Instructional Implications for Grade 7

To meet the goals of *Each Child, Our Future*, Ohio's strategic plan for education, schools and districts will find it essential to have appropriate local curricula supported by high-quality instructional materials. Science is part of providing well-rounded content for students, as well-rounded content is one of the four learning domains listed in the strategic plan.

Science is an essential subject for students in grades K-12. It is important to build a strong foundation in science in early elementary years so students are prepared for understanding more complex material in intermediate and middle grades. It is equally important to continue students' science instruction by offering more advanced courses at the high school level. This allows students to better compete for admission to college or other postsecondary programs, as well as jobs. Advanced science courses in high schools also help produce a more scientifically literate public.

This document outlines the most notable changes from the 2010 standards to the 2018 standards and offers insight into how teachers can best prepare their students using the revised content. **The document is merely an overview; it does not provide a comprehensive treatment of changes or take the place of the model curriculum or instructional resources.**

The document consists of tables containing three columns that show the 2010 standard, the 2018 standard and the implications of any significant shifts from 2010 to 2018. The document addresses only areas in which the focus of instruction has changed. Standards that say "No change to content focus" should continue to be taught with the same goals as the corresponding 2010 standards. For standards in which the instructional focus has shifted, only the changed content is included in the third column of the table. Portions of the standard unaffected by the changes may not appear here but should continue to be taught.

Educators should teach all content in the standards incorporating the science and engineering practices, and they should engage students in scientific thought processes. Where possible, instructors should use real-world data and both problem-based and project-based experiences. *Ohio's Cognitive Demands*, which Ohio initiated in the 2010 standards, are clarified in the 2018 standards, featuring additional *Visions into Practice* examples categorized by cognitive demand. These levels of knowledge relate to current understanding and research about the ways people learn, and they are important aspects of an overall understanding of science concepts. Educators should give their students opportunities to practice all four types of thinking. Please note, the *Visions into Practice* section of the Model Curriculum suggests ways to incorporate these levels into instruction, but the examples are not mandatory; they are simply ideas educators could implement or adapt to suit local curriculum.

Also, educators need to design lessons to incorporate the concepts described in the *Nature of Science* sections. The *Nature of Science* provides a way for increasing students' understanding of science as more than a body of knowledge about how the natural world works. It also is a process for gathering information and gaining deeper knowledge about the world. These concepts of science should not form a standalone unit or be additional course materials. They should be embedded in each area of the science classroom experience, including lessons, laboratory or field studies, and assessments.

GRADE BAND THEME: ORDER AND ORGANIZATION

This theme focuses on helping students use scientific inquiry to discover patterns, trends, structures and relationships that may be inferred by simple principles. These principles are related to the properties or interactions within and between systems.

