

## Chapter 112. Texas Essential Knowledge and Skills for Science

### Subchapter B. Middle School

*Statutory Authority: The provisions of this Subchapter B issued under the Texas Education Code, §7.102(c)(4) and §28.002, unless otherwise noted.*

#### §112.17. Implementation of Texas Essential Knowledge and Skills for Science, Middle School, Adopted 2017.

The provisions of §§112.18-112.20 of this subchapter shall be implemented by school districts beginning with the 2018-2019 school year.

*Source: The provisions of this §112.17 adopted to be effective August 4, 2009, 34 TexReg 5063; amended to be effective August 24, 2010, 35 TexReg 7230; amended to be effective August 27, 2018, 42 TexReg 5052.*

#### §112.18. Science, Grade 6, Adopted 2017.

(a) Introduction.

- (1) Grade 6 science is interdisciplinary in nature; however, much of the content focus is on physical science. National standards in science are organized as multi-grade blocks such as Grades 5-8 rather than individual grade levels. In order to follow the grade level format used in Texas, the various national standards are found among Grades 6, 7, and 8. Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include change and constancy, patterns, cycles, systems, models, and scale.

The strands for Grade 6 include the following.

(A) Scientific investigations and reasoning.

- (i) To develop a rich knowledge of science and the natural world, students must become familiar with different modes of scientific inquiry, rules of evidence, ways of formulating questions, ways of proposing explanations, and the diverse ways scientists study the natural world and propose explanations based on evidence derived from their work.
- (ii) Scientific investigations are conducted for different reasons. All investigations require a research question, careful observations, data gathering, and analysis of the data to identify the patterns that will explain the findings. Descriptive investigations are used to explore new phenomena such as conducting surveys of organisms or measuring the abiotic components in a given habitat. Descriptive statistics include frequency, range, mean, median, and mode. A hypothesis is not required in a descriptive investigation. On the other hand, when conditions can be controlled in order to focus on a single variable, experimental research design is used to determine causation. Students should experience both types of investigations and understand that different scientific research questions require different research designs.
- (iii) Scientific investigations are used to learn about the natural world. Students should understand that certain types of questions can be answered by investigations, and the methods, models, and conclusions built from these investigations change as new observations are made. Models of objects and events are tools for understanding the natural world and can show how systems work. Models have limitations and based on new discoveries are constantly being modified to more closely reflect the natural world.

(B) Matter and energy.

- (i) Matter can be classified as elements, compounds, or mixtures. Students have already had experience with mixtures in Grade 5, so Grade 6 will concentrate on

developing an understanding of elements and compounds. It is important that students learn the differences between elements and compounds based on observations, description of physical properties, and chemical reactions. Elements are represented by chemical symbols, while compounds are represented by chemical formulas. Subsequent grades will learn about the differences at the molecular and atomic level.

- (ii) Elements are classified as metals, nonmetals, and metalloids based on their physical properties. The elements are divided into three groups on the Periodic Table. Each different substance usually has a different density, so density can be used as an identifying property. Therefore, calculating density aids classification of substances.
  - (iii) Energy resources are available on a renewable or nonrenewable basis. Understanding the origins and uses of these resources enables informed decision making. Students should consider the ethical/social issues surrounding Earth's natural energy resources, while looking at the advantages and disadvantages of their long-term uses.
- (C) Force, motion, and energy. Energy occurs in two types, potential and kinetic, and can take several forms. Thermal energy can be transferred by conduction, convection, or radiation. It can also be changed from one form to another. Students will investigate the relationship between force and motion using a variety of means, including calculations and measurements.
- (D) Earth and space. The focus of this strand is on introducing Earth's processes. Students should develop an understanding of Earth as part of our solar system. The topics include organization of our solar system, the role of gravity, and space exploration.
- (E) Organisms and environments. Students will gain an understanding of the broadest taxonomic classifications of organisms and how characteristics determine their classification. The other major topics developed in this strand include the interdependence between organisms and their environments and the levels of organization within an ecosystem.
- (2) Science, as defined by the National Academy of Science, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.
- (3) Scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions become theories. Scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Students should know that scientific theories, unlike hypotheses, are well established and highly reliable, but they may still be subject to change as new information and technologies are developed. Students should be able to distinguish between scientific decision-making methods and ethical/social decisions that involve the application of scientific information.
- (4) Statements containing the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.
- (b) Knowledge and skills.
- (1) Scientific investigation and reasoning. The student, for at least 40% of instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices. The student is expected to:
- (A) demonstrate safe practices during laboratory and field investigations as outlined in Texas Education Agency-approved safety standards; and

- (B) practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials.
- (2) Scientific investigation and reasoning. The student uses scientific practices during laboratory and field investigations. The student is expected to:
- (A) plan and implement comparative and descriptive investigations by making observations, asking well defined questions, and using appropriate equipment and technology;
  - (B) design and implement experimental investigations by making observations, asking well defined questions, formulating testable hypotheses, and using appropriate equipment and technology;
  - (C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;
  - (D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and
  - (E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.
- (3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:
- (A) analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;
  - (B) use models to represent aspects of the natural world such as a model of Earth's layers;
  - (C) identify advantages and limitations of models such as size, scale, properties, and materials; and
  - (D) relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.
- (4) Scientific investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:
- (A) use appropriate tools, including journals/notebooks, beakers, Petri dishes, meter sticks, graduated cylinders, hot plates, test tubes, balances, microscopes, thermometers, calculators, computers, timing devices, and other necessary equipment to collect, record, and analyze information; and
  - (B) use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher.
- (5) Matter and energy. The student knows the differences between elements and compounds. The student is expected to:
- (A) know that an element is a pure substance represented by a chemical symbol and that a compound is a pure substance represented by a chemical formula;
  - (B) recognize that a limited number of the many known elements comprise the largest portion of solid Earth, living matter, oceans, and the atmosphere; and
  - (C) identify the formation of a new substance by using the evidence of a possible chemical change such as production of a gas, change in temperature, production of a precipitate, or color change.
- (6) Matter and energy. The student knows matter has physical properties that can be used for classification. The student is expected to:

