

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)

Kindergarten

INTRODUCTION TO CONTENT STATEMENTS

GRADE BAND THEME: OBSERVATIONS OF THE ENVIRONMENT

This theme focuses on helping students develop the skills for systematic discovery to understand the science of the physical world around them in greater depth by using scientific inquiry.

SCIENCE INQUIRY AND APPLICATION

During the years of PreK-4, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content areas:

- Observe and ask questions about the natural environment;
- Plan and conduct simple investigations;
- Employ simple equipment and tools to gather data and extend the senses;
- Use appropriate mathematics with data to construct reasonable explanations;
- Communicate about observations, investigations and explanations; and
- Review and ask questions about the observations and explanations of others.

STRANDS

Strand Connections: Living and nonliving things have specific physical properties that can be used to sort and classify. The physical properties of air and water are presented as they apply to weather.

EARTH AND SPACE SCIENCE (ESS)

PHYSICAL SCIENCE (PS)

LIFE SCIENCE (LS)

Topic: **Daily and Seasonal Changes**

This topic focuses on observing, exploring, describing and comparing weather changes, patterns in the sky and changing seasons.

Topic: **Properties of Everyday Objects and Materials**

This topic focuses on the production of sound and on observing, exploring, describing and comparing the properties of objects and materials with which the student is familiar.

Topic: **Physical and Behavioral Traits of Living Things**

This topic focuses on observing, exploring, describing and comparing living things in Ohio.

CONDENSED CONTENT STATEMENTS

- Weather changes are long-term and short-term.
- The moon, sun and stars are visible at different times of the day or night.
- Objects and materials can be sorted and described by their properties.
- Some objects and materials can be made to vibrate to produce sound.
- Living things are different from nonliving things.
- Living things have physical traits and behaviors, which influence their survival.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)**MODEL CURRICULUM KINDERGARTEN****EARTH AND SPACE SCIENCE (ESS)****Topic: Daily and Seasonal Changes**

This topic focuses on observing, exploring, describing and comparing weather changes, patterns in the sky and changing seasons.

CONTENT STATEMENT**Kindergarten Concepts****Weather changes are long-term and short-term.**

Weather changes occur throughout the day and from day to day.

Air is a nonliving substance that surrounds Earth and wind is air that is moving.

Wind, temperature and precipitation can be used to document short-term weather changes that are observable.

Yearly weather changes (seasons) are observable patterns in the daily weather changes.

Grades 1-2: The properties of water and air are explored as they relate to the weather observations and measurement from Kindergarten.

Grades 3-5: Different states of water are defined in Physical Sciences. Wind and water are recognized as processes that can change the surface of Earth through weathering and erosion. The observed seasons from Kindergarten are related to the sun and the tilt and orbit of Earth in grade 5.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

This section provides examples of tasks that students may perform; this includes guidance for developing classroom performance tasks. It is not an all-inclusive checklist of what should be done, but is a springboard for generating innovative ideas.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)

MODEL CURRICULUM KINDERGARTEN

EARTH AND SPACE SCIENCE (ESS)

Topic: Daily and Seasonal Changes

This topic focuses on observing, exploring, describing and comparing weather changes, patterns in the sky and changing seasons.

CONTENT STATEMENT

Kindergarten Concepts

The moon, sun and stars can be observed at different times of the day or night.

The moon, sun and stars are in different positions at different times of the day or night. Sometimes the moon is visible during the night, sometimes the moon is visible during the day and at other times, the moon is not visible at all. The observable shape of the moon changes in size very slowly throughout each day of every month. The sun is visible only during the day.

The sun's position in the sky changes in a single day and from season to season. Stars are visible at night; some are visible in the evening or morning and some are brighter than others.



Observations also can be made virtually. This data can be compared from month to month to monitor changes. Stars, groups of stars and different phases of the moon can be observed through books or virtually and documented throughout the month. The names of the stars, constellations or moon phases are not appropriate for Kindergarten; only the changes in appearances and what can actually be observed are included. The moon also can be observed in the daylight, at times. Drawings, photographs or other graphics can be used to document student observations.

Demonstrating (either 3-D or virtual) and testing/experimenting (through kits or models) must be used to explain the changing positions (in the sky) of the sun, stars and moon. Review, question and discuss the demonstrations and observations to deepen understanding.

Future Application of Concepts

Grades 1-2: The sun is introduced as a primary source of energy that relates to long- and short-term weather changes.

Grades 3-5: The tilt and orbit of the Earth and position of the sun are related to the seasons; the sun is the only star in the solar system and celestial bodies orbit the sun.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE KINDERGARTEN

LIFE SCIENCE (LS)

Topic: Physical and Behavioral Traits of Living Things

This topic focuses on observing, exploring, describing and comparing living things in Ohio.

CONTENT STATEMENT

CONTENT ELABORATION

Living things are different from nonliving things.

Living things include anything that is alive or has ever been alive. Living things have specific characteristics and traits. Living things grow and reproduce. Living things are found almost everywhere in the world. There are somewhat different kinds in different places.



The emphasis of this content statement is to build a grade-appropriate understanding of what it means to be living, not to distinguish living and nonliving.

There are different kinds of living things. The focus is on familiar organisms (e.g., grass, trees, flowers, cats, dogs, horses). Some grade-appropriate characteristics include that living things respond to stimuli, grow and require energy. Living things respond to stimuli. The responses described must be easy to observe (e.g., fish in an aquarium respond to a stimulus – food). Living things grow (e.g., plant seeds or seedlings and watch them grow). Observing plants growing toward a light source can lead to experiments and explorations of what happens when the plant is placed in a different place in the classroom (e.g., on the floor, in a closet, on a desk) or rotated 90 degrees. Some observations also can be done virtually.

Animals need food; plants make their own food. Read grade-appropriate, non-fiction books to students or by students (e.g., picture books) that accurately describe the characteristics of living things found in Ohio. Technology also can be used to find photographs and stories or take photographs of living things in Ohio.

Note 1: The focus is on the traits and behaviors of living things not on attributes of nonliving things. See Kindergarten Physical Science for nonliving things.

Note 2: Listing the characteristics that distinguish living things from nonliving things is not appropriate at this grade level. Further details will appear in the model curriculum.

Future Application of Concepts

Grades 1-2: This content builds to understanding that living things use the environment to acquire what they need in order to survive.

Grades 3-5: Food webs and food chains are used to illustrate energy transfer within an ecosystem.

Grades 6-8: The characteristics of life are detailed via Modern Cell Theory and reproduction.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)

MODEL CURRICULUM KINDERGARTEN

LIFE SCIENCE (LS)

Topic: Physical and Behavioral Traits of Living Things

This topic focuses on observing, exploring, describing and comparing living things in Ohio.

CONTENT STATEMENT

CONTENT ELABORATION

Kindergarten Concepts

Living things have physical traits and behaviors, which influence their survival.

Living things are made up of a variety of structures. Some of these structures and behaviors influence their survival.



leaf

At this grade level, providing exposure through personal observation and stories to a large variety of living things is required. The focus is not on naming the parts of living things, but associating through interaction and observation that living things are made of parts, and because of those parts, living things can do specific things. The scientific explanations of how those parts function will come later. Identify and discuss examples such as birds have wings for flying and beaks for eating. Dogs have eyes for seeing, teeth for chewing and legs for moving. Trees have leaves and trunks.

Note: This concept is addressed in PreK, but is included here for districts that do not have a PreK program. Further information for districts is provided in the model curriculum section.

Note: To ensure the health of students, check for allergies prior to raising a classroom pet.

Future Application of Concepts

Grades 1-2: The physical environment is identified as the source for what organisms need to survive.

Grades 3-5: Plants and animals have certain physical or behavioral characteristics that improve their chances of surviving in particular environments.

Grades 6-8: Changes in environmental conditions can affect how beneficial a trait will be for survival and reproductive success of an individual or an entire species.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)

MODEL CURRICULUM KINDERGARTEN

PHYSICAL SCIENCE (PS)

Topic: Properties of Everyday Objects and Materials

This topic focuses on the production of sound and on observing, exploring, describing and comparing the properties of objects and materials with which the student is familiar.

CONTENT STATEMENT

CONTENT ELABORATION

Objects and materials can be sorted and described by their properties.

Objects can be sorted and described by the properties of the materials from which they are made. Some of the properties can include color, size and texture.

Kindergarten Concepts

In Kindergarten, the concept that objects are made of specific materials (e.g., clay, cloth, paper, metal, glass) is reinforced. Objects have certain properties (e.g., color, shape, size, temperature, odor, texture, flexibility) that can be described, compared and sorted. Temperature observations must be limited to descriptors such as hot, warm and cold. Observations of weight must be limited to describing objects as heavy or light. Comparisons must be used to sort and describe objects (e.g., *is the wooden block heavier or lighter than the plastic block?*). Standard and nonstandard measuring tools can give additional information about the environment and can be used to make comparisons of objects and events. Magnifiers can be used to see detail that cannot be seen with the unaided eye. Familiar objects from home, the classroom or the natural environment must be explored and investigated.

Note: Using the sense of taste should be prohibited in the classroom. Discussions of taste can be limited to experiences outside the classroom. Comparisons of objects are a precursor to measurement.

Future Application of Concepts

Grades 1-2: Changes in objects are investigated, including temperature changes, solid-liquid phase changes and possible changes in amount of liquid water in open and/or closed containers.

Grades 3-5: Matter is defined and gases (air) are introduced. Measurements of weight and liquid volume are made. The mass and kind of material remains the same when an object is reshaped or broken into pieces. The properties of solids, liquids and gases (air), and phase changes are explored.

*While mass is the scientifically correct term to use in this context, the NAEF 2019 Science Framework (page 27) recommends using the more familiar term "weight." In the elementary grades with the distinction between mass and weight being introduced at the middle school level, in Ohio, students will not be assessed on the differences between mass and weight until Grade 6.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM KINDERGARTEN

PHYSICAL SCIENCE (PS)

Topic: Properties of Everyday Objects and Materials

This topic focuses on the production of sound and on observing, exploring, describing and comparing the properties of objects and materials with which the student is familiar.

CONTENT STATEMENT

Some objects and materials can be made to vibrate to produce sound.

Sound is produced by touching, blowing or tapping objects. The sounds that are produced vary depending on the properties of objects. Sound is produced when objects vibrate.

CONTENT ELABORATION

Kindergarten Concepts

Sound can be made in many ways. Objects like cymbals, the tabletop or drums can be tapped to produce sound. Objects like a rubber band or a guitar string can be plucked to produce sound. Objects like a bottle or a trumpet can be blown into to produce sound. A wide variety of sounds can be made with the same object (e.g., a plastic bottle could be tapped or blown into). The connection between sound energy and the vibration of an object must be made. Vibrations can be made visible when water splashes from a cymbal or triangle placed in water or rice vibrates on the top of a banging drum. The concepts of pitch (low vs. high notes) and loudness are introduced. The pitch of sound can be changed by changing how fast an object vibrates. Objects that vibrate slowly produce low pitches; objects that vibrate quickly produce high pitches. Sound must be experienced, investigated and explored through observations and experimentation. Standard, virtual and student-constructed instruments must be used to explore sound.

Note: Wave descriptions of sound and the propagation of sound energy are not appropriate at this grade.

Future Application of Concepts

Grades 1-2: Exploring sound provides an experiential basis for the concepts of motion and energy. A variety of motions is explored. Forces are needed to change the motion of objects.

Grades 3-5: Energy is introduced as something that can make things move or cause change. The concept of a medium for sound is introduced and disturbances in liquid and solid media are observed.

Grades 6-8: The wave nature of sound is introduced.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)

Grade 1

INTRODUCTION TO CONTENT STATEMENTS

GRADE BAND THEME: OBSERVATIONS OF THE ENVIRONMENT

This theme focuses on helping students develop the skills for systematic discovery to understand the science of the physical world around them in greater depth by using their knowledge and understanding in all science content areas:

- Observe and ask questions about the natural environment;
- Plan and conduct **simple investigations**;
- Employ simple equipment and tools to gather data and extend the senses;
- Use appropriate mathematics with data to construct reasonable explanations;
- Communicate about observations, investigations and explanations; and
- Review and ask questions about the observations and explanations of others.

