

Priority Academic Student Skills

SCIENCE OVERVIEW ORGANIZATION

The Priority Academic Student Skills (PASS) are organized by Science Process and Inquiry Standards and Content Standards which include Physical Science, Life Science, and Earth/Space Science. They are arranged by grade level at Grades 1-8, and by course subject area at the high school level. Each standard is followed by two or more objectives to accomplish each standard. Students should be provided with science experiences at each grade level from all areas of the content standards. This integrated approach will provide students with a coordinated, coherent understanding of the necessary skills and knowledge of scientifically literate citizens.

The Oklahoma State Testing Program assesses the Science *Priority Academic Student Skills (PASS)* with a 5th and 8th grade criterion-referenced test and a Biology I End-of-Instruction test. All of these state level assessments are based on the standards in this document.

The objectives presented in the “Science Processes and Inquiry” standards are included at all grade levels because the understandings and abilities associated with these concepts need to be developed throughout a student’s educational experience.

The content standard areas (physical, life, earth/space) are designed to facilitate conceptual development by building on the content knowledge introduced at the Pre-Kindergarten level. Because each of the content standards subsumes the knowledge and skills of the other standards, they are designed to be used as a whole. Although material can be added to the content standards, using only a portion of the standards will leave gaps in the scientific understanding expected of students.

SCIENCE STANDARDS Grades 1-12

The science framework presented in this outline is what students should know, understand, and be able to do in the natural sciences. Students combine process and knowledge as they use scientific reasoning and critical thinking to develop their understanding of science. Inquiry builds conceptual bridges between process and scientific knowledge. Relevant use of developmentally appropriate technology facilitates the inquiry process.

The attainment of scientific literacy is the result of a sequential curriculum that is dependent on quality science teaching at each grade level beginning in prekindergarten. Quality science teaching requires direct, inquiry-oriented learning experiences that emphasize the processes of science and major science concepts. Consistent with national standards, fewer concepts in physical, life and earth/space sciences are explored while more emphasis is placed on in-depth understanding. The following standards provide a framework to achieve the above goals.

The science standards are not a scope and sequence or a district curriculum guide. They provide a framework for schools to develop an aligned science curriculum and for teachers to develop their own classroom lessons. The science standards in this document were developed

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based on the *National Science Education Standards* by the National Research Council (NRC), the *Benchmarks for Scientific Literacy by the American Association* for the Advancement of Science (AAAS), and the *Science Frameworks* by the National Association for Educational Progress (NAEP). The United States has established a goal for all students to achieve scientific literacy. These national publications, developed by science and education experts, will enable the nation and the state of Oklahoma to meet this goal.

NOTE:

Asterisks (*) have been used to identify standards and objectives that must be assessed by the local school district. All other skills may be assessed by the Oklahoma School Testing Program (OSTP).

Book Icons (📖) identify Information Literacy skills. Students are best served when these are taught in collaboration and cooperation between the classroom teacher and the library media specialist.

Use of term i.e. means “in exactness”; use of the term e.g. means “example given”.

OAC 210:15-3-70—210:15-3-82

Approved by the Oklahoma State Board of Education, March 24, 2011.

SCIENCE

Priority Academic Student Skills

Grade 1

Standards for Inquiry, Physical, Life, and Earth/Space Science

The *Priority Academic Students Skills (PASS)* should be taught by investigating broad concepts, and principles of major themes in Physical, Life, and Earth/Space Sciences.

SCIENCE PROCESSES AND INQUIRY

Grade 1

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an object, organism, or event. Opportunities for observation are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

- *1. Observe and measure objects, organisms and/or events using developmentally appropriate nonstandard units of measurement (e.g., hand, paper clip, book); and International System of Units (SI) (i.e., meters, centimeters, and degrees Celsius).
2. Compare and contrast similar and/or different characteristics in a given set of simple objects, familiar organisms and/or observable events.

Process Standard 2: Classify – classifying establishes order. Objects, organisms, and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Classify a set of simple objects, familiar organisms, and/or observable events by observable properties.
2. Arrange simple objects, familiar organisms, and/or observable events in a serial order (e.g., least to greatest, tallest to shortest).

Process Standard 3: Experiment and Inquiry - Experimenting is a method of discovering information. It requires making observations and measurements to test ideas. Inquiry can be defined as the skills necessary to carry out the process of scientific or systemic thinking. In order for inquiry to occur, students must have the opportunity to ask a question, formulate a procedure, and observe phenomena. The student will accomplish these objectives to meet this process standard.

- *1. Ask a question about objects, organisms, or events in the environment.

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- *2. Plan and conduct a simple investigation.
- *3. Employ simple equipment and tools such as magnifiers, thermometers, and rulers to gather data.
- 4. Recognize potential hazards and practice safety procedures in all science activities.

Process Standard 4: Interpret and Communicate – Interpreting is a process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, and other visual representations. The student will accomplish these objectives to meet this process standard.

- 1. Interpret pictures, simple bar graphs, and/or tables.
- 2. Recognize and describe patterns, then make predictions based on patterns. 📖
- *3. Communicate the results of a simple investigation using drawings, tables, graphs, and/or written and oral language. 📖

PHYSICAL SCIENCE

Grade 1

Standard 1: Properties of Objects and Materials – Characteristics of objects can be described using physical properties such as size, shape, color, or texture. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

- 1. Objects have properties that can be observed, described, and measured.
- 2. Using the five senses, objects can be grouped or ordered by physical properties.
- 3. Water can be a liquid or a solid, and can be made to go back and forth from one form to the other.

LIFE SCIENCE

Priority Academic Student Skills

Grade 1

Standard 2: Characteristics and Basic Needs of Organisms – All living things have structures that enable them to function in unique and specific ways to obtain food, reproduce, and survive. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Plants and animals need to take in air, water, and food. In addition, plants need light.
2. Scientists use the five senses and tools (e.g., magnifiers and rulers) to gather information, such as size and shape about living things.

EARTH/SPACE SCIENCE

Grade 1

Standard 3: Changes of Earth and Sky – Observe natural changes of all kinds such as the movement of the sun and variable changes like the weather. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. The sun warms the land, air, and water.
2. Weather changes from day to day and over the seasons. Weather can be observed by measuring temperature and describing cloud formations.

SCIENCE

Priority Academic Student Skills

Grade 2

Standards for Inquiry, Physical, Life, and Earth/Space Science

The *Priority Academic student Skills (PASS)* should be taught by investigating broad concepts, and principles of major themes in Physical, Life, and Earth/Space Sciences.

SCIENCE PROCESSES AND INQUIRY

Grade 2

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an object, organism, or event. Opportunities for observation are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Observe and measure objects, organisms, and/or events using developmentally appropriate standard units of measurement (e.g., inches, feet, yard, degrees Fahrenheit) and the International System of Units (SI) (i.e., meters, centimeters, grams, and degrees Celsius).
2. Compare and contrast similar and/or different characteristics in a given set of simple objects, familiar organisms and/or observable events.

Process Standard 2: Classify – Classifying establishes order. Objects, organisms, and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Classify a set of simple objects, familiar organisms, and/or observable events by observable properties (e.g., graphic organizers, t-charts, tables, and Venn diagrams).
2. Arrange simple objects, familiar organisms, and/or observable events in a serial order (e.g., least to greatest, tallest to shortest).

Process Standard 3: Experiment and Inquiry – Experimenting is a method of discovering information. It requires making observations and measurements to test ideas. Inquiry can be defined as the skills necessary to carry out the process of scientific or systemic thinking. In order for inquiry to occur, students must have the opportunity to ask a question, formulate a procedure, and observe phenomena. The student will accomplish these objectives to meet this process standard.

- *1. Ask a question about objects, organisms, or events in the environment. 📖

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- *2. Plan and conduct a simple investigation.
- *3. Employ simple equipment and tools such as magnifiers, thermometers, and rulers to gather data.
4. Recognize potential hazards and practice safety procedures in all science activities.

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, and other visual representations. The student will accomplish these objectives to meet this process standard.

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- *3. Communicate the results of a simple investigation using drawings, tables, graphs, and/or written and oral language. 📖

PHYSICAL SCIENCE

Grade 2

Standard 1: Properties and Interactions of Objects and Materials – characteristics of objects can be described using physical properties such as size, shape, color, texture, or magnetism. Interactions change the position and motion of objects. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Objects can be described in terms of materials of which they are made. Physical properties of materials can be changed by tearing, sifting, sanding, or pounding.
2. Motion and interaction of objects can be observed in toys and playground activities.
3. Magnets attract and repel each other and certain other materials. Magnetic force passes through materials such as paper, glass, and water.

LIFE SCIENCE

Priority Academic Student Skills

Grade 2

Standard 2: Life Cycles and Organisms – Life cycles represent the stages an organism passes through from its own birth to the birth of the next generation. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Plants and animals have life cycles that include developing into adults, reproducing, and eventually dying. The details of this life cycle are different for different organisms.
2. Plants and animals often have characteristics similar to their parents.

EARTH/SPACE SCIENCE

Grade 2

Standard 3: Properties and Changes of Earth and Sky – Earth materials consist of rocks, soils, water, and air. The sun appears to move across sky in the same way every day. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Earth materials have different properties and serve as natural resources that sustain plant and animal life.
2. The size and shape of shadows change at different times of the day.

SCIENCE

Priority Academic Student Skills

Grade 3

Standards for Inquiry, Physical, Life and Earth/Space Science

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SCIENCE PROCESSES AND INQUIRY

Grade 3

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an object, organism, or event. Opportunities for observation are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Observe and measure objects, organisms, and/or events using developmentally appropriate International System of Units (SI) (i.e., meters, centimeters, grams, and degrees Celsius).
2. Compare and contrast similar and/or different characteristics in a given set of simple objects, familiar organisms, and/or observable events.