- (A) compare metals, nonmetals, and metalloids using physical properties such as luster, conductivity, or malleability;
  - (B) calculate density to identify an unknown substance; and
  - (C) test the physical properties of minerals, including hardness, color, luster, and streak.
- (7) Matter and energy. The student knows that some of Earth's energy resources are available on a nearly perpetual basis, while others can be renewed over a relatively short period of time. Some energy resources, once depleted, are essentially nonrenewable. The student is expected to
- research and discuss the advantages and disadvantages of using coal, oil, natural gas, nuclear power, biomass, wind, hydropower, geothermal, and solar resources.
- (8) Force, motion, and energy. The student knows force and motion are related to potential and kinetic energy. The student is expected to:
- (A) compare and contrast potential and kinetic energy;
  - (B) identify and describe the changes in position, direction, and speed of an object when acted upon by unbalanced forces;
  - (C) calculate average speed using distance and time measurements;
  - (D) measure and graph changes in motion; and
  - (E) investigate how inclined planes can be used to change the amount of force to move an object.
- (9) Force, motion, and energy. The student knows that the Law of Conservation of Energy states that energy can neither be created nor destroyed, it just changes form. The student is expected to:
- (A) investigate methods of thermal energy transfer, including conduction, convection, and radiation;
  - (B) verify through investigations that thermal energy moves in a predictable pattern from warmer to cooler until all the substances attain the same temperature such as an ice cube melting; and
  - (C) demonstrate energy transformations such as energy in a flashlight battery changes from chemical energy to electrical energy to light energy.
- (10) Earth and space. The student understands the structure of Earth, the rock cycle, and plate tectonics. The student is expected to:
- (A) build a model to illustrate the compositional and mechanical layers of Earth, including the inner core, outer core, mantle, crust, asthenosphere, and lithosphere;
  - (B) classify rocks as metamorphic, igneous, or sedimentary by the processes of their formation;
  - (C) identify the major tectonic plates, including Eurasian, African, Indo-Australian, Pacific, North American, and South American; and
  - (D) describe how plate tectonics causes major geological events such as ocean basin formation, earthquakes, volcanic eruptions, and mountain building.
- (11) Earth and space. The student understands the organization of our solar system and the relationships among the various bodies that comprise it. The student is expected to:
- (A) describe the physical properties, locations, and movements of the Sun, planets, moons, meteors, asteroids, and comets;
  - (B) understand that gravity is the force that governs the motion of our solar system; and
  - (C) describe the history and future of space exploration, including the types of equipment and transportation needed for space travel.

- (12) Organisms and environments. The student knows all organisms are classified into domains and kingdoms. Organisms within these taxonomic groups share similar characteristics that allow them to interact with the living and nonliving parts of their ecosystem. The student is expected to:
- (A) understand that all organisms are composed of one or more cells;
  - (B) recognize that the presence of a nucleus is a key factor used to determine whether a cell is prokaryotic or eukaryotic;
  - (C) recognize that the broadest taxonomic classification of living organisms is divided into currently recognized domains;
  - (D) identify the basic characteristics of organisms, including prokaryotic or eukaryotic, unicellular or multicellular, autotrophic or heterotrophic, and mode of reproduction, that further classify them in the currently recognized kingdoms;
  - (E) describe biotic and abiotic parts of an ecosystem in which organisms interact; and
  - (F) diagram the levels of organization within an ecosystem, including organism, population, community, and ecosystem.

*Source: The provisions of this §112.18 adopted to be effective August 4, 2009, 34 TexReg 5063; amended to be effective August 27, 2018, 42 TexReg 5052.*

#### **§112.19. Science, Grade 7, Adopted 2017.**

- (a) Introduction.
- (1) Grade 7 science is interdisciplinary in nature; however, much of the content focus is on organisms and the environment. National standards in science are organized as multi-grade blocks such as Grades 5-8 rather than individual grade levels. In order to follow the grade level format used in Texas, the various national standards are found among Grades 6, 7, and 8. Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include change and constancy, patterns, cycles, systems, models, and scale.
- The strands for Grade 7 include the following.
- (A) Scientific investigation and reasoning.
    - (i) To develop a rich knowledge of science and the natural world, students must become familiar with different modes of scientific inquiry, rules of evidence, ways of formulating questions, ways of proposing explanations, and the diverse ways scientists study the natural world and propose explanations based on evidence derived from their work.
    - (ii) Scientific investigations are conducted for different reasons. All investigations require a research question, careful observations, data gathering, and analysis of the data to identify the patterns that will explain the findings. Descriptive investigations are used to explore new phenomena such as conducting surveys of organisms or measuring the abiotic components in a given habitat. Descriptive statistics include frequency, range, mean, median, and mode. A hypothesis is not required in a descriptive investigation. On the other hand, when conditions can be controlled in order to focus on a single variable, experimental research design is used to determine causation. Students should experience both types of investigations and understand that different scientific research questions require different research designs.
    - (iii) Scientific investigations are used to learn about the natural world. Students should understand that certain types of questions can be answered by investigations, and the methods, models, and conclusions built from these investigations change as new observations are made. Models of objects and events are tools for understanding the natural world and can show how systems

work. Models have limitations and based on new discoveries are constantly being modified to more closely reflect the natural world.

- (B) Matter and energy. Matter and energy are conserved throughout living systems. Radiant energy from the Sun drives much of the flow of energy throughout living systems due to the process of photosynthesis in organisms described as producers. Most consumers then depend on producers to meet their energy needs. Subsequent grade levels will learn about the differences at the molecular and atomic level.
  - (C) Force, motion, and energy. Force, motion, and energy are observed in living systems and the environment in several ways. Interactions between muscular and skeletal systems allow the body to apply forces and transform energy both internally and externally. Force and motion can also describe the direction and growth of seedlings, turgor pressure, and geotropism. Catastrophic events of weather systems such as hurricanes, floods, and tornadoes can shape and restructure the environment through the force and motion evident in them. Weathering, erosion, and deposition occur in environments due to the forces of gravity, wind, ice, and water.
  - (D) Earth and space. Earth and space phenomena can be observed in a variety of settings. Both natural events and human activities can impact Earth systems. There are characteristics of Earth and relationships to objects in our solar system that allow life to exist.
  - (E) Organisms and environments.
    - (i) Students will understand the relationship between living organisms and their environment. Different environments support different living organisms that are adapted to that region of Earth. Organisms are living systems that maintain a steady state with that environment and whose balance may be disrupted by internal and external stimuli. External stimuli include human activity or the environment. Successful organisms can reestablish a balance through different processes such as a feedback mechanism. Ecological succession can be seen on a broad or small scale.
    - (ii) Students learn that all organisms obtain energy, get rid of wastes, grow, and reproduce. During both sexual and asexual reproduction, traits are passed onto the next generation. These traits are contained in genetic material that is found on genes within a chromosome from the parent. Changes in traits sometimes occur in a population over many generations. One of the ways a change can occur is through the process of natural selection. Students extend their understanding of structures in living systems from a previous focus on external structures to an understanding of internal structures and functions within living things.
    - (iii) All living organisms are made up of smaller units called cells. All cells use energy, get rid of wastes, and contain genetic material. Students will compare plant and animal cells and understand the internal structures within them that allow them to obtain energy, get rid of wastes, grow, and reproduce in different ways. Cells can organize into tissues, tissues into organs, and organs into organ systems. Students will learn the major functions of human body systems such as the ability of the integumentary system to protect against infection, injury, and ultraviolet (UV) radiation; regulate body temperature; and remove waste.
- (2) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

