pedigree chart.
E3: Identify relatives using a family tree.

1 - Organisms and their environments are interconnected. Changes in one part of the system will affect other parts of the system.

- 8.1 Survey the diversity of organisms in a local or model ecosystem. Recognizing that a population consists of all individuals of a species that occur together at a given place and time, describe how to estimate and then calculate the size of a large population of a variety of organisms. Chart the diversity of the organisms in the ecosystem.
Essence: Diversity of ecosystems
E1: Collect data on the number of different organisms and species in an ecosystem.
E2: Given data, identify the number of specified species in an ecosystem.
E3: Identify different populations within an ecosystem.
- 8.2 Categorize populations of organisms according to the roles (producers, consumers, and decomposers) they play in an ecosystem.
Essence: Role of organisms in an ecosystem
E1: Identify the roles organisms play in a given ecosystem.
E2: Match given organisms to their corresponding roles in an ecosystem.
E3: Identify if given organisms are producers of food or consumers of food.
- 8.3 Describe and explain how factors (i.e., space, food, water, disease) limit the number of organisms an ecosystem can support.
Essence: Organisms in ecosystems
E1: Describe how limiting factors impact the number of organisms in an ecosystem.
E2: Identify factors that can affect the number of organisms in a given environment.
E3: Identify the amount of a specified organism in a given environment as abundant or scarce.
- 8.4 Construct a data table or line graph to show population changes of a selected species over time. Describe the population changes portrayed by the graph.
Essence: Charting changing populations
E1: Create a simple graph or table to show the changing of a population over time.
E2: Given a simple graph, identify if the population of an organism has increased or decreased.
E3: Identify increases and decreases on a graph.
- 8.5 Observe graphs or data tables showing both the population growth of a species and the consequences of resource depletion on the population. Analyze the data and explain the effect that may occur from exponential growth of a population (given finite resources).
Essence: Population growth and resources
E1: Describe the relationship between population growth and the decrease of resources.
E2: Given a graph, identify if there is an increase or decrease in resources as a population increases.
E3: Identify increases and decreases on a graph.
- 8.6 Investigate and discuss how short-term physiological changes of an organism (e.g., skin tanning, muscle development, formation of calluses) differ from long-term evolutionary adaptations (e.g., white coloration of polar bears, seed formation in plants) that occur in a group of organisms over generations.
Essence: Short versus long-term physiological changes
E1: Describe the difference between short and long-term physiological changes.
E2: Identify short or long-term physiological changes.
E3: Identify if examples are inherited characteristics.

1 - Organisms and their environments are interconnected. Changes in one part of the system will affect other parts of the system. (continued)

- 8.7 Investigate local areas, disturbed and undisturbed, that are undergoing succession (i.e., abandoned gardens, ditch banks, and the edge of a forest). Predict how plant communities that grow in the area may change over time and how their presence determines what kinds of animals may move into and out of the areas.

Essence: Ecological succession

- E1: Describe the process of ecological succession and its affect on animals and plants.
E2: Identify areas that have undergone ecological succession.
E3: Identify if a given area is disturbed or undisturbed.

2 - Matter needed to sustain life is continually recycled among and between organisms and the environment. Energy from the Sun flows irreversibly through ecosystems and is conserved as organisms use and transform it.

- 8.1 Construct food webs and identify the relationships among producers, consumers, and decomposers.

Essence: Food webs

- E1: Create a food web of an ecosystem.
E2: Given a diagram of a food web, identify the producers and consumers.
E3: Match organisms to their roles in the ecosystem.

- 8.2 Design food webs and trace the flow of matter and energy (beginning with the Sun) through the food web.

Essence: Food webs

- E1: Create a food web of an ecosystem that shows the flow of energy.
E2: Given a food web, identify the main source of energy.
E3: Trace the flow of a given food web.

3 - Humans can alter the living and non-living factors within an ecosystem, thereby creating changes to the overall system.

- 8.1 Research and analyze data on human population changes that have occurred in a specific Delaware ecosystem. Discuss reasons for changes in human population and explain how these changes have affected the biodiversity of local organisms and availability of natural resources in the given ecosystem (e.g., habitat loss, water quality, preservation/conservation efforts).

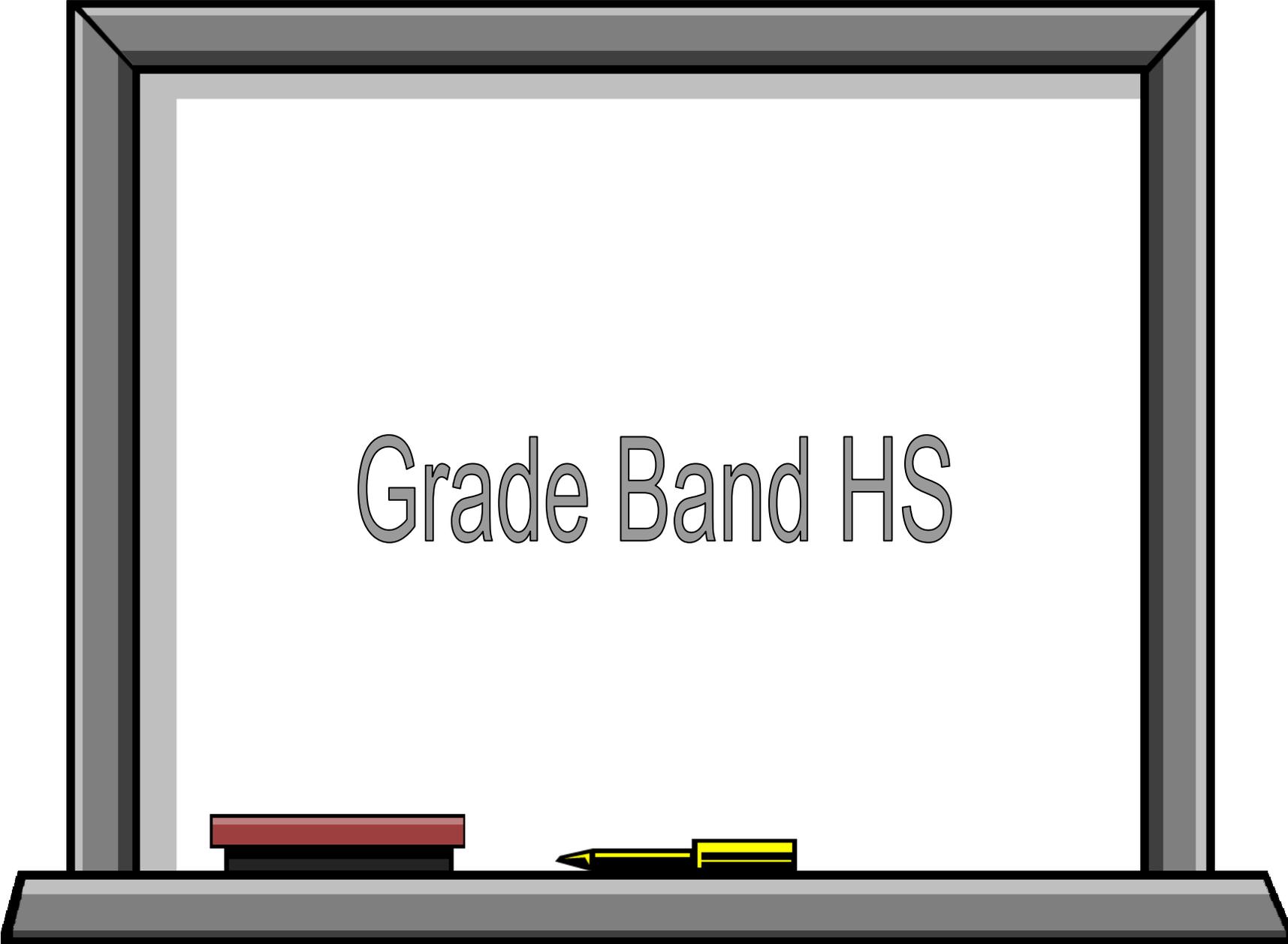
Essence: Human population and ecosystems

- E1: Describe the impact human population has on an ecosystem.
E2: Given an ecosystem, identify natural resources.
E3: Identify different ecosystems on a map of Delaware.

- 8.2 Identify ways in which invasive species can disrupt the balance of Delaware as well as other ecosystems (i.e., competition for resources including habitat and/or food). Research and report on an invasive species, indicating how this species has altered the ecosystem.

Essence: Invasive species

- E1: Give examples of the impact invasive species have on an ecosystem in Delaware.
E2: Identify examples of invasive species that have impacted an ecosystem.
E3: Identify if given animals live in a specified ecosystem.



Grade Band HS

1 - Scientific inquiry involves asking scientifically-oriented questions, collecting evidence, forming explanations, connecting explanations to scientific knowledge and theory, and communicating and justifying the explanation.

