Kentucky Science

Grade 6

Adopted 2022

Grade 6

Physical Science

6-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. 6-PS1-1

6-SEPS1-1. Developing and Using Models - Develop a model to predict and/or describe phenomena. 6-SEPS1-1

1A. Structure and Properties of Matter - Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). 6-DCI.PS1.1A

PS1-1. Scale, Proportion, and Quantity - Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 6-CC.PS1-1

6-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. 6-PS1-4

6-SEPS1-4. Developing and Using Models - Develop a model to predict and/or describe phenomena. 6-SEPS1-4

4A. Structure and Properties of Matter - Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. 6-DCI.PS1.4A

4A. Definitions of Energy - The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. 6-DCI.PS3.4A

PS4. Cause and Effect - Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. 6-CC.PS4

6-PS2-1. Apply Newton's third law to design a solution to a problem involving the motion of two colliding objects. 6-PS2-1

6-SEPS2-1. Constructing Explanations and Designing Solutions - Apply scientific ideas or principles to design an object, tool, process, or system. 6-SEPS2-1

A. Forces and Motion - For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). 6-DCI.PS2.A

PS2-1. Systems and System Models - Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy and matter flows within systems. 6-CC.PS2-1

6-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. 6-PS2-4

6-SEPS2-4. Engaging in Argument from Evidence - Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. 6-SEPS2-4

4B. Types of Interactions - Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have a large mass—e.g., Earth and the sun. 6-DCI.PS2.4B

PS2-4. Systems and System Models - Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy and matter flows within systems. 6-CC.PS2-4

Life Science

6-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. 6-LS1-6

6-SEPLS1-6. Constructing Explanations and Designing Solutions - Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. 6-SEPLS1-6

6C. Organization for Matter and Energy Flow in Organisms - Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide in the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. 6-DCI.LS1.6C

LS1-6. Energy and Matter - Within a natural system, the transfer of energy drives the motion and/or cycling of matter. 6-CC.LS1-6

6-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. 6-LS2-1

6-SEPLS2-1. Analyzing and Interpreting Data - Analyze and interpret data to provide evidence for phenomena. 6-SEPLS2-1

1A. Interdependent Relationships in Ecosystems - Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with non-living factors. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. The growth of organisms and population increases are limited by access to resources. 6-DCI.LS2.1A

LS2-1. Cause and Effect - Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. 6-CC.LS2-1

6-LS2-2. Construct an explanation that predicts patterns of interaction among organisms across multiple ecosystems. 6-LS2-2

6-SEPLS2-2. Constructing Explanations and Designing Solutions - Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. 6-SEPLS2-2

2A. Interdependent Relationships in Ecosystems - Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and non-living, are shared. 6-DCI.LS2.2A

- **LS2-2.** Patterns - Patterns can be used to identify cause-and-effect relationships. 6-CC.LS2-2
- **6-LS2-3.** Develop a model to describe the cycling of matter and flow of energy among living and non-living parts of an ecosystem. 6-LS2-3
- **6-SEPLS2-3.** Developing and Using Models - Develop a model to describe phenomena. 6-SEPLS2-3
- **3B.** Cycle of Matter and Energy Transfer in Ecosystems - Food webs are models that demonstrate how matter and energy are transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and non-living parts of the ecosystem. 6-DCI.LS2.3B
- **LS2-3.** Energy and Matter - The transfer of energy can be tracked as energy flows through a natural system. 6-CC.LS2-3

Earth and Space Science

6-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. 6-ESS1-1

6-SEPESS1-1. Developing and Using Models - Develop and use a model to describe phenomena. 6-SEPESS1-1

1A. The Universe and Its Stars - Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. 6-DCI.ESS1.1A

1B. Earth and the Solar System - This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. 6-DCI.ESS1.1B

ESS1-1. Patterns - Patterns can be used to identify cause-and-effect relationships. 6-CC.ESS1-1

6-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. 6-ESS1-2

6-SEPESS1-2. Developing and Using Models - Develop and use a model to describe phenomena. 6-SEPESS1-2

2A. The Universe and Its Stars - Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. 6-DCI.ESS1.2A

2B. Earth and the Solar System - The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. 6-DCI.ESS1.2B

ESS1-2. Systems and System Models - Models can be used to represent systems and their interactions. 6-CC.ESS1-2

6-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system. 6-ESS1-3

6-SEPESS1-3. Analyzing and Interpreting Data - Analyze and interpret data to determine similarities and differences in findings. 6-SEPESS1-3

