# Instructional Implications for Grade 6

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: ORDE 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:** All matter is made of small particles called atoms. The properties of matter are based on the order and organization of atoms and molecules. Cells, minerals, rocks and soil are all examples of matter.

| 2010 Content Statement | 2018 Content Statement | Instructional implications of revisions |
|---|---|---|
| **Earth and Space Science (ESS)** | **Earth and Space Science (ESS)** | |
| **Minerals have specific, quantifiable properties.**<br><br>Minerals are naturally occurring, inorganic solids that have a defined chemical composition. Minerals have properties that can be observed and measured. Minerals form in specific environments. | **6.ESS.1: Minerals have specific, quantifiable properties.**<br><br>Minerals are naturally occurring, inorganic solids that have a defined chemical composition. Minerals have properties that can be observed and measured. Minerals form in specific environments.<br><br>**Note:** *The emphasis is on learning how to identify the mineral by conducting tests (not through memorization).* | 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. |
| **Igneous, metamorphic and sedimentary rocks have unique characteristics that can be used for identification and/or classification.**<br><br>Most rocks are composed of one or more minerals, but there are a few types of sedimentary rocks that contain organic material, such as coal. The composition of the rock, types of mineral present, mineral arrangement, and/or mineral shape and size can be used to identify the rock and to interpret its history of formation, breakdown. | **6.ESS.2: Igneous, metamorphic and sedimentary rocks have unique characteristics that can be used for identification and/or classification.**<br><br>Most rocks are composed of one or more minerals, but there are a few types of sedimentary rocks that contain organic material, such as coal. The composition of the rock, types of mineral present, and/or mineral shape and size can be used to identify the rock and to interpret its history of formation, breakdown (weathering) and transport (erosion). | 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. |
| **Igneous, metamorphic and sedimentary rocks form in different ways.**<br><br>Magma or lava cools and crystallizes to form igneous rocks. Heat and pressure applied to existing rock forms metamorphic rocks. Sedimentary rock forms as existing rock weathers chemically and/or physically and the weathered material is compressed and then lithifies. Each rock type can provide information about the environment in which it was formed. | **6.ESS.3: Igneous, metamorphic and sedimentary rocks form in different ways.**<br><br>Magma or lava cools and crystallizes to form igneous rocks. Heat and pressure applied to existing rock forms metamorphic rocks. Sedimentary rock forms as existing rock weathers chemically and/or physically and the weathered material is compressed and then lithifies. Each rock type can provide information about the environment in which it was formed. | 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. |

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| **Soil is unconsolidated material that contains nutrient matter and weathered rock.**<br><br>Soil formation occurs at different rates and is based on environmental conditions, types of existing bedrock and rates of weathering. Soil forms in layers known as horizons. Soil horizons can be distinguished from one another based on properties that can be measured.<br><br>**Note:** The introduction to soil is found in grade 3. | **6.ESS.4: Soil is unconsolidated material that contains organic matter and weathered rock.**<br><br>Soil formation occurs at different rates and is based on environmental conditions, types of existing bedrock and rates of weathering. Soil forms in layers known as horizons. Soil horizons can be distinguished from one another based on properties that can be measured. The terms dirt and soil are not synonymous, use the term "soil".<br><br>**Note:** *The emphasis should be on properties of soil rather than memorization.* | 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. |
| **Rocks, minerals and soils have common and practical uses.**<br><br>Nearly all manufactured material requires some kind of geologic resource. Most geologic resources are considered nonrenewable. Rocks, minerals and soil are examples of geologic resources that are nonrenewable.<br><br>**Note:** Nonrenewable energy sources should be included (such as fossil fuels). | **6.ESS.5: Rocks, minerals and soils have common and practical uses.**<br><br>Nearly all manufactured material requires some kind of geologic resource. Most geologic resources are considered nonrenewable. Rocks, minerals and soil are examples of geologic resources that are nonrenewable. | 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. |

