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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.

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.

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: 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.

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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
Design and construct a pond, water garden or a wetland environment in a terrarium. Evaluate different soil types to ensure that the chosen soil is able to hold water and support plant life. Present the explanation of the process and the findings to the class. **Note: Must use the soil properties investigated to make these determinations.**	Plan and implement an investigation to test specific properties of different types of soil, such as ability to absorb (hold) water, matching/designating soil color, the ability for water to pass through the soil, the filtering properties of soil. **Note: A similar investigation can be conducted for the characteristics of rocks.**	Make a chart, identification key or a local soil map that can be used to interpret soil composition (sand, silt, clay organic material) and/or compare soil types (based on soil properties). **Note: A similar chart or map can be made for the characteristics of rocks.**	Identify rock, soil, air and water as examples of non-living resources. Recognize that soil can have different texture, composition or color depending on the environment in which it formed.
	Plan and build a simple sediment tube that can demonstrate how sand, silt, clay and organic material settle in water. Based on the findings, ask: *Which soil type would create muddy water in a stream? Which soil type would wash away faster/farther? What properties of soil contribute to these observations?*	Make a dichotomous key to organize different types of rocks by grain size, texture, color or patterns. Graphically represent and clarify the sorted results.	Recall that rocks can be sorted based on characteristics such as grain-size (texture), color and patterns.

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INSTRUCTIONAL STRATEGIES AND RESOURCES

This section provides additional support and information for educators. These are strategies for actively engaging students with the topic and for providing hands-on, minds-on observation and exploration of the topic, including authentic data resources for scientific inquiry, experimentation and problem-based tasks that incorporate technology and technological and engineering design. Resources selected are printed or Web-based materials that directly relate to the particular Content Statement. It is not intended to be a prescriptive list of lessons.

- Conducting student-led experiments, research and investigations to test soil properties is an important way to allow students to explore and learn about all aspects of soil. The **GLOBE Program** provides examples, data and resources to test specific types of soil and soil properties for elementary students. There also are opportunities to connect to other classrooms and compare soil data.
- The **Ohio Department of Natural Resources'** Soil and Water Conservation Division provides resources and support to teach about soil and properties of soil to elementary students. This page provides examples of soil profiling, how to conduct soils tests and maps of local soils (including a ***Web Soil Survey*** feature that allows students to locate the soil types in their own backyards or at their schools.
- The **Soil Science Society of America** provides information about soils, testing the properties of soil and what soil scientists do. It also provides links to educational resources for soils. There are numerous age-appropriate resources that can support the teaching of soils in the third-grade classroom.
- **NASA** developed a program called ***Dr. Soil*** that includes numerous references, resources and lab activities to help support the teaching of soil to young students.
- Encouraging student rock collections to create classroom sample sets can connect nature to the classroom. **ODNR** provides helpful resources and geologic maps that can be used to study landforms and surface geology of Ohio. The surface geology map can be used to determine the types of rocks that may be found in the local areas (near the school) and to assist in field collections or discussions. **GeoFacts** is another site within ODNR that provides geologic facts related to Ohio.

COMMON MISCONCEPTIONS

- Funded by the National Science Foundation, ***Beyond Penguins and Polar Bears*** is an online magazine for K-5 teachers. It provides some common misconceptions about sorting rocks at early elementary levels, which can begin at the preschool level when children may think that size or color should be used to identify types of rocks. For common misconceptions about rocks and minerals, visit **http://beyondpenguins.nsdl.org/issue/column.php?date=September2008&departmentid=professional&columnid=professional!misconceptions**.
- Students often think soil is alive. While living things live in soil and organic soil is composed of once-living things, they need to understand that soil itself is not alive.
- Students may think soil type is determined by color. Soil type is actually determined based on particle size. Color is dependent upon the rock type from which the soil is formed over time.

DIVERSE LEARNERS

Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at **this site**. Resources based on the Universal Design for Learning principles are available at **www.cast.org**.

CLASSROOM PORTALS

These are windows into the classroom through webcasts, podcasts or video clips to exemplify and model classroom methods of teaching science using inquiry.

A series of case studies of K-8 science classrooms by the Smithsonian and Harvard University can be found at **http://www.learner.org/resources/series21.html**. Teachers need to sign up to use this free site. The case study ***Erien, Year One–Grade 5*** is an example of how to conduct soil profiling in an elementary class setting. Of particular interest are the questioning techniques that Erien uses with her students to generate interest.

