Grade 7

INTRODUCTION TO CONTENT STATEMENTS

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 from simple principles. These principles are related to the properties or interactions within and between systems.

STRANDS

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.

EARTH AND SPACE SCIENCE (ESS)	PHYSICAL SCIENCE (PS)	LIFE SCIENCE (LS)
Topic: Cycles and Patterns of Earth and the Moon This topic focuses on Earth's hydrologic cycle, patterns that exist in atmospheric and oceanic currents, the relationship between thermal energy and the currents, and the relative position and movement of the Earth, sun and moon.	**Topic: Conservation of Mass and Energy** This topic focuses on the empirical evidence for the arrangements of atoms on the Periodic Table of Elements, conservation of mass and energy, transformation and transfer of energy.	**Topic: Cycles of Matter and Flow of Energy** This topic focuses on the impact of matter and energy transfer within the biotic component of ecosystems.
CONDENSED CONTENT STATEMENTS		
7.ESS.1 The hydrologic cycle illustrates the changing states of water as it moves through the lithosphere, biosphere, hydrosphere and atmosphere. **7.ESS.2** Thermal-energy transfers in the ocean and the atmosphere contribute to the formation of currents, which influence global climate patterns. **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. **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. **7.ESS.5** The relative positions of Earth and the sun cause patterns we call seasons.	**7.PS.1** Elements can be organized by properties. **7.PS.2** Matter can be separated or changed, but in a closed system, the number and types of atoms remains constant. **7.PS.3** Energy can be transformed or transferred but is never lost. **7.PS.4** Energy can be transferred through a variety of ways.	**7.LS.1** Energy flows and matter is transferred continuously from one organism to another and between organisms and their physical environments. **7.LS.2** In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors.

NATURE OF SCIENCE GRADES 6-8

Nature of Science One goal of science education is to help students become scientifically literate citizens able to use science as a way of knowing about the natural and material world. All students should have sufficient understanding of scientific knowledge and scientific processes to enable them to distinguish what is science from what is not science and to make informed decisions about career choices, health maintenance, quality of life, community and other decisions that impact both themselves and others.	
Categories	**6-8**
Scientific Inquiry, Practice and Applications All students must use these scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas.	• Apply knowledge of science content to real-world challenges. • Identify questions that can be answered through scientific investigations. • Design and conduct scientific investigations using appropriate safety techniques. • Use appropriate mathematics, tools and techniques to gather data and information. • Analyze and interpret data. • Develop descriptions, models, explanations and predictions. • Think critically and logically to connect evidence and explanations. • Recognize and analyze alternative explanations and predictions. • Communicate scientific procedures and explanations. • Design technological/engineering solutions.
Science is a Way of Knowing Science assumes the universe is a vast single system in which basic laws are consistent. Natural laws operate today as they did in the past and they will continue to do so in the future. Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise and extend this knowledge.	• Science is a way of knowing about the world around us based on evidence from experimentation and observations. • Science is a continual process and the body of scientific knowledge continues to grow and change. • Science assumes that objects and events occur in consistent patterns that are understandable through measurement and observation. • Science should carefully consider and evaluate all data including outliers. • Science is based on observable phenomena and empirical evidence. • Science disciplines share common rules for obtaining and evaluating empirical evidence.
Science is a Human Endeavor Science has been, and continues to be, advanced by individuals of various races, genders, ethnicities, languages, abilities, family backgrounds and incomes.	• Individuals from different social, cultural, and ethnic backgrounds work as scientists and engineers. • Scientists and engineers are guided by habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism and openness to ideas. • Scientists and engineers rely on human qualities such as persistence, precision, reasoning, logic, imagination and creativity.
Scientific Knowledge is Open to Revision in Light of New Evidence Science is not static. Science is constantly changing as we acquire more knowledge.	• Science explanations are subject to revision and improvement in light of additional scientific evidence or new understanding of scientific evidence.

*Adapted from Appendix H – Understanding the Scientific Enterprise: The Nature of Science in the Next Generation Science Standards

Complete *Nature of Science* document is found on pages 8-12.

Grade 7 continued

EARTH AND SPACE SCIENCE (ESS)

Topic: Cycles and Patterns of Earth and the Moon
This topic focuses on Earth's hydrologic cycle, patterns that exist in atmospheric and oceanic currents, the relationship between thermal energy and the currents, and the relative position and movement of the Earth, sun and moon.

CONTENT STATEMENT

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.

CONTENT ELABORATION

Prior Concepts Related to Hydrologic Cycle
PreK-2: Water is observed through weather. Water is in the atmosphere. Water can be a solid, a gas and a liquid.

Grades 3-5: Water is present in soil. Water is a non-living resource. Properties of the different states of water, how water can change the surface of Earth and how water is a factor in some weather-related events (e.g., flooding, droughts) are discussed.

Grade 6: The changes in the state of water are related to the motion of atoms (changes in energy). Water flows through rock and soil (porosity and permeability).

Grade 7 Concepts
The different aspects of the hydrologic cycle (e.g., properties of water, changes of state, relationships of water to weather, effects of water on Earth's surface) from the elementary grades are formally combined in grade 7 and applied to the components of the hydrologic cycle.

The movement of water through the spheres of Earth is known as the hydrologic cycle. As water changes state and energy is transferred, it cycles from one sphere into another (e.g., water transfers from the hydrosphere to the atmosphere when evaporation occurs). Groundwater and surface water quality are components of the hydrologic cycle. The porosity and permeability of the rock and/or soil can affect the rate at which the water flows. The pattern of the cycling illustrates the relationship between water, energy and weather.