Process Standard 2: Classify – Classifying establishes order. Objects, organisms, and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Classify a set of simple objects, familiar organisms, and/or observable events by observable properties (e.g., graphic organizers, t-charts, tables, and Venn diagrams).
2. Arrange simple objects, familiar organisms, and/or observable events in a serial order (e.g., least to greatest, order of steps, and smallest to largest).

Process Standard 3: Experiment and Inquiry – Experimenting is a method of discovering information. It requires making observations and measurements to test ideas. Inquiry can be defined as the skills necessary to carry out the process of scientific or systemic thinking. In order for inquiry to occur, students must have the opportunity to ask a question, formulate a procedure, and observe phenomena. The student will accomplish these objectives to meet this process standard.

- *1. Ask a question about objects, organisms, or events in the environment. 📖

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- *2. Plan and conduct a simple investigation.
- *3. Employ simple equipment and tools such as magnifiers, thermometers, and rulers to gather data.
- 4. Recognize potential hazards and practice safety procedures in all science activities.

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

- 1. Interpret tables, pictorial, and/or simple bar graphs. 📖
- 2. Recognize and describe patterns, then make predictions based on patterns. 📖
- *3. Communicate the results of a simple investigation using drawings, tables, graphs, and/or written and oral language. 📖

PHYSICAL SCIENCE

Grade 3

Standard 1: Properties of Objects and Materials – Describe characteristics of objects based on physical properties such as size, shape, color, or texture. Vibration of materials causes sound. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

- 1. Objects can be described in terms of the materials of which they are made. Mixtures and solutions can be separated (i.e., sand and marbles, salt and water).
- 2. Sound is produced by vibrations (i.e., pitch and loudness).
- 3. Sound travels through air, water, and/or solids.

LIFE SCIENCE

Priority Academic Student Skills

Grade 3

Standard 2: Characteristics and Basic Needs of Organisms and Environments – All living things have structures that enable them to function in unique and specific ways to obtain food, reproduce, and survive. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Plants and animals have features (i.e., breathing structures, limbs, skin covering, seed dispersal, roots, stems, and leaves) that help them live in different environments such as air, water, or land.
2. Each plant or animal has different structures that serve different functions in growth and survival (i.e., the way it moves, type of food it needs, and where it lives).
3. All animals depend on plants. Some animals eat plants for food. Other animals consume animals that eat the plants.
 - a. The primary source of energy in a food chain is the sun.
 - b. Animals can be classified by the type of food they eat.

EARTH/SPACE SCIENCE

Grade 3

Standard 3: Properties of Earth Materials – Earth materials consist of rock, soils, water, and air. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Rocks and minerals have similarities and differences (i.e., size of particles, color pattern, and layering).
2. Soils have properties of color and texture, capacity to retain water, and ability to support the growth of many kinds of plants and animals, including those in our food supply.
3. Earth exerts a force called gravity which attracts objects, pulling them toward Earth's center.

SCIENCE

Priority Academic Student Skills

Grade 4

Standards for Inquiry, Physical, Life, and Earth/Space science

The *Priority Academic Student Skills (PASS)* should be taught by investigating content, concepts, and principles of major themes in Physical, Life, and Earth/Space Sciences.

SCIENCE PROCESSES AND INQUIRY

Grade 4

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an object, organism, or event. Opportunities for observation are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Observe and measure objects, organisms, and/or events (e.g., mass, length, time, volume, temperature) using International System of Units (SI) (i.e., grams, milligrams, meters, millimeters, centimeters, kilometers, liters, milliliters, and degrees Celsius).
2. Compare and/or contrast similar and/or different characteristics (e.g., color, shape, size, texture, sound, position, change) in a given set of objects organisms or events.

Process Standard 2: Classify – Classifying establishes order. Objects, organisms, and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Classify a set of objects, organisms, and/or events using two or more observable properties (e.g., simple dichotomous keys).
2. Arrange objects, organisms, and/or events in serial order (e.g., least to greatest, fastest to slowest).

Process Standard 3: Experiment – Experimenting is a method of discovering information. It requires making observations and measurements to test ideas. The student will accomplish these objectives to meet this process standard.

- *1. Ask questions about the world and formulate an orderly plan to investigate a question. 

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2. Evaluate the design of a scientific investigation.
- *3. Design and conduct a scientific investigation.
4. Recognize potential hazards and practice safety procedures in all science investigations.

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

- *1. Report data using tables, line, bar, trend, and/or simple circle graphs. 📖
2. Interpret data tables, line, bar, trend and/or simple circle graphs. 📖
3. Make predictions based on patterns in experimental data.
4. Communicate the results of investigations and/or give explanations based on data. 📖

Process Standard 5: Inquiry – Inquiry can be defined as the skills necessary to carry out the process of scientific or systemic thinking. In order for inquiry to occur, students must have the opportunity to ask a question, formulate a procedure, and observe phenomena. The student will accomplish these objectives to meet this process standard.

- *1. Use different ways to investigate questions and evaluate the fairness of the test.
- *2. Use a variety of measurement tools and technology.
- *3. Formulate a general statement to represent the data.
- *4. Share results of an investigation in sufficient detail so that data may be combined with data from other students and analyzed further.

PHYSICAL SCIENCE

Priority Academic Student Skills

Grade 4

Standard 1: Position and Motion of Objects – The position of a moving object can be described relative to a stationary object or the background. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull.
2. The motion of an object can be described by tracing and measuring its position over time.

Standard 2: Energy – Energy is the ability to do work or to cause a change in matter. Forms of energy include electricity, heat (thermal), light and sound. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Electricity is the flow of electrical power or charge.
 - a. The flow of electricity is controlled by open and closed circuits.
 - b. Some materials are conductors of electricity while others are insulators.
2. Heat results when substances burn, when certain kinds of materials rub against each other, and when electricity flows through wires.
 - a. Metals are good conductors of heat and electricity.
 - b. Increasing the temperature of any substance requires the addition of heat energy.
3. Light is a form of energy made of electromagnetic waves.
 - a. Light waves travel in a straight line.
 - b. Substances may cause light waves to change direction of travel (e.g., reflection, refraction).
 - c. Sound is a form of energy caused by waves of vibrations that spread from its source.

LIFE SCIENCE

Priority Academic Student Skills

Grade 4

Standard 3: Characteristics of Organisms – Each type of organism has structures that enable it to function in unique and specific ways to obtain food, reproduce and survive. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Organisms can survive only in environments in which their needs can be met (e.g., food, shelter, air, reproduction, and water).
2. Living organisms may be grouped by various characteristics or the environment in which they live (e.g., habitats, anatomy, behaviors).
3. Many observable characteristics of an organism, are inherited from the parents of the organisms (e.g., color of flowers, number of limbs on an animal).
4. Energy from the Sun is passed to organisms through food chains.

ELEMENTARY EARTH/SPACE SCIENCE

Grade 4

Standard 4: Properties of Earth and Moon - The Earth and its Moon have specific properties. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Earth materials consist of rock, soils, water, and air.
2. The processes of erosion, weathering, and sedimentation affect Earth materials (e.g., earthquakes, floods, landslides, volcanic eruptions).
3. Fossils provide evidence about the plants and animals that lives long ago and the nature of the environment at that time (e.g., the formation of fossils).
4. The observable shape of the moon changes from day to day in a cycle that lasts about a month.

SCIENCE Grade 5

Priority Academic Student Skills

Standards for Inquiry, Physical, Life, and Earth/Space Science

The *Priority Academic Student Skills (PASS)* should be taught by investigating content, concepts, and principles of major themes in Physical, Life, and Earth/Space Sciences.

SCIENCE PROCESSES AND INQUIRY

Grade 5

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an objects, organism, or event. Opportunities for observation are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Observe and measure objects, organisms, and/or events (e.g., mass, length, time, volume, temperature) using the International System of Units (SI) (i.e., grams, milligrams, meters, millimeters, centimeters, kilometers, liters, milliliters, and degrees Celsius). Measure using tools (e.g., simple microscopes or magnifier, graduated cylinders, gram spring scales, metric rulers, metric balances and Celsius thermometers).
2. Compare and/or contrast similar and/or different characteristics (e.g., color, shape, size, texture, sound, position, change) in a given set of objects, organisms, or events.

Process Standard 2: Classify – Classifying establishes order. Objects, organisms, and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Classify a set of objects, organisms, and/or events using no more than three observable properties (e.g., dichotomous keys).
2. Arrange objects, organisms and/or events in serial order (e.g., least to greatest, fastest to slowest).

Priority Academic Student Skills

Process Standard 3: Experiment – Experimenting is a method of discovering information. It requires making observations and measurements to test ideas. The student will accomplish these objectives to meet this process standard.

- *1. Ask questions about the world and formulate an orderly plan to investigate a question. 📖
2. Evaluate the design of a scientific investigation (e.g., order of investigation procedures, number of tested variables). 📖
- *3. Design and conduct a scientific investigation.
4. Recognize potential hazards and practice safety procedures in all science investigations.

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

- *1. Report data using tables, line, bar, trend, and/or simple circle graphs. 📖
2. Interpret data tables, line bar, trend, and/or simple circle graphs. 📖
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4. Communicate the results of investigations and/or give explanations based on data. 📖

Process Standard 5: Inquiry – Inquiry can be defined as the skills necessary to carry out the process of scientific or systemic thinking. In order for inquiry to occur, students must have the opportunity to ask a question, formulate a procedure, and observe phenomena. The student will accomplish these objectives to meet this process standard.

- *1. Use different ways to investigate questions and evaluate the fairness of the test.
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Priority Academic Student Skills

- *4. Share results of an investigation in sufficient detail so that data may be combined with data from other students and analyzed further. 📖

PHYSICAL SCIENCE

Grade 5

Standard 1: Properties of Matter and Energy – Describe characteristics of objects based on physical qualities such as size, shape, color, mass, temperature, and texture. Energy can produce changes in properties of objects such as changes in temperature. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Matter has physical properties that can be used for identification (e.g., color, texture, shape).
2. Physical properties of objects can be observed, described, and measured using tools such as simple microscopes, gram spring scales, metric rulers, metric balances, and Celsius thermometers.
3. Energy can be transferred in many ways (e.g., energy from the Sun to air, water, and metal).
4. Energy can be classified as either potential or kinetic.