The Annenberg Foundation offers training modules that support Earth and Space Sciences for K-4 teachers. There are numerous resources and video clips of actual classroom practices that can be useful training tools at **http://www.learner.org/resources/series195.html**.

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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

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VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

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DESIGNING TECHNOLOGICAL/ ENGINEERING SOLUTIONS USING SCIENCE CONCEPTS	DEMONSTRATING SCIENCE KNOWLEDGE	INTERPRETING AND COMMUNICATING SCIENCE CONCEPTS	RECALLING ACCURATE SCIENCE
Research, design and/or construct a model of a simple energy collection system for a specific location (use locations in Ohio or areas near water/ prairies/rivers/mountains). Provide a selection of everyday materials for the model (rather than a preplanned kit), such as PVC piping and Mylar to make a windmill or water wheel to allow student-led investigation and design.	Develop a plan to determine the most effective method of collecting renewable energy (e.g., shapes/number/materials used in wind or water turbines, locations that allow solar panels to collect the most energy from the sun).	Research the efficiency and cost of different types of energy resources (renewable and/or nonrenewable). Compare and contrast the findings. Present or discuss findings with the class.	Recognize the differences between renewable and nonrenewable energy. Be able to provide examples of each.

INSTRUCTIONAL STRATEGIES AND RESOURCES

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- To understand the relationship between energy and wind, the **Texas Energy Conservation Office** developed fact sheets and other resources for elementary students and teachers. There also are ideas for activities and projects, all related to renewable energy.
- The **National Renewable Energy Laboratory** provides links to elementary wind programs (like KidWind and Wind for Schools) and resources and support for teaching about wind and wind turbines. There is information about national challenges for building wind turbine models at different grade levels and links to learn about solar energy and the relationship of solar and wind energy.
- The **National Energy Education Development Project** provides online information about energy sources at the primary grades, offers free downloads of primary books, and supports the teaching of a variety of energy resources, inquiry-based labs and experiments.
- Hydrologic power basics (at the teacher level) can be found at the **USGS** website. This basic information can be adapted to an observational level for students in grade 3. Building simple water turbines can be a good way to explore this renewable energy resource.
- Combine/integrate energy resources with PS grade 3 to learn about different forms of energy.

Career Connection

Students will explore the concept of "green jobs", by identifying careers, organizations, and policies that reflect the conservation of energy or utilization of alternative energy sources. They may focus on aspects of green jobs such as wind, solar, and wave, energy, renewable materials, transportation, and buildings and structures that conserve energy. Additional information about green jobs is available at: **http://www.bls.gov/green/**.

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COMMON MISCONCEPTIONS

- **Misconceptions about fossil fuels** and energy resources are common. Use effective questioning to help understand preconceptions that elementary students may have about energy resources and address the misconceptions.
- Students may have difficulty differentiating between renewable and nonrenewable resources. Providing investigations and local (Ohio) examples can help students make the connections needed for this understanding. For a teacher fact sheet with important examples to support this content statement and to ensure that misconceptions are addressed, see **http://www.epa.gov/osw/education/quest/pdfs/unit1/chap1/u1_natresources.pdf**.

DIVERSE LEARNERS

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CLASSROOM PORTALS

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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.

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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
Design and carry out a plan to reduce the use of specific resources at the school, school district or local community. Data collection can include water use, paper use, soil erosion, composting (food waste), hazardous waste and examination of the types of programs available in the local area. Once data is analyzed and plans are chosen, present findings to school and/or community officials.	Plan and implement an investigation to collect and analyze data pertaining to the school's recycling rate to determine what types of materials have a high recycling rate and which have low rates (and reasons why). Graph and present the findings to school administrators or community officials.	Research different types of recycling (paper, plastics, metals, glass) and make a comparison table to document methods, effectiveness, recycling rates, benefits and/or problems.	Recognize that some of Earth's resources are limited and need to be conserved.

