Science Standards
Grades PK

Strand:

S1 Scientific Inquiry: The student begins to develop abilities necessary to do scientific inquiry and to explore through scientific inquiry; that is, the student:

Standard:

S1a: asks questions about objects, organisms, and events

S1b: uses observations to make simple predictions

S1c: conducts simple explorations and investigations

Components:

S1c1: discusses and identifies questions to pursue and predictions to confirm or disprove

S1c2: uses senses to observe, describe, and collect data

S1c3: uses simple hand tools such as hand lenses and measuring devices to make observations and collect data

S1c4:adds data to class charts and graphs

S1c5: records work by drawing, dictating, and contributing to documentation panels

Standard:

S1d: identifies a pattern or relationship based on observations

S1e: compares objects based on observable characteristics

S1f: sorts and categorizes objects based on observable characteristics

S1g: communicates about scientific explorations through discussions with peers and through drawing, dictation, and class or group documentation panels

S1h: learns to use safe practices while doing science

Components:

S1h1: demonstrates appropriate use of all tools

S1h2: washes hands after relevant explorations

Strand:

S2 History and Nature of Science: The student begins to develop an awareness of science as a human endeavor; that is, the student:

Standard:

S2a: realizes that many people do science

S2b: expresses that science involves asking questions about the natural world and investigating to find out

S2c: recognizes that in science people share ideas and findings

S2d: Identifies self as someone who does science

Strand:

S3 Personal & Social Perspectives: The student begins to develop an awareness of safety and types of resources as it relates to the immediate environment; that is, the student:

Standard:

S3a: describes how some basic resources found in their environment, such as water, trees, can be used for different purposes

Strand:

S4 Science and Technology: The student begins to develop an understanding about science and technology; that is, the student:

Standard:

S4a: identifies and finds a solution for a simple problem

S4b: recognizes that things found in nature are different from those that are made by humans

Strand:

S5 Physical Science: The student begins to develop an understanding of matter, motion, and energy; that is, the student:

Standard:

S5a: Explores, and describes physical properties of simple material and objects

Components:

S5a1: observes and describes objects used for out door and classroom activities (e.g., blocks, collage materials, collections) in terms of observable physical properties (e.g., shape, size, color and texture) and behaviors (rolls, bounces)

S5a2: observes and describes materials used in outdoor and classroom activities (e.g., water, sand, paint) in terms of observable physical properties (color, texture, hardness) and simple behaviors (e.g., water flows, clay squishes, wet sand sticks to itself)

S5a3. explores and demonstrates how simple objects and materials change (e.g., mixing paints to change color; cutting paper to make small pieces; adding water to sand to make it sticky; leaving play dough to harden)

Standard:

S5b: explores how objects and materials move

Components:

S5b1: observes and explores moving objects and materials outdoors and in daily classroom activity (e.g., balls rolling, blocks sliding, streamers waving; water and sand flowing)

S5b2: investigates and compares movement caused by different forces (e.g., wind blowing streamers and bubble; gravity pulling blocks, balls, cars down; physical energy making trucks go)

Standard:

S5c: explores and describes observable properties of light and sound

Components:

S5c1: explores and describes observable properties of light and sound

S5c2: explores shadows indoors and out identifying light source and the object casting the shadow

S5c3: investigates how the shape and size of shadows change

S5c4: explores and compares different sounds by playing simple instruments (e.g., homemade drums and shakers; guitar; recorder), and using own bodies and voices

S5c5: describes sounds as high or low; loud or soft

S5c6: observes beams of light from different light sources (e.g. flashlight, sunlight)

Strand:

S6 Life Science: The student begins to develop an understanding of the characteristics of organisms, their life cycles, and their environments; that is, the student:

Standard: S6a: observes and describes observable characteristics and behaviors of organisms in the local environment

Components:

S6a1: gives examples of living and non-living things

S6a2: describes external body parts and features of self and other familiar animals

S6a3: describes observable behaviors of self and other animals (e.g., eating, moving, sleeping)

S6a4: observes and describes familiar plants and their basic parts (e.g., root, stem, leaf, flower, fruit)

S6a5: identifies basic needs of living things (water, food, shelter)

Standard:

S6b: observes and describes changes in self and other living things over time

Components:

S6b1: investigates growth of plants in the classroom

S6b2: observes and describes changes in plants in the local environment

S6b3: observes and records changes in self (teeth, height)

Standard:

S6c: describes how a variety of living things meet their needs in the local environment

Components:

S6c1: explores local environment for living things

S6c2: observes several animals and identifies how they meet some of their needs (food, water, shelter)

S6c3: notices where different kinds of plants grow

S6c4: develops awareness of basic relationships among plants and animals (some animals eat plants; some plants provide homes for animals)

Strand:

S7 Earth & Space Sciences: The student begins to develop an understanding of Earth materials, objects in the sky, and changes in Earth and sky; that is, the student:

Standard: S7a: observes and describes observable properties of familiar earth materials

Components:

S7a1: describes and sorts by physical properties samples of rocks collected from local environment

S7a2: explores samples of soils and/or sand from local environment

S7a3: investigates water outdoors (e.g., puddles, drops, streams) and changes of water puddles evaporate, stream flows)

Standard:

S7b: observes, describes, and records basic elements of local weather (temperature, cloud cover, wind, and precipitation)

Components:

S7b1: describes daily weather conditions regularly

S7b2: compares weather conditions from day to day

S7b3: recognizes some of the effects of weather on the environment (puddles, dust, wind blown objects) and on daily life. (e.g., clothing, whether recess is outdoors)

Standard:

S7c: observes and describes familiar objects in the sky

Components:

S7c1: identifies Sun, moon, stars, and clouds as objects in the sky

S7c2: can describe some of the different apparent shapes of the moon

S7c3: recognizes that the moon does not always appear to be the same

S7c4: is aware that the Sun and moon are not always in the same part of the sky

Science Standards
Grades K

Strand:

S1 Scientific Inquiry: The student develops abilities necessary to do scientific inquiry and an understanding about scientific inquiry; that is, the student:

Standard:

S1a: asks questions about objects, organisms, and events

S1b: uses observations to make simple predictions

S1c: conducts simple explorations and investigations

Components:

S1c1: Records by drawing or dictating

S1c2: discusses how the class' questions might be answered

S1c3.: is exposed to a variety of teacher-selected resources

S1c4: uses simple tools such as hand lenses and measuring devises to make observations and collect data

S1c5.: displays data in graphs

Standard:

S1d: identifies a pattern based on observations

S1e: compares objects based on observable and measurable characteristics (e.g., faster/slower)

S1f: analyzes and makes statements about data displayed in a graph

S1g: communicates scientific explorations through discussions with peers and through drawings, graphs, and dictation

S1h: identifies examples of safe practices in science

Components:

S1h1: demonstrates safe sky viewing procedures

S1h2: demonstrates appropriate uses of scissors, weather measuring devises, and hand lenses in science investigations

Strand:

S2 History and Nature of Science: The student develops an awareness of science as a human endeavor; that is, the student:

Standard: S2a: realizes that people have been doing science for a long time

S2b: expresses that science involves thinking, asking questions about the world, and trying to answer those questions

S2c: recognizes that in science people share ideas and findings

S2d: provides examples of how diverse people (children, fathers, mothers, teachers, weather reporters, etc.) participate in doing science

Components:

S2d1: demonstrates knowledge of some of the things meteorologists study

S2d2: demonstrates knowledge of some of things geologists study

Strand:

S3 Personal & Social Perspectives: The student develops an understanding of safety and types of resources as it relates to their immediate environment; that is, the student:

Standard: S3a: describes basic resources that are found in their environments, such as soil, water, and tress, and other resources that are produced from these resources, such as building materials

Strand:

S4 Science and Technology: The student develops an understanding about science and technology, and the nature of technological design; that is, the student:

Standard: S4a: identifies a simple problem, proposes a solution for the problem, and then evaluates the solution in terms of its ability to solve the problem

S4b: recognizes that technological solutions are human designed

S4c: recognizes that things found in nature are different from those that are made by humans

Components:

S4c1: compares grow lights with the Sun's light

Strand:

S5 Physical Science: The student develops an understanding of matter, motion, and energy; that is, the student:

Standard: S5a: builds awareness that objects can be described by their physical properties

Components:

S5a1: observes and identifies properties of common objects (e.g., size, shape, color)

S5a2: observes and identifies uses of common objects based on their properties

Standard:

S5b: recognizes that objects can move in a variety of ways

Components:

S5b1: explores the motion of a variety of objects (e.g., balls, rolling objects pinwheels, windsocks, leaves)

S5b2: identifies the movement of objects (i.e. straight, round and round, zigzag, back and forth, fast and slow)

S5b3: explains how the physical properties of an object may affect its motion (e.g., shape, size)

Standard:

S5c: explores sources of light and heat within the environment

Components:

S5c1: explains that that heat has many sources (e.g., the Sun, flames, light bulbs, flashlights, heating elements)

S5c2: demonstrates that many things that produce light also produce heat

Strand:

S6 Life Science: The student develops an understanding of the characteristics of organisms, their life cycles, and their environments; that is, the student:

Standard: S6a: identifies differences between living and nonliving things

Components:

S6a1: identifies attributes and behaviors that help differentiate living from non-living things

S6a2 : describes examples of likenesses and differences in the appearance and behavior of some living things

Standard:

S6b: describes ways in which animals resemble their parents

Components:

S6b1: Provides examples of how animals (including humans) are alike and different from their biological parents

Standard: S6c: builds an awareness of the basic needs of living things

Components:

S6c1: Investigates and identifies resources (light, water, and air) that plants need to survive

S6c2: Investigates and identifies resources (food, water, and air) that animals need to survive

Strand:

S7 Earth & Space Sciences: The student develops an understanding of Earth materials, objects in the sky, and changes in Earth and sky; that is, the student:

Standard: S7a: recognizes and describes the variety of earth materials

Components:

S7a1: Identifies rocks, sand, soil, air, and water as earth materials

S7a2: Describes the various sizes, shapes, colors, and textures of rocks

Standard:

S7b: investigates how weather can change from day to day

Components:

S7b1: Identifies basic weather features (e.g., temperature, wind, rain, clouds)

S7b2: describes changes in weather, based on observations

S7b3: demonstrates that wind is moving air that has direction and force

Standard:

S7c: recognizes that the Sun is the major source of light and warmth on earth

Components:

S7c1: identifies day and night as a repeating pattern

S7c2: investigates and describes how the Sun warms the land, air, and water

Standard:

S7d: examines the celestial objects that can be seen at various times in the daytime sky and nighttime sky

Components:

S7d1: compares the things that can be seen in the day sky with those that that can be seen at night

Science Standards
Grades 1

Strand:

S1 Scientific Inquiry: The student demonstrates abilities necessary to do scientific inquiry and an understanding about scientific inquiry; that is, the student:

Standard: S1a: asks questions about objects, organisms, and events

Components:

S1a1: discusses how their questions might be answered

Standard:

S1b: uses observations to make simple predictions

S1c: plans and conducts simple explorations and investigations

Components:

S1c1: gathers materials and/or information needed to conduct investigations

S1c2: follows logical steps to conduct investigations

S1c3: uses simple tools such as rulers, magnifiers, and balances to collect data. (u.s. customary units)

S1c4: records data from investigations in an organized and appropriate format (e.g., lab book, log, notebook, t-chart, etc)

Standard:

S1d: identifies patterns based on observations

S1e: compares objects based on observable and measurable characteristics (e.g., harder/softer, heavier/lighter,)

S1f: analyzes and makes statements about data displayed in a graph

S1g: communicates scientific explorations through discussions with peers, drawings, graphs, and words

S1h: identifies examples of safe practices in science

Components:

S1h1: demonstrates appropriate uses safety goggles, hammers, and hand lenses in science

Strand:

S2 History and Nature of Science: The student demonstrates an understanding of science as a human endeavor; that is, the student:

Standard: S2a: realizes that people have been doing science for a long time

S2b: expresses that science involves thinking, asking questions about the world, and trying to answer those questions

S2c: recognizes that in science people share ideas and findings

S2d: provides examples of how diverse people (children, fathers, mothers, teachers, gardeners, scientists, etc.) participate in doing science

Components:

S2d1: demonstrates knowledge of some of things geologists study

Strand:

S3 Personal & Social Perspectives: The student demonstrates an understanding of safety, types of resources, and changes in the environment; that is, the student:

Standard: S3a: describes basic resources that are found in their environments, such as soil, water, and tress, and other resources that are produced from these resources, such as building materials

S3b: identifies ways in which humans use resources obtained from the environment and discusses ways some of those resources can be conserved

Strand:

S4 Science and Technology: The student demonstrates an understanding about science and technology and the nature of technological design; that is, the student:

Standard: S4a: identifies a simple problem, proposes a solution for the problem, and then evaluates the solution in terms of its ability to solve the problem

S4b: recognizes that technological solutions are human designed

S4c: recognizes that things found in nature are different from those that are made by humans

Strand:

S5 Physical Science: The student demonstrates an understanding of matter, motion, and energy; that is, the student:

Standard: S5a: examines how properties of objects may differ from the properties of the materials by which they were made

Components:

S5a1: groups common objects according to the materials of which they are made

S5a2: compares and contrasts different materials based on properties (e.g., hardness, flexibility, and magnetic attraction)

Standard:

S5b: demonstrates that pushes and pulls can change the motion of objects

Components:

S5b1: describes how the motion of a variety of objects changes when pushed or pulled

Standard:

S5c: builds an understanding that the motion of objects is affected by a “pull” towards earth

Components:

S5c1: demonstrates that things fall towards the ground if not held up

Standard:

S5d: examines how light travels in a straight line until it reaches an object; and that it can travel through or be reflected off the object

Components:

S5d1: shows that light travels in a straight line until it reaches an object

S5d2: demonstrates that light travels through some objects, but not others

S5d3: demonstrates that light can be reflected off certain objects

Strand:

S6 Life Science: The student demonstrates an understanding of the characteristics of organisms, their life cycles, and their environments; that is, the student:

Standard: S6a: examines characteristics of plants and animals and describes how those characteristics help the organism to live

Components:

S6a1: observes and describes structures and responses that enable plants to stay alive

S6a2: observes and describes structures and behaviors that enable animals to stay alive

S6a3: identifies physical characteristics that enable an organism to survive (e.g., legs for moving, sharp teeth for eating, hard shell for protection)

S6a4: provides examples of diverse structures (e.g., wings, legs, fins) that serve similar functions (e.g., movement)

S6a5: identifies differences in individuals with the same parents

S6a6: describes ways in which individuals within a population (including humans) can vary

Standard:

S6b: determines how an organism's habitat provides for its basic needs

Components:

S6b1: observes and explains that there are a variety of local environments (e.g., field, forest, marsh, river)

S6b2: provides examples of how an organism depends on other organisms

Strand:

S7 Earth & Space Sciences: The student demonstrates an understanding of Earth materials, objects in the sky, and changes in Earth and sky; that is, the student:

Standard: S7a: examines how rocks and soils can vary greatly in appearance

Components:

S7a1: groups rocks by color, texture, size, and other observable properties

S7a2: observes and describes differences in the physical appearance of sand and soil

S7a3: identifies the components of soil (i.e., rocks, sand, and the remains of plants and animals)

Standard:

S7b: investigates how weather can cause change

Components:

S7b1: describes and provides examples of the effects of rain on different materials, based on extended investigations

S7b2: describes and provides examples of the effects of wind on different materials

S7b3: observes and describes changes in water that affect materials (e.g., freezing water, hail)

Standard:

S7c: monitors the apparent path of the Sun across the sky

Components:

S7c1: observes safely and records the path of the Sun's movement during the day

S7c2: describes how the Sun's changing position in the sky causes shadows to change

Science Standards
Grade 2

Strand:

S1 Scientific Inquiry: The student demonstrates abilities necessary to do scientific inquiry and an understanding about scientific inquiry; that is, the student:

Standard: S1a: asks questions about objects, organisms, and events

Components:

S1a1. Discusses how their questions might be answered

S1a2. Determines which questions might be answered with a "testable" question, those that might be answered through observations, and those that might be answered through research

Standard: S1b: uses observations to make simple predictions

S1c: conducts and designs simple explorations and investigations

Components:

S1c1; gathers materials and/or information needed to conduct investigations

S1c2; follows logical steps to conduct investigations

S1c3: uses simple tools such as rain gauges, thermometers, anemometers, stopwatches, rulers, magnifiers, and balances to collect data (U.S. customary units)

S1c4: records data from investigations in an organized and appropriate format (e.g., lab book, log, notebook, t-chart, etc)

S1c5: Records by drawing and dictating

Standard: S1d: identifies patterns based on observations

S1e: compares and groups objects based on observable and measurable characteristics (e.g., harder/softer, heavier/lighter) and justifies the groups based on a logical classification scheme