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| **Physical Science (PS)** | **Physical Science (PS)** | |
| **All matter is made up of small particles called atoms.**<br><br>Each atom takes up space, has mass and is in constant motion. Mass is the amount of matter in an object.<br><br>Elements are a class of substances composed of a single kind of atom.<br><br>Molecules are the combination of two or more atoms that are joined together chemically.<br><br>Compounds are composed of two or more different elements. Each element and compound has properties, which are independent of the amount of the sample. | **6.PS.1: Matter is made up of small particles called atoms.**<br><br>Matter has mass, volume and density and is made up of particles called atoms.<br><br>Elements are a class of substances composed of a single kind of atom.<br><br>Molecules are the combination of two or more atoms that are joined together chemically. | At grade 6, the focus is a conceptual understanding of density, which can be developed by handling and measuring the mass and volume of a variety of objects and substances. Rocks and minerals could be included in the study to tie instruction to the Earth science content statements.<br><br>Using mass versus volume graphs to find and compare densities by identifying the unit rate is a good way to gain conceptual understanding of density. These graphs can be plotted from experimental data. This material reinforces the understanding of unit rate from the grade 6 mathematics standards.<br><br>A basic understanding of atoms, elements and molecules is included with this standard. However, subatomic particles, the periodic table or details about how molecules form is not necessary at this level. Content dealing with compounds has been moved to grade 7. |
| **Changes of state are explained by a model of matter composed of atoms and/or molecules that are in motion.**<br><br>When substances undergo changes of state, neither atoms nor molecules themselves are changed in structure.<br><br>Thermal energy is a measure of the motion of the atoms and molecules in a substance.<br><br>Mass is conserved when substances undergo changes of state.<br><br>**Note:** Thermal energy can be connected to kinetic energy at this grade level. The rate of vibration is related to the pitch of the sound.<br><br>**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. | **6.PS.2: Changes of state are explained by a model of matter composed of particles that are in motion.**<br><br>Temperature is a measure of the average motion of the particles in a substance.<br><br>Heat is a process of energy transfer rather than a type of energy. Energy transfer can result in a change in temperature or a phase change.<br><br>When substances undergo changes of state, atoms change their motion and position.<br><br>**Note:** *It is not the intent of this standard to encourage vocabulary identification (matching definitions with heat, temperature, and thermal energy). Instead, these are provided as conceptual tools for understanding the role of energy in physical, biotic, atmospheric, oceanic, and geologic systems covered in grade 6 and subsequent grades and courses.* | This standard continues to focus on the role of energy in changes of state. At this level, students should begin to understand the relationship between heat, temperature and thermal energy.<br><br>Experiencing that temperature does not change during phase changes can tie into discussions of potential vs. kinetic energy (6.PS.3).<br><br>This content also provides a foundation for understanding the role of energy, as well as how it transfers and transforms, in various systems. These concepts will continue to be developed throughout middle school and high school. |

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| **There are two categories of energy: kinetic and potential.**<br><br>Objects and substances in motion have kinetic energy.<br><br>Objects and substances can have energy as a result of their position (potential energy).<br><br>**Note:** Kinetic and potential energy should be introduced at the macroscopic level for this grade. Chemical and elastic potential energy should not be included at this grade; this is found in PS grade 8. | **6.PS.3: There are two categories of energy: kinetic and potential.**<br><br>Objects and substances in motion have kinetic energy.<br><br>Objects and substances can have energy as a result of their position (potential energy).<br><br>**Note:** *Chemical and elastic potential energy should not be included at this grade; this is found in PS grade 7.* | 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. |
| **An object's motion can be described by its speed and the direction in which it is moving.**<br><br>An object's position and speed can be measured and graphed as a function of time.<br><br>**Note 1:** This begins to quantify student observations using appropriate mathematical skills.<br><br>**Note 2:** Velocity and acceleration rates should not be included at this grade level; these terms are introduced in high school. | **6.PS.4: An object's motion can be described by its speed and the direction in which it is moving.**<br><br>An object's position and speed can be measured and graphed as a function of time.<br><br>**Note:** *Velocity and acceleration rates should not be included at this grade level; these terms are introduced in high school.* | Speed versus time graphs have been removed from this grade level and reserved for high school. This is to allow time to develop a deeper conceptual understanding of position versus time graphs by eliminating the confusion of trying to interpret two types of graphs where similar line segments represent different motions.<br><br>Skills at this level include constructing a position versus time graph from data, explaining the motion depicted on a position versus time graph and comparing the motion of two objects using their position versus time graphs. |