INSTRUCTIONAL STRATEGIES AND RESOURCES

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- The **National Institute of Environmental Health Sciences** offers support for teaching about recycling, reducing waste and reusing materials for elementary-aged students. Sign up for a newsletter to keep abreast of current events related to reducing, reusing and recycling materials.
- The **EPA** provides educational resources for primary students pertaining to Earth's resources, including background information, project ideas, starting up school recycling programs, how to reduce material use, challenges/contests for student participation and recycling clubs for K-5 students.
- The **Ohio Department of Natural Resources** provides a recycling guide for Ohio with an explanation of what and how things can be recycled in Ohio.
- The **Ohio EPA** provides lists of educational projects and educational opportunities that address Earth's resources. The lists can be used as idea starters and for inquiry-based student projects and provide contact information for teacher training.
- NSTA provides learning modules called SciPacks that are designed to increase teacher content knowledge through inquiry-based modules. This module addresses **Earth's Resources**.
- The **National Energy Education Development Project** provides online information about energy sources at the primary grades, offers free downloads of primary books, and supports the teaching of a variety of energy resources, inquiry-based labs and experiments.
- Take a field trip to a local landfill, recycling center, factory/industry that makes materials such as glass or metal or go to a water treatment facility to learn about the cycling of materials from production to disposal. **SWACO** offers fieldtrips, as do many landfill facilities.

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COMMON MISCONCEPTIONS

- A common misconception is that as long as an item is recycled there is no need to limit the use of that item. It is important that students know that it is always better to reduce or limit the use of a resource than to use and recycle. Recycling requires energy resources and also can create other unintended issues (due to the recycling process). By investigating the efficiency of recycling, students can begin to understand that many resources are limited and cannot be effectively recycled after use.
- **Misconceptions about fossil fuels** and energy resources are common. Use effective questioning to help understand preconceptions that elementary students may have about energy resources and address the misconceptions.

DIVERSE LEARNERS

Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at **this site**. Resources based on the Universal Design for Learning principles are available at **www.cast.org**.

CLASSROOM PORTALS

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The Annenberg Foundation offers training modules that support Earth and Space Sciences for K-4 teachers. There are numerous resources and video clips of actual classroom practices that can be useful training tools at **http://www.learner.org/resources/series195.html**.

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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.

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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
Design an enriched environment that will support a classroom pet. Provide for all of its needs. The Smithsonian National Zoological Park states, "Environmental enrichment is the process of providing stimulating environments for Zoo animals in order for them to demonstrate their species-typical behavior, to allow them to exercise control or choice over their environment and to enhance their wellbeing." Find more about animal environment enrichment at **http://nationalzoo.si.edu/SCBI/AnimalEnrichment/default.cfm**.	Conduct a real-time observational study of a familial grouping of organisms. Use webcams to view animals in their natural habitat or simulated environments to observe and record physical characteristics of the animals as well as behavioral traits that are taught from parent to offspring. Falcon cams are used by the Ohio Department of Natural Resources and can be used for this study at **http://ohiodnr.com/wildlife/dow/falcons/Default.aspx**.	Based on data from Demonstrating Science Knowledge, develop a chart that compares features such as stages of development, food sources, where it is found in the environment, and physical appearance to emphasize the similarity and differences between offspring and parents.	Give examples of variations among individuals of a local population of dandelions (e.g., height, color, weight).

INSTRUCTIONAL STRATEGIES AND RESOURCES

This section provides additional support and information for educators. These are strategies for actively engaging students with the topic and for providing hands-on, minds-on observation and exploration of the topic, including authentic data resources for scientific inquiry, experimentation and problem-based tasks that incorporate technology and technological and engineering design. Resources selected are printed or Web-based materials that directly relate to the particular Content Statement. It is not intended to be a prescriptive list of lessons.

- Use webcams to view animals in their natural habitat or simulated environments to observe and record physical characteristics of the animals as well as behavioral traits that are taught from parent to offspring. **Falcon cams** are used by the Ohio Department of Natural Resources and can be used for this study. The **North American Bear Center** and the **International Wolf Center** also have webcams that can be used to study animals in their habitat.
- The Annenberg Media series **Essential Science for Teachers: Life Science: Session 3 and 4** provides information about how children can learn about the life cycles of animals and offers classroom footage to illustrate implementation.
- *Project Wild* was developed through a joint effort of the Western Association of Fish and Wildlife Agencies and the Council for Environmental Education. This program helps students learn basic concepts about wild animals, their needs and importance and their relationships to people and the environment. The activity guides are available to educators free of charge when they attend a workshop. Information about upcoming workshops are available on the **ODNR Website**. In the *Aquatic Project Wild activity, Are You Me?* students match picture cards into juvenile and adult aquatic animal pairs.