LIFE SCIENCE

Grade 5

Standard 2: Organisms and Environments – Organisms within an ecosystem are dependent on one another and the environment. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Organisms in an ecosystem depend on each other for food, shelter, and reproduction.
 - a. Ecosystems include food chains and food webs.
 - b. Relationships exist between consumers, producers, and decomposers within an ecosystem.
 - c. Predators and prey relationships affect populations in an ecosystem.
2. Changes in environmental conditions due to human interactions or natural phenomena can affect the survival of individual organisms and/or entire species.

Priority Academic Student Skills

- a. Earth's resources can be natural (non-renewable) or man-made (renewable).
- b. The practices of recycling, reusing, and reducing help to conserve Earth's limited resources.

EARTH/SPACE SCIENCE

Grade 5

Standard 3: Structure of Earth and the Solar System – Interaction between air, water, rock/soil, and all living things. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Soil consists of weathered rocks and decomposed organic material from dead plants, animals, and bacteria. Soils are often found in layers.
2. Weather exhibits daily and seasonal patterns (i.e., air temperature, basic cloud types – cumulus, cirrus, stratus, and nimbus, wind direction, wind speed, humidity, precipitation).
 - a. Weather measurement tools include thermometer, barometer, anemometer, and rain gauge.
 - b. Weather maps are used to display current weather and weather predictions.
3. Earth is the third planet from the Sun in a system that includes the moon, the Sun, and seven other planets.
 - a. Most objects in the solar system are in regular and predictable motion (e.g., phases of the moon).
 - b. Objects in the Solar System have individual characteristics (e.g., distance from Sun, number of moons, temperature of object).
 - c. The Earth rotates on its axis while making revolutions around the Sun.

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Priority Academic Student Skills

SCIENCE Grade 6

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SCIENCE PROCESSES AND INQUIRY

Grade 6

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an object, organism, or event. Opportunities for observation are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Identify qualitative and/or quantitative changes given conditions (e.g., temperature, mass, volume, time, position, length) before, during, and after an event.
2. Use appropriate tools (e.g., metric ruler, graduated cylinder, thermometer, balances, spring scales, stopwatches, computers and handheld data collection devices) to measure objects, organisms, and/or events.
3. Use appropriate International System of Units (SI) (i.e., grams, meters, liters, degrees Celsius, and seconds) and SI prefixes (i.e. milli-, centi-, and kilo-) when measuring objects, organisms and/or events.

Process Standard 2: Classify – Classifying establishes order. Objects, organisms, and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Using observable properties, place an object, organism, and/or event into a classification system (e.g., dichotomous keys, periodic table, biological hierarchy).
2. Identify properties by which a set of objects, organisms, or events could be ordered.

Process Standard 3: Experimental design – Understanding experimental designs requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

Priority Academic Student Skills

- *1. Ask questions about the world and design investigations that lead to scientific inquiry. Identify testable questions based on prior knowledge, background research, or observations. 📖
2. Evaluate the design of a scientific investigation.
3. Identify variables and/or controls in an experimental setup: independent variable and dependent variable.
- *4. Identify a testable hypothesis for an experiment.
- *5. Follow a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
6. Recognize potential hazards and practice safety procedures in all science activities.

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

- *1. Report and record both quantitative/qualitative data in an appropriate method when given an experimental procedure or data. 📖
2. Interpret data tables, line, bar, trend, and/or circle graphs. 📖
3. Evaluate data to develop reasonable explanations and/or predictions. 📖
4. Determine if results of investigations support or do not support hypotheses. 📖
- *5. Communicate scientific processes, procedures, and conclusions (e.g., model, poster, diagram, journal entry, lab report, scientific paper, oral presentation, and digital presentation). 📖

Process Standard 5: Inquiry – Inquiry can be defined as the skills necessary to carry out the process of scientific thinking. In order for inquiry to occur students must have the opportunity to make observations, pose questions, formulate testable hypotheses, carry out experiments, and make conclusions based on evidence. The student will accomplish these objectives to meet this process standard.

Priority Academic Student Skills

- *1. Ask questions that can be answered through scientific investigation.
- *2. Design and conduct experiments utilizing scientific processes.
- *3. Use the engineering design process to address a problem or need (e.g., identify a need, conduct background research, prepare preliminary designs, build and test a prototype, test and revise design, communicate results). 
- *4. Understand the value of technology and use technology to gather data and analyze results of investigations (e.g., probes, hand-held digital devices, digital cameras, software).
- *5. Develop a logical relationship between evidence and explanation to form and communicate a valid conclusion, and suggest alternative explanations.

PHYSICAL SCIENCE

Grade 6

Standard 1: Physical Properties in Matter - Physical characteristics of objects can be described using shape, size, and mass whereas the materials from which objects are made can be described using color and texture. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

- 1. Matter has physical properties that can be measured (i.e., mass, volume, temperature, color, and texture). Changes in physical properties of objects can be observed, described, and measured using tools such as simple microscopes, gram spring scales, metric rulers, metric balances, and Celsius thermometers.
- 2. The mass of an object is not altered due to changes in shape.

Standard 2: Transfer of Energy - Change from one form of energy to another. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

- 1. Energy exists in many forms such as heat, light, electricity, mechanical motion, and sound. Energy can be transferred in various ways (e.g., potential to kinetic, electrical to light, chemical to electrical, mechanical to electrical).
- 2. Electrical circuits provide a means of transferring electrical energy when heat, light, and sound are produced (e.g., open and closed circuits, parallel and series circuits).
- 3. Electric currents and magnets can exert a force on each other (e.g., direct and alternating currents).

Priority Academic Student Skills

LIFE SCIENCE

Grade 6

Standard 3: Structure and Function in Living Systems - Living systems at all levels of organization demonstrate the complementary nature of structure and function. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Cells are the building blocks of all organisms (both plants and animals).
 - a. Plant and animal cells have similarities and differences (i.e., nucleus, mitochondria, cell wall, plasma membrane, chloroplast, and vacuole).
2. Living systems are organized by levels of complexity (i.e., cells, organisms, and ecosystems).

Standard 4: Populations and Ecosystems - Populations consist of individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Organisms within an ecosystem are dependent on one another and on nonliving components of the environment. Some source of energy is needed for all organisms to stay alive and grow. Energy transfer can be followed in food chains and webs.
2. In all environments, organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter. Other relationships may be beneficial (e.g., producers/autotrophs, consumers/heterotrophs, symbiosis).

Standard 5: Structures of the Earth and the Solar System - The earth is mostly rock, three-fourths of its surface is covered by a relatively thin layer of water, and the entire planet is surrounded by a relatively thin blanket of air, and is able to support life. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Earth has four main systems that interact: the geosphere, the hydrosphere, the atmosphere, and the biosphere.
 - a. The geosphere is the portion of the Earth system that includes the Earth's interior, rocks and minerals, landforms, and the processes that shape the Earth's surface.
 - b. The hydrosphere is the liquid water component of the Earth. Water covers the majority of the Earth's surface and circulates through the crust, oceans and atmosphere in what is known as the water cycle.

Priority Academic Student Skills

- c. The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has a different physical and chemical composition at different elevations.
 - d. The biosphere is made up of all that is living on the Earth. It is a life-supporting global ecosystem, where living things depend on other organisms and the environment.
2. The sun provides the light and heat necessary to maintain life on Earth and is the ultimate source of energy (i.e., producers receive their energy from the sun).

Priority Academic Student Skills

SCIENCE

Grade 7

Standards for Inquiry, Physical, Life, and Earth/Space Science

The *Priority Academic student Skills (PASS)* should be taught by investigating content, concepts, and principles of major themes in Physical, Life, and Earth/Space Sciences.

SCIENCE PROCESSES AND INQUIRY

Grade 7

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an object, organism, or event. Opportunities for observation are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Identify qualitative and/or quantitative changes given conditions (e.g., temperature, mass, volume, time, position, length) before, during, and after an event.
2. Use appropriate tools (e.g., metric ruler, graduated cylinder, thermometer, balances, spring scales, stopwatches, computers and handheld data collection devices) to measure objects, organisms, and/or events.
3. Use appropriate International System of Units (SI) (i.e., grams, meters, liters, degrees Celsius, and seconds) and SI prefixes (i.e., milli-, centi-, and kilo-) when measuring objects, organisms and/or events.

Process Standard 2: Classify – Classifying establishes order. Objects, organisms, and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Using observable properties, place an object, organism, and/or event into a classification system (i.g., dichotomous keys, periodic table, biological hierarchy).
2. Identify properties by which a set of objects, organisms, or events could be ordered.

Process Standard 3: Experimental design – Understanding experimental designs requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

Priority Academic Student Skills

1. Evaluate the design of a scientific investigation. 📖
2. Identify variables and/or controls in an experimental setup: independent variable and dependent variable.
- *3. Identify a testable hypothesis for an experiment.
- *4. Follow a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
5. Recognize potential hazards and practice safety procedures in all science activities.

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

- *1. Report and record both quantitative/qualitative data in an appropriate method when given an experimental procedure or data. 📖
2. Interpret data tables, line, bar, trend, and/or circle graphs. 📖
3. Evaluate data to develop reasonable explanation and/or predictions. 📖
- *4. Determine if results of investigations support or do not support hypotheses. 📖
- *5. Communicate scientific processes, procedures, and conclusions (e.g., model, poster, diagram, journal entry, lab report, scientific paper, oral presentation, and digital presentation). 📖

Process Standard 5: Inquiry – Inquiry can be defined as the skills necessary to carry out the process of scientific thinking. In order for inquiry to occur students must have the opportunity to make observations, pose questions, formulate testable hypotheses, carry out experiments, and make conclusions based on evidence. The student will accomplish these objectives to meet this process standard.