The movement of water in the cycle can have both positive and negative impacts, such as nutrient and contaminant transport. Contamination can occur within any step of the hydrologic cycle. Groundwater is easily contaminated as pollution present in the soil or spilled on the ground surface moves into the groundwater and impacts numerous water sources. Relating water flow to geographic and topographic landforms and/or features leads to an understanding of where water flows and how it moves through the different spheres. Topographic and aerial maps (can be virtual) can be used to identify drainage patterns and watersheds that contribute to the cycling of water. Lab investigations or technology can be used to simulate different segments of the hydrologic cycle.

	Future Application of Concepts **Grade 8:** The relationship between the hydrosphere, atmosphere and lithosphere are studied as they relate to weathering and erosion. **High School:** The hydrologic cycle is a component of biology as it relates to ecosystems and the diversity of life. In Environmental Science, the connections and interactions of energy and matter between Earth's spheres are researched and investigated in more depth

EXPECTATIONS FOR LEARNING

The content in the standards needs to be taught in ways that incorporate the nature of science and engage students in scientific thought processes. Where possible, real-world data and problem- and project-based experiences should be utilized. *Ohio's Cognitive Demands* relate to current understanding and research about the ways people learn and are important aspects to the overall understanding of science concepts. Care should be taken to provide students opportunities to engage in all four types of thinking. Additionally, lessons need to be designed so that they incorporate the concepts described in the *Nature of Science*.

VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

This section provides guidance for developing classroom tasks that go beyond traditional approaches to instruction. It is a springboard for generating innovative ideas to address the cognitive demands. A variety of activities are presented so that teachers can select those that best meet the needs of their students. This is not an all-inclusive checklist and is not intended to cover every aspect of the standards. **These activities are suggestions and are not mandatory.**

Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Hydrologic cycle			
Design and test solutions for reducing acid rain, road salt runoff, erosion and/or surface runoff rates in specific regions (e.g., urban, agricultural, construction). Present findings/plan to school administrators or local government. Develop, test and evaluate plans outlining methods to reduce storm water flow at a site in the local community (e.g., a housing construction project, the school parking lot). Present findings/plans to school administrators or local government.	Design and conduct an investigation to measure and analyze surface-water discharge rates. Build a model to represent a cross section of Earth's surface (e.g., topography, soil, rock, groundwater) that can enable investigation of multiple water pathways. Investigate and use different methods and tools that measure water flow and water quality, and evaluate which methods and tools are most effective for the desired outcome.	Use GPS/GIS programs, geographic, topographic and/or aerial maps to identify water flow and drainage patterns. Identify regions where surface water run-off and/or acid rain could impact ground or surface water quality. Investigate an area in Ohio that exhibits a water contamination problem (e.g., acid mine drainage in southeastern Ohio, mercury contamination and algae blooms in Lake Erie). Document recent discoveries, case studies, cleanup technologies or field investigations that are occurring in these areas.	Describe the movement of water through all four spheres of Earth (lithosphere, hydrosphere, atmosphere, biosphere). Identify the changes in thermal energy as water changes state in the hydrologic cycle. Explain the roles of the sun and gravity in the hydrologic cycle.

Grade 7 continued

EARTH AND SPACE SCIENCE (ESS)

Topic: Cycles and Patterns of Earth and the Moon
This topic focuses on Earth's hydrologic cycle, patterns that exist in atmospheric and oceanic currents, the relationship between thermal energy and the currents, and the relative position and movement of the Earth, sun and moon.

CONTENT STATEMENT

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.

CONTENT ELABORATION

Prior Concepts Related to Energy Transfers, Atmosphere and Hydrosphere
PreK-2: Water is observed through weather. Water is in the atmosphere. Water can be a solid, a gas and a liquid.

Grades 3-5: Water is present in soil. Water is a non-living resource. Properties of the different states of water, how water can change the surface of Earth and how water is a factor in some weather-related events (e.g., flooding, droughts) are discussed.

Grade 6: The changes in the state of water are related to the motion of atoms. Atoms take up space and have mass. Changes of state occur due to the amount of motion of atoms and molecules. Density is a property of matter.

Grade 7 Concepts
The earlier concepts of weather and the physical properties of air and water, and their changes are expanded in grade 7 to the relationship of atmospheric and oceanic currents and climate. Current and climate patterns on a global level should be studied using a variety of maps, models and technology (e.g., remote sensing, satellite images, LANDSAT).

The causes of moving currents in the atmosphere and ocean are connected to thermal energy, density, pressure, composition and topographic/geographic influences (e.g., continental mountains, ocean ridges). Studies should also include specific current patterns in both the atmosphere and the ocean that are mapped and documented through data. Contemporary studies regarding global climate must be based on facts and evidence.

This content statement is connected to the Life Science, grade 7 content pertaining to biomes and the climatic zones of Earth.

Future Application of Concepts
Grade 8: In grade 8, global climate is expanded through the investigation of climate change that occurred throughout Earth's history (as evidenced through the rock record and more recently though ice cores).

High School: Gravity, density, gases and properties of air and water are found in physical science courses. In the Physical Geology and Environmental Science courses, climate change is explored in greater depth.

EXPECTATIONS FOR LEARNING

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VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

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Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Ocean and atmospheric currents			
Using the analytical data from Demonstrating Science Knowledge, evaluate and map the fastest and most effective route to travel from Spain to Florida. Document all scientific data, data analysis and steps in the evaluation process to support the selection.	Using Adopt a Buoy data (NOAA), calculate the average buoy velocities at specific segments of the year. Predict where ocean current patterns change and may result in climate changes (based on the data). How does this relate to Jet Stream patterns and changes? Present findings to the class and be prepared to defend the predictions using evidence and data.	Analyze data from storms (e.g. hurricane debris in the Atlantic Ocean) to map currents. Analyze data from debris and materials falling off ships in the Pacific to track and map currents in the ocean. Record drifter-buoy velocity data in a graph or chart. Use the velocity data to make a simple map showing the general patterns of the Gulf Stream. Research the documented patterns of the Jet Stream.	Identify the general patterns of the Jet Stream and the Gulf Stream using a world map.

Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Drifter buoys			
Drifter buoys are ocean buoys that are equipped with sensors that can transmit data (e.g., water temperature, air temperature, location) via satellites. Based on the interpretation and analysis of drifter buoy data, develop a list of criteria (including cost) for successful buoy deployment and life span. Design, build and test a buoy that can sample water temperatures or another water-quality test (e.g., pH, turbidity levels) of a local lake, pond, pool or stream. Deploy the buoy and collect/analyze data. Compare and discuss results with the class.	Analyze real-time drifter buoy data to determine the pattern of the Gulf Stream. Compare the present pattern with documented seasonal patterns over a five-year period. Using quantifiable data, outline factors that contribute to the changing patterns and influence the Gulf Stream. Additional buoy data is available at NOAA Drifter Buoy Program.	Adopt a drifter buoy (NOAA), record its movement and record water temperature data over time. Represent the oceanic data on a graph or chart.	Identify the factors that contribute to global climate.

Grade 7 continued

EARTH AND SPACE SCIENCE (ESS)

Topic: Cycles and Patterns of Earth and the Moon
This topic focuses on Earth's hydrologic cycle, patterns that exist in atmospheric and oceanic currents, the relationship between thermal energy and the currents, and the relative position and movement of the Earth, sun and moon.

CONTENT STATEMENT

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.*

CONTENT ELABORATION

Prior Concepts Related to Atmosphere
PreK-2: Wind is air in motion. Wind speed and direction can be measured. Sunlight warms the air. The atmosphere is primarily made up of air. Air has properties. Transfer of energy causes air movement. Water is present in the atmosphere.

Grades 3-5: Air is a non-living resource that can be used for energy. Air can be contaminated. Wind can change the surface of Earth. Earth is a planet that has an atmosphere.

Grade 6: Atoms take up space, have mass and are in constant motion. Elements and molecules are discussed. Changes of state occur due to the amount of motion of atoms and molecules.

Grade 7 Concepts
The properties and composition of the layers of Earth's atmosphere are studied, as they are essential in understanding atmospheric currents, climate and biogeochemical cycles, which are seventh-grade concepts.

Understanding the interactions between Earth's spheres (Earth Systems Science) and how specific elements and/or compounds move between them should be emphasized. This study includes standard greenhouse gases (including water vapor), ozone (in the atmosphere and at Earth's surface) and natural events/human activities that can change the properties of the atmosphere. Contemporary issues and technological advances should be included within this concept. Real-time scientific data pertaining to air quality and properties of air can be incorporated into the study of atmospheric properties and air quality.

Future Application of Concepts
Grade 8: Changes in environmental and climate conditions (including atmospheric changes) as evidenced in the rock record and contemporary studies of ice cores are studied.

High School: Gravity, density, gases and properties of air are found in physical science courses. In Physical Geology and Environmental Science, the atmosphere and climate change are explored further.

EXPECTATIONS FOR LEARNING

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Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Atmosphere			
Build a model of a human lung and use it to explore the impact of air pollution on lung tissue.	Plan and implement an investigation to collect and test ground levels of ozone or carbon monoxide in a local area. Compare results to statewide data. Determine the existing factors that contribute to these levels. Use data sets to investigate the relationship between air pressure, elevation and temperature.	Using ozone data from the stratospheric level, generate a graph that illustrates the changes in the ozone over a specific period of years. Explain how humans are a part of the biogeochemical cycles through gas exchanges in the respiratory system. Research how humans obtain and process nitrogen. Include the role of nitrogen-fixing microbes, uptake by plants, processing by the liver and elimination through the urinary system.	Identify the general properties of the different layers of the atmosphere. Recognize human-made and natural factors that can change the properties of the atmosphere. Identify the different gases that are present in Earth's atmosphere. Trace the different biogeochemical cycles through each of Earth's spheres.

Grade 7 continued

EARTH AND SPACE SCIENCE (ESS)

Topic: Cycles and Patterns of Earth and the Moon
This topic focuses on Earth's hydrologic cycle, patterns that exist in atmospheric and oceanic currents, the relationship between thermal energy and the currents, and the relative position and movement of the Earth, sun and moon.

CONTENT STATEMENT

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.

CONTENT ELABORATION

Prior Concepts Related to Moon, Earth and Sun
PreK-2: The moon, sun and stars can be observed at different times of the day or night. The observable shape of the moon changes throughout the month. The sun's position appears to change in a single day and from day to day. The sun is the principal source of energy.

Grades 3-5: Earth's atmosphere, introduction to gravitational forces, orbits of planets and moons within the solar system and predictable cycles and patterns of motion between Earth and the sun are explored.

Grade 6: Objects and substances in motion have kinetic energy. Objects and substances can store energy as a result of their positions (gravitational potential energy).

Grade 7 Concepts
The role of gravitational forces and tides are introduced with relation to the position of Earth, moon and sun. Models and simulations (can be 3-D or virtual) are used to demonstrate the changing positions of the moon and Earth (as they orbit the sun) and lunar/solar eclipses, daily tides, neap and spring tides and the phases of the moon. Our solar system is a part of the Milky Way galaxy, which is part of the universe.

The emphasis should not be on naming the phases of the moon or tides, but in understanding why the phases of the moon or tides are cyclical and predictable. Advances in scientific knowledge regarding patterns and movement in the solar system are included in this content statement.

Future Application of Concepts
Grade 8: Gravitational forces, frame of reference, and net forces affecting motion are studied in more detail.