Strand Connections: Systems can exchange energy and/or matter when interactions occur within systems and between systems. Systems cycle matter and energy in observable and predictable patterns.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
Earth and Space Science (ESS)	**Earth and Space Science (ESS)**	
The hydrologic cycle illustrates the changing states of water as it moves through the lithosphere, biosphere, hydrosphere and atmosphere. Thermal energy is transferred as water changes state throughout the cycle. The cycling of water in the atmosphere is an important part of weather patterns on Earth. The rate at which water flows through soil and rock is dependent upon the porosity and permeability of the soil or rock. Note: Contamination can occur within any step of the hydrologic cycle. Ground water is easily contaminated as pollution present in the soil or spilled on the ground surface moves into the ground water and impacts numerous water sources.	**7.ESS.1: The hydrologic cycle illustrates the changing states of water as it moves through the lithosphere, biosphere, hydrosphere and atmosphere.** Thermal energy is transferred as water changes state throughout the cycle. The cycling of water in the atmosphere is an important part of weather patterns on Earth. The rate at which water flows through soil and rock is dependent upon the porosity and permeability of the soil or rock. ~~Note: Contamination can occur within any step of the hydrologic cycle. Ground water is easily contaminated as pollution present in the soil or spilled on the ground surface moves into the ground water and impacts numerous water sources.~~	No change to content focus, but be sure instruction reflects the strong emphasis on the *Nature of Science* and the *Cognitive Demands* included in the 2018 standards.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
Thermal-energy transfers in the ocean and the atmosphere contribute to the formation of currents, which influence global climate patterns. The sun is the major source of energy for wind, air and ocean currents and the hydrologic cycle. As thermal energy transfers occur in the atmosphere and ocean, currents form. Large bodies of water can influence weather and climate. The jet stream is an example of an atmospheric current and the Gulf Stream is an example of an oceanic current. Ocean currents are influenced by factors other than thermal energy, such as water density, mineral content (such as salinity), ocean floor topography and Earth's rotation. All of these factors delineate global climate patterns on Earth. Note: This content statement is related to LS grade 7 (biomes). Regional temperature and precipitation contribute to the identification of climatic zones.	**7.ESS.2: Thermal-energy transfers in the ocean and the atmosphere contribute to the formation of currents, which influence global climate patterns.** The sun is the major source of energy for wind, air and ocean currents and the hydrologic cycle. As thermal energy transfers occur in the atmosphere and ocean, currents form. Large bodies of water can influence weather and climate. The jet stream is an example of an atmospheric current and the Gulf Stream is an example of an oceanic current. Ocean currents are influenced by factors other than thermal energy, such as water density, mineral content (such as salinity), ocean floor topography and Earth's rotation. All of these factors delineate global climate patterns on Earth. ~~Note: This content statement is related to LS grade 7 (biomes). Regional temperature and precipitation contribute to the identification of climatic zones.~~	No change to content focus, but be sure instruction reflects the strong emphasis on the *Nature of Science* and the *Cognitive Demands* included in the 2018 standards.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
The atmosphere has different properties at different elevations and contains a mixture of gases that cycle through the lithosphere, biosphere, hydrosphere and atmosphere. The atmosphere is held to the Earth by the force of gravity. There are defined layers of the atmosphere that have specific properties, such as temperature, chemical composition and physical characteristics. Gases in the atmosphere include nitrogen, oxygen, water vapor, carbon dioxide and other trace gases. Biogeochemical cycles illustrate the movement of specific elements or molecules (such as carbon or nitrogen) through the lithosphere, biosphere, hydrosphere and atmosphere. **Note:** The emphasis is on why the atmosphere has defined layers, not on naming the layers.	**7.ESS.3: The atmosphere has different properties at different elevations and contains a mixture of gases that cycle through the lithosphere, biosphere, hydrosphere and atmosphere.** The atmosphere is held to the Earth by the force of gravity. There are defined layers of the atmosphere that have specific properties, such as temperature, chemical composition and physical characteristics. Gases in the atmosphere include nitrogen, oxygen, water vapor, carbon dioxide and other trace gases. Biogeochemical cycles illustrate the movement of specific elements or molecules (such as carbon or nitrogen) through the lithosphere, biosphere, hydrosphere and atmosphere. **Note:** The emphasis is on why the atmosphere has defined layers, not on naming the layers.	No change to content focus, but be sure instruction reflects the strong emphasis on the *Nature of Science* and the *Cognitive Demands* included in the 2018 standards.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