- 10.1 Identify and form questions that generate a specific testable hypothesis that guide the design and breadth of the scientific investigation.
Essence: Generating hypotheses
E1: Create a testable hypothesis to guide a scientific investigation.
E2: Given the design of the investigation, identify a related hypothesis.
E3: Given the hypothesis, identify an appropriate experiment from given choices.
- 10.2 Design and conduct valid scientific investigations to control all but the testable variable in order to test a specific hypothesis.
Essence: Conduct a scientific investigation
E1: Design a multi-step investigation to explore a hypothesis.
E2: Participate in an experiment and identify the control and variables.
E3: Participate in an experiment and select the purpose from an array of choices.
- 10.3 Collect accurate and precise data through the selection and use of tools and technologies appropriate to the investigations. Display and organize data through the use of tables, diagrams, graphs, and other organizers that allow analysis and comparison with known information and allow for replication of results.
Essence: Collect, record, and compare data
E1: Collect, display, and compare data related to an investigation.
E2: Collect and display data from multiple sources.
E3: Record data in a given chart or table.
- 10.4 Construct logical scientific explanations and present arguments which defend proposed explanations through the use of closely examined evidence.
Essence: Scientific explanations based on evidence
E1: Based on examined evidence, defend a scientific explanation.
E2: Identify evidence to defend a scientific explanation.
E3: Categorize evidence as related or unrelated to a given scientific explanation.
- 10.5 Communicate and defend the results of scientific investigations using logical arguments and connections with the known body of scientific information.
Essence: Defending results of scientific investigations
E1: Present a logical argument to support conclusions from a scientific investigation.
E2: Identify conclusions of a scientific investigation based on the data.
E3: Answer literal questions about the results of a scientific investigation.
- 10.6 Use mathematics, reading, writing and technology when conducting scientific inquiries.
Essence: Integrate reading, writing, math, or technology into scientific investigations
No extensions available - Multiple content areas should be incorporated into scientific investigations.

1 - The structures of materials determine their properties.

- 9.1 Explain that matter is composed of tiny particles called atoms that are unique to each element, and that atoms are composed of subatomic particles called protons, neutrons, and electrons.
Essence: Parts of an atom
E1: Construct a simple model of an atom.
E2: Given a model, identify the parts of an atom.
E3: Match models of atoms to corresponding pictures or models.
- 9.2 Describe the relative charge, approximate mass, and location of protons, neutrons, and electrons in an atom.
Essence: Structure of an atom
E1: Describe characteristics of protons, neutrons, and electrons.
E2: Identify the location of particles in an atom.
E3: Match relative charge with protons, neutrons, or electrons.
- 9.3 Classify matter as mixtures (which are either homogenous or heterogeneous) or pure substances (which are either compounds or elements).
Essence: Mixtures and pure substances
E1: Compare and contrast mixtures and pure substances.
E2: Identify differences between mixtures and pure substances.
E3: Categorize given substances as mixtures or pure substances.
- 9.4 Explain that elements are pure substances that cannot be separated by chemical or physical means. Recognize that compounds are pure substances that can be separated by chemical means into elements.
Essence: Elements and compounds
E1: Differentiate between elements and compounds.
E2: Identify characteristics of elements and compounds.
E3: Given examples, identify as elements or compounds.
- 9.5 Classify various common materials as an element, compound or mixture.
Essence: Elements, compounds, and mixtures
E1: Sort given materials as elements, compounds, or mixtures.
E2: Given examples, identify as an element or compound.
E3: Match mixtures or compounds with their component parts.
- 9.6 Describe isotopes of elements in terms of protons, neutrons, electrons, and average atomic masses. Recognize that isotopes of the same element have essentially the same chemical properties that are determined by the proton and electron number.
Essence: Isotopes
E1: Determine the isotopes of an element by counting the number of neutrons.
E2: Given a Periodic Table, locate and identify an element's mass number.
E3: Given an element, identify the atomic number.

1 - The structures of materials determine their properties. (continued)

- 9.7 Use the Periodic Table to identify an element's atomic number, valence electron number, atomic mass, group/family and be able to classify the element as a metal, non-metal or metalloid.
Essence: Periodic Table
E1: Use the Periodic Table to identify facts about elements.
E2: Given a Periodic Table with a key, identify if an element is a metal or nonmetal.
E3: Given the Periodic Table, match atomic number with the corresponding element.
- 9.8 Determine the physical and chemical properties of an element based on its location on the Periodic Table.
Essence: Properties of elements
E1: Describe the physical or chemical properties of an element.
E2: Identify physical properties of metals.
E3: Given elements on the Periodic Table, identify as metal or nonmetal.
- 9.9 Investigate differences between the properties of various elements in order to predict the element's location on the Periodic Table.
Essence: Properties of elements and location on the Periodic Table
E1: Given a property, make a prediction about the location of an element on the Periodic Table.
E2: Using the Periodic Table, classify given elements as metal, nonmetal, or metalloid.
E3: Identify given elements as metal or nonmetal.
- 9.12 Explain how an atom's electron arrangement influences its ability to transfer or share electrons and is related to its position on the Periodic Table. Recognize that an atom in which the positive and negative charges do not balance is an ion.
Essence: Atoms and ions
E1: Recognize that an atom in which the positive and negative charges do not balance is an ion.
E2: Compare the number of protons and electrons in an element.
E3: Count the number of electrons in an atom.
- 9.13 Recognize that metals have the physical properties of conductivity, malleability, luster, and ductility.
Essence: Properties of metals
E1: Describe physical properties of metals.
E2: Categorize given metals as malleable or lustrous.
E3: Sort metals based on attributes.
- 9.14 Explore the extent to which a variety of solid materials conduct electricity in order to rank the materials from good conductors to poor conductors. Based on the conductivity data, determine patterns of location on the Periodic Table for the good conductors versus the poor conductors.
Essence: Conductivity based on the Periodic Table
E1: Identify elements on the Periodic Table that are good conductors based on gathered conductivity data.
E2: Categorize given elements as good or poor conductors based on the Periodic Table.
E3: Identify a metal on the Periodic Table.

1 - The structures of materials determine their properties. (continued)

- 9.15 Recognize that physical changes alter some physical properties of a substance but do not alter the chemical composition of the substance.
Essence: Conservation of matter
E1: Describe how an object is the same after manipulation.
E2: Identify the physical changes once an object has been manipulated.
E3: Manipulate an object without changing its chemical properties.
- 9.16 Conduct investigations to determine the effect of heat energy on the change of state (change of phase) of water. Sketch and interpret graphs representing the melting, freezing, evaporation and condensation of water.
Essence: States of water
E1: Conduct an investigation on phases of water change.
E2: Identify the four phases of water change.
E3: Given descriptions of the properties of water, match to the corresponding phase.
- 9.17 Recognize that molecular and ionic compounds are electrically neutral.
Essence: Molecular and ionic compounds
E1: Describe the relationship between negatively and positively charged atoms.
E2: Identify the number of atoms in an ionic or molecular compound.
E3: Identify given descriptions of a specific atom as negatively or positively charged.
- 9.18 Apply the kinetic molecular theory to explain that a change in the energy of the particles may result in a temperature change or a change of phase (change in state).
Essence: Kinetic molecular theory
E1: Identify the effects changing temperatures have on matter.
E2: Identify the three states of matter.
E3: Observe a change in the energy of particles and match the outcome (e.g., temperature change or phase change).
- 9.19 Use a model or a diagram to explain water's properties (e.g., density, polarity, hydrogen bonding, boiling point, cohesion, and adhesion) in the three states of matter. Cite specific examples of how water's properties are important (i.e., water as the "universal").
Essence: Properties of water
E1: Describe the properties of water (e.g., density, boiling point, adhesion).
E2: Identify the effects changing temperatures have on water.
E3: Identify the three states of matter as they relate to water.

2 - The properties of the mixture are based on the properties of its components.

- 9.1 Recognize that mixtures can be separated by physical means into pure substances.
Essence: Separation of mixtures
E1: Describe a process to separate mixtures into pure substances.
E2: Given a mixture, sequence the steps needed to separate into pure substances.
E3: Using pure substances, create a mixture.

