

# ***Priority Academic Student Skills***

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## **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 5<sup>th</sup> and 8<sup>th</sup> 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. After the standards for each of the tested grade levels is an Oklahoma Core Curriculum Test Blueprint. The blueprints show the approximate number of items and the approximate percent of the test for each standard and objective in this document that is assessed on the state level test.

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 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 based on the *National Science Education Standards* by the National Research Council and the


## ***Priority Academic Student Skills***

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*Benchmarks for Scientific Literacy* by the American Association for the Advancement of Science. 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:**

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# *Priority Academic Student Skills*

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## PHYSICAL SCIENCE

### High School

#### **Standards for Inquiry and the Physical Sciences (including Earth/Space Science)**

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 (e.g., metric ruler, graduated cylinder, thermometer, balances, spring scales, stopwatches) when measuring objects and/or events.
3. Use appropriate System International (SI) units (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: 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. Evaluate the design of a physical science investigation.
2. Identify the independent variables, dependent variables, and controls in an experiment.
3. Use mathematics to show relationships within a given set of observations.

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## ***Priority Academic Student Skills***

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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 data in an appropriate manner. 
3. Interpret data tables, line, bar, trend, and/or circle graphs. 
4. Accept or reject hypotheses when given results of a physical science investigation. 
5. Evaluate experimental data to draw the most logical conclusion. 
- \*6. Prepare a written report describing the sequence, results, and interpretation of a physical science investigation or event. 
- \*7. Communicate or defend scientific thinking that resulted in conclusions. 
8. Identify and/or create an appropriate graph or chart from collected data, tables, or written description. 


**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.
- \*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.

## *Priority Academic Student Skills*

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- \*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, such as hand tools, 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.

### **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 composed of a single type of atoms. When elements are listed in order according to the number of protons (called the atomic number), repeating patterns of physical and chemical properties identify families of elements with similar properties.
- 3. Matter has characteristic properties, such as boiling points, melting points, and density, which distinguish pure substances and can be used to separate one substance from another.

**Standard 2: Motion and Forces - The motion of an object can be described by its position, direction of motion, and speed. A change in motion occurs when a net force is applied. 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 when a net force is applied. Laws of motion are used to determine the effects of forces on the motion of objects.
- 2. Gravitation is a universal force that each mass exerts on any other mass.

**Standard 3: Interactions of Energy and Matter - Energy, such as potential, kinetic, and field, 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. All energy can be considered to be either kinetic energy, which is the energy of motion; potential energy, which depends on relative position; or energy contained by a field, such as electromagnetic waves.

## ***Priority Academic Student Skills***

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2. Waves, including sounds and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter (such as used in telescopes, solar power, and telecommunication technology).

**Standard 4: The Earth System - A system that has changed over time, which includes dynamic changes in the earth's crust, is the Earth system. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:**

1. Geologic time can be estimated by observing rock sequences and using fossils to correlate the sequences at various locations.
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 and mountain building).

**Standard 5: The Universe - The universe is an ever-changing system of matter and energy that exists now, in the past, and in the future. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:**

1. The stars differ from each other in size, temperature, and age, but they appear to be made up of the same elements that are found on the earth.
2. All stars have a life cycle including birth, development, and death. Fusion reactions in stars release great amounts of energy and matter over millions of years.

# *Priority Academic Student Skills*

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## 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. 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 (e.g., microscope, pipette, metric ruler, graduated cylinder, thermometer, balances, stopwatches) when measuring cells, organisms, populations, and ecosystems.
3. Use appropriate System International (SI) units (i.e., grams, meters, liters, degrees Celsius, and seconds); and SI prefixes (i.e., micro-, milli-, centi-, and kilo-) when measuring cells, organisms, populations, and ecosystems.


**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.
2. Identify the properties by which a biological classification system is based.

**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. Evaluate the design of a biology laboratory investigation.
2. Identify the independent variables, dependent variables, and controls in an experiment.