STRANDS

Strand Connections: Energy is observed through movement, heating, cooling and the needs of living organisms.

EARTH AND SPACE SCIENCE (ESS)

PHYSICAL SCIENCE (PS)

Topic: Sun, Energy and Weather

This topic focuses on the sun as a source of energy and energy changes that occur to land, air and water.

LIFE SCIENCE (LS)

Topic: Motion and Materials

This topic focuses on the changes in properties that occur in objects and materials. Changes of position of an object are a result of pushing or pulling.

This topic focuses on the physical needs of living things in Ohio. Energy from the sun or food, nutrients, water, shelter and air are some of the physical needs of living things.

CONDENSED CONTENT STATEMENTS

- The sun is the principal source of energy.
- The physical properties of water change.
- Properties of objects and materials can change.
- Objects can be moved in a variety of ways, such as straight, zigzag, circular and back and forth.
- Living things have basic needs, which are met by obtaining materials from the physical environment.
- Living things survive only in environments that meet their needs.



Department
of Education

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 1**EARTH AND SPACE SCIENCE (ESS)****Topic: Sun, Energy and Weather**

This topic focuses on the sun as a source of energy and energy changes that occur to land, air and water.

CONTENT STATEMENT**CONTENT ELABORATION****The sun is the principal source of energy.**

Sunlight warms Earth's land, air and water. The amount of exposure to sunlight affects the amount of warming or cooling of air, water and land.



PreK-K: Weather changes every day, weather changes are short and long term, the sun is visible during the day and the position of the sun can change.

Grade 1 Concepts

Quantitative measurements must be used to observe and document the warming and cooling of air, water or soil. The length of time an object or material (including water) is exposed to sunlight and its resulting temperature must be observed, as should the amount of time for the object or material to cool down after it is taken out of the sunlight.

Appropriate tools and technology must be used to collect, compare and document data. Investigation and experimentation must be combined with explanation, questioning and discussion of the results and findings.

Future Application of Concepts

Grade 2: The relationship between energy and long- and short-term weather is introduced.

Grades 3-5: Renewable energy, forms of energy (e.g., heat, light, electrical energy), the solar system and patterns/cycles between the Earth and sun are explored.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 1**EARTH AND SPACE SCIENCE (ESS)****Topic: Sun, Energy and Weather**

This topic focuses on the sun as a source of energy and energy changes that occur to land, air and water.

CONTENT STATEMENT**The physical properties of water can change.**

These changes occur due to changing energy. Water can change from a liquid to a solid and from a solid to a liquid. Weather observations can be used to examine the property changes of water.

Note: Water as a vapor is not introduced until grade 2; only solid and liquid water should be discussed at this level. A broader coverage of states of matter is found in grade 4. This concept builds on the PS Kindergarten strand pertaining to properties (liquids and solids).

**CONTENT ELABORATION****Prior Concepts Related to Water**

PreK-K: Water can be observed in many different forms; precipitation (rain, sleet, hail or snow) is a component of weather that can be measured.

Grade 1 Concepts

Water can be observed in lakes, ponds, streams, wetlands, the ocean and through weather events. Freezing and melting of water are investigated through measurements and observations using technology, in the classroom or in a natural setting. Examining maps (virtual or 2-D) of Ohio, world maps or globes can illustrate the amount of Earth's surface that is covered in water and why it is important to learn about water. Water can change the shape of the land (e.g. moving soil or sand along the banks of a river or at the beach). Water also can be observed in the air as clouds, steam or fog, but this comment should be limited to observation only at this grade level (see **Note**).

Investigations (inside or outside) and experimentation must be used to demonstrate the changing properties of water. Use appropriate tools to test and measure water's weight, texture, temperature or size (e.g., compare measurements of water before and after freezing, examine the texture of snow or ice crystals using a hand lens) to document the physical properties.

Future Application of Concepts

Grade 2: Water as a vapor is introduced (water is present in the atmosphere).

Grades 3-5: Water is identified as a non-living resource that can be used for energy, common states of matter include liquids, solids and gases. Earth's surface has been changed by processes involving water and where water is found on Earth.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 1

LIFE SCIENCE (LS)

Topic: Basic Needs of Living Things

This topic focuses on the physical needs of living things in Ohio. Energy from the sun or food, nutrients, water, shelter and air are some of the physical needs of living things.

CONTENT STATEMENT

Living things have basic needs, which are met by obtaining materials from the physical environment.

Grade 1 Concepts

Living things require energy, water and a particular range of temperatures in their environments.

Plants get energy from sunlight. Animals get energy from plants and other animals.

Living things acquire resources from the living and nonliving components of the environment.



CONTENT ELABORATION

Prior Concepts Related to Interactions within Habitats

PreK-K: Use macroscopic ways to identify living things. Living things have physical traits, which enable them to live in different environments.

Grade 1 Concepts

Earth has many different environmental conditions that support living things. The emphasis of this content statement is that living things meet their basic needs for survival by obtaining necessary materials from the environment. This includes, but is not limited to, temperature range, amount of water, amount of sunlight and available food sources. The environment includes both living (plants and animals) and nonliving (e.g., water, air, sunlight, nutrients) things.

Living things get the energy they require to respond, grow and reproduce from the environment. Observing energy being used in everyday situations can help promote understanding that living things get resources from the physical environment. A detailed discussion of energy is not appropriate at this grade level (see section heading E). Energy is not scientifically explained until grade 3.

When studying living things, ethical treatment of animals and safety must be employed. Respect for and proper treatment of living things must be modeled. For example, rattling on insect bottles, unclean cages or aquariums, leaving living things in the hot sun or exposure to extreme temperatures (hot or cold) must be avoided. The National Science Teachers Association (NSTA) has a position paper to provide guidance in the ethical use and treatment of animals in the classroom at <http://www.nsta.org/about/positions/animals.aspx>.

Investigations about the types of living things that live in specific environments can be done virtually or in nature.

Future Application of Concepts

Grade 2: How living things impact the environment and how the environment impacts living things will be examined.

Grade 3-5: Life cycles of plants and animals will be explored.

Grades 6-8: Changes in environmental conditions can affect how beneficial a trait will be for survival and reproductive success of an individual or an entire species.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 1**LIFE SCIENCE (LS)****Topic: Basic Needs of Living Things**

This topic focuses on the physical needs of living things in Ohio. Energy from the sun or food, nutrients, water, shelter and air are some of the physical needs of living things.

CONTENT STATEMENT

Living things survive only in environments that meet their needs.

Resources are necessary to meet the needs of an individual and populations of individuals. Living things interact with their physical environments as they meet those needs.

Effects of seasonal changes within the local environment directly impact the availability of resources.

**CONTENT ELABORATION****Prior Concepts Related to Interactions within Habitats**

PreK-K: Use macroscopic ways to identify living things. Living things have physical traits, which enable them to live in different environments.

Grade 1 Concepts

Plants and animals require resources from the environment. The focus at this grade level is on macroscopic interactions and needs of common living things (plants and animals).

Animals require basic habitat components, including food, water, cover, and space. The amount and distribution of the basic components will influence the types of animals that can survive in an area. Food sources might include insects, plants, seeds or other animals. Water sources may be as small as drops of dew found on grass or as large as a lake or river. Animals need cover for many life functions, including nesting, escaping from predators, seeking shelter from the elements on a cold winter day and resting. Animals also need space in which to perform necessary activities such as feeding or raising young. Seasonal changes affect the resources available to living things (e.g., grasses are not as available in winter as they are in summer).

The needs of plants include room to grow, temperature range, light, water, air, nutrients and time (growing season). The amount and distribution of these will influence the types of plants that can survive in an area. Observations of seasonal changes in temperature, liquid water availability, wind and light must be applied to the effect of seasonal changes on local plants.

Future Application of Concepts

Grade 2: This concept expands to include interactions between organisms and the physical environment in which the organisms or the physical environment are changed.

Grade 3-5: The fact that organisms have life cycles that are part of their adaptations for survival in their natural environment builds upon this concept.

Grades 6-8: In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 1

PHYSICAL SCIENCE (PS)

Topic: Motion and Materials

This topic focuses on the changes in properties that occur in objects and materials. Changes of position of an object are a result of pushing or pulling.

CONTENT STATEMENT

Properties of objects and materials can change.

Objects and materials change when exposed to various conditions, such as heating or freezing. Not all materials change in the same way.



Prior Concepts Related to Properties of Objects and Materials

PreK-K: Objects are things that can be seen or felt. Properties can be observed using tools or one's senses and can be used to sort objects. Comparisons of objects are made as a precursor to measurement.

Grade 1 Concepts:

Materials can be exposed to conditions that change some of their properties, but not all materials respond the same way. The properties of a material can change as it interacts with other materials. Heating and cooling changes some, but not all, properties of materials.

Some materials can be a liquid or solid at room temperature and may change from one form to the other with a change in the temperature. A liquid may turn into a solid when frozen. A solid may turn into a liquid when heated. The amount of the material in the solid or liquid remains the same. Investigations and experiments (may include virtual investigations) must be conducted to explore property changes of objects and materials.

Parts of objects have specific properties that allow them to work with other parts to carry out a particular function. Something may not work well or at all if a part of it is missing, broken, worn out, mismatched or disconnected. Toys that can be assembled from several parts can be investigated when one or more of the parts are missing.

Note: Emphasis is placed on observations. Concepts of thermal energy, atoms and heat transfer are inappropriate at this grade.

Future Application of Concepts

Grade 2: Water can change from liquid to vapor in the air and from vapor to liquid (ESS).

Grades 3-5: Matter is defined. Measurements of weight and liquid volume are made. Properties of solids, liquids and gases, and phase changes are explored. During any change, including phase changes, the total mass^{*} remains constant. The sum of the mass^{*} of the parts of an object is equal to the mass^{*} of the entire object.

^{*}While mass is the scientifically correct term to use in this context, the NAEF 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 1

PHYSICAL SCIENCE (PS)

Topic: Motion and Materials

This topic focuses on the changes in properties that occur in objects and materials. Changes of position of an object are a result of pushing or pulling.

CONTENT STATEMENT

Objects can be moved in a variety of ways, such as straight, zigzag, circular and back and forth.

The position of an object can be described by locating it relative to another object or to the object's surroundings.

An object is in motion when its position is changing.

The motion of an object can be affected by pushing or pulling. A push or pull is a force that can make an object move faster, slower or go in a different direction.

Note: Changes in motion are a result of changes in energy.

CONTENT ELABORATION

Prior Concepts Related to Motion

PreK-K: Vibrating objects can cause sound.

Grade 1 Concepts:

The position of an object is described by comparing its location relative to another object (e.g., in front, behind, above, below). Objects can be moved and their positions are changed.

Objects can move in a straight line (like a dropped coin falling to the ground) or a circle (like a pinwheel) or back and forth (like a swing) or even in a zigzag pattern. Objects near Earth fall to the ground unless something holds them up. Object motion can be faster, slower or change direction by pushing or pulling the object. Experimentation, testing and investigations of different ways to change the motion of different objects (such as a ball, a pinwheel or a kite) must be used to demonstrate movement.

Note 1: Scientific definitions and calculations of speed are inappropriate at this grade.

Note 2: Force is a push or pull between two objects and energy is the property of an object that can cause change. A force acting on an object can sometimes result in a change in energy. The differences between force and energy will be developed over time and are not appropriate for this grade.

Future Application of Concepts

Grade 2: Forces are necessary to change the motion of objects.

Grades 3-5: The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted.

