Instructional Implications for Grade 8

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 be described and understood by analysis of the interaction of their components. Energy, forces and motion combine to change the physical features of Earth. The changes of the physical Earth and the species that have lived on Earth are found in the rock record. For species to continue, reproduction must be successful.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
Earth and Space Science (ESS)	**Earth and Space Science (ESS)**	
The composition and properties of Earth's interior are identified by the behavior of seismic waves. The refraction and reflection of seismic waves as they move through one type of material to another is used to differentiate the layers of Earth's interior. Earth has an inner and outer core, an upper and lower mantle, and a crust. The formation of the planet generated heat from gravitational energy and the decay of radioactive elements, which are still present today. Heat released from Earth's core drives convection currents throughout the mantle and the crust. **Note:** The thicknesses of each layer of Earth can vary and be transitional, rather than uniform and distinct as often depicted in textbooks.	**8.ESS.1: The composition and properties of Earth's interior are identified by the behavior of seismic waves.** The refraction and reflection of seismic waves as they move through one type of material to another ~~is~~ are used to differentiate the layers of Earth's interior. Earth has a~~n inner and outer~~ core, a~~n upper and lower~~ mantle, and a crust. ~~The formation of the planet generated heat from gravitational energy and the decay of radioactive elements, which are still present today. Heat released from Earth's core drives convection currents throughout the mantle and the crust.~~ Impacts during planetary formation generated primordial heat converting gravitational potential energy into kinetic and thermal energy. Gravitational heat was also released when the Earth's layers separated as heavier elements sank to form the core. Earth also generates heat via radioactive decay from elements in the mantle. Thermal energy from Earth's mantle drives convection currents in the asthenosphere. **Note 1:** *Radioactive decay is not the focus; this will be discussed in Physical Science and Chemistry.* ~~The thicknesses of each layer of Earth can vary and be transitional, rather than uniform and distinct as often depicted in textbooks.~~ **Note 2:** *At this grade level, analyzing seismograms (e.g. amplitude and lag time) and reading a travel time curve are not the focus. At this grade, the properties of seismic waves should be addressed.*	The focus and content of this standard has not changed. However, there are significant wording changes to clarify content. The new language clarifies the processes involved and the terms used with reference to the interior dynamics of Earth. It reflects current understanding of the locations, sources and roles of thermal energy and heat in the Earth's interior.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
Earth's crust consists of major and minor tectonic plates that move relative to each other. Historical data and observations such as fossil distribution, paleomagnetism, continental drift and sea-floor spreading contributed to the theory of plate tectonics. The rigid tectonic plates move with the molten rock and magma beneath them in the upper mantle. Convection currents in the crust and upper mantle cause the movement of the plates. The energy that forms convection currents comes from deep within the Earth. There are three main types of plate boundaries: divergent, convergent and transform. Each type of boundary results in specific motion and causes events (such as earthquakes or volcanic activity) or features (such as mountains or trenches) that are indicative of the type of boundary.	**8.ESS.2: Earth's ~~crust~~ lithosphere consists of major and minor tectonic plates that move relative to each other.** Historical data and observations such as fossil distribution, paleomagnetism, continental drift and sea-floor spreading contributed to the theory of plate tectonics. The rigid tectonic plates move with the molten rock and magma beneath them in the upper mantle. Convection currents in the ~~crust and upper mantle~~ asthenosphere cause the movement of the lithospheric plates. The energy that forms convection currents comes from deep within the Earth. There are three main types of plate boundaries: divergent, convergent and transform. Each type of boundary results in specific motion and causes events (such as earthquakes or volcanic activity) or features (such as mountains or trenches) that are indicative of the type of boundary.	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.