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COMMON MISCONCEPTIONS

- The Annenberg Media series **Essential Science for Teachers** can be used to provide greater detail on life cycles within the elementary curriculum and misconceptions students may have about various traits.

DIVERSE LEARNERS

Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at **this site**. Resources based on the Universal Design for Learning principles are available at **www.cast.org**.

- Many ***Project Wild*** activities feature Universal Design for Learning principals by providing multiple means of concept representation; means of physically interacting with materials; and multiple means of engagement, including collaboration and communication. In the ***Aquatic Project Wild activity, Are You Me?*** students match picture cards into juvenile and adult aquatic animal pairs.

CLASSROOM PORTALS

These are windows into the classroom through webcasts, podcasts or video clips to exemplify and model classroom methods of teaching science using inquiry.

Sessions 3 and 4 of the Annenberg Media series ***Essential Science for Teachers: Life Science*** provide information about how children can learn about the life cycles of animals and offer classroom footage to illustrate implementation at **http://www.learner.org/resources/series179.html**.

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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. Adaption 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.

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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
In the process of planning an investigation to study the life cycle of a butterfly, evaluate the design of three emergence cages. Evaluate each cage using scientific knowledge about the needs of butterflies. Using the information from the study, design and build an "improved" butterfly emergence cage. Learn more at **http://monarchwatch.org/rear/cages.htm**. 	Plan and conduct an experiment to find out the optimal conditions for seed germination. Include in the conclusions scientific information about why not all seeds germinated. 	Write a report explaining how the behavioral or physical characteristic is an advantage of a specific animal or plant for surviving in its environment (e.g., ***what adaptations does a pine tree have for living in colder environments?***) 	Name some physical features of plants and animals that are associated with the environment in which they live (e.g., coloration, location of eyes, type of feet). 
		Conduct a comparative study of a population of plants in the school yard, measure and compare some of the following: root size (width and depth) leaf size (length and width) flower color, number of petals, time of year when plant blooms, number of seeds produced or when seeds are produced. 	

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INSTRUCTIONAL STRATEGIES AND RESOURCES

This section provides additional support and information for educators. These are strategies for actively engaging students with the topic and for providing hands-on, minds-on observation and exploration of the topic, including authentic data resources for scientific inquiry, experimentation and problem-based tasks that incorporate technology and technological and engineering design. Resources selected are printed or Web-based materials that directly relate to the particular Content Statement. It is not intended to be a prescriptive list of lessons.

- *Smithsonian Biodiversity Science in the Classroom: Teach, Learn, Explore, Observe and Inquire* illustrates how to set up a **meter square investigation** so that children can conduct an investigation by documenting seasonal changes in their local area.
- **Monarchwatch.org** provides guidance on how to hatch and raise butterflies for classroom observations of the life cycle. Additional information about **emergence cages** also can be found on this site.
- The program **One Species at a Time** allows an audio tour of the wonders of nature by examining a variety of life forms through stories and ways to hone backyard observation skills. This program is developed by the Encyclopedia of Life and Atlantic Public Media.
- *Project Wild* was developed through a joint effort of the Western Association of Fish and Wildlife Agencies and the Council for Environmental Education. This program helps students learn basic concepts about wild animals, their needs and importance and their relationships to people and the environment. The activity guides are available to educators free of charge when they attend a workshop. Information about upcoming workshops are available on the **ODNR Website**. In the activity *Thicket Game* students illustrate animal survival adaptations through a game of hide and seek. In *Quick Frozen Critters* students illustrate animal survival adaptations through a game of freeze tag.

COMMON MISCONCEPTIONS

- The Annenberg Media series **Essential Science for Teachers** can be used to provide greater detail on life cycles within the elementary curriculum and misconceptions students may have about various traits.

DIVERSE LEARNERS

Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at **this site**. Resources based on the Universal Design for Learning principles are available at **www.cast.org**.

- Many *Project Wild* activities feature Universal Design for Learning principals by providing multiple means of concept representation; means of physically interacting with materials; and multiple means of engagement, including collaboration and communication. In the activity *Thicket Game* students illustrate animal survival adaptations through a game of hide and seek. In *Quick Frozen Critters* students illustrate animal survival adaptations through a game of freeze tag.

