Arizona Department of Education
John Huppenthal, Superintendent of Public Instruction

# Arizona Adult Education Standards

# Science

Revised 2006
www.azed.gov/adult-ed

# Science Introduction

The Arizona Adult Education Science Standards revision, like the revised Social Studies Standards, responds to teacher feedback regarding use and usefulness. The Science Standards have been revised into two levels, ABE and ASE, and address Science in the following areas:

►Nature of Science
►Science as Inquiry
►Science and Technology
►Life Science
►Physical Science
►Earth and Space Science

The Standards include the acquisition of a broad knowledge base and the ability to use a range of reasoning skills including analyzing and solving problems, applying information to new situations, explaining results and interpreting information.
The Science Standards are cross-walked with the Reading, Writing, Math and Technology Standards, and allow teachers to draw on the "big ideas" identified by the national and international scientific community at a basic and more sophisticated level.

# Science

## Standard: The adult learner applies methods of science and technology toward the advancement of personal and community well being.

**The Science Standard addresses the following indicators:**

- **A Nature of Science**
- **B Science as Inquiry**
- **C Science and Technology**
- **D Life Science**
- **E Physical Science**
- **F Earth and Space Science**

**Proficiency Descriptions:**

| Beginning | Approaching | Met | Exceeds |
|---|---|---|---|
| At this level, the evidence indicates basic understanding of the concepts and limited reasoning skills. The learner's explanations are often minimal and presented without much supporting information. | At this level, the learner demonstrates some understanding of the concepts. Although reasoning skills are evident and supporting information is present, explanations are not always complete. | At this level, the learner makes sound decisions and applies both procedural knowledge and conceptual understanding. The learner explains and justifies reasoning used. | At this level, the learner consistently applies both procedural knowledge and conceptual understanding to both familiar and unfamiliar situations providing solutions that are clear, logical and go beyond the obvious. |

# ABE: Science

## Indicator A: The learner understands that science is a special way of knowing that uses questioning, reasoning, theorizing and experimentation

| Nature of Science Sub-Indicator | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 1. Understands and uses the processes of scientific investigation and scientific ways of knowing. | Recognizes how scientific knowledge, thinking processes and skills are used in a variety of careers.<br><br>Recognizes that scientific inquiry has produced much knowledge about the world, that some is still unknown and may always be unknown.<br><br>Recognizes that scientific contributions have been made by all kinds of people everywhere in the world. | Describes major advances in science and technology and their impact on society.<br><br>Recognizes that when an experiment is repeated under the same conditions, the results should be the same.<br><br>Understands that scientists have ethical codes that extend to potential risks to human subjects, property and communities. | Defines the terms: hypothesis, model, principle, law, theory and paradigm.<br><br>Explains how scientific theory, hypothesis generation and experimentation are related.<br><br>Recognizes that scientific ideas are tentative, subject to change and often require experimental and observational confirmation.<br><br>Explains the interplay among society, politics and the research that gets funded. | Analyzes and evaluates the validity of conclusions based on scientific studies.<br><br>Analyzes an argument by reviewing current scientific understanding, weighing evidence and examining the logic used to determine the validity of the argument.<br><br>Illustrates how a new discovery could impact further scientific thought.<br><br>Describes major scientific contributions of historical figures and their continuing impact on society (e.g., Newton, Galileo, Einstein, Darwin, Salk, Watson & Crick). |

# ABE: Science

## Indicator B: The learner understands the processes of scientific investigation and concepts that unify scientific disciplines

| Science as Inquiry Sub-Indicators | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 1. Designs, conducts, describes and evaluates investigations. | Formulates basic questions about objects, organisms, events and relationships in a natural and designed world.<br><br>States simple hypotheses about cause-and-effect relationships.<br><br>Performs observations, simple measures and comparisons and records data.<br><br>Sorts, classifies and sequences objects, organisms, or events based on observations.<br><br>Constructs models (e.g., paper airplane, solar system) that illustrate simple concepts, and compares those models to what they represent. | Plans and designs a basic experiment.<br><br>Conducts an experiment using safe procedures and records data.<br><br>Organizes and presents data using appropriate mathematical analyses and graphical representations (e.g., bar graph, line graph, frequency table, Venn diagram).<br><br>Reports through various means the conclusions of an experiment.<br><br>Describes the functions of variables in experiments. | Formulates hypotheses.<br><br>Designs and executes scientific investigations, testing only one variable at a time using a control.<br><br>Interprets data in graphical representations; establishes relationships based on evidence and logical argument; and draws conclusions.<br><br>Presents information in a report including gathering, recording and organizing data accurately. Uses histograms, stem and leaf plots, scatter plots, circle graphs, flow charts, line graphs and bar graphs correctly.<br><br>Analyzes the reliability of scientific reports from magazines, television or other media, using evidence to support or refute conclusions. | Designs and conducts an investigation of a scientific problem, and reports results to peers, teachers and others.<br><br>Analyzes and critiques alternative explanations to phenomena.<br><br>Bridges relationships among hypotheses, laws, concepts, experiments conducted and data collected. |
| 2. Understands and applies concepts that unify scientific disciplines. | Observes and describes simple systems. | Identifies parts of familiar systems, describes relationships among those parts and records changes and patterns of change within these systems. | Describes the parts and functions of a system and/or subsystems. | Understands the regularity and order of systems, including a whole in terms of its parts and parts in terms of how they relate to one another and to the whole.<br><br>Explains conservation of mass and energy, and the connections among systems. |

# ABE: Science

## Indicator C: The learner understands the connections between science and technology

| Science & Technology Sub-Indicator | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 1. Understands the impact of science and technology on human activity and the environment. | Describes how science and technology are interrelated.<br><br>Identifies occupations that require the application of science and technology.<br><br>Identifies ways that scientific technology affects our daily lives, jobs and recreation. | Describes how human activities can induce hazards through resource acquisition, urban growth, land use decisions and waste disposal.<br><br>Evaluates the merit of a proposed solution to a social or environmental problem.<br><br>Explains how technology has impacted both earth and space science. | Describes and compares the intended benefits and unintended consequences of scientific and technological innovations, including how they affect quality of life and availability of resources.<br><br>Analyzes the risk factors associated with natural, biological, chemical, social and personal hazards. | Demonstrates an understanding of the reciprocity between science and technology including assessing the consequences of any design adaptations to the natural world. |

## Indicator D: The learner understands the characteristics of living things and the interrelationships of living organisms with one another and their environments

| Life Science Sub-Indicators | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 1. Understands the characteristics of living things and the diversity of life. | Classifies organisms according to common characteristics.<br><br>Traces the life cycles of various organisms. | Constructs a simple classification system based on physical characteristics of organisms.<br><br>Identifies and differentiates between the basic structures and functions of various cells.<br><br>Identifies the basic structures in plants and animals and describes their functions. | Identifies organisms based on existing classification systems.<br><br>Compares and contrasts the basic structures, components and functions of different types of cells, tissues and organs.<br><br>Identifies the main structures of cells, tissues and organ systems within an organism and identifies the interrelationships among them. | Describes the physiology of each system in multi-celled organisms and how each relates to homeostasis. |