- (3) Scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions become theories. Scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Students should know that scientific theories, unlike hypotheses, are well established and highly reliable, but they may still be subject to change as new information and technologies are developed. Students should be able to distinguish between scientific decision-making methods and ethical/social decisions that involve the application of scientific information.
  - (4) Statements containing the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.
- (b) Knowledge and skills.
- (1) Scientific investigation and reasoning. The student, for at least 40% of the instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices. The student is expected to:
    - (A) demonstrate safe practices during laboratory and field investigations as outlined in Texas Education Agency-approved safety standards; and
    - (B) practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials.
  - (2) Scientific investigation and reasoning. The student uses scientific practices during laboratory and field investigations. The student is expected to:
    - (A) plan and implement comparative and descriptive investigations by making observations, asking well defined questions, and using appropriate equipment and technology;
    - (B) design and implement experimental investigations by making observations, asking well defined questions, formulating testable hypotheses, and using appropriate equipment and technology;
    - (C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;
    - (D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and
    - (E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.
  - (3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:
    - (A) analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;
    - (B) use models to represent aspects of the natural world such as human body systems and plant and animal cells;
    - (C) identify advantages and limitations of models such as size, scale, properties, and materials; and
    - (D) relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.
  - (4) Science investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:

- (A) use appropriate tools, including life science models, hand lenses, stereoscopes, microscopes, beakers, Petri dishes, microscope slides, graduated cylinders, test tubes, meter sticks, metric rulers, metric tape measures, timing devices, hot plates, balances, thermometers, calculators, water test kits, computers, temperature and pH probes, collecting nets, insect traps, globes, digital cameras, journals/notebooks, and other necessary equipment to collect, record, and analyze information; and
  - (B) use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher.
- (5) Matter and energy. The student knows that interactions occur between matter and energy. The student is expected to:
- (A) recognize that radiant energy from the Sun is transformed into chemical energy through the process of photosynthesis; and
  - (B) diagram the flow of energy through living systems, including food chains, food webs, and energy pyramids.
- (6) Matter and energy. The student knows that matter has physical and chemical properties and can undergo physical and chemical changes. The student is expected to
- distinguish between physical and chemical changes in matter.
- (7) Force, motion, and energy. The student knows that there is a relationship among force, motion, and energy. The student is expected to:
- (A) illustrate the transformation of energy within an organism such as the transfer from chemical energy to thermal energy; and
  - (B) demonstrate and illustrate forces that affect motion in organisms such as emergence of seedlings, turgor pressure, geotropism, and circulation of blood.
- (8) Earth and space. The student knows that natural events and human activity can impact Earth systems. The student is expected to:
- (A) predict and describe how catastrophic events such as floods, hurricanes, or tornadoes impact ecosystems;
  - (B) analyze the effects of weathering, erosion, and deposition on the environment in ecoregions of Texas; and
  - (C) model the effects of human activity on groundwater and surface water in a watershed.
- (9) Earth and space. The student knows components of our solar system. The student is expected to:
- (A) analyze the characteristics of objects in our solar system that allow life to exist such as the proximity of the Sun, presence of water, and composition of the atmosphere; and
  - (B) identify the accommodations, considering the characteristics of our solar system, that enabled manned space exploration.
- (10) Organisms and environments. The student knows that there is a relationship between organisms and the environment. The student is expected to:
- (A) observe and describe how different environments, including microhabitats in schoolyards and biomes, support different varieties of organisms;
  - (B) describe how biodiversity contributes to the sustainability of an ecosystem; and
  - (C) observe, record, and describe the role of ecological succession such as in a microhabitat of a garden with weeds.



- (11) Organisms and environments. The student knows that populations and species demonstrate variation and inherit many of their unique traits through gradual processes over many generations. The student is expected to:
- (A) examine organisms or their structures such as insects or leaves and use dichotomous keys for identification;
  - (B) explain variation within a population or species by comparing external features, behaviors, or physiology of organisms that enhance their survival such as migration, hibernation, or storage of food in a bulb; and
  - (C) identify some changes in genetic traits that have occurred over several generations through natural selection and selective breeding such as the Galapagos Medium Ground Finch (*Geospiza fortis*) or domestic animals and hybrid plants.
- (12) Organisms and environments. The student knows that living systems at all levels of organization demonstrate the complementary nature of structure and function. The student is expected to:
- (A) investigate and explain how internal structures of organisms have adaptations that allow specific functions such as gills in fish, hollow bones in birds, or xylem in plants;
  - (B) identify the main functions of the systems of the human organism, including the circulatory, respiratory, skeletal, muscular, digestive, excretory, reproductive, integumentary, nervous, and endocrine systems;
  - (C) recognize levels of organization in plants and animals, including cells, tissues, organs, organ systems, and organisms;
  - (D) differentiate between structure and function in plant and animal cell organelles, including cell membrane, cell wall, nucleus, cytoplasm, mitochondrion, chloroplast, and vacuole;
  - (E) compare the functions of cell organelles to the functions of an organ system; and
  - (F) recognize the components of cell theory.
- (13) Organisms and environments. The student knows that a living organism must be able to maintain balance in stable internal conditions in response to external and internal stimuli. The student is expected to:
- (A) investigate how organisms respond to external stimuli found in the environment such as phototropism and fight or flight; and
  - (B) describe and relate responses in organisms that may result from internal stimuli such as wilting in plants and fever or vomiting in animals that allow them to maintain balance.
- (14) Organisms and environments. The student knows that reproduction is a characteristic of living organisms and that the instructions for traits are governed in the genetic material. The student is expected to:
- (A) define heredity as the passage of genetic instructions from one generation to the next generation;
  - (B) compare the results of uniform or diverse offspring from asexual or sexual reproduction; and
  - (C) recognize that inherited traits of individuals are governed in the genetic material found in the genes within chromosomes in the nucleus.

*Source: The provisions of this §112.19 adopted to be effective August 4, 2009, 34 TexReg 5063; amended to be effective August 27, 2018, 42 TexReg 5052.*

**§112.20. Science, Grade 8, Adopted 2017.**

- (a) Introduction.

- (1) Grade 8 science is interdisciplinary in nature; however, much of the content focus is on earth and space science. National standards in science are organized as multi-grade blocks such as Grades 5-8 rather than individual grade levels. In order to follow the grade level format used in Texas, the various national standards are found among Grades 6, 7, and 8. Recurring themes are pervasive in sciences, mathematics, and technology. These ideas transcend disciplinary boundaries and include change and constancy, patterns, cycles, systems, models, and scale.

The strands for Grade 8 include the following.