S1f: analyzes and makes statements about data displayed in a graph

S1g: communicates scientific explorations through discussions with peers, drawings, graphs, and oral presentations

S1h: identifies examples of safe practices in science

Components:

S1h1: Demonstrates appropriate uses of measuring and construction tools

S1h2: Demonstrates safe sky viewing procedures

S1h3: Practices appropriate methods for handling plants and animals

Strand:

S2 History and Nature of Science: The student demonstrates abilities necessary to do scientific inquiry and an understanding about scientific inquiry; that is, the student:

Standard: S2a: builds awareness that science and technology have been practiced for a long time and there is still more to be learned

S2b: explains that science involves thinking, asking questions about the world, and trying to answer those questions

S2c: recognizes that in science people share and critique new information with others

S2d: recognizes that people of all ages, backgrounds, and cultures have made and continue to make contributions to science knowledge

Components:

S2d1: Demonstrates knowledge of some of the things meteorologists study

Strand:

S3 Personal & Social Perspectives: The student demonstrates an understanding of safety, types of resources, and changes in the environment; that is, the student:

Standard: S3a: describes basic resources that are found in their environments, such as soil, water, and trees, and other resources that are produced from these resources such as building materials

S3b: Identifies ways in which humans use resources obtained from the environment and discuss ways some of these resources can be conserved

Strand:

S4 Science and Technology: The student demonstrates an understanding of science and technology and the nature of technological design; that is, the student:

Standard: S4a: identifies a simple problem, proposes a solution for the problem, and then evaluates the solution in terms of its ability to solve the problem

S4b: recognizes that technological solutions are human designed

S4c: recognizes that things found in nature are different from those that are made by humans

S4c: identifies some of the human-made things that aid in scientific inquiry

Strand:

S5 Physical Science: The student demonstrates a conceptual understanding of matter, motion and energy; that is, the student:

Standard: S5a: begins to understand that materials can exist as solids, liquids, and gases that have describable differences

Components:

S5a1: compares and contrasts liquids and solids and their properties

S5a2: identifies air as a gas that surrounds us and takes up space

Standard: S5b: Investigates changes in the observable properties of materials due to heat, cold, and exposure to weather

Components:

S5b1: observes and describes changes associated with heat (e.g., materials melting, materials warping, temperature changes), cold (cracking, splitting), and weather (i.e. color changes, change in texture)

Standard: S5c: Investigates how vibrations produce sound and that sound can travel through many materials

Components:

S5c1: explains that vibrations make sounds

S5c2: explores the relationship between pitch and rate of vibration

S5c3; compares a variety of materials that transmit sound (e.g., air, water, solid objects)

Strand:

S6 Life Science: The student demonstrates a conceptual understanding of the characteristics of organisms, their life cycles, and their environments; that is, the student:

Standard: S6a: describes structures of plants and animals that help them meet basic needs in different environments

Components:

S6a1: describes structures of animals and how those structures help the animal live in a particular environment

S6a2: describes structures of plants and how those structures help the plant live in a particular environment

S6b: determines that the life cycles of living things include birth or germination, growth and development, reproduction, and death

Components:

S6b1: observes, records and describes how structures change over time in an organism's life cycle (e.g., frog, butterfly, mustard plant)

S6b2: recognizes that the stages of an observed life cycle are predictable

S6b3: explains that organisms may have different needs (e.g., dependence on a particular type of food and/or environment) during their life cycle

Standard: S6c: observes how organisms interact with their environments to meet their needs

Components:

S6c1: describes that some animals eat plants for food, others eat other animals, and some eat both plants and animals

S6c2: identifies potential sources of food (in the case of animals), shelter, water, air and light within a particular organism's habitat

S6c3; describes how organisms interact with other organisms and with nonliving components of their habitat

Standard: S6c4: examines and records how organisms respond to changes in their habitat

Strand:

S7 Earth & Space Sciences: The student demonstrates a conceptual understanding of Earth materials, objects in the sky, and changes in Earth and sky; that is, the student:

Standard: S7a: recognizes humans' dependence on earth materials

Components:

S7a1: indicates how people use earth's resources (i.e., as building materials, as sources of fuel, for growing food and obtaining water)

S7a2; observes and describes that the properties of earth's resources determine how people use them

S7a3: identifies air as an earth material

Standard: S7b: identifies patterns of seasonal changes in weather

Components:

S7b1: observes and records seasonal changes in weather (e.g. temperature, wind, and precipitation)

S7b2: describes changes (if any) in weather patterns over the seasons, after gathering long-term data

Standard: S7c: compares the apparent path of the Sun and moon across the sky

Components:

S7c1: observes safely, records, and describes the apparent daily changes in the Sun's and moon's position during the day (i.e. east-west motion, point of rise/set)

S7c2.: describes the Sun and moon's apparent daily motion as similar

S7c3: identifies and compares celestial objects seen in the day/night sky (i.e., Sun, moon, stars)

Standard: S7d: investigates the appearance of stars in the night sky

Components:

S7d1: describes differences between the day and night sky (e.g. the Sun is only seen during the day, the stars can be seen at night)

S7d2: describes differences in the appearance of stars (i.e. brightness, color)

Science Standards
Grade 3

Strand:

S1 Scientific Inquiry: The student demonstrates abilities necessary to do scientific inquiry and an understanding about scientific inquiry; that is, the student:

Standard: S1a: asks questions about objects, organisms, and events

Components:

S1a1: proposes ways their questions might be answered

S1a2: determines which questions might be answered with a "testable" question, those that might be answered through observations, and those that might be answered through research

Standard: S1b: uses observations to make predictions

S1c: plans and conducts a "fair test" with the teacher's help

Components:

S1c1: gathers materials and/or information needed to conduct investigations

S1c2: identifies ways to conduct a "fair test" by testing for only one variable at a time

S1c3: follows logical steps to conduct a "fair test"

S1c4: uses simple tools (such as magnifiers, scales, mineral testing devices, timers, etc.) and units of measure (U.S. customary units and metric)

S1c5: records data from investigations in an organized and appropriate format (e.g., lab book, log, notebook, t-chart, etc)

Standard: S1d: identifies patterns based on observations and summarizes findings

S1e: compares and groups objects based on observable and measurable characteristics (e.g., solubility, hardness, reactivity) and justifies the groups based on a logical classification scheme

S1f: analyzes and makes statements about data displayed in a Venn diagram, graph and table

S1g: communicates scientific explorations through discussions with peers, drawing, graphs, tables, simple reports, and oral presentations

S1h: demonstrates safe practices in science

Components:

S1h1: explains and conducts safe Sun viewing procedures and practices

S1h2: explains and conducts safe use of tools

S1h3: explains and conducts safe experiments with batteries and bulbs

Strand:

S2 History and Nature of Science: The student demonstrates an understanding of science as a human endeavor, that is, the student:

Standard: S2a: builds awareness that science and technology have been practiced for a long time and there is still more to be learned

S2b: knows that scientists share and critique new information with others

S2c: describes some historical examples of diverse women and men who have made contributions to science

Strand:

S3 Personal & Social Perspectives: The student demonstrates an understanding of safety, types of resources, and changes in the environment; that is, the student:

Standard: S3a: compares the needs of a population with the sources and quantities of resources

S3b: realizes that some resources humans obtain from the environment are limited and resources can be extended through recycling and decreased use

Strand:

S4 Science and Technology: The student demonstrates an understanding of science and technology and the nature of technological design; that is, the student:

Standard: S4a: identifies a problem, implements a proposed solution for the problem, discusses the merit of the solution, and improves on the solution after evaluation

S4b: identifies some of the technological solutions that make life easier and the trade-offs (safety, cost, efficiency, health and environmental side effects, etc.) involved in those solutions

S4c: identifies some of the human-made things that aid in scientific inquiry

Strand:

S5 Physical Science: The student demonstrates a conceptual understanding of matter, motion, and energy; that is, the student:

Standard: S5a: gains an understanding that mass is conserved even when materials are reshaped or broken into smaller and smaller pieces

Components:

S5a1: observes, measures, describes that the reshaped or dissembled parts of an object are equal to the weight of the whole object

Standard: S5b: recognizes that materials have properties that are independent of the shape or size of the sample

Components:

S5b1: demonstrates actions that change the shape or size of a material (cutting, breaking tearing, shredding, sanding) and differentiates the properties that changed and those that did not (e.g. paper may be shredded and cut into smaller and smaller pieces but the fundamental properties of paper can still be described)

S5b2: observes and describes that one of the properties of a material is how it reacts with other materials

Standard: S5c: demonstrates a basic knowledge of the relationship between force and change of motion

Components:

S5c1: compares the motion of various objects by examining the time it takes for the object to travel a certain distance

S5c2: describes the position of an object by locating it in relationship to another object or to a background

S5c3: describes speed in qualitative ways (e.g., faster vs. slower)

S5c4: identifies simple situations in which forces are balanced (e.g., designing mobiles, balance toys, and structures in which equal and opposite forces cause no change in motion)

Standard: S5d: examines how magnets can cause some things to move without touching them

Components:

S5d1: determines situations where magnets act at a distance to cause other magnets or objects to move towards them or away

S5d2: compares the magnetic attraction of different objects and materials to a magnet

S5d3: demonstrates that magnets can repel or attract each other

Standard: S5e: builds awareness of how electrical flow can produce light, movement, heat, and magnetic fields

Components:

S5e1: demonstrates that electric circuits require a complete loop in which an electrical current can pass

S5e2: predicts and tests the electrical conductivity or insulating abilities of various materials

Strand:

S6 Life Science: The student demonstrates a conceptual understanding of the characteristics of organisms, their life cycles, and their environments; that is, the student:

Standard: S6a: compares and contrasts structure and function among different organisms

Components:

S6a1: identifies structures that are responsible for growth, survival, and reproduction in observed plants

S6a2: identifies structures that are responsible for growth, survival, and reproduction in observed animals

S6a3: investigates and explains the functions of different parts of plants (e.g., seeds, leaves, flowers)

S6a4: identifies examples of plant structures that serve the same function but differ in appearance (e.g., seeds, leaves, flowers)

S6a5: compares and contrasts structures that animals use to obtain food and protect themselves

S6a6: identifies examples of structures in animals that serve the same purpose but differ in appearance (e.g. bird beaks)

S6a7: draws conclusions about the functions of plant and animal structures seen in fossils

Standard: S6b: gains an understanding that the details in the life cycles of organisms are different for different types of organisms

Components:

S6b1: observes and compares the life cycles of different plants

Standard: S6c: differentiates between inherited physical traits and those that are not inherited in plants

Components:

S6c1: discusses that when plants reproduce, both biological parents pass on information that determine characteristics of the offspring

S6c2: examines and identifies physical characteristics of plants that are caused by interaction with the environment and those that are inherited

Standard: S6d: investigates how changes in environments affect plants and animals (including humans)

Components:

S6d1: observes and describes how organisms can cause changes (both beneficial and detrimental) in their environments

S6d2: provides examples of situations that cause some plants and animals to change their behavior in order to survive and reproduce; die out; or find new locations to live

S6d3: describe how growth, death, and decay are integral aspects of living systems by providing evidence from readings and observations

Strand:

S7 Earth & Space Sciences: The student demonstrates a conceptual understanding of Earth materials, objects in the sky, and changes in Earth and sky; that is, the student:

Standard: S7a: gains an understanding of how some earth materials are created and change

Components:

S7a1: observes and describes fossils as evidence of organisms that once lived and can provide information about earth's past

S7a2: compares how sand and soil are formed, based on investigations

S7a3: categorizes sand and soil in different ways (i.e., grain size, color, texture, water-holding capacity)

Standard: S7b: realizes that some earth processes are rapid and some are slow

Components:

S7b1: compares rapid earth processes (e.g. volcanic eruptions, earthquakes) to slow ones (e.g. formation of metamorphic rock)

Standard: S7c: builds awareness that our Sun is a star among other stars in the universe

Components:

S7c1: provides examples of how the Sun is necessary for life on earth

S7c2: explains that our Sun is a star that gives off a tremendous amount of heat and light

Science Standards
Grade 4

Strand:

S1 Scientific Inquiry: The student demonstrates abilities necessary to do scientific inquiry and an understanding about scientific inquiry; that is, the student:

Standard: S1a: proposes questions about scientific phenomena, objects, and organisms

Components:

S1a1: groups questions according to those that are not scientific questions; those that can be answered through scientific investigations; and those that can be answered through secondary resources

S1a2: refines questions that can be answered through investigations

Standard: S1b: uses observations and past experiences to make predictions and explain the reasoning behind the predictions

S1c: plans and conducts a "fair test"

Components:

S1c1: gathers materials and/or information needed to conduct a "fair test"

S1c2: identifies variables to be controlled in a "fair test"

S1c3: follows logical steps to conduct a "fair test"

S1c4: uses simple tools (such as scales, thermometers, timers, microscopes, hot plate, etc.) and units of measure (U.S. customary units and metric units)

S1c5: records data from investigations in an organized and appropriate format (e.g., lab book, log, notebook, t-chart, etc)

Standard: S1d: compares data, identifies patterns, and forms conclusions based on investigations

S1e: compares and groups objects based on observable and measurable characteristics (e.g., characteristics of the phases of matter) and justifies the groups based on a logical classification scheme

S1f: analyzes and makes statements about models and data displayed in a Venn diagram, graph and table

S1g: communicates scientific explorations through discussions with peers, drawing, graphs, tables, reports, and poster presentations

S1h: demonstrates safe practices in science

Components:

S1h1: explains and conducts safe Sun viewing procedures and practices

S1h2: explains and conducts safe use of tools

S1h3: explains and conducts safe experiments with batteries and bulbs

Strand:

S2 History and Nature of Science: The student demonstrates an understanding of science as a human endeavor, that is, the student:

Standard: S2a: realizes how difficult it can be for scientific innovators to break through the accepted ideas of their time to reach conclusions we currently take for granted

S2b: understands that scientists value peer review and making public the result of scientific pursuits; science is not separate from society

S2c: understands that doing science requires varying human abilities, interest, and habits of mind (such as: reasoning, insight, skill, creativity, intellectual honesty, skepticism, and openness to new ideas)

Strand:

S3 Personal & Social Perspectives: The student demonstrates an understanding of safety, types of resources, and changes in the environment; that is, the student:

Standard: S3a: identifies natural and human-made changes in the environment and explains how they affect resources in the environment

S3b: recognizes that science and technology are used to identify ways to extend resources and contribute solutions to social problems

Strand:

S4 Science and Technology: The student demonstrates an understanding of science and technology and the nature of technological design; that is, the student:

Standard: S4a: identifies a problem, implements a proposed solution for the problem, discusses the merit of the solution, and improves on the solution after evaluation

S4b: identifies some of the technological solutions that make life easier and the trade-offs (safety, cost, efficiency, health and environmental side effects, etc.) involved in those solutions

S4c: gives examples of ways technology is essential for the advancement of scientific knowledge

Strand:

S5 Physical Science: The student demonstrates a conceptual understanding of matter, motion, and energy; that is, the student:

Standard: S5a: demonstrates an understanding that many of the observable properties of materials allow us to group them into categories such as solid, liquid, or gas

Components:

S5a1: describe the properties matter

S5a2: distinguish among solids, liquids and gases (i.e. volume, shape they take in container)

Standard: S5b: explains that water can change from one state to another by heating or cooling

Components:

S5b1: explains that water can freeze, melt, evaporate, and condense

S5b2: demonstrates that changes of state are reversible

S5b3: observes and measures conservation of mass as water changes from a solid to a liquid and back

Standard: S5c: Recognizes that heat can spread from one place to another

Components:

S5c1: Demonstrates that heat moves from one place to another by conduction

S5c2: Compares materials for their ability to conduct heat

Strand:

S6 Life Science: The student demonstrates a conceptual understanding of organisms, and their environments; that is, the student:

Standard: S6a: builds awareness that reproduction is essential to the continuation of a species

Components:

S6a1: examines and describes the production of offspring in observed animals (e.g., snails, fish, brine shrimp)

S6a2: investigates and provides examples of the varying reproductive strategies in organisms (e.g., lots of eggs, one offspring that is cared for, wide dispersal of seeds), citing evidence from observations and readings

Standard: S6b: builds an awareness of variations and similarities in organisms

Components:

S6b1: illustrates through simulations how different variations of a structure (e.g., bird beaks) are suited to specific functions (e.g., cracking seeds, digging for worms)

S6b2: describes that internal and external cues influence the behavior of organisms

S6b3: identifies variations and similarities in the behavior of organisms

S6b4: classifies animals according to various organizational schemes and recognizes that the organizing schemes can vary according to purpose

Standard: S6c: differentiates between inherited physical traits and those that are not inherited in animals

Components:

S6c1: discusses that when animals reproduce, both biological parents pass on information that determine characteristics of the offspring

S6c2: lists physical characteristics of animals that are caused by interaction with the environment and those that are inherited