*While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

This section provides examples of tasks that students may perform; this includes guidance for developing classroom performance tasks. It is not an all-inclusive checklist of what should be done, but is a springboard for generating innovative ideas.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)

Grade 2

INTRODUCTION TO CONTENT STATEMENTS**GRADE BAND THEME: OBSERVATIONS OF THE ENVIRONMENT**

This theme focuses on helping students develop the skills for systematic discovery to understand the science of the physical world around them in greater depth by using scientific inquiry.

SCIENCE INQUIRY AND APPLICATION

During the years of PreK-4, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content areas:

- Observe and ask questions about the natural environment;
- Plan and conduct simple investigations;
- Employ simple equipment and tools to gather data and extend the senses;
- Use appropriate mathematics with data to construct reasonable explanations;
- Communicate about observations, investigations and explanations; and
- Review and ask questions about the observations and explanations of others.

STRANDS

Strand Connections: Living and nonliving things may move. A moving object has energy. Air moving is wind and wind can make a windmill turn. Changes in energy and movement can cause change to organisms and the environments in which they live.

EARTH AND SPACE SCIENCE (ESS)**Topic: The Atmosphere**

This topic focuses on air and water as they relate to weather and weather changes that can be observed and measured.

PHYSICAL SCIENCE (PS)**Topic: Changes in Motion**

This topic focuses on observing the relationship between forces and motion.

LIFE SCIENCE (LS)**Topic: Interactions within Habitats**

This topic focuses on how ecosystems work by observations of simple interactions between the biotic/living and abiotic/nonliving parts of an ecosystem. Just as living things impact the environment in which they live, the environment impacts living things.

CONDENSED CONTENT STATEMENTS

- The atmosphere is made up of air.
- Water is present in the air
- Long- and short-term weather changes occur due to changes in energy.

- Forces change the motion of an object.

- Living things cause changes on Earth.
- Some kinds of individuals that once lived on Earth have completely disappeared, although they were something like others that are alive today.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 2

EARTH AND SPACE SCIENCE (ESS)

Topic: The Atmosphere

This topic focuses on air and water as they relate to weather and weather changes that can be observed and measured.

CONTENT STATEMENT

The atmosphere is made up of air. Prior Concepts Related to Air and Atmosphere

PreK-1: Wind is moving air; air is a nonliving substance that surrounds Earth; wind can be measured and sunlight warms the air.

Air has properties that can be observed and measured. The transfer of energy in the atmosphere causes air movement, which is felt as wind. Wind speed and direction can be measured.



Grade 2 Concepts

In the earlier grades, wind is measured but not with a numerical value or directional data (e.g., wind may be moving faster/slower than yesterday and is coming from a different direction). Wind can change the shape of the land (e.g. sand dunes, rock formations). In grade 2, wind can be measured with numeric value and direction (e.g., wind speed is 6 mph, wind direction is west to east).

Air takes up space (has volume) and has mass.* Heating and cooling of air (transfer of energy) results in movement of air (wind). The direction and speed of wind and the air temperature can be measured using a variety of instruments, such as windsocks, weather vanes, thermometers or simple anerometers. Weather events that are related to wind (e.g., tornadoes, hurricanes) are included in this context. Monitoring weather changes using technology (e.g., posting/sharing classroom data with other classes at the school or at other schools) can lead to review and questioning of data and evaluation of wind patterns that may be documented.

Experiments, models (including digital/virtual) and investigations must be conducted to demonstrate the properties of air, wind and wind-related weather events. Questions, comparisons and discussions related to actual data and the analysis of the data is an important way to deepen the content knowledge.

*While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.

Future Application of Concepts

Grades 3-5: Renewable energy, air pollution and wind can weather and erode Earth's surface.

Grades 6-8: Thermal energy transfers in the atmosphere, air currents and global climate patterns.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)**MODEL CURRICULUM GRADE 2****EARTH AND SPACE SCIENCE (ESS)****Topic: The Atmosphere**

This topic focuses on air and water as they relate to weather and weather changes that can be observed and measured.

CONTENT STATEMENT**Water is present in the air.**

Water is present in the air as clouds, steam, fog, rain, ice, snow, sleet or hail. When water in the air cools (change of energy), it forms small droplets of water that can be seen as clouds. Water can change from liquid to vapor in the air and from vapor to liquid. The water droplets can form into raindrops. Water droplets can change to solid by freezing into snow, sleet or hail. Clouds are moved by flowing air.



Note: This concept builds upon the changing properties of water from ESS grade 1.

CONTENT ELABORATION**Prior Concepts Regarding Relationship of Water and Air**

PreK-1: Wind and water are observable parts of weather; sunlight warms water and air, and the physical properties of water can change (liquid to solid and solid to liquid).

Grade 2 Concepts

The physical properties of water (from grade 1) are expanded to include water vapor (water in the air). The different states of water are observed in weather events, nature and/or classroom investigations. The concepts of condensation and evaporation are explored through experimentation and observation. The different parts of the water cycle are explored and discussed. The emphasis at this grade level is investigating condensation and evaporation at depth, not memorizing the water cycle itself. The focus is on investigation and understanding, not on the vocabulary. Cloud formation and types of clouds are introduced as they relate to weather, storm fronts and changing weather. Again, the emphasis is not in naming cloud types, but in relating the characteristics of the clouds with weather. Factors such as water contamination/pollution can be introduced within this content statement as it relates to pollutants that can enter waterways through precipitation, evaporation and condensation.

Experiments and investigations that demonstrate the conditions required for condensation or evaporation to occur lead to a deeper understanding of these concepts. Appropriate tools and technology (to observe, share results or to document data) is required. Relating the required conditions to actual observations (outside the classroom), collecting and documenting data, drawing conclusions from the data, and discussions about the findings must be included for this content statement.

Future Application of Concepts

Grades 3-5: The states and conservation of matter, weathering and erosion of Earth's surface, seasonal changes and energy transfer are explored.

Grades 6-8: The hydrologic cycle, transfer of energy between the hydrosphere and lithosphere, and biogeochemical cycles are studied.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 2**EARTH AND SPACE SCIENCE (ESS)****Topic: The Atmosphere**

This topic focuses on air and water as they relate to weather and weather changes that can be observed and measured.

CONTENT STATEMENT

Long- and short-term weather changes occur due to changes in energy.

Changes in energy affect all aspects of weather, including temperature, precipitation amount and wind.



Note: Discussion of energy at this grade level should be limited to observable changes.

CONTENT ELABORATION**Prior Concepts Related to Weather Changes**

PreK-1: Weather changes during the day and from day to day. Weather changes can be long- or short-term. Weather changes can be measured and have patterns.

Grade 2 Concepts

Weather is a result of energy change. Heating and cooling of water, air and land (from sunlight) are directly related to wind, evaporation, condensation, freezing, thawing and precipitation. Weather patterns (long-term) and fronts (short-term) can be documented through consistent measuring of temperature, air pressure, wind speed and direction, and precipitation. Some forms of severe weather can occur in specific regions/areas, scientists forecast severe weather events.

Weather data must be measured, collected and documented over a period of time and then connected to observable forms of energy (e.g., wind causes a sailboat to move, the sun can heat the sidewalk). Experiments and investigations (both inside and outside of the classroom) must be used to demonstrate the connection between weather and energy.

Note: Density and convection should not be introduced at this grade level.

Future Application of Concepts

Grades 3-5: Changes in energy and changing states of matter are explored in greater depth through applications other than weather. Renewable resources (energy sources) and changes in Earth's environment through time are examined.

Grades 6-8: Changes of state are explained by molecules in motion, kinetic and potential energy. The hydrologic cycle and thermal energy transfers between the hydrosphere and atmosphere are studied.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 2

LIFE SCIENCE (LS)

Topic: Interactions within Habitats

This topic focuses on how ecosystems work by observations of simple interactions between the biotic/living and abiotic/nonliving parts of an ecosystem. Just as living things impact the environment in which they live, the environment impacts living things.

CONTENT STATEMENT

Living things cause changes on Earth.

Living things function and interact with their physical environments.

Living things cause changes in the environments where they live; the changes can be very noticeable or slightly noticeable, fast or slow.



CONTENT ELABORATION

Prior Concepts Related to Interactions within Habitats

PreK-1: Observe macroscopic characteristics of living things. Including basic survival needs of living things, how living things get resources from the environment and how available resources vary throughout the course of a year.

Grade 2 Concepts

The environment is a combination of the interactions between living and non-living components. Living things can cause changes in their environment, which can be observed. These interactions can cause changes in groups of living things and the physical environment (soil, rocks, water). Conducting investigations (in nature or virtually) to document specific changes and the results of the changes must be used to demonstrate this concept (e.g., moles tunneling in a lawn, beavers or muskrats building dams, plants growing in cracks of rocks). Maps or charts (digital or 2-D) can be used to document the location of specific types of living things found in the local area.

The impact and actions of living things must be investigated and explored. The focus is not limited to human interaction with the environment (such as resource use or recycling). Observe earthworm compost bins, ant farms and weeds growing on vacant lots.

Future Application of Concepts

Grades 3-5: Changes that occur in an environment can sometimes be beneficial and sometimes harmful.

Grades 6-8: Matter is transferred continuously between one organism to another and between organisms and their physical environment.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 2

LIFE SCIENCE (LS)

Topic: **Interactions within Habitats**

This topic focuses on how ecosystems work by observations of simple interactions between the biotic/living and abiotic/nonliving parts of an ecosystem. Just as living things affect the environment in which they live, the environment impacts living things.

CONTENT STATEMENT

Some kinds of individuals that once lived on Earth have completely disappeared, although they were something like others that are alive today.

Living things that once lived on Earth no longer exist; their basic needs were no longer met.



CONTENT ELABORATION

Prior Concepts Related to Interactions within Habitats

PreK-1: Living things have physical traits, which enable them to live in different environments.

Grade 2 Concepts

Fossils are physical traces of living things that are preserved in rock. By examining fossils, it can be determined that some fossils look similar to plants and animals that are alive today, while others are very different from anything alive today. Extinction refers to the disappearance of the last member of a living thing's kind. Sometimes extinction is described as the dying out of all members of the living thing's kind. Extinction generally occurs as a result of changed conditions to which the living thing's kind is not suited. Some kinds of living things that once lived on Earth have completely disappeared (e.g., the Sabertooth Cat, Smilodon). Some kinds of living things that once lived on Earth are something like others that are alive today (e.g., horses). Explore and compare a vast array of organisms, both extinct (e.g., Rugose Coral, Sphenopids) and extant (e.g., Brain Coral, Equisetum). Research and exposure should focus on the organism and its environment for both extinct and extant organisms. Photographs, video, websites, books, local parks and museums can be used to visualize past environments and the organisms that lived in them.

Future Application of Concepts

Grade 3-5: Fossils will be addressed in more detail.

Grades 6-8:

This concept will be expanded to providing a partial explanation of biodiversity.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 2

PHYSICAL SCIENCE (PS)

Topic: Changes in Motion

This topic focuses on observing the relationship between forces and motion.

CONTENT STATEMENT

Forces change the motion of an object.

Motion can increase, change direction or stop depending on the force applied.

The change in motion of an object is related to the size of the force.

Some forces act without touching, such as using a magnet to move an object or objects falling to the ground.

Note: At this grade level, gravitational and magnetic forces should be introduced through observation and experimentation only. The definitions of these forces should not be the focus of the content statements.

CONTENT ELABORATION

Prior Concepts Related to Forces and Motion

PreK-1: Vibrating objects are observed producing sound. Motion is described as a change in an object's position. Forces are pushes and pulls that can change the motion of objects.

Grade 2 Concepts:

Forces are needed to change the movement (speed up, slow down, change direction or stop) of an object. Some forces may act when an object is in contact with another object (e.g., pushing or pulling). Other forces may act when objects are not in contact with each other (e.g., magnetic or gravitational).