- (A) Scientific investigation and reasoning.
- (i) To develop a rich knowledge of science and the natural world, students must become familiar with different modes of scientific inquiry, rules of evidence, ways of formulating questions, ways of proposing explanations, and the diverse ways scientists study the natural world and propose explanations based on evidence derived from their work.
  - (ii) Scientific investigations are conducted for different reasons. All investigations require a research question, careful observations, data gathering, and analysis of the data to identify the patterns that will explain the findings. Descriptive investigations are used to explore new phenomena such as conducting surveys of organisms or measuring the abiotic components in a given habitat. Descriptive statistics include frequency, range, mean, median, and mode. A hypothesis is not required in a descriptive investigation. On the other hand, when conditions can be controlled in order to focus on a single variable, experimental research design is used to determine causation. Students should experience both types of investigations and understand that different scientific research questions require different research designs.
  - (iii) Scientific investigations are used to learn about the natural world. Students should understand that certain types of questions can be answered by investigations, and the methods, models, and conclusions built from these investigations change as new observations are made. Models of objects and events are tools for understanding the natural world and can show how systems work. Models have limitations and based on new discoveries are constantly being modified to more closely reflect the natural world.
- (B) Matter and energy. Students recognize that matter is composed of atoms. Students examine information on the Periodic Table to recognize that elements are grouped into families. In addition, students understand the basic concept of conservation of mass. Lab activities will allow students to demonstrate evidence of chemical reactions. They will use chemical formulas to identify substances.
- (C) Force, motion, and energy. Students experiment with the relationship between forces and motion through the study of Newton's three laws. Students learn how these forces relate to geologic processes and astronomical phenomena. In addition, students recognize that these laws are evident in everyday objects and activities. Mathematics is used to calculate speed using distance and time measurements.
- (D) Earth and space. Students identify the role of natural events in altering Earth systems. Cycles within Sun, Earth, and Moon systems are studied as students learn about seasons, tides, and lunar phases. Students learn that stars and galaxies are part of the universe. In addition, students use data to research scientific theories of the origin of the universe. Students will illustrate how Earth features change over time by plate tectonics. They will interpret land and erosional features on topographic maps and satellite views. Students learn how interactions in solar, weather, and ocean systems create changes in weather patterns and climate.
- (E) Organisms and environments. In studies of living systems, students explore the interdependence between these systems. Students describe how biotic and abiotic factors

affect the number of organisms and populations present in an ecosystem. In addition, students explore how organisms and their populations respond to short- and long-term environmental changes, including those caused by human activities.

- (2) Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.
  - (3) Scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions become theories. Scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Students should know that scientific theories, unlike hypotheses, are well established and highly reliable, but they may still be subject to change as new information and technologies are developed. Students should be able to distinguish between scientific decision-making methods and ethical/social decisions that involve the application of scientific information.
  - (4) Statements containing the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.
- (b) Knowledge and skills.
- (1) Scientific investigation and reasoning. The student, for at least 40% of instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices. The student is expected to:
    - (A) demonstrate safe practices during laboratory and field investigations as outlined in Texas Education Agency-approved safety standards; and
    - (B) practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials.
  - (2) Scientific investigation and reasoning. The student uses scientific practices during laboratory and field investigations. The student is expected to:
    - (A) plan and implement comparative and descriptive investigations by making observations, asking well defined questions, and using appropriate equipment and technology;
    - (B) design and implement experimental investigations by making observations, asking well defined questions, formulating testable hypotheses, and using appropriate equipment and technology;
    - (C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;
    - (D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and
    - (E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.
  - (3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:
    - (A) analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;
    - (B) use models to represent aspects of the natural world such as an atom, a molecule, space, or a geologic feature;

- (C) identify advantages and limitations of models such as size, scale, properties, and materials; and
  - (D) relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.
- (4) Scientific investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:
- (A) use appropriate tools, including lab journals/notebooks, beakers, meter sticks, graduated cylinders, anemometers, psychrometers, hot plates, test tubes, spring scales, balances, microscopes, thermometers, calculators, computers, spectrosopes, timing devices, and other necessary equipment to collect, record, and analyze information; and
  - (B) use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher.
- (5) Matter and energy. The student knows that matter is composed of atoms and has chemical and physical properties. The student is expected to:
- (A) describe the structure of atoms, including the masses, electrical charges, and locations, of protons and neutrons in the nucleus and electrons in the electron cloud;
  - (B) identify that protons determine an element's identity and valence electrons determine its chemical properties, including reactivity;
  - (C) interpret the arrangement of the Periodic Table, including groups and periods, to explain how properties are used to classify elements;
  - (D) recognize that chemical formulas are used to identify substances and determine the number of atoms of each element in chemical formulas containing subscripts; and
  - (E) investigate how evidence of chemical reactions indicates that new substances with different properties are formed and how that relates to the law of conservation of mass.
- (6) Force, motion, and energy. The student knows that there is a relationship between force, motion, and energy. The student is expected to:
- (A) demonstrate and calculate how unbalanced forces change the speed or direction of an object's motion;
  - (B) differentiate between speed, velocity, and acceleration; and
  - (C) investigate and describe applications of Newton's three laws of motion such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches.
- (7) Earth and space. The student knows the effects resulting from cyclical movements of the Sun, Earth, and Moon. The student is expected to:
- (A) model and illustrate how the tilted Earth rotates on its axis, causing day and night, and revolves around the Sun, causing changes in seasons;
  - (B) demonstrate and predict the sequence of events in the lunar cycle; and
  - (C) relate the positions of the Moon and Sun to their effect on ocean tides.
- (8) Earth and space. The student knows characteristics of the universe. The student is expected to:
- (A) describe components of the universe, including stars, nebulae, and galaxies, and use models such as the Hertzsprung-Russell diagram for classification;
  - (B) recognize that the Sun is a medium-sized star located in a spiral arm of the Milky Way galaxy and that the Sun is many thousands of times closer to Earth than any other star;

- (C) identify how different wavelengths of the electromagnetic spectrum such as visible light and radio waves are used to gain information about components in the universe; and
  - (D) research how scientific data are used as evidence to develop scientific theories to describe the origin of the universe.
- (9) Earth and space. The student knows that natural events can impact Earth systems. The student is expected to:
- (A) describe the historical development of evidence that supports plate tectonic theory;
  - (B) relate plate tectonics to the formation of crustal features; and
  - (C) interpret topographic maps and satellite views to identify land and erosional features and predict how these features may be reshaped by weathering.
- (10) Earth and space. The student knows that climatic interactions exist among Earth, ocean, and weather systems. The student is expected to:
- (A) recognize that the Sun provides the energy that drives convection within the atmosphere and oceans, producing winds;
  - (B) identify how global patterns of atmospheric movement influence local weather using weather maps that show high and low pressures and fronts; and
  - (C) identify the role of the oceans in the formation of weather systems such as hurricanes.
- (11) Organisms and environments. The student knows that interdependence occurs among living systems and the environment and that human activities can affect these systems. The student is expected to:
- (A) investigate how organisms and populations in an ecosystem depend on and may compete for biotic factors such as food and abiotic factors such as quantity of light, water, range of temperatures, or soil composition;
  - (B) explore how short- and long-term environmental changes affect organisms and traits in subsequent populations; and
  - (C) recognize human dependence on ocean systems and explain how human activities such as runoff, artificial reefs, or use of resources have modified these systems.