- *1. Ask questions that can be answered through scientific investigation.
- *2. Design and conduct experiments utilizing scientific processes.

Priority Academic Student Skills

- *3. Use the engineering design process to address a problem or need (e.g., identify a need, conduct background research, prepare preliminary designs, build and test a prototype, test and revise design, communicate results). 📖
- *4. Understand the value of technology and use technology to gather data and analyze results of investigations (e.g., probes, hand-held digital devices, digital cameras, software, computers, calculators, digital balances, GPS).
- *5. Develop a logical relationship between evidence and explanation to form and communicate a valid conclusion, and suggest alternative explanation.

PHYSICAL SCIENCE

Grade 7

Standard 1: Properties and Physical changes in Matter – Physical characteristics of objects can be described using shape, size, and mass whereas the materials from which objects are made can be described using color and texture. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Matter has physical properties that can be measured (i.e., mass, volume, temperature, color, texture, and density). Physical changes of a substance do not alter the chemical nature of a substance (e.g., phase changes of water, sanding wood).
2. Mixtures can be classified as homogeneous or heterogeneous and can be separated by physical means.

LIFE SCIENCE

Grade 7

Standard 2: Structure and Function in Living Systems - Living systems at all levels of organization demonstrate the complementary nature of structure and function. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Living systems are organized by levels of complexity (i.e., cells, tissues, organs, systems).
2. Specialized structures perform specific functions at all levels of complexity (e.g., leaves on trees, wings on birds, organelles in cells).

Priority Academic Student Skills

Standard 3: Reproduction and Heredity – Reproduction is the process by which organisms give rise to offspring. Heredity is the passing of traits to offspring. All organisms must be able to grown and reproduce. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Characteristics of an organism result from inheritance and from interactions with the environment (e.g., genes, chromosomes, DNA, inherited traits, cell division).
2. Similarities among organisms are found in anatomical features, which can be used to infer the degree of relatedness among organisms.

Standard 4: Behavior and Regulations - All organisms must be able to maintain stable internal conditions while living in a constantly changing external environment. Behavioral response is a set of actions determined in part by heredity and in part by experience. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Living organisms strive to maintain a constant internal environment (i.e., homeostasis).
2. Living organisms have physical and/or behavioral responses to external stimuli (e.g., hibernation, migration, geotropism).

EARTH/SPACE SCIENCE

Grade 7

Standard 5: Structures of the Earth Structures of the Earth System - The Earth is mostly rock, three-fourths of its surface is covered by a relatively thin layer of water, and the entire planet is surrounded by a relatively thin blanket of air, and is able to support life. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Global patterns of atmospheric movement influence local weather such as oceans' effect on climate (e.g., sea breezes, land breezes, ocean currents). Clouds, formed by the condensation of water vapor, affect local weather and climate.
2. The solid crust of the earth consists of separate plates that move very slowly pressing against one another in some places and pulling apart in other places (i.e., volcanoes, earthquakes, mountain creation).

Priority Academic Student Skills

Standard 6: Earth and the Solar System - The earth is the third planet from the sun in a system that includes the moon, the sun, seven other planets and their moons, and smaller objects (e.g., asteroids, comets, dwarf planets. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.
- *2. Seasons result from variations in the amount of the sun's energy hitting the surface, due to the tilt of the earth's rotation on its axis and the length of the day. The relationship of motion of the Sun, Earth, and Earth's Moon is a result of the force of gravity.

Priority Academic Student Skills

SCIENCE Grade 8

Standards for Inquiry, Physical, Life, and Earth/Space Science

The *Priority Academic Student Skills (PASS)* should be taught by investigating content, concepts, and principles of major themes in Physical, Life, and Earth/Space Sciences.

SCIENCE PROCESSES AND INQUIRY

Grade 8

Process Standard 1: Observe and Measure - Observing is the first action taken by the learner to acquire new information about an object, organism, or event. Opportunities for observation are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Identify qualitative and/or quantitative changes given conditions (e.g., temperature, mass, volume, time, position, length) before, during, and after an event.
2. Use appropriate tools (e.g., metric ruler, graduated cylinder, thermometer, balances, spring scales, stopwatches, computers, handheld data collection devices) to measure objects, organisms, and/or events.
3. Use appropriate International System of Units (SI) (i.e., grams, meters, liters, degrees Celsius, and seconds) and SI prefixes (i.e. milli-, centi-, and kilo-) when measuring objects, organisms and/or events.

Process Standard 2: Classify - Classifying establishes order. Objects, organisms, and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Using observable properties, place an object, organism, and/or event into a classification system (e.g., dichotomous keys, periodic table, biological hierarchy).
2. Identify properties by which a set of objects, organisms, or events could be ordered.

Process standard 3: Experimental design - Understanding experimental design requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

Priority Academic Student Skills

- *1. Ask questions about the world and design investigations that lead to scientific inquiry. Identify testable questions based on prior knowledge, background research, or observations.
2. Evaluate the design of a scientific investigation.
3. Identify variables and/or controls in an experimental setup: independent variable and dependent variable.
- *4. Identify a testable hypothesis for an experiment.
- *5. Follow a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
6. Recognize potential hazards and practice safety procedures in all science activities.

Process Standard 4: Interpret and Communicate - Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

- *1. Report and record both quantitative/qualitative data in an appropriate method when given an experimental procedure or data. 📖
2. Interpret data tables, line, bar, trend, and/or circle graphs. 📖
3. Evaluate to develop reasonable explanation and/or predictions. 📖
- *4. Determine if results of investigations support or do not support hypotheses. 📖
- *5. Communicate scientific processes, procedures, and conclusions (e.g., model, poster, diagram, journal entry, lab report, scientific paper, oral presentation, and digital presentation). 📖

Priority Academic Student Skills

Process Standard 5: Inquiry - Inquiry can be defined as the skills necessary to carry out the process of scientific thinking. In order for inquiry to occur students must have the opportunity to make observations, pose questions, formulate testable hypotheses, carry out experiments, and make conclusions based on evidence. The student will accomplish these objectives to meet this process standard.

- *1. Ask questions that can be answered through scientific investigation.
- *2. Design and conduct experiments utilizing scientific processes.
- *3. Use the engineering design process to address a problem or need (e.g., identify a need, conduct background research, prepare preliminary designs, build and test a prototype, test and revise design, communicate results). 
- *4. Understand the value of technology and use technology to gather data and analyze results of investigations (e.g., probes, hand-held digital devices, digital cameras, software, computers, calculators, digital balances, GPS).
- *5. Develop a logical relationship between evidence and explanation to form and communicate a valid conclusion, and suggest alternative explanation.

PHYSICAL SCIENCE

Grade 8

Standard 1: Properties and Chemical Changes in Matter - Physical characteristics of objects can be described using shape, size, and mass. The materials from which objects are made can be described using color, texture, and hardness. These properties can be used to distinguish and separate one substance from another. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

- 1. Substances react chemically with other substances to form new substances with different characteristics (e.g., oxidation, combustion, acid/base reactions).
- 2. Matter has physical properties that can be measured (i.e., mass, volume, temperature, color, texture, density, and hardness) and chemical properties. In chemical reactions and physical changes, matter is conserved (e.g., compare and contrast physical and chemical changes).

Standard 2: Motions and Forces - The motion of an object can be described by its position, direction of motion, and speed as prescribed by Newton's Laws of Motion. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

Priority Academic Student Skills

1. The motion of an object can be measured. The position of an object, its speed, and direction can be represented on a graph.
2. An object that is not being subjected to a net force will continue to move at a constant velocity (i.e., inertia, balanced and unbalanced forces).

LIFE SCIENCE

Grade 8

Standard 3: Diversity and Adaptations of Organisms - Millions of species of animals, plants, and microorganisms are alive today. Although different species might look dissimilar, the unity among organisms becomes apparent from an analysis of internal and external structures. Adaptation involves the selection of naturally occurring variations in populations. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. By classifying organisms, biologists consider details of internal and external structure to infer the degree of relatedness among organisms (i.e., kingdom, phylum, class, order, family, genus, species).
2. Organisms have a great variety of internal and external structures that enable them to survive in a specific habitat (e.g., echolocation, seed dispersal).

EARTH/SPACE SCIENCE

Grade 8

Standard 4: Structures and Forces of the Earth and Solar System - The earth is mostly rock, three-fourths of its surface is covered by a relatively thin layer of water, and the entire planet is surrounded by a relatively thin blanket of air, and is able to support life. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Landforms result from constructive forces such as crustal deformation, volcanic eruption, and deposition of sediment and destructive forces such as weathering and erosion.
2. The formation, weathering, sedimentation, and reformation of rock constitute a continuing “rock cycle” in which the total amount of material stays the same as its form changes.
3. Atmospheric and ocean circulation patterns affect weather on a global scale (e.g., El Niño, La Niña, Gulf Stream).

Priority Academic Student Skills

Standard 5: Earth's History - The Earth's history involves periodic changes in the structures of the earth over time. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Earth's history has been punctuated by occasional catastrophic events (e.g., the impact of asteroids or comets, enormous volcanic eruptions, periods of continental glaciation, and the rise and fall of sea level).
2. Fossils provide important evidence of how life and environmental conditions have changed (e.g., Law of Superposition, index fossil, geologic time period, extinction).

Priority Academic Student Skills

SCIENCE OVERVIEW ORGANIZATION

The *Priority Academic Student Skills (PASS)* are organized by Science Process and Inquiry Standards and Content Standards which include Physical Science, Life Science, and Earth/Space Science. They are arranged by grade level at Grades 1-8, and by course subject area at the high school level. Each standard is followed by two or more objectives to accomplish each standard. Students should be provided with science experiences at each grade level from all areas of the content standards. This integrated approach will provide students with a coordinated, coherent understanding of the necessary skills and knowledge of scientifically literate citizens.

The Oklahoma State Testing Program assesses the Science *Priority Academic Student Skills (PASS)* with a 5th and 8th grade criterion-referenced test and a Biology I End-of-Instruction test. All of these state level assessments are based on the standards in this document.