Earth's gravity pulls any object toward it, without touching the object. Static electricity also can pull or push objects without touching the object. Magnets can pull some objects to them (attraction) or push objects away from them (repulsion). Gravity, static electricity and magnets must be explored through experimentation, testing and investigation at this grade level.

For a particular object, larger forces can cause larger changes in motion. A strong kick to a rock is able to cause more change in motion than a weak kick to the same rock. Real-world experiences and investigations must be used for this concept.

Note 1: Introducing fields, protons, electrons or mathematical manipulations of positive and negative to explain observed phenomena are not appropriate at this grade level.

Note 2: There often is confusion between the concepts of force and energy. Force can be thought of as a push or pull between two objects and energy as the property of an object that can cause change. A force acting on an object can sometimes result in a change in energy. The differences between force and energy will be developed over time and is not appropriate at this grade level.

Note 3: Charges and poles are often confused. It is important to emphasize they are different.

Future Application of Concepts

Grades 3-5: The amount of change in movement of an object depends on the mass* of the object and the amount of force exerted.

Grades 6-8: Speed is defined and calculated. The field concept for forces at a distance is introduced.

*While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)

Grade 3

INTRODUCTION TO CONTENT STATEMENTS**GRADE BAND THEME: INTERCONNECTIONS WITHIN SYSTEMS**

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

SCIENCE INQUIRY AND APPLICATION

During the years of PreK-4, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content areas:

- Observe and ask questions about the natural environment;
- Plan and conduct simple investigations;
- Employ simple equipment and tools to gather data and extend the senses;
- Use appropriate mathematics with data to construct reasonable explanations;
- Communicate about observations, investigations and explanations; and
- Review and ask questions about the observations and explanations of others.

STRANDS

Strand Connections: Matter is what makes up all substances on Earth. Matter has specific properties and exists in different states. Earth's resources are made of matter. Matter can be used by living things and can be used for the energy they contain. There are many different forms of energy. Each living component of an ecosystem is composed of matter and uses energy.

EARTH AND SPACE SCIENCE (ESS)**Topic: Earth's Resources**

This topic focuses on Earth's resources. While resources can be living and nonliving, within this strand, the emphasis is on Earth's nonliving resources, such as water, air, rock, soil and the energy resources they represent.

PHYSICAL SCIENCE (PS)**Topic: Matter and Forms of Energy**

This topic focuses on the relationship between matter and energy. Matter has specific properties and is found in all substances on Earth. Heat is a familiar form of energy that can change the states of matter.

LIFE SCIENCE (LS)**Topic: Behavior, Growth and Changes**

This topic explores life cycles of organisms and the relationship between the natural environment and an organism's (physical and behavioral) traits, which affect its ability to survive and reproduce.

CONDENSED CONTENT STATEMENTS

- Earth's nonliving resources have specific properties.
 - Earth's resources can be used for energy.
 - Some of Earth's resources are limited.
- All objects and substances in the natural world are composed of matter.
 - Matter exists in different states, each of which has different properties.
 - Heat, electrical energy, light, sound and magnetic energy are forms of energy.
- Offspring resemble their parents and each other.
 - Individuals of the same kind differ in their traits and sometimes the differences give individuals an advantage in surviving and reproducing.
 - Plants and animals have life cycles that are part of their adaptations for survival in their natural environments.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 3

EARTH AND SPACE SCIENCE (ESS)

Topic: Earth's Resources

This topic focuses on Earth's resources. While resources can be living and nonliving, within this strand, the emphasis is on Earth's nonliving resources, such as water, air, rock, soil and the energy resources they represent.

CONTENT STATEMENT

Earth's nonliving resources have specific properties.

Soil is composed of pieces of rock, organic material, water and air and has characteristics that can be measured and observed. Rocks have unique characteristics that allow them to be sorted and classified. Rocks form in different ways. Air and water are nonliving resources.



CONTENT ELABORATION

Prior Concepts Related to Properties of Nonliving Resources

PreK-2: Objects and materials can be sorted and described by their properties. Living things are different than nonliving things. Properties of objects and materials can change. Water and air have specific properties that can be observed and measured.

Grade 3 Concepts

The properties of air and water are introduced in the early elementary grades, so the focus at the third-grade level is on soil and rocks. Air and water are present within rocks and soil. Air and water also play an important role in the formation of rocks and soil. All are considered nonliving resources.

The characteristics of rocks and soil must be studied through sampling, observation and testing. This testing includes the ability of water to pass through samples of rock or soil and the determination of color, texture, composition and moisture level of soil. Measurable and observable characteristics of rocks include size and shape of the particles or grains (if present) within the rock, texture and color. Age-appropriate tools must be used to test and measure the properties. The characteristics of the rock can help determine the environment in which it formed. Technology can be used to analyze and compare test results, connect to other classrooms to compare data or share samples, and document the findings.

Note 1: Rock classification is not the focus for this grade level; this is found in grade 6. At this grade, the actual characteristics of rocks can be used to sort or compare, rather than formal classification.

Note 2: Properties of air and water have been addressed in PreK.

Note: It is important to use the term "soil," not "dirt." Dirt and soil are not synonymous.

Future Application of Concepts

Grades 4-5: The characteristics of both soil and rock are related to the weathering and erosion of soil and rock, which result in changes on Earth's surface. The general characteristics of Earth are studied.

Grades 6-8: Further exploration of soil and rock classification is found with the expansion of instruction to minerals and mineral properties.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 3

EARTH AND SPACE SCIENCE (ESS)

Topic: Earth's Resources

This topic focuses on Earth's resources. While resources can be living and nonliving, within this strand, the emphasis is on Earth's nonliving resources, such as water, air, rock, soil and the energy resources they represent.

CONTENT STATEMENT

Earth's resources can be used for energy.

Many of Earth's resources can be used for the energy they contain. Renewable energy is an energy resource, such as wind, water or solar energy, that is replenished within a short amount of time by natural processes. Nonrenewable energy is an energy resource, such as coal or oil, that is a finite energy source that cannot be replenished in a short amount of time.



CONTENT ELABORATION

Prior Concepts Related to Energy from Earth's Resources

PreK-2: Wind is moving air; water and wind have measurable properties, and sunlight warms the air and water

Grade 3 Concepts
Distinguishing between renewable and nonrenewable resources through observation and investigation is the emphasis for this content statement. This can be connected to learning about the different forms of energy (PS grade 3). Electrical circuit or solar panel models can be used to demonstrate different forms of energy and the source of the energy. The conservation of energy is explored within the content statement. Some of Earth's resources are limited. Specific energy sources in Ohio are introduced, such as fossil fuels found in Ohio, new energy technologies, and the development of renewable energy sources within Ohio. Ohio must be compared to other states regarding energy sources.

Future Application of Concepts

Grades 4-5: Energy is explored through electrical energy, magnetic energy, heat, light and sound.

Grades 6-8: The formation of coal, oil and gas, kinetic and potential energy, thermal energy, energy conservation, energy transfer (includes renewable energy systems) and additional examination of nonrenewable resources are studied.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

This section provides examples of tasks that students may perform; this includes guidance for developing classroom performance tasks. It is not an all-inclusive checklist of what should be done, but is a springboard for generating innovative ideas.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 3

EARTH AND SPACE SCIENCE (ESS)

Topic: Earth's Resources

This topic focuses on Earth's resources. While resources can be living and nonliving, within this strand, the emphasis is on Earth's nonliving resources, such as water, air, rock, soil and the energy resources they represent.

CONTENT STATEMENT

Some of Earth's resources are limited.

Some of Earth's resources become limited due to overuse and/or contamination. Reducing resource use, decreasing waste and/or pollution, recycling and reusing can help conserve these resources.



CONTENT ELABORATION

Prior Concepts Related to Limit of Earth's Resources

PreK-2: Properties of objects and materials can change. The amount of exposure to sunlight affects the warming of air, water and land. Living things acquire resources from nonliving components. Resources are necessary for living things.

Grade 3 Concepts

Within third grade, the focus is on the different types of Earth's resources, how they are used and how they can be conserved. Scientific data should be used to evaluate and compare different methods of conservation (e.g., effectiveness of different kinds of recycling such as paper vs. metal). The concentration must be the science behind the conservation of resources and why certain resources are limited. Reducing or limiting the use and/or waste of resources should be emphasized (rather than concentrating only on recycling of resources).

Future Application of Concepts

Grades 4-5: Conservation of matter, environmental changes through Earth's history and erosion (loss of resources/contamination) are introduced.

Grades 6-8: Common and practical uses of soil, rock and minerals (geologic resources), biogeochemical cycles, global climate patterns and interactions between the spheres of Earth (Earth Systems) are found.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 3

LIFE SCIENCE (LS)

Topic: Behavior, Growth and Changes

This topic explores life cycles of organisms and the relationship between the natural environment and an organism's (physical and behavioral) traits, which affect its ability to survive and reproduce.

CONTENT STATEMENT

Offspring resemble their parents and each other.

Individual organisms inherit many traits from their parents indicating a reliable way to transfer information from one generation to the next.

Some behavioral traits are learned through interactions with the environment and are not inherited.



CONTENT ELABORATION

Prior Concepts Related to Behavior, Growth and Changes

PreK-2: Similarities and differences exist among individuals of the same kinds of plants and animals.

Grade 3 Concepts

Organisms are similar to their parents in appearance and behavior but still show some variation. Although the immature stages of some living things may not resemble the parents, once the offspring matures, it will resemble the parent. At this grade level, the focus is on establishing, through observation, that organisms have a reliable mechanism for ensuring that offspring resemble their parents. It is not appropriate or necessary to introduce the genetic mechanisms involved in heredity; however, care should be taken to avoid introducing the misconception that the individual organism has a way to select the traits that are passed on to the next generation. As part of the study of the life cycle of organisms, the physical appearance of the adults will be compared to the offspring (e.g., compare butterflies to determine if offspring look exactly like the parents).

A considerable amount of animal behavior is directly related to getting materials necessary for survival (food, shelter) from the environment and that influences what an animal learns. The focus at this grade level is on examples provided through observation or stories of animals engaging in instinctual and learned behaviors. Some organisms have behavioral traits that are learned from the parent (e.g., hunting). Other behavior traits that are in response to environmental stimuli (e.g., a plant stem bending toward the light). At this grade level, the definition of either instinctual or learned behavior is not learned. The focus is on making observations of different types of plant and animal behavior.

Technology (e.g., a webcam) can be used to observe animals in their natural or human-made environments.

Future Application of Concepts

Grades 6-8: These observations will build to a description and understanding of the biological mechanisms involved in ensuring that offspring resemble their parents. Cell Theory will be introduced which will explore how cells come from pre-existing cells and new cells will have the genetic information of the old cells. The details of reproduction will be outlined.

Note: Human genetic study is not recommended since not all students may have information available from their biological parents.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)**MODEL CURRICULUM GRADE 3****LIFE SCIENCE (LS)****Topic: Behavior, Growth and Changes**

This topic explores life cycles of organisms and the relationship between the natural environment and an organism's (physical and behavioral) traits, which affect its ability to survive and reproduce.

CONTENT STATEMENT

Individuals of the same kind differ in their traits and sometimes the differences give individuals an advantage in surviving and reproducing.

Plants and animals have physical features that are associated with the environments where they live.

Plants and animals have certain physical or behavioral characteristics that improve their chances of surviving in particular environments.

Individuals of the same kind have different characteristics that they have inherited. Sometimes these different characteristics give individuals an advantage in surviving and reproducing.



Note: The focus is on the individual, not the population. Adaptation is not the focus at this grade level.

CONTENT ELABORATION**Prior Concepts Related to Behavior, Growth and Changes**

PreK-2: Similarities and differences exist among individuals of the same kinds of plants and animals. Living things have physical traits and behaviors that influence their survival.

Grade 3 Concepts

Organisms have different structures and behaviors that serve different functions. Some plants have leaves, stems and roots; each part serves a different function for the plant. Some animals have wings, feathers, beaks; each part serves a different function for the animals. The observation of body parts should be limited to gross morphology and not microscopic or chemical features. Comparison across species is not appropriate at this grade level; only observation of variation within the same species is expected. This content statement can be combined with the observation of the life cycles of organisms and/or the observation of the similarity between offspring and parents.