High School: Patterns of motion within the solar system are expanded to the universe. The Big Bang theory and origin of the universe are explored. Forces and motion are investigated in depth.

EXPECTATIONS FOR LEARNING

The content in the standards needs to be taught in ways that incorporate the nature of science and engage students in scientific thought processes. Where possible, real-world data and problem- and project-based experiences should be utilized. *Ohio's Cognitive Demands* relate to current understanding and research about the ways people learn and are important aspects to the overall understanding of science concepts. Care should be taken to provide students opportunities to engage in all four types of thinking. Additionally, lessons need to be designed so that they incorporate the concepts described in the *Nature of Science*.

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Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Patterns of motion and positions of Earth, moon and sun			
Make a recommendation for a site to build a tidal power plant in the United States. Research the coastal conditions (e.g., ocean depth, geographic features, currents) necessary for tidal power facilities. Support your site selection with tidal and coastline data.	Investigate the factors that must exist for a full or partial solar or lunar eclipse using 3-D modeling.	Make a chart or graph that illustrates moon phases, Earth's rotation, sun position and resulting tidal data for one month. Include specific data about spring and neap tides. Use actual data to document the graphic representation.	Describe the relationship between gravity and tidal movement. Map the different phases of the moon during a cycle.

Grade 7 continued

EARTH AND SPACE SCIENCE (ESS)

Topic: Cycles and Patterns of Earth and the Moon
This topic focuses on Earth's hydrologic cycle, patterns that exist in atmospheric and oceanic currents, the relationship between thermal energy and the currents, and the relative position and movement of the Earth, sun and moon.

CONTENT STATEMENT	CONTENT ELABORATION
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.	**Prior Concepts Related to Moon, Earth and Sun** **PreK-2:** The moon, sun and stars can be observed at different times of the day or night. The observable shape of the moon changes throughout the month. The sun's position appears to change in a single day and from day to day. The sun is the principal source of energy. **Grades 3-5**: Earth's atmosphere, introduction to gravitational forces, orbits of planets and moons within the solar system and predictable cycles and patterns of motion between Earth and sun are explored. **Grade 6:** Objects and substances in motion have kinetic energy. Objects and substances can store energy as a result of their positions (gravitational potential energy). **Grade 7 Concepts** Each day, the total energy that a particular location on Earth receives from sunlight is directly related to the angle at which the sun's rays strike Earth and the amount of time the sun is above the horizon (i.e. the number of hours of sunlight). Seasonal change should be expanded to include regions of the world that experience specific seasonal weather patterns and natural weather hazards (e.g., hurricane season, monsoon season, rainy season, dry season). This builds upon making observations of the seasons throughout the school year in the earlier grades. Three-dimensional models are used to demonstrate that the tilt of Earth's axis is related to the amount of direct sunlight received and seasonal temperature changes. **Future Application of Concepts** **High School**: Patterns of motion within the solar system are expanded to the universe. The Big Bang theory and origin of the universe are explored. Forces and motion are investigated in depth.

EXPECTATIONS FOR LEARNING

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Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Causes of seasons			
Solar energy collection is most effective in areas that receive the most direct sunlight for long periods of time. Research the amount of sunlight received in specific locations around Ohio. Evaluate the data and make a recommendation for a location to build a solar-powered electric generation facility. Defend your proposed location. Compare the effectiveness of solar power in Ohio with other areas of the United States.		Use data for the amount of sunlight that different regions (e.g., Ohio, polar regions, tropics, northern vs. southern hemisphere) on Earth receive in a single day, to identify and compare patterns over a period of time. Explain weather and seasons based on the amount and intensity of sunlight. This can be tied to 7.ESS.2. Create a physical model (including an axis tilted 23.5°) to demonstrate how the angle of sunlight striking Earth's surface causes seasons and varies for different locations at different points in Earth's orbit.	Demonstrate that Earth's spin axis is fixed and tilted at 23.5° relative to its orbit around the sun. Explain that the rotation of Earth on its tilted axis, in conjunction with its revolution around the sun, affects the amount of direct sunlight that each portion of Earth receives in a single day and throughout the year. Explain that seasons are a result of Earth's tilted axis and are caused by the differential intensity of sunlight on different areas of Earth throughout the year.

Grade 7 continued

PHYSICAL SCIENCE (PS)

Topic: Conservation of Mass and Energy
This topic focuses on the empirical evidence for the arrangements of atoms on the Periodic Table of Elements, conservation of mass and energy, transformation and transfer of energy.

CONTENT STATEMENT

7.PS.1: Elements can be organized by properties.

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.*

CONTENT ELABORATION

Prior Concepts Related to Properties of Matter
PreK-2: Properties can be used to sort objects. Changes, including phase changes, are explored.

Grades 3-5: Objects are composed of matter which has mass and volume. Properties of solids, liquids and gases are explored. Phase changes are reversible and do not change the identity of the material. The total amount of matter and mass remains the same when something changes.

Grade 6: All matter is made up of atoms that are in constant random motion. Elements are introduced. The properties of solids, liquids and gases and changes of phase are explained by the motion and spacing of the particles.

Grade 7 Concepts
All substances are composed of one or more elements. Elements are organized into groups based on their properties (including melting and/or boiling points). Elements with similar properties are grouped together on the periodic table. These groups include metals, non-metals and metalloids. Most metals are malleable, have high melting points, are usually solid at room temperature and are good conductors of heat and electricity. Nonmetals are poor conductors of heat and electricity and tend to be dull and brittle in the solid state. Depending on the element, they may be solid, liquid or gas at room temperature. Metalloids demonstrate some properties of both metals and non-metals.