2 - The properties of the mixture are based on the properties of its components. (continued)

- 9.2 Explain the effect of water's polarity on the solubility of substances (e.g., alcohol, salt, oil).
Essence: Water's polarity and solubility of substances
E1: Describe water's impact on solubility of substances.
E2: Given different mixtures, identify which mixture is most polar.
E3: Given liquids, create a polar mixture.
- 9.3 Separate mixtures into their component parts according to their physical properties such as melting point, boiling point, magnetism, solubility and particle size. Explain how the properties of the components of the mixture determine the physical separation techniques used.
Essence: Component properties and separation
E1: Given a mixture, explain the techniques needed to separate the components according to their physical properties.
E2: Given mixtures, identify the most effective separation technique for each.
E3: Given components of a mixture, identify physical properties.
- 9.4 Describe how the process of diffusion or the movement of molecules from an area of high concentration to an area of low concentration (down the concentration gradient) occurs because of molecular collisions.
Essence: Diffusion
E1: Describe the process of diffusion and give examples.
E2: Conduct a given experiment to determine the effects of diffusion.
E3: Demonstrate the spread of a substance from a small to a large area (e.g., tea bag in a cup of water).
- 9.5 Explore how various solutions conduct electricity and rank the liquids from good conductors to poor conductors. Explain the characteristics that allow some solutions to have better electrical conductivity than others.
Essence: Conductivity of electricity in liquids
E1: Conduct given experiments to determine the conductivity of various solutions and compare results.
E2: Identify characteristics that allow solutions to be good conductors of electricity.
E3: Categorize given solutions as good or poor conductors of electricity.
- 9.6 Measure the pH of a solution using chemical indicators to determine the relative acidity or alkalinity of the solution. Identify the physical properties of acids and bases.
Essence: pH of a solution
E1: Use a chemical indicator to measure the pH of a solution.
E2: Given data, determine the pH range for the solution and identify as an acid or base.
E3: Match the color of the pH strip to the key to determine the pH of a solution.
- 9.7 Investigate factors that affect the materials' solubility in water and construct solubility curves to compare the extent to which the materials dissolve.
Essence: Solubility
E1: Collect data and create a simple graph charting the amount of time it takes a solute to dissolve in a solvent.
E2: Given a data table on solubility, create a simple graph.
E3: Identify points on a solubility curve.

3 - When materials interact within a closed system, the total mass of the system remains the same.

- 9.1 Conduct and explain the results of simple investigations to demonstrate that the total mass of a substance is conserved during both physical and chemical changes.

Essence: Conservation of mass

- E1: Conduct an investigation of mass by combining substances and describe the physical or chemical change.
E2: Given the results of an investigation of mass, identify physical changes.
E3: Given the results of a simple investigation of mass, identify if any changes occurred.

4 - There are several ways in which elements and/or compounds react to form new substances and each reaction involves energy.

- 9.1 Recognize that chemical changes alter the chemical composition of a substance forming one or more new substances. The new substance may be a solid, liquid, or gas.

Essence: Changes in chemical composition create a new substance

- E1: Conduct an investigation on chemical reactions and describe changes that occur.
E2: Given the results of an investigation on chemical changes, identify a substance as a solid, liquid, or gas.
E3: Conduct a simple experiment to cause a chemical change.

- 9.2 Balance simple chemical equations and explain how these balanced chemical equations represent the conservation of matter.

Essence: Balanced equations

- E1: Balance a simple chemical equation using a model.
E2: Identify the parts of a chemical equation.
E3: Use a balance to show equal weight between two objects.

5 - People develop new materials as a response to the needs of society and the pursuit of knowledge. This development may have risks and benefits to humans and the environment.

- 9.1 Research and report on a variety of manufactured goods and show how the chemical properties of the component materials were used to achieve the desired qualities.

Essence: Chemical properties of manufactured goods

- E1: Choose a manufactured good and research component materials and their chemical properties.
E2: Identify component materials of manufactured goods.
E3: Match manufactured goods to given components.

1 - Energy takes many forms. These forms can be grouped into types of energy that are associated with the motion of mass (kinetic energy), and types of energy associated with the position of mass and energy fields (potential energy).

- 9.1 Recognize that electromagnetic energy (radiant energy) is carried by electromagnetic waves.
Essence: Electromagnetic energy and electromagnetic waves
E1: Describe the relationship between electromagnetic energy and electromagnetic waves.
E2: Match the definition of electromagnetic waves and electromagnetic energy to the corresponding terms.
E3: Identify types of electromagnetic waves.
- 9.2 Use diagrams to illustrate the similarities shared by all electromagnetic waves and differences between them. Show how wavelength is used to distinguish the different groups of EM waves (radio waves, microwaves, IR, visible and UV waves, X-rays, and gamma waves).
Essence: Electromagnetic waves
E1: Create a diagram to show the difference in wavelength between electromagnetic waves.
E2: Use a diagram to identify differences and similarities between electromagnetic waves.
E3: Identify given examples as electromagnetic waves.
- 9.3 Conduct investigations involving moving objects to examine the influence that the mass and the speed have on the kinetic energy of the object. Collect and graph data that supports that the kinetic energy depends linearly upon the mass, but nonlinearly upon the speed. Recognize that the kinetic energy of an object depends on the square of its speed, and that $KE = 1/2mv^2$.
Essence: The impact of mass and speed on kinetic energy
E1: Conduct an investigation and record data to show that increasing mass and/or speed increases kinetic energy.
E2: Given results of an investigation, identify the impact mass has on kinetic energy.
E3: Given results of an investigation, identify if speed or mass has an impact on the kinetic energy.
- 9.4 Collect and graph data that shows that the potential energy of an object increases linearly with the weight of an object (mg) and with its height above a pre-defined reference level, h. ($GPE = mgh$).
Essence: Potential energy
E1: Conduct an investigation on the effects weight and vertical distance have on potential energy and graph results.
E2: Given the weight and the vertical distance of an object, identify which object will have the greatest potential energy.
E3: Given various scenarios, identify which objects have the most potential energy.
- 9.5 Conduct investigations and graph data that indicate that the energy stored in a stretched elastic material increases nonlinearly with the extent to which the material was stretched.
Essence: Potential energy
E1: Conduct an investigation on stored energy using elasticity and record results.
E2: Categorize scenarios involving elastic as demonstrating stored potential energy or not.
E3: Sort given objects into groups by their ability to stretch.
- 9.7 Explain that heat energy represents the total random kinetic energy of molecules of a substance.
Essence: Heat energy
E1: Describe the relationship between heat energy and kinetic energy.
E2: Identify the relationship between particle movement and heat energy.
E3: Identify objects that use heat energy.

1 - Energy takes many forms. These forms can be grouped into types of energy that are associated with the motion of mass (kinetic energy), and types of energy associated with the position of mass and energy fields (potential energy). (continued)

9.8 Recognize that chemical energy is the energy stored in the bonding of atoms and molecules.

Essence: Chemical energy

E1: Explain how atoms and molecules use chemical energy to bond.

E2: Give examples of chemical energy.

E3: Match the words molecules and bonds to their definitions.

2 - Changes take place because of the transfer of energy. Energy is transferred to matter through the action of forces. Different forces are responsible for the different forms of energy.

9.1 Recognize that electromagnetic waves transfer energy from one charged particle to another. Use graphics or computer animations to illustrate this transfer process. Give everyday examples of how society uses these transfer processes (for example, communication devices such as radios and cell phones).

Essence: Transfer of electromagnetic waves

E1: Describe the process electromagnetic waves use to transfer energy and illustrate this process.

E2: Complete a diagram illustrating how electromagnetic waves transfer energy.

E3: Identify if given devices use electromagnetic waves to transfer energy.

9.2 Use diagrams to illustrate how the motion of molecules when a mechanical wave passes through the substance is different from the motion associated with their random kinetic energies.

Essence: Motion of molecules

E1: Describe the differences in the motion of molecules between mechanical waves and random kinetic energies.

E2: Identify the differences between mechanical waves and random kinetic energies when given a diagram on molecule motion.

E3: Match given characteristics of molecule motion with the corresponding term.

9.3 Use diagrams or models to explain how mechanical waves can transport energy without transporting matter.

Essence: Energy transfer of mechanical waves

E1: Using a diagram, describe how mechanical waves can transport energy.

E2: Identify characteristics of mechanical waves using a diagram/model.

E3: Identify examples of mechanical waves.

9.4 Reflect on why mechanical waves will pass through some states of matter better than others.

Essence: Mechanical waves

E1: Compare how mechanical waves travel through solids, liquids, and gases.

E2: Identify the state of matter that allows the most mechanical waves to pass through.

E3: Order the states of matter from most to least, based on their ability to transfer mechanical waves.

9.5 Recognize that the gravitational force is a universal force of attraction that acts between masses, but this force is only significant when one (or both) of the objects is massive (for example, a star, planet or moon).

Essence: Gravity

E1: Explain the relationship between gravitational force and objects that are significant in mass.

E2: Identify objects that have strong gravitational forces based on mass (e.g., the Moon, Earth, Sun, and planets).

E3: Given a set of objects varying in mass, order from strongest to weakest gravitational force.

