Instructional Implications for Grade 5

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: INTERCONNECTIONS WITHIN SYSTEMS

This theme focuses on helping students explore the components of various systems and then investigate dynamic and sustainable relationships within systems using scientific inquiry.

Strand Connections: Cycles on Earth, such as those occurring in ecosystems, in the solar system, and in the movement of light and sound result in describable patterns. Speed is a measurement of movement. Change in speed is related to force and mass*. The transfer of energy drives changes in systems, including ecosystems and physical systems.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
Earth and Space Science (ESS)	**Earth and Space Science (ESS)**	
The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics. The distance from the sun, size, composition and movement of each planet are unique. Planets revolve around the sun in elliptical orbits. Some of the planets have moons and/or debris that orbit them. Comets, asteroids and meteoroids orbit the sun. **Note:** The shape of Earth's orbit is nearly circular (also true for other planets). Many graphics that illustrate the orbit overemphasize the elliptical shape, leading to the misconception regarding seasonal change being related to how close Earth is to the sun. The discussion of planet characteristics should be at an introductory level for this grade.	**5.ESS.1: The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics.** The distance from the sun, size, composition and movement of each planet are unique. Planets revolve around the sun in elliptical orbits. Some of the planets have moons and/or debris that orbit them. Comets, asteroids and meteoroids orbit the sun.	Content around the solar system, its components and recent projects remains a part of this standard. There is an increased emphasis on understanding the role of gravity in causing celestial bodies to remain in orbit. Students should develop the understanding that gravity is a force between two objects that pulls in both directions. Care should be taken not to further the misconception that only the larger object pulls on the smaller object. Provide various opportunities to explore circular motion and observe the result of removing the force toward the center (e.g., whiffle ball swung on a string and released, marble rolled around a paper plate with a wedge removed). At this level, only a conceptual understanding, based on observations, is appropriate. A detailed understanding of the mechanisms of circular motion is not required until high school.
The sun is one of many stars that exist in the universe. The sun appears to be the largest star in the sky because it is the closest star to Earth. Some stars are larger than the sun and some stars are smaller than the sun.	**5.ESS.2: The sun is one of many stars that exist in the universe.** The sun appears to be the largest star in the sky because it is the closest star to Earth. Some stars are larger than the sun and some stars are smaller than the sun.	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
Most of the cycles and patterns of motion between the Earth and sun are predictable. Earth's revolution around the sun takes approximately 365 days. Earth completes one rotation on its axis in a 24-hour period, producing day and night. This rotation makes the sun, stars and moon appear to change position in the sky. 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. Changes in average temperature throughout the year are identified as seasons. **Note 1:** The amount of direct sunlight that Earth receives is related to the altitude of the sun, which affects the angle of the sun's rays and the amount of time the sun is above the horizon each day. **Note 2:** Different regions around the world have seasonal changes that are not based solely on average temperature (e.g., rainy season, dry season, monsoon season).	**5.ESS.3: Most of the cycles and patterns of motion between the Earth and sun are predictable.** Earth's revolution around the sun takes approximately 365 days. Earth completes one rotation on its axis in a 24-hour period, producing day and night. This rotation makes the sun, stars and moon appear to change position in the sky. **Note:** *Moon phases should not be the focus.*	Content about the cause of seasonal changes on Earth has been moved to grade 7. The standard emphasizes understanding the effects of Earth's motion. Provide opportunities to explore daily and seasonal differences in the appearance of the sky and to track repetitious patterns in the apparent location of the sun, moon and stars. These patterns should be explicitly linked to the rotation and revolution of Earth. The movement of shadows throughout the day should be explored and tied to Earth's rotation. The cause of night should be recognized as the time when a particular portion of Earth's surface is in the shadow created when sunlight is blocked by the planet. Rich experiences with models and manipulatives at this level provide a base for development of the three-dimensional thinking that is required to understand seasonal changes and the effects of other interactions within the universe at later grade levels.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
Physical Science (PS)	**Physical Science (PS**	
The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted. Movement can be measured by speed. The speed of an object is calculated by determining the distance (d) traveled in a period of time (t). Earth pulls down on all objects with a gravitational force. Weight is a measure of the gravitational force between an object and the Earth. Any change in speed or direction of an object requires a force and is affected by the mass* of the object and the amount of force applied. **Note1:** Gravity and magnetism are introduced (through observation) in PS grade 2. *While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.	**5.PS.1: The amount of change in movement of an object is based on the mass of the object and the amount of force exerted.** Movement can be measured by speed. The speed of an object is calculated by determining the distance (d) traveled in a period of time (t). Any change in speed or direction of an object requires a force and is affected by the mass of the object and the amount of force applied. **Note:** *Differentiating between mass and weight is not necessary at this grade level.*	Forces are described by strength and direction. The study of forces is expanded to the effects of two forces acting on an object simultaneously. Both balanced and unbalanced forces should be observed and discussed. Although average speed can be calculated from a mathematical formula, performing this calculation does not provide a conceptual understanding of speed as a measurement of how quickly position changes. To develop this understanding, explore and compare a variety of objects moving at various speeds. Examining the distances traveled in successive units of time as an object moves with constant, increasing and decreasing speed is an important experience at this level. This provides the foundation necessary for the application of mathematical reasoning in later grades.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
Light and sound are forms of energy that behave in predictable ways. Light travels and maintains its direction until it interacts with an object or moves from one medium to another and then it can be reflected, refracted or absorbed. Sound is produced by vibrating objects and requires a medium through which to travel. The rate of vibration is related to the pitch of the sound. **Note:** At this grade level, the discussion of light and sound should be based on observable behavior. Waves are introduced at the middle school level.	**5.PS.2: Light and sound are forms of energy that behave in predictable ways.** Light travels and maintains its direction until it interacts with an object or moves from one medium to another and then it can be reflected, refracted or absorbed. Sound is produced by vibrating objects and requires a medium through which to travel. The rate of vibration is related to the pitch of the sound. **Note:** *At this grade level, the discussion of light and sound should be based on observable behavior. Waves are introduced at the middle school level.*	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.
Life Science (LS)	**Life Science (LS**	
Organisms perform a variety of roles in an ecosystem. Populations of organisms can be categorized by how they acquire energy. Food webs can be used to identify the relationships among producers, consumers and decomposers in an ecosystem.	**5.LS.1: Organisms perform a variety of roles in an ecosystem.** Populations of organisms can be categorized by how they acquire energy. Food webs can be used to identify the relationships among producers, consumers and decomposers in an ecosystem.	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
All of the processes that take place within organisms require energy. For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred and transformed by producers into energy that organisms use through the process of photosynthesis. That energy then passes from organism to organism as illustrated in food webs. In most ecosystems, energy derived from the sun is transferred and transformed into energy that organisms use by the process of photosynthesis in plants and other photosynthetic organisms.	**5.LS.2: All of the processes that take place within organisms require energy.** For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred and transformed by producers into energy that organisms use through the process of photosynthesis. That energy is used or stored by the producer and can be passed from organism to organism as illustrated in food webs.	It is important to foster an understanding that most of the energy entering an organism is transformed by the organism during its daily activities, leaving only a small percentage of energy to move from organism to organism within any ecosystem. This emerging understanding of energy continuously being dissipated to the environment leads to understanding the need for a continual input of energy (usually sunlight) into ecosystems.