A combination of constructive and destructive geologic processes formed Earth's surface. Earth's surface is formed from a variety of different geologic processes, including but not limited to plate tectonics. **Note:** The introduction of Earth's surface is found in ESS grade 4.	**8.ESS.3: A combination of constructive and destructive geologic processes formed Earth's surface.** Earth's surface is formed from a variety of different geologic processes, including but not limited to plate tectonics. ~~**Note:** The introduction of Earth's surface is found in ESS grade 4.~~	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
Evidence of the dynamic changes of Earth's surface through time is found in the geologic record. Earth is approximately 4.6 billion years old. Earth history is based on observations of the geologic record and the understanding that processes observed at present day are similar to those that occurred in the past (uniformitarianism). There are different methods to determine relative and absolute age of some rock layers in the geologic record. Within a sequence of undisturbed sedimentary rocks, the oldest rocks are at the bottom (superposition). The geologic record can help identify past environmental and climate conditions. **Note:** Environmental and climate conditions also can be documented through the cryosphere as seen through ice cores.	**8.ESS.4: Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.** Earth is approximately 4.6 billion years old. Earth history is based on observations of the geologic record and the understanding that processes observed at present day are similar to those that occurred in the past (uniformitarianism). There are different methods to determine relative and absolute age of some rock layers in the geologic record. Within a sequence of undisturbed sedimentary rocks, the oldest rocks are at the bottom (superposition). The geologic record can help identify past environmental and climate conditions. ~~**Note:** Environmental and climate conditions also can be documented through the cryosphere as seen through ice cores.~~	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.
Physical Science (PS)	**Physical Science (PS)**	
Forces between objects act when the objects are in direct contact or when they are not touching. Magnetic, electrical and gravitational forces can act at a distance. **Note:** Direct contact forces were addressed in the elementary grades.	**8.PS.1: ~~Forces between objects act when the objects are in direct contact or when they are not touching.~~ Objects can experience a force due to an external field such as magnetic, electrostatic, or gravitational fields.** Magnetic, electrical and gravitational forces can act at a distance. ~~**Note:** Direct contact forces were addressed in the elementary grades.~~	This standard focuses on using a field model to understand interactions between objects that are not touching. Investigating the effects of external fields on various objects supports this understanding. Take care to foster understanding of fields as scientific models rather than physical materials (for example, field lines are conceptual modeling tools, not actual lines consisting of matter or energy). Content relating to motors and generators was moved to grade 7, but the general relationship between electricity and magnetism, including electromagnets, continues to be grade 8 content.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
Forces have magnitude and direction. The motion of an object is always measured with respect to a reference point. Forces can be added. The net force on an object is the sum of all of the forces acting on the object. The net force acting on an object can change the object's direction and/or speed. When the net force is greater than zero, the object's speed and/or direction will change. When the net force is zero, the object remains at rest or continues to move at a constant speed in a straight line.	**8.PS.2: ~~Forces have magnitude and direction.~~ Forces can act to change the motion of objects.** The motion of an object is always measured with respect to a reference point. Forces can be added. The net force on an object is the sum of all of the forces acting on the object. ~~The net force acting on an object can change the object's direction and/or speed.~~ ~~When the net force is greater than zero, the object's speed and/or direction will change. When the net force is zero, the object remains at rest or continues to move at a constant speed in a straight line.~~ If there is a nonzero net force acting on an object, its speed and/or direction will change. Kinetic friction and drag are forces that act in a direction opposite the relative motion of objects.	Circular motion was added to this standard. Students should understand that the net force causing circular motion is toward the center. Forces due to kinetic friction and drag were emphasized by adding them to the standard descriptor, although the content already was in the elaboration. Balanced and unbalanced forces now are being introduced in grade 5. The content on forces for this standard is unchanged, but the depth of coverage should increase. Be aware that there will be several years before students entering grade 8 will have had this additional instruction in grade 5. The relative nature of motion should continue to be an emphasis.
There are different types of potential energy. Gravitational potential energy changes in a system as the masses or relative positions of objects are changed. Objects can have elastic potential energy due to their compression or chemical potential energy due to the nature and arrangement of the atoms that make up the object.	~~**There are different types of potential energy.**~~ ~~Gravitational potential energy changes in a system as the masses or relative positions of objects are changed.~~ ~~Objects can have elastic potential energy due to their compression or chemical potential energy due to the nature and arrangement of the atoms that make up the object.~~	This content was moved from grade 8 and now can be found in grade 7. It is important to plan for a transition year, so that a cohort of students does not entirely miss this content. If both grades move entirely to the new standards during one school year, students who are in grade 8 during the first year of implementation will not cover this content in either grade.