CLASSROOM PORTALS

These are windows into the classroom through webcasts, podcasts or video clips to exemplify and model classroom methods of teaching science using inquiry.

Sessions 3 and 4 of the Annenberg Media series *Essential Science for Teachers: Life Science* provide information about how children can learn about the life cycles of animals and offer classroom footage to illustrate implementation at **http://www.learner.org/resources/series179.html**.

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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.

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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
In the process of planning an investigation to study the life cycle of a butterfly, evaluate the design of three emergence cages. Evaluate each cage using scientific knowledge about the needs of butterflies. Using the information from the study, design and build an "improved" butterfly emergence cage. Learn more at **http://monarchwatch.org/rear/cages.htm**.	Plan and conduct an experiment to find out the optimal conditions for seed germination. Include in the conclusions scientific information about why not all seeds germinated.	Explain why some animals have offspring in the spring and some plants produce seeds in the fall.	Given labeled photographs of stages of animal or plant life cycles, place them in sequence from egg to adult.

INSTRUCTIONAL STRATEGIES AND RESOURCES

This section provides additional support and information for educators. These are strategies for actively engaging students with the topic and for providing hands-on, minds-on observation and exploration of the topic, including authentic data resources for scientific inquiry, experimentation and problem-based tasks that incorporate technology and technological and engineering design. Resources selected are printed or Web-based materials that directly relate to the particular Content Statement. It is not intended to be a prescriptive list of lessons.

- ODNR-Division of Wildlife's **A to Z Species Guide** has photos, information, tracks and sounds of Ohio's wild animals
- Explore how organisms reproduce, grow and find shelter in habitats around the world. The **National Geographic website** for kids houses information about the life cycles of animals from around the world. **The National Wildlife Federation** features Ranger Rick, with links to a variety of different types of wildlife. Plants and animals are featured in their natural habitats and their life cycles can be explored though stories and pictures.
- The life cycle of organisms can be observed in the classroom or virtually via **The Children's Butterfly Site**, or other grade-appropriate sources of information on the life cycle of organisms **http://www.learningscience.org/lsc1blifecycles.htm**. These sites include local, national and international projects and interactive games that **explore various organisms**.
- Sessions 3 and 4 of the Annenberg Media series *Essential Science for Teachers: Life Science* provide information about how children can learn about the life cycles of animals and offer classroom footage to illustrate implementation at **http://www.learner.org/resources/series179.html**.

COMMON MISCONCEPTIONS

- The Annenberg Media series **Essential Science for Teachers** can be used to provide greater detail on life cycles within the elementary curriculum and misconceptions students may have about various traits.

DIVERSE LEARNERS

Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at **this site**. Resources based on the Universal Design for Learning principles are available at **www.cast.org**.

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CLASSROOM PORTALS

These are windows into the classroom through webcasts, podcasts or video clips to exemplify and model classroom methods of teaching science using inquiry.

Session 5 of the Annenberg Media series ***Essential Science for Teachers: Life Science*** provides information about how children can learn about the variations of living things and offers classroom footage to illustrate implementation at **http://www.learner.org/resources/series179.html**.

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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:

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.

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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
Draw conclusions to characterize types of matter based on observations made from experimental evidence.			
Investigate the parts of a (classroom-made) lava lamp exhibit when various conditions (e.g., temperature, size of bottle) are changed and record the results. Compare how the findings can apply to a real-world scenario (e.g., responding to an oil spill in different climates or parts of the world). **Note: This is not a kit. For directions on constructing the lava lamp, visit http://www.sciencebob.com/experiments/lavalamp.php**	Given three different items, measure as many properties for each item as possible. Record the measurements for each item on a separate index card. Switch samples with another group and identify which set of measurements belong with which item.	Distinguish between weight and volume. Represent the differences in words and visual models.	Name observable differences between the three states of matter.
		Investigate an ice balloon and the various conditions that affect the rate at which the ice melts, using the **Ice Balloon Investigation**.	Recognize that matter continues to exist when broken into pieces too tiny to be visible.