S6c3: explains that learned behaviors are not passed on to the next generation

Standard: S6d: explains that variations in organisms can determine whether the individual will survive and reproduce

Components:

S6d1: describes how individuals of the same species vary and sometimes these variations can help the organism survive and reproduce

Standard: S6e: illustrates the interdependence of organisms in an ecosystem

Components:

S6e1: discusses and provides examples of how all organisms ultimately depend on plants

S6e2: identifies that some organisms depend on dead plants and animals for food

S6e3: identifies microorganisms as necessary components in all ecosystems

S6e4: describes and explains that the world has many distinct environments (e.g., rainforest, desert, plains, wetlands)

S6e5; identifies factors in the ecosystem that enable or prevent an organism from surviving and reproducing

S6e6: provides examples of how an organism's patterns of behavior are affected by the environment (e.g., availability of food sources, change in the number of predators)

Strand:

S7 Earth & Space Sciences: The student demonstrates a conceptual understanding of Earth materials, objects in the sky, and changes in Earth and sky; that is, the student:

Standard: S7a: develops an understanding of the importance of water as an earth material

Components:

S7a1: identifies major sources of water on earth

S7a2: verifies that water can be found underground, on the surface of earth and in the atmosphere

Standard: S7b: explains that water on earth can exist in different states

Components:

S7b1: investigates conditions associated with change in the states of water

Standard: S7c: examines components and relationships in the solar system

Components:

S7c1; describes common objects (i.e. Sun, planets, moons) in the solar system

S7c2: observes safely, records, and describes the yearly pattern of the Sun's apparent path (i.e., seasonal change in length of day/night, changes in point of Sunrise/set, changes in noon altitude)

S7c3: identifies the predictable monthly pattern of the moon's phases (new, crescent quarter, gibbous, full)

S7c4: identifies, observes and describes the physical features of the moon (e.g. craters, plains, mountains) using photographic images

S7c5: demonstrates and explains that the rotation of planet earth produces the night and day cycle

Science Standards
Grade 5

Strand:

S1 Scientific Inquiry: The student demonstrates abilities necessary to do scientific inquiry and an understanding about scientific inquiry; that is, the student:

Standard: S1a: identifies and clarifies questions that can be answered through scientific investigations

Components:

S1a1: analyzes a problem and determines appropriate questions that can be answered through investigations

S1a2: develops a plan for how their questions might be answered based on a hypothesis

Standard: S1b: identifies a hypothesis to guide their investigations

S1c: designs and conducts controlled investigations

Components:

S1c1: identifies and gathers materials and/or information sources needed to conduct investigations

S1c2: identifies variables to be controlled

S1c3: plans and follows logical steps to conduct controlled investigations

S1c4: performs measurements using appropriate scientific tools (such as thermometers, microscopes, probes, planispheres, etc.) and units of measure (U.S. customary units and metric units)

S1c5: records data from investigations in an organized and appropriate format (e.g., t-chart, table, list, line graph, written log, etc)

Standard: S1d: forms relationships between evidence and explanations

S1e: begins to recognize and analyze alternative explanation and conclusions

S1f: analyzes, makes statements, and forms conclusions using models and data displayed in a Venn diagram, graph and table

S1g: communicates scientific explorations through discussions, drawing, graphs, tables, reports, and multi-media presentations

S1h: demonstrates safe practices in science

Components:

S1h1: explains and conducts safe Sun and night sky viewing procedures and practices

S1h2: explains and conducts safe use of tools and simple machines

S1h3: explains and conducts safe experiments involving chemicals

Strand:

S2 History and Nature of Science: The student demonstrates an understanding of science as a human endeavor, that is, the student:

Standard: S2a: explains the variety of contributions and discoveries about objects, events, and phenomena in nature were made by women and men who chose careers in science

S2b: understands that scientists value peer review and making public the result of scientific pursuits; science is not separate from society

S2c: understands that doing science requires varying human abilities, interest, and habits of mind (such as: reasoning, insight, skill, creativity, intellectual honesty, skepticism, and openness to new ideas)

Strand:

S3 Personal & Social Perspectives: The student demonstrates an understanding of safety, types of resources, and changes in the environment; that is, the student:

Standard: S3a: explores the personal and societal challenges caused by both natural and human-made changes to the environment

S3b: weighs the risks and benefits of resource use and management on the environment and human population

Strand:

S4 Science and Technology: The student demonstrates an understanding of science and technology and the nature of technological design; that is, the student:

Standard: S4a: identifies a problem, designs a solution or product that addresses the problem, implements the design, and evaluates and communicates the design process to others

S4b: identifies some of the technological solutions that make life easier and the trade-offs (safety, cost, efficiency, health and environmental side effects, etc.) involved in those solutions

S4c: explains how scientific inquiry and technological design are similar and different

Strand:

S5 Physical Science: The student demonstrates a conceptual understanding of matter, motion and energy; that is, the student:

Standard: S5a: explains that some materials may be composed of pieces too small to see without tools that magnify the material

Components:

S5a1: explains that some materials are collections of small solids (e.g., sand, sugar, salt, powder) that can be viewed with a hand lens

S5a2: determines that some materials (i.e., powders, sands) can be separated by their physical properties

S5a3: demonstrates methods used to separate mixtures based on observable physical properties (e.g., screening, filtering)

Standard: S5b: investigates how some common materials interact to form new materials

Components:

S5b1: demonstrates that combining two or more materials may retain or lose the materials' original properties

S5b2: groups materials by their reactions with other materials and explains how reactions can be used to identify materials

S5b3: identifies properties of a material, made from combining two or materials, that are the same and/or different from the original materials

Standard: S5c: demonstrates an understanding of how force, distance, and work are involved in simple machines

Components:

S5c1: demonstrates that simple machines can change the direction or the size of an applied force

S5c2: explains that simple machines reduce the force, or change the direction of force, needed to do work

S5c3: compares the mass of an object to the force required to move it

S5c4: describes the motion of an object by its position, direction of motion, and speed

S5c5: describe and explain the relationship between the strength of a force and its effect on the motion on an object

S5c6: describes tradeoffs of various simple machines (e.g., the easier it is to lift an object with a lever, the less high it is lifted)

Standard: S5d: distinguishes among different forms of energy and demonstrates that energy can change forms

Components:

S5d1: recognizes that heat, light, sound, electricity, magnetism and motion are associated with energy

S5d2: demonstrates that energy can be changed from one form into another (e.g., electrical energy into light, sunlight into heat or electricity)

Strand:

S6 Life Science: The student demonstrates a conceptual understanding of the structure and function of living systems, and ecosystems; that is, the student:

Standard: S6a: gains an understanding that the cell is the fundamental unit of life

Components:

S6a1: observes and draws a variety of cells, using microscopes or video technology

S6a2: explains that all organisms are composed of cells, the fundamental units of life

S6a3: recognizes that most organisms are single-celled; others, including humans, are multi-cellular

S6a4: relates cells to building blocks for more complex structures in multi-cellular organisms (e.g., tissues, organs, systems)

Standard: S6b: investigates adaptations of structures that carry out essential functions

Components:

S6b1: provides examples of adaptations in structures that carry out essential life functions after studying various organisms and ecosystems (e.g., radulae in snails, gills in fish, ciliae in rotifers)

Standard: S6c: investigates how structures in organisms coordinate to carry out essential functions

Components:

S6c1: recognizes the complementary nature of structure and function in living things, using examples from a studied ecosystem

S6c2: investigates and describes how structures within organisms work together to serve specialized functions

S6c3: predicts what might happen if one structure of an organism's body fails to perform its particular function

Standard: S6d: examines and describes the flow of matter and energy in living systems

Components:

S6d1: illustrates, with examples, food chains and webs that show the flow of matter and energy in an ecosystem

S6d2: explains that (most) living things depend on food and oxygen for growth, repair, and energy

S6d3: discusses and provides examples of how all organisms ultimately depend on the Sun for food and energy

Strand:

S7 Earth & Space Sciences: The student demonstrates a conceptual understanding of Earth's systems, history, and significance in the solar system; that is, the student:

Standard: S7a: investigates landforms and relates a combination of constructive and destructive forces to their formation

Components:

S7a1: identifies major features of earth's surface

S7a2.: describes and examines constructive forces (including volcanic eruption and sediment deposition) that change landforms

S7a3: describes and examines destructive forces (including weathering and erosion from waves, wind, and water) that change landforms

S7a4: observes and explains that weathered rock, along with organic materials from decomposed plants, animals, and bacteria (and possibly pieces of living organisms), make up soil

S7a5: observe and describe that soils are often found in layers, each having a different composition and texture

Standard: S7b: describes and gives examples of ways in which earth's surface is built up and torn down by natural and human-produced processes

Components:

S7b1: examines and differentiates the geological processes that build and/or change features of the earth's surface

S7b2: explains how weathering and erosion reshape landforms by eroding rock and soil in some areas and depositing them in others

S7b3: describes how forces over time lead to the formation of sedimentary rock

S7b4: interprets the impact of weather on earth materials

Standard: S7c: develops an understanding of the Sun as a source of energy

Components:

S7c1: identifies different forms of energy emitted by the Sun and provides examples from investigations

S7c2: identifies, observes and describes the physical features of the Sun (e.g., sunspots, flares) using photographic images

S7c3: identifies the Sun as our most important source of energy

S7c4: describes how sunlight falling upon a tilted surface is less intense than direct sunlight and understands how that affects temperatures and seasons

S7c5: identifies, observes and describes the physical features of the Sun (e.g. sunspots, flares) using photographic images

Standard: S7d: investigates the apparent motion of the stars

Components:

S7d1: identifies and finds constellations in the nighttime sky using a planisphere

S7d2: observes, records, and describes the apparent motion of the constellations daily and seasonally

Science Standards
Grade 6

Strand:

S1 Scientific Inquiry: The student demonstrates abilities necessary to do scientific inquiry and an understanding about scientific inquiry; that is, the student:

Standard: S1a: develops research questions that can be answered through scientific investigations

S1b: accesses, evaluates and uses information from a variety of reliable sources

S1c: designs, conducts, and records scientific investigations following the general procedures of scientific inquiry

S1d: applies appropriate tools and techniques to systematically collect, record, analyze, interpret and present data

S1e: develops logical descriptions, explanations, predictions, and models using evidence

S1f: recognizes and analyzes interpretations, conclusions, and predictions based upon alternative evidence and explanations

S1g: communicates scientific procedures, explanations, and conclusions using appropriate scientific language and mathematics

Strand:

S2 History and Nature of Science: The student demonstrates an understanding of science as a human endeavor, and the history and nature of science; that is, the student:

Standard: S2a: describes how doing science requires varying human abilities, interest and habits of mind (such as: reasoning, insight, skill, creativity, intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas)

S2b: identifies contributions of individuals from diverse cultures who have extended the knowledge in science and technology

S2c: explains how the effects of science and technology affect cultural development, innovation and human history

Strand:

S3 Personal & Social Perspectives: The student demonstrates an understanding of safety and risks and benefits associated with natural and personal hazards; that is, the student:

Standard: S3a: demonstrates personal and group safety and resource conservation

S3b: compares the safety precautions needed during different natural hazards

S3c: describes the risks, costs, and benefits of human decisions related to natural hazards

S3d: explores causes of environmental degradation and resources depletion

Strand:

S4 Science and Technology: The student demonstrates an understanding about science and technology, and the nature of technological design; that is, the student:

Standard: S4a: explores how societal challenges may drive scientific research

S4b: designs and conducts a test on an invention (or existing product) based on specified criteria

S4c: compares the intended benefits and unintended consequences of technology and how it impacts society

S4d: describes how technology responds to societal needs

Strand:

S5 Physical Science: The student demonstrates a conceptual understanding of matter, motions and forces, and transfer of energy; that is, the student:

Standard: S5a: examines characteristic physical properties of matter

Components:

S5a1: explains that every substance has a distinct boiling point, and this property is independent of the quantity of the substance

S5a2: demonstrates and distinguishes between ways to measure mass and volume of liquids, solids, and gases

S5a3: analyzes data to determine the relationship between mass and volume for a variety of substances, and shows that the relationship is constant for a substance

S5a4: explains that density is an identifying property that is independent of the quantity of material
S5a5 Shows that equal volumes of different substances usually have different masses"

Standard: S5b: investigates how vibrations in materials set up wavelike disturbances that spread away from the source

Components:

S5b1: models and describes the characteristic properties of waves, such as wavelength, frequency, amplitude, and speed

S5b2: models and describes wave behaviors (i.e., reflection and refraction)

Standard: S5c: investigates how radiant energy (light) interacts with matter

Components:

S5c1: demonstrates through investigations that light can be reflected, transmitted, and/or absorbed when it strikes an object

S5c2.: explores how transmitted light is refracted to different degrees by a variety of materials

S5c3: groups materials based on physical properties that affect the behavior of light (e.g., transparent, translucent, opaque, absorbent, reflective materials)

S5c4: investigates and explains that an object can be seen when light waves emitted or reflected by it enter the eye

Strand:

S6 Life Science: The student demonstrates a conceptual understanding of the structure and function of living systems, populations and ecosystems; that is, the student:

Standard: S6a: compares and contrasts structure and function in unicellular and multi-cellular organisms

Components:

S6a1: describes basic functions that all cells must carry out (e.g., extracts energy from food, eliminates waste), citing evidence from microscopic examination of unicellular organisms

S6a2: describes structures (e.g., cell membrane, nucleus) that many cells share to carry out essential functions

S6a3: relates the structures used by unicellular organisms to the structures used by multi-cellular organisms

S6a4: compares and contrasts plant and animal cells, using microscopes or video technology

S6a5.: compares and contrasts the diverse structures that unicellular organisms use to survive, citing evidence from microscopic observations

S6a6: explains how diverse species of animals, plants, and micro-organisms share essential similarities in cell organelles and cell processes

Standard: S6b: explains that reproduction is a characteristic of life and essential to the continuance of a species

Components:

S6b1: compares and contrasts asexual and sexual reproduction

S6b2: identifies examples of asexual reproduction and sexual reproduction

S6b3: investigates and describes the functions of reproductive structures in plants

S6b4: explains how, in sexual reproduction of animals and flowering plants, a male sperm cell and a female egg cell merge to form a fertilized cell

S6b5: describes ways in which physical traits (e.g., of a flowering plant) might maximize the chances of successful reproduction

Standard: S6c: analyzes the functions of and relationships among producers, consumers, and decomposers in ecosystems

Components:

S6c1: categorizes organisms according to the function they serve as consumers, producers, and decomposers

S6c2: determines through investigations the raw materials plants need to photosynthesize

S6c3: explains why photosynthetic organisms are called producers

S6c4: investigates and explains the importance of decay in an ecosystem

S6c5: describes the flow of energy and matter through food webs for various ecosystems

S6c6: identifies sunlight as the original source of energy for most ecosystems

S6c7: identifies the two main interconnected global food webs (i.e., one that includes microscopic ocean plants, and the other that includes land plants)

S6c8: distinguishes between biotic and abiotic factors in multiple ecosystems

S6c9: distinguishes among individuals, populations, communities, and ecosystems

S6c10: collects data on and describes the interactions among organisms and between organisms and the physical environment in multiple ecosystems

Strand:

S7 Earth & Space Sciences: The student demonstrates a conceptual understanding of the Earth's systems, history, and place in the solar system; that is, the student:

Standard: S7a: differentiates the layers of the geosphere, including the crust, the hot convecting mantle, and the dense metallic core

Components:

S7a1: distinguishes among layers of the geosphere by their composition, state, positions relative to one another, and temperature

S7a2: explains how heat is transferred, by convection, from the core to the mantle and crust

Standard: S7b: applies concepts of rotation, revolution, and alignment to explain the predictable patterns of phasing, eclipses and seasons

Components:

S7b1: differentiates between rotation and revolution

S7b2: demonstrates and explains that the rotation of earth produces the night and day cycle, and its revolution produces the year

S7b3: models how the moon's phases can be explained by simulating the moon's orbit around the earth and its position relative to the earth and Sun

S7b4: demonstrates the situations that will result in lunar and solar eclipses as seen from earth

S7b5: relates seasons on earth to variations in the amount of the Sun's energy that strikes different latitudes on the surface of the earth, due to earth's tilted axis of rotation

Standard: S7c: recognizes that gravity is the force that pulls all things towards earth's center, and governs the motions of objects in the solar system and the universe beyond

Components:

S7c1: explains how earth's spherical shape and the force of gravity hold us on earth and cause all objects on earth to fall towards earth's center

S7c2: Explains that most objects in the solar system are in regular and predictable motion and that this motion is caused largely by the force of gravity

S7c3: illustrates how the gravitational attractions of the Sun and moon in different positions relative to earth cause tides on earth

Science Standards
Grade 7

Strand:

S1 Scientific Inquiry: The student demonstrates abilities necessary to do scientific inquiry and an understanding about scientific inquiry; that is, the student:

Standard:

S1a: develops research questions that can be answered through scientific investigations

S1b: accesses, evaluates and uses information from a variety of reliable scientific sources

S1c: designs, conducts and records scientific investigations following the general procedures of scientific inquiry

S1d: applies appropriate tools and techniques to systematically collect, record, analyze, and interpret data

S1e: develops logical descriptions, explanations, predictions, and models using evidence

S1f: recognizes and analyzes interpretations, conclusions, and predictions based upon alternative evidence and explanations

S1g: communicates scientific procedures, explanations, and conclusions using appropriate scientific language and writing, and mathematics

Strand:

S2 History and Nature of Science: The student demonstrates an understanding of science as a human endeavor, and the history and nature of science; that is, the student:

Standard:

S2a: recognizes that scientists are from diverse backgrounds, but that all use scientific habits of mind (such as: reasoning, insight, skill, creativity, intellectual honesty, tolerance for ambiguity, skepticisms, and openness to new ideas) in their work

S2b: explains how scientists formulate and test their explanations, revising when necessary

S2c: investigates and identifies how scientists communicate their results and ideas, and describes and identifies situations in which scientists disagree about interpretation of evidence

S2d: examines the effects of science on cultural development and the relationship between scientific innovation and human history

Strand:

S3 Personal & Social Perspectives: The student demonstrates an understanding of safety, natural and human hazards, and their risks and benefits; that is, the student:

Standard: S3a: demonstrates personal and group safety and resource conservation

S3b: thinks critically about risks and benefits of natural, chemical, biological, and personal hazards

S3c: explains environmental degradation on a global scale

Strand:

S4 Science and Technology: The student demonstrates an understanding about science and technology and the nature of technological design; that is, the student:

Standard: S4a: explains how societal challenges may impact scientific research

S4b: tests a design or invention and evaluates its effectiveness

S4c: compares the intended benefits and unintended consequences of technology and how it impacts society

S4d: describes how technology responds to societal needs

Strand:

S5 Physical Science: The student demonstrates a conceptual understanding of matter, motions and forces, and transfer of energy; that is, the student:

Standard: S5a: investigates how substances combine to form homogeneous mixtures, and how those mixtures can be separated

Components:

S5a1: distinguishes between a solution and a mixture

S5a2: demonstrates ways in which mixtures of substances can be physically separated into the original substances (e.g., filtering, chromatography)

S5a3: shows and explains how the concentration of a solution can be changed by varying the amount of solute or solvent

S5a4: demonstrates that many substances dissolve in water

S5a5: shows through investigations that the solubility of a solute can vary in different solvents

S5a6: distinguishes between a mixture and a compound

S5a7: determines that the mass of a mixture is equal to the sum of the masses f its components

Standard: S5b: compares chemical and physical properties of matter and groups substances according to those properties and their changes

Components:

S5b1: recognizes and distinguishes chemical and physical properties

S5b2: cites evidence to show that groups of substances have similar properties (e.g., metals)

S5b3: demonstrates that substances can be sorted into categories or groups based on their physical and chemical properties

Standard: S5c: investigates sequences of energy transformations in circuits

Components:

S5c1: explains that energy can appear in different forms and can be changed from one form to another (describes the flow of energy from a source (e.g., a battery), through a circuit, to a device (e.g., a light bulb, a motor)

S5c2: investigates and compares how different circuits (e.g., parallel, series) affect the amount of electrical energy transferred to a device

S5c3: cites evidence to explain how electrical energy is transformed into heat energy through resistance

S5c4: explains that energy in the form of heat is often one of the products of an energy transformation

S5c5: uses current, voltage, and resistance to describe how much electrical energy is delivered to a device within a circuit

Standard: S5d: investigates the relationships among force, mass, and motion of an object or system

Components:

S5d1: conducts investigations to determine the speed of moving objects

S5d2: measures and describes the motion of an object in term of its position, direction of motion and speed, and represents that motion on a graph

S5d3: cites evidence to explain that unbalanced forces cause changes in the speed and direction of an object’s motion

S5d4: analyzes the forces that are involved in maintaining the motion of an object (i.e., objects at rest and objects moving at a constant velocity)

S5d5: relates mass to the tendency of an object to maintain its motion

Strand:

S6 Life Science: The student demonstrates a conceptual understanding of the structure and function of living systems, populations and ecosystems, that is, the student:

Standard: S6a: communicates an understanding of the specialized structures and functions found in multi-cellular organisms including humans

Components:

S6a1: assesses through observations and investigations the functions of the digestive, respiratory, reproductive, circulatory, excretory, nervous, and immune systems

S6a2: analyzes the complementary nature of structure and function at all levels of organization in organisms including humans

S6a3: observes and draws examples of specialized cells, and illustrates how these cells perform specialized functions in multi-cellular organisms

S6a4: shows, using microscopes or video technology, how groups of specialized cells cooperate to form a tissue (e.g., muscle)

S6a5: investigates and illustrates how groups of tissue cooperate to form organs

S6a6: explains that cells, tissues, and organs have functions that serve the whole organism

Standard: S6b: assesses similarities and differences among internal structures in diverse organisms

Components:

S6b1: compares and contrasts, through observations and investigations, the internal structures of a variety of multi-cellular organisms

S6b2: recognizes the unity among diverse organisms by providing examples of similar internal structures that accomplish similar functions

Standard: S6c: analyzes mechanisms for disease at the cellular, tissue, organ, and system levels

Components:

S6c1: describes that disease is a breakdown in the structures or functions of an organism

S6c2: explains how infectious agents can disrupt system, organ, tissue, and cell function

S6c3: compares and contrasts bacterial, viral, and parasitic infections

S6c4: recognizes that some diseases are the result of intrinsic failure of the system

Standard: S6d: explains the influence of genes and the environment on trait expression in organisms

Components:

S6d1: identifies that, in sexual reproduction, half of the genes come from each parent

S6d2: explains that a fertilized egg carries genetic information from both parents

S6d3: explains why sexual reproduction results in genetic variation

S6d4: Observes and explains that organisms are a combination of traits, some inherited and others resulting from interactions with the environment

S6d5: Explains that chromosomes contain genes, and that each gene carries a single unit of hereditary information

S6d6: Collects and analyzes data on the transmission of inherited traits

S6d7: Shows through experimental results that parents can be selected to achieve desired traits (selective breeding)

Standard: S6e: Describes growth processes

Components:

S7e1: Observes (using microscopes or video technology) and illustrates how multi-cellular organisms grow from a single fertilized cell through cell division

S7e2: Explains that as a fertilized cell divides, the same genetic information is copied in each cell

Strand:

S7 Earth & Space Sciences: The student demonstrates a conceptual understanding of Earth's systems, history, and place in the solar system; that is, the student:

Standard: S7a: recognizes how the movement of earth's lithospheric plates causes both slow changes in earth's surface (e.g., formation of mountains and ocean basins) and rapid ones (e.g., volcanic eruptions and earthquakes)

Components:

S7a1: models how heat flow and movement of material within the mantle results in the constant movement of lithospheric plates on the surface, at rates of centimeters per year

S7a2: differentiates between types of plate boundaries and the kinds of slow and rapid changes that can occur at these boundaries

S7a3: distinguishes the characteristics and formation of sedimentary, metamorphic, and igneous rock, in the process described as the "rock cycle"

S7a4: explains how each type of rock can be transformed into the other under condition of time, pressure, and heat

Standard: S7b: analyzes the constructive and destructive forces that impact earth and its inhabitants over geologic time

Components:

S7b1: explains how the natural processes that cause changes in earth's surface today are consistent with those that occurred in the past

S7b2: verifies, using a variety of evidence (such as the fossil record, rock formations, and glaciation patterns) the idea of continental drift

S7b3: demonstrates how the stratigraphic record (rock layers) can be used to create a timeline of events, climate conditions, and life forms in earth's history

Standard: S7c: compares and contrasts the motion, properties and characteristics of objects in the solar system

Components:

S7c1: differentiates groups of objects in the solar system—including the Sun, the planets and their moons and rings, smaller objects such as asteroids and comets—by their physical properties and position in the solar system

S7c2: compares and contrasts the properties and characteristics of earth with those of the other planets in our solar system

S7c3: explains, based on naked eye and telescopic observation, how objects in the solar system change position against the background of stars

Science Standards
Grades 8

Strand:

S1 Scientific Inquiry: The student demonstrates abilities necessary to do scientific inquiry and an understanding about scientific inquiry; that is, the student:

Standard: S1a: develops research questions that can be answered through scientific investigations

S1b: accesses, evaluates and uses information from a variety of reliable scientific sources

S1c: designs, conducts and records scientific investigations following the general procedures of scientific inquiry

S1d: applies appropriate tools and techniques to systematically collect, record, analyze, and interpret data

S1e: develops logical descriptions, explanations, predictions, and models using evidence

S1f: recognizes and analyzes interpretations, conclusions, and predictions based upon alternative evidence and explanations

S1g: communicates scientific procedures, explanations, and conclusions using appropriate scientific language and writing, and mathematics

Strand:

S2 History and Nature of Science: The student demonstrates an understanding of science as a human endeavor and the history and nature of science; that is, the student:

Standard: S2a: cites examples of scientists from diverse backgrounds, and explains how they use scientific habits of mind (such as: reasoning, insight, skill, creativity, intellectual honesty, tolerance for ambiguity, skepticisms, and openness to new ideas) in their work

S2b: explains how scientists formulate and test their explanations, revising when necessary

S2c: investigates and explains how scientists communicate their results and ideas, and describes and identifies situations in which scientists disagree about interpretation of evidence

S2d: examines the effects of science on cultural development and states the relationship between scientific innovation and human history

Strand:

S3 Personal & Social Perspectives: The student demonstrates an understanding of safety, natural and human hazards, and their risks and benefits; that is, the student:

Standard: S3a: demonstrates personal and group safety and resource conservation when engaged in science

S3b: thinks critically and analyzes risks and benefits associated with natural, chemical, biological, and personal hazards

S3c: evaluates the interrelationships of environmental degradation on the global community

Strand:

S4 Science and Technology: The student demonstrates an understanding about science and technology and the nature of technological design; that is, the student:

Standard: S4a: assesses societal challenges that may inspire scientific research

S4b: evaluates an invention or design and proposes modifications

S4c: identifies a technological problem and develops a plan for design, implementation, and evaluation

S4d: explores how technological risks lead to new technologies and how unintended consequences impact society

S4e: analyzes how technology responds to societal, political, and economic needs

Strand:

S5 Physical Science: The student demonstrates a conceptual understanding of matter, motions and forces, and transfer of energy; that is, the student:

Standard: S5a: examines particulate nature of matter and chemical change

Components:

S5a1: describes the characteristics of an element, and recognizes that everything is made out of elements

S5a2: shows how elements can combine in a multitude of ways to produce a great number of compounds

S5a3 :compares the properties of compounds with those of the elements from which they are made

S5a4: explains that matter can be thought of as being composed of particles

S5a5: compares the motion and arrangement of particles in different phases of matter

Standard: S5b: examines conservation of matter by exploring phase change and chemical change

Components:

S5b1: demonstrates through investigations that mass is conserved when substances change state

S5b2: cites evidence to explain that the products of a chemical change have different properties than the reactants

S5b3: demonstrates through investigations that mass is conserved during a chemical change

S5b4: analyzes data to determine factors (e.g., concentration, temperature) that can influence reaction rates

S5b5: describes the effect of temperature change on the motion and arrangement of particles

S5b6: explains why mass is conserved (in terms of particles) during phase changes and chemical change

Standard: S5c: investigates the relationships among force, mass, and motion of an object or system

Components:

S5c1: distinguishes kinetic and potential energy

S5c2: investigates and identifies conditions/variables that would change the potential energy and resulting kinetic energy of an object

Standard: S5d: investigates phase change and the transfer of heat energy

Components:

S5d1: investigates and explains that heat energy moves in predictable ways, flowing from warmer objects to cooler ones, until both are at the same temperature

S5d2: differentiates among conduction, convection and radiation

S5d3: describes heat transfer using a particulate model

S5d4: investigates and explains how temperature changes during phase changes

Strand:

S6 Life Science: The student demonstrates a conceptual understanding of the structure and function of living systems, populations and ecosystems; that is, the student:

Standard: S6a: describes cell processes

Components:

S6a1: connects an organism's need for food with cells' need for food

S6a2: demonstrates through investigations that food is a source of energy (fuel) and building materials for cells

S6a3: relates cellular respiration to the functions of body systems (e.g., how body systems function to provide cells with the necessary raw materials)

S6a4: recognizes that cells in diverse organisms share similar chemical processes

S6a5: connects the processes of cell respiration and photosynthesis

Standard: S6b: explains how adaptive characteristics of a species influence their chance for survival or possible extinction

Components:

S6b1: models and describes how new trait variations can arise and gradually accumulate in successive generations through sexual reproduction

S6b2: defines a species as all organisms that can mate with one another to produce fertile offspring

S6b3: provides examples of biological adaptations (i.e., changes in structures, behaviors, or physiology) that enhance survival and reproductive success in a particular environment

S6b4: assesses through observations and investigations the reproductive advantage of different trait variations in various environments

S6b5: provides examples of situations in which an environment changed, the adaptive characteristics of a species were insufficient, and the species went extinct

S6b6: investigates and describes conditions that can result in extinction

S6b7:shows through simulations, how successful traits variation are selected

S6b8: explains how environmental changes can alter the genetic makeup of population in future generations

S6b9: describes how new species emerge

Standard: S6c: relates diversity and evolution

Components:

S6c1: explains that similar internal structures and chemical processes can be used to infer common ancestry among organisms

S6c2: models and forms hypotheses about how evolutionary paths diverged from a common ancestor

S6c3: explains how the selection of naturally occurring variations in a population leads to greater species diversity

Standard: S6d: describes factors that limit or support the growth of populations within an ecosystem

Components:

S6d1: analyzes data and identifies factors that influence population growth (e.g., availability of food and water, breeding space, shelter, disease, lack of resources)

S6d2: predicts how an increase or decrease in the population size of any one species could affect other populations in an ecosystem

S6d3 :analyzes data collected over time and explains ways in which organisms limit one another (e.g., predator and prey)

S6d4: compares growth for populations with and without limiting factors

S6d5: explains why a healthy population depends on limiting factors

Strand:

S7 Earth & Space Sciences: The student demonstrates a conceptual understanding of the Earth's systems and history; that is, the student:

Standard: S7a: analyzes the interaction of the four spheres (hydrosphere, geosphere, atmosphere and biosphere) on earth's system

Components:

S7a1: describes the distribution and circulation of earth's water through ocean currents, glaciers, rivers, ground water, and the atmosphere

S7a2: analyzes the impact of pollution and depletion on the global supply of water available to the biosphere

S7a3: provides evidence that the abundance of water on earth makes earth unique among planets in the solar system

Standard: S7b: Examines the composition and properties of the atmosphere

Components:

S7b1: identifies the atmosphere as a mixture of nitrogen, oxygen, and trace gases that include water vapor

S7b2: recognizes that atmosphere has different composition and properties at different locations and altitudes

S7b3: recognizes the basic relationship between atmosphere and Earth's weather and climate

S7b4: explains how radiant energy from the Sun drives global patterns of atmospheric circulation

S7b5: illustrates the action of convection currents in the movement of fluid and air masses and in the transfer of heat energy in the atmosphere and oceans

Standard: S7c: Evaluates the impact of changes in the atmosphere and hydrosphere on weather, climate, and landforms

Components:

S7c1: distinguishes between weather and climate

S7c2: demonstrates how global temperature changes in the atmosphere and oceans influence local, regional and global weather

S7c3: gives examples of how abrupt geologic changes (such as volcanic eruptions) or long term temperature changes have led to climate and landform changes in the past

S7c4: predicts how long term changes in atmospheric and ocean temperatures can influence global climate and landform changes in the future

Standard: S7d: Compares and contrasts characteristics of the Sun and Milky Way to those of other stars and galaxies in the universe

Components:

S7d1: recognizes that the Sun is an average star located near the edge of a galaxy composed of billions of stars

S7d2; identifies our milky way galaxy as one of billions of galaxies in the universe

S7d3: classifies stars and galaxies by their major characteristics

S7d4: compares our Sun to other stars (i.e., size, distance, color)

S7d5: recognizes that light emitted from stars and galaxies travels over great distances to reach us and takes a very long time, which explains why the stars and galaxies that we see are as they were in the distant past

S7d6: observes, records, describes and explains the apparent circumpolar motion of stars and constellations daily and seasonally

Science Process Standards
Grades 9-12

S1 Scientific Inquiry: The student demonstrates abilities necessary to do scientific inquiry and an understanding about scientific inquiry; that is, the student:

S1a: constructs questions that initiate and guide scientific investigations

S1b: designs and conducts scientific investigations using established procedures that are safe, humane, and ethical