The objectives presented in the “Science Processes and Inquiry” standards are included at all grade levels, because the understandings and abilities associated with these concepts need to be developed throughout a student’s educational experience.

The content standard areas (physical, life, earth/space) are designed to facilitate conceptual development by building on the content knowledge introduced at the PreKindergarten level. Because each of the content standards subsumes the knowledge and skills of the other standards, they are designed to be used as a whole. Although material can be added to the content standards, using only a portion of the standards will leave gaps in the scientific understanding expected of students.

SCIENCE STANDARDS Grades 1-12

The science framework presented in this outline is what students should know, understand, and be able to do in the natural sciences. Students combine process and knowledge as they use scientific reasoning and critical thinking to develop their understanding of science. Inquiry builds conceptual bridges between process and scientific knowledge. Relevant use of developmentally appropriate technology facilitates the inquiry process.

The attainment of scientific literacy is the result of a sequential curriculum that is dependent on quality science teaching at each grade level beginning in prekindergarten. Quality science teaching requires direct, inquiry-oriented learning experiences that emphasize the processes of science and major science concepts. Consistent with national standards, fewer concepts in physical, life and earth/space sciences are explored while more emphasis is placed on in-depth understanding. The following standards provide a framework to achieve the above goals.

The science standards are not a scope and sequence or a district curriculum guide. They provide a framework for schools to develop an aligned science curriculum and for teachers to develop their own classroom lessons. The science standards in this document were developed

Priority Academic Student Skills

based on the *National Science Education Standards* by the National Research Council (NRC) and the *Benchmarks for Scientific Literacy* by the American Association for the Advancement of Science (AAAS), and the *Science Frameworks* by the National Association for Education Progress (NAEP). The United States has established a goal for all students to achieve scientific literacy. These national publications, developed by science and education experts, will enable the nation and the state of Oklahoma to meet this goal.

NOTE:

Asterisks (*) have been used to identify standards and objectives that must be assessed by the local school district. All other skills may be assessed by the Oklahoma School Testing Program (OSTP).

Book icons (📖) identify Information Literacy skills. Students are best served when these are taught in collaboration and cooperation between the classroom teacher and the library media specialist.

Use of the term i.e. means “in exactness”; use of the term e.g. means “example given”.

OAC 210:15-3-70—210:15-3-82

Approved by the Oklahoma State Board of Education, March 24, 2011. Final approval pending by Oklahoma Governor and Legislature.

Priority Academic Student Skills

PHYSICAL SCIENCE

High School

Standards for Inquiry and the Physical Sciences

The *Priority Academic Student Skills (PASS)* should be taught by investigating broad, integrated content, concepts, and principles of major themes in the physical sciences.

SCIENCE PROCESSES AND INQUIRY

Process Standard 1: Observe and Measure - Observing is the first action taken by the learner to acquire new information about an object or event. Opportunities for observation are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Identify qualitative and quantitative changes given conditions (e.g., temperature, mass, volume, time, position, length) before, during, and after an event.
2. Use appropriate tools with accuracy and precision (e.g., metric ruler, graduated cylinder, thermometer, balances, spring scales, stopwatches) when measuring objects and/or events.
3. Use appropriate International System of Units (SI) (i.e., grams, meters, liters, degrees Celsius, and seconds) and SI prefixes (i.e., micro-, milli-, centi-, and kilo-) when measuring objects and/or events.

Process Standard 2: Classify - Classifying establishes order. Objects and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Using observable properties, place an object or event into a classification system.
2. Identify the properties by which a classification system is based.

Process Standard 3: Experimental Design - Understanding experimental design requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

1. Evaluate the design of a physical science experiment.
2. Identify the independent variables, dependent variables, controlled variables, and control set-up in an experiment.

Priority Academic Student Skills

3. Use mathematics to show relationships within a given set of observations.
4. Identify a hypothesis for a given problem in physical science investigations.
5. Recognize potential hazards and practice safety procedures in all physical science activities.

Process Standard 4: Interpret and Communicate - Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

1. Select appropriate predictions based on previously observed patterns of evidence.
- *2. Report and display data using appropriate technology and other media.
3. Interpret data tables, line, bar, trend, and/or circle graphs from existing science research or student experiments.
4. Determine if results of physical science investigations support or do not support hypotheses.
5. Evaluate experimental data to draw the most logical conclusion.
- *6. Routinely prepare a written report describing the sequence, results, and interpretation of a physical science investigation or event.
 - a. Establish and maintain a formal style and objective tone.
 - b. When appropriate or possible, utilize technology to produce, publish, or revise writing products.
 - c. Gather relevant information from multiple authoritative print and digital sources and follow a standard format for citation, avoiding plagiarism.
- *7. Communicate or defend scientific thinking that resulted in conclusions.
 - a. Read, comprehend, and present evidence from a range of sources (e.g. texts, experiments, simulations) to support conclusions.
 - b. Recognize bias in observation/research.

Priority Academic Student Skills

8. Identify and/or create an appropriate graph or chart from collected data, tables, or written description.
 - a. Translate quantitative information expressed in words into visual form (e.g., table, chart).
 - b. Translate information expressed visually or mathematically (e.g. a table, chart, or equation) into words.

Process Standard 5: Model - Modeling is the active process of forming a mental or physical representation from data, patterns, or relationships to facilitate understanding and enhance prediction. The student will accomplish these objectives to meet this process standard.

1. Interpret a model which explains a given set of observations.
2. Select predictions based on models, and when appropriate, apply mathematical reasoning to make accurate predictions.
- *3. Compare a given model to the physical world.

Process Standard 6: Inquiry - In order for inquiry to occur, students must have the opportunity to make observations, pose questions, formulate testable hypotheses, carry out experiments, and make conclusions based on evidence. The student will accomplish these objectives to meet this process standard.

- *1. Formulate a testable hypothesis and design an appropriate experiment relating to the physical world.
- *2. Design and conduct physical science investigations in which variables are identified and controlled.
- *3. Use a variety of technologies (e.g., probes, handheld digital devices, digital cameras, software, calculators, digital balances, microscopes, measuring instruments, computers) to collect, analyze, and display data.
- *4. Inquiries should lead to the formulation of explanations or models (physical, conceptual, and mathematical). In answering questions, students should engage in discussions (based on scientific knowledge, the use of logic, and evidence from the investigation) and arguments that encourage the revision of their explanations, leading to further inquiry.

Process Standard 7: Engineering Design - Engineering design can be defined as the creative process of turning abstract ideas into a physical prototype (laboratory apparatus, trial product, or model) that addresses a need

Priority Academic Student Skills

or solves a problem. In order for engineering design to occur, students must have the opportunity to identify a need or problem, establish design criteria, prepare preliminary designs, build then test a prototype, and test and redesign as necessary. The student will accomplish these objectives to meet this process standard:

- *1. Identify a need or problem or improve an existing design.
- *2. Identify design criteria and constraints (e.g., materials used, product limitations, time limits).
- *3. Use a variety of resources (e.g., Internet, databases, texts) to conduct research in order to develop a preliminary design.
- *4. Build and test a prototype. Document the strengths and weaknesses of the prototype in writing.
- *5. Analyze and redesign to determine which solution best meets the criteria and constraints.
- *6. Communicate results in a variety of ways (e.g., orally, written, Internet publications, videos, posters, product demonstrations).

PHYSICAL SCIENCE

High School

Standard 1: Structure and Properties of Matter – All matter is made up of atoms. Its structure is made up of repeating patterns and has characteristic properties. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

- 1. Matter is made up of minute particles called atoms, and atoms are composed of even smaller components (i.e., protons, neutrons, and electrons).
- 2. An element is identified by the number of protons (atomic number) in the nucleus.
 - a. When elements are listed in order of increasing number of protons, repeating patterns of physical and chemical properties identify families of elements with similar properties.
 - b. Elements found on the earth are also found throughout the universe.
- 3. Matter has characteristic properties that are unique for pure substances and can be used to separate one substance from another (e.g., boiling points, melting points, density).

Priority Academic Student Skills

4. A compound is formed when two or more kinds of atoms bind together chemically. Each compound is formed when two or more kinds of atoms bind together chemically. Each compound has unique chemical and physical properties.

Standard 2: Conservation of Matter – Matter is neither created nor destroyed in physical and chemical interactions. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Chemical changes are identified by one or more events (i.e., precipitate, color change, gas production, heat gain or loss).
2. Chemical equations are used to represent chemical changes in which reactant(s) form product(s).
3. Chemical reactions can be classified (e.g., synthesis/combination, decomposition, single displacement, double displacement).

Standard 3: Motion and Forces – The motion of an object can be described by its position, direction of motion, and speed. A change in motion occurs as a result of a net force. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Objects change their motion only due to a net force. Laws of motion are used to determine the effects of forces on the motion of objects. Gravitation is a universal force that each object exerts on any other object.
2. Moving electric charges produce magnetic forces, and moving magnets produce electric forces. Electricity and magnetism are two aspects of a single electromagnetic force (e.g., voltage, current, resistance, induction).

Standard 4: Interactions of Energy and Matter – Energy can be transferred or transformed but never destroyed. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Energy can be classified as kinetic energy (energy of motion) or potential energy (e.g., positional, elastic, chemical, nuclear).
2. Waves radiate energy and interact with matter.
 - a. Propagation of mechanical waves (e.g., sound, seismic, water) requires a medium.
 - b. Electromagnetic waves (radio waves to gamma rays) do not require a medium.

Priority Academic Student Skills

BIOLOGY I

HIGH SCHOOL

Standards for Inquiry and the Biological Sciences

The Priority Academic Student Skills (PASS) should be taught by investigating content, concepts, and principles of major themes in the Biological Sciences.