INSTRUCTIONAL STRATEGIES AND RESOURCES

This section provides additional support and information for educators. These are strategies for actively engaging students with the topic and for providing hands-on, minds-on observation and exploration of the topic, including authentic data resources for scientific inquiry, experimentation and problem-based tasks that incorporate technology and technological and engineering design. Resources selected are printed or Web-based materials that directly relate to the particular Content Statement. It is not intended to be a prescriptive list of lessons.

- **Essential Science for Teachers: Physical Science: Session 1: Matter**, a video on demand produced by Annenberg, explores the concept of matter with elementary children and teachers. The segment includes defining matter and exploring properties and states of matter. It incorporates interviews with children and classroom segments to identify common misconceptions and gives teaching strategies to address these misconceptions. While the segment on plasma is interesting, it is content beyond this grade level.

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COMMON MISCONCEPTIONS

- From a time of 3:15 to 16:40, this video on demand produced by Annenberg shows individual interviews with children that highlight **common misconceptions about what is matter** (e.g., air is not matter) and ways that this can be addressed in the classroom.
- Kind (2004) cites that students think matter has no permanent aspect. When matter disappears from sight (e.g., when sugar dissolves in water), it ceases to exist.
- Students often think of solids at matter, but not liquids and gases (AAAS, 1993).
- Kind (2004, p.8) cites that children do not reason consistently. They may use sensory reasoning on some occasions and logical reasoning on others. Sensory experience dominates in cases where matter is not visible.
- Students often think that:
  - **Measurement is only linear.**
  - Any quantity can be measured as accurately as you want.
  - Some objects cannot be measured because of their size or inaccessibility.
  - The five senses are infallible.
  - **Gases are not matter** because most are invisible.
  - Gases do not have mass.
  - Air and oxygen are the same gas.
  - Helium and hot air are the same gas.
  - Materials can only exhibit properties of one state of matter.
  - Melting/freezing and boiling/condensation are often understood only in terms of water.
  - Steam is visible water gas molecules.
  - **Materials can** only exhibit properties of one state of matter.
  - Melting and dissolving are confused.
  - Dew formed on the outside of glass comes from the inside of the glass.
  - Gases are not matter because most are invisible.
  - Weight and volume, which both describe an amount of matter, are the same property.
  - Steam is water vapor over boiling water.

DIVERSE LEARNERS

Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at **this site**. Resources based on the Universal Design for Learning principles are available at **www.cast.org**.

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CLASSROOM PORTALS

These are windows into the classroom through webcasts, podcasts or video clips to exemplify and model classroom methods of teaching science using inquiry.

Starting at a time of 9:55 on this video on demand produced by Annenberg, children **test a mixture of unknown powders** to identify what is in the mixture. Children use data and procedures from previous investigations to solve the problem. Jean, an inclusion teacher, talks about classroom management and organization for messy lab activities and the benefits of cooperative learning. The video shows how the teacher helped students who were having difficulties. Notice that the students are asked continually to support their claims with evidence.

Jean, an **inclusion teacher**, helps third-grade students who are having difficulties during classroom inquiry activities in this video on demand, produced by Annenberg. She has been trying to develop multi-sensory approaches to learning science to help a diversity of students, including ESL, inclusion students and other special needs students. Jean talks about classroom management and organization for messy lab activities and the benefits of cooperative learning. The video shows how an inclusion teacher can be used in this lesson.

Select Video 10, *Linda–Grades 2-4*, to see a resource teacher who models **inquiry-based science lessons** in her large urban district. Although not all of the content is directly aligned to this content statement, the strategies could be applied to any content.

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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.

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.

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:

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.

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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
Draw conclusions to characterize types of matter based on observations made from experimental evidence.			
Investigate the parts of a (classroom-made) lava lamp exhibit when various conditions are changed and record the results. Consider how the findings can apply to a real-world scenario (e.g., responding to an oil spill in different climates or parts of the world). **Note: For directions on constructing the lava lamp, visit http://www.sciencebob.com/experiments/lavalamp.php**	Predict the fastest way for ice to form. Design an investigation to determine what parameters ensure the fastest formation (e.g., change temperature of the starting water using cold, room-temperature and very hot water, condition the starting water with salt or sugar, change the starting water by adding food coloring).	Explain why which data sets (e.g., descriptions of various physical properties) match given substances focusing on specific states of matter.	Recognize three different states of matter.