S1c: uses technology and mathematics to systematically gather, record, analyze, explain, and interpret data

S1d: formulates and revises scientific conclusions, explanations and models (physical, conceptual, mathematical) based on scientific knowledge, logic, and evidence

S1e: recognizes, analyzes and evaluates alternative explanations and models

S1f: evaluates and defends scientific arguments, acknowledging references and contributions of others

S1g: communicates the scientific inquiry process using appropriate scientific language and mathematics

S2 History and Nature of Science: The student demonstrates an understanding of science as a human endeavor, and the history and nature of science; that is, the student:

S2a: describes how the work of scientists is influenced by their ethical standards and by societal, cultural, and personal beliefs, and how scientists use the habits of mind (such as: reasoning, insight, creativity, intellectual honesty, tolerance for ambiguity and openness to new ideas) in their work

S2b: compares and contrasts the difference between science and other ways of knowing through use of empirical standards, logical arguments, and skepticism

S2c: assesses the work of scientists showing that all scientific ideas depend on experimental and observational confirmation and are subject to change as new evidence becomes available

S2d: describes the contributions of diverse cultures to scientific knowledge

S2e: describes the changes to scientific thinking that evolve over time, building upon earlier knowledge

S3 Personal & Social Perspectives: The student demonstrates an understanding of safety and risks and benefits associated with natural and personal hazards; that is, the student:

S3a: employs the tenets of personal and community health, safety and resource conservation in all investigations and other class-related activities

S3b: identifies, accesses and uses data to construct explanations about the characteristics, rates, and sources of changes in populations, natural resources, and environmental quality

S3c: assesses potential danger and risk of natural and human-induced hazards

S3d: analyzes the relationships among technological, social, political, and economic changes and the impact on humans and the environment

S4 Science and Technology: The student demonstrates an understanding about science and technology, and the nature of technological design; that is, the student:

S4a: uses technology to perform scientific investigations to secure valid and reliable results

S4b: identifies and/or constructs a problem or need in relation to technological designs; proposes new designs and chooses between alternative solutions

S4c: constructs understandings about the fields of science and engineering, the interrelationships between science and technology, and explains their contribution to society

S4d: analyzes innovations in science and technology with respect to alternatives, risks, costs and benefits to society and the environment

Physics
Grades 9-12

Strands:

S5 Physics: The student demonstrates a conceptual understanding of the organization and interaction of matter and energy, and motion and forces; that is, the student:

Standard: S5a: Communicates an understanding of atomic and subatomic structure, addressing parts and properties of the atom, nuclear forces, radioactivity, and nuclear reactions

Components:

S5a1 Describes matter as being made of minute particles called atoms, and the atoms as composed of even smaller components (e.g., quarks, mesons)

S5a2 Explains that the electric force between the nucleus and electrons holds the atom together

S5a3 Explains how neutrons affect the mass and stability of the nucleus, while having little effect on how an atom interacts with others

S5a4 Describes the process of radioactive decay as the spontaneous breakdown of unstable elements (i.e., radioactive isotopes) into new elements (radioactive or not) through the spontaneous emission by the nucleus of alpha or beta particles and/or wave-like radiation

S5a5 Calculates the estimated age of material using the predictability of the decay of a large number of the nuclei of radioactive isotopes can be used to estimate the age of materials

S5a6 Distinguishes nuclear reactions from chemical reactions in relation to the energy involved, and the conversion of a fraction of the mass into energy

S5a7 Describes and distinguishes among alphas, beta, and gamma particles, and properties of alpha, beta, and gamma radiation in relation to their penetrating power

S5a8 Distinguishes fission from fusion

S5a9 Recognizes that reactions of nuclear material, for example fission and fusion, convert a fraction of the mass of interacting particles into energy

S5a10 Contrasts the nuclear forces that hold the nucleus of an atom together (e.g., usually stronger) to the electric forces that would make it fly apart

Physics Applications

Components:

S5a11 Describes matter as being made of minute particles called atoms, and the atoms as composed of even smaller components (e.g., electrons, protons, neutrons, as well as quarks, mesons)

S5a12 Explains that the electric force between the nucleus and electrons holds the atom together and is responsible for the formation of molecules

S5a13 Describes the process of radioactive decay as the spontaneous breakdown of unstable elements (i.e., radioactive isotopes) into new elements (radioactive or not) through the spontaneous emission by the nucleus of alpha or beta particles and/or wave-like radiation and the impact of radioactive materials found in building materials (e.g., radon gas)

S5a14 Distinguishes fission from fusion

S5a15 Contrasts the nuclear forces that hold the nucleus of an atom together (e.g., usually stronger) to the electric forces that would make it fly apart

Physics

Standard: S5b: Analyzes and explains the relationship between structure and properties of matter in its different energy states [Solid, Liquid, Gas, and Plasma] and uses those relationships to predict physical changes in matter under the influence of various forces and energy change

Components:

S5b1 Compares and contrasts the physical states of matter based upon their properties and energy state

S5b2 Connects the behaviors of substances under compression or tension with the physical properties of solids and fluids (e.g., compressibility, elasticity, internal pressure, and fluid velocity)

S5b3 Analyzes physical phenomena that are uniquely demonstrated by solids and fluids in a gravitational field (i.e., pressure, buoyancy in a liquid, floating in a gas)

S5b4 Contrast the relationships among linear growth, surface area growth, and volumetric growth

S5b5 Gives examples and practical applications of thermal expansion and contraction of solids and fluids

S5b6 Infers the behavior of fluids in response to variable pressure, volume, and temperature as defined by the relationships known as gas laws

S5b7 Evaluates the effects of the local environment (e.g., vapor pressure, dissolved solids and gases) on the temperature at which phase change occurs

S5b8 Differentiates phase changes in terms of the effect of energy on particle motion and the direction of energy flow (e.g., boiling/condensation, melting/freezing)

Physics Applications

Components:

S5b9 Investigates stress and strain in static materials subject to compression or tension

S5b10 Compares and contrasts the physical states of matter based upon their properties and energy state

S5b11 Analyzes physical phenomena that are uniquely demonstrated by solids and fluids in a gravitational field (I.e., pressure, buoyancy in a liquid, floating in a gas)

S5b12 Contrast the relationships among linear growth, surface area growth, and volumetric growth as it relates to changing the sizes and strengths of structures

S5b13 Gives examples and practical applications of thermal expansion and contraction of solids and fluids

P**hysics**

Standard: S5c Articulates and demonstrates the principles of motions and forces and applies them to examples of interactions between objects

Components:

S5c1 Assesses and interprets an object's motion by measurements of position, velocity, and acceleration relative to a specific point in space

S5c2 Explains that the fundamental difference between objects whose motion is changing and those whose motion is remaining the same is that objects in motion are under the influence of an applied, unbalanced net force

S5c3 Analyzes the effects of forces on the motion of objects by referencing Newton's three Law's of Motion (i.e., Law of Conservation of Momentum, Law of Conservation of Energy, and Law of Universal Gravitation)

S5c4 Analyzes the magnitude of the change in motion using the relationship F = ma, which is independent of the nature of the force

S5c5 Evaluates collisions and interactions between objects using laws of motion and conservation

S5c6 Describes the magnitude of the force that is exerted in the opposite direction whenever one object exerts a force on another

S5c7 Predicts the conditions required as well as the resulting motion produced, when all the forces and torques acting on a body balance one another such that a state of static and rotational equilibrium exists

S5c8 Analyzes the effect of unbalanced force acting on the linear and rotary motion of an object and the quantities involved (e.g., momentum, inertia, force, velocity, acceleration, speed, rotational speed, tangential speed)

S5c9 Provides varied examples that show any mass will exert on any other mass the universal force known as Gravitation

S5c10 Evaluates and predicts the motion of a projectile moving through a force field (gravity, electrical, magnetic)

S5c11 Analyses the approximate strength of the gravitational attractive force between two masses, by considering that force is proportional to the masses and inversely proportional to the square of the distance between them

S5c12 Analyses the approximate strength and direction of the universal electric force between two charged objects by considering that force is proportional to the magnitude of charge and inversely proportional to the square of the distance between their centers

S5c13 Describes the universal electric force that exists between any two charged objects, wherein: opposite charges attract while like charges repel, and the strength of the force is proportional to the charges and, as with gravitation, inversely proportional to the square of the distance between them

S5c14 Differentiates between the relative strength of the electric force between any two charged particles (vastly greater) and the universal gravitational force between the particles

S5c15 Explains observable forces (e.g., those exerted by a coiled spring or by friction) in terms of the electric forces acting between atoms and molecules

S5c16 Describes electricity and magnetism as two aspects of a single electromagnetic force since moving or changing electric charges produce magnetic forces and moving or changing magnetic fields produce electric forces

S5c17 Categorizes and rates the relative strengths and range of fundamental forces (gravitational, electromagnetic, strong and weak nuclear forces)

Physics Applications

Components:

S5c18 Explains that the fundamental difference between objects whose motion is changing and those whose motion is remaining the same is that objects in motion are under the influence of an applied, unbalanced net force

S5c19 Analyzes the effects of forces on the motion of objects by referencing Newton's three Law's of Motion (i.e., Law of Conservation of Momentum, Law of Conservation of Energy, Law of Universal Gravitation)

S5c20 Analyzes the magnitude of the change in motion using the relationship F = ma, which is independent of the nature of the force

S5c21 Describes the magnitude of the force that is exerted in the opposite direction whenever one object exerts a force on another

S5c22 Provides varied examples that show any mass will exert on any other mass the universal force known as Gravitation

S5c23 Analyses the approximate strength of the gravitational attractive force between two masses, by considering that force is proportional to the masses and inversely proportional to the square of the distance between them

S5c24 Analyses the approximate strength and direction of the universal electric force between two charged objects by considering that force is proportional to the magnitude of charge and inversely proportional to the square of the distance between their centers

S5c25 Describes the universal electric force that exists between any two charged objects, wherein: opposite charges attract while like charges repel, and the strength of the force is proportional to the charges and, as with gravitation, inversely proportional to the square of the distance between them

S5c26 Differentiates between the relative strength of the electric force between any two charged particles (vastly greater) and the universal gravitational force between the particles

S5c27 Explains observable forces (e.g., those exerted by a coiled spring or by friction) in terms of the electric forces acting between atoms and molecules

S5c28 Describes electricity and magnetism as two aspects of a single electromagnetic force since moving or changing electric charges produce magnetic forces and moving or changing magnetic fields produce electric forces

Physics

Standard: S5d: Analyzes the distinctions among thermal, potential, and kinetic energy and explains conservation of energy

Components:

S5d1 Interprets and provides examples of how energy can be converted from gravitational potential energy to kinetic energy and vice versa in projectiles, falling objects, and athletics

S5d2 Provides evidence that energy can be transferred for example by collision, but can never be destroyed

S5d3 Explains why energy is transferred by collisions, reactions, or radiation (i.e., waves), the matter and energy involved will become steadily less ordered (i.e., entropy)

S5d4 Classifies examples of energy as kinetic, potential and/or energy stored in a field (e.g., electromagnetic waves)

S5d5 Differentiates the states of matter based upon their energy state (e.g., the structure of molecules and atoms in these different states varies from rigid in solids to independent motion in a gas)

S5d6 Explains thermal energy (i.e., heat) in terms of atomic and molecular motion (i.e., the higher the temperature, the greater is the atomic or molecular motion)

S5d7 Justifies that heat is often produced as a byproduct when one form of energy is converted to another form

S5d8 Distinguishes heat (i.e., energy being transferred from one body to another by virtue of a difference in temperature) from internal energy (i.e., the total potential and kinetic energy contained within a body)

S5d9 Provides examples of the transfer of energy from hotter to cooler objects by conduction, radiation, or convection; and the warming of our surroundings when we burn fuels)

S5d10 Explains the relationships among temperature changes in a substance, the amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance

Physics Applications

Components:

S5d11 Differentiates the states of matter based upon their energy state (e.g., the structure of molecules and atoms in these different states varies from rigid in solids to independent motion in a gas)

S5d12 Explains thermal energy (i.e., heat) in terms of atomic and molecular motion (i.e., the higher the temperature, the greater is the atomic or molecular motion) and performs measurements of temperature

S5d13 Distinguishes heat (i.e., energy being transferred from one body to another by virtue of a difference in temperature) from internal energy (i.e., the total potential and kinetic energy contained within a body)

S5d14 Provides examples of the transfer of energy from hotter to cooler objects by conduction, radiation, or convection; and the warming of our surroundings when we burn fuels as a consideration in energy conservation

S5d15 Uses the relationships among temperature changes in a substance, the amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance to determine the flow of energy through the walls of a closed structure

S5d16 Provides evidence that energy can be transferred by collisions, reactions, or radiation (i.e., waves), the matter and energy involved will become steadily less ordered (i.e., entropy)

S5d17 Classifies examples of energy as kinetic~~,~~ potential and/or energy stored in a field (e.g., electromagnetic waves)

Physics

Standard: S5e: Uses knowledge of waves and wave properties (including light, sound, transverse, longitudinal and electromagnetic waves) to analyze the transfer of energy as vibrations

Components:

S5e1 Explains that energy is a property of many substances and materials (e.g., the disorderly motion of molecules; the arrangement of bonds between atoms; elastically distorted shapes; and energy in the attraction or repulsion between charges and magnetic poles)

S5e2 Recognizes that waves, including sound, seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter

S5e3 Compares and contrasts the properties and behaviors of mechanical (sounds, earthquake) and electromagnetic waves

S5e4 Compares the characteristics of vibrations (period, amplitude, resonance) and their relationship to simple harmonic motion

S5e5 Distinguishes between transverse and longitudinal waves and provides examples of each

S5e6 Compares, in different materials, the velocity and wavelengths of wave-like disturbances that spread away from a source of vibrations (e.g., sounds, earthquakes, light)

S5e7 Diagrams the process of eave interference and provides examples of its manifestation (e.g., vibration in a string, locations of loud and soft sound in a room, bright and dark interference fringes of light, Young's interference experiment, monochromatic light reflected from a thin material, colors shining from soap bubbles, and gasoline slicks on a wet surface)

S5e8 Generates and attributes the generation of electromagnetic waves to the acceleration or deceleration of a charged object

S5e9 Categorizes electromagnetic waves by both wavelength and frequency in a continuum spectrum

S5e10 Organizes electromagnetic waves by both wavelength and frequency in a continuum spectrum

S5e11 Justifies that only a narrow range of wavelengths of electromagnetic radiation can be seen by the human eye, and that differences of wavelength within that range of visible light are perceived as difference in color

S5e12 Supports with historical references significant experimental evidence for the fundamental components of quantum theory and mechanics, i.e., 1) each kind of atom or molecule can gain or lose energy only in discrete packets whose magnitudes are inversely proportional to their wavelengths; and 2) these atoms and molecules can absorb and emit light only at wavelengths corresponding to these

packets and those wavelengths can be used to identify a specific substance

S5e13 Presents evidence for the dual nature of light (wave-particle duality) as well as the wave properties of matter and the wave nature of electrons

Physics Applications

Components:

S5e14 Recognizes that waves, including sound, seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter

S5e15 Generates and attributes the generation of electromagnetic waves to the acceleration or deceleration of a charged object

S5e16 Categorizes electromagnetic waves by both wavelength and frequency in a continuum spectrum

Physics

Standard: S5f: Will articulate and use an understanding of electrical and magnetic fields to describe the requirements for the transfer and storage of energy in electrical and magnetic “circuits”

Components:

S5f1 Describes the kinds of electric charge and the properties of charged objects (e.g., electric charge is always conserved; and the fundamental unit of charge, e, is the charge of a single electron or proton)

S5f2 Describes the features of an electric circuit represented by current, voltage, resistance, and the connection between them

S5f3 Illustrates how electric energy can be stored, transferred, and transformed into other energy forms

S5f4 Distinguishes among semiconductors, conductors, and insulators, in terms of the flow of charge and the materials involved and the temperature of that material

Physics Applications

Components:

S5f5 Describes the kinds of electric charge and the properties of charged objects (e.g., electric charge is always conserved; and the

fundamental unit of charge, e, is the charge of a single electron or proton)

S5f6 Describes the features of an electric circuit represented by current, voltage, resistance, and the connection between them

S5f7 Distinguishes among semiconductors, conductors, and insulators, in terms of the flow of charge and the materials involved and the temperature of that material

Biology
Marine Biology, Anatomy & Physiology and Environmetal Science
Grades 9-12

Strand:

S6 Biology The student demonstrates a conceptual understanding of the organization of life on Earth; that is, the student:

Standard: S6a: Describes, analyzes and compares structure, function, and organization of various cells

Biology

Components:

S6a1 Analyzes cell differentiation and explains that complex multicellular organisms are formed as a highly organized arrangement of differentiated cells

S6a2 Explains how individual cells differentiate functions despite having the same genetic materials