There may be variations in the traits that are passed down that increase the ability of organisms to thrive and reproduce. Some variations in traits that are passed down may reduce the ability of organisms to survive and reproduce. Some variations in traits that are passed down may have no appreciable effect on the ability of organisms to survive and reproduce. Variations in physical features among animals and plants can help them survive in different environmental conditions. Variations in color, size, weight, etc., can be observed as the organism develops.

Plants and animals that survive and reproduce pass successful features on to future generations. Some grade-appropriate organisms to study are plants (e.g., radishes, beans) and insects (e.g., butterflies, moths, beetles, brine shrimp). Comparisons can be made in nature or virtually. Venn diagrams can be used to illustrate the similarities and differences between individuals of the same type.

Future Application of Concepts

Grades 4-5: Changes in the environment may benefit some organisms and be a detriment to other organisms.

Grades 6-8: The reproduction of organisms will explain how traits are transferred from one generation to the next.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 3

LIFE SCIENCE (LS)

Topic: Behavior, Growth and Changes

This topic explores life cycles of organisms and the relationship between the natural environment and an organism's (physical and behavioral) traits, which affect its ability to survive and reproduce.

CONTENT STATEMENT

Plants and animals have life cycles that are part of their adaptations for survival in their natural environments.

Over the whole earth, organisms are growing, reproducing, dying and decaying. The details of the life cycle are different for different organisms, which affects their ability to survive and reproduce in their natural environments.



Note: The names of the stages within the life cycles are not the focus.

Note: New organisms are produced by the old ones.

CONTENT ELABORATION

Prior Concepts Related to Behavior, Growth and Changes

PreK-2: Plants and animals have variations in their physical traits that enable them to survive in a particular environment. Some organisms exhibit seasonal behaviors that enable them to survive environmental conditions and changes.

Grade 3 Concepts

Plants and animals have life cycles that are adapted to survive in distinct environments (e.g., bean plants can be grown inside during winter, but cannot grow outside in the winter). Most life cycles start with birth, then progress to growth, development, adulthood, reproduction and death. The process can be interrupted at any stage. The details of the life cycle are different for different organisms.

Observation of the complete life cycle of an organism can be made in the classroom (e.g., butterflies, mealworms, plants) or virtually. Hand lens, magnifying lenses, metric rulers and scales are some of the tools that can be used to question, explore and investigate the physical appearance of living things.

When studying living things, ethical treatment of animals and safety must be employed. Respect for and proper treatment of living things must be modeled. For example, shaking a container, rapping on insect bottles, unclean cages or aquariums, leaving living things in the hot sun or exposure to extreme temperatures (hot or cold) must be avoided. The National Science Teachers Association (NSTA) has a position paper to provide guidance in the ethical use and treatment of animals in the classroom at <http://www.nsta.org/about/positions/animals.aspx>.

Future Application of Concepts

Grades 4-5: Organisms perform a variety of roles in an ecosystem.

Grades 6-8: The structure and organization of organisms and the necessity of reproduction for the continuation of the species will be detailed.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)**MODEL CURRICULUM GRADE 3****PHYSICAL SCIENCE (PS)****Topic: Matter and Forms of Energy**

This topic focuses on the relationship between matter and energy. Matter has specific properties and is found in all substances on Earth. Heat is a familiar form of energy that can change the states of matter.

CONTENT STATEMENT**All objects and substances in the natural world are composed of matter.**

Matter takes up space and has mass*.

*While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.

**CONTENT ELABORATION****Prior Concepts Related to Matter**

PreK-2: Objects are things that can be seen or felt. Properties of objects may be described, measured and sorted. The physical properties of water change as observed in weather. Air has mass* and takes up space (ESS).

Grade 3 Concepts:

Grades 4-5: Objects are composed of matter and matter has observable properties. Matter is anything that has mass* and takes up space. All solids, liquids and gases are made of matter.

Volume is a measure of the amount of space an object takes up. Volumes of liquids can be measured in metric units with a beaker or graduated cylinder. Weight is a measure of gravity (how strongly Earth's gravity pulls the object toward Earth). Weight is measured using a scale. For any given location, the more matter there is in an object, the greater the weight. Opportunities to investigate and experiment with different methods of measuring weight and liquid volume must be provided.

Objects are made of smaller parts, some too small to be seen even with magnification. Matter continues to exist, even when broken into pieces too tiny to be visible.

Notes: Atomic and subatomic nature of matter is not appropriate at this grade. Math standards at this grade limit volume measurements to liquids measured to the nearest whole number. This document follows the recommendations of the NAEP 2009 Science Framework (see page 27) for dealing with the concepts of mass and weight.

Future Application of Concepts

Grades 4-5: The mass* and total amount of matter remains the same when it undergoes a change, including phase changes. The sum of the mass* of the parts of an object is equal to the weight (mass) of the entire object.

Grades 6-8: The atomic model is introduced. Properties are explained by the arrangement of particles.

*While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)**MODEL CURRICULUM GRADE 3****PHYSICAL SCIENCE (PS)****Topic: Matter and Forms of Energy**

This topic focuses on the relationship between matter and energy. Matter has specific properties and is found in all substances on Earth. Heat is a familiar form of energy that can change the states of matter.

CONTENT STATEMENT**Matter exists in different states, each of which has different properties.****CONTENT ELABORATION****Prior Concepts Related to Matter**

PreK-2: Materials can be sorted by properties. The physical properties of water change as observed in weather (ESS).

Grade 3 Concepts:

The most common states of matter are solids, liquids and gases.

Shape and compressibility are properties that can distinguish between the states of matter.

One way to change matter from one state to another is by heating or cooling.



Gases, liquids and solids are different states of matter that have different properties. Liquids and solids do not compress into a smaller volume as easily as do gases. Liquids and gases flow easily, but solids do not flow easily. Solids retain their shape and volume (unless a force is applied). Liquids assume the shape of the part of the container that it occupies (retaining its volume). Gases assume the shape and volume of its container.

Heating may cause a solid to melt to form a liquid, or cause a liquid to boil or evaporate to form a gas. Cooling may change a gas into a liquid or cause a liquid to freeze and form a solid. Conducting experiments or investigations that demonstrate phase changes, such as the melting or freezing of substances other than water (e.g., vinegar, vegetable oil, sugar, butter), must be used to reinforce the concept that materials other than water also go through phase changes.

Note 1: Purdue University provides a table that can help in differentiating the properties of solids, gases and liquids. Teaching about the atomic structure as related to the phases is not appropriate for this grade level.

Note 2: Only solids, liquids and gases are appropriate at this grade, even though other phases have been identified. The differences between boiling and evaporation are not dealt with at this grade.

Future Application of Concepts

Grades 4-5: The amount of mass* and matter remains the same during phase changes.

Grades 6-8: Atomic theory is introduced. Properties of solids, liquids and gases are related to the spacing and motion of particles. Thermal energy and temperature are related to the motion of particles.

*While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 3

PHYSICAL SCIENCE (PS)

Topic: Matter and Forms of Energy

This topic focuses on the relationship between matter and energy. Matter has specific properties and is found in all substances on Earth. Heat is a familiar form of energy that can change the states of matter.

CONTENT STATEMENT

Heat, electrical energy, light, sound and magnetic energy are forms of energy.

There are many different forms of energy. Energy is the ability to cause motion or create change.



Note: The different forms of energy that are outlined at this grade level should be limited to familiar forms of energy that a student is able to observe.

CONTENT ELABORATION

Prior Concepts Related to Sound, Energy and Motion

PreK-2: Vibrations are associated with sound. An object is in motion when its position is changing. Forces change the motion of an object. Sunlight is the principal source of energy on Earth and warms Earth's land, air and water (ESS). Weather changes occur due to changes in energy (ESS). Living things require energy (LS). Plants get energy from sunlight (LS).

Grade 3 Concepts:

Examples of energy causing motion or creating change include a falling rock causing a crater to form on the ground, heating water causing water to change into a gas, light energy from the sun contributing to plant growth, electricity causing the blades of a fan to move, electrically charged objects causing movement in uncharged objects or other electrically charged objects, sound from a drum causing rice sitting on the drum to vibrate, and magnets causing other magnets and some metal objects to move.

Investigations (3-D or virtual) must be used to demonstrate the relationship between different forms of energy and motion.

Note 1: It is not appropriate at this grade level to explore the different types of energy in depth or use wave terminology when discussing energy. These will be developed at later grades.

Note 2: There often is confusion between the concepts of force and energy. Force can be thought of as a push or pull between two objects and energy as the property of an object that can cause change. If forces actually push or pull something over a distance, then there is an exchange of energy between the objects. The differences between force and energy will be developed over time and are not appropriate for this grade level.

Note 3: The word "heat" is used loosely in everyday language; yet it has a very specific scientific meaning. Usually what is called heat is actually "thermal or radiant energy." An object has thermal energy due to the random movement of the particles that make up the object. Radiant energy is that which is given off by objects through space (e.g., warmth from a fire, solar energy from the sun). "Heating" is used to describe the transfer of thermal or radiant energy to another object or place. Differentiating between these concepts is inappropriate at this grade. This document uses the same conventions as noted in the NAEPE 2009 Science Framework (see page 29) where "heat" is used in lower grades. However, the word "heat" has been used with care so it refers to a transfer of thermal or radiant energy. The concept of thermal energy, as it relates to particle motion, is introduced in grade 6.

Future Application of Concepts

Grades 4-5: Processes of energy transfer and transformation are introduced. Heat, electrical energy, light and sound are explored in more detail.

Grades 6-8: Energy is classified as kinetic or potential. The concepts of conservation of energy and thermal energy as it relates to particle motion are introduced.

[BACK TO INDEX](#)

Grade 4

[BACK TO K-8 INDEX](#)**INTRODUCTION TO CONTENT STATEMENTS****GRADE BAND THEME: INTERCONNECTIONS WITHIN SYSTEMS**

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

SCIENCE INQUIRY AND APPLICATION

During the years of PreK-4, all students must become proficient in the use of the following scientific processes, with appropriate **laboratory safety techniques**, to construct their knowledge and understanding in all science content areas:

- Observe and ask questions about the natural environment;
- Plan and conduct **simple investigations**;
- Employ simple equipment and tools to gather data and extend the senses;
- Use appropriate mathematics with data to construct reasonable explanations;
- Communicate about observations, investigations and explanations; and
- Review and ask questions about the observations and explanations of others.

STRANDS

Strand Connections: Heat and electrical energy are forms of energy that can be transferred from one location to another. Matter has properties that allow the transfer of heat and electrical energy. Heating and cooling affect the weathering of Earth's surface and Earth's past environments. The processes that shape Earth's surface and the fossil evidence found can help decode Earth's history.

EARTH AND SPACE SCIENCE (ESS)**Topic: Earth's Surface**

This topic focuses on the variety of processes that shape and reshape Earth's surface.

PHYSICAL SCIENCE (PS)**Topic: Electricity, Heat and Matter**

This topic focuses on the conservation of matter and the processes of energy transfer and transformation, especially as they relate to heat and electrical energy.

LIFE SCIENCE (LS)**Topic: Earth's Living History**

This topic focuses on using fossil evidence and living organisms to observe that suitable habitats depend upon a combination of biotic and abiotic factors.

CONDENSED CONTENT STATEMENTS

- Earth's surface has specific characteristics and landforms that can be identified.
- The surface of Earth changes due to weathering.
- The surface of Earth changes due to erosion and deposition.
- The total amount of matter is conserved when it undergoes a change.
- Energy can be transformed from one form to another or can be transferred from one location to another.
- Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.
- Fossils can be compared to one another and to present day organisms according to their similarities and differences.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 4

EARTH AND SPACE SCIENCE (ESS)

Topic: Earth's Surface

This topic focuses on the variety of processes that shape and reshape Earth's surface.