# ABE: Science

**Indicator D: (continued)**

| Life Science Sub-Indicators | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 2. Understands the interdependence and interaction of living things with their environments. | Identifies living versus non-living components within ecosystems, and describes the interaction between the two.<br>Explains how organisms cause changes, beneficial or detrimental, to their environments. | Describes organism adaptations or constancy over geologic time.<br>Describes relationships among various organisms within an environment (e.g., predator/prey, parasite/host, food chains and webs). | Describes the theory of evolution.<br>Describes species' diversity and adaptation, variation and extinction over geologic time.<br>Explains the interaction and interdependence of living and non-living components within ecosystems, including the adaptation of plants and animals to their environment, food webs, resource use and energy transfer.<br>Describes how green plants are the foundation of the energy flow in most ecosystems because they are capable of producing their own food by photosynthesis. | Explains the processes of photosynthesis and respiration in the interdependency of plants and animals.<br>Describes how an environmental change could affect various species within an ecosystem.<br>Explains how natural selection provides a mechanism for evolution.<br>Explains the possible effects of atmospheric change brought on by acid rain, volcanic dust, green house gases and ozone depletion. |
| 3. Understands how organisms change over time in terms of biological adaptations and genetics. | Recognizes that offspring within families have both similarities and differences. | Describes the role of genes in heredity and distinguishes between physical characteristics which are and are not inherited.<br>Describes the processes of sexual and asexual reproduction. | Describes the role of chromosomes and genes in heredity.<br>Distinguishes between dominant and recessive traits and describes information that is carried in a gene. | Explains how exposure to certain factors may increase the rate of mutation and cause variances in human diversity.<br>Using scientific evidence, illustrates that descent from common ancestors produced today's diversity of organisms. |
| 4. Understands the major structures and functions of the human body systems. | Recognizes that component parts make up the human body systems (e.g., digestive, muscular, skeletal), including major organs (e.g., lungs, heart, skin) within systems. | Identifies the major components of vital body systems and identifies the functions of those systems (e.g., digestion, respiration, reproduction, circulation, excretion, movement, control, coordination). | Identifies and describes the function of the systems for digestion, respiration, reproduction, circulation, excretion, movement, control and coordination in the human body.<br>Explains how systems in the body work together. | Describes the feedback loops of the endocrine and nervous systems.<br>Describes how the complementary activity of major body systems provides cells with oxygen and nutrients, and removes toxic waste products such as carbon dioxide.<br>Describes the advances in health |

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| | | | Identifies the function of feedback and equilibrium in the human body. | practices and ways to prevent disease. |

# ABE: Science

## Indicator E: The learner understands the nature of matter and energy, including their forms, the changes they undergo and their interactions

| Physical Science Sub-Indicators | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 1. Understands energy and matter have multiple forms and can be changed from one form to another. | Identifies the different states of matter, and recognizes that matter can change and exist in one or more states.<br><br>Describes, measures and compares tangible objects in terms of common physical properties (e.g., length, mass, volume, temperature, size, weight, shape, texture, flexibility, color). | Understands that all matter is composed of one or more elements and that all elements are composed of atoms.<br><br>Classifies objects and mixtures of substances based on common physical and chemical properties (e.g., states of matter, mass, volume, electrical charge, density, boiling points, pH, magnetism, solubility).<br><br>Identifies various types of energy sources and describes how energy is transferred. | Understands the principles involved in the conservation of matter. (i.e., matter changes but does not go away: Iron + oxygen = rust)<br><br>Predicts the effects of external forces on the properties of matter.<br><br>Classifies and describes matter in terms of elements, compounds, mixtures, atoms and molecules.<br><br>Describes how energy is a property of many substances, occurs in many forms (heat, light, electrical, mechanical, sound, nuclear and chemical, either potential or kinetic) and can be transferred in many ways. | Defines the law of conservation of energy.<br><br>Knows that atoms and molecules are perpetually in motion and that the states (solid, liquid, and gaseous) of matter depend on molecular motion. |
| 2. Understands chemical reactions are processes in which atoms are rearranged into different combinations of molecules. | Differentiates between a physical change and a chemical change.<br><br>Recognizes that rearranging combinations of atoms creates new substances. | Distinguishes between mixtures and compounds.<br><br>Understands that elements are made up of atoms and arranged according to their atomic weight in the Periodic Table of the Elements. | Describes, measures and calculates quantities before and after a chemical or physical change within a system and uses that data to support the concept of conservation of mass within a closed system.<br><br>Understands the central role of carbon plus the five other key elements that make up most of the Earth's biomass. | Explains how, in chemical reactions, the number of atoms stays the same no matter how they are arranged, so their total mass stays the same.<br><br>Describes how reactions occur at different rates and that rates can be changed by altering concentration of reactants, temperature, surface areas and catalysts. |

# ABE: Science

**Indicator E: (continued)**

| Physical Science Sub-Indicators | Beginning | Approaching | Met | Exceeds |
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| 3. Understands that electricity and magnetism are related effects that have many useful applications in everyday life. | Demonstrates that light, heat, motion, magnetism, gravity and sound can cause changes.<br><br>Identifies electrical conductors and insulators. | Describes the connection between electricity and magnetism (i.e., all electric currents produce magnetic effects). | Explains how electrical circuits provide a means of transferring energy from sources such as generators to devices in which heat, light, sound and chemical changes are produced.<br><br>Understands different methods of producing electricity. | Knows how to build a simple electromagnet. |

**Indicator F: The learner understands the composition, formative processes and history of the Earth, the solar system and the universe**

| Earth & Space Science Sub-Indicators | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 1. Understands the composition of Earth, including its atmosphere, hydrosphere and lithosphere. | Describes the basic Earth materials (rock, soil, water and gas) and their physical properties.<br><br>Identifies major features of the Earth's surface (e.g., mountains, rivers, plains, plateaus).<br><br>Investigates and describes the general characteristics of atmosphere and the fundamental processes of weather.<br><br>Describes the water resource, its uses, importance and cyclic patterns of movement through the environment. | Describes the layers of the Earth and their compositions.<br><br>Describes currents, waves, tides and ocean floor features.<br><br>Describes the properties and composition of the layers of the atmosphere.<br><br>Describes the basic characteristics of the Earth's bodies of fresh water and salt water. | Describes the composition (including minerals, rocks and soil) and the structure of the Earth including landforms, oceans and lithospheric plates.<br><br>Describes the composition and physical characteristics of the Earth's bodies of water.<br><br>Describes the composition, properties and structures of the atmosphere, such as the range and distribution of temperature and pressure in the troposphere. | Explains the processes of the hydrologic cycle including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration and transpiration.<br><br>Describes the thermal structure and chemical composition of the atmosphere. |

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# ABE: Science

**Indicator F: (continued)**

| Earth & Space Science Sub-Indicators | Beginning | Approaching | Met | Exceeds |
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| 2. Understands the basic composition of the solar system and universe. | Distinguishes between revolution and rotation.<br><br>Identifies the planets in our solar system and describes their relationship to the Sun.<br><br>Recognizes that a major source of the Earth's heat and light is the Sun. | Identifies and describes the patterns of movement of objects visible in the sky over time (e.g., seasonal position of the sun, constellations, the moon).<br><br>Describes common objects in the solar system and explains how they are related. | Describes the motion of the Earth in relation to the Sun, including the concepts of day, night, year and the seasons.<br><br>Describes common objects in the universe and explains their relationships including the concepts of multiple star systems, star clusters, galaxies, sun, moon, eclipses, planets, asteroids, comets and gravity. | Explains the laws of planetary motion (Kepler).<br><br>Describes the composition and characteristics of the Sun (this is a typical star powered by nuclear reactions) and how it powers winds and ocean currents and is the Earth's major source of energy. |
| 3. Explains how geologic evidence allows us to understand the evolution of life on Earth. | Describes how fossils provide evidence about the plants and animals that lived long ago. | Describes how life and environmental conditions have changed over time (geologic and recent).<br><br>Explains how fossils are formed and provide evidence of how life and environmental conditions have changed. | Describes theories about the origin of the universe (e.g., Big Bang Theory). | Analyzes the theories of the origin of the universe and the evidence that supports them. |
| 4. Analyzes the Earth's cycles and processes of change. | Describes the difference between weather and climate.<br><br>Defines basic terms associated with weather systems including fronts, pressure systems and types of clouds.<br><br>Identifies the natural events and forces that shape the Earth's surface, including earthquakes, volcanic activity, weathering and erosion. | Explains how rock and soil are formed.<br><br>Explains how water is cycled in nature and identifies the distribution of water on the Earth, underground and in the atmosphere.<br><br>Describes the natural events and forces that shape the Earth's surface, including earthquakes and volcanic activity.<br><br>Describes how the Earth's natural | Explains how plate tectonics are involved in the formation of the Earth's structures.<br><br>Describes the distribution and circulation of the world's water through ocean currents, glaciers, rivers, ground water and atmosphere.<br><br>Compares Earth processes today, including erosion, movement of lithospheric plates and changes in | Uses the theory of plate tectonics to explain the relationship among volcanoes, earthquakes, mid-ocean ridges and deep-sea trenches. |

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| | Describes how natural processes and events may affect humans. | process, such as weathering and erosion affect the Earth's surface. | atmospheric composition, to those that occurred in the past. | |