3B. Earth and the Solar System - The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. 6-DCI.ESS1.3B

ESS1-3. Scale, Proportion, and Quantity - Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 6-CC.ESS1-3

6-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. 6-ESS2-1

6-SEPESS2-1. Developing and Using Models - Develop and use a model to describe phenomena. 6-SEPESS2-1

1A. Earth's Materials and Systems - All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. 6-DCI.ESS2.1A

ESS2-1. Stability and Change - Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. 6-CC.ESS2-1

6-ESS2-2. Construct an explanation based on evidence for how biological and geoscience processes have changed Earth's surface at varying time and spatial scales. 6-ESS2-2

6-SEPESS2-2. Constructing Explanations and Designing Solutions - Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. 6-SEPESS2-2

2A. Earth's Materials and Systems - The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. 6-DCI.ESS2.2A

2C. The Roles of Water in Earth's Surface Processes - Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. 6-DCI.ESS2.2C

2E. Biogeology - The evolution and proliferation of living things over geological time have in turn changed the rates of weathering and erosion of land surfaces, altered the composition of Earth's soils and atmosphere, and affected the distribution of water in the hydrosphere. 6-DCI.ESS2.2E

ESS2-2. Scale, Proportion, and Quantity- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 6-CC.ESS2-2

6-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions. 6-ESS2-3

6-SEPESS2-3. Analyzing and Interpreting Data - Analyze and interpret data to provide evidence for phenomena. 6-SEPESS2-3

C. The History of Planet Earth - Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. 6-DCI.ESS1.C

B. Plate Tectonics and Large-Scale System Interactions - Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. 6-DCI.ESS2.B

ESS2-3. Patterns - Patterns in rates of change and other numerical relationships can provide information about natural systems. 6-CC.ESS2-3

6-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. 6-ESS2-4

6-SEPESS2-4. Developing and Using Models - Develop a model to describe unobservable mechanisms. 6-SEPESS2-4

4C. The Roles of Water in Earth's Surface Processes - Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. Global movements of water and its changes in form are propelled by sunlight and gravity. 6-DCI.ESS2.4C

ESS2-4. Energy and Matter - Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. 6-CC.ESS2-4

6-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions. 6-ESS2-5

6-SEPESS2-5. Planning and Carrying Out Investigations - Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. 6-SEPESS2-5

5C. The Roles of Water in Earth's Surface Processes - The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. 6-DCI.ESS2.5C

5D. Weather and Climate - Because these patterns are so complex, weather can only be predicted probabilistically. 6-DCI.ESS2.5D

ESS2-5. Cause and Effect - Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. 6-CC.ESS2-5

6-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. 6-ESS2-6

6-SEPESS2-6. Developing and Using Models - Develop and use a model to describe phenomena. 6-SEPESS2-6

6C. The Roles of Water in Earth's Surface Processes - Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. 6-DCI.ESS2.6C

D. Weather and Climate - Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. 6-DCI.ESS2.D

ESS2-6. Systems and System Models - Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. 6-CC.ESS2-6

6-8 Engineering Design

MS-ETS1-1. **Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.** MS-ETS1-1

MS-SEPETS1-1. **Asking Questions and Defining Problems - Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.** MS-SEPETS1-1

1A. **Defining and Delimiting Engineering Problems - The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.** MS-DCI.ETS1.1A

MS-ETS1-2. **Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.** MS-ETS1-2

MS-SEPETS1-2. **Engaging in Argument from Evidence - Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.** MS-SEPETS1-2

1-2B. **Developing Possible Solutions - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.** MS-DCI.ETS1.1-2B

MS-ETS1-3. **Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.** MS-ETS1-3

MS-SEPETS1-3. **Analyzing and Interpreting Data - Analyze and interpret data to determine similarities and differences in findings.** MS-SEPETS1-3

B. **Developing Possible Solutions - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.** MS-DCI.ETS1.B

C. **Optimizing the Design Solution - Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.** MS-DCI.ETS1.C

MS-ETS1-4. **Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.** MS-ETS1-4

MS-SEPETS1-4. **Developing and Using Models - Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.** MS-SEPETS1-4

1B. **Developing Possible Solutions - A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. Models of all kinds are important for testing solutions.** MS-DCI.ETS1.1B

1C. **Optimizing the Design Solution - The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.** MS-DCI.ETS1.1C