2 - Changes take place because of the transfer of energy. Energy is transferred to matter through the action of forces. Different forces are responsible for the different forms of energy. (continued)

- 9.6 Explain that as objects move away from the surface of a planet or moon, the gravitational pull on the object will decrease.
Essence: Gravity
E1: Describe what happens to the gravitational pull of an object when it moves away from the Earth.
E2: Give examples of objects that have lost their gravitational pull as they move away from Earth.
E3: Identify if an object has gained or lost gravitational force (e.g., spaceship going in and out of Earth's gravitational pull).
- 9.9 Explain the difference between the mass of an object and its weight. Identify that near the surface of the Earth, the gravitational force acting on the object (its weight) depends only on its mass, and that this force can be simply calculated from knowledge of the mass ($F_G = mg$).
Essence: Mass and weight
E1: Describe the differences between weight and mass.
E2: Match the definitions of weight and mass to the corresponding terms.
E3: Identify the components of weight or mass.
- 9.10 Conduct investigations to determine the behavior of elastic materials. Graph the data and identify the relationship between the extent of the stretch and the size of the elastic force (i.e., $F_{\text{elastic}} = kx$ where x = stretch).
Essence: Elasticity
E1: Conduct an investigation on elasticity and interpret results.
E2: Given the length of stretched elastic, predict what will happen when released.
E3: Categorize given objects based on their elasticity.
- 9.11 Describe the role that forces play when energy is transferred between interacting objects and explain how the amount of energy transferred can be calculated from measurable quantities.
Essence: Transfer of energy
E1: Describe the significance of force in the transfer of energy between interacting objects.
E2: Describe how energy is transferred between interacting objects.
E3: Identify the amount (e.g., large, small, a little, a lot) of force used between interacting objects.
- 9.12 Give examples of common forces transferring energy to (or away from) objects. For example, a pulling force can transfer energy to an object (when the object is pulled along a floor), a pushing force can transfer energy away from an object (to slow its motion), and friction and air resistance always transfer kinetic energy away from moving objects.
Essence: Energy transfer
E1: Describe how common forces transfer energy to objects.
E2: Identify forces that have an effect on the transfer of energy.
E3: Identify what type of energy transfer is needed to continue or stop a given motion.
E3: Given an example, identify the source of energy or power (e.g., picture of a car- source of energy is gas, source of power is the engine).

2 - Changes take place because of the transfer of energy. Energy is transferred to matter through the action of forces. Different forces are responsible for the different forms of energy. (continued)

- 9.15 Recognize that power is a quantity that tells us how quickly energy is transferred to an object or transferred away from the object. Give examples that illustrate the differences between power, force and energy (for example, the energy needed to propel a vehicle is stored in the chemical energy of the fuel. Static friction is the force that propels the vehicle, and the power of the vehicle's engine helps to determine how quickly the vehicle can speed up and how quickly its engine uses fuel).

Essence: Power and work

- E1: Describe the differences between power, force, and energy.
E2: Identify characteristics of power, force, and energy.

- 9.16 Use models and diagrams to illustrate the structure of the atom. Include information regarding the distribution of electric charge and mass in the atom. Identify the forces that are responsible for the stability of the atom, and which parts of the atom exert and feel these forces.

Essence: Structure of an atom

- E1: Create a diagram to show the structure of an atom; label and indicate the electrical charge of parts of an atom.
E2: Identify the protons, neutrons, and electrons on a diagram of an atom.
E3: Given a specific part of an atom, identify the charge.

3 - Energy readily transforms from one form to another, but these transformations are not always reversible. The details of these transformations depend upon the initial form of the energy and the properties of the materials involved. Energy may transfer into or out of a system and it may change forms, but the total energy cannot change.

- 9.1 Describe why it is significant that energy cannot be created (made) nor destroyed (consumed), and identify that this property of energy is referred to as the Law of the Conservation of Energy.

Essence: Law of Conservation of Energy

- E1: Describe the importance of the Law of Conservation of Energy.
E2: Identify the key points of the Law of Conservation of Energy.
E3: Match an object that has been physically manipulated to its original form (e.g., shredded paper with a sheet of paper).

- 9.2 Give examples that illustrate the transfer of energy from one object (or substance) to another, and examples of energy being transformed from one to another.

Essence: Transfer and transformation of energy

- E1: Create an illustration of energy transformation and energy transfer.
E2: Provide examples of energy transformation and energy transfer.
E3: Identify given examples as energy transfer or energy transformation.

- 9.3 Use energy chains to trace the flow of energy through physical systems. Indicate the source of the energy in each example, and trace the energy until it leaves the system or adopts a form in the system that neither changes nor is transferred. Make qualitative estimates of all the forms of the energy involved and reflect on the consequences of the energy transfers and transformations that take place. For example, trace the flow of the radiant energy carried by sunlight that strikes the roof of a home. Reflect on how the color of the roof (light vs. dark) will have an impact on the ability to heat and cool the house, and possibly the functional lifetime of the roofing materials themselves.

Essence: Energy flow and transformation

- E1: Describe the transfer of energy through physical systems.
E2: Identify the sources of energy within a given energy chain.
E3: Trace the transfer of energy through a physical system given an energy chain.

3 - Energy readily transforms from one form to another, but these transformations are not always reversible. The details of these transformations depend upon the initial form of the energy and the properties of the materials involved. Energy may transfer into or out of a system and it may change forms, but the total energy cannot change. (continued)

- 9.4 Use diagrams and energy chains to illustrate examples of the selective absorption of mechanical waves in natural phenomena and give examples of how the selective absorption of mechanical waves is used to conduct investigations in medicine, industry and science (for example ultrasound imagery, detecting the epicenter of earthquakes, testing structures for defects, and conducting explorations of the Earth's crust and mantle).
Essence: Selective absorption of mechanical waves
E1: Identify examples of selective absorption of mechanical energy on a given energy chain or diagram.
E2: Provide examples of technology that use the selective absorption of mechanical waves.
E3: Identify if given examples use mechanical waves.
- 9.5 Explain that what happens to electromagnetic waves that strike a substance (reflection, transmission, absorption) depends on the wavelength of the waves and the physical properties of the substance.
Essence: Reflection, transmission, and absorption of electromagnetic waves
E1: List factors that influence the transmission of electromagnetic waves.
E2: Give an example of technologies that use electromagnetic waves.
E3: Identify if given objects use electromagnetic waves.
- 9.6 Investigate how radio waves, microwaves, infrared waves, visible waves and ultraviolet waves behave when they strike different substances.
Essence: Wave behavior
E1: Conduct an investigation to determine how various waves behave when striking different substances.
E2: Given the results of an investigation, identify differences in wave behavior when interacting with various substances.
E3: Match given characteristics with the corresponding waves.
- 9.7 Record how effectively different materials reflect, absorb and transmit different kinds of EM waves. Draw conclusions based on this data and the physical properties of the substances (e.g., some substances absorb visible waves, but not radio waves. Other materials absorb UV waves, but not visible waves).
Essence: Behavior of electromagnetic waves
E1: Compare and contrast the impact various types of electromagnetic waves have on substances.
E2: Identify the behavior electromagnetic waves have on various substances from given data.
E3: Identify examples of various electromagnetic waves.
- 9.8 Give examples that illustrate how the selective absorption of electromagnetic waves explains physical phenomena. For example, how X-rays can be used to detect broken bones beneath the skin and how coating on eyeglasses and sunglasses protect the eyes by permitting visible waves to pass but absorb ultraviolet waves.
Essence: Selective absorption of electromagnetic waves
E1: Identify examples of selective absorption of electromagnetic waves on a given energy chain or diagram.
E2: Give examples of technology that use the selective absorption of electromagnetic waves.
E3: Identify if given examples use electromagnetic waves.
- 9.9 Use energy chains to trace the flow of energy in a selective absorption process (e.g., sunburn, Greenhouse Effect, microwave cooking).
Essence: Selective absorption
E1: Describe the process of selective absorption.
E2: Trace the flow of energy in selective absorption on a given energy chain.
E3: Identify if selective absorption was used in given examples.

3 - Energy readily transforms from one form to another, but these transformations are not always reversible. The details of these transformations depend upon the initial form of the energy and the properties of the materials involved. Energy may transfer into or out of a system and it may change forms, but the total energy cannot change. (continued)

9.10 Use energy chains to trace the flow of energy through systems involving sliding friction and air resistance (for example, the braking action in vehicles or bicycles or a vehicle rolling to rest).

Essence: Friction and air resistance

E1: Describe the flow of an energy chain through friction and air resistance.

E2: Given an energy chain, identify places where friction or air resistance occurs.

E3: Sort given examples based on their use of friction or air resistance.

9.11 Explain that through the action of resistive forces (friction and air resistance) mechanical energy is transformed into heat energy, and because of the random nature of heat energy, transforming all of the heat energy back into mechanical energy (or any other organized form of energy) is impossible. Give examples where organized forms of energy (GPE, elastic PE, the KE of large objects) are transformed into heat energy but the reverse transformations are not possible.

Essence: Energy transformation

E1: Describe how mechanical energy is transformed into heat energy through friction or air resistance.

E2: Identify if friction or air resistance was used to transform mechanical energy.

E3: Sort given examples based on their use of friction or air resistance.

9.12 Reflect on why organized forms of energy are more useful than disorganized forms (heat energy).

Essence: Forms of energy

E1: List reasons why organized energy is useful.

E2: Identify examples of organized or disorganized energy.

E3: Identify a form of heat energy.

4 - People utilize a variety of resources to meet the basic and specific needs of life. Some of these resources cannot be replaced. Other resources can be replenished or exist in such vast quantities they are in no danger of becoming depleted. Often the energy stored in resources must be transformed into more useful forms and transported over great distances before it can be helpful to us.

9.1 Research the factors that contribute to the energy efficiency of cars and trucks. Examine the role that the power of the engine and the weight and physical size and shape of the vehicle have on the fuel efficiency of the vehicle. Identify and report on the sources of the fuels currently used by vehicles and alternative fuels being developed.