# ASE: Science

## Indicator A: The learner understands that science is a special way of knowing that uses questioning, reasoning, theorizing and experimentation

| Nature of Science Sub-Indicator | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 1. Understands and uses the processes of scientific investigation and scientific ways of knowing. | Explains why keeping accurate and detailed records are important.<br><br>Explains how scientific theory, hypothesis generation and experimentation are related.<br><br>Knows that scientists cannot always control conditions in order to obtain evidence and will instead observe as wide a range of natural occurrences as possible to discern patterns. | Explains how peer review, reporting of methods and outcomes of investigations and accepting criticism are important to the ethical traditions of science.<br><br>Understands that new ideas are limited by the historical context in which they are conceived, are often initially rejected by the scientific establishment and grow or transform slowly through the contributions of many different investigators. | Analyzes an argument by reviewing current scientific understanding, weighing evidence and examining the logic used to determine the validity of the argument.<br><br>Illustrates how a new discovery could impact further scientific thought.<br><br>Describes major scientific contributions of historical figures and their continuing impact on society (e.g., Newton, Galileo, Einstein, Darwin, Salk, Watson & Crick). | Analyzes and evaluates the validity of conclusions based on scientific studies. |

## Indicator B: The learners understands the processes of scientific investigation and concepts that unify scientific disciplines

| Science as Inquiry Sub-Indicators | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 1. Designs, conducts, describes and evaluates investigations. | Executes scientific investigations, testing only one variable at a time using a control.<br><br>Analyzes the reliability of scientific reports from magazines, television or other media, using evidence to support or refute conclusions. | Designs and conducts an investigation of a scientific problem and reports results to peers, teachers and others.<br><br>Writes clear, step-by-step instructions for conducting investigations or following a | Proposes solutions to practical and theoretical problems based on information gained from scientific investigations.<br><br>Analyzes and critiques alternative explanations to phenomena. | Analyzes investigations and solves problems that require combining and applying concepts from more than one area of science. |

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| | | procedure. | | |

# ASE: Science

## Indicator B: (continued)

| Science as Inquiry Sub-Indicators | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 2. Understands and applies concepts that unify scientific disciplines. | Describes the parts and functions of a system and/or subsystems. | Illustrates the relationship of equilibrium to form and function within natural and designed systems.<br><br>Understands the regularity and order of systems, including a whole in terms of its parts and parts in terms of how they relate to one another and to the whole.<br><br>Explains conservation of mass and energy and the connections among systems. | Predicts the effects of various factors on the equilibrium of a system.<br><br>Knows how different hierarchies of structure of matter (atoms, molecules, DNA, organisms, geological forms, or ecosystems) are related, how structure is directly related to function and how individual structures contribute to the overall behavior of the system. | Describes the characteristics and properties of various cycles and the ways in which matter is converted from one form to another, including:<br>• geochemical cycles –movement of elements among the solid Earth, atmosphere, oceans and organisms<br>• water cycles – weather and climate<br>• carbon cycles – role of plants in removing carbon dioxide from the atmosphere, using carbon to synthesize sugars<br>• rock cycles – weathering, sedimentation and reformation<br>• food cycles – from ocean plants to land plants, the animals that feed on them, then the decomposition of those animals after death to return matter to the cycle. |

## Indicator C: The learner understands the connections between science and technology

| Science & Technology Sub-Indicator | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 1. Understands the impact of science and technology on human activity and the environment. | Identifies how technology can affect personal growth.<br><br>Illustrates how an invention or new technology could impact further scientific thought. | Describes how the factors of technology, world events, public personalities and societal views can affect the development and acceptance of scientific thought.<br><br>Explains how an accepted idea | Demonstrates an understanding of the reciprocity between science and technology including assessing the consequences of any design adaptations to the natural world. | Applies scientific thought processes of skepticism, objectivity and logic to seek a solution to a personal, social or environmental issue. |

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| | | could be challenged by scientific innovation. | | |

# ASE: Science

**Indicator D: The learner understands the characteristics of living things and the interrelationships of living organisms with one another and their environments**

| Life Science Sub-Indicators | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 1. Understands the characteristics of living things and the diversity of life. | Describes how energy is used in growth, development maintenance and repair of cells. | Describes how a single-celled organism carries out the function of each of the systems found in multi-celled organisms. | Describes the physiology of each system in multi-celled organisms and how each relates to homeostasis. | Explains the molecular interactions within cells. |
| 2. Understands the interdependence and interaction of living things with their environments. | Lists factors that can affect population size, growth, stability and quality of life, and identifies the effects of each factor.<br><br>Suggests ways in which the following events affect living organisms: floods, droughts, earthquakes, heat waves, storms, sunspots, novas.<br><br>Describes the factors that influence the reuse, recycling and conservation of water. | Predicts how change in an environmental factor can affect the success or failure of a population to survive.<br><br>Illustrates how increasing human populations affect natural resources and environmental pollution.<br><br>Discusses the availability, geographic distribution, wise use, conservation and recycling of the Earth's finite rock, mineral and fossil fuels.<br><br>Explains how biotic and abiotic factors cycle in an ecosystem. | Explains the processes of photosynthesis and respiration in the interdependence of plants and animals.<br><br>Describes how an environmental change could affect various species within an ecosystem.<br><br>Explains how natural selection provides a mechanism for evolution.<br><br>Explains the possible effects of atmospheric change brought on by acid rain, volcanic dust, green house gases and ozone depletion. | Explains how biodiversity is the result of genetic changes that occur in constantly changing environments.<br><br>Explains how ecosystems are altered by climate changes, various natural causes, human activity, or when a new or non-native species appears. |
| 3. Understands how organisms change over time in terms of biological adaptations and genetics. | Describes the role of chromosomes and genes in heredity.<br><br>Distinguishes between dominant and recessive traits and describes information that is carried in a gene. | Describes how mutations contribute to genetic diversity.<br><br>Describes the structures and functions of DNA, RNA and protein.<br><br>Using scientific evidence, illustrates that descent from common ancestors produced today's diversity of organisms. | Compares the purpose and process of mitosis with meiosis.<br><br>Explains how exposure to certain factors may increase the rate of mutation and cause variances in human diversity.<br><br>Identifies the relationship of DNA, genes and chromosomes and explains how a mutation affects this | Explains the processes of gene replication, transcription and translation.<br><br>Explains the genetic basis for Mendel's laws of segregation and independent assortment. |

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| | | | relationship. | |

# ASE: Science

**Indicator D: (continued)**

| Life Science Sub-Indicators | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 4. Understands the major structures and functions of the human body. | Describes how the immune system functions and how disease affects the body. | Explains the complementary activities of major body systems.<br><br>Describes how the functions of individual systems within humans are integrated to maintain a homeostatic balance in the body. | Describes the feedback loops of the endocrine and nervous systems.<br><br>Describes how the complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide.<br><br>Describes the advances in health practices and ways to prevent disease. | Explains how the human immune system is designed to protect against microscopic organisms and foreign substances that enter from outside the body and against some cancer cells that arise within. |

**Indicator E: The learner understands the nature of matter and energy, including their forms, the changes they undergo and their interactions**

| Physical Science Sub-Indicators | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 1. Explains how physical and chemical properties can be used to classify and describe matter. | Identifies and measures qualitative and quantitative relationships associated with energy.<br><br>Classifies and describes matter based on physical and chemical properties. | Differentiates among elements, atoms and compounds and their relationship to each other.<br><br>Relates equilibrium in physical science to homeostasis in life science.<br><br>Relates an element's location in the Periodic Table to its atomic number and mass. | Explains how hierarchies of structures of matter (atoms, molecules, DNA, organisms, geological forms or ecosystems) are related.<br><br>Explains how structure is directly related to function, and how individual structures contribute to the overall behavior of the system. | Explains the development of atomic theory and the structure of the atom from the ancient Greeks to the present (Dalton, Thompson, Rutherford, Bohr, and modern theory).<br><br>Uses an element's location in the Periodic Table to determine its number of valence electrons, and predicts what stable ion or ions an element is likely to form in reacting |

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| | | | | with other elements. |