*Source: The provisions of this §112.20 adopted to be effective August 4, 2009, 34 TexReg 5063; amended to be effective August 27, 2018, 42 TexReg 5052.*

**§112.25. Implementation of Texas Essential Knowledge and Skills for Science, Middle School, Adopted 2021.**

- (a) The provisions of §§112.26-112.28 of this subchapter shall be implemented by school districts.
- (b) No later than July 31, 2023, the commissioner of education shall determine whether instructional materials funding has been made available to Texas public schools for materials that cover the essential knowledge and skills for science as adopted in §§112.26-112.28 of this subchapter.
- (c) If the commissioner makes the determination that instructional materials funding has been made available under subsection (b) of this section, §§112.26-112.28 of this subchapter shall be implemented beginning with the 2024-2025 school year and apply to the 2024-2025 and subsequent school years.
- (d) If the commissioner does not make the determination that instructional materials funding has been made available under subsection (b) of this section, the commissioner shall determine no later than July 31 of each subsequent school year whether instructional materials funding has been made available. If the commissioner determines that instructional materials funding has been made available, the commissioner shall notify the State Board of Education and school districts that §§112.26-112.28 of this subchapter shall be implemented for the following school year.
- (e) Sections 112.18-112.20 of this subchapter shall be superseded by the implementation of §§112.26-112.28 of this subchapter.

Source: The provisions of this §112.25 adopted to be effective April 26, 2022, 47 TexReg 2136.

### §112.26. Science, Grade 6, Adopted 2021.

(a) Introduction.

- (1) In Grades 6 through 8 Science, content is organized into recurring strands. The concepts within each grade level build on prior knowledge, prepare students for the next grade level, and establish a foundation for high school courses. In Grade 6, the following concepts will be addressed in each strand.
  - (A) Scientific and engineering practices. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, correlative, comparative, or experimental. The method chosen should be appropriate to the grade level and question being asked. Student learning for different types of investigations includes descriptive investigations, which have no hypothesis that tentatively answers the research question and involve collecting data and recording observations without making comparisons; correlative and comparative investigations, which have a hypothesis that predicts a relationship and involve collecting data, measuring variables relevant to the hypothesis that are manipulated, and comparing results; and experimental investigations, which involve processes similar to comparative investigations but in which a hypothesis can be tested by comparing a treatment with a control.
    - (i) Scientific practices. Students ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.
    - (ii) Engineering practices. Students identify problems and design solutions using appropriate tools and models.
  - (B) Matter and energy. Students build upon their knowledge of properties of solids, liquids, and gases and further explore their molecular energies. In Grade 6, students learn how elements are classified as metals, nonmetals, or metalloids based on their properties on the Periodic Table. Students have previous experience with mixtures in Grade 5. Grade 6 furthers their understanding by investigating the different types of mixtures. Subsequent grades will learn about compounds. In Grade 6, students compare the density of substances relative to fluids and identify evidence of chemical changes.
  - (C) Force, motion, and energy. Students investigate the relationship between force and motion using a variety of means, including calculations and measurements through the study of Newton's Third Law of Motion. Subsequent grades will study force and motion through Newton's First and Second Laws of Motion. Energy occurs as either potential or kinetic energy. Potential energy can take several forms, including gravitational, elastic, and chemical energy. Energy is conserved throughout systems by changing from one form to another and transfers through waves.
  - (D) Earth and space. Cycles within Sun, Earth, and Moon systems are studied as students learn about seasons and tides. Students identify that the Earth is divided into spheres and examine the processes within and organization of the geosphere. Researching the advantages and disadvantages of short- and long-term uses of resources enables informed decision making about resource management.
  - (E) Organisms and environments. All living organisms are made up of smaller units called cells. Ecosystems are organized into communities, populations, and organisms. Students compare and contrast variations within organisms and how they impact survival. Students examine relationships and interactions between organisms, biotic factors, and abiotic factors in an ecosystem.
- (2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge

is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not currently scientifically testable.

- (3) Scientific observations, inferences, hypotheses, and theories. Students are expected to know that:
    - (A) observations are active acquisition of either qualitative or quantitative information from a primary source through the senses;
    - (B) inferences are conclusions reached on the basis of observations or reasoning supported by relevant evidence;
    - (C) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and
    - (D) scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed.
  - (4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students distinguish between scientific decision-making practices and ethical and social decisions that involve science.
  - (5) Recurring themes and concepts. Science consists of recurring themes and making connections between overarching concepts. Recurring themes include structure and function, systems, models, and patterns. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Models have limitations but provide a tool for understanding the ideas presented. Students analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.
  - (6) Statements containing the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.
- (b) Knowledge and skills.
- (1) Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:
    - (A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;
    - (B) use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;
    - (C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;
    - (D) use appropriate tools such as graduated cylinders, metric rulers, periodic tables, balances, scales, thermometers, temperature probes, laboratory ware, timing devices, pH indicators, hot plates, models, microscopes, slides, life science models, petri dishes, dissecting kits, magnets, spring scales or force sensors, tools that model wave behavior, satellite images, hand lenses, and lab notebooks or journals;
    - (E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;

- (F) construct appropriate tables, graphs, maps, and charts using repeated trials and means to organize data;
  - (G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and
  - (H) distinguish between scientific hypotheses, theories, and laws.
- (2) Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:
- (A) identify advantages and limitations of models such as their size, scale, properties, and materials;
  - (B) analyze data by identifying any significant descriptive statistical features, patterns, sources of error, or limitations;
  - (C) use mathematical calculations to assess quantitative relationships in data; and
  - (D) evaluate experimental and engineering designs.
- (3) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:
- (A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;
  - (B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and
  - (C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.
- (4) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:
- (A) relate the impact of past and current research on scientific thought and society, including the process of science, cost-benefit analysis, and contributions of diverse scientists as related to the content;
  - (B) make informed decisions by evaluating evidence from multiple appropriate sources to assess the credibility, accuracy, cost-effectiveness, and methods used; and
  - (C) research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field to investigate STEM careers.
- (5) Recurring themes and concepts. The student understands that recurring themes and concepts provide a framework for making connections across disciplines. The student is expected to:
- (A) identify and apply patterns to understand and connect scientific phenomena or to design solutions;
  - (B) identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems;
  - (C) analyze how differences in scale, proportion, or quantity affect a system's structure or performance;
  - (D) examine and model the parts of a system and their interdependence in the function of the system;
  - (E) analyze and explain how energy flows and matter cycles through systems and how energy and matter are conserved through a variety of systems;