Essence: Energy efficiency in vehicles

E1: List factors that affect fuel efficiency.

E2: Define fuel efficiency.

E3: Identify if a given object needs fuel to produce power.

2 – Most objects in the Solar System orbit the Sun and have distinctive physical characteristics and orderly motion which are a result of their formation and changes over time.

9.2 Describe how the Earth formed (using the Solar Nebular Theory) into a solid core, molten mantle, crust of solid rock composed of plates, and early atmosphere as a result of the densities of the elements.

Essence: Earth's elements

E1: Identify and describe the layers that form the Earth.

E2: Sequence the four layers of the Earth.

E3: Given a diagram/model, identify a layer of the Earth.

1 - Earth's systems can be broken down into individual components which have observable measurable properties.

- 9.1 Identify mineral specimens according to their chemical and physical properties. Mineral specimens include calcite, quartz, mica, feldspar, and hornblende. Properties include hardness (Moh's scale), streak, specific gravity, luster, cleavage, crystal shape, and color, and other properties that are useful for identification of specific minerals such as reaction with hydrochloric acid.
Essence: Mineral properties
 E1: Given an assortment of minerals, identify differences in physical and chemical properties.
 E2: Sort given minerals based on physical or chemical properties.
 E3: Identify if a given substance is a mineral.
- 9.2 Identify a few of the most common elements in the Earth's crust, oceans, and atmosphere and confirm their location on the Periodic Table. (Example: Si, O, C, N, H, Al). Compare the relative abundance of elements found in the Earth's crust, oceans, and atmosphere. Trace carbon as it cycles through the crust, ocean, and atmosphere.
Essence: Earth's elements
 E1: Name common elements in the Earth's crust, ocean, and atmosphere.
 E2: Given chemical symbols, locate a common element on the periodic table.
 E3: Match element symbol with common elements in Earth's crust, ocean, or atmosphere.
- 9.3 Classify and describe features that are used to distinguish between igneous, sedimentary, and metamorphic rocks.
Essence: Characteristics of rocks
 E1: Identify the difference between igneous, sedimentary, and metamorphic rocks.
 E2: Identify the three types of rocks.
 E3: Identify if a given feature is a characteristic of a rock.
- 9.5 Describe how igneous rocks are formed. Classify igneous rocks according to crystal size and mineral assemblage.
Essence: Igneous rocks
 E1: Describe how igneous rocks are formed.
 E2: Identify a way igneous rocks are classified.
 E3: Identify an igneous rock.
- 9.6 Identify sandstone, shale and limestone by their composition and texture. Explain how sandstone, shale, and limestone can be changed into the metamorphic rocks quartzite, slate, and marble.
Essence: Sedimentary rocks
 E1: Describe the differences and similarities in sedimentary rocks.
 E2: Given rocks and pictures, identify the differences or similarities between sandstone, limestone, and shale rocks.
 E3: Identify the texture of a sedimentary rock.
- 9.7 Investigate the densities, composition, and relative age of continental (felsic) and oceanic (mafic) rocks. Explain why the continental crust, although thicker in most places, overlies oceanic crust. Use this information to explain why oceanic crust subducts below continental crust in convergent plate boundaries and explain the configuration of land masses and ocean basins.
Essence: Continental and oceanic rocks
 E1: Describe the properties of oceanic and continental rocks.
 E2: Identify the properties of oceanic or continental rocks.
 E3: Identify where oceanic rocks can be found.

2 - Earth's components form systems. These systems continually interact at different rates of time, affecting the Earth locally and globally.

- 9.1 Explain how explosivity, type (shield, strato, etc.) and shape of a volcano is related to the properties of its magma and its location along different plate margins.
Essence: Magma and volcanic characteristics
 E1: Identify types of volcanoes.
 E2: Define magma.
 E3: Sort given pictures of volcanoes by shape.
- 9.2 Identify volcanic products (lava, mudflow, pyroclastic projectiles, ash, gases) associated with various types of volcanoes and their eruptions. Describe the effect of these products on life and property. Explain how the products of volcanic activity influence both long-term and short-term changes in the Earth system.
Essence: Volcanic characteristics
 E1: Identify how volcanic products impact the environment.
 E2: Given an example, label various volcanic products.
 E3: Identify types of volcanic products.
- 9.3 Describe how energy within the Earth's interior is released in the form of earthquake waves, and explain how these waves affect the Earth's surface.
Essence: Earthquake energy and waves
 E1: Explain how an earthquake is formed.
 E2: Identify characteristics of an earthquake.
 E3: Identify how earthquakes can affect Earth's surface.
- 9.4 Describe how earthquake energy is represented on seismograms and describe how these waves can be used to determine the origin and intensity of earthquakes.
Essence: Earthquake energy and origins
 E1: Given a map with appropriate data, locate the epicenter of an earthquake.
 E2: Given seismograms, identify the intensity of earthquakes.
 E3: Given word descriptors, identify characteristics of an earthquake.
- 9.5 Describe the effects on life and property from consequences of earthquakes such as landslides, liquefaction, surface faulting, and tsunamis. Cite ways these hazards can be minimized.
Essence: Earthquake consequences
 E1: List ways that the damage from an earthquake can be minimized.
 E2: Identify a consequence of an earthquake.
 E3: Given descriptors, identify characteristics of an earthquake.
- 9.6 Use models or computer simulations to demonstrate the processes and origin of landforms at divergent, convergent, and transform plate boundaries. Show on a map how plate tectonics, earthquakes, and volcanoes are spatially related.
Essence: Plate tectonics
 E1: Given a map showing plate tectonics, label the points where earthquakes and volcanoes occur.
 E2: Given a map showing plate tectonics, point to where earthquakes or volcanoes occur.
 E3: Distinguish between earthquakes and volcanoes.
- 9.7 Investigate how thermal convection relates to movement of materials. Apply this knowledge in explaining the cause of movement of the Earth's plates.
Essence: Thermal convection
 E1: Describe how heat moves the Earth's plates.
 E2: Identify examples of thermal convection.
 E3: Given examples, identify if heat rises.

2 - Earth's components form systems. These systems continually interact at different rates of time, affecting the Earth locally and globally. (continued)

- 9.9 Explain how the Theory of Plate Tectonics demonstrates that scientific knowledge changes by evolving over time. Recognize that although some theories are initially rejected, they may be re-examined and eventually accepted in the face of new evidence.

Essence: Scientific theory

- E1: Describe how new evidence impacts scientific theory.
- E2: List factors that cause scientific theories to change.
- E3: Sequence a scientific change over time given pictures.

3 - Technology enables us to better understand Earth's systems. It also allows us to analyze the impact of human activities on Earth's systems and the impact of Earth's systems on human activity.

- 9.3 Describe ways in which people use historical data, geologic maps, and technologies to minimize earthquake damage.

Essence: Technology and earthquakes

- E1: Describe how historical data can help make decisions about earthquake damage.
- E2: Name technologies used to minimize earthquake damage.
- E3: Categorize data or maps as occurring before or after an earthquake.

1 - Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.

- 10.1 Use microscopes to identify similarities and differences among a variety of cells (e.g., muscle, nerve, epithelial, blood, adipose), and explain how structural variations relate to the function that each of the cells performs.
Essence: Cell structure determines function
E1: Classify cells based on their structure.
E2: Identify and label cell parts.
E3: Match cell type to the corresponding function (e.g., nerve cells to nerves, muscle cells to muscles).
- 10.2 Differentiate between prokaryotic cells and eukaryotic cells in terms of their general structures (cell membrane & genetic material) and degree of complexity. Give examples of prokaryotic organisms and organisms with eukaryotic cells.
Essence: Prokaryotic cells and eukaryotic cells
E1: Describe the differences between prokaryotic and eukaryotic cells.
E2: Sort given cell examples into prokaryotic or eukaryotic groups.
E3: Match prokaryotic and eukaryotic to their corresponding definition.
- 10.3 Explain how organelles of single-celled organisms function as a system to perform the same basic life processes as are performed in multi-cellular organisms (e.g., acquisition of energy, elimination of waste, reproduction, gas exchange, growth, repair, and protein synthesis).
Essence: Functions of single and multi-cellular organisms
E1: Compare and contrast the functions of single and multi-cellular organisms.
E2: Identify the functions of single and multi-cellular organisms.
E3: Identify if given organisms are multi-cellular.
- 10.4 Use fluid mosaic models of the plasma membrane to explain how its structure regulates the movement of materials across the membrane.
Essence: Plasma membrane
E1: Describe how properties of the plasma membrane regulate the movement of materials.
E2: Identify the function of the plasma membrane.
E3: Given a cell model, identify the plasma membrane.
- 10.5 Show how water moves in and out of cells down a concentration gradient. Recognize that this process, known as osmosis, requires no input of energy.
Essence: Osmosis
E1: Demonstrate how water moves in and out of cells using a model or illustration.
E2: Define the process of osmosis.
E3: Identify if osmosis occurred in a given example.
- 10.7 Distinguish between active and passive transport. Recognize that active transport requires energy input to move molecules from an area of low concentration to an area of high concentration (against the concentration gradient).
Essence: Active and passive transport of molecules
E1: Compare and contrast the ways materials move into and out of cells.
E2: Define active transport.
E3: Identify the direction (e.g., high to low or low to high) molecules move during active transport.