# ASE: Science

**Indicator E: (continued)**

| Physical Science Sub-Indicators | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 2. Understands the enormous variety of biological, chemical and physical properties of matter result from the ability of atoms to form bonds. | Determines physical and chemical properties of a substance through observation, experimentation and measurement. | Uses the Periodic Table to predict the properties of elements and compounds.<br><br>Explains the ability of atoms to form bonds.<br><br>Explains how energy is exchanged or transformed in all chemical reactions and physical changes of matter. | Describes chemical reactions by writing balanced chemical equations.<br><br>Assesses chemical reaction rates and the factors that effect chemical reaction rates (e.g. temperature and catalyst).<br><br>Explains how equilibrium is established when forward and reverse reaction rates are equal. | Predicts chemical formulas based on the number of valence electrons.<br><br>Explains the nature of ionic, covalent, and hydrogen bonds and gives examples of how they contribute to the formation of various types of compounds.<br><br>Writes the equilibrium expression and calculates the equilibrium constant for a reaction. |
| 3. Understands the laws of conservation of energy and momentum to predict and describe the movement of objects. | Uses the law of conservation of energy to explain energy changes in chemical reactions.<br><br>Explains how the sum of energy and matter in systems remains the same despite transference of energy and change in matter. | Differentiates between gravitational and electromagnetic forces.<br><br>Uses the universal laws of gravitation to predict how gravity forces changes of distance and/or mass.<br><br>Applies the properties of electricity to everyday situations. | Describes, measures and calculates characteristics of moving objects and their interactions (e.g., force, velocity, acceleration, potential energy, kinetic energy) within a system using Newton's laws of motion.<br><br>Uses the First Law of Thermodynamics to explain the energy changes within a physical system. | Analyzes the concepts of mass, force and acceleration and their relationships to Newton's three laws of motion and to the universal law of gravitation.<br><br>Describes a sequence of events that illustrates the Second Law of Thermodynamics. |

# ASE: Science

## Indicator F: The learner understands the composition, formative processes and history of the Earth, the solar system and the universe

| Earth & Space Science Sub-Indicators | Beginning | Approaching | Met | Exceeds |
|---|---|---|---|---|
| 1. Understands how the interactions among the lithosphere, hydrosphere and atmosphere have resulted in ongoing evolution of the Earth's systems over geologic time. | Differentiates among sudden disastrous natural occurrences and slower progressive natural hazards. | Describes the processes of the hydrologic cycle including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration and transpiration. | Explains the principles of hydrology, including surface and ground water flows, aquifers, percolation, desalinization and sources of water contamination and pollution.<br><br>Describes the thermal structure and chemical composition of the atmosphere. | Explains how the composition of the Earth's atmosphere has evolved over geologic time (outgassing, origin of atmospheric oxygen, variations in carbon dioxide concentration).<br><br>Explains the nitrogen and carbon cycles and their roles in the improvement of soils for agriculture. |
| 2. Explains the composition and evolution of our solar system. | Illustrates the Earth's tilt, rotation, and revolution and their effects on seasons and the length of days.<br><br>Explains how the solar system is composed of a star, planets, moons, asteroids, comets and residual material left from the evolution of the solar system. | Describes characteristics of the Milky Way galaxy.<br><br>Describes the characteristics and motions of the various objects in our solar system, including planets, satellites, comets and asteroids.<br><br>Explains the influence of gravity and inertia on the motions of objects in our solar system. | Explains laws of planetary motion (Kepler).<br><br>Describes the composition and characteristics of the Sun and how it powers winds and ocean currents and is the Earth's major source of energy. | Describes the relationship between planetary systems, stars, multiple-star systems, star clusters, galaxies and galactic groups in the universe. |
| 3. Explains the history of the Earth, its solar system and the universe. | Explains the effect of asteroids on shaping the surface of planets and their moons and on mass extinctions of life on the Earth. | Explains the diversity of life through time and the evolution and extinction of species on the Earth. | Analyzes the theories of the origin of the universe and the evidence that supports them.<br><br>Explains the nebular theory concerning the formation of solar systems. | Explains how the concept of conservation of energy is at the heart of advances in fields as diverse as the study of nuclear particles and the study of the origin of the universe. |

# Science Sample Activities

## Standard: The adult learner applies methods of science and technology toward the advancement of personal and community well-being.

**Indicator A: The learner understands that science is a special way of knowing that uses questioning, reasoning, theorizing and experimentation. (Nature of Science)**
**&**
**Indicator B: The learner understands the processes of scientific investigation and concepts that unify scientific disciplines. (Science as Inquiry)**

| | Family | Workplace | Community |
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| **ABE** | Students identify and use safe procedures in the storage and use of chemicals in the home. Students pick a room, closet, cabinet, or drawer. Sort and classify contents into groups according to physical properties (e.g., size, weight, color, texture, shape). Determine how many ways they can be grouped together. (Writing: BL-A2 ; Reading BL-C1; ABE I-C3; ABE II-A1, C1, 2, 3; ABE III-C1; ASE I- C2)<br><br>Students identify basic parts of a simple familiar system (e.g., clock, bike, and park) and describe the relationship between the parts.<br><br>Students evaluate the family's water intake. Collect data of how many 8-ounce glasses of water they drink over a period of 24 hours. Graph the results for the family. Devise a plan to ensure that everyone is taking in at least six glasses of water daily. (Math ABE III B-1; Writing: BL-A2; ABE 1-A2; ABE II-A1; Reading: ABE I-C2; ABE II-B3, C1,2,3; ABE III-C1; ASE I-C2) | Students sort items on a desktop or from within a desk drawer. Classify content into groups according to physical properties (e.g., size, weight, color, texture, shape). (Reading: ABEI-C2; ABE II-B3, 4; C1,2,3)<br><br>Students apply knowledge that objects are made out of different materials (paper, cloth, plastic, metal, wood, stone, glass) by identifying an object (or part of one) composed of each type.<br><br>Students collect and graphically represent data comparing preferences of co-workers using a survey of ten categories that offer two options (e.g., smoking/non-smoking, soda/coffee, cookies/chips). Make predictions about larger groups for each category. Use results to check your predictions. (Writing BL-A2; ABE I-A2; ABE II-A1) | Students investigate how many ways duct tape can be used for problem solving. Compare duct tape to other tapes in terms of physical properties, including strength, durability and function.<br><br>Students conduct an experiment to determine which brand of paper towel is the best in terms of form and function, cost, and personal preference, and write an advertisement for the brand highlighting the findings of the investigation and chart on a computer. (Math ABE III B-1; Writing: BL-A2, B1,2,3,4,5; ABE I-A1,2; ABE II-A1; Reading BL-D5; ABE I-C2,3,4; ABE II-A1, C1, 2, 3)<br><br>Students research a biological hazard (viral, bacterial, or parasitic) that has affected the community. Investigate and identify the cause, symptoms and treatments or cures.<br><br>Identify risk factors and precautions people should take to protect themselves against common hazards. Compare local with national risk factors. (Reading: BL-C1, D5; ABE I-C3, 4; D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1,2,3; ASE I-B4, C2; ASE II-C1,2) |

Technology Standards can easily be integrated into these activities.

## Science Sample Activities

**Indicator A: The learner understands that science is a special way of knowing that uses questioning, reasoning, theorizing and experimentation. (Nature of Science, continued)**
**&**
**Indicator B: The learner understands the processes of scientific investigation and concepts that unify scientific disciplines. (Science as Inquiry, continued)**