The relative patterns of motion and positions of Earth, moon and sun cause solar and lunar eclipses, tides and phases of the moon. The moon's orbit and its change of position relative to Earth and sun result in different parts of the moon being visible from Earth (phases of the moon). A solar eclipse is when Earth moves into the shadow of the moon (during a new moon). A lunar eclipse is when the moon moves into the shadow of Earth (during a full moon). Gravitational force between Earth and the moon causes daily oceanic tides. When the gravitational forces from the sun and moon align (at new and full moons) spring tides occur. When the gravitational forces of the sun and moon are perpendicular (at first and last quarter moons), neap tides occur.	**7.ESS.4: The relative patterns of motion and positions of Earth, moon and sun cause solar and lunar eclipses, tides and phases of the moon.** The moon's orbit and its change of position relative to Earth and sun result in different parts of the moon being visible from Earth (phases of the moon). A solar eclipse is when Earth moves into the shadow of the moon (during a new moon). A lunar eclipse is when the moon moves into the shadow of Earth (during a full moon). Gravitational force between Earth and the moon causes daily oceanic tides. When the gravitational forces from the sun and moon align (at new and full moons) spring tides occur. When the gravitational forces of the sun and moon are perpendicular (at first and last quarter moons), neap tides occur.	No change to content focus, but be sure instruction reflects the strong emphasis on the *Nature of Science* and the *Cognitive Demands* included in the 2018 standards.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
New content	**7.ESS.5: The relative positions of Earth and the sun cause patterns we call seasons.** Earth's axis is tilted at an angle of 23.5°. This tilt along with Earth's revolution around the sun, affects the amount of direct sunlight that the earth receives in a single day and throughout the year. The average daily temperature is related to the amount of direct sunlight received.	The focus of this new content statement is on the causes of seasonal changes. This content previously was in grade 5. Students entering grade 7 prior to fall 2022 already should have been taught this content but may need it reinforced or deepened. Students should develop an understanding about the role Earth's axial tilt has on both the changing number of hours of daylight during different seasons and the angle at which the light strikes the ground in various locations. Comparing different locations across the globe allows for deeper conceptual understanding of the length of day and the angle of sunlight, as well as their roles in temperature ranges. Exploring light striking a curved surface can foster an understanding of the relationship between a region's location on Earth's surface and the amount of energy the sun provides to the area each day. Specific seasonal weather patterns can be tied to content about global currents in 7.ESS.2. Global currents work in conjunction with the effects of Earth's revolution to cause these patterns.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
Physical Science (PS)	**Physical Science (PS)**	
The properties of matter are determined by the arrangement of atoms. Elements can be organized into families with similar properties, such as highly reactive metals, less-reactive metals, highly reactive nonmetals and some gases that are almost completely nonreactive. Substances are classified according to their properties, such as metals and acids. When substances interact to form new substances, the properties of the new substances may be very different from those of the old, but the amount of mass does not change. **Note 1:** This is the conceptual introduction of the Periodic table of Elements. **Note 2:** Acids and bases are included in this topic; further detail will be provided in the Model Curriculum. **Note 3:** It is important to emphasize that most changes in the properties of matter have some combination of chemical and physical change (at different levels).	**7.PS.1:** ~~**The properties of matter are determined by the arrangement of atoms.**~~ **Elements can be organized by properties.** ~~Elements can be organized into families with similar properties, such as highly reactive metals, less-reactive metals, highly reactive nonmetals and some gases that are almost completely nonreactive.~~ ~~Substances are classified according to their properties, such as metals and acids.~~ ~~When substances interact to form new substances, the properties of the new substances may be very different from those of the old, but the amount of mass does not change.~~ ~~**Note 1:** This is the conceptual introduction of the Periodic table of Elements.~~ ~~**Note 2:** Acids and bases are included in this topic; further detail will be provided in the Model Curriculum.~~ ~~**Note 3:** It is important to emphasize that most changes in the properties of matter have some combination of chemical and physical change (at different levels).