Future Application of Concepts
High School: Acids, bases and pH are introduced. Mixtures are classified as homogeneous or heterogeneous. Trends in the properties and atomic structure of elements are related to the periodic table. The role of valence electrons in reactivity is explored, and stoichiometric problems are solved.

EXPECTATIONS FOR LEARNING

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Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Properties of elements			
Select elements that would be appropriate for use in certain products (e.g., a pan, an electronic device, a cooler) based on the intended usage of the product and the properties of the element.		Research element facts (e.g., melting point, boiling point, brittle vs. malleable, electrical conductivity, luster). Create a classification system and provide a rationale for the system.	Explain that the periodic table is organized based on physical and chemical properties. Identify characteristics of metals, non-metals and metalloids. Given a set of elements identify similar properties (e.g., melting and/or boiling points, conductors of heat and electricity, luster, brittle) and classify these elements as metals, nonmetals and metalloids.

Grade 7 continued

PHYSICAL SCIENCE (PS)

Topic: Conservation of Mass and Energy
This topic focuses on the empirical evidence for the arrangements of atoms on the Periodic Table of Elements, conservation of mass and energy, transformation and transfer of energy.

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*.

CONTENT ELABORATION

Prior Concepts Related to Properties of Matter
PreK-2: Properties can be used to sort objects. Changes, including phase changes, are explored.

Grades 3-5: Objects are composed of matter which has mass and volume. Properties of solids, liquids and gases are explored. Phase changes are reversible and do not change the identity of the material. The total amount of matter and mass remains the same when something changes.

Grade 6: All matter is made up of atoms that are in constant random motion. Elements are introduced. The properties of solids, liquids and gases and changes of phase are explained by the motion and spacing of the particles.

Grade 7 Concepts
Elements are basic building blocks of matter that are uniform and not further broken into simpler substances by chemical or physical means. Instruction on subatomic particles is reserved for high school.

Compounds are composed of two or more different elements joined together chemically. Each compound has its own unique composition of type and number of elements and atoms.

Molecules are the combination of two or more atoms that are joined together chemically. Molecules can be either elements or compounds (e.g., elemental hydrogen is a molecule containing two atoms of hydrogen; water is a molecule containing two atoms of hydrogen joined with one atom of oxygen).

All particles of a pure substance have nearly identical mass. Particles of different substances usually have different masses, depending on their composition. Each element and compound has properties, some of which are independent of the amount of the sample.

For any change in a closed system, the number and type of atoms stay the same, even if the atoms are rearranged. Therefore, the mass remains constant. Mass is always conserved in a closed system; this is not always the case for volume. Mixing isopropyl alcohol (90%) with water results in a volume that is less than the sum of the volumes. Heating liquid results in an increase in volume. The conservation of matter can be demonstrated using simple balanced equations with their chemical formulas or pictorial representations of the reactants and products. The equations for photosynthesis and cellular respiration can be used to demonstrate this concept.

Energy input is required to break a molecule apart. When the separated atoms form new molecules, the output energy can be greater than or less than the original input energy.

Mixtures are materials composed of two or more substances that retain their separate compositions, even when mixed (e.g., water and sugar can be mixed together thoroughly at the molecular level but the water particles and sugar particles remain separate). When a solid substance dissolves in water, the particles of the solid separate and move freely with the water particles. Types of mixtures include solutions, suspensions, and colloids.

Future Application of Concepts
High School: Mixtures are classified as homogeneous or heterogeneous. The role of valence electrons in reactivity is explored, more complex balanced chemical equations are written and stoichiometric problems are solved.

EXPECTATIONS FOR LEARNING

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VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

This section provides guidance for developing classroom tasks that go beyond traditional approaches to instruction. It is a springboard for generating innovative ideas to address the cognitive demands. A variety of activities are presented so that teachers can select those that best meet the needs of their students. This is not an all-inclusive checklist and is not intended to cover every aspect of the standards. **These activities are suggestions and are not mandatory.**

Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Matter			
	Analyze an unknown mixture then create and implement a plan to separate the mixture using physical processes.	Explain why mass is always conserved in a closed system, but volume is not (e.g., mixing isopropyl alcohol with water, pouring sand into gravel, heating a substance). Use a simple balanced chemical equation to explain the Law of Conservation of Mass.	Compare the properties of different elements and the compounds formed from them (e.g., hydrogen and oxygen vs. water, chlorine and sodium vs. salt). Identify properties of compounds, molecules and mixtures. Display a simple balanced equation using pictorial representations of reactants and products. Define open and closed systems. Identify and provide examples of types of mixtures (e.g., solutions, suspensions, colloids).

Grade 7 continued

PHYSICAL SCIENCE (PS)

Topic: Conservation of Mass and Energy
This topic focuses on the empirical evidence for the arrangements of atoms on the Periodic Table of Elements, conservation of mass and energy, transformation and transfer of energy.

CONTENT STATEMENT

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.

CONTENT ELABORATION

Prior Concepts Related to Energy Transfer
PreK-2: Sound is produced by vibrating objects. The sun is the principal source of energy and affects the warming or cooling of Earth. Weather changes occur due to changes in energy. Plants get energy from sunlight and animals get energy from plants and other animals.

Grades 3-5: Objects with energy have the ability to cause change. Energy can transfer from one location or object to another and can be transformed from one form to another (e.g., light, sound, heat, electrical energy, magnetic energy). Earth's resources can be used for energy. Sunlight is transformed by producers into energy that organisms can use and pass from organism to organism.

Grade 6: There are two forms of energy: kinetic and potential. Energy can transform from one form to another. Thermal energy is due to the random motion of the particles of a substance.