2010 Content Statement	2018 Content Statement	Instructional implications of revisions
Life Science (LS)	**Life Science (LS)**	
Diversity of species occurs through gradual processes over many generations. Fossil records provide evidence that changes have occurred in number and types of species. Fossils provide important evidence of how life and environmental conditions have changed. Changes in environmental conditions can affect how beneficial a trait will be for the survival and reproductive success of an organism or an entire species. Throughout Earth's history, extinction of a species has occurred when the environment changes and the individual organisms of that species do not have the traits necessary to survive and reproduce in the changed environment. Most species (approximately 99 percent) that have lived on Earth are now extinct. **Note:** Population genetics and the ability to use statistic mathematics to predict changes in a gene pool are reserved for grade 10.	**8.LS.1: Diversity of species, ~~occurs through gradual processes over many generations.~~ a result of variation of traits, occurs through the process of evolution and extinction over many generations. ~~Fossil~~ The fossil records provide evidence that changes have occurred in number and types of species.** Fossils provide important evidence of how life and environmental conditions have changed. Changes in environmental conditions can affect how beneficial a trait will be for the survival and reproductive success of an organism or an entire species. Throughout Earth's history, extinction of a species has occurred when the environment changes and the individual organisms of that species do not have the traits necessary to survive and reproduce in the changed environment. Most species (approximately 99 percent) that have lived on Earth are now extinct. **Note:** Population genetics and the ability to use statistic mathematics to predict changes in a gene pool are reserved for ~~grade 10.~~ high school Biology.	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
Reproduction is necessary for the continuation of every species. Every organism alive today comes from a long line of ancestors who reproduced successfully every generation. Reproduction is the transfer of genetic information from one generation to the next. It can occur with mixing of genes from two individuals (sexual reproduction). It can occur with the transfer of genes from one individual to the next generation (asexual reproduction). The ability to reproduce defines living things.	**8.LS.2:** ~~**Reproduction is necessary for the continuation of every species.**~~ **Every organism alive today comes from a long line of ancestors who reproduced successfully every generation.** ~~Every organism alive today comes from a long line of ancestors who reproduced successfully every generation.~~ Reproduction is the transfer of genetic information from one generation to the next. It can occur with mixing of genes from two individuals (sexual reproduction). It can occur with the transfer of genes from one individual to the next generation (asexual reproduction). The ability to reproduce defines living things.	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.
The characteristics of an organism are a result of inherited traits received from parent(s). Expression of all traits is determined by genes and environmental factors to varying degrees. Many genes influence more than one trait, and many traits are influenced by more than one gene. During reproduction, genetic information (DNA) is transmitted between parent and offspring. In asexual reproduction, the lone parent contributes DNA to the offspring. In sexual reproduction, both parents contribute DNA to the offspring. **Note 1:** The focus should be the link between DNA and traits without being explicit about the mechanisms involved. **Note 2:** The ways in which bacteria reproduce is beyond the scope of this content statement. **Note 3:** The molecular structure of DNA is not appropriate at this grade level.	**8.LS.3: The characteristics of an organism are a result of inherited traits received from parent(s).** Expression of all traits is determined by genes and environmental factors to varying degrees. Many genes influence more than one trait, and many traits are influenced by more than one gene. During reproduction, genetic information (DNA) is transmitted between parent and offspring. In asexual reproduction, the lone parent contributes DNA to the offspring. In sexual reproduction, both parents contribute DNA to the offspring. **Note 1:** The focus should be the link between DNA and traits without being explicit about the mechanisms involved. **Note 2:** The ways in which bacteria reproduce is beyond the scope of this content statement. **Note 3:** The molecular structure of DNA is not appropriate at this grade 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.