~~ Elements can be classified as metals, non-metals and metalloids, and can be organized by similar properties such as color, solubility, hardness, density, conductivity, melting point and boiling point, viscosity, and malleability. **Note 1:** This is the conceptual introduction of the Periodic Table of Elements and should be limited to classifications based on observable properties; it should not include the names of the families.	**The content from the first physical science standard in the 2010 standards was divided between this standard and 7.PS.2.** Content related to acids and bases was moved to high school. Subatomic particles also are reserved for high school; therefore, it is no longer necessary to cover content related to protons, neutrons, electrons, atomic number or mass number. Likewise, ions, isotopes and mechanisms of chemical bonding are above grade level. Study of the periodic table at this level should focus on the trends in properties of elements. Students should explore properties (listed in the descriptor) of various elements, either in the laboratory, virtually or through research. Identifying trends and patterns on the periodic table based on these properties will lay the foundation for a more complete understanding of bonding patterns and other chemistry concepts at the high school level. Identifying patterns from data rather than simply memorizing the location and properties of particular groups on the periodic table provides the richest learning experience.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
New content statement	**7.PS.2: Matter can be separated or changed, but in a closed system, the number and types of atoms remains constant.** When substances interact and form new substances the properties of the new substances may be very different from those of the original substances, but the amount of mass does not change. Physically combining two or more substances forms a mixture, which can be separated through physical processes. **Note:** Under these standards, classifying specific changes as chemical or physical is not appropriate.	This standard focuses on the conservation of matter at the microscopic level. Distinguishing among elements, molecules, compounds and mixtures (previously in grades 6 and 7) continues to be a part of this standard. However, the instructional focus should be the conservation of matter as mixtures or compounds are formed or separated. Simple balanced chemical equations can be used to visualize the conservation of atoms during chemical reactions. Basic photosynthesis and cellular respiration equations can be used to tie this content to 7.LS.1. An introduction to the idea that energy is required to break bonds, and that energy is released when bonds are formed, is appropriate, but the mechanisms of bonding are reserved for high school. Understanding that energy can be taken in from, or released to, the environment during chemical changes should be tied to the conceptual idea of conservation of energy in the overall system.
Energy can be transformed or transferred but is never lost. When energy is transferred from one system to another, the quantity of energy before transfer equals the quantity of energy after transfer. When energy is transformed from one form to another, the total amount of energy remains the same.	**7.PS.3: Energy can be transformed or transferred but is never lost.** When energy is transferred from one system to another, the quantity of energy before transfer equals the quantity of energy after transfer. When energy is transformed from one form to another, the total amount of energy remains the same.	No change to content focus, but be sure instruction reflects the strong emphasis on the *Nature of Science* and the *Cognitive Demands* included in the 2018 standards.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
Energy can be transferred through a variety of ways. Mechanical energy can be transferred when objects push or pull on each other over a distance. Electromagnetic waves transfer energy when they interact with matter. Thermal energy can be transferred through radiation, convection and conduction. Electrical energy transfers when an electrical source is connected in a complete electrical circuit to an electrical device. **Note 1:** Energy transfers should be experiential and observable. This builds upon PS grade 4 and is directly connected to ESS grade 7 (thermal energy transfers in the hydrologic cycle.) **Note 2:** Electricity can be measured through current, voltage and resistance. In addition, renewable energy systems should be included (such as wind, geothermal, water or solar). **Note 3:** The types of waves used within this topic include seismic, oceanic, sound and light. Seismic waves also are found in ESS grade 8.	**7.PS.4: Energy can be transferred through a variety of ways.** Mechanical energy can be transferred when objects push or pull on each other over a distance. Mechanical and electromagnetic waves transfer energy when they interact with matter. Thermal energy can be transferred through radiation, convection and conduction. ~~Electrical energy transfers when an electrical source is connected in a complete electrical circuit to an electrical device~~. An electrical circuit transfers energy from a source to a device. **Note 1:** Energy transfers should be experiential and observable at this grade level. ~~This builds upon PS grade 4 and is directly connected to ESS grade 7 (thermal energy transfers in the hydrologic cycle.)