| | Family | Workplace | Community |
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| **ASE** | Students keep a written record for one week of all food and drink they consume. List approximate amounts and categorize each entry as a protein, carbohydrate or fat. (Math ASE I B-2, 3, 4; Writing: BL-A2; ABE I-A2; ABE II-A1; Reading: BL-D5; ABE I-C4; ABE II-A1, B4, C1,2,3; ABE III- C1)<br><br>Students approximate the role of pressure in the formation of metamorphic rocks. Snap wooden toothpicks in half, leaving them connected. Make similar piles of these "mineral grains" side by side on a tray. Place large books on top of one pile and press. Observe differences in the "rocks" brought about by pressure. (Reading: ABEI-B2)<br><br>Students prepare different soil mixes using commercial potting soil, worm compost and sand. Compare growth of plants in the different mixes and chart on a computer. (Reading: ABEI-C1) | Students create a chart showing the hierarchy of responsibility for a system such as a business, school or church to illustrate the interrelationship of each member to others. (Math ASE I B-1, 2, 4; Writing: BL-A2, B1,2,3,4,5; ABE I-A1,2; ABE II-A1; Reading: BL-D5; ABE I-C2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1)<br><br>Students identify an environmental problem at work and list several proposed solutions. (Reading: BL-D5; ABE I-B4,5; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4,C2; ASE II-C1,2)<br><br>Students identify the activities at work that take knowledge of science and technology. (Reading: BL-D5; ABE I-B4,5, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ASE I-B4,C2)<br><br>Students identify the snacks in a vending machine and sort them by different characteristics (e.g., taste, color, color of package, price). Determine how many ways they can be grouped together and chart on a computer. (Math ASE I B-1,2) | Students identify a community environmental problem, list several proposed solutions, and evaluate the consequences and costs to each faction within the community. (Reading: BL-D5; ABE I-B4,5, C2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2)<br><br>Students identify a local facility that is science-based (e.g., planetarium, water/sewage treatment plant, Audubon Society, arboretum) and investigate the types of activities with which it is involved. (Reading: BL-D5; ABE I-B4,5, D3; ABE II-A1)<br><br>Students use a hand lens to observe, describe and document the properties of a soil sample (e.g., color, texture, granularity, etc.) They are asked to repeat this activity with a sample of wet soil, sand and dried soil. Students should contrast their findings and compare their documentation efforts to those of others. (Writing: BL-A2; BL-B1,2,3,4,5; ABE I-A2; ABE II-A1) |

Technology Standards can easily be integrated into these activities.

## Science Sample Activities

### Indicator C: The learner understands the connections between science and technology. (Science and Technology)

| | Family | Workplace | Community |
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| **ABE** | Students describe a technological device and how it affects their daily life.<br><br>Students invent new uses for used items. Identify items in the home that can be recycled by reusing them in other ways. Be creative.<br><br>Students evaluate how technological inventions have impacted life in the home (e.g., computers, the Internet, cable/digital cable television, DVD players, etc.). List the changes these have or can make on one's lifestyle. (Reading: BL-D5; ABE I-C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1)<br><br>  Students prepare a timeline that shows changes in the way we communicate now and in the past. (Math ABE III A-5,10; B-1, 2, 3; Writing: BL-A2; ABE I-A2; Reading: BL-D5; ABE I-C1,2,3,4; ABE II-A1; ABE III-C1)<br><br>Students evaluate the claims and potential risks and benefits of an advertised product (diet plan, tooth cleaner, over the counter drug, etc.). (Reading: BL-D5; ABE I-C1,2,3,4, D3; ABEII- A1, B3,4, C1,2,3; ABE III-C1; ASE I-, B4, C2; ASE II-C1,2) | Students identify examples of simple technology (e.g., paper clip, scissors, zipper) and describe how they are used in the workplace.<br><br>Students identify and explain how work might be done differently if certain technologies had not been invented and whether the same work would require hiring more employees.<br><br>Students identify major scientific contributions that have had a direct impact on how work is produced around the community (e.g., pagers, cellular phones, laptop computers, FAX machines, etc.). (Reading: BL-D5; ABE I-B4, C2,3,4, D3; ABE II-A1; B3,4, C1,2,3; ABE III-C1; ASE I-B4,C2; ASE II-C1,2)<br><br>  Students investigate the cost of acquiring new or updating technology and determine advantages and disadvantages of each. Use findings to support or refute recommendations for purchase. (Math ABE III A-1, 2, 4, 5, 10, 11; B-1, 3; E-1; Reading: BL-D5; ABE I-B4, C,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2) | Students explain why people should wash their hands before and during food preparation and consumption.<br><br>Students identify occupations that require the application of science and technology. Ask a variety of questions to gather information about the jobs. (Reading: BL-D5; ABE I-C3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4)<br><br>Students investigate the ways that law enforcement agencies use science and technology to solve crimes in the community. (Reading: BL-D5; ABE I-C2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4)<br><br>  Students describe how the Internet has affected human activity. Investigate the history of the Internet and make a prediction about its uses in the future. (Reading: BL-D5; ABE I-B4, C1,2,3,4, D3; ABE II-A1; B3,4, C1,2,3; ABE III-C1; ASE I-B4; ASE II-C1,2)<br><br>Students prepare a timeline showing the technological advances in science and medicine. (Math ABE III B-1; Writing: BL-A2; ABE I-A2; Reading: BL-D5; ABE I-C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4) |
| **ASE** | Students identify a machine or appliance used in their homes and list the ways it has affected their lives.<br><br>Students describe how life would be affected by removing any three technological products from their lives. | Students describe ways in which technology used in their workplace has affected the environment for better or for worse. (Reading: BL-D5; ABE II-A1)<br><br>Using a piece of paper, students design a container that can be filled with water. Explore how many times the container can be filled with water before it falls apart. Discuss why some designs may be more effective than others. (Math ASE I D-2; E-1) | Students interview community leaders to assess their plans to accommodate the population after a natural disaster.<br><br>Students compare and contrast the benefits and risks of genetic engineering. (Reading: BL-D5; ABE I-B4, C1,2,3,4, D3; ABE II-A1, B3,4,C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2) |

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| Technology Standards can easily be integrated into these activities. | | | |

## Science Sample Activities

### Indicator D: The learner understands the connections between science and technology. (Life Science)

| | Family | Workplace | Community |
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| **ABE** | Students identify and list how family members have both similar and different characteristics. Discuss traits that are inherited and those that might result from interaction with the environment over time. (Writing: BL-A2; ABE I-A2)<br><br>Students describe what happens when a healthy plant is placed in a dark closet for a week. For example, students investigate the role of sunlight in changing the colors of poinsettias.<br><br>Students analyze the frequency of physical fitness activities for each family member over a week's time. Devise a plan to incorporate physical fitness activities into their daily schedules. Discuss the advantages of having a fitness regimen. (Math ABE II B-1, 3; ABE III B-1; Writing: BL-A2)<br><br>Students use the Food Guide Pyramid (USDA) to plan nutritionally balanced meals for the family's breakfast, lunch/dinner menus for the week. Investigate healthy snacks to eat in between meals. (Reading: BL-D5; ABE I-B2,3,4,5,6; C2,3,4; ABE II-A1)<br><br>Students recognize characteristics of plants that show adaptations to their environments. Students compare and contrast a plant with an animal (e.g., rattlesnake/Saguaro cactus). (Writing: BL-A2)<br><br>Students hypothesize about why people get more colds and flu during the winter and discuss ways to prevent the spread of illness. (Reading: BL-D5; ABE I-C4) | Students explain the impacts of food and sleep on the body, work performance, and safety. (Reading: BL-D5; ABE I-B2,3,4,5,6; ABE II-A1)<br><br>Students conduct an experiment to find out which of their co-workers have the inherited characteristic of rolling their tongue and which ones do not. Make a prediction about which will be the larger group. Use results to check predictions, document and report findings. (Math ABE III B-3)<br><br>Students investigate which plants grow best in an office with no windows or with artificial light. Identify plants that will thrive in a windowless office.<br><br>Students compare the effects of eating a carbohydrate-based snack (e.g., apple, crackers, chips) versus a protein-based snack (a snack with at least 10 g of protein). On one day eat the carbohydrate snack, and record how they feel in half-hour intervals. Note the time they start to feel tired and the time they start to feel hungry. The next day, repeat this with the protein snack. Compare the results. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2)<br><br>Students identify a pest in the immediate environment, and use an understanding of food webs to propose and test a way to eliminate the pest without introducing environmental poisons. (Writing: BL-A2) | Students identify ways that humans depend on natural and man-made environments, investigate and discuss ways to protect, preserve and maintain them. (Reading: BL-D5; ABE I-B2,3,4,5,6, D3; ABE II-A1; ABE III-C1; ASE I-B4, C2)<br><br>Students compare and contrast the various ways diseases are transmitted from one person to another. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2)<br><br>  Students investigate plants that are used to treat medical conditions and diseases, such as cancer. Use the Internet, books, and periodicals to help with research. Which parts of a plant can be used to make medicine? How are plants made into medicine? How many types of these medicines could they find? Have they ever used a medicine that was made from a plant? (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2)<br><br>Students investigate Fetal Alcohol Syndrome and Fetal Alcohol Effects. How are these two the same? How are they different? They do the same with the effects of smoking during pregnancy. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2)<br><br>Students survey (sample) the local community to see how many possess certain inheritable traits (tongue rolling, ear wiggling, widow's peak, chin cleft, etc.) to determine the dominance of certain traits.(Math ABE II B-1,3;ABEIII B-3;Writing:BL-A2) |

Technology Standards can easily be integrated into these activities.