SCIENCE PROCESSES AND INQUIRY

High School

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an organism or event. Opportunities for observation are developed through the use of a variety of scientific tools, allowing the student to distinguish between observation and inference. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Identify qualitative and quantitative changes in cells, organisms, populations, and ecosystems given conditions (e.g., temperature, mass, volume, time, position, length, quantity) before, during, and after an event.
2. Use appropriate tools with accuracy and precision (e.g., microscope, pipette, metric ruler, graduated cylinder, thermometer, balance, stopwatch) when measuring cells, organisms, populations, and ecosystems.
3. Use appropriate International System of Units (SI) (i.e., grams, meters, liters, degrees Celsius, and seconds) and SI prefixes (i.e., micro-, milli-, centi-, and kilo-) when measuring objects and/or events.

Process Standard 2: Classify – Classifying establishes order. Organisms and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Using observable properties, place cells, organisms, and/or events into a biological classification system (e.g., dichotomous keys, taxonomy charts, cladograms).
2. Identify the properties by which a biological classification system is based.

Process Standard 3: Experimental Design – Understanding experimental design requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

Priority Academic Student Skills

1. Evaluate the design of a biology laboratory experiment.
2. Identify the independent variables, dependent variables, controlled variables, and control set-up in an experiment.
3. Use mathematics to show relationships within a given set of observations (e.g., population studies, biomass, probability).
4. Identify a hypothesis for a given problem in biology investigations.
5. Recognize potential hazards and practice safety procedures in all biology activities.

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

1. Select appropriate predictions based on previously observed patterns of evidence.
- *2. Report and display data using appropriate-technology and other media.
3. Interpret data tables, line, bar, trend, and/or circle graphs from existing science research or student experiments.
4. Determine if results of biological science investigations support or do not support hypotheses.
5. Evaluate experimental data to draw the conclusion that is best supported by the evidence.
- *6. Routinely prepare a written report describing the sequence, results, and interpretation of a biological investigation or event.
 - a. Establish and maintain a formal style and objective tone.
 - b. When appropriate or possible, utilize technology to produce, publish, or revise writing products.
 - c. Gather relevant information from multiple authoritative print and digital sources and follow a standard format for citation, avoiding plagiarism.

Priority Academic Student Skills

- *7. Communicate or defend scientific thinking that results in conclusions.
 - a. Read, comprehend, and present evidence from a range of sources (e.g., texts, experiments, or simulations) to support conclusions.
 - b. Recognize bias in observation/research.
- 8. Identify and/or create an appropriate graph or chart from collected data, tables, or written description (e.g., population studies, plant growth, heart rate).
 - a. Translate quantitative information expressed in words into visual form (e.g., a table or chart).
 - b. Translate information expressed visually or mathematically (e.g., a table, chart or equation) into words.

Process Standard 5: Model – Modeling is the active process of forming a mental or physical representation from data, patterns, or relationships to facilitate understanding and enhance prediction. The student will accomplish these objectives to meet this process standard.

- 1. Interpret a biological model which explains a given set of observations.
- 2. Select predictions based on models (e.g., pedigrees, life cycles), and when appropriate, apply mathematical reasoning to make accurate predictions.
- *3. Compare a given model to the living world.

Process Standard 6: Inquiry – Inquiry can be defined as the skills necessary to carry out the process of scientific or systemic thinking. In order for inquiry to occur students must have the opportunity to make observation, pose questions, formulate testable hypotheses, carry out experiments, and make conclusions based on evidence. The student will accomplish these objectives to meet this process standard.

- *1. Ask a scientific question, formulate a testable hypothesis, and design an appropriate experiment relating to the living world.
- *2. Design and conduct biological investigations in which variables are identified and controlled.
- *3. Use a variety of technologies (e.g., probes, handheld digital devices, electrophoresis equipment, digital cameras, software, calculators, digital balances, microscopes, measuring instruments, and computers) to collect, analyze and display data.

Priority Academic Student Skills

- *4. Inquiries should lead to the formulation of explanations or models (physical, conceptual, and mathematical). In answering questions, students should engage in research and discussions (based on scientific knowledge, the use of logic, and evidence from the investigation) and arguments that encourage the revision of their explanations, leading to further inquiry.

BIOLOGY I

High School

Standard 1: The Cell – Cells are the fundamental unit of life, composed of a variety of structures that perform functions necessary to maintain life. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Cells are composed of a variety of structures such as the nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.
 - a. The cell/plasma membrane functions (i.e., active transport, passive transport, diffusion, osmosis, and surface area to volume ratio) to maintain homeostasis.
 - b. Differentiate among hypotonic, hypertonic, and isotonic conditions.
 - c. Compare and contrast prokaryotic and eukaryotic cells.
2. In multicellular organisms, cells have levels of organization (i.e., cells, tissues, organs, organ systems, organisms).
3. Specialized cells enable organisms to monitor what is going on in the world around them (e.g., detect light, sound, specific chemicals, gravity, plant tropism, sense organs, homeostasis).

Standard 2: The Molecular Basis of Heredity – DNA determines the characteristics of organisms. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Cells function according to the information contained in the master code of DNA (i.e., cell cycle, DNA replication and transcription). Transfer RNA and protein synthesis will be taught in life science courses with rigor greater than Biology I.
2. A sorting and recombination of genes during sexual reproduction results in a great variety of possible gene combinations from the offspring of any two parents (i.e., Punnett squares and pedigrees). Students will understand concepts in a single trait cross (e.g., alleles, dominant trait, recessive trait, phenotype, genotype, homozygous, heterozygous, incomplete dominance, and sex-linked traits).

Priority Academic Student Skills

Standard 3: Biological Diversity – Diversity of species is developed through gradual processes over many generations. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Different species might look dissimilar, but the unity among organisms becomes apparent from an analysis of internal structures, the similarity of their chemical processes, and the evidence of common ancestry (e.g., homologous and analogous structures, embryology, fossil record, genetic data).
2. Characteristics of populations change through the mechanism of natural selection. These biological adaptations, including changes in structures, behaviors, and/or physiology, may enhance or limit survival and reproductive success within a particular environment.
3. Broad patterns of behavior exhibited by animals have changed over time to ensure reproductive success. Responses to external stimuli can result from interactions with the organism's own species and others, as well as environmental changes; these responses can be either innate or learned.

Standard 4: The Interdependence of Organisms – Interdependence of organisms in an environment includes the interrelationships and interactions between and among organisms. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Organisms both cooperate and compete in ecosystems (e.g., symbiotic relationships).
2. Living organisms have the capacity to produce populations of infinite size, but environments and resources limit population size (e.g., carrying capacity, limiting factors, ecological succession).

Standard 5: Matter, Energy, and Organization in Living Systems – Living systems require a continuous input of energy to maintain their chemical and physical organizations. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. The complexity and organization of organisms accommodates the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism (i.e., photosynthesis and cellular respiration).
2. As matter and energy flow through different levels of organization of living systems and between living systems and the physical environment, chemical elements are recombined in different ways by different structures. Matter and energy are conserved in each change (i.e., water cycle, carbon cycle, nitrogen cycle, food webs, and energy pyramids).

Priority Academic Student Skills

3. Matter on earth cycles among the living (biotic) and nonliving (abiotic) components of the biosphere.

Priority Academic Student Skills

CHEMISTRY

HIGH SCHOOL

The Priority Academic Student Skills (PASS) should be taught by investigating content, concepts, and principles of major themes in chemistry.

SCIENCE PROCESSES AND INQUIRY

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an object or event. Opportunities for observation are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Identify qualitative changes in reactions and quantitative changes in chemical reactions given conditions (e.g., temperature, mass, volume, time, position, length) before, during and after an event.
2. Use appropriate tools with accuracy and precision (e.g., metric ruler, graduated cylinder, thermometer, balance, spring scale, stopwatch, probeware, graphing calculators, digital cameras, computer simulations) when measuring objects and/or events.
3. Use appropriate International Systems of Units (SI) (i.e., meters, liters, degrees Celsius, and seconds) and SI prefixes (i.e., micro-, milli-, centi-, and kilo-) when measuring mass volume and temperature.

Process Standard 2: Classify – Classifying establishes order. Objects and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Using observable properties, place an object or event (i.e., chemical versus physical, charge, electron level, and reaction types) into a classification system
2. Identify properties by which a classification system is based.

Process Standard 3: Experimental Design – Understanding experimental design requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

1. Evaluate the design of a chemistry laboratory experiment.

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2. Identify the independent variables, dependent variables, controlled variables, and control in an experiment.
3. Use mathematics to show relationships within a given set of observations (i.e., conservation of mass and stoichiometry).
4. Identify a hypothesis for a given problem in chemistry investigations.
5. Recognize potential hazards and practice safety procedures in all chemistry laboratory activities.

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

1. Select appropriate predictions based on previously observed patterns of evidence.
- *2. Report and display data using appropriate technology and other media.
3. Interpret data tables, line, bar, trend, and/or circle graphs from existing science research or student experiments.
4. Determine if results of chemical science investigations support or do not support hypotheses.
5. Evaluate experimental data to draw the most logical conclusion.
- *6. Routinely prepare a written report describing the sequence, results, and interpretation of a chemistry investigation or event.
 - a. Establish and maintain a formal style and objective tone.
 - b. When appropriate or possible, utilize technology to produce, publish, or revise writing products.
 - c. Gather relevant information from multiple authoritative print and digital sources and follow a standard format for citation, avoiding plagiarism.
- *7. Communicate or defend scientific thinking that resulted in conclusions.

Priority Academic Student Skills

- a. Read, comprehend, and present evidence from a range of sources (e.g., texts, experiments, or simulations) to support conclusions.
 - b. Recognize bias in observation/research.
8. Identify and/or create an appropriate graph or chart from collected data, tables, or written description.
- a. Translate quantitative information expressed in words into visual form (e.g., a table or chart).
 - b. Translate information expressed visually or mathematically (e.g., a table, chart, or equation) into words.

Process Standard 5: Model – Modeling is the active process of forming a mental or physical representation from data, patterns, or relationships to facilitate understanding and enhance prediction. The student will accomplish these objectives to meet this process standard.