S6a3 Describes the variety of biomolecules in cells and how they join together to form specialized structures

S6a4 Identifies cell structures and explains how they work together to carry out the functions of the cell (i.e., energy production/transfer, transport, information feedback, waste disposal, storage of genetic material, and synthesis of new molecules)

S6a5 Investigates and illustrates the lipid and protein structure of the cell membrane

S6a6 Relates the structure of the cell membrane to its diffusion and transport mechanisms (e.g., models how the membrane structure regulates the movement of materials across the membrane)

S6a7 Explains that cells carry out specialized functions as the result of the differential expression of the information in their DNA

S6a8 Investigates and describes the effect of temperature and acidity on a cell's functioning

S6a9 Describes the process of cell division (i.e., mitosis) and explains its role in the characteristics of life (i.e., growth, replication, cancer, repair and maintenance)

Anatomy & Physiology

Components:

S6a10 Describes how cells differentiate functions and the importance of this process to multi-cellular organisms

S6a11 Investigates and describes how cells communicate in order to coordinate body functions

S6a12 Illustrates and explains how the circulatory system transports nutrients, oxygen, carbon dioxide, cell wastes, and hormones to and from cells throughout the body

S6a13 Compares and contrasts the structure and function of the components of whole blood

S6a14 Classifies types of white blood cells and the role-played by each in the immune response

S6a15 Describes the reactions of antibodies in the body and how they are produced

S6a16 Determines through investigations the activity of muscle cells in response to a stimulus

S6a17 Illustrates and describes the mechanisms by which bones produce red and white blood cells

Biology

Standard: S6b: Analyzes and communicates an understanding of the biochemistry of life including organic compounds, enzymes, cellular respiration and photosynthesis

Components:

S6b1 Compares and contrasts the molecular structure and functions of biomolecules (i.e., carbohydrates, lipids, proteins, and nucleic acids)

S6b2 Explains the chemical reactions underlying cell functions

S6b3 Summarizes the characteristics of organic compounds and their importance in organisms by analyzing the chemical composition of biomolecules

S6b4 Analyzes how cell structures play a role in metabolic processes

S6b5 Explains how the processes of life depend on metabolism

S6b6 Traces the flow of molecules and energy from nutrients through the stages of metabolism (i.e., the chemical transformations by which cells break down biomolecules to extract energy and building blocks and create new biomolecules)

S6b7 Analyzes the chemical transformations and transfers of energy that occur during the processes of cellular respiration and describes the temporary storing of energy in the phosphate bonds of ATP

S6b8 Explains that matter tends toward more disorganized states to the need for continuous input of energy to maintain the chemical and physical organization of living systems

S6b9 Identifies and describes the properties and functions of enzymes in metabolism (i.e., in catalyzing biochemical reactions through metabolic pathways)

S6b10 Explains the chemical reactions, recycling of matter and transfers of energy that occur during photosynthesis

S6b11 Analyzes the complementary nature of the processes of photosynthesis and cellular respiration

S6b12 Identifies the importance of proteins in carrying out the work of the cell and their characteristics that are essential to life

S6b13 Describes the interactions among different molecules within the cell and defines their role in activities such as growth and division

S6b14 Describes that the diversity of life results from six elements and four types of biomolecules (i.e., carbohydrates, lipids, proteins, and nucleic acids)

S6b15 Models and explains how DNA is made up of pairs of complementary nucleotides (i.e., A, G, C, and T) in a double-helix structure

S6b16 Differentiates between DNA and RNA and types of RNA

S6b17 Describes the major steps in the process of photosynthesis and its importance to life on Earth

S6b18 Explains the transfers of energy that occur during photosynthesis

Anatomy & Physiology

Components:

S6b19 Explains how molecules make up cells, which, in turn, make up tissues and organs

S6b20 Relates the molecular structure of biomolecules to their functions within body systems

S6b21 Explains the gas exchange processes carried out by the respiratory system

S6b22 Differentiates between breathing, external respiration, internal respiration, and cellular respiration

S6b23 Compares and contrasts the microscopic structure, organization, function, and molecular basis of contraction in skeletal, smooth, and cardiac muscle

S6b24 Describes the mechanisms by which muscles obtain and use energy to power contractions

S6b25 Relates the chemical structure of bone to its development, repair, and growth

S6b26 Traces the flow of molecules and energy from nutrients through the biochemical processes involved in metabolism (i.e., catabolism and anabolism)

S6b27 Determines through investigations the role of enzymes in metabolism

S6b28 Describes the pH scale and the role of buffers in body fluids

Biology

Standard: S6c: Describes the behavior of organisms and hypothesizes the relationship to nervous and endocrine systems and various external stimuli

Components:

S6c1 Investigates and describes the role of hormones in regulating growth and sexual development

S6c2 Describes the role of the nervous and endocrine systems in coordinating the activity of the body's cells and in achieving homeostasis

S6c3 Illustrates how nerve cells communicate with each other, transmitting information from the internal and external environment to generate physiological or behavioral responses

S6c4 Differentiates between innate and learned behaviors and speculates about the relationship between genetics and environment in influencing behavior

Marine Biology

Components:

S6c5 Provides examples of organisms using sense organs to monitor their environment and react to stimuli in ways that maximize their fitness

S6c6 Compares and contrasts the ways motile and non-motile organisms respond to external stimuli

S6c7 Compares and contrasts innate and learned responses to stimuli (e.g., prey choice, predator avoidance and deterrence, social behavior)

Anatomy & Physiology

Components:

S6c8 Identifies the interrelationships among the nervous system and other organ systems

S6c9 Describes the role of the nervous and endocrine systems in achieving homeostasis

S6c10 Identifies the functional relationships between the endocrine system and other body systems

S6c11 Analyzes and describes the relationship between the endocrine and reproductive systems

S6c12 Identifies nerve cells as the cellular units of the nervous system and explains their function in the rapid transmission of information

S6c13 Determines through investigations how stimulus information is signaled to the brain

S6c14 Analyzes how rapid electrochemical signals transport from one neuron to the next

S6c15 Illustrates and explains the structure and function of excitatory and inhibitory neurotransmitters in a synapse

S6c16 Compares the major chemical classes of hormones and relates them to their functions

S6c17 Analyzes how endocrine glands are stimulated to release hormones

S6c18 Relates the functions of hormones to processes such as growth and development, metabolism, reproduction, and body defense

Biology

Standard: S6d: Elaborates on the principles of genetics and explains the role of DNA, genes, chromosomes, and mutation in reproduction and heredity

Components:

S6d1 Compares and contrasts the processes of mitosis and meiosis (i.e., that sex cells created through meiosis contain half the number of chromosomes of body cells)

S6d2 Examines and describes how meiosis results in haploid sex cells

S6d3 Explains how fertilization restores the original chromosome number (i.e., two haploid sex cells fuse together to create a new diploid cell)

S6d4 Explains the relationships between sexual reproduction, meiosis, genetic variation, and evolution

S6d5 Examines and describes the process of fertilization (i.e., a haploid egg and sperm cell fuse together, creating a diploid cell with two copies of each gene, one from each parent) and the stages of embryo formation and development

S6d6 Identifies the role of DNA in determining the fate of a cell during the formation and development of an embryo

S6d7 Investigates and describes how DNA acts as the blueprint that directs the processes of life

S6d8 Explains the function of DNA in encoding the complex information needed to direct the synthesis of proteins

S6d9 Explains the relationship among DNA, genes, chromosomes, proteins, and traits (i.e., that genes are a portion of DNA, contained on chromosomes, which contain the genetic information, as a string of molecular “letters,” to code for a specific sequence of amino acids which comprise a protein, which in turn, is responsible for a specific trait)

S6d10 Explains that cell functions are regulated by selective expression of specific genes

S6d11 Describes the structure of chromosomes and relates it to their functions

S6d12 Illustrates and explains the chromosome replication process

S6d13 Applies the principles of Mendelian genetics (i.e, dominance and recessiveness, segregation, independent assortment) to predict the outcome of genetic crosses

S6d14 Uses genetic tools, (i.e., Punnett squares and pedigrees) to predict traits of offspring

S6d15 Examines and explains more complex patterns of heredity which cannot be explained using Mendel's findings (e.g., incomplete dominance, codominance, multiple alleles, and polygenic traits)

S6d16 Analyzes the statistical effects of recombination on the variety of gene combinations in offspring

S6d17 Analyzes how mutations in the DNA sequence of a gene may or may not affect the expression of the gene (i.e., that the type of cell in which a mutation occurs determines heritability of the mutation)

S6d18 Describes that mutations may be harmful, beneficial, or have no impact on the survival of the organism

S6d19 Relates random mutation (i.e., changes in DNA) and recombination within gametes to the heritable variations that give individuals within a species survival and reproductive advantage or disadvantage over others in the species

S6d20 Examines and explains the effect of mutation on the genetic variation of a population

Anatomy & Physiology

Components:

S6d21 Explains how meiosis results in haploid gametes and increases genetic variation within a population

S6d22 Compares and contrasts the processes that form sperm and egg cells (i.e., spermatogenesis and oogenesis)

S6d23 Summarizes the process of fertilization in terms of the number of chromosomes in each sex cell and the resulting zygotic cell

S6d24 Explains the importance of cell-to-cell communication and the role of DNA in determining the fate of a cell during the formation and development of an embryo

Biology

Standard: S6e: Relates the theory of biological evolution to geologic time and addresses speciation, biodiversity, natural selection, and biological classification

Components:

S6e1 Classifies organisms into groups and subgroups based on similarities that reflect their evolutionary relationships or degree of kinship estimated from the similarity of DNA sequences

S6e2 Explains the relationship between the variation of organisms within a species and the increased likelihood that at least some members of the species will survive under changed environmental conditions

S6e3 Relates the diversity of species to the increased chance that at least some living things will survive in the face of large changes in the environment

S6e4 Provides evidence that natural selection can explain both the unity and diversity of life

S6e5 Examines and describes the role of evolution over the past 4 billion years in creating the great diversity of organisms and filling every available ecological niche with life forms

S6e6 Identifies how adaptations arise through mutations and create variation in the gene pool

S6e7 Describes Darwin's theory and how the principles of natural selection can lead to speciation

S6e8 Analyzes the factors, which contribute to species evolution (i.e., the potential for a species to increase its population; the genetic variability of offspring due to mutation and recombination of genes; a finite supply of the resources required for life; and the ensuing selection by the environment of those offspring better able to survive and reproduce)

S6e9 Explains that evolution involves changes in the genetic make-up of whole populations over time, not changes in the genes of an individual organism

S6e10 Investigates and explains how natural selection acts as the mechanism for evolution and can lead to speciation

S6e11 Relates the variation of organisms within a species and the increased likelihood that at least some members of the species will survive under changed environmental conditions

S6e12 Describes how natural selection provides a scientific explanation for the fossil record of ancient life forms and the molecular and anatomical similarities observed within the diversity of existing organisms

S6e13 Describes the relationships between changes in the genetic makeup of populations and the processes of natural selection, speciation, extinction and species diversity

S6e14 Describes how all of the species that exist today are related by descent from common ancestors

S6e15 Provides evidence for common ancestry based on the universal nature of the biomolecules and the metabolic processes found in all organisms

S6e16 Explains how behaviors have evolved through natural selection and often have an adaptive logic when viewed in terms of evolutionary principles

Marine Biology

Components:

S6e17 Describes the scope of biological diversity in the marine environment and relationships among major groups of marine organisms

S6e18 Compares and contrasts early and late successional species

S6e19 Explains the relationship between organisms living in unpredictable environments and the evolution of characteristics that are flexible enough to accommodate uncertainty and change

S6e20 Distinguishes adaptation from acclimation

S6e21 Analyzes the costs and benefits, under different environmental conditions, of characteristics that can be observed at the whole-organism level (i.e., structure, chemistry, behavior)

S6e22 Explains why organisms in similar environments converge in form and function

S6e23 Analyzes life history patterns (e.g., lifespan, age of reproduction, iteroparous vs. semelparous reproduction) in terms of trade-offs in the allocation of limited resources, in a way that optimizes the fitness of the organism

S6e24 Analyzes dispersal (e.g., migration, larval transport) in terms of risks (e.g., extinction), rewards (e.g., escaping predators and parasites), and the unpredictability of many environments

S6e25 Explains why, although diversity has traditionally been defined at the species level, distinctions that are broader (e.g., community, ecosystem) and narrower (e.g., within-species) may be necessary for some conservation-related purposes

S6e26 Summarizes that molecular evidence is generally substantiating the anatomical evidence for evolution, but sometimes altering dramatically the sequence in which various lines of descent are thought to have branched off from one another

S6e27 Explains why evolution does not necessitate long-term progress in some set direction, or necessarily create traits that are beneficial to the species in the long term (e.g., explaining that the survival value of inherited characteristics may change when the environment changes)

S6e28 Explains that some traits that reduce an individual's chance of survival spread through and are maintained in a population because of advantages those traits confer in reproductive success

S6e29 Recognizes that some heritable characteristics can persist in a population due to chance alone

S6e30 Recognizes that populations of species evolve at different rates and may or may not keep up with rates of environmental change

Environmental Science

Components:

S6e31 Describes the ways in which biodiversity is important to ecosystems and humans

S6e32 Explains how organisms are adapted to the environment in terms of ecological niches and natural selection

S6e33 Relates the importance of genetic diversity and population size to the conservation of a species

S6e34 Investigates and explains how natural selection acts as the mechanism for evolution and can lead to speciation

S6e35 Provides evidence that natural selection can explain both the unity and diversity of life

Biology

Standard: 6f: Analyzes ecology as interrelationships of biotic and abiotic factors and explains the transfer of matter and energy within ecosystems

Components:

S6f1 Describes the scope of biological diversity and relationships among major groups of organisms

S6f2 Explains the effect of evolutionary forces on the diversity of ecosystems and the species within them

S6f3 Explains how interspecific population interactions and resource use affects population size

S6f4 Predicts the impact of changes in an ecosystem to its equilibrium

S6f5 Identifies effects of human activities (e.g, habitat destruction, pollution, technology, and urbanization) on populations and ecosystems

S6f6 Describes the effects of natural disasters, disease, population increase, and depletion of food on populations

S6f7 Explains that the distribution and abundance of organisms and populations in ecosystems is limited by the availability of matter and energy and the ecosystem's ability to recycle them

S6f8 Traces the flow of matter and energy between living systems and the physical environment and analyzes how chemical elements are recombined in different ways

S6f9 Analyzes how organisms in food webs recycle nutrients and serve as a source of energy for populations within an ecosystem

S6f10 Investigates and explains the diminishing amount of energy (e.g, loss by heat) available in each succeeding trophic level

S6f11 Relates death and decomposers to the recycling of organic materials in nature and the transfer of matter and energy in ecosystems

S6e12 Examines and analyzes the interactions among organisms and their environments

S6f13 Analyzes the factors which limit the distribution and abundance of organisms in ecosystems (e.g., predators, disease, parasites, resources, and competition)

S6f14 Analyzes the population size that an ecosystem can sustain

S6f15 Explains how the interrelationships and interdependencies of organisms may generate ecosystems that are stable for hundreds or thousands of years

Marine Biology

Components:

S6f16 Provides examples of how human activities can alter marine ecosystems in ways hat affect humans (e g., by introducing new species, adding nutrients to coastal waters, over-harvesting food species)

S6f17 Explains why ecosystems tend to recover from a disturbance in stages that eventually result in a system similar to the original one (e.g., by referring to larval supply, life-history characteristics of organisms, and positive and negative interactions between organisms)

S6f18 Explains why distinct communities can persist in very similar environments (e.g., by referring to succession, trophic cascades, and alternative stable states)

S6f19 Explains that organisms may be well suited for environments other than those in which they are found, provides examples of interactions between organisms that can be either positive or negative depending on the environmental circumstances

S6f20 Hypothesizes about how marine ecosystems may change due to climate changes and due to the appearance of one or more new species as a result of migration or transport by humans

S6f21 Explains why small populations are at increased risk of extinction

S6f22 Hypothesizes about the likelihood that a given species will become extinct in a given period of time (e.g., based on population size, distribution, specialization, life history traits, and the amount of genetic and phenotypic variation within the species)

S6f23 Justifies recommendations for marine protected areas (e.g., based on source-sink dynamics, analysis of life history characteristics, and human use)

S6f24 Recognizes that the earth is primarily a closed system with respect to matter

S6f25 Recognizes that the earth is primarily a closed system with respect to matter

S6f26 Analyzes the factors that limit the amount of life a given environment can support (e.g., energy, oxygen, minerals, rate of nutrient cycling)

S6f27 Analyzes the ways in which the physical environment (e.g., currents, tides, waves, weather) influences the structure of marine communities

S6f28 Explains the effect of heterogeneity within a community and within the larger ecosystem on the abundance and diversity of life that can and does persist within those systems