- (F) analyze and explain the complementary relationship between the structure and function of objects, organisms, and systems; and
  - (G) analyze and explain how factors or conditions impact stability and change in objects, organisms, and systems.
- (6) Matter and energy. The student knows that matter is made of atoms, can be classified according to its properties, and can undergo changes. The student is expected to:
- (A) compare solids, liquids, and gases in terms of their structure, shape, volume, and kinetic energy of atoms and molecules;
  - (B) investigate the physical properties of matter to distinguish between pure substances, homogeneous mixtures (solutions), and heterogeneous mixtures;
  - (C) identify elements on the periodic table as metals, nonmetals, metalloids, and rare Earth elements based on their physical properties and importance to modern life;
  - (D) compare the density of substances relative to various fluids; and
  - (E) identify the formation of a new substance by using the evidence of a possible chemical change, including production of a gas, change in thermal energy, production of a precipitate, and color change.
- (7) Force, motion, and energy. The student knows the nature of forces and their role in systems that experience stability or change. The student is expected to:
- (A) identify and explain how forces act on objects, including gravity, friction, magnetism, applied forces, and normal forces, using real-world applications;
  - (B) calculate the net force on an object in a horizontal or vertical direction using diagrams and determine if the forces are balanced or unbalanced; and
  - (C) identify simultaneous force pairs that are equal in magnitude and opposite in direction that result from the interactions between objects using Newton's Third Law of Motion.
- (8) Force, motion, and energy. The student knows that the total energy in systems is conserved through energy transfers and transformations. The student is expected to:
- (A) compare and contrast gravitational, elastic, and chemical potential energies with kinetic energy;
  - (B) describe how energy is conserved through transfers and transformations in systems such as electrical circuits, food webs, amusement park rides, or photosynthesis; and
  - (C) explain how energy is transferred through transverse and longitudinal waves.
- (9) Earth and space. The student models the cyclical movements of the Sun, Earth, and Moon and describes their effects. The student is expected to:
- (A) model and illustrate how the tilted Earth revolves around the Sun, causing changes in seasons; and
  - (B) describe and predict how the positions of the Earth, Sun, and Moon cause daily, spring, and neap cycles of ocean tides due to gravitational forces.
- (10) Earth and space. The student understands the rock cycle and the structure of Earth. The student is expected to:
- (A) differentiate between the biosphere, hydrosphere, atmosphere, and geosphere and identify components of each system;
  - (B) model and describe the layers of Earth, including the inner core, outer core, mantle, and crust; and

- (C) describe how metamorphic, igneous, and sedimentary rocks form and change through geologic processes in the rock cycle.
- (11) Earth and space. The student understands how resources are managed. The student is expected to:
- (A) research and describe why resource management is important in reducing global energy, poverty, malnutrition, and air and water pollution, and
  - (B) explain how conservation, increased efficiency, and technology can help manage air, water, soil, and energy resources.
- (12) Organisms and environments. The student knows that interdependence occurs between living systems and the environment. The student is expected to:
- (A) investigate how organisms and populations in an ecosystem depend on and may compete for biotic factors such as food and abiotic factors such as availability of light and water, range of temperatures, or soil composition;
  - (B) describe and give examples of predatory, competitive, and symbiotic relationships between organisms, including mutualism, parasitism, and commensalism; and
  - (C) describe the hierarchical organization of organism, population, and community within an ecosystem.
- (13) Organisms and environments. The student knows that organisms have an organizational structure and variations can influence survival of populations. The student is expected to:
- (A) describe the historical development of cell theory and explain how organisms are composed of one or more cells, which come from pre-existing cells and are the basic unit of structure and function;
  - (B) identify and compare the basic characteristics of organisms, including prokaryotic and eukaryotic, unicellular and multicellular, and autotrophic and heterotrophic; and
  - (C) describe how variations within a population can be an advantage or disadvantage to the survival of a population as environments change.

*Source: The provisions of this §112.26 adopted to be effective April 26, 2022, 47 TexReg 2136.*

### **§112.27. Grade 7, Adopted 2021.**

- (a) Introduction.
- (1) In Grades 6 through 8 Science, content is organized into recurring strands. The concepts within each grade level build on prior knowledge, prepare students for the next grade level, and establish a foundation for high school courses. In Grade 7, the following concepts will be addressed in each strand.
- (A) Scientific and engineering practices. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, correlative, comparative, or experimental. The method chosen should be appropriate to the grade level and question being asked. Student learning for different types of investigations includes descriptive investigations, which have no hypothesis that tentatively answers the research question and involve collecting data and recording observations without making comparisons; correlative and comparative investigations, which have a hypothesis that predicts a relationship and involve collecting data, measuring variables relevant to the hypothesis that are manipulated, and comparing results; and experimental investigations, which involve processes similar to comparative investigations but in which a hypothesis can be tested by comparing a treatment with a control.
    - (i) Scientific practices. Students ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.

- (ii) Engineering practices. Students identify problems and design solutions using appropriate tools and models.
  - (B) Matter and energy. Students have prior experience with elements in Grade 6 and develop an understanding that compounds are also pure substances in Grade 7. Students investigate the differences between elements and compounds through observations, descriptions of physical properties, and chemical reactions. Students build upon their understanding of solutions by exploring aqueous solutions.
  - (C) Force, motion, and energy. Students measure, calculate, graph, and investigate how forces impact linear motion. Students build upon their understanding of the laws of motions by exploring Newton's First Law of Motion. Temperature is a measure of the average kinetic energy of molecules. Thermal energy is transferred by conduction, convection, or radiation in order to reach thermal equilibrium.
  - (D) Earth and space. Students explore characteristics and organization of objects and the role of gravity within our solar system. Earth has a specific set of characteristics that allows life to exist. Students further their understanding of the geosphere by illustrating how Earth's features change over time through tectonic movement. Students investigate how humans depend on and affect the hydrosphere.
  - (E) Organisms and environments. Students further their understanding of organisms as systems made up of cells organized into tissues, tissues into organs, and organs into organ systems by identifying the main functions of the organs within the human body. During both sexual and asexual reproduction, traits are passed on to the next generation. Students understand how traits in populations can change through the processes of natural and artificial selection. Students analyze how energy flows through trophic levels and how biodiversity impacts an ecosystem's sustainability. Students gain an understanding of the taxonomic classifications of organisms and how characteristics determine their classification.
- (2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not currently scientifically testable.
- (3) Scientific observations, inferences, hypotheses, and theories. Students are expected to know that:
- (A) observations are active acquisition of either qualitative or quantitative information from a primary source through the senses;
  - (B) inferences are conclusions reached on the basis of observations or reasoning supported by relevant evidence;
  - (C) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and
  - (D) scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed.
- (4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students distinguish between scientific decision-making practices and ethical and social decisions that involve science.
- (5) Recurring themes and concepts. Science consists of recurring themes and making connections between overarching concepts. Recurring themes include structure and function, systems, models,

and patterns. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Models have limitations but provide a tool for understanding the ideas presented. Students analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

- (6) Statements containing the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.
- (b) Knowledge and skills.
- (1) Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:
- (A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;
  - (B) use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;
  - (C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;
  - (D) use appropriate tools such as graduated cylinders, metric rulers, periodic tables, balances, scales, thermometers, temperature probes, laboratory ware, timing devices, pH indicators, hot plates, models, microscopes, slides, life science models, petri dishes, dissecting kits, magnets, spring scales or force sensors, tools that model wave behavior, satellite images, hand lenses, and lab notebooks or journals;
  - (E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;
  - (F) construct appropriate tables, graphs, maps, and charts using repeated trials and means to organize data;
  - (G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and
  - (H) distinguish between scientific hypotheses, theories, and laws.
- (2) Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:
- (A) identify advantages and limitations of models such as their size, scale, properties, and materials;
  - (B) analyze data by identifying any significant descriptive statistical features, patterns, sources of error, or limitations;
  - (C) use mathematical calculations to assess quantitative relationships in data; and
  - (D) evaluate experimental and engineering designs.
- (3) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:
- (A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;
  - (B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