## Science Sample Activities

### Indicator D: The learner understands the connections between science and technology. (Life Science, continued)

| | Family | Workplace | Community |
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| **ABE (continued)** | | Students conduct a research project to identify bird species and compare their distribution using a field guide for the region to see if local distributions are the same as they are regionally. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2)<br><br>Students investigate workplace pollutants and the ways of reducing them. (Writing: BL-A2, B1,2,3,4,5; ABE I-A2 Reading: BL-D5; ABE I-C3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2) | Students compare the benefits of pesticides with the risks and effects on the environment and life. (Writing: BL-A2; Reading: BL-C1, D5; ABE I.-B2,3,4,5,6, C1,2,3,4; D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2)<br><br>Students investigate the benefits of organic/biological controls in growing crops around the nation. (Reading: BL-C1, D5; ABE I.-B2,3,4,5,6, C1,2,3,4; D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2) |
| **ASE** | Students write a week's menu that provides all the appropriate nutrients for optimum function of bodily systems. (Reading: BL-D5; ABE I-B3,4,5,6, C1,2,3,4; ABE III-C1)<br><br>Students compare eye colors of family members for as many generations as possible, noting dominant traits, and determining as best as possible whether parents and grandparents are homozygous or heterozygous. (Math ASE I B-1, 2)<br><br>Students study the effects of inbreeding on families or pets. (Reading: BL-D5; ABE I-B2,4, C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4)<br><br>Students examine and compare manmade objects engineered to enhance the senses or protect parts of bodies that are centers of the senses, e.g., hearing aids, gloves, glasses, ear plugs.<br><br>Students follow the complete life cycle of a metamorphic organism such as a frog or a moth. Draw pictures of the frog at various stages of | Students conduct an experiment to determine the effects of light, noise and temperature on worker efficiency. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1; ABE III-C1; ASE I-B4, C2; ASE II-C1,2)<br><br>Students investigate the benefits and risks of the latest attempts at genetic engineering. (Writing: BL-A2; Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASEI-B4,C2; ASE II-C1,2)<br><br>Students study a crime case to determine how DNA evidence might help to solve the crime.<br><br>Compare the physical properties of hard and soft woods (density, hardness, knots, etc.) and their use in construction at work.<br><br>Students observe and document the effects of decay on materials (e.g., fruits) left to rot. (Writing: BL-A2; B1,2,3,4,5; ABE II-A2; ABE II-A1) | Students create an ecosystem of at least five species, and document how an environmental change affects each species. (Writing: BL-A2, B1,2,3,4,5; ABE I-A2; ABE II-A1; Reading: BL-D5; ABE I-B2,4, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4,C2)<br><br>Students prepare a timeline that shows the history of medical treatments for diseases and wounds. (Math ASE I B-1; Reading: BL-D5; ABE I-B2,4, C1,2,3,4; ABE II- B3,4, C1,2,3; ABE III-C1; ASE I-B4,C2)<br><br>Students look at genetic evidence that corresponds to certain diseases. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2)<br><br>Students investigate the effects of adding non-indigenous species to an environment. |

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## Science Sample Activities

### Indicator D: The learner understands the connections between science and technology. (Life Science, continued)

| | Family | Workplace | Community |
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| **ASE (continued)** | Students discuss the challenges of living in a coastal, desert or mountainous environment. What stresses do plants and animals need to adapt to?<br><br>Students observe plants' responses to stresses in their environment.<br><br>Students use computer simulations to model the growth of plants on a plot of land or a sand dune or after a volcanic eruption. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1; ABE III-C1) | Students establish a compost bin. Analyze the decay of the contents and the gradual appearance of various organisms over time. | Students investigate the adaptation of plants to their environment. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2)<br><br>Students compare heads, bodies, and tails of geckos. Explain how these adaptations help the gecko survive. (Reading: BL-D5; ABE B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1)<br><br>Students compare a desert food chain to a coastal food chain.<br><br>Students investigate the interactions of organisms in a local environment. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1)<br><br>Students review the data (on websites) gathered by scientists who are conducting long-term ecological research. How are they monitoring sea level rises? Effects of global warming? (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2) |

Technology Standards can easily be integrated into these activities.

## Science Sample Activities

### Indicator E: Understands the nature of matter and energy including their forms, the changes they undergo and their interactions (Physical Science)

| | Family | Workplace | Community |
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| **ABE** | Students measure the amount of time it takes for an apple slice to change color and compare it to a potato slice. (Math ABE II E-1)<br><br>Students predict which items in their house are magnetic and use a refrigerator magnet to check predictions.<br><br>Students compare usage of electricity from month to month using the utility company's billing statement. Determine ways to decrease the family's use of electricity. (Math ABE II A-2; ABE III B-1; E-1; Reading: BL-D5; ABE I-B3, C1,2,3,4)<br><br>Students identify items in the home that are flammable and/or volatile and how to store them safely. (Writing: BL-A2; Reading: BL-C1, D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3)<br><br>Students identify and describe chemical and physical changes that take place when cooking different foods. (Writing: BL-A2)<br><br>Students slice a number of different fruits and vegetables into pieces that measure the same size. Make predictions about which ones will float. Test each piece separately in a bowl of water. Check results with original predictions. (Writing: BL-A2; ABE I-A2)<br><br>Students examine, build and/or repair a simple mechanical device (bicycle, part of car, grandfather clock) and describe how it works. | Students compare the mass and volume of items to be safely stored in a storage cabinet or shed. (Math ABE III D; E-1)<br><br>Students describe how electricity produces heat, light, sound and magnetic effects. Explain the impact of electricity on workplace activities. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4,C2)<br><br>Students investigate the effect of magnetism on computers. Identify items that contain magnets or strong electromagnetic fields.<br><br>Students explain the importance of fuses, circuit breakers and GFIs and describe safety practices. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4,C2)<br><br>Students conduct an energy audit of the workplace and develop procedures for reducing waste (of energy). (Writing: BL-A2,B.1,2,3,4,5; ABE I-A2; ABE II-A1; Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1)<br><br>Students devise a fire safety plan, which includes escape routes from their place of work (or each room in the house). (Reading: BL-D5; ABE I-B2,3, C1,2,3,4; ABE III-C1) | Using previous observations of force and motion, students predict the bouncing pattern of a basketball under different throwing conditions.<br><br>Students compare the momentum of several different types of balls down a sloped surface. What effect does the shape, size and angle have on speed, and distance? Check predictions with results. (Math ABE III E; C-1, C-2)<br><br>Students compare the frequency, length, and speed of a swing to a pendulum. (Math ABE III B-1, D-3; Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4)<br><br>Students investigate solar energy as an alternative to using electricity. Determine the advantages and disadvantages of using ONLY solar energy. Identify changes people can make to their homes to utilize solar energy and reduce the amount of electricity that they use. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4;<br>ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4,C2)<br><br>Students investigate food additives (e.g., artificial sweeteners, artificial emulsifiers, preservatives). Compare the advantages to the disadvantages of having chemicals in the foods that we eat. Research health risks associated with food additives. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4,C2; ASE II- C1,2) |

Technology Standards can easily be integrated into these activities.