CONTENT STATEMENT	CONTENT ELABORATION
Earth's surface has specific characteristics and landforms that can be identified.	<p>Prior Concepts Related to Surface of Earth</p> <p>PreK-2: Wind and precipitation can be measured, water can change state, heating and freezing can change the properties of materials, and living things can cause changes on Earth.</p> <p>Grade 3: The composition and characteristics of rocks and soil are studied.</p> <p>Grade 4 Concepts</p> <p>Earth is known as the Blue Planet because about 70 percent of Earth's surface is covered in water. Freshwater is a small percentage of the overall water found on Earth; the majority is oceanic.</p> <p>There are many different processes that continually build up or tear down the surface of Earth. These processes include erosion, deposition, volcanic activity, earthquakes, glacial movement and weathering.</p> <p>Beginning to recognize common landforms or features through field investigations, field trips, topographic maps, remote sensing data, aerial photographs, physical geography maps and/or photographs (through books or virtually) are important ways to understand the formation of landforms and features. Common landforms and features include streams, deltas, floodplains, hills, mountains/mountain ranges, valleys, sinkholes, caves, canyons, glacial features, dunes, springs, volcanoes and islands.</p> <p>Connecting the processes that must occur to the resulting landform, feature or characteristic should be emphasized. This can be demonstrated through experiments, investigations (including virtual experiences) or field observations. Technology can help illustrate specific features that are not found locally or demonstrate change that occurred (e.g., using satellite photos of an erosion event such as flooding).</p>

Future Application of Concepts

- Grade 5:** Earth is a planet in the solar system that has a unique composition. Global seasonal changes are introduced, including monsoons and rainy seasons, which can change erosion and deposition patterns.
- Grades 6-8:** Changes in the surface of Earth are examined using data from the rock record and through the understanding of plate tectonics and the interior of Earth. Historical studies of erosion and deposition patterns are introduced, in addition to soil conservation, the interaction of Earth's spheres and ocean features specific to erosion and deposition.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 4

EARTH AND SPACE SCIENCE (ESS)

Topic: Earth's Surface

This topic focuses on the variety of processes that shape and reshape Earth's surface.

CONTENT STATEMENT

CONTENT ELABORATION

The surface of Earth changes due to weathering.

Rocks change shape, size and/or form due to water or ice movement, freeze and thaw, wind, plant growth, gases in the air, pollution and catastrophic events such as earthquakes, mass wasting, flooding and volcanic activity.



Prior Concepts Related to Weathering

PreK-2: Wind is moving air; water and wind have measurable properties; water changes state; properties of materials change when exposed to various conditions (e.g., heating, freezing) and living organisms interact with their environment.

Grade 3: Rocks and soil have unique characteristics. Soil contains pieces of rock.

Grade 4 Concepts

Different types of rock weather at different rates due to specific characteristics of the rock and the exposure to weathering factors (e.g., freezing/thawing, wind, water). Weathering is defined as a group of processes that change rock at or near Earth's surface. Some weathering processes take a long time to occur, while some weathering processes occur quickly.

The weathering process must be observed in nature, through classroom experimentation or virtually. Seeing tree roots fracturing bedrock or the effect of years of precipitation on a marble statue can illustrate ways that rocks change shape over time. Investigations can include classroom simulations, laboratory testing and field observations.

Future Application of Concepts

Grade 5: Earth is a planet in the solar system that has a unique composition, global seasonal changes and patterns are introduced, including temperature fluctuations/ranges, monsoons and/or rainy seasons which can impact the weathering of Earth's surface.

Grades 6-8: The relationship between the characteristics of rocks and the environment in which they form is explored as well as how rocks break down (weather) and are transported (erosion), water flows through rock and soil at different rates, and the causes of changes on Earth's surface.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 4

EARTH AND SPACE SCIENCE (ESS)

Topic: Earth's Surface

This topic focuses on the variety of processes that shape and reshape Earth's surface.

CONTENT STATEMENT

The surface of Earth changes due to erosion and deposition.

Water, wind and ice physically remove and carry (erosion) rock, soil and sediment and deposit the material in a new location.

Gravitational force affects movements of water, rock and soil.



CONTENT ELABORATION

Prior Concepts Related to Erosion and Deposition

PreK-2: Wind is moving air; water and wind have measurable properties; water changes state; forces change the motion of an object and some forces act without touching (e.g., gravitational forces).

Grade 3: Soil and rock have unique characteristics. Soil and rock are nonliving resources that can be conserved.

Grade 4 Concepts

Erosion is a process that transports rock, soil or sediment to a different location. Weathering is the breakdown of large rock into smaller pieces of rock. Erosion is what carries the weathered material to a new location. Gravity plays an important role in understanding erosion, especially catastrophic events like mass wasting (e.g., mudslides, avalanches, landslides) or flooding. Erosion is a "destructive" process and deposition is a "constructive" process. Erosion and deposition directly contribute to landforms and features formation that are included in grade 4. Topographic maps and aerial photographs can be used to locate erosional and depositional areas in Ohio. Surficial geology maps also can illustrate the patterns of glacial erosion and deposition that have occurred. Field trips and field investigations (may be virtual) are recommended as erosional and depositional features that can be seen locally or within the state can help to connect the concept of erosion and deposition to the real world.

Future Application of Concepts

Grade 5: Earth is a planet in the solar system that has a unique composition, global seasonal changes are introduced, including monsoons and rainy seasons, which can change erosion and deposition patterns.

Grades 6-8: Historical studies of erosional and depositional patterns are introduced, in addition to soil conservation, the interaction of Earth's spheres, ocean features specific to erosion and deposition, and plate tectonics.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 4

LIFE SCIENCE (LS)

Topic: Earth's Living History

This topic focuses on using fossil evidence and living organisms to observe that suitable habitats depend upon a combination of biotic and abiotic factors.

CONTENT STATEMENT

CONTENT ELABORATION

Prior Concepts Related to Behavior, Growth and Changes

Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.

Ecosystems can change gradually or dramatically. When the environment changes, some plants and animals survive and reproduce and others die or move to new locations. An animal's patterns of behavior are related to the environment. This includes the kinds and numbers of other organisms present, the availability of food and resources, and the physical attributes of the environment.



PreK-2: Plants and animals have variations in their physical traits that enable them to survive in a particular environment. Living things that once lived on Earth no longer exist, as their needs were not met. Living things have basic needs, which are met by obtaining materials from the physical environment.

Grade 3: Plants and animals have life cycles that are part of their adaptations for survival in their natural environments.

Grade 4 Concepts

Ecosystems are based on interrelationships among and between biotic and abiotic factors. Ohio has experienced various weather patterns. Some parts of Ohio hosted glaciers and other parts of Ohio were submerged with water. Ecosystems can change rapidly (e.g., volcanoes, earthquakes, or fire) or very slowly (e.g., climate change). Major changes over a short period of time can have a significant impact on the ecosystem and the populations of plants and animals living there. The changes that occur in the plant and animal populations can impact access to resources for the remaining organisms, which may result in migration or death. The fossil record provides evidence for changes in populations of species.

Researching and investigating specific areas in Ohio (e.g., Cedar Bog, Lake Erie, Hocking Hills, Caesar Creek, Kellys Island) via field studies, virtual field trips or other references must be used to explore the relationships between previous environments, changes that have occurred in the environments and the species that lived there.

Note: Grade 4 ES focuses on changes to Earth's surface due to erosion, deposition of soil, rock sediment, flooding, volcanoes and earthquakes that can be taught along with this content.

Future Application of Concepts

Grades 6-8: Organisms that survive pass on their traits to future generations. Climate, rock record and geologic periods are explored in Earth and Space Science.

High School: The concepts of evolution are explored.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 4

LIFE SCIENCE (LS)

Topic: Earth's Living History

This topic focuses on using fossil evidence and living organisms to observe that suitable habitats depend upon a combination of biotic and abiotic factors.

CONTENT STATEMENT

CONTENT ELABORATION

Prior Concepts Related to Behavior, Growth and Changes

Fossils can be compared to one another and to present-day organisms according to their similarities and differences.

The concept of biodiversity is expanded to include different classification schemes based upon shared internal and external characteristics of organisms.

Most types of organisms that have lived on Earth no longer exist.

Fossils provide a point of comparison between the types of organisms that lived long ago and those existing today.



Grade 4 Concepts

Fossils provide evidence that many plant and animal species are extinct and that many species have changed overtime. The types of fossils that are present provide evidence about the nature of the environment at that time. As the environment changed so did the types of organisms that could survive in that environment.

The opportunity to learn about an increasing variety of living organisms, both the familiar and the exotic, should be provided. The observations and descriptions of organisms should become more precise in identifying similarities and differences based upon observed structures. Emphasis can still be on external features; however, finer detail than before should be included. Hand lenses and microscopes should be routinely used. Microscopes are used not to study cell structure but to begin exploring the world of organisms that cannot be seen by the unaided eye. Non-Linnaean classification systems should be developed that focus on gross anatomy, behavior patterns, habitats and other features.

Future Application of Concepts

Grades 6-8: Diversity of species will be explored in greater detail. The study of Modern Cell Theory and rock formation is required (Earth and Space Science).

High School:

The concepts of evolution and cell biology are explored.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 4

PHYSICAL SCIENCE (PS)

Topic: Electricity, Heat and Matter

This topic focuses on the conservation of matter and the processes of energy transfer and transformation, especially as they apply to heat and electrical energy.

CONTENT STATEMENT

The total amount of matter is conserved when it undergoes a change.

When an object is broken into smaller pieces, when a solid is dissolved in a liquid or when matter changes state (solid, liquid, gas), the total amount of matter remains constant.

Note 1: At this grade, the discussion of conservation of matter should be limited to a macroscopic, observable level.

Note 2: States of matter are found in PS grade 3. Heating and cooling is one way to change the state of matter.

CONTENT ELABORATION

Prior Concepts Related to Changes of Matter

PreK-2: Simple measuring instruments are used to observe and compare properties of objects. Changes in objects are investigated.

Grade 3: Objects are composed of matter, which has weight mass* and takes up space. Matter includes solids, liquids and gases [air]. Phase changes are explored.

Grade 4 Concepts:

Some properties of objects may stay the same even when other properties change. For example, water can change from a liquid to a solid, but the mass* of the water remains the same. Parts of an object or material may be assembled in different configurations, but the mass* remains the same. The sum of all of the parts in an object equals the mass* of the object.

When a solid is dissolved in a liquid, the mass* of the mixture is equal to the sum of the masses* of the liquid and solid. At this grade level, the discussion of conservation of matter should be limited to a macroscopic, observable level. Conservation of matter must be developed from experimental evidence collected in the classroom. After the concept has been well established with experimental data and evidence, investigations can include interactions that are more complex where the mass* may not appear to stay constant (e.g., fizzing tablets in water).

Note: Mass* is an additive property of objects and volume is usually an additive property for the same material at the same conditions. However, volume is not always an additive property, especially if different substances are involved. For example, mixing alcohol with water results in a volume that is significantly less than the sum of the volumes.

Future Application of Concepts

Grades 6-8: Conservation of matter in phase changes and chemical reactions is explained by the number and type of atoms remaining constant. The idea of conservation of energy is introduced.

*While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 4

PHYSICAL SCIENCE (PS)

Topic: Electricity, Heat and Matter

This topic focuses on the conservation of matter and the processes of energy transfer and transformation, especially as they apply to heat and electrical energy.

CONTENT STATEMENT

Energy can be transformed from one form to another or can be transferred from one location to another.

Energy transfers from hot objects to cold objects as heat, resulting in a temperature change.

Electric circuits require a complete loop of conducting materials through which an electrical energy can be transferred. Electrical energy in circuits can be transformed to other forms of energy, including light, heat, sound and motion. Electricity and magnetism are closely related.