Grade 7 Concepts
A system is separated from its surroundings by either a physical or mental boundary. An isolated system is one that does not interact with its surroundings. Matter and energy cannot get into or out of an isolated system. Most systems on Earth are open systems. Matter and energy can be transferred into or out of an open system. If energy appears to be gained or lost, it has just transformed or transferred into a different system. Examples of systems include ecosystems, the atmosphere, the hydrosphere, the solar system and the human body.

When energy transfers to a large system, it may be difficult to measure the effects of the added energy. Dissipated energy (energy that is transformed into thermal energy and released into the surroundings) is difficult or impossible to recapture. Some systems dissipate less energy than others, leaving more energy to use. Investigation, testing and experimentation are used to explore energy transfers and transformations.

Observing the quantifiable energy changes in a virtual environment is recommended at this introductory level, as energy changes can be difficult to measure accurately.

Future Application of Concepts
High School: Waves are further explored as a method of transferring energy. Basic formulas are used to perform calculations with energy. Work is a method of, and power is a rate of, energy transfer.

EXPECTATIONS FOR LEARNING

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VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

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Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Energy transformations			
Design and build a solar oven. Trace the energy transformations that are occurring.	Plan and implement a scientific experiment to explore energy transformations for a skateboarder using the Skate Park simulation. The program can track changes in different types of energy over time. Analyze the data to determine patterns and trends. Formulate a conclusion about energy transformations. Share the results with the class.	Given a project or situation (e.g., playing football, a solar-powered calculator) trace the energy transformations through the system, beginning with the Sun's energy and culminating with an observable phenomenon on Earth (e.g., throwing a ball, displaying numbers).	
Conservation of energy within a system			
Use everyday materials to design and construct a machine that performs a simple task in many steps. Test the machine as each additional component is added. Redesign to solve problems encountered during the testing and to reduce the loss of energy to the surrounding environment. Record any problems encountered as well as the changes made to the machine to overcome these problems.	Use design software to make a labeled pictorial representation of the final project design (from Designing technological/engineering solutions). Explain the solutions to problems encountered during testing.	Trace all the energy transformations that occur as a machine performs its task. Explain why the energy from a teaspoon of hot water appears to have disappeared as it is placed into a gallon of room temperature water. Explain where the energy of a swinging pendulum goes as it slows to an eventual stop.	Identify where energy has been dissipated to the environment. Describe two ways that energy can leave a system so it may appear to disappear. Recognize that energy or matter cannot enter or leave a closed system.

Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Roller coaster energy transformations			
Design and construct a roller coaster so that a marble will travel over a track that involves at least three hills. Apply the Law of Conservation of Energy to the roller coaster design.		Make a series of bar graphs that show kinetic energy, potential energy and thermal energy for eight different positions on a roller coaster. Place each set of bar graphs on a different index card for each position and shuffle the cards. Switch index cards and roller coaster designs with another group in the class. Organize the index cards in the correct order for the coaster.	Recognize that energy can change forms but the total amount of energy remains constant.

Grade 7 continued

PHYSICAL SCIENCE (PS)

Topic: Conservation of Mass and Energy
This topic focuses on the empirical evidence for the arrangements of atoms on the Periodic Table of Elements, conservation of mass and energy, transformation and transfer of energy.

CONTENT STATEMENT

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.

An electrical circuit transfers energy from a source to a device.

Note: *Energy transfers should be experiential and observable at this grade level.*

CONTENT ELABORATION

Prior Concepts Related to Energy Transfer
PreK-2: Temperature changes are observed. The sun is the principal source of energy. It affects the temperature of Earth and supplies life's energy.

Grades 3-5: Objects with energy have the ability to cause change. Electrical, heat, light and sound energy are explored. Earth's resources can be used for energy. Energy is transferred and transformed by organisms in ecosystems.

Grade 6: Energy is identified as kinetic or potential and can transform from one form to another (gravitational, electrical, magnetic, heat, light, sound). Density depends on the mass and volume of a substance. Thermal energy is related to the motion of particles.

Grade 7 Concepts
Mechanical energy is transferred when a force acts between objects to move one of the objects some distance with or against the force. The amount of energy transferred increases as the strength of the force and/or the distance covered by the object increases. This energy transfer (work) stops when the objects no longer exert forces on each other. Energy transfers should be experiential and observable at this grade level.

Waves can be described by their speed, wavelength, amplitude and frequency. Vibrations cause wave-like disturbances that transfer energy from one place to another. Mechanical waves require a material (medium) in which to travel. The medium moves temporarily as the energy passes through it but returns to its original undisturbed position. Mechanical waves are classified as transverse or longitudinal (compressional) depending on the direction of movement of the medium. The energy of a mechanical wave depends on the material and increases with amplitude. While light and other electromagnetic waves do not require a medium and can travel through a vacuum, they can travel through some media, such as clear glass. A wave travels at a constant speed through a particular material as long as it is uniform (e.g., for water waves, having the same depth). The speed of the wave depends on the nature of the material (e.g., sound waves travel faster through most solids than gases). For a particular uniform medium, as the frequency (f) of the wave is increased, the wavelength (λ) of the wave is decreased.

Gravitational potential energy is associated with the mass of an object and its height above a reference point (e.g., above ground level, above floor level). A change in the height of an object is evidence that the gravitational potential energy has changed.

Elastic potential energy is associated with how much an elastic object has been stretched or compressed and how difficult such a compression or stretch is. A change in the amount of compression or stretch of an elastic object is evidence that the elastic potential energy has changed.

Chemical potential energy is associated with the position and arrangement of the atoms within substances. Rearranging atoms into new positions to form new substances (chemical reaction) is evidence that the chemical potential energy has most likely changed. The energy transferred when a chemical system undergoes a reaction is often thermal energy.