~~ ~~**Note 2:** Electricity can be measured through current, voltage and resistance. In addition, renewable energy systems should be included (such as wind, geothermal, water or solar).~~ ~~**Note 3:** The types of waves used within this topic include seismic, oceanic, sound and light. Seismic waves also are found in ESS grade 8.~~	The existing content remains in place and still should be covered at the previous depth. In addition, forms of potential energy, motors and generators have been incorporated into this standard. This material previously was in the grade 8 standards. This standard lays the foundation for deeper understanding of the mechanisms of energy transfer in high school. It is important to build a strong conceptual understanding of the ways energy moves. Much of the material in this energy transfer standard relates to other content in grade 7 and should be a focus throughout the curriculum. Introducing this content early in the year allows students to apply their knowledge to understanding other systems (hydrologic cycle, global currents, ecosystems) studied at this level.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
Life Science (LS)	**Life Science (LS)**	
Matter is transferred continuously between one organism to another and between organisms and their physical environments. Plants use the energy in light to make sugars out of carbon dioxide and water (photosynthesis). These materials can be used and immediately stored for later use. Organisms that eat plants break down plant structures to produce the materials and energy they need to survive. Then they are consumed by other organisms. Energy can transform from one form to another in living things. Animals get energy from oxidizing food, releasing some of its energy as heat. The total amount of matter and energy remains constant, even though its form and location change. **Note 1:** Chemical reactions are resented as the rearrangement of atoms in molecules. **Note 2:** Chemical reactions in terms of subatomic structures of atoms are not appropriate.	**7.LS.1:** ~~**Matter is transferred continuously between**~~ **Energy flows and matter is transferred continuously from one organism to another and between organisms and their physical environments.** Plants use the energy in light to make sugars out of carbon dioxide and water (photosynthesis). These materials can be used ~~and immediately~~ or stored for later use. Organisms that eat plants break down plant structures to release the energy and produce the materials ~~and energy~~ they need to survive. ~~Then they are consumed by other organisms.~~ The organism may then be consumed by other organisms for materials and energy. Energy can transform from one form to another in living things. Animals get energy from oxidizing food, releasing some of its energy as heat. The total amount of matter and energy remains constant, even though its form and location change. ~~**Note 1:** Chemical reactions are resented as the rearrangement of atoms in molecules.~~ ~~**Note 2:** Chemical reactions in terms of subatomic structures of atoms are not appropriate.~~ **Note:** Chemical reactions in terms of subatomic structures of atoms are not appropriate at this grade level. Chemical reactions are presented as the rearrangement of atoms in molecules.	No change to content focus, but be sure instruction reflects the strong emphasis on the *Nature of Science* and the *Cognitive Demands* included in the 2018 standards.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors. Biomes are regional ecosystems characterized by distinct types of organisms that have developed under specific soil and climatic conditions. The variety of physical (abiotic) conditions that exists on Earth gives rise to diverse environments (biomes) and allows for the existence of a wide variety of organisms (biodiversity). Ecosystems are dynamic in nature; the number and types of species fluctuate over time. Disruptions, deliberate or inadvertent, to the physical (abiotic) or biological (biotic) components of an ecosystem impact the composition of an ecosystem. **Note:** Predator-prey and producer consumer relations are addressed in grade 5.	**7.LS.2: In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors.** ~~Biomes are regional ecosystems characterized by distinct types of organisms that have developed under specific soil and climatic conditions.~~ The variety of physical (abiotic) conditions that exists on Earth gives rise to diverse environments (biomes) and allows for the existence of a wide variety of organisms (biodiversity). Biomes are regional ecosystems characterized by distinct types of organisms that have developed under specific soil and climatic conditions. Ecosystems are dynamic in nature; the number and types of species fluctuate over time. Disruptions, deliberate or inadvertent, to the physical (abiotic) or biological (biotic) components of an ecosystem impact the composition of an ecosystem. ~~**Note:** Predator-prey and producer consumer relations are addressed in grade 5.~~	No change to content focus, but be sure instruction reflects the strong emphasis on the *Nature of Science* and the *Cognitive Demands* included in the 2018 standards.