1. Interpret an atomic model which explains a given set of observations.
2. Select predictions based on models (e.g., electron configuration, bonding, compound formation), and when appropriate, apply mathematical reasoning to make accurate predictions.
- *3. Compare a given model to the physical world.

Process Standard 6: Inquiry – In order for inquiry to occur, students must have the opportunity to make observations, pose questions, formulate testable hypotheses, carry out experiments, and make conclusions based on evidence. The student will accomplish these objectives to meet this process standard.

- *1. Ask a scientific question, formulate a testable hypothesis, and design an appropriate experiment to identify an unknown substance.
- *2. Design and conduct scientific investigations in which variables are identified and controlled.
- *3. Use a variety of technologies (e.g., hand tools, balances, conductivity apparatus, thermometers, graduated cylinders, volumetric flasks, computers, probeware, graphing calculators, digital cameras, computer simulations) to collect, analyze, and display data.
- *4. Inquiries should lead to the formulation of explanations or models (physical, conceptual, and mathematical). In answering questions, students should engage in

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discussions (based on scientific knowledge, the use of logic, and evidence from the investigation) and arguments that encourage the revision of their explanations, leading to further inquiry.

Process Standard 7: Engineering Design - Engineering design can be defined as the creative process of turning abstract ideas into a physical prototype (laboratory apparatus, trial product, model) that addresses a need or solves a problem. In order for engineering design to occur, students must have the opportunity to identify a need or problem, establish design criteria, prepare preliminary designs, build then test a prototype, and test and redesign as necessary. The student will accomplish these objectives to meet this process standard:

- *1. Identify a need or problem or improve an existing design.
- *2. Identify design criteria and constraints (e.g., materials used, product limitations, time limits).
- *3. Use a variety of resources (e.g., Internet, databases, text) to conduct research in order to develop a preliminary design.
- *4. Build and test a prototype. Document the strengths and weaknesses of the prototype in writing.
- *5. Analyze and redesign to determine which solutions best meet the criteria and constraints.
- *6. Communicate results in a variety of ways (e.g., orally, written, Internet publications, videos, posters, or product demonstrations).

CHEMISTRY

High School

Standard 1: Structure and Properties of Matter - All matter is made up of atoms. Its structure is made up of repeating patterns and has characteristic properties. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

- 1. Matter is made of atoms which are in constant motion. Atoms are composed of subatomic particles (e.g., protons, neutrons, electrons, quarks).
- 2. Atoms interact with one another by transferring or sharing outer electrons that are farthest from the nucleus. These outer electrons govern the chemical properties of the element.

Priority Academic Student Skills

3. When elements are listed in order by increasing numbers of protons, repeating patterns of physical and chemical properties identify families of elements with similar properties.
4. A compound is formed when two or more kinds of atoms bind together chemically.
 - a. Atoms interact with one another by transferring (ionic) or sharing (covalent) valence electrons.
 - b. Valence electrons govern the chemical properties and reactivity of the element.
 - c. Each compound has unique chemical and physical properties.

Standard 2: Chemical Reactions - A chemical reaction is a reaction in which one or more substances are changed into different substances. A chemical change cannot be reversed by physical means. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Chemical substances react in definite molar weight proportions and mass is conserved. Balanced chemical equations are used to determine molar ratios.
2. Chemical reactions can be classified (e.g., synthesis/combination, decomposition, single displacement, double displacement, combustion, oxidation/reduction, acid/base). Reaction classification aids in the prediction of products.
3. The rate of a chemical reaction is affected by the concentration and temperature of reactants and presence of a catalyst.

Standard 3: Interactions of Energy and Matter – Total energy is conserved in a closed system. The student will engage in investigations that integrate the process and inquiry standards and lead to the discovery of the following objectives:

1. Matter can be found in four phases (i.e., solid, liquid, gas, plasma). Phase change occurs when heat energy is absorbed or released from the system.
2. Chemical reactions in a system either release energy to the surroundings (exothermic) or absorb energy from the surroundings (endothermic), as a result of breaking or forming bonds between atoms.
3. The amount of heat gained or released during interactions (e.g., phase changes, chemical reactions, specific heat) can be quantified using calorimetric methods.
4. As energy varies in a closed system containing a gas, the parameters (i.e., volume, temperature, and pressure) are governed by specific laws (i.e., Avogadro's Law, Boyle's Law, Charles' Law, Dalton's Law, Ideal Gas Law).

Priority Academic Student Skills

Standard 4: Solution chemistry – Solutions are homogenous mixtures of solutes dissolved in solvents. Most chemical reactions occur in solutions. The student will engage in investigations that integrate the process and inquiry standards and lead to the discovery of the following objectives:

1. Dissolving rates can be influenced by conditions (e.g., temperature, surface area of solute, particle collisions, pressure concentration).
2. Solutions can be classified by the amount of solute dissolved by a solvent (i.e., unsaturated, saturated, supersaturated). Solution concentration can be quantified.

Priority Academic Student Skills

PHYSICS

High School

Standards for Inquiry and Physics

The *Priority Academic Student Skills (PASS)* should be taught by investigating content, concepts, and principles of major themes in Physics.

SCIENCE PROCESSES AND INQUIRY

Process Standard 1: Observe and Measure - Observing is the first action taken by the learner to acquire new information about an object or event. Opportunities for observation are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Identify qualitative and quantitative changes given conditions (e.g., temperature, mass, volume, time, position, length) before, during, and after an event.
2. Use appropriate tools with accuracy and precision (e.g., metric ruler, graduated cylinder, thermometer, balance, spring scale, stopwatch, probeware, graphing calculators, digital cameras, computer simulations) when measuring objects and/or events.
3. Use appropriate International System of Units (SI) (i.e., grams, meters, liters, degrees Celsius, and seconds) and SI prefixes (i.e., micro-, milli-, centi-, and kilo-) when measuring objects and/or events.

Process Standard 2: Classify - Classifying establishes order. Objects and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Using observable properties, place an object or event into a classification system.
2. Identify the properties by which a classification system is based.
3. Graphically classify physical relationships (e.g., linear, parabolic, inverse).

Process Standard 3: Experimental Design - Understanding experimental design requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

Priority Academic Student Skills

1. Evaluate the design of a physics experiment.
2. Identify the independent variables, dependent variables, controlled variables, and control in an experiment.
3. Use mathematics to show relationships within a given set of observations.
4. Identify a hypothesis for a given problem in physics investigations.
5. Recognize potential hazards and practice safety procedures in all physics activities.

Process Standard 4: Interpret and Communicate - Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

1. Select appropriate predictions based on previously observed patterns of evidence.
- *2. Report and display data using appropriate using technology and other media.
3. Interpret data tables, line, bar, trend, and/or circle graphs from existing science research or student experiments.
4. Determine if results of physical science investigations support or do not support hypotheses.
5. Evaluate experimental data to draw the most logical conclusion.
- *6. Routinely prepare a written report describing the sequence, results, and interpretation of a chemistry investigation or event.
 - a. Establish and maintain a formal style and objective tone.
 - b. When appropriate or possible, utilize technology to produce, publish, or revise writing products.
 - c. Gather relevant information from multiple authoritative print and digital sources and follow a standard format for citation, avoiding plagiarism.
- *7. Communicate or defend scientific thinking that resulted in conclusions.

Priority Academic Student Skills

- a. Read, comprehend, and present evidence from a range of sources (e.g., texts, experiments, or simulations) to support conclusions.
 - b. Recognize bias in observation/research.
8. Identify and/or create an appropriate graph or chart from collected data, tables, or written description.
 - a. Translate quantitative information expressed in words into visual form (e.g., a table or chart).
 - b. Translate information expressed visually or mathematically (e.g., a table, chart, or equation) into words.

Process Standard 5: Model - Modeling is the active process of forming a mental or physical representation from data, patterns, or relationships to facilitate understanding and enhance prediction. The student will accomplish these objectives to meet this process standard.

1. Interpret a model which explains a given set of observations.
2. Select predictions based on models and when appropriate, apply mathematical reasoning to make accurate predictions.
- *3. Compare a given model to the physical world.

Process Standard 6: Inquiry - Inquiry can be defined as the skills necessary to carry out the process of scientific or systemic thinking. In order for inquiry to occur, students must have the opportunity to ask a question, formulate a procedure, and observe phenomena. The student will accomplish these objectives to meet this process standard.

- *1. Ask a scientific question, formulate a testable hypothesis, and design an appropriate experiment relating to the physical world.
- *2. Design and conduct physics investigations in which variables are identified and controlled.
- *3. Use a variety of technologies (e.g., hand tools, measuring instruments, computers, probeware, graphing calculators, digital cameras, digital balances, computer simulations) to collect, analyze, and display data).
- *4. Inquiries should lead to the formulation of explanations or models (physical, conceptual, and mathematical). In answering questions, students should engage in discussions (based on scientific knowledge, the use of logic, and evidence from the

Priority Academic Student Skills

investigation) and arguments that encourage the revision of their explanations, leading to further inquiry.

Process Standard 7: Engineering Design - Engineering design can be defined as the creative process of turning abstract ideas into a physical prototype (laboratory apparatus, trial product, model) that addresses a need or solves a problem. In order for engineering design to occur, students must have the opportunity to identify a need or problem, establish design criteria, prepare preliminary designs, build then test a prototype, and test and redesign as necessary. The student will accomplish these objectives to meet this process standard:

- *1. Identify a need or problem or improve an existing design.
- *2. Identify design criteria and constraints (e.g., materials used, product limitations, time limits).
- *3. Use a variety of resources (e.g., Internet, databases, text) to conduct research in order to develop a preliminary design.
- *4. Build and test a prototype. Document the strengths and weaknesses of the prototype in writing.
- *5. Analyze and redesign to determine which solutions best meet the criteria and constraints.
- *6. Communicate results in a variety of ways (e.g., orally, written, Internet publications, videos, posters, product demonstrations).