1 - Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function. (continued)

- 10.8 Design a controlled experiment to investigate the capacity of the cell membrane to regulate how materials enter and leave the cell.
Essence: Structure of the cell membrane
E1: Explain how materials enter and exit a cell.
E2: Identify the function of the cell membrane.
E3: Given a cell model, identify the cell membrane.
- 10.9 Construct cell models (e.g., phenolphthalein-agar cubes, potato-iodine cubes) to investigate the relationship among cell size, surface area to volume ratio and the rates of diffusion into and out of the cell. Explain why large organisms have developed from many cells rather than one large cell.
Essence: Cells
E1: Use various cell models to identify the relationship between cell size, surface area, and diffusion rates of cells.
E2: Identify the direction (e.g., high to low or low to high) molecules move during the process of diffusion.
E3: Identify examples of diffusion.
- 10.10 Recognize that as a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable despite changes in the outside environment.
Essence: Internal and external environment of the human body
E1: Describe the relationship between the internal and external environments of the human body.
E2: List ways the body reacts to stimuli.
E3: Identify environmental changes.
- 10.11 Explain how the cells of a multi-cellular organism work together for the benefit of the colonial or singular organism.
Essence: Multi-cellular organism
E1: Describe how body parts work together.
E2: Identify body parts that work together.
E3: Identify types of cells in the body.

2 - All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.

- 10.2 Observe formulas and diagrams of compounds found in food (fats, proteins, carbohydrates). Identify elements that comprise these compounds.
Essence: Compounds & elements found in food
E1: Using a molecular formula or a diagram, identify the elements present in a compound.
E2: Given a molecular model, identify the compound found in food.
E3: Given the name of a common element, locate it on the Periodic Table.
- 10.4 Observe and recognize that unicellular organisms take in food from their environment and chemically digest it (if needed) within their cell body.
Essence: Unicellular organisms/chemical digestion
E1: Describe the role of unicellular organisms in chemical digestion.
E2: Discuss how food items change during chemical digestion.
E3: Identify the starting point of chemical digestion.

2 - All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism. (continued)

- 10.5 Recognize that both mechanical and chemical processes are necessary in digestion for multi-cellular organisms to get molecules that come from food to enter the cells. Trace the process whereby nutrients are transported to cells where they serve as building blocks for the synthesis of body structures and as reactants for cellular respiration.
Essence: Digestion
E1: Describe the chemical and mechanical processes that are needed in digestion.
E2: Given the major steps of digestion, sequence the order that they occur.
E3: Identify where digestion begins.
- 10.6 Explain the processes used by autotrophs to transform light energy into chemical energy in the form of simple sugars. Give examples of how these compounds are used by living things as sources of matter and energy.
Essence: Process used by autotrophs
E1: Describe how autotrophs create chemical energy.
E2: Identify the chemical energy living things use that is produced by autotrophs.
E3: Identify if given examples are autotrophs.
- 10.7 Describe the process by which water is removed from sugar molecules (dehydration synthesis) to form carbohydrates and is added to break them down (hydrolysis).
Essence: Dehydration synthesis and hydrolysis
E1: Describe the difference between dehydration synthesis and hydrolysis.
E2: Identify given processes as dehydration synthesis or hydrolysis.
E3: Given examples, identify if water has been removed or gained.
- 10.8 Describe photosynthesis as an energy storing process and explain how environmental factors such as temperature, light intensity, and the amount of water available can affect photosynthesis.
Essence: Photosynthesis
E1: Describe the process of photosynthesis.
E2: Identify factors that affect the process of photosynthesis.
E3: Identify if given factors are environmental.
- 10.9 Identify the reactants and the products in equations that represent photosynthesis and cellular respiration. Explain how the equations demonstrate the Law of Conservation of Matter and Energy in terms of balanced equations.
Essence: Photosynthesis and cellular respiration
E1: Identify the products and reactants of photosynthesis and cellular respiration.
E2: Identify products of photosynthesis.
E3: Identify given examples as using photosynthesis or cellular respiration.
- 10.11 Recognize that during photosynthesis, plants use energy from the sun and elements from the atmosphere and the soil to make specific compounds. Recognize that these compounds are used by living things as sources of matter and energy.
Essence: Photosynthesis
E1: Describe the process of photosynthesis.
E2: List factors that are part of the process of photosynthesis.
E3: Identify a product of photosynthesis.

2 - All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism. (continued)

- 10.12 Compare the amount of chemical potential energy stored in chemical bonds of a variety of foods (calorimetry). Recognize that equal amounts of different types of food contain different amounts of energy.

Essence: Food energy as calories

E1: Compare the number of calories in serving sizes of different foods.

E2: Categorize given foods according to calories.

E3: Given nutritional facts, identify the calories.

- 10.13 Recognize that during cellular respiration, chemical bonds between food molecules are broken (hydrolysis), and energy is transferred to ADP to create ATP (the energy storage molecule that fuels cellular processes). Acknowledge that all organisms must break the high energy chemical bonds in food molecules during cellular respiration to obtain the energy needed for life processes.

Essence: Energy from food

E1: Describe the process in which living organisms obtain energy.

E2: Identify the types of energy produced when food molecules are broken down.

E3: Given nutritional information, identify the calories.

- 10.14 Recognize that in general, synthesis reactions (i.e. photosynthesis) require energy while decomposition reactions (i.e. cellular respiration) usually release energy.

Essence: Synthesis reaction and decomposition

E1: Identify differences between synthesis reactions and decomposition.

E2: Given characteristics, identify the process as a synthesis reaction or decomposition.

E3: Identify if given reactions release energy.

- 10.16 Explain how enzymes permit low temperature chemical reactions to occur in cells.

Essence: Enzymes

E1: Explain how enzymes affect chemical reactions.

E2: Define the function of an enzyme in a chemical reaction.

E3: Identify if a chemical reaction involving enzymes occurs at high or low temperatures.

- 10.17 Investigate how various factors (temperature, pH, enzyme/substrate concentration) affect the rate of enzyme activity.

Essence: Factors of enzyme activity

E1: Conduct an investigation on the rate of enzyme activity and record results.

E2: Given the result of an investigation on enzymes, identify factors that affect the rate of activity.

E3: Given examples, identify if given factors affect rate of activity.

3 - Organisms respond to internal and external cues, which allow them to survive.

- 10.1 Illustrate how nerve cells communicate with each other to transmit information from the internal and external environment often resulting in physiological or behavioral responses.

Essence: Communication of nerve cells

E1: Describe how nerve cells communicate and transmit information.

E2: Label the parts of a nerve cell.

E3: Identify a nerve cell.

3 - Organisms respond to internal and external cues, which allow them to survive. (continued)

- 10.2 Draw a schematic to illustrate a positive and negative feedback mechanism that regulates body systems in order to help maintain homeostasis.
Essence: Stability within the body
E1: Describe how the body regulates its internal environment through positive and negative feedback mechanisms.
E2: Given a schematic diagram of a positive or negative feedback mechanism, identify the components involved in the feedback.
E3: Identify examples of homeostasis.
- 10.3 Recognize that in order to help maintain the health of an organism, the immune system works in nonspecific ways (e.g., skin, mucous, membranes) and specific ways (e.g., antibody-antigen interactions).
Essence: Immune system
E1: Describe how the body's immune system works.
E2: Identify specific or non-specific ways the immune system works.
E3: Using a model, identify a part of the immune system.

4 - The health of humans and other organisms is affected by their interactions with each other and their environment, and may be altered by human manipulation.

- 10.1 Investigate how scientists use biotechnology to produce more nutritious food, more effective medicine, and new ways to mitigate pollution.
Essence: Biotechnology
E1: Describe ways scientists use biotechnology to improve products.
E2: Identify products of biotechnology that have improved the way humans live.
E3: Identify if given products are biotechnological advancements.
- 10.2 Investigate how drugs can affect neurotransmission.
Essence: Drugs and neurotransmission
E1: Describe how drugs change the way the body functions.
E2: Identify positive and negative ways drugs affect your body.
E3: Match ailment with the corresponding drug (e.g., cough with cough suppressant).
- 10.3 Explain how antibiotics (e.g., penicillin, tetracycline) kill bacterial cells without harming human cells due to differences between prokaryotic and eukaryotic cell structure.
Essence: Antibiotics
E1: Discuss how antibiotics fight infections in the human body.
E2: Identify the function of antibiotics.
E3: Identify an antibiotic.
- 10.4 Describe how environmental factors (e.g., UV light or the presence of carcinogens or pathogens) alter cellular functions.
Essence: Environmental factors and cellular functions
E1: Discuss how environmental factors affect cells.
E2: List ways to protect the body from harmful environmental factors.
E3: Given an example, identify an environmental factor that is harmful to the body.