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## ***Priority Academic Student Skills***

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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 data in an appropriate manner. 
3. Interpret data tables, line, bar, trend, and/or circle graphs. 
4. Accept or reject hypotheses when given results of a biological investigation. 
5. Evaluate experimental data to draw the most logical conclusion. 
- \*6. Prepare a written report describing the sequence, results, and interpretation of a biological investigation or event. 
- \*7. Communicate or defend scientific thinking that results in conclusions. 
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). 

**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 such as pedigrees, life cycles, energy pyramids.
- \*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 ask a question, formulate a procedure, and observe phenomena. The student will accomplish these objectives to meet this process standard.**

- \*1. Formulate a testable hypothesis and design an appropriate experiment relating to the living world.

## ***Priority Academic Student Skills***

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- \*2. Design and conduct biological investigations in which variables are identified and controlled.
- \*3. Use a variety of technologies, such as hand tools, 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.

### **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 membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.
2. Cells can differentiate and may develop into complex multicellular organisms (i.e., cells, tissues, organs, organ systems, organisms).

**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 to DNA, and DNA to RNA). 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 in 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 the following concepts in a single trait cross: alleles, dominant trait, recessive trait, phenotype, genotype, homozygous, and heterozygous.

**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).
2. Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations. Biological adaptations include changes in structures, behaviors, or physiology, which may enhance or limit the survival and reproductive success in a particular environment.

## ***Priority Academic Student Skills***

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**Standard 4: The Interdependence of Organisms - Interrelationships and interactions between and among organisms in an environment is the interdependence of organisms. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:**

1. Matter on the earth cycles among the living and nonliving components of the biosphere.
2. Organisms both cooperate and compete in ecosystems (i.e., parasitism and symbiosis).
3. Living organisms have the capacity to produce populations of infinite size, but environments and resources limit population size (i.e., carrying capacity and limiting factors).

**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).

**Standard 6: The Behavior of Organisms - Organisms have behavioral responses to internal changes and to external stimuli. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:**

1. 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).
2. Responses to external stimuli can result from interactions with the organism's own species and others, as well as environmental changes; these responses either can be innate or learned. Broad patterns of behavior exhibited by animals have changed over time to ensure reproductive success.

# *Priority Academic Student Skills*

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## CHEMISTRY High School

### Standards for Inquiry and Chemistry

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 (e.g., metric ruler, graduated cylinder, thermometer, balances, spring scales, stopwatches) when measuring objects and/or events.
3. Use appropriate System International (SI) units (i.e., grams, 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, electrons into charge, electron levels, and reaction types) into a classification system.
2. Identify properties by which a classification system is based.

**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. Evaluate the design of a chemistry laboratory investigation.
2. Identify the independent variables, dependent variables, and controls in an experiment.
3. Use mathematics to show relationships within a given set of observations (i.e., conservation of mass and stoichiometry).

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## ***Priority Academic Student Skills***

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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 data in an appropriate manner. 
3. Interpret data tables, line, bar, trend, and/or circle graphs. 
4. Accept or reject hypotheses when given results of a chemistry investigation. 
5. Evaluate experimental data to draw the most logical conclusion. 
- \*6. Prepare a written report describing the sequence, results, and interpretation of a chemistry investigation or event. 
- \*7. Communicate or defend scientific thinking that resulted in conclusions. 
8. Identify and/or create an appropriate graph or chart from collected data, tables, or written description. 

**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 such as electron configuration, bonding, and compound formation.
- \*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. Formulate a testable hypothesis and design an appropriate experiment to identify an unknown substance.

## *Priority Academic Student Skills*

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- \*2. Design and conduct scientific investigations in which variables are identified and controlled.
- \*3. Use a variety of technologies, such as hand tools, balances, conductivity apparatus, thermometers, graduated cylinders, volumetric flasks, 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.

### **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 and inquiry standards and lead to the discovery of the following objectives:**

1. Matter is made of atoms and atoms are composed of even smaller components (i.e., protons, neutrons and electrons).
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.
3. An element is composed of a single type of atom. When elements are listed in order according to the number 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. Each compound has unique chemical and physical properties.
5. Solids, liquids, and gases differ in the energy that binds them together.