CONTENT ELABORATION

Prior Concepts Related to Heat and Electricity

PreK-2: Temperature is a property of objects. Sunlight affects the warming or cooling of air, water and land (ESS). Charged objects can attract uncharged objects and may either attract or repel other charged objects. Magnetic objects can attract things made of iron and may either attract or repel other magnetic objects.

Grade 3: Objects that have energy can cause change. Heat, electrical energy, light, sound and magnetic energy are all forms of energy.

Grade 4 Concepts:

The addition of heat may increase the temperature of an object. The removal of heat may decrease the temperature of an object. There are materials in which the entire object becomes hot when one part of the object is heated (e.g., in a metal pan, heat flows through the pan on the stove transferring the heat from the burner outside the pan to the food in the pan). There are other objects in which parts of the object remain cool even when another part of the object is heated (e.g., in a Styrofoam® cup; very little of the warmth from hot liquid inside the cup is transferred to the hand holding the cup).

Electrical conductors are materials through which electricity can flow easily. Electricity introduced to one part of the object spreads to other parts of the object (e.g., copper wire is an electrical conductor because electricity flows through the wires in a lamp from the outlet to the light bulb and back to the outlet).

Electrical insulators are materials through which electricity cannot flow easily. Electricity introduced to one part of the object does not spread to other parts of the object (e.g., rubber surrounding a copper wire is an electrical insulator because electricity does not flow through the rubber to the hand holding it).

Electrical conductivity must be explored through testing common materials to determine their conductive properties.

In order for electricity to flow through a circuit, there must be a complete loop through which the electricity can pass. When an electrical device (e.g., lamp, buzzer, motor) is not part of a complete loop, the device will not work. Electric circuits must be introduced in the laboratory by testing different combinations of electrical components. When an electrical device is a part of a complete loop, the electrical energy can be changed into light, sound, heat or magnetic energy. Electrical devices in a working circuit often get warmer.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

When a magnet moves in relation to a coil of wire, electricity can flow through the coil. When a wire conducts electricity, the wire has magnetic properties and can push and/or pull magnets. The connections between electricity and magnetism must be explored in the laboratory through experimentation.

Note 1: Exploring heat transfer in terms of moving submicroscopic particles is **not appropriate at this grade level**.

Note 2: The word "heat" is used loosely in everyday language, yet it has a very specific scientific meaning. Usually what is called heat is actually "thermal or radiant energy." An object has thermal energy due to the random movement of the particles that make up the object. Radiant energy is that which is given off by objects through space (e.g., warmth from a fire, solar energy from the sun). "Heating" is used to describe the transfer of thermal or radiant energy to another object or place. Differentiating between these concepts is inappropriate at this grade level. This document uses the same conventions as noted in the NAEP 2009 Science Framework (see page 29) where "heat" is used in lower grades. However, the word "heat" has been used with care so it refers to a transfer of thermal or radiant energy. The concept of thermal energy, as it relates to particle motion, is introduced in grade 6.

Note 3: Knowing the specifics of electromagnetism is not appropriate at this grade level. At this point, the connections between electricity and magnetism are kept strictly experiential and observational.

Note 4: Energy transfer (between objects or places) should not be confused with energy transformation from one form of energy to another (e.g., electrical energy to light energy).

Future Application of Concepts

Grade 5: Light and sound are explored further as forms of energy.

Grades 6-8: Thermal energy is related to the atomic theory. Kinetic and potential energy are two ways objects can store energy. Conservation of energy and energy transfer through radiation, convection and conduction, and the transfer of electrical energy in circuits are introduced.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

Grade 5

INTRODUCTION TO CONTENT STATEMENTS

GRADE BAND THEME: INTERCONNECTIONS WITHIN SYSTEMS

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

SCIENCE INQUIRY AND APPLICATION

During the years of grades 5-8, all students must use the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content areas:

- Identify questions that can be answered through scientific investigations;
- Design and conduct a scientific investigation;
- 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; and
- Communicate scientific procedures and explanations.

STRANDS

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

EARTH AND SPACE SCIENCE (ESS)

Topic: Cycles and Patterns in the Solar System

This topic focuses on the characteristics, cycles and patterns in the solar system and within the universe.

PHYSICAL SCIENCE (PS)

Topic: Light, Sound and Motion

This topic focuses on the forces that affect motion. This includes the relationship between the change in speed of an object, the amount of force applied and the mass* of the object. Light and sound are explored as forms of energy that move in predictable ways, depending on the matter through which they move.

LIFE SCIENCE (LS)

Topic: Interactions within Ecosystems

This topic focuses on foundational knowledge of the structures and functions of ecosystems.

CONDENSED CONTENT STATEMENTS

- The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics.
- The sun is one of many stars that exist in the universe.
- Most of the cycles and patterns of motion between the Earth and sun are predictable.
- Organisms perform a variety of roles in an ecosystem.
- All of the processes that take place within organisms require energy.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 5

EARTH AND SPACE SCIENCE (ESS)

Topic: Cycles and Patterns in the Solar System

This topic focuses on the characteristics, cycles and patterns in the solar system and within the universe.

CONTENT STATEMENT

The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics.

The distance from the sun, size, composition and movement of each planet are unique. Planets revolve around the sun in elliptical orbits. Some of the planets have moons and/or debris that orbit them. Comets, asteroids and meteoroids orbit the sun.



Note: The shape of Earth's orbit is nearly circular (also true for other planets). Many graphics that illustrate the orbit overemphasize the elliptical shape, leading to the misconception regarding seasonal change being related to how close Earth is to the sun. The discussion of planet characteristics should be at an introductory level for this grade.

CONTENT ELABORATION

Prior Concepts Related to Solar System

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 in the sky changes in a single day and from day to day and the sun is the principal source of energy. Earth's atmosphere is discussed.

Grades 3-4: All objects are made of matter and light is a form of energy. Earth's surface is discussed and gravitational forces are introduced.

Grade 5 Concepts

Eight major planets in the solar system orbit the sun. Some of the planets have a moon or moons that orbit them. Earth is a planet that has a moon that orbits it. The planets orbits are because of their gravitational attraction to the sun. Moons orbit around planets because of their gravitational attraction to the planets.

Asteroids are metallic, rocky bodies that orbit the sun but are too small to be classified as a planet. A meteor appears when a particle or chunk of metallic or stony matter called a meteoroid enters Earth's atmosphere from outer space. Comets are a mixture of ices (both water and frozen gases) that are not part of a planet. Pluto is classified as a dwarf planet (definition from <http://www.nasa.gov>).

Note: Additional information about gravity is found in PS grade 5. General information regarding planetary positions, orbital patterns, planetary composition and recent discoveries and projects (e.g., missions to Mars) are included in this content. Tools and technology are an essential part of understanding the workings within the solar system.

Grades 6-8: The interior and exterior composition of Earth, Earth's unique atmosphere, light waves, electromagnetic waves, interactions between the Earth, moon and sun, and gravitational forces are explored in more depth.

Future Application of Concepts

High School: Galaxies, stars and the universe are studied in the physical sciences.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 5

EARTH AND SPACE SCIENCE (ESS)

Topic: Cycles and Patterns in the Solar System

This topic focuses on the characteristics, cycles and patterns in the solar system and within the universe.

CONTENT STATEMENT

Prior Concepts Related to Sun

The sun is one of many stars that exist in the universe.

The sun appears to be the largest star in the sky because it is the closest star to Earth. Some stars are larger than the sun and some stars are smaller than the sun.



PreK-2: The sun can be observed at different times of the day or night. The sun's position in the sky changes in a single day and from day to day. The sun is the principal source of energy.

Grades 3-4: All objects are made of matter. Heat and light are forms of energy. Gravitational forces are introduced.

Grade 5 Concepts

The sun is the closest star to the Earth. Scaled models (3-D or virtual) and graphics can be used to show the vast difference in size between the sun and the Earth. The sun is a medium-sized star and is the only star in our solar system. There are many other stars of different sizes in the universe. Stars appear in patterns called constellations, which can be used for navigation. Because they are so far away, they do not appear as large as the sun.

Grades 6-8: General facts about the size and composition of the sun are introduced. Details (e.g., age of the sun, specific composition, temperature values) are above grade level. The emphasis should be on general characteristics of stars and beginning to understand the size and distance of the sun in relationship to the Earth and other planets.

Current and new discoveries related to stars and the sun must be included.

Future Application of Concepts

Grades 6-8: Earth's unique atmosphere, light waves, electromagnetic waves, interactions between the Earth, moon and sun (including the phases of the moon and tides), and gravitational forces are explored in more depth.

High School: Galaxies, stars and the universe are studied in the Physical Sciences.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 5

EARTH AND SPACE SCIENCE (ESS)

Topic: Cycles and Patterns in the Solar System

This topic focuses on the characteristics, cycles and patterns in the solar system and within the universe.

CONTENT STATEMENT

Most of the cycles and patterns of motion between the Earth and sun are predictable.

Grade 5 Concepts
Earth's revolution around the sun takes approximately 365 days. Earth completes one rotation on its axis in a 24-hour period, producing day and night. This rotation makes the sun, stars and moon appear to change position in the sky. Earth's axis is tilted at an angle of 23.5°. This tilt, along with Earth's revolution around the sun, affects the amount of direct sunlight that the Earth receives in a single day and throughout the year. The average daily temperature is related to the amount of direct sunlight received. Changes in average temperature throughout the year are identified as seasons.



Note 1: The amount of direct sunlight that Earth receives is related to the altitude of the sun, which affects the angle of the sun's rays, and the amount of time the sun is above the horizon each day.

Note 2: Different regions around the world have seasonal changes that are not based solely on average temperatures (e.g., rainy season, dry season, monsoon season).

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 5

LIFE SCIENCE (LS)

Topic: Interconnections within Ecosystems

This topic focuses on foundational knowledge of the structures and functions of ecosystems.

CONTENT STATEMENT

Organisms perform a variety of roles in an ecosystem.

Populations of organisms can be categorized by how they acquire energy.

Food webs can be used to identify the relationships among producers, consumers and decomposers in an ecosystem.



CONTENT ELABORATION

Prior Concepts Related to Behavior, Growth and Changes

PreK-2: Plants get energy from sunlight. Animals get energy from plants and other animals. Living things cause changes on Earth.

Grade 5 Concepts

The content statements for fifth-grade life science are each partial components of a larger concept. The parts have been isolated to call attention to the depth of knowledge required to build to one of biology's foundational theories: dynamic relationships within ecosystems. It is recommended that the content statements be combined and taught as a whole. For example, it is important that the ecological role of organisms is interwoven with a clear understanding that all living things require energy.

Plants and some microorganisms are producers. They are the foundation of the food web. Producers transform energy from the sun and make food through a process called photosynthesis. Animals get their energy by eating plants and other animals that eat plants. Animals are consumers and many form predator-prey relationships. Decomposers (primarily bacteria and fungi) are consumers that use waste materials and dead organisms for food. Decomposers also return nutrients to the ecosystem.

One way ecosystem populations interact is centered on relationships for obtaining energy. Food webs are defined in many ways, including as a scheme of feeding relationships, which resemble a web. This web serves as a model for feeding relationships of member species within a biological community. Members of a species may occupy different positions during their lives. Food chains and webs are schematic representations of real-world interactions. For this grade level, it is enough to recognize that food webs represent an intertwining of food chains within the same biological community. See the next content statement for details on grade-appropriate food webs.

Organisms have symbiotic relationships in which individuals of one species are dependent upon individuals of another species for survival. Symbiotic relationships can be categorized as mutualism where both species benefit, commensalism where one species benefits and the other is unaffected, and parasitism where one species benefits and the other is harmed.

Investigations of locally threatened or endangered species must be conducted and include considerations of the effects of remediation programs, species loss and the introduction of new species on the local environment.

Note: At this grade, **species can be defined by using Ernst Mayr's definition "groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups."** Assessments will not include the definition of species.