S6f29 Compares and contrasts the environmental factors that hold in check different populations of organisms within a given community (e.g., referring to density-dependent vs. density-independent regulation; interactions between disturbance, predation, competition, and larval supply; and different forms of competition)

S6f30 Describes potential effects of size-selective predation on populations, community structure, and ecosystem function

S6f31 Models simple predator-prey and competitive interactions (e.g., using the Lotka-Volterra models)

S6f32 Provides examples of ecological factors that can allow greater diversity within a community (e.g., facilitation, microhabitats, keystone species, disturbance, prey-switching)

S6f33 Provides examples of factors that limit the distribution of organisms (e.g., larval transport, physiology, predators, food, enemy-free space)

S6f34Explains the role of foundation species in structuring communities

Environmental Science

Components:

S6f34 Analyzes the natural processes of change in the environment, including examples of succession, evolution, and extinction

S6f35 Analyzes the natural processes of change in the environment, including examples of succession, evolution, and extinction

S6f36 Analyzes the stability and sustainability of ecosystems as a result of changes in environmental conditions

S6f37 Identifies factors that lead to ecological succession, including invasive species, loss of biodiversity, change in abiotic conditions, and catastrophic events

S6f38 Evaluates the factors that determine the plant life that can exist in a given biome

S6f39 Identifies environmental issues in terms of interrelationships among natural systems in time and space

S6f40 Evaluates the factors that impact resource availability and explains why certain resources are becoming depleted

S6f41 Identifies the factors limiting population growth in a given area (carrying capacity)

S6f42 Predicts changes in population size in response to altered environmental conditions

S6f43 Gives examples that illustrate how a change in one part of a system can have an impact on other parts of the system

Anatomy & Physiology

Standard: S6g: Analyzes and explains the relationships between the structures, systems, molecular and cellular organization, and processes of multi-cellular organisms, especially humans

Components:

S6g1 Examines and classifies tissues and the various cells types found in them

S6g2 Connects the make-up and organization of tissue types and their functions

S6g3 Explains the significance of organisms' ability to regulate their internal environment to maintain a stable, constant condition (I e., homeostasis)

S6g4 Identifies how positive and negative feedback are involved in homeostatic regulation

S6g5 Investigates and describes how body systems interact to maintain homeostasis

S6g6 Determines through investigations how the integumentary system distinguishes, separates, protects and informs an organism with regard to its surroundings

S6g7 Explains the role of the integumentary system in regulating body temperature and water balance

S6g8 Describes how the skin responds to injury and repairs itself

S6g9 Examines and explains how the skeletal and muscular systems work with other systems to support the body and allow for movement

S6g10 Categorizes types of bone and their functions

S6g11 Compares and contrasts the major types of joints in terms of their mobility and the tissues that hold them together

S6g12 Relates the structures of the heart to its pumping function to propel blood through arteries, capillaries, and veins

S6g13 Investigates and illustrates the flow of blood through the circulatory system

S6g14 Connects the functions of the liver and the circulatory system

S6g15 Identifies the structures and functions of the lymphatic system and the interrelationships with other body systems

S6g16 Explains how the structures of the lymphatic system are functionally related to the circulatory and immune systems

S6g17 Describes the immune system and the strategies the body uses to protect itself from microscopic organisms, foreign substances, and cancer cells

S6g18 Analyzes the functions of blood in the immune system (ie., its role in essential protection to combat invading microorganisms, acute inflammation, and immune responses).

S6g19 Relates respiratory functions and the structural specializations of the tissues and organs in the system

S6g20 Identifies the interrelationships among the respiratory and circulatory systems

S6g21 Describes the mechanisms by which the digestive system provides cells in the body with macromolecules from food

S6g22 Explains why metabolic byproducts must be removed from the body by excretion and identifies the organs that are responsible for their excretion

S6g23 Identifies the interrelationships among the digestive system and other organ systems

S6g24 Relates the structures of the urinary system to their functions in removing nitrogenous wastes from the blood and producing, storing and eliminating urine

S6g25 Examines the distribution of water and electrolytes within the body and explains the kidney's role in balancing these levels

S6g26 Identifies the interrelationships among the urinary systems and other organ systems, particularly with regard to maintaining homeostasis in body fluids

S6g27 Identifies the interrelationships among the reproductive system and other organ systems

S6g28 Identifies effects of aging, their causes, and ways of reducing these effects

S6g29 Describes the hormonal mechanisms regulating male and female reproductive functions

S6g30 Identifies the stages of development of germ cell layers, the processes that occur in each stage, and the fate of each germ cell layer in humans

S6g31 Differentiates between a zygote, embryo, and fetus and describes the characteristics and events associated with each stage

S6g32 Characterizes the major stages of development after delivery

S6g33 Compares and contrasts patterns of human development to those of other vertebrates

S6g34 Describes how growth is regulated

Environmental Science

Standard: S6h: Identifies the effect of human activities on natural processes and interrelationships within ecosystems

Components:

S6h1 Describes how people impact their environment through the use of natural resources

S6h2 Identifies and assesses the effects of human resource use at various scales in terms of ecosystem functioning and human health

S6h3 Predicts how changes in the availability and use of natural resources will affect society and human activities

S6h4 Describes the ways in which the use of technology has an impact on the environment and the standard of living

S6h5 Assesses the environmental and societal costs and benefits of various common natural resource management strategies

S6h6 Identifies and describes the factors that have contributed to the growth of the human population and examine the impact this growth will have on the environment

Earth & Space Science
Grades 9-12

Strand:

S7 Earth & Space Sciences The student demonstrates a conceptual understanding of the organization of Earth and other celestial bodies; that is, the student:

Standard: S7a Categorizes the sources of internal energy in the Earth system, and presents evidence that this internal energy drives slow, but constant plate motion

Components:

S7a1 Describes the sources of Earth's internal heat energy (gravitational energy from the Earth's original formation and the decay of radioactive isotopes)

S7a2 Diagrams on a global scale how Earth's internal heat energy is released to the surface via convection, and relates convection currents in the mantle to plate tectonic motion

S7a3 Presents evidence (such as magnetic striping in ocean basins and the change in location of hot spot volcanoes) that plate movement is ongoing

Standard: S7b: Identifies the geologic activity (such as volcanoes and earthquakes) resulting from the release of Earth's internal energy

Components:

S7b1 Describes volcanoes as a mechanism for the release of Earth's internal heat, and describes the processes that result in volcanic activity at convergent and divergent boundaries, as well as hot spots in the middle of plates

S7b2 Explains the relationship between plate tectonics and the fault movements that cause earthquakes

Standard: S7c Identifies the Sun as the external source of energy to the Earth system, and describes the processes within Earth's atmosphere and hydrosphere that are driven by energy transfer from the Sun

Components:

S7c1 Describes how radiant energy from the Sun drives convection within the atmosphere and oceans, producing winds and ocean currents

S7c2 Diagrams the potential pathways of light energy that is transmitted to Earth from the Sun (e.g., reflected by atmosphere back into space, absorbed by atmosphere, reflected off of Earth's surface, absorbed into Earth's surface and reradiated as heat energy)

S7c3 Describes how the transfer of energy from the Sun is influenced by such factors as cloud cover, the albedo of Earth's surface, the composition of the atmosphere, Earth's rotation and revolution, and static conditions (e.g., the position of mountains ranges and oceans)

Standard: S7d Categorizes the sources and types of energy in the Earth system, identifying how the process of nuclear fusion in the Sun and other stars provides enormous amounts of energy over billions of years

Components:

S7d1 Describes how the Sun and other stars produce energy from nuclear reactions, primarily the fusion of hydrogen to form helium, and how these and other processes in stars have led to the formation of all the other elements

S7d2 Discusses the constant changes that occur in the Sun, and how solar activity (such as flares and sunspot cycles) can affect life on Earth

S7d3 Explains the Big Bang Theory, which states that the Universe began in a hot dense state and has been expanding ever since

Standard: S7e Compares and contrasts the composition of Earth materials and the processes within the geochemical cycle that govern their formation (including rocks, minerals, fossils, and other natural resources)

Components:

S7e1 Identifies common rocks and minerals that make up Earth's crust based on their chemical and physical properties

S7e2 Relates the formation of igneous, metamorphic and sedimentary rocks to plate tectonic processes driven by Earth's internal energy and surface geologic processes (such as erosion, transport and deposition) driven by external energy from the Sun

Standard: S7f Presents evidence that Earth is a system containing essentially a fixed amount of each stable chemical atom or element which moves among reservoirs in the solid Earth, oceans, atmosphere, and organisms as part of geochemical cycles

Components:

S7f1 Presents evidence that Earth is a system containing essentially a fixed amount of each stable chemical atom or element which moves among reservoirs in the solid Earth, oceans, atmosphere, and organisms as part of geochemical cycles

S7f2 Diagrams and explains multiple pathways of carbon movement between reservoirs (such as from geosphere to atmosphere via volcanic eruptions and fossil fuel combustion; from organisms to geosphere via fossil fuel formation; from organisms to atmosphere via respiration and decomposition, etc.)

Standard: S7g Investigates and displays the relationships among weather, climate, solar input, cloud cover, land features, atmosphere and oceans

Components:

S7g1 Names and illustrates factors influencing regional and global climate such as solar input, atmospheric circulation, ocean circulation, land features, and atmospheric composition that can change the dynamic equilibrium of Earth's atmosphere

S7g2 Gives examples to demonstrate how Earth's systems (such as the climate system) contain feedbacks that may oppose changes that occur (and lead to stability) or may encourage more change (and so drive the system toward one extreme or another)

S7g3 Presents how changes to complex patterns and interactions between cloud cover, land features, atmosphere and oceans can have far reaching consequences for the local weather and conditions for animals and plants, but also the climate on Earth as a whole

Standard: S7h Presents and critiques theories of the origin and evolution of the Solar System

Components:

S7h1 Describes the solar nebula condensation theory

S7h2 Recognizes patterns in the physical and chemical characteristics of objects in the Solar System, which provide evidence of Solar System origin (e.g., direction of rotation and revolution of the planets, compositional similarities and differences between planets, etc.)

S7h3 Describes how the known decay rates of radioactive isotopes are used to mathematically determine the absolute age of rocks of terrestrial and extraterrestrial origin, providing evidence of the age of the Solar System

S7h4 Discusses examples of technology and space explorations and how they contribute to new insights about the origin and evolution of the Solar System

Standard: S7i Presents and critiques theories of the origin and evolution of the Earth System

Components:

S7i1 Identifies how life on Earth is adapted to certain unique conditions, including the force of gravity that enables the planet to retain an adequate

atmosphere, and an intensity of radiation from the Sun that allows water to cycle between liquid and vapor

S7i2 Describes how the early Earth was very different from the planet we live on today, and gives examples of how interactions among the solid Earth, the oceans, the atmosphere, and organisms have resulted in the ongoing evolution of the Earth system

S7i3 Describes the atmosphere of early Earth, which contained no molecular oxygen, and relates the development of an oxygen-rich atmosphere to the evolution of photosynthetic plants more than 3 billion years ago (which removed CO2 from the early Earth atmosphere, using C to make sugars and release O2)

Standard: S7j Investigates the nature of stars, and the process of star formation, evolution and destruction

Components:

S7j1 Describes how billions of stars, in gravitationally-bound clusters called galaxies, form most of the visible mass of the Universe

S7j2 Describes evidence that although stars differ from each other in size, temperature, and age, they are made up of the same elements that are found on Earth and behave according to the same physical principals

S7j3 Recognizes that stars are not static objects but rather form, evolve, and eventually die over billions of years. This process of star formation and destruction has been ongoing since the Universe first formed 10 to 20 billion years ago

Chemistry
Grades 9-12

Strand:

S8 Chemistry: The student demonstrates a conceptual understanding of the organization and behavior of matter; that is, the student:

Standard: S8a: Communicates an understanding of atomic structure, addressing parts and properties of the atom

Components:

S8a1 Describes matter (e.g., chemical substances, common materials, living organisms) as being made of enormous numbers of minute particles called atoms (e.g., by referring to mixtures, pure substances, Avogadro's number, and the mole concept)

S8a2 Explains that each substance is characterized by a unique set of physical and chemical properties because it has a unique atomic composition and arrangement

S8a3 Analyzes the relationship between the measurable properties of atoms (e.g., mass, volume, charge) and the properties of the smaller components of which atoms are composed (i.e., protons and neutrons in the nucleus, electrons in the electron cloud)

S8a4 Illustrates the structure of the atom, including the charge, relative mass, relative volume, and position within the atom of the electrons (in the electron cloud), and the protons and neutrons (which compose the nucleus)

S8a5 Recognizes the relationship between the charges on the nucleus and electrons, and the electric force that holds the atom together

S8a6 Compares and contrasts isotopes of the same element (e.g., based on number of protons, neutrons, and electrons; atomic mass; electric charge; stability of the nucleus)

S8a7 Analyzes the relationship between the measurable properties of atoms (e.g., mass, volume, charge) and the properties of the smaller components of which atoms are composed (i.e., protons and neutrons in the nucleus, electrons in the electron cloud)

S8a8 Compares and contrasts isotopes of the same element (e.g., based on number of protons, neutrons, and electrons; atomic mass; electric charge; stability of the nucleus)

S8a9 Describes matter as being made of enormous numbers of minute particles called atoms (e.g., by referring to mixtures, pure substances, Avogadro's number, and the mole concept)

S8a10 Illustrates the structure of the atom, including the charge, relative mass, relative volume, and position within the atom of the electrons (in the electron cloud), and the protons and neutrons (which compose the nucleus)

S8a11 Recognizes the relationship between the charges on the nucleus and electrons, and the electric force that holds the atom together

Chemistry

Standard: S8b: Analyzes and demonstrates the relationship between the structure and the properties of matter, focusing on chemical properties of elements and their placement in the Periodic Table

Components:

S8b1 Distinguishes elements (i.e., substances composed of a single kind of atom) from compounds (i.e., substances composed of two or more kinds of atoms bonded together chemically)

S8b2 Predicts the placement of elements on the Periodic Table given physical and chemical properties, and vice versa (e.g., by referring to the atomic number, classes of elements, and repeating patterns of physical and chemical properties that identify families of elements with similar properties)

S8b3 Identifies, and explains the relationships between, trends in the properties of atoms on the Periodic Table (e.g., atomic number, number of valence electrons, ionization energy, electronegativity, relative sizes of atoms and ions)

S8b4 Analyzes the relationship between the chemical properties of an element, and the tendency of atoms of that element to interact with other atoms by transferring or sharing electrons that are furthest from the nucleus (e.g., using the octet rule and differences in electronegativity)

Chemistry Applications

Components:

S8b5 Predicts the placement of elements on the Periodic Table given physical and chemical properties, and vice versa (e.g., by referring to the atomic number, classes of elements, and repeating patterns of physical and chemical properties that identify families of elements with similar properties)

Chemistry

Standard: S8c: Analyzes and demonstrates the relationship between the structure and the properties of matter focusing on physical properties of molecular substances

Components:

S8c1 Predicts that particles with opposite charges will attract (e.g., protons and electrons, positive and negative ions, molecules with partial but opposite charges), that particles with like charges will repel (e.g., protons in the nucleus, electrons in the electron clouds of atoms and molecules), and that the strength of the electric force between the particles increases in proportion to the charges but decreases with distance

S8c2 Describes the factors that affect how simple molecules interact and form intermolecular bonds (e.g., constituent atoms, distances and angles between the atoms, charges and partial charges on the molecules)

S8c3 Explains physical properties of molecular substances (e.g., melting point, boiling point, density, viscosity, vapor pressure, solubility in different solvents) based on the nature of the interactions among those substances' molecules (e.g., tendency to form intermolecular attractions and crystalline structures)

S8c4 Compares and contrasts solids, liquids, and gases, based on the ability of molecules or atoms to move around or away from each other (i.e., based on average kinetic energy of the system, and the strength of attraction between molecules or atoms)

S8c5 Applies the kinetic molecular theory to explain the behavior of gases, and the relationship between pressure and volume, volume and temperature, pressure and temperature, and the number of particles in a gas sample

S8c6 Compares and contrasts the properties of solutions and pure solvents (e.g., boiling point and melting point, vapor pressure, separate and combined volumes, ability to conduct electricity)

Chemistry Applications

Components:

S8c7 Applies the atomic-molecular theory to chemical reactions (e.g., balancing equations, calculating percent yield, identifying limiting reactants, determining percent composition)

S8c8 Applies the kinetic molecular theory to explain the behavior of gases, and the relationship between pressure and volume, volume and temperature, pressure and temperature, and the number of particles in a gas sample

S8c9 Compares and contrasts the properties of solutions and pure solvents (e.g., boiling point and melting point, vapor pressure separate and combined volumes, ability to conduct electricity)

S8c10 Compares and contrasts solutions, suspensions, and colloids, using knowledge of intermolecular forces