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| **Life Science (LS)** | **Life Science (LS)** | |
| **Cells are the fundamental unit of life.**<br><br>All living things are composed of cells.<br><br>Different body tissues and organs are made of different kinds of cells. The ways cells function are similar in all living organisms.<br><br>**Note 1:** Specific information about the organelles that need to be addressed at this grade level will be found in the model curriculum.<br><br>**Note 2:** Emphasis should be placed on the function and coordination of these components, as well as on their roles in overall cell function. | **6.LS.1: Cells are the fundamental unit of life.**<br><br>All living things are composed of cells. Different body tissues and organs are made of different kinds of cells. The ways cells function are similar in all living organisms.<br><br>**Note:** *Emphasis should be placed on the function and coordination of cell organelles as well as their roles in overall cell function. Specific information about the organelles that need to be addressed at this grade level will be found in the model curriculum.* | The standard focuses on understanding the relationship between structure and function. A variety of cell organelles should be examined. Knowing their names or identifying them on a diagram is less important than understanding their general structures and how the structure relates to their functions, as well as the types of cells in which they are found.<br><br>Knowing the details of cellular processes is above grade level, but a general sense of the cell as a system of organelles with coordinated functions should be developed.<br><br>Comparing single-celled and multicellular organisms and the relationships between cells, tissues, organs and systems in complex organisms continues to be a part of this standard. |
| **All cells come from pre-existing cells.**<br><br>Cells repeatedly divide resulting in more cells and growth and repair in multicellular organisms.<br><br>**Note:** This is not a detailed discussion of the phases of mitosis or meiosis. The focus should be on reproduction as a means of transmitting genetic information from one generation to the next, cellular growth and repair. | **6.LS.2: All cells come from pre-existing cells.**<br><br>Cells repeatedly divide resulting in more cells and growth and repair in multicellular organisms.<br><br>**Note:** *This is not a detailed discussion of the phases of mitosis or meiosis. The focus should be on reproduction as a means of transmitting genetic information from one generation to the next, cellular growth and repair.* | 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. |

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| **Cells carry on specific functions that sustain life.**<br><br>Many basic functions of organisms occur in cells. Cells take in nutrients and energy to perform work, like making various molecules required by that cell or an organism.<br><br>Every cell is covered by a membrane that controls what can enter and leave the cell.<br><br>Within the cell are specialized parts for the transport of materials, energy capture and release, protein building, waste disposal, information feedback and movement.<br><br>**Note:** Emphasis should be placed on the function and coordination of cell components, as well as on their roles in overall cell function. | **6.LS.3: Cells carry on specific functions that sustain life.**<br><br>Many basic functions of organisms occur in cells. Cells take in nutrients and energy to perform work, like making various molecules required by that cell or an organism.<br><br>Every cell is covered by a membrane that controls what can enter and leave the cell.<br><br>Within the cell are specialized parts for the transport of materials, energy capture and release, protein building, waste disposal, information feedback and movement.<br><br>**Note:** *Emphasis should be placed on the function and coordination of cell components, as well as on their roles in overall cell function.* | 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. |
| **Living systems at all levels of organization demonstrate the complementary nature of structure and function.**<br><br>The level of organization within organisms includes cells, tissues, organs, organ systems and whole organisms.<br><br>Whether the organism is single-celled or multicellular, all of its parts function as a whole to perform the tasks necessary for the survival of the organism.<br><br>Organisms have diverse body plans, symmetry and internal structures that contribute to their being able to survive in their environments. | **6.LS.4: Living systems at all levels of organization demonstrate the complementary nature of structure and function.**<br><br>The level of organization within organisms includes cells, tissues, organs, organ systems and whole organisms.<br><br>Whether the organism is single-celled or multicellular, all of its parts function as a whole to perform the tasks necessary for the survival of the organism.<br><br>Organisms have diverse body plans, symmetry and internal structures that contribute to their being able to survive in their environments. | 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. |