Future Application of Concepts

Grades 6-8: The importance of biodiversity within an ecosystem is explored.

High School: The concepts of evolution and biodiversity are explored.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 5

LIFE SCIENCE (LS)

Topic: Interconnections within Ecosystems

This topic focuses on foundational knowledge of the structures and functions of ecosystems.

CONTENT STATEMENT

All of the processes that take place within organisms require energy.

For ecosystems, the major source of energy is sunlight.

Energy entering ecosystems as sunlight is transferred and transformed by producers into energy that organisms use through the process of photosynthesis. That energy then passes from organism to organism as illustrated in food webs.

In most ecosystems, energy derived from the sun is transferred and transformed into energy that organisms use by the process of photosynthesis in plants and other photosynthetic organisms.

CONTENT ELABORATION

Prior Concepts Related to Behavior, Growth and Changes

PreK-2: Living things have basic needs, which are met by obtaining materials from physical environments.

Grade 5 Concepts

The content statements for fifth-grade life science are each partial components of a larger concept. The parts have been isolated to call attention to the depth of knowledge required to build to one of biology's foundational theories: dynamic relationships within ecosystems. It is recommended that the content statements be combined and taught as a whole. For example, it is important that the ecological role of organisms is interwoven with a clear understanding that all living things require energy. Virtual simulations and investigations can help demonstrate energy flow through the trophic levels.

Energy flows through an ecosystem in one direction, from photosynthetic organisms to consumers (herbivores, omnivores to carnivores) and decomposers. The exchange of energy that occurs in an ecosystem can be represented as a food web. The exchange of energy in an ecosystem is essential because all processes of life for all organisms require a continual supply of energy.

Satellite imaging, remote sensing or other digital-research formats can be used to help visualize what happens in an ecosystem when new producers (e.g., Tamarisk plants) are introduced into an ecosystem. The information gained should be used to determine the relationship between the producers and consumers within an ecosystem.

Future Application of Concepts

Grades 6-8: Concepts will build for an understanding of the interdependencies and interrelationships of organisms that are required to build stability in an ecosystem.

High School: Photosynthesis will be introduced.

Note: The chemical details of photosynthesis will be addressed in grade 10. This is just an introduction of the process, not the details of the process.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 5

PHYSICAL SCIENCE (PS)

Topic: Light, Sound and Motion

This topic focuses on the forces that affect motion. This includes the relationship between the change in speed of an object, the amount of force applied and the ‘mass’ of the object. Light and sound are explored as forms of energy that move in predictable ways, depending on the matter through which they move.

CONTENT STATEMENT

The amount of change in movement of an object is based on the ‘mass’ of the object and the amount of force exerted.

Movement can be measured by speed. The speed of an object is calculated by determining the distance (d) traveled in a period of time (t).

Earth pulls down on all objects with a gravitational force. Weight is a measure of the gravitational force between an object and the Earth.

Any change in speed or direction of an object requires a force and is affected by the ‘mass’ of the object and the amount of force applied.

Note 1: Gravity and magnetism are introduced (through observation) in PS grade 2.

*While mass is the scientifically correct term to use in this context, the NAEF 2009 Science Framework page 271 recommends using the more familiar term “weight” in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.

CONTENT ELABORATION

Prior Concepts Related to Force and Motion

PreK-2: Motion is described as a change in position. Forces are introduced as pushes and pulls. Forces are needed to change the motion of objects. Greater force on an object results in a greater change of motion.

Grades 3-4: Forces in nature are responsible for water movement, wind movement and movement of sediment through the process of erosion (ESS).

Grade 5 Concepts:

The motion of an object can change by speeding up, slowing down or changing direction. Forces cause changes in motion. If a force is applied in the same direction of an object’s motion, the speed will increase. If a force is applied in the opposite direction of an object’s motion, the speed will decrease. Generally, the greater the force acting on an object, the greater the change in motion. Generally, the more mass an object has, the less influence a given force will have on its motion. If no forces act on an object, the object does not change its motion and moves at constant speed in a given direction. If an object is not moving and no force acts on it, the object will remain at rest.

Movement is measured by speed (how fast or slow the movement is). Speed is measured by time and distance traveled (how long it took the object to go a specific distance). Speed is calculated by dividing distance by time. Speed must be investigated through testing and experimentation. Real-world settings are recommended for the investigations when possible. Virtual investigations and simulations also can be used to demonstrate speed.

An object that moves with constant speed travels the same distance in each successive unit of time. In the same amount of time, a faster object moves a greater distance than a slower object. When an object is speeding up, the distance it travels increases with each successive unit of time. When an object is slowing down, the distance it travels decreases with each successive unit of time.

Speed must be explored and tested through investigations 3-D or virtual inside and outside of the classroom. Video technology can be used to stop movement and measure changes at different steps in the investigations.

Note 1: This content can be taught in conjunction with the following ESS content: Everything on or anywhere near Earth is pulled toward Earth's center by gravitational force. Weight is a measure of this force. The planets are kept in orbit due to their gravitational attraction for the sun.

Note 2: While concepts are related to Newton’s second law, remain conceptual at this grade. Knowing the name of the law is not required. Memorizing and reciting words to describe Newton’s second law is not appropriate.

Note 3: Although mathematics is applied to the concept of speed at this grade level, its use should support deeper understanding of the concept of speed and not be taught as the primary definition of speed.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)**Future Application of Concepts**

Grades 6-8: Force and Motion involve both magnitude and direction. Two equal forces in opposite directions can give a net force of zero. Position vs. time and speed vs. time graphs are used to represent motion. Fields are introduced for forces that act over a distance.

High School: Newton's second law is used to solve mathematical problems in one and two dimensions.

*While mass is the scientifically correct term to use in this context, the NAEF 2019 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

This section provides examples of tasks that students may perform; this includes guidance for developing classroom performance tasks. It is not an all-inclusive checklist of what should be done, but is a springboard for generating innovative ideas.

DESIGNING TECHNOLOGICAL / ENGINEERING SOLUTIONS USING SCIENCE CONCEPTS	DEMONSTRATING SCIENCE KNOWLEDGE	INTERPRETING AND COMMUNICATING SCIENCE CONCEPTS	RECALLING ACCURATE SCIENCE

Investigate changes in motion.

- Plan and implement a scientific experiment that determines how the mass* of an object (or amount of force acting on an object) affects how the motion of an object changes.
- Analyze the data to determine trends.
- Formulate a conclusion.



Represent the data graphically.



- Recognize that increasing the force acting on an object will result in greater changes in motion.
- Recognize that objects with greater mass* will change their motion less than objects with less mass*.

[BACK TO INDEX](#)
[BACK TO K-8 INDEX](#)

MODEL CURRICULUM GRADE 5

PHYSICAL SCIENCE (PS)

Topic: Light, Sound and Motion

This topic focuses on the forces that affect motion. This includes the relationship between the change in speed of an object, the amount of force applied and the mass* of the object. Light and sound are explored as forms of energy that move in predictable ways, depending on the matter through which they move.

*While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.

CONTENT STATEMENT

Light and sound are forms of energy that behave in predictable ways.

Light travels and maintains its direction until it interacts with an object or moves from one medium to another and then it can be reflected, refracted or absorbed.

Sound is produced by vibrating objects and requires a medium through which to travel. The rate of vibration is related to the pitch of the sound.

Note: At this grade level, the discussion of light and sound should be based on observable behavior. Waves are introduced at the middle school level.

CONTENT ELABORATION

Prior Concepts Related to Light and Sound

PreK-2: Sound is related to vibrations (PS). The moon, sun and stars are visible at different times. The sun is the principal source of energy. Sunlight affects the warming and cooling of air, water and land (ESS).

Grades 3-4: Objects with energy can cause motion or create change. Energy can transfer between objects and locations. Light energy from the sun can cause plants to grow (LS).

Grade 5 Concepts:

Light can travel through some materials, such as glass or water. Light also can travel through empty space, like from the sun to Earth. When light travels from one location to another, it goes in a straight line until it interacts with another object or material. When light strikes objects through which it cannot pass, shadows are formed. As light reaches a new material, it can be absorbed, refracted, reflected or can continue to travel through the new material; one of these interactions may occur or many may occur simultaneously, depending on the material.

Light can be absorbed by objects, causing them to warm. How much an object's temperature increases depends on the material of the object, the intensity of and the angle at which the light striking its surface, how long the light shines on the object and how much light is absorbed. Investigating and experimenting with temperature changes caused by light striking different surfaces can be virtual or in a lab setting.

When light passes from one material to another, it is often refracted at the boundary between the two materials and travels in a new direction through the new material (medium). For example, a magnifying lens bends light and focuses it toward a single point. A prism bends white light and separates the different colors of light. Experiment with prisms and magnifying lenses to observe the refraction of light.

Visible light may be emitted from an object (like the sun) or reflected by an object (like a mirror or the moon). The reflected colors are the only colors visible when looking at an object. For example, a red apple looks red because the red light that hits the apple is reflected while the other colors are absorbed.

Pitch can be changed by changing how fast an object vibrates. Objects that vibrate slowly produce low pitches; objects that vibrate quickly produce high pitches. Audible sound can only be detected within a certain range of pitches. Sound must travel through a material (medium) to move from one place to another. This medium may be a solid, liquid or gas. Sound travels at different speeds through different media. Once sound is produced, it travels outward in all directions until it reaches a different medium. When it encounters this new medium, the sound can continue traveling through the new medium, become absorbed by the new medium, bounce back into the original medium (reflected) or engage in some combination of these possibilities.

[BACK TO INDEX](#)[BACK TO K-8 INDEX](#)

Light travels faster than sound. Technology and virtual simulations and models can help demonstrate movement of light and sound. Experimentation, testing and investigation (3-D or virtual) are essential components of learning about light and sound properties.

Note: Students are not responsible for knowing the additive rules for color mixing of light other than the fact that white light is a mixture of many colors. The wave nature of sound and light are not introduced at this level nor are parts of the electromagnetic spectrum other than visible light. At this grade, how sound travels through the medium is not appropriate as atoms and molecules are not introduced until grade 6.

Future Application of Concepts

Grades 6-8: The atomic nature of matter is introduced and energy is classified as kinetic and potential. Waves are introduced. Energy transfer and transformation, and conservation of energy are explored further.

High School: The wave nature of light and sound is expanded upon including mathematical analysis of wavelength, frequency and speed, and the Doppler effect.

EXPECTATIONS FOR LEARNING: COGNITIVE DEMANDS

This section provides definitions for Ohio's science cognitive demands, which are intrinsically related to current understandings and research about how people learn. They provide a structure for teachers and assessment developers to reflect on plans for teaching science, to monitor observable evidence of student learning, and to develop summative assessment of student learning of science.

VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

This section provides examples of tasks that students may perform; this includes guidance for developing classroom performance tasks. It is not an all-inclusive checklist of what should be done, but is a springboard for generating innovative ideas.

DESIGNING TECHNOLOGICAL / ENGINEERING SOLUTIONS USING SCIENCE CONCEPTS	Demonstrating Science Knowledge	Interpreting and Communicating Science Concepts
--	---------------------------------	---

Investigate reflection.

Design a mirror system to use when building a periscope. <http://pbskids.org/zoom/activities/sci/periscope.html>

Plan and implement a scientific investigation to determine the ideal angle to place a reflective surface to bend light through a right angle.

Draw a picture of the periscope design and trace the path of light as it travels from the object to the eye.

Recognize that the angle that light approaches a reflective surface affects the direction in which the light is reflected.

Note: Many different ideas for building the exterior structure of the periscope can be found at <http://www.scientotymaker.org/periscope/index.html>. However, please note that in order to meet this cognitive demand, students must be able to experiment to determine the placement of the mirrors. Instructions on how the teacher can make inexpensive mirrors out of old CDs and DVDs can be found at <http://www.scientotymaker.org/periscope/asmbLCD.htm>