## Science Sample Activities

### Indicator E: Understands the nature of matter and energy including their forms, the changes they undergo and their interactions (Physical Science, continued)

| | Family | Workplace | Community |
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| **ABE (continued)** | Students use knowledge of wave frequency and pitch to compare and purchase stereo speakers. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4,C2)<br><br>Ask students to bring in different types of containers from home. Discuss and demonstrate whether the containers are appropriate to hold solids and liquids ( e.g., an unwaxed cardboard box will absorb water and eventually disintegrate while a glass bottle will not). | Students use solid objects such as a ball, a cube, and a cone. First try to roll each object on a hard smooth level surface. Observe and describe its motion and the path it takes. Next, tilt the surface, place each object on it at the center and release the object. Observe and describe its motion and the path it takes. Repeat using various surfaces, (e.g., rough, soft, etc.) and then devise the best way to move heavy objects at work. (Reading: BL-D5; ABE I-B2,3, C1,2,3,4)<br><br>Students measure the distance that objects move on a hard, smooth surface after being pushed or pulled with different force. Repeat using various surfaces (e.g., rough, soft, etc.) in order to determine the best means to move objects at work. (Reading: BL-D5; ABE I-B2,3, C1,2,3,4) | Students explain the difference between recycling and reusing items in terms of mass and energy conservation. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, C1,2,3; ABE III-C1; ASE I-B4)<br><br>Students compare the benefits and risks of nuclear energy. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4,C2; ASE II- C1,2)<br><br>Students prepare a timeline showing when different subatomic particles were discovered. (Math ABE III A-1; Writing: BL-A2; ABE I-A2 Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4,C2) |
| **ASE** | Students trace solar energy to its use by living organisms. (Reading: BL-D5; ABE I B2,3,4,5,6, C1,2,3,4; ABE II-A1, C1,2,3; ABE III-C1; ASE I-B4)<br><br>Students investigate heat transfer by placing plastic, metal and wooden spoons in hot water and determining how quickly they heat up (conduction).<br>• Investigate heat transfer from a room by adding 50 ml of cold water to a cup or beaker. Stir it and record its temperature changes every few minutes over a ten-minute period.<br>• Investigate heat transfer to the room by adding 50 ml of warm water to a cup or beaker. Stir and record temperature changes every few minutes over a ten-minute period.<br>(Math ASE I B-1, 2; Reading: BL-D5; ABE I- | Students determine how different construction materials affect cost, quality and usefulness of furniture. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, B3, C1,2,3; ASE I-C2)<br><br>Students manipulate various objects. Observe the different methods (forces) that can be used to make objects move. Include pushing with a stick, pulling with a string, and pushing by blowing on a light object. Devise the best way to move various objects at work with the least effort.<br><br>Students use the objects from the preceding activity and an inclined smooth hard surface. Note that objects slide or roll down. | Students list air quality problems in urban areas, potential solutions and the effects of both on the community. (Writing: BL-A2, .B1,2,3,4,5; ABE I-A2; Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4) |

| | | | |
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| | C1,2,3,4) | | |

## Science Sample Activities

### Indicator E: Understands the nature of matter and energy including their forms, the changes they undergo and their interactions (Physical Science, continued)

| | Family | Workplace | Community |
|---|---|---|---|
| **ASE (continued)** | Use tuning forks to demonstrate the relationship between vibration and sound.<br><br>Use a flashlight, mirrors and water to demonstrate reflection and refraction.<br>Design and build a prototype to inhibit solar heating of a car (e.g., windshield reflector, window tinting) (Reading: BL-D5; ABE I-B2,3,4,5,6; C1,2,3,4)<br><br>Provide a collection of materials that are good conductors and good insulators. Have students determine each material's electrical conductivity by testing the materials with a simple battery/bulb circuit.<br><br>Use atomic models (or Lego blocks, assigning colors to various atoms) to build molecules of water, sodium chloride, carbon dioxide, ammonia, etc. (Reading: BL-D5; ABE I-B2,3,4,5,6; C1,2,3,4) | Students balance a large block of wood on a smaller one (fulcrum). Observe that adding some weight to one end of the large block will unbalance it. Find ways to keep it balanced by using two weights, one on each side of the fulcrum. Consider how fulcrums (levers) are used in industry. (Math ASE II D-2; Reading: BL-D5; ABE I-B2,3, C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1)<br><br>Students design and construct a simple game or toy (prototype) that works because of electromagnets.<br><br>At work, students calculate the volumes of regular objects from linear measurements. Measure the volumes of the same objects by displacement of water. Use the metric system. Discuss the accuracy limits of your procedures and how they explain any observed differences between your calculated volumes and your measured volumes. (Math ASE I E-1; Writing: BL-A2; ABE I -A2; Reading: BL-D5; ABE I-B2,3, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1) | Rub two pieces of wood together (mechanical energy) and observe, plot and graph the change in temperature of the wood.<br><br>Using given insulating materials, try to keep an ice cube from melting. |

## Science Sample Activities

### Indicator F: The learner understands the composition, formative processes and history of the Earth, the solar system and the universe. (Earth and Space Science)

| | Family | Workplace | Community |
|---|---|---|---|
| **ABE** | Students observe and keep a record of the changes of an object's shadow during the course of a day and investigate the source of the variation. (Math ABE III B-1; ABE II E-1); Writing: BL-A2; Reading: BL-D5; ABE I-B2,3,4,5,6; C1,2,3,4)<br><br>Students identify items in the home that can be recycled (e.g., paper, newspaper, aluminum cans, plastics, etc.). With the plastics, look for the symbol for recycling (three arrows curved into the shape of a triangle). Devise a plan to get the family to participate in recycling these items.<br><br>Students observe and record the shape of the moon for several months, then make drawings to predict what will happen in the next week. Students do some stargazing with a constellation chart or guide. Students demonstrate the ability to use a star chart properly so they can trace constellations. (Writing: BL-A2, B1,2,3,4,5; ABE I-A2; ABE II-A1)<br><br>Students identify planets that are visible in the night sky. (Reading: BL-D5; ABE I-B2,3,4,5,6; C1,2,3,4)<br><br>Students investigate old buildings and/or headstones in local cemetery for evidence of differential weathering and explain any differences found. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, C1,2,3)<br><br>Students compare and contrast planets in the solar system. (Writing: BL-A2, B 1,2,3,4,5) | Students identify items in the workplace made of basic earth materials.<br><br>Students identify the seasons, their characteristics (e.g., amount of daylight, general temperature range, weather patterns) and calendar events associated with them. Observe and note how the changing of the seasons affects the people they work with, as well as the general atmosphere of the office/workplace. (Reading: BL-D5; ABE I-B2,3,4,5,6; C1,2,3,4; ABE II-C1,2,3; ABE III-C1)<br><br>Students identify items in the office/workplace that are made from limited (natural) resources. Investigate possible alternatives (e.g., using items made of man-made materials, items made from recycled goods, altering procedure that utilizes limited resources items, etc.). Use findings to determine the best solution for decreasing the overall consumption of limited resources items.<br><br>Students examine their workplace to identify safest place(s) to be in case of extreme weather and/or earthquake and develop plan for all personnel in case of such event. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-C1,2,3; ABE III-C1)<br><br>Students hold a strip of paper in various positions around a fan to determine patterns in air movement. | Students identify possible geological hazards in the community (rockslides, flooding in washes, etc.) and recommend ways to avoid them. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2)<br><br>Students explain and describe how physical environments change due to human activity (e.g., building housing developments, utilizing recreational areas, damming rivers). (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE III-C1; ASE I-B4)<br><br>Students collect and record weather data and note how human activities are affected by it. (Writing: BL-A2, B.1,2,3,4,5; ABE I-A2; ABE II-A1; Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, C1,2,3; ABE III-C1)<br><br>Students investigate a local environmental issue, such as air or water pollution. Evaluate possible solutions. Identify the best solution and modify if necessary. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1 )<br><br>Students investigate the causes and problems associated with the "Greenhouse Effect." Identify the culprits responsible for breaking down the ozone layer in the Earth's atmosphere. Evaluate possible solutions. Research what is being done on global, national, and local levels, and devise a plan as far as what they can do on a personal level to help slow global warming. (Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, B3-4, C1,2,3; ABE III-C1; ASE I-B4, C2; ASE II-C1,2) |