Electrical potential energy is associated with the position of electrically charged objects relative to each other and the amount of charge they have. A change in the position of charged particles relative to each other is evidence of a change in electrical potential energy.

Generators convert mechanical energy into electrical energy and are used to produce electrical energy in power plants. Electric motors convert electrical energy into mechanical energy.

For grade 7, investigation and experiments (3-D and virtual) are used to connect energy transfer and waves to the natural world. Real wave data (e.g., oceanic, seismic, light, sound) can be used.

Heat is the transfer of energy from a warmer object to a cooler one. Thermal energy can be transferred when moving atoms collide. This energy transfer is conduction. Thermal energy can also be transferred by means of thermal currents in air, water or other fluids. As fluids are heated, they expand, decreasing the density. Cooler material with a greater density sinks while warmer material with less density rises, causing currents that transfer energy. This energy transfer is convection. Thermal energy can also be transformed into waves that radiate outward. This radiation can be absorbed by an object and transformed back into thermal energy. This energy transfer is radiation. Technology (e.g., virtual simulations, satellite imagery, remote sensing, accessing real-time temperature data) can be used to demonstrate the transfer of thermal energy on the surface or interior of Earth and within the solar system.

An electric circuit exists when an energy source (e.g., battery, generator, solar cell) is connected to an electrical device (e.g., light bulb, motor) in a closed circuit. The energy source transfers energy to charges in the circuit. Charges flow through the circuit. Electric potential is a measure of the potential electrical energy of each charge. Differences in voltages can be measured with a voltmeter. The energy source does not create the charges; they were already present in the circuit. When the charges reach an electrical device, energy can be transformed into other forms of energy (e.g., light, sound, thermal, mechanical). The voltage drops after this energy transfer, but the charges continue to move through the circuit. In an open circuit, the charges stop flowing and energy is not transferred. Current is the rate of charge flow through conductors and can be measured with an ammeter. The degree to which current is opposed in a circuit is called resistance. Generally, for a particular energy source, the greater the resistance, the lower the current. The resistance through a wire depends upon the type of metal, the length of the wire and the diameter of the wire. Electrical devices can be connected in a series or as a parallel circuit. As the number of devices in a series loop increases, the current in the loop decreases. As loops are added in parallel, the current though the devices in each loop is the same as it would be if that loop were the only loop in the circuit. Many of the circuits used in modern devices

involve arrangements of circuit elements that are much more complex than a simple series or parallel circuit. Testing and experimenting (3-D or virtually) with electrical circuits to observe results of energy transfers due to changes in resistance, current and voltage are encouraged.

Note 2: *The electromagnetic nature of electromagnetic radiation is not appropriate at this grade level nor are mathematical calculations of work or electricity.*

Future Application of Concepts
Grade 8: Seismic waves are explored.

High School: Energy and work are explored mathematically.

EXPECTATIONS FOR LEARNING

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VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

This section provides guidance for developing classroom tasks that go beyond traditional approaches to instruction. It is a springboard for generating innovative ideas to address the cognitive demands. A variety of activities are presented so that teachers can select those that best meet the needs of their students. This is not an all-inclusive checklist and is not intended to cover every aspect of the standards. **These activities are suggestions and are not mandatory.**

Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Parallel and series circuits			
	Use an ammeter to measure the amount of electric current flowing through different positions of series and parallel circuits. Formulate a general rule about the current in series or parallel circuits.	Trace the current flow in parallel and series circuits. Compare the results for parallel and series circuits.	Explain why current is the same at all parts of a series circuit. Explain why the flow of current varies in different parts of a parallel circuit.

Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Energy transfer in a device			
Pinball Machine			
Design a way to give a steel marble the most possible potential energy in a pinball machine before it is launched.	Compare the amount of energy of pinball machines designed by the different groups. Formulate a hypothesis about which design features provide the marble with the most potential energy. Analyze data to determine patterns and trends between design and effectiveness. Formulate a hypothesis about what design features are most effective.	Explain which design features affect the amount of potential energy given to the ball. Create a design portfolio documenting the design process (e.g., prototypes, modifications, technical drawings, testing, results). Represent the design with a labeled picture constructed with design software. Orally present the design to the class, explaining how energy is transferred at each step.	Explain how mechanical energy is transferred in a pinball machine.
Candle wheel			
Design and construct a candle wheel that will turn a maximum number of times in one minute. Test the designs from the class to determine the effectiveness of each one. Anticipate two applications in which the concepts addressed in this design could be used in the real world.	Test potential components of a candle wheel to determine relationships between the material/design of the component and the effectiveness in allowing maximum energy transfer. Use test results to choose appropriate components for the candle wheel design.	Create a promotional presentation for the candle wheel. Include documentation of the design process (e.g., prototypes, testing, redesign, technical drawings), energy transfers involved and applications for the device.	Recognize that thermal energy can be converted to mechanical energy. Use a particle model of matter to explain how energy can be transferred through convection. Explain how energy is transferred in a candle wheel.
Gravitational potential energy			
	Plan and implement an investigation to determine the relationship between the height/mass of a metal sphere and the amount of change it can make to sand that is held in a container. Determine how to quantify the changes to the sand. Formulate a conclusion about how the height/mass of an object is related to its potential energy.	Graphically represent the data from the investigation in demonstrating science knowledge. Support the conclusion with data from the experiment.	Show how gravitational potential energy is affected by height and mass.

Grade 7 continued

LIFE SCIENCE (LS)

Topic: Cycles of Matter and Flow of Energy
This topic focuses on the impact of matter and energy transfer within the biotic component of ecosystems.

CONTENT STATEMENT

7.LS.1: 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 or stored for later use. Organisms that eat plants break down plant structures to release the energy and produce the materials they need to survive. 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: *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.*

CONTENT ELABORATION

Prior Concepts Related to Cycles of Matter and Flow of Energy
Grades 3-5: Conservation of matter is introduced. Populations of organisms can be categorized by how they acquire energy. Food webs can be used to identify the relationships among organisms. 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.