1 - Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring.

- 10.1 Describe the relationship between DNA, genes, chromosomes and proteins.
Essence: Genetics
E1: Discuss how genes are passed from one generation to the next through DNA.
E2: Identify a difference between DNA, chromosomes, and proteins.
E3: Identify a strand of DNA.
- 10.2 Explain that a gene is a section of DNA that directs the synthesis of a specific protein associated with a specific trait in an organism.
Essence: Genes and traits
E1: Describe the significance of protein in DNA synthesis.
E2: Define gene.
E3: Identify a strand of DNA.
- 10.3 Trace how a DNA sequence, through transcription and translation, results in a sequence of amino acids.
Essence: Transcription and translation of DNA
E1: Describe the process of translation as it relates to DNA sequencing.
E2: Identify purposes of DNA sequencing.
E3: Identify if amino acids build or break down proteins.
- 10.4 Demonstrate that when DNA replicates, the complementary strands separate and the old strands serve as a template for the new complementary strands. Recognize that this results in two identical strands of DNA that are exact copies of the original.
Essence: DNA replication
E1: Describe the process of DNA replication.
E2: Replicate a model of DNA to represent the idea that replication happens in the body.
E3: Given a simple model, match DNA strands.
- 10.5 Illustrate how a sequence of DNA nucleotides codes for a specific sequence of amino acids.
Essence: DNA and amino acids
E1: Given an amino acid and a genetic code, create a simple amino acid sequence.
E2: Match an amino acid to its nucleotide codes.
E3: Identify a strand of DNA.
- 10.6 Use Punnett squares, including dihybrid crosses, and pedigree charts to determine probabilities and patterns of inheritance (i.e., dominant/recessive, co-dominance, sex-linkage, multi-allele inheritance).
Essence: Punnett squares and trait probability
E1: Using a simple Punnett square, discuss the concepts of dominant and recessive traits.
E2: Given an example, create a Punnett square using a simple trait.
E3: Identify traits that can be investigated through Punnett squares.
- 10.7 Analyze a karyotype to determine chromosome numbers and pairs. Compare and contrast normal and abnormal karyotypes.
Essence: Karyotypes
E1: Discuss the differences in normal and abnormal karyotypes.
E2: Given pictures, identify abnormal karyotypes.
E3: Given pictures, identify a karyotype.

1 - Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring. (continued)

- 10.9 Describe how exposure to radiation, chemicals and pathogens can increase mutations.
Essence: Environmental factors and genetic mutation
E1: Discuss ways that the environment impacts genetic mutation.
E2: Discuss a genetic effect of radiation.
E3: Identify if exposure to a given substance is hazardous to DNA.
- 10.10 Explain that mutations in the DNA sequence of a gene may or may not affect the expression of the gene. Recognize that mutations may be harmful, beneficial, or have no impact on the survival of the organism.
Essence: DNA mutation
E1: Explain the impact mutations have on the survival of an organism.
E2: Identify examples of mutations as harmful, beneficial, or no impact.
E3: Identify examples of given mutations.
- 10.11 Explain how the type of cell (gamete or somatic) in which a mutation occurs determines heritability of the mutation.
Essence: Gene mutation
E1: Identify the cell location of a mutation (e.g., gamete or somatic cell) based on heritability.
E2: Match gamete and somatic cells with the corresponding definitions.
E3: Categorize given examples based on heritability.
- 10.12 Predict the possible consequences of a somatic cell mutation.
Essence: Somatic cell mutation
E1: Describe types of somatic cell mutations.
E2: Given examples, identify types of somatic cell mutations.
E3: Identify objects that have been mutated.
- 10.13 Describe the cell cycle as an orderly process that results in new somatic cells that contain an exact copy of the DNA that make up the genes and chromosomes found in the parent somatic cells.
Essence: Life cycle of cells
E1: Describe the steps of the cell cycle.
E2: Given the steps, sequence the cell cycle.
E3: Identify that a cycle is a continual process.
- 10.14 Explain how the cell cycle contributes to reproduction and maintenance of the cell and/or organism.
Essence: Cell cycle growth and repair
E1: Describe the growth and repair of cells.
E2: Identify the relationship between cell growth and repair.
E3: Identify if given examples are ways to repair cells.
- 10.17 Compare and contrast the processes of growth (cell division) and development (differentiation).
Essence: Growth and development of cells
E1: Identify the similarities and differences between cell growth and development.
E2: Given characteristics of a process, identify as cell growth or cell development.
E3: Given pictures of cell growth and development, identify differences.

1 - Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring. (continued)

10.18 Recognize that any environmental factor that influences gene expression or alteration in hormonal balance may have an impact on development.

Essence: Impact of environmental factors on development

E1: List environmental factors that impact gene expression or hormonal balance.

E2: Identify environmental factors and their impact on development from a given real-world example.

E3: Identify environmental factors that impact development.

2 - The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring.

10.1 Recognize random mutation (changes in DNA) and recombination within gametes as the sources of heritable variations that give individuals within a species survival and reproductive advantage or disadvantage over others in the species.

Essence: Species survival and reproductive advantage

E1: Describe survival rates of different species based on random mutations.

E2: Identify traits that help species survive in their environment.

E3: Identify if given traits allow humans to survive.

10.2 Analyze natural selection simulations and use data generated from them to describe how environmentally-favored traits are perpetuated over generations resulting in species survival, while less favorable traits decrease in frequency or may lead to extinction.

Essence: Species survival

E1: Discuss reasons why some species survive better than others.

E2: Identify traits that help species survive in their environment.

E3: Identify if given traits allow humans to survive.

10.3 Explain how biochemical evidence, homologous structures, embryological development and fossil evidence support or refute prior hypotheses of common ancestry.

Essence: Evidence of common ancestry

E1: Describe ways to determine routes of prior ancestries.

E2: Identify fossils of different species.

E3: Match given fossils to the corresponding species.

10.5 Explain how species evolve through descent with modification, thus allowing them to adapt to different environments.

Essence: Evolution

E1: Describe evolution.

E2: Identify species that have evolved.

E3: Identify types of adaptations.

10.6 Discuss how environmental pressure, genetic drift, mutation and competition for resources influence the evolutionary process. Recognize that a change in a species over time does not follow a set pattern or timeline.

Essence: Evolution

E1: Describe factors that influence the evolutionary process.

E2: Identify ways species evolve based on their environment.

E3: Match given environments to necessary traits.

2 - The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring. (continued)

- 10.7 Compare and contrast the role of sexual selection to the role of natural selection on the evolutionary process.
Essence: Natural selection
E1: Describe natural selection.
E2: Identify species that have adapted to their environments.
E3: Identify basic needs for survival.
- 10.8 Relate a population's survival to the reproductive success of adapted individuals in that population.
Essence: Survival and reproductive success
E1: Describe how reproduction impacts a population.
E2: Identify factors that allow a population to survive and grow.
E3: Identify adaptations of parents to an offspring.
- 10.9 Explain the roles of geographical isolation and natural selection on the evolution of new species.
Essence: Geographical isolation
E1: Describe the impact that geographical isolation has on evolution.
E2: Identify places that are geographically isolated (e.g., deep ocean).
E3: Identify if a given location is geographically isolated.
- 10.10 Predict possible evolutionary implications for a population due to environmental changes over time (e.g., volcanic eruptions, global climate change, industrial pollution).
Essence: Environmental disruptions impact on evolution
E1: Predict how various environmental disruptions will affect different populations.
E2: List different types of environmental disruptions.
E3: Given pictures, identify an environmental disruption.
- 10.11 Explain why homogenous populations may be more vulnerable to environmental changes than heterogeneous populations.
Essence: Homogenous and heterogeneous populations.
E1: Compare and contrast heterogeneous and homogeneous populations.
E2: Identify populations that are heterogeneous or homogeneous.
E3: Identify if a given population is homogeneous.
- 10.12 Explain how evolutionary relationships between species are used to group organisms together.
Essence: Similar traits within species
E1: Identify shared traits in a species.
E2: Classify animals based on species.
E3: Identify different species of animals.
- 10.13 Explain how antibiotic resistant populations evolve from common bacterial populations.
Essence: Antibiotic resistance
E1: Explain why a population that is resistant to antibiotics has less of a chance for survival.
E2: Identify an antibiotic.
E3: Discuss the harmful effects of bacteria.

2 - The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with adaptive traits survive, reproduce, and pass those traits to offspring. (continued)

10.14 Research how invasive species have genetically altered an indigenous population.

Essence: Invasive species

E1: Describe the effects of an invasive species on indigenous populations.

E2: List an example of an invasive species.

E3: Given a species, identify its native environment.

3 - The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human needs and wants.

10.1 Explain how DNA evidence can be used to determine evolutionary relationships.

Essence: DNA evidence and ancestry

E1: Describe the role of DNA in ancestry.

E2: Define evolutionary relationships.

E3: Identify if given examples are an evolutionary relationship.