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

1. A large number of important reactions involve the transfer of either electrons (oxidation/reduction) or hydrogen ions (acid/base reactions).
2. The rate of chemical reactions is affected by the concentration and temperature of the reacting materials. Catalysts accelerate chemical reactions.
3. Chemical substances react in definite molar weight proportions.
4. Mass is conserved in chemical reactions (balancing of equations).

# *Priority Academic Student Skills*

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## 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 (e.g., metric ruler, graduated cylinder, thermometer, balances, spring scales, stopwatches) when measuring objects and/or events.
3. Use appropriate System International (SI) units (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: 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. Evaluate the design of a physics investigation.
2. Identify the independent variables, dependent variables, and controls 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.

## ***Priority Academic Student Skills***

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**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 data in an appropriate manner. 
3. Interpret data tables, line, bar, trend, and/or circle graphs. 
4. Accept or reject hypotheses when given results of a physics investigation. 
5. Evaluate experimental data to draw the most logical conclusion. 
- \*6. Prepare a written report describing the sequence, results, and interpretation of a physics investigation or event. 
- \*7. Communicate or defend scientific thinking that resulted in conclusions. 
8. Identify and/or create an appropriate graph or chart from collected data, tables, or written description. 

**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.
- \*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. 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, such as hand tools, measuring instruments, and computers to collect, analyze, and display data.

## *Priority Academic Student Skills*

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- \*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.

### **PHYSICS**

#### **High School**

**Standard 1: Motions and Forces - The motion of an object can be described by its position, direction of motion, and speed. A change in motion occurs when a net force is applied. The student will engage in investigations that integrate the process and inquiry standards and lead to the discovery of the following objectives:**

1. Objects change their motion only when a net force is applied. Newton's laws of motion are used to calculate precisely the effects of forces on the motion of objects.
2. Gravitation is a universal force that each mass exerts on any other mass. The strength of the gravitational attractive force between two masses is proportional to the masses and inversely proportional to the square of the distance between them.
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, as with gravitation, inversely proportional to the square of the distance between them.
4. Electricity and magnetism are two aspects of a single electromagnetic force.

**Standard 2: Conservation of Energy - The total energy of the universe is constant. The student will engage in investigations that integrate the process and inquiry standards and lead to the discovery of the following objectives:**

1. Energy can be transferred but never destroyed. As these transfers occur, the matter involved becomes steadily less ordered.
2. All energy can be considered to be kinetic energy, potential energy, or energy contained by a field.
3. Heat consists of random motion and the vibrations of atoms, molecules, and ions. The higher the temperature, the greater the atomic or molecular motion.

**Standard 3: Interactions of Energy and Matter - Energy (potential, kinetic and field) interacts with matter and is transferred during these interactions. The student will engage in investigations that integrate the process and inquiry standards and lead to the discovery of the following objectives:**

1. Waves have energy and can transfer energy when they interact with matter. Sound waves and electromagnetic waves are fundamentally different.
2. Electromagnetic waves result when a charged object is accelerated or decelerated.

# *Priority Academic Student Skills*

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## GLOSSARY

**classifying** - classifying establishes order. Objects, organisms, and events are classified based on similarities, differences, and interrelationships.

**communicating** - 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.

**experimenting** - experimenting is a method of discovering information. It requires making observations and measurements to test ideas.

**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.

**interpreting** - interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions.

**modeling** - modeling is the active process of forming a mental or physical representation from data, patterns, or relationships to facilitate understanding and enhance prediction.

**observing and measuring** - observing is the first action taken by the learner to acquire new information about an object or event. Opportunities for observations are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified.

**qualitative changes** - qualitative changes refer to any characteristics of, relating to, or involving quality or kind. Examples include texture, color, or odor.

**qualitative observations** - qualitative observations describe property such as color, texture, odor, and taste (as appropriate). Qualitative observations utilize descriptive language.

**quantitative changes** - quantitative changes can be measured by quantity or amount. Examples include mass, volume, and temperature.

**quantitative observations** - quantitative observations describe the amount of mass, weight, temperature, length, and time. Quantitative observations require the use of numbers.

**safety** - safety is an essential part of any science activity. Safety in the classroom and care of the environment are individual and group responsibilities.

**serial order** - serial order refers to the task of ordering objects from least to greatest and greatest to least.