## Science Sample Activities

**Indicator F: The learner understands the composition, formative processes and history of the Earth, the solar system and the universe. (Earth and Space Science, continued)**

| | Family | Workplace | Community |
|---|---|---|---|
| **ASE** | Students place white flowers (e.g., carnation, rose) in vase with food coloring added to the water. Observe change in flower color and relate to uptake of pollution by plants.<br><br>Students identify products using recycled resources and compare their quality and price to similar products using virgin resources. (Reading: BL-C1, D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-C2; ASE I-B4)<br><br>Students engage in composting (worm farms).<br><br>Students illustrate the growth of crystals (important in forming both igneous and sedimentary rocks). Make concentrated solutions of various salts. Allow them to evaporate slowly and observe the formation of crystals. Commonly used salts include table salt (sodium chloride), alum, and Epsom salt.<br><br>In the classroom, students demonstrate evaporation, condensation and precipitation. (Reading: BL-D5; ABE I-B2,3,4, C1,2,3,4; ABE II-C2)<br><br>Students create a model of the solar system and use a flashlight to demonstrate the effects of the earth's rotation and revolution. (Math ASE I E; ASE II B-5; Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-C2)<br><br>Using a model (light source and sphere), students demonstrate how the various phases of the moon are formed.<br><br>Students look at maps and photos to observe coastal changes. (Reading: BL-C1,2; ABE I-B2,3, C1,2,3,4; ABE II-C2) | Students initiate a recycling project and determine the costs and convenience involved in collection, transportation and sale of collected products. (Writing: BL-A2; Reading: BL-D5; ABE I-B2,3,4,5,6; C1,2,3,4; ABE II-A1, C1,2,3; ABE III-C1; ASE I-B4, C2)<br><br>Students construct a mini-landfill. Unearth and observe decomposition of buried waste ( e.g., food, paper, plastic, metal).<br><br>Students visit local sites that show examples of the earth changing due to slow processes (e.g., schoolyard, mountains) and rapid processes (e.g., localized erosion after a large storm). Document the changes using newspaper photographs. (Writing: BL-A2, B1,2,3,4,5; ABE I-A2; ABE II-A1; Reading: BL-C2, D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III C1)<br><br>Students watch national/international weather broadcasts. Discuss the relationship between precipitation, temperature and location on the globe. (Reading: BL-C2, D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, C1,2,3; ABE III-C1; ASE I-B4)<br><br>Students use weather websites or access newspaper websites from other international cities. | Students record the temperature outdoors in a sunny location and in a shady location. Discuss the reason for the difference in temperature. (Math ABE III A-4; Writing: BL-A2; ABE I-A2)<br><br>Using graphs, students chart the change in days' lengths and average temperatures for at least six months. Correlate the Earth's tilt to the results. (Math ASE I A-4; B-1, 2, 3; Writing: BL-A2; ABE I-A2; Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1; B3,4, C1,2,3; ABE III-C1; ASE I-B4, C2)<br><br>Students use the Internet to investigate the health effects of long-term space travel. (Reading: B-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, B3,4, C1,2,3; ABE III-C1; ASE I- B4, C2; ASE II-C1,2)<br><br>Students identify a place subject to periodic flooding, evaluate the positive and negative consequences of flooding, study different ways of maintaining, reducing or eliminating the likelihood of flooding and make recommendations for appropriate land use. (Reading: BL-C2, D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-A1, B3,4, C1,2,3; ABE III-C1)<br><br>On a diagram of the water cycle, students show the effects of regional weather events such as heavy rainstorms, heavy winter snow totals and droughts. (Reading: BL-D5; ABE I-B2,3,4,5,6;, C1,2,3,4)<br><br>With a hand lens, students examine a sample of coarse sand containing many kinds of grains. Also examine a collection of local rocks. Notice that rocks usually contain grains of many different minerals and that sand grains can be pure |

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| | | | minerals, e.g., quartz, mica, etc. |
| Technology Standards can easily be integrated into these activities. | | | |

## Science Sample Activities

**Indicator F: The learner understands the composition, formative processes and history of the Earth, the solar system and the universe. (Earth and Space Science, continued)**

| | Family | Workplace | Community |
|---|---|---|---|
| **ASE** | Students acquire a collection of minerals that includes (a) duplicates of the same mineral, somewhat different in appearance (size, shape, exact color) and (b) samples of minerals that look similar but are actually different. Sort as accurately as possible. Test all samples using three field tests: magnetism, streak and hardness. If this new information changes prior conclusions about samples being identical or not, re-sort the minerals. (Writing: BL-A2)<br><br>Students create a model that demonstrates how the tilt of the Earth causes seasonal changes. (Math ASE II B-5; ASE I E-1) | | Students discuss the scales (e.g., the Richter Scale) used to measure earth events. (Math ASE I F-1, 2, 3, 4; Reading: BL-D5; ABE I-B2,3,4,5,6, C1,2,3,4, D3; ABE II-A1, C1,2,3; ABE III-C1; ASE I-B4,C2)<br><br>Students study the local landscape, and if possible, natural (undeveloped) terrain (e.g., a state park) for signs of glaciation (e.g., eskers, drumlins, kettle holes). Discuss whether any of these features give evidence as to which way the glacier that formed them was moving. (Reading: BL-C2, D5; ABE I-B2,3,4,5,6, C1,2,3,4; ABE II-C1,2,3; ABE III-C1) |

# Glossary of Science Terms

**acceleration** - a change in velocity (either speed or direction)

**cell** - the structural and functional basic unit of all living things

**chromosomes** - threadlike structures located in cell nuclei of organisms which determine the individual characteristics of the organism

**climate** - characteristic pattern of weather elements in an area over a period of time

**density** - mass of a substance per unit volume

**equilibrium** - state of a system in which forces, influences, reactions, etc. balance each other out so there is no net change

**force** - push or pull

**front** - sloping interface between two air masses of different temperature and humidity

**gene** - unit of heredity composed of DNA forming part of a chromosome

**heterozygous –** a zygote with inherited different alleles at one or more loci

**histogram** - a graphic representation of a frequency distribution in which the widths of the contiguous vertical bars are proportional to the class widths of the variable and the heights of the bars are proportional to the class frequencies

**homeostasis** - state of equilibrium produced by a balance of functions and chemical composition within a system

**homozygous –** having identical alleles at corresponding chromosomal loci

**inertia** - resistance to acceleration

**kinetic energy** - energy of motion

**law** - a formulation describing a relationship that is presumed to hold between or among phenomena for all cases in which the specified conditions are met

**law of conservation of energy** - the total energy of an isolated system remains constant regardless of changes within a system

**law of conservation of mass** - the total mass of an isolated system is unchanged by the interaction of its parts

**1st law of thermodynamics** - (see the law of conservation of energy)

**2nd law of thermodynamics** - the ability of a closed system to do work will decrease over time

**mass** - measure of a body's inertia, usually measured by gravitation (weight)

**matter** - anything having mass and volume

**meiosis** - cell division creating four reproductive cells, each with one half the chromosome number of the parent cell

**mitosis** - division of a cell creating two daughter cells containing the same number and kind of chromosomes as the mother cell

**Newton's law of gravity** - gravity is a force between two objects, directly proportional to the product of their masses and inversely proportional to the square of the distance between them

**Newton's laws of motion** -
1) a body at rest tends to remain at rest, and a body in (straight line) motion tends to remain in motion unless acted upon by an outside force
2) the acceleration of a body is proportional to the body's mass and the force acting upon it (F= ma)
3) if one body exerts a force on another, there is an equal and opposite reaction (opposite force) exerted on the first body by the second

**organ** - any distinct part of an organism specialized to perform one or more functions (will contain many different tissues)

**paradigm** - an example that epitomizes a set of beliefs at a point in time

**pH** - from a scale used to express acidity or alkalinity of a solution (pH of 7 is neutral, pH <7 is acid, pH >7 alkaline)

**potential energy** - energy stored in a body or system as a consequence of its position, shape, or state

**pressure system** - air mass, area of atmosphere possessing more or less uniform temperature and humidity

**principle** - a rule or law concerning the operation of natural phenomena or mechanical processes

**revolution** - orbital motion about a point

**rotation** - motion in which the path of every point in a moving object is circular or a circular arc centered on a specified axis

**scatter plot** - graph of points representing a collection of data

**solubility** - measure of the ability of a substance to be dissolved in a liquid

**theory** - systematically organized knowledge applicable in a relatively wide variety of circumstances, especially a system of assumptions, accepted principles, and rules of procedures devised to analyze, predict, or otherwise explain the nature or behavior of a specified set of phenomenon

**tissue** - collection of similar cells organized to carry out one or more particular functions

**velocity** - speed of a body in a specified direction

**volume** - space occupied by a body or mass of fluid

**weather** - state of atmospheric conditions (humidity, precipitation, temperature, cloud cover, visibility, wind) at any one place and time