PHYSICS

High School

Standard 1: Motion – The change in position of an object is motion. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

- 1. The motion of an object can be described by its position, direction, and speed.
- 2. Motion can be modeled in terms of 1- or 2-dimensions relative to a system's defined reference point (e.g., particle model, vector model, graphical model).
- 3. Objects undergoing acceleration can be mathematically modeled using time, displacement, velocity, and acceleration equations.

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Standard 2: Force - A change in motion occurs as a result of a net force. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Objects change their motion due to a net force. Newton's Laws of Motion are used to calculate the effects of forces on the motion of objects (e.g., balanced vs. unbalanced forces, momentum, inertia, impulse, action vs. reaction, friction, torque).
2. Gravitation is a universal force that each object exerts on any other object. The strength of the gravitational attractive force between two objects is proportional to the masses and inversely proportional to the square of the distance between them (e.g., Law of Universal Gravitation, Kepler's Law).
3. The electric force is a universal force that exists between any two charged objects. The strength of the force is proportional to the charges and inversely proportional to the square of the distance between them (e.g., Coulomb's Law).
4. Electricity and magnetism are two aspects of a single electromagnetic force (e.g., series/parallel/complex circuits, electromagnets, induction, Ohm's Law, generators, motors, capacitors).

Standard 3: Energy - The total energy of the universe is constant. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Energy in a system is never created nor destroyed but may be transferred or transformed (e.g., Law of Conservation of Energy, Laws of Thermodynamics).
 - a. As changes occur, energy becomes less ordered.
 - b. Conservation of energy can be modeled (e.g., pendulum motion, spring system).
2. Energy can be classified as kinetic energy (energy of motion) or potential energy (e.g., positional, elastic, chemical, nuclear).

Standard 4: Interactions of Energy and Matter – Energy interacts with matter and is transferred during these interactions. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Heat is energy transferred due to temperature differences within a system. The amount of heat is also dependent on the mass and type of substances.
2. Transfer of energy and changes in wave properties (e.g., speed, amplitude, wavelength, frequency) may occur as waves and matter interact (e.g., reflection, refraction, diffraction, interference).

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3. When work is done on an object, energy is transferred.
4. Machines change the force/distance ratios involved in doing work.
5. Power is the rate at which work is done.

Priority Academic Student Skills

Environmental Science

High School

Standards for Environmental Science

The *Priority Academic Student Skills (PASS)* should be taught by investigating content, concepts, and principles of major themes in Environmental Science.

SCIENCE PROCESSES AND INQUIRY

Process Standard 1: Observe and Measure - Observing is the first action taken by the learner to acquire new information about an object or event. Opportunities for observation are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Identify qualitative and quantitative changes given conditions (e.g., temperature, mass, volume, time, position, length) before, during, and after an event.
2. Use appropriate tools (e.g., metric ruler, graduated cylinder, thermometer, balance, spring scale, stopwatch) when measuring objects and/or events.
3. Use appropriate International System of Units (SI) (i.e., grams, meters, liters, degrees Celsius, and seconds) and SI prefixes (i.e., micro-, milli-, centi-, and kilo-) when measuring objects and/or events.

Process Standard 2: Classify - Classifying establishes order. Objects and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Using observable properties, place an object or event into a classification system.
2. Identify the properties by which a classification system is based.

Process Standard 3: Experimental Design – Understanding experimental design requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

1. Evaluate the design of an environmental experiment.
2. Identify the independent variables, dependent variables, controlled variables, and controls in an experiment.

Priority Academic Student Skills

3. Use mathematics to show relationships within a given set of observations.
4. Identify a hypothesis for a given problem in environmental investigations.
5. Recognize potential hazards and practice safety procedures in all environmental activities.

Process Standard 4: Interpret and Communicate - Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

1. Select appropriate predictions based on previously observed patterns of evidence.
- *2. Report and display data using appropriate technology and other media.
3. Interpret data tables, line, bar, trend, and/or circle graphs from existing research or student experiments.
4. Determine if results of environmental science investigations support or do not support hypotheses.
5. Evaluate experimental data to draw the most logical conclusion.
- *6. Routinely prepare a written report describing the sequence, results, and interpretation of an environmental investigation or event.
 - a. Establish and maintain a formal style and objective tone.
 - b. When appropriate or possible, utilize technology to produce, publish, or revise writing products.
 - c. Gather relevant information from multiple authoritative print and digital sources and follow a standard format for citation, avoiding plagiarism.
- *7. Communicate or defend scientific thinking that resulted in conclusions.
 - a. Read, comprehend, and present evidence from a range of sources (e.g. texts, experiments, or simulations) to support conclusions.
 - b. Recognize bias in observation/research.

Priority Academic Student Skills

8. Identify and/or create an appropriate graph or chart from collected data, tables, or written description.
 - a. Translate quantitative information expressed in words into visual form (e.g. a table or chart).
 - b. Translate information expressed visually or mathematically (e.g. a table, chart, or equation) into words.

Process Standard 5: Model - Modeling is the active process of forming a mental or physical representation from data, patterns, or relationships to facilitate understanding and enhance prediction. The student will accomplish these objectives to meet this process standard.

1. Interpret a model which explains a given set of observations.
2. Select predictions based on models, and when appropriate, apply mathematical reasoning to make accurate predictions.
- *3. Compare a given model to the physical world.

Process Standard 6: Inquiry - Inquiry can be defined as the skills necessary to carry out the process of scientific or systemic thinking. In order for inquiry to occur, students must have the opportunity to ask a question, formulate a procedure, and observe phenomena. The student will accomplish these objectives to meet this process standard.

- *1. Ask a scientific question, formulate a testable hypothesis and design an appropriate experiment relating to the physical world.
- *2. Design and conduct environmental investigations in which variables are identified and controlled.
- *3. Use a variety of technologies, (e.g., hand tools, measuring instruments, computers, handheld digital devices, digital cameras, software, calculators, digital balances, microscopes, measuring instruments and computers) to collect, analyze, and display data).
- *4. Inquiries should lead to the formulation of explanations or models (physical, conceptual, and mathematical). In answering questions, students should engage in discussions (based on scientific knowledge, the use of logic, and evidence from the investigation) and arguments that encourage the revision of their explanations, leading to further inquiry.

Priority Academic Student Skills

Environmental Science

High School

Standard 1: The Physical Earth system – The Physical Earth system is determined by dynamic and static processes revealed through investigations of the geosphere, atmosphere, and hydrosphere. These interrelated processes are large-scale and long-term characteristics of the Earth that require knowledge of energy and matter. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Composition and structure of the Earth is affected by an interaction of processes and events.
 - a. Geologic processes affect the Earth over time (e.g., plate tectonics, erosion).
 - b. Atmospheric processes affect the Earth over time (e.g., changes in daily weather conditions, convection/conduction/radiation, greenhouse effect, climate trends).
 - c. Hydrologic processes affect the Earth over time (e.g., water cycle, ocean currents, ground water transport).
 - d. Earth’s current structure has been influenced by both sporadic and gradual events.
2. Natural systems require a certain amount of energy input to maintain their organization (i.e., Laws of Thermodynamics).

Standard 2: The Living Earth System – The living environment is comprised of interrelated, dynamic systems of the biosphere. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. The biosphere can be examined at several levels (e.g., biome, ecosystem, community, population, species, organism).
2. Ecosystems are composed of biotic and abiotic factors. Matter and energy move between these factors.
3. Energy flows through ecosystems from the sun to producers to consumers (e.g., photosynthesizers, chemoautotrophs).
4. Matter flows through biogeochemical cycles (i.e., carbon, nitrogen, phosphorus, water).

Priority Academic Student Skills

5. Cycling of matter and the flow of energy are governed by the Laws of Conservation of Matter and Energy.

Standard 3: Populations – A population is a group of naturally-interbreeding individuals of one species, living in a defined area, and usually isolated to some degree from similar groups. Populations are dynamic: they increase, decrease, or stabilize depending on their interactions with other populations and with their environment. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Organisms and populations both cooperate and compete in ecosystems and/or habitats for resources (e.g., symbiotic relationships, limiting factors).
2. Mutation and environmental selective pressures may result in adaptations which may enhance or limit the survival and reproductive success in a particular environment (e.g., changes in structures, behaviors, diversity).
3. Each population has specific properties including size, density, and pattern of dispersion (e.g., carrying capacity and exponential growth).

Standard 4: Natural Resources – Natural resources are raw materials and energy obtained or derived from the environment. The student will engage in investigations that integrate the process and inquiry standards and lead to the discovery of the following objectives:

1. Natural resources are classified as renewable or nonrenewable.
 - a. Only a small fraction of Earth’s water supply is available for human use.
 - b. Soil conservation methods are important for protecting and managing topsoil and reducing erosion.
 - c. Fossil fuels (coal, oil, natural gas) are carbon containing molecules that take millions of years to form. Reserves are being depleted much faster than new ones are being made.
2. Pollution is an undesired change in air, water, or soil that adversely affects the health, survival, or activities of organism (e.g., temperature inversion, pH changes, organic and inorganic substances).
3. Alternative energy sources include wind power, active and passive solar power, geothermal power, and biomass power.

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Standard 5: Environment and Society – Environmental perspective encompasses how one thinks society works in relation to environmental issues, what one believes the environmental world should be, and what is ethical environmental behavior. Sustainability is a long-term process to maintain a quality environment for future generations. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. As human populations and their consumption levels increase, it becomes more difficult to sustain environmental quality.
2. Environmental issues can be described in terms of qualitative and quantitative costs and benefits for different groups of people and specific species or ecosystems (e.g., oil spills, energy consumption, invasive species, natural disasters).
3. People are capable of reducing and reversing their impact on the environment because they can think, plan, and educate.
 - a. Governments develop policies to address environmental problems and establish agencies to implement those policies.
 - b. Individuals and groups have the ability and responsibility to help maintain environmental quality and resolve environmental problems and issues.
 - c. A variety of methods are used to analyze the sustainability of current trends in world population growth and natural resource consumption (e.g., carrying capacity, ecological footprints).