- (C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.
- (4) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:
- (A) relate the impact of past and current research on scientific thought and society, including the process of science, cost-benefit analysis, and contributions of diverse scientists as related to the content;
  - (B) make informed decisions by evaluating evidence from multiple appropriate sources to assess the credibility, accuracy, cost-effectiveness, and methods used; and
  - (C) research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field to investigate STEM careers.
- (5) Recurring themes and concepts. The student understands that recurring themes and concepts provide a framework for making connections across disciplines. The student is expected to:
- (A) identify and apply patterns to understand and connect scientific phenomena or to design solutions;
  - (B) identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems;
  - (C) analyze how differences in scale, proportion, or quantity affect a system's structure or performance;
  - (D) examine and model the parts of a system and their interdependence in the function of the system;
  - (E) analyze and explain how energy flows and matter cycles through systems and how energy and matter are conserved through a variety of systems;
  - (F) analyze and explain the complementary relationship between structure and function of objects, organisms, and systems; and
  - (G) analyze and explain how factors or conditions impact stability and change in objects, organisms, and systems.
- (6) Matter and energy. The student distinguishes between elements and compounds, classifies changes in matter, and understands the properties of solutions. The student is expected to:
- (A) compare and contrast elements and compounds in terms of atoms and molecules, chemical symbols, and chemical formulas;
  - (B) use the periodic table to identify the atoms and the number of each kind within a chemical formula;
  - (C) distinguish between physical and chemical changes in matter;
  - (D) describe aqueous solutions in terms of solute and solvent, concentration, and dilution; and
  - (E) investigate and model how temperature, surface area, and agitation affect the rate of dissolution of solid solutes in aqueous solutions.
- (7) Force, motion, and energy. The student describes the cause-and-effect relationship between force and motion. The student is expected to:
- (A) calculate average speed using distance and time measurements from investigations;
  - (B) distinguish between speed and velocity in linear motion in terms of distance, displacement, and direction;

- (C) measure, record, and interpret an object's motion using distance-time graphs; and
  - (D) analyze the effect of balanced and unbalanced forces on the state of motion of an object using Newton's First Law of Motion.
- (8) Force, motion, and energy. The student understands the behavior of thermal energy as it flows into and out of systems. The student is expected to:
- (A) investigate methods of thermal energy transfer into and out of systems, including conduction, convection, and radiation;
  - (B) investigate how thermal energy moves in a predictable pattern from warmer to cooler until all substances within the system reach thermal equilibrium; and
  - (C) explain the relationship between temperature and the kinetic energy of the particles within a substance.
- (9) Earth and space. The student understands the patterns of movement, organization, and characteristics of components of our solar system. The student is expected to:
- (A) describe the physical properties, locations, and movements of the Sun, planets, moons, meteors, asteroids, comets, Kuiper belt, and Oort cloud;
  - (B) describe how gravity governs motion within Earth's solar system; and
  - (C) analyze the characteristics of Earth that allow life to exist such as the proximity of the Sun, presence of water, and composition of the atmosphere.
- (10) Earth and space. The student understands the causes and effects of plate tectonics. The student is expected to:
- (A) describe the evidence that supports that Earth has changed over time, including fossil evidence, plate tectonics, and superposition; and
  - (B) describe how plate tectonics causes ocean basin formation, earthquakes, mountain building, and volcanic eruptions, including supervolcanoes and hot spots.
- (11) Earth and space. The student understands how human activity can impact the hydrosphere. The student is expected to:
- (A) analyze the beneficial and harmful influences of human activity on groundwater and surface water in a watershed; and
  - (B) describe human dependence and influence on ocean systems and explain how human activities impact these systems.
- (12) Organisms and environments. The student understands that ecosystems are dependent upon the cycling of matter and the flow of energy. The student is expected to:
- (A) diagram the flow of energy within trophic levels and describe how the available energy decreases in successive trophic levels in energy pyramids; and
  - (B) describe how ecosystems are sustained by the continuous flow of energy and the recycling of matter and nutrients within the biosphere.
- (13) Organisms and environments. The student knows how systems are organized and function to support the health of an organism and how traits are inherited. The student is expected to:
- (A) identify and model the main functions of the systems of the human organism, including the circulatory, respiratory, skeletal, muscular, digestive, urinary, reproductive, integumentary, nervous, immune, and endocrine systems;
  - (B) describe the hierarchical organization of cells, tissues, organs, and organ systems within plants and animals;

- (C) compare the results of asexual and sexual reproduction of plants and animals in relation to the diversity of offspring and the changes in the population over time; and
  - (D) describe and give examples of how natural and artificial selection change the occurrence of traits in a population over generations.
- (14) Organisms and environments. The student knows how the taxonomic system is used to describe relationships between organisms. The student is expected to:
- (A) describe the taxonomic system that categorizes organisms based on similarities and differences shared among groups; and
  - (B) describe the characteristics of the recognized kingdoms and their importance in ecosystems such as bacteria aiding digestion or fungi decomposing organic matter.

*Source: The provisions of this §112.27 adopted to be effective April 26, 2022, 47 TexReg 2136.*

### §112.28. Grade 8, Adopted 2021.

- (a) Introduction.
- (1) In Grades 6 through 8 Science, content is organized into recurring strands. The concepts within each grade level build on prior knowledge, prepare students for the next grade level, and establish a foundation for high school courses. In Grade 8, the following concepts will be addressed in each strand.
- (A) Scientific and engineering practices. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, correlative, comparative, or experimental. The method chosen should be appropriate to the grade level and question being asked. Student learning for different types of investigations includes descriptive investigations, which have no hypothesis that tentatively answers the research question and involve collecting data and recording observations without making comparisons; correlative and comparative investigations, which have a hypothesis that predicts a relationship and involve collecting data, measuring variables relevant to the hypothesis that are manipulated, and comparing results; and experimental investigations, which involve processes similar to comparative investigations but in which a hypothesis can be tested by comparing a treatment with a control.
    - (i) Scientific practices. Students ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.
    - (ii) Engineering practices. Students identify problems and design solutions using appropriate tools and models.
  - (B) Matter and energy. Students make connections between elements, compounds, and mixtures that were introduced in prior grade levels. Students examine the properties of water, acids, and bases. In addition, students understand the basic concept of conservation of mass using chemical equations.
  - (C) Force, motion, and energy. Students are introduced to Newton's Second Law of Motion and investigate how all three laws of motion act simultaneously within systems. Students understand that waves transfer energy and further explore the characteristics and applications of waves.
  - (D) Earth and space. Students learn that stars and galaxies are part of the universe. In addition, students use data to research scientific theories of the origin of the universe. Students learn how interactions in solar, weather, and ocean systems create changes in weather patterns and climate. In addition, students understand that climate can be impacted by natural events and human activities.
  - (E) Organisms and environments. Students identify the function of organelles. Traits are contained in genetic material that is found on genes within a chromosome from the

parent. These traits influence the success of a species over time. Students explore how organisms and their populations respond to environmental changes, including those caused by human activities.