Grade 6: Atomic Molecular Theory, Cell Theory and the function of cell organelles, including mitochondria and chloroplasts, are studied.

Grade 7 Concepts
The basic concepts for matter and energy flow were introduced in grades 3-5. The grades 3-5 concepts are expanded to include a comparison of photosynthesis and cellular respiration.

The use of light energy to make food is called photosynthesis. The breakdown of food to release the stored energy is called respiration. General formulas are appropriate at this grade level, because atoms and molecules are taught in grade 6. Details of both processes are not grade appropriate. In grade 6, cellular organelles are introduced. It is appropriate to reinforce that the chloroplast (the plant cell organelle that contains chlorophyll) captures the sun's energy to begin the process of converting the energy from the sun into sugars and sugar polymers, such as starch.

As matter is cycled within the environment, it promotes sustainability. The elements that make up the molecules of living things are continuously recycled. Energy-rich molecules that are passed from organism to organism are eventually recycled by decomposers back into mineral nutrients usable by plants. The emphasis is not on food webs, but on the transfer of matter and energy between organisms. The concepts of conservation of matter and conservation of energy are applied to ecosystems. Matter within an ecosystem is continually undergoing changes in form and location; however, as long as it remains within that ecosystem, the total amount of matter in the ecosystem remains constant. An energy pyramid graphic can illustrate the flow of energy. At each stage in the transfer of energy within an ecosystem, some energy is stored in newly synthesized molecules and some energy is transferred into the environment as heat produced by the chemical processes in cells. This dissipated energy is not easy to detect or recapture but continues to exist.

New discoveries, technology and research are used to connect the concept of energy transfer and transformation within the ecosystem and between ecosystems. For example, the use of biomass as an alternative energy source for the local area can focus on different types of biomass, competition between human food crops and biomass crops, and biomass vs. other types of alternatives to fossil-fuels energy.

Future Application of Concepts
High School: The chemical flow of energy during reactions will be explored as the molecular structure of molecules is studied.

EXPECTATIONS FOR LEARNING

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Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Flow of matter and energy			
Ethanol, a plant product, is used in place of fossil fuels. Research the effects of production and usage over the past decade. Evaluate the pros and cons of using biomass products such as ethanol vs. traditional fossil fuels.	Plan and conduct an investigation to determine what factors impact photosynthesis in plants that live in aquatic habitats (e.g., Elodea).	Distinguish between photosynthesis and respiration and illustrate how the two processes are connected. Create a chart that compares the reactants and products of both processes. Trace the flow of energy through the human digestive system showing how food is broken down to release energy through the process of digestion and then through cellular respiration.	Identify the cellular structures primarily responsible for photosynthesis and respiration. Trace and explain how matter and energy are transferred through an ecosystem.

Grade 7 continued

LIFE SCIENCE (LS)

Topic: Cycles of Matter and Flow of Energy
This topic focuses on the impact of matter and energy transfer within the biotic component of ecosystems.

CONTENT STATEMENT	CONTENT ELABORATION
7.LS.2: In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors. 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.	**Prior Concepts Related to Biomes** **PreK-2:** Plants and animals have traits that improve their chances of survival in different environments. Living things have basic needs, which are met by obtaining materials from the physical environment. **Grades 3-5:** Populations of organisms can be categorized by how they acquire energy. Food webs can be used to identify the relationships among organisms. 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. Predator-prey and producer-consumer relations are addressed in grade 5. **Grade 7 Concepts** Biomes are defined by abiotic components of the environment – topography, soil types, precipitation, solar radiation and temperature. Comparing the different biomes found on Earth is the focus of this content statement. Examples of the Earth's biomes include aquatic (freshwater, brackish water and marine water), forest (tropical and temperate), desert (cold and hot), grassland, taiga and tundra. Biomes should be linked to climate zones on a global level by using a variety of maps, models and technology (e.g., remote sensing, satellite images, LANDSAT). An ecosystem is composed of linked and fluctuating interactions between biotic and abiotic factors. Given adequate resources and an absence of disease or predators, populations of organisms in ecosystems increase at rapid rates. Finite resources and other factors limit population growth. As one population proliferates, it is held in check by one or more environmental factors (e.g., depletion of food or nesting sites, increased loss to predators, invasion by parasites). If a natural disaster such as a flood or fire occurs, the damaged ecosystem is likely to recover in a succession of stages that eventually results in a system similar to the original one. **Future Application of Concepts** **High School:** The evolutionary mechanisms that build unity and diversity are studied.

EXPECTATIONS FOR LEARNING

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Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Ecosystems			
Analyze or critique the impact of Ohio's wetland mitigation plans on a local community or the state as a whole. Include real-world data from the sites in the analysis or critique. Anticipate future trends on the flora and fauna in the ecosystem based upon the real-world data.	Monitor the local ecosystem (e.g., stream, river, construction site) for the impact Ohio's wetland mitigation plans have on water quality (e.g., oxygen levels, pH, phosphorus levels, nitrogen levels) and how the plans will impact living organisms (e.g., algae, diatoms, mussels, insect larvae).	Research an endangered species and examine environmental conditions that may contribute to that organism's classification. Determine if any conservation efforts have been employed and document whether or not any efforts have been successful. Use evidence to support responses. Compare biomes to identify common abiotic factors that support life.	Identify the biotic and abiotic elements of the major biomes and describe how these elements impact each other. Explain how the abiotic factors support the types of organisms that can survive in an environment. Explain the differences between the environment, a biome, an ecosystem and a habitat.