10.2 Investigate how the human ability to manipulate genetic material and reproductive processes can be applied to many areas of medicine, biology, and agriculture. Evaluate the risks and benefits of various ethical, social and legal scenarios that arise from this ability.

Essence: Genetic modifications

E1: List examples of genetic modifications.

E2: Categorize real world examples as modified or not modified.

E3: Identify if a given object has been manipulated.

10.3 Discuss examples of how genetic engineering technology can be applied in biology, agriculture and medicine in order to meet human wants and needs.

Essence: Genetic engineering technology

E1: Discuss the benefits of genetic engineering.

E2: Give an example of a product that has been genetically modified.

E3: Identify human needs.

10.4 Explain the basic process of bacterial transformation and how it is applied in genetic engineering.

Essence: Bacterial transformation

E1: Discuss the basic process of bacterial transformation.

E2: Discuss harmful effects of bacteria.

E3: Identify ways to avoid harmful bacteria.

10.5 Explain how developments in technology (e.g., gel electrophoresis) have been used to identify individuals based on DNA as well as to improve the ability to diagnose genetic diseases.

Essence: Uses of DNA in identification and medicine

E1: Describe the ways in which technology can help identify an individual based on DNA.

E2: List examples of technology that help to identify an individual based on DNA.

E3: Determine if an example of a given technology can be used for identification purposes.

1 - Organisms and their environments are interconnected. Changes in one part of the system will affect other parts of the system.

- 12.2 Using models, computer simulations, or graphic representations, demonstrate how changes in these indicators may affect interactions within ecosystems. Evaluate the current health of the ecosystem and suggest possible interventions for mitigation.
Essence: Health of an ecosystem
E1: Describe interventions that would help an ecosystem become or stay healthy.
E2: Given a model or data, identify the health of an ecosystem.
E3: Identify if an ecosystem is healthy or unhealthy based on a given model or picture.
- 12.3 Explain how feedback loops keep an ecosystem (at the local and global level) in a state of dynamic equilibrium (e.g., positive and negative feedback loops associated with global climate).
Essence: Feedback loops
E1: Describe the effects feedback loops have on an ecosystem.
E2: Identify if a given feedback loop keeps an ecosystem in balance.
E3: Identify examples of feedback loops as stable or unstable.
- 12.4 Explain how niches help to increase the diversity within an ecosystem and maximize the number of populations that can live in the same habitat.
Essence: Niches impact on ecosystems
E1: List the advantages of niches in ecosystems.
E2: Identify examples of niches in an ecosystem.
E3: Match a given organism to its niche in a habitat.
- 12.5 Using graphs of population data of a predator and its prey, describe the patterns observed. Explain how the interactions of predator and prey generate these patterns, and predict possible future trends in these populations.
Essence: Predator and prey
E1: Given a graph, describe the relationship between predators and prey.
E2: Identify a predator and its prey (e.g., lion eats zebra, spider eats insects).
E3: Identify if given examples are predators or prey.
- 12.6 Analyze and explain the short-term impact of a natural disaster on the biological, chemical, and physical components of the affected ecosystem and their associated interrelationships, including geochemical cycles and food webs.
Essence: Natural disasters and ecosystems
E1: Describe the effects of a natural disaster on various components of an ecosystem, and give examples.
E2: Given a natural disaster, identify impacts on the ecosystem.
E3: Identify if given examples are natural disasters.
- 12.8 Explain the significance of the introduction of non-native and invasive species to a stable ecosystem and describe the consequent harm to the native species and the environment (e.g., zebra mussels, purple loosestrife, phragmites, Japanese Beetles).
Essence: Invasive species and native species
E1: Give examples of the impact invasive species have on native species.
E2: Given an ecosystem, identify the native and invasive species.
E3: Identify if given animals live in a specified ecosystem.

1 - Organisms and their environments are interconnected. Changes in one part of the system will affect other parts of the system. (continued)

- 12.9 Describe how the biotic and abiotic factors can act as selective pressures on a population and can alter the diversity of the ecosystem over time.
Essence: Biotic and abiotic factors
E1: Describe the relationship between biotic and abiotic factors.
E2: List examples of biotic and abiotic factors.
E3: Categorize given examples as biotic (living) or abiotic (nonliving).
- 12.10 Identify limiting factors in an ecosystem and explain why these factors prevent populations from reaching biotic potential. Predict the effects on a population if these limiting factors were removed. Explain why a population reaching unlimited biotic potential can be detrimental to the ecosystem.
Essence: Limiting factors in an ecosystem
E1: Explain how limiting factors can harm the population of an ecosystem.
E2: Identify examples of limiting factors that can affect ecosystems.
E3: Identify if given examples will harm or help an ecosystem.
- 12.12 Describe how birth rate, death rate, emigration, and immigration contribute to a population's growth rate.
Essence: Population growth
E1: Describe the relationship between birth rate and death rate with growth of a population.
E2: Identify factors that contribute to population growth.
E3: Given a growth model, identify if there is an increase or decrease.

2 - Matter needed to sustain life is continually recycled among and between organisms and the environment. Energy from the Sun flows irreversibly through ecosystems and is conserved as organisms use and transform it.

- 12.2 Recognize that the amount of matter in a closed ecosystem will remain constant.
Essence: Matter in an ecosystem
E1: Describe what happens to matter in a closed ecosystem.
E2: Identify if an ecosystem is closed or open given the amount of matter.
E3: Identify a closed ecosystem.
- 12.3 Relate an ecosystem's requirement for the continual input of energy to the inefficiency of energy transfer.
Essence: Energy in an ecosystem
E1: Describe the transfer of energy in an ecosystem.
E2: Identify types of energy needed in an ecosystem.
E3: Identify the main source of energy in an ecosystem.
- 12.4 Explain how ecosystems that do not rely on radiant energy obtain energy to maintain life.
Essence: Energy in an ecosystem
E1: Identify sources of non-radiant energy.
E2: Identify the type of energy an ecosystem needs to maintain life.
E3: Identify if a given source has radiant energy.

2 - Matter needed to sustain life is continually recycled among and between organisms and the environment. Energy from the Sun flows irreversibly through ecosystems and is conserved as organisms use and transform it. (continued)

- 12.5 Explain how the inefficiency of energy transfer determines the number of trophic levels and affects the relative number of organisms at each trophic level in an ecosystem.
Essence: Trophic levels
E1: Use trophic levels to describe the position an organism occupies.
E2: Identify the position of a given organism in the food chain.
E3: Identify if a given organism is at the top or bottom of a food chain.
- 12.9 Analyze how an understanding of biomagnification has led to the regulation of chemical use and disposal.
Essence: Biomagnification
E1: Describe the effects biomagnification has on foods.
E2: Identify foods that may contain unsafe toxins.
E3: Identify if given examples are toxins.

3 - Humans can alter the living and non-living factors within an ecosystem, thereby creating changes to the overall system.

- 12.1 Examine and describe how social and biological factors influence the exponential growth of the human population (e.g., economic, cultural, age at reproduction, fertility rate, birth/death rate, and environmental factors).
Essence: Population growth
E1: Describe what factors influence the exponential growth of a population.
E2: Identify factors that influence the exponential growth of a population.
E3: Given a graph or chart, identify if a given population is increasing or decreasing.
- 12.2 Examine and describe how the exponential growth of the human population has affected the consumption of renewable and non-renewable resources.
Essence: Population growth and resources
E1: Describe the impact human population has on available resources.
E2: Identify examples of renewable and nonrenewable resources.
E3: Given a resource, identify if it is renewable.
- 12.3 Evaluate decisions about the use of resources in one country and how these decisions can impact the diversity and stability of ecosystems globally.
Essence: Global interdependence
E1: Identify resources shared with other countries.
E2: Identify resources used in the U.S.
E3: Identify if given examples are resources.
- 12.4 Analyze ways in which human activity (i.e., producing food, transporting materials, generating energy, disposing of waste, obtaining fresh water, or extracting natural resources) can affect ecosystems and the organisms within.
Essence: Human effects on ecosystems
E1: Explain how human activities impact an ecosystem.
E2: Identify human activity that has negatively or positively impacted the environment.
E3: Match given environmental materials to corresponding human use (e.g., wood to house, lake to swim).

3 - Humans can alter the living and non-living factors within an ecosystem, thereby creating changes to the overall system. (continued)

- 12.5 Research and discuss ways in which humans use technology to reduce the negative impact of human activity on the environment (e.g., phytoremediation, smokestack scrubbers).
- Essence: Environmental technology**
- E1: Research ways students can reduce negative impacts on the environment.
 - E2: Categorize technologies that help the environment from those that harm the environment.
 - E3: Identify human activities that negatively affect the environment.
- 12.6 Describe how advances in technology can increase the carrying capacity of an ecosystem (i.e., advances in agricultural technology have led to increases in crop yields per acre).
- Essence: Technological advancements**
- E1: Describe how technology has influenced the environment.
 - E2: Identify technologies that have positively affected the environment.
 - E3: Match technologies with the ecosystem they have impacted.

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