S8c11 Compares and contrasts water and other substances in their solid, liquid, and gaseous states, based on the ability of molecules or atoms to move around or away from each other (i.e., based on average kinetic energy of the system, and the strength of attraction between molecules or atoms)

S8c12 Describes the factors that affect how simple molecules interact and form intermolecular bonds (e.g., constituent atoms, distances and angles between the atoms, charges and partial charges on the molecules)

S8c13 Describes the process (for petroleum, as an example) of fractional distillation and names the products from each fraction

S8c14 Distinguishes between chemical and physical properties and/or changes

S8c15 Distinguishes between chemical and physical properties and/or changes

S8c16 Explains physical properties of molecular substances (e.g., food matter) as based on the nature of the interactions among those substances' molecules (e.g., carbohydrates and fats)

S8c17 Explains physical properties of water, petroleum, and other molecular substances (e.g., melting point, boiling point, density, viscosity, vapor pressure, solubility in different solvents) based on the nature of the interactions among those substances' molecules (e.g., tendency to form intermolecular attractions and crystalline structures) and the implications of these properties for transformations in manufacturing

S8c18 Identifies the chemical and physical processes of conserving renewable and nonrenewable resources

S8c19 Identifies the chemical and physical processes of conserving renewable and nonrenewable resources

S8c20 Predicts that particles (such as those in water) with opposite charges will attract (e.g., protons and electrons, positive and negative ions, molecules with partial but opposite charges), those with like charges will repel (e.g., protons in the nucleus, electrons in the electron clouds of atoms and molecules), and that the strength of the electric force between the particles increases in proportion to the charges but decreases with distance

S8c21 Describes the process (for petroleum, as an example) of fractional distillation and names the products from each fraction

Chemistry

Standard: S8d: Assesses interactions of matter focusing on chemical reactions and bonds

Components:

S8d1 Explains chemical bonding (e.g., covalent, polar-covalent, ionic) as the pairing of electrons via transfer or sharing between atoms, resulting in distinct molecules or repeating three-dimensional crystalline arrangements of atoms

S8d2 Applies the atomic-molecular theory to chemical reactions (e.g., balancing equations, calculating percent yield, identifying limiting reactants, determining percent composition)

S8d3 Categorizes chemical reactions into one of five basic types (i.e., synthesis, decomposition, single replacement, double replacement, combustion) based on chemical equations and experimental observations

S8d4 Compares and contrasts reactions that involve the transfer of electrons (i.e., oxidation/reduction reactions) or hydrogen ions (i.e., acid/base reactions) between reacting ions, molecules, or atoms

S8d5 Explains the role of highly reactive radicals in chemical chain reactions (e.g., the presence of ozone and greenhouse gases in the atmosphere, the burning and processing of fossil fuels, the formation of polymers, and explosions)

S8d6 Explains why such an enormous variety of substances (e.g., synthetic polymers, oils, the large molecules essential to life) can be formed from a backbone of carbon atoms (i.e., because carbon atoms can form four bonds, including single, double, and triple bonds, and bond to each other to form chains, rings, and branching networks)

S8d7 Explains why such an enormous variety of substances (e.g., synthetic polymers, oils, the large molecules essential to life) can be formed from a backbone of carbon atoms (i.e., because carbon atoms can form four bonds, including single, double, and triple bonds, and bond to each other to form chains, rings, and branching networks)

S8d8 Provides examples of and describes chemical reactions that occur in everyday life (e.g., in health care, cooking, cosmetics, automobiles, and in our bodies)

Chemistry Applications

Components:

S8d8 Applies the atomic-molecular theory to chemical reactions (e.g., balancing equations, calculating percent yield, identifying limiting reactants, determining percent composition)

S8d9 Compares and contrasts reactions that involve the transfer of electrons (i.e., oxidation/reduction reactions) or hydrogen ions (i.e., acid/base reactions) between reacting ions, molecules, or atoms

S8d10 Compares saturated/unsaturated hydrocarbons (models, formulas, structures, properties)

S8d11 Describes chemically the transformations of elements (e.g., nitrogen) and molecules (e.g., water) through the environment (e.g., water and nitrogen cycles)

S8d12 Explains the role of highly reactive radicals in chemical chain reactions (e.g., the presence of ozone and greenhouse gases in the atmosphere, the burning and processing of fossil fuels, the formation of polymers, the extraction of minerals from ores, and explosions)

S8d13 Explains why such an enormous variety of substances (e.g., synthetic polymers, oils, the large molecules essential to life) can be formed from a backbone of carbon atoms (i.e., because carbon atoms can form four bonds, including single, double, and triple bonds, and bond to each other to form chains, rings, and branching networks)

S8d14 Provides examples of and describes chemical reactions that occur in everyday life (e.g., in health care, cooking, cosmetics, automobiles, and in our bodies)

Chemistry

Standard: S8e: Analyzes variables that govern the rates of chemical and physical change

Components:

S8e1 Compares and contrasts physical and chemical change (e.g., based on bond strength, reversibility, applicability of conservation laws), explaining both as changes in the arrangement and motion of atoms and molecules

S8e2 Describes the enormous range of time periods over which chemical reactions can take place (i.e., from a few seconds to billions of years)

S8e3 Describes factors that can change the rate of dissolving (e.g., concentration, pressure, temperature, mixing, particle size and shape, surface area)

S8e4 Investigates and explains the effect of factors that can change the rate of chemical reactions (e.g., concentration, pressure, temperature, mixing, particle size and shape, surface area)

S8e5 Compares and contrasts catalysis by metal surfaces and by enzymes

S8e6 Investigates and describes equilibrium systems (e.g., buffers, indicators, and other chemical systems) and factors that can cause a shift in the equilibrium of a system (e.g., concentration, pressure, volume, temperature)

Chemistry Applications

Components:

S8e7 Compares and contrasts catalysis by metal surfaces and by enzymes (such as the effect of proteins on cellular reactions)

S8e8 Describes factors that can change the rate of dissolving (e.g., concentration, pressure, temperature, mixing, particle size and shape, surface area)

S8e9 Investigates and explains the effect of factors that can change the rate of chemical reactions (e.g., concentration, pressure, temperature, mixing, particle size and shape, surface area)

Chemistry

Standard: S8f Explains and illustrates the conservation of energy

Components:

S8f1 Explains that energy can be transferred (e.g., by collisions and radiations) but never destroyed

S8f2 Provides examples of kinetic energy (e.g., electrical, radiant, thermal) being transformed into potential energy (e.g., chemical) and vice versa (e.g., during chemical reactions, changes of state, and the formation of solutions)

S8f3 Explains that energy tends to spread out uniformly (e.g., from hotter to cooler objects) unless hindered (e.g., by insulation, or by high-energy intermediates in some chemical reactions)

S8f4 Provides examples of energy being released by or initiating chemical reactions (e.g., burning fossil fuels, photosynthesis, the evolution of urban smog)

S8f5 Predicts whether energy will be released or absorbed during a chemical or physical change (e.g., chemical reaction, change of state, formation of a solution), given the configuration of atoms and molecules and their associated energy levels

S8f6 Predicts and explains the ability of electric energy to flow readily through some materials (e.g., metals, ionic solutions) but not others (i.e., relating conductivity to the ability of charged particles to flow through the material)

S8f7 Distinguishes between temperature and heat

S8f8 Explains that each kind of atom or molecule can gain or lose energy only in particular discrete amounts

Chemistry Applications

Components:

S8f9 Describes major sources of energy and alternative sources of fuels and builder molecules

S8f10 Explains that energy can be transferred (e.g., by collisions and radiation) but never destroyed

S8f11 Explains that light can initiate reactions such as photosynthesis and the evolution of urban smog

S8f12 Provides examples of kinetic energy (electrical, radiant, thermal) being transformed into potential energy (e.g., chemical) and vice versa (e.g., during chemical reactions, changes of state, and the formation of solutions)

S8f13 Distinguishes the split (fission) of certain nuclei into small nuclei and several neutrons from the combination (fusion) of two small nuclei into a more massive, given high temperature and pressure

S8f14 Provides examples of energy being released by or initiating chemical reactions (e.g., burning petroleum and other fossil fuels, photosynthesis, the evolution of urban smog)

S8f15 Predicts whether energy will be released or absorbed during a chemical or physical change (e.g., chemical reaction, change of state, formation of a solution), given the configuration of atoms and molecules and their associated energy levels

S8f16 Predicts and explains the ability of electrical energy to flow readily through some materials (e.g., metals, ionic solutions) but not others (i.e., relating conductivity to the ability of charged particles to flow through the material)

Environmental Science
Grades 9-12

Strand:

S9 Environmental Science investigates environmental problems from multiple perspectives and utilizes these perspectives to develop decision-making skills utilizing the fields of economics, social studies, and mathematics

Standard:

Envi S9a: Identifies and describes current environmental issues, and considers of the role of beliefs, attitudes, and values in proposing solutions to environmental problems

Components:

S9a1. Utilizes research methods to investigate environmental questions, reevaluates their personal beliefs to accommodate new knowledge and perspectives, and is able to effectively communicate this understanding to others

S9a2. Identifies the strengths and weaknesses of different approaches to investigating an environmental issue and identifies some of the assumptions for each approach

S9a3. Evaluates the advantages and disadvantages of balancing short term interests with long term welfare of the society

S9a4. Explains how individual activities and decisions can have an impact on the environment

S9a5. Identifies a variety of approaches to environmental issues and evaluates the benefits and consequences of each from a social, economic, and ecological standpoint

S9a6. Applies basic principles of cost-benefit analysis and shows who pays and who benefits of selected proposed interventions to environmental problems

S9a7. Assesses the environmental and social costs and benefits of natural resource management strategies
Identifies a variety of approaches to environmental issues and evaluates the costs and benefits of each from a social, economic, and ecological standpoint

S9a8. Evaluates the ways in which government can influence environmental policy

S9a9. Identifies how the choices individuals make affect the environment

Standard:

Envi S9b: identifies the effect of human activities on natural processes and interrelationships within ecosystems

Components:

S9b1. Identifies and describes the factors that have contributed to the growth of the human population

S9b2. Provides evidence for how human population growth has impacted the environment and the use of natural resources

S9b3. Describes the ways in which the use of technology has an affected the environment and standard of living

S9b4. Describes the different ways the environment has been perceived by and utilized by human societies over time

S9b5. Provides evidence for how people impact their environment through the use of natural resources

S9b6. Recognizes the ways in which technology, while improving our standard of living, has increased the human impact on the environment

S9b7. Predicts how changes in the availability and use of natural resources will affect society and human activities

S9b8. Identifies and analyzes the effects of human resource use on the environment at various scales

S9b9. Evaluates a variety of land management practices on their ability to restore ecosystem functioning and trophic relationships

S9b10. Describes how people affect biodiversity through land use practices, pollution, and their use of organisms

S9b11. Identifies and assesses the effects of human activities on ecosystems at various scales in terms of ecosystem functioning

S9b12. Recognizes the ways in which technology, while improving our standard of living, has increased the human impact on the environment

S9b13. Assesses the environmental and societal costs and benefits of various common natural resource management strategies

Standard:

Envi S9c: identifies a variety of Earth's finite natural resources and their formation

Components:

S9c1. Identifies minerals that are important to our lives and describes their distribution on Earth

S9c2. Explains how fossil fuels are formed and where they can be found

S9c3. Recognizes land, clean air, and fresh water as critical natural resources that are in increasing demand

S9c4. Illustrates the naturally occurring cycles of Earth's finite resources through Earth's four major systems (atmosphere, hydrosphere, lithosphere, and biosphere) by describing the path of an element or a molecule in a natural resource (for example carbon or water)

S9c5. Recognizes that certain resources are nonrenewable because they are replenished at timescales of thousands to millions of years

Standard:

Envi S9d: Assesses the (sustainable) availability of Earth's natural resources given the growing human demand

Components:

S9d1. Lists natural resources that play a vital role in daily life and identifies where they come from

S9d2. Identifies and evaluates multiple uses of natural resources and to which extent society is dependent on them

S9d3. Recognizes that some natural resources are very rare and some exist in great quantities, but the ability to recover them is just as important as their abundance

S9d4. Presents evidence that as natural resources are depleted, obtaining them becomes more difficult

S9d5. Assesses how changes to the availability of nonrenewable natural resources might affect society (considering, for example, manufacturing industries, agriculture, transportation)

Standard:

Envi S9e: Analyzes the future availability of nonrenewable energy resources considering the trend of human consumption of energy

Components:

S9e1. Names and describes the three major fossil fuels (gas, coal, and oil) used in the United States and their uses

S9e2. Evaluates the pros and cons of using fossil fuels

S9e3. Compares and contrasts the historical demand for fossil fuels in various nations

S9e4. Compares and contrasts the estimated supply of fossil fuel and the projected demand

Standard:

Envi S9f: Describes the current and potential future effects of the burning of fossil fuels on the environment considering the trend of human consumption of energy

Components:

S9f1. Summarizes how the burning of fossil fuels generates the power that is used in homes and offices and how it has an impact on the environment

S9f2. Defines and applies the concept of the human carbon footprint

S9f3. Compares the effects of natural and human-caused activities that either contribute to or challenge an ecologically sustainable environment

S9f4. Critiques the use of fossil fuels from an economic and environmental point of view

Standard:

Envi S9g: proposes renewable energy resources that are alternatives to the burning of fossil fuels and technological developments that can reduce the human carbon footprint

Components:

S9g1. Lists alternative energy resources and assesses the costs and benefits of these alternative resources on society and the environment

S9g2. Compares and contrasts the economics of investing into nonrenewable or renewable energy sources for the society

S9g3. Assesses how changes in the availability of energy will affect society and human activities, such as transportation, agricultural systems, and manufacturing

S9g4. Concludes that the use of renewable energies and the development of superior technologies can reduce the rate of depletion of natural resources and decrease the human impact on the environment

S9g5. Outlines the ways in which individuals can alter their own behavior to reduce the human carbon footprint

Standard:

Envi S9h: explains how geochemical cycles and ecological processes on Earth interact through time to cycle matter and energy and how human activity can alter the rates of these processes

Components:

S9h1. Recognizes that the different spheres such as the atmosphere are resources
S9h2. Provides examples and explains that the Earth is a complex system with connected and interconnected components and processes
S9h3. Describes the major (carbon) reservoirs within Earth's systems

S9h4. Diagrams and explains multiple pathways of carbon movement between reservoirs

S9h5. Presents evidence that Earth is a system containing essentially a fixed amount of each stable chemical atom or element which moves among reservoirs in the solid Earth, oceans, atmosphere, and organisms as part of geochemical cycles

S9h6. Lists potential consequences of increased use of fossil fuels or drastic reduction of vegetation on earth's dynamic equilibrium

S9h7. Use computer modeling/simulations to predict the effects of carbon dioxide on Earth's systems

Standard:

Envi S9i: relates the theory of biological evolution to geologic time and addresses speciation, biodiversity, natural selection, and biological classification

Components:

S9i1. Describes the ways in which biodiversity is important to ecosystems and human society

S9i2. Assesses the potential value of a single species to a particular ecosystem

S9i3. Explains how organisms are adapted to the environment in terms of ecological niches and natural selection

S9i4. Investigates and explains how natural selection acts as the mechanism for evolution and can lead to speciation

S9i5. Provides evidence that natural selection can explain both the unity and diversity of life

S9i6. Relates the importance of genetic diversity and population size to the conservation of a species

Envi S5j: analyzes ecology as interrelationships of biotic and abiotic factors and explains the transfer of matter and energy within ecosystems

Components:

S9j1. Recognizes that the Earth is primarily a closed system with respect to matter

S9j2. Identifies the factors limiting population growth in a given area (carrying capacity)

S9j3. Gives examples that illustrate how a change in one part of a system can have an impact on other parts of the system

S9j4. Identifies and describes the factors that have contributed to the growth of the human population and examine the impact this growth will have on the environment

S9j5. Identifies environmental issues in terms of interrelationships among natural systems in time and space

S9j6. Evaluates the factors that impact resource availability and explains why certain natural resources are becoming depleted

S9j7. Takes into consideration that Earth's systems exist in a state of dynamic equilibrium and that certain compositions of the Earth's system(s) may fluctuate on short or long time scales but the Earth's system will generally stay within a certain narrow range for millions of years

S9j8. Identifies environmental issues in terms of the interconnectedness of nature

S9j9. Analyzes the natural processes of change in the environment, including examples of succession, evolution, and extinction

S9j10. Analyzes how the stability and sustainability of ecosystems change as a result of changes in environmental conditions

S9j11. Identifies factors that influence patterns of ecological succession, including invasive species, loss of biodiversity, change in abiotic conditions, and catastrophic events

S9j12. Evaluates the factors that determine the plant life existing in a given biome

S9j13. Predicts changes in population size in response to altered environmental conditions

S9j14. Assesses the stability and sustainability of ecosystems as a result of changes in environmental conditions