- (2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not currently scientifically testable.
  - (3) Scientific observations, inferences, hypotheses, and theories. Students are expected to know that:
    - (A) observations are active acquisition of either qualitative or quantitative information from a primary source through the senses;
    - (B) inferences are conclusions reached on the basis of observations or reasoning supported by relevant evidence;
    - (C) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and
    - (D) scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed.
  - (4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students distinguish between scientific decision-making practices and ethical and social decisions that involve science.
  - (5) Recurring themes and concepts. Science consists of recurring themes and making connections between overarching concepts. Recurring themes include structure and function, systems, models, and patterns. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Models have limitations but provide a tool for understanding the ideas presented. Students analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.
  - (6) Statements containing the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.
- (b) Knowledge and skills.
- (1) Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:
    - (A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;
    - (B) use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;
    - (C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;
    - (D) use appropriate tools such as graduated cylinders, metric rulers, periodic tables, balances, scales, thermometers, temperature probes, laboratory ware, timing devices, pH indicators,



- hot plates, models, microscopes, slides, life science models, petri dishes, dissecting kits, magnets, spring scales or force sensors, tools that model wave behavior, satellite images, weather maps, hand lenses, and lab notebooks or journals;
- (E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;
  - (F) construct appropriate tables, graphs, maps, and charts using repeated trials and means to organize data;
  - (G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and
  - (H) distinguish between scientific hypotheses, theories, and laws.
- (2) Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:
- (A) identify advantages and limitations of models such as their size, scale, properties, and materials;
  - (B) analyze data by identifying any significant descriptive statistical features, patterns, sources of error, or limitations;
  - (C) use mathematical calculations to assess quantitative relationships in data; and
  - (D) evaluate experimental and engineering designs.
- (3) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:
- (A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;
  - (B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and
  - (C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.
- (4) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:
- (A) relate the impact of past and current research on scientific thought and society, including the process of science, cost-benefit analysis, and contributions of diverse scientists as related to the content;
  - (B) make informed decisions by evaluating evidence from multiple appropriate sources to assess the credibility, accuracy, cost-effectiveness, and methods used; and
  - (C) research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field to investigate STEM careers.
- (5) Recurring themes and concepts. The student understands that recurring themes and concepts provide a framework for making connections across disciplines. The student is expected to:
- (A) identify and apply patterns to understand and connect scientific phenomena or to design solutions;
  - (B) identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems;

- (C) analyze how differences in scale, proportion, or quantity affect a system's structure or performance;
  - (D) examine and model the parts of a system and their interdependence in the function of the system;
  - (E) analyze and explain how energy flows and matter cycles through systems and how energy and matter are conserved through a variety of systems;
  - (F) analyze and explain the complementary relationship between the structure and function of objects, organisms, and systems; and
  - (G) analyze and explain how factors or conditions impact stability and change in objects, organisms, and systems.
- (6) Matter and energy. The student understands that matter can be classified according to its properties and matter is conserved in chemical changes that occur within closed systems. The student is expected to:
- (A) explain by modeling how matter is classified as elements, compounds, homogeneous mixtures, or heterogeneous mixtures;
  - (B) use the periodic table to identify the atoms involved in chemical reactions;
  - (C) describe the properties of cohesion, adhesion, and surface tension in water and relate to observable phenomena such as the formation of droplets, transport in plants, and insects walking on water;
  - (D) compare and contrast the properties of acids and bases, including pH relative to water; and
  - (E) investigate how mass is conserved in chemical reactions and relate conservation of mass to the rearrangement of atoms using chemical equations, including photosynthesis.
- (7) Force, motion, and energy. The student understands the relationship between force and motion within systems. The student is expected to:
- (A) calculate and analyze how the acceleration of an object is dependent upon the net force acting on the object and the mass of the object using Newton's Second Law of Motion; and
  - (B) investigate and describe how Newton's three laws of motion act simultaneously within systems such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches.
- (8) Force, motion, and energy. The student knows how energy is transferred through waves. The student is expected to:
- (A) compare the characteristics of amplitude, frequency, and wavelength in transverse waves, including the electromagnetic spectrum; and
  - (B) explain the use of electromagnetic waves in applications such as radiation therapy, wireless technologies, fiber optics, microwaves, ultraviolet sterilization, astronomical observations, and X-rays.
- (9) Earth and space. The student describes the characteristics of the universe and the relative scale of its components. The student is expected to:
- (A) describe the life cycle of stars and compare and classify stars using the Hertzsprung-Russell diagram;
  - (B) categorize galaxies as spiral, elliptical, and irregular and locate Earth's solar system within the Milky Way galaxy; and

- (C) research and analyze scientific data used as evidence to develop scientific theories that describe the origin of the universe.
- (10) Earth and space. The student knows that interactions between Earth, ocean, and weather systems impact climate. The student is expected to:
- (A) describe how energy from the Sun, hydrosphere, and atmosphere interact and influence weather and climate;
  - (B) identify global patterns of atmospheric movement and how they influence local weather; and
  - (C) describe the interactions between ocean currents and air masses that produce tropical cyclones, including typhoons and hurricanes.
- (11) Earth and space. The student knows that natural events and human activity can impact global climate. The student is expected to:
- (A) use scientific evidence to describe how natural events, including volcanic eruptions, meteor impacts, abrupt changes in ocean currents, and the release and absorption of greenhouse gases influence climate;
  - (B) use scientific evidence to describe how human activities, including the release of greenhouse gases, deforestation, and urbanization, can influence climate; and
  - (C) describe the carbon cycle.
- (12) Organisms and environments. The student understands stability and change in populations and ecosystems. The student is expected to:
- (A) explain how disruptions such as population changes, natural disasters, and human intervention impact the transfer of energy in food webs in ecosystems;
  - (B) describe how primary and secondary ecological succession affect populations and species diversity after ecosystems are disrupted by natural events or human activity; and
  - (C) describe how biodiversity contributes to the stability and sustainability of an ecosystem and the health of the organisms within the ecosystem.
- (13) Organisms and environments. The student knows how cell functions support the health of an organism and how adaptation and variation relate to survival. The student is expected to:
- (A) identify the function of the cell membrane, cell wall, nucleus, ribosomes, cytoplasm, mitochondria, chloroplasts, and vacuoles in plant or animal cells;
  - (B) describe the function of genes within chromosomes in determining inherited traits of offspring; and
  - (C) describe how variations of traits within a population lead to structural, behavioral, and physiological adaptations that influence the likelihood of survival and reproductive success of a species over generations.

*Source: The provisions of this §112.28 adopted to be effective April 26, 2022, 47 TexReg 2136.*