INSTRUCTIONAL STRATEGIES AND RESOURCES

This section provides additional support and information for educators. These are strategies for actively engaging students with the topic and for providing hands-on, minds-on observation and exploration of the topic, including authentic data resources for scientific inquiry, experimentation and problem-based tasks that incorporate technology and technological and engineering design. Resources selected are printed or Web-based materials that directly relate to the particular Content Statement. It is not intended to be a prescriptive list of lessons.

- **Essential Science for Teachers: Physical Science: Session 1: Matter,** a video on demand produced by Annenberg, explores the concept of matter with elementary children and teachers. The segment includes defining matter and exploring properties and states of matter. It incorporates interviews of children and classroom segments to identify common misconceptions and gives teaching strategies to address these misconceptions. While the segment on plasma is interesting, it is content beyond this grade level.
- *Solids and Liquids*, an interactive simulation from BBC Schools, has children **determine the melting point** of different substances to observe the properties of liquids and solids.
- *Changing State* is an interactive simulation from BBC Schools that allows students to heat and cool water and to **observe phase changes**. The optional section dealing with heating the gas further is not aligned to this content statement.
- *Gases Around Us* is an **interactive simulation** from BBC Schools that demonstrates that **gases expand** to fill a container.

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COMMON MISCONCEPTIONS

- **Essential Science for Teachers: Physical Science: Session 1: Matter**, a video on demand produced by Annenberg, explores the concept of matter with elementary children and teachers. The segment from a time of 7:00 to 16:40 shows individual student interviews that highlight common misconceptions about states of matter (e.g., air is not matter) and ways that they can be addressed in the classroom.
- Children often think that:
  - **Measurement is only linear.**
  - Any quantity can be measured as accurately as you want.
  - Some objects cannot be measured because of their size or inaccessibility.
  - The five senses are infallible.
  - **Gases are not matter** because most are invisible.
  - Gases do not have mass.
  - Air and oxygen are the same gas.
  - Helium and hot air are the same gas.
  - Materials can only exhibit properties of one state of matter.
  - Melting/freezing and boiling/condensation are often understood only in terms of water.
  - Steam is visible water gas molecules.
  - **Materials can** only exhibit properties of one state of matter.
  - Melting and dissolving are confused.
  - Dew formed on the outside of glass comes from the inside of the glass.
  - Gases are not matter because most are invisible.
  - Weight and volume, which both describe an amount of matter, are the same property.
  - Steam is the visible cloud of water vapor over boiling water.
- One study showed that some children, ages 5-13, tend to associate solids with rigid materials (Stavy & Stachel, 1984). They regard powders as liquids and any non-rigid materials, such as a sponge or a cloth, as being somewhere in between a solid and liquid (Driver, Squires, Rushworth & Wood-Robinson, 1994).
- Children can classify liquids more easily than they can solids, perhaps because liquids are less varied in their physical characteristics (Kind, 2004).
- Students' explanation of powders as liquids is often "because they can be poured." Reasons for non-rigid objects being neither solid nor liquid are because they "are soft," "crumble," or "can be torn." Children characterized the state of matter of a material according to its macroscopic appearance and behavior with the result that solids are associated with hardness, strength and an inability to bend (Driver et al., 1994).
- Students' understanding of boiling comes before their understanding of evaporation (Keeley, 2005). Driver (1994) states that from a sample of students ages 6-8, 70 percent understood that when water boils, vapor comes from it and that the vapor is made of water; the same students did not recognize that when a wet surface dries, the water turns to water vapor.
- Because students confuse heat and temperature as being the same, they believe that the longer something is heated, the hotter it gets and the boiling point increases the longer it is allowed to boil (Driver et al., 1994).

DIVERSE LEARNERS

Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at **this site**. Resources based on the Universal Design for Learning principles are available at **www.cast.org**.

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CLASSROOM PORTALS

These are windows into the classroom through webcasts, podcasts or video clips to exemplify and model classroom methods of teaching science using inquiry.

Beginning at a time of about 0:50, this video on demand produced by Annenberg explores the **properties of gases, liquids and solids**. Students observe phase changes of water from ice to steam, discuss what they know so far, test the properties of Oobleck to classify its state. Notice the questioning strategy: ***What do you think about that? and Give me reasons for your thinking.***

Ingrid, a first-grade teacher, has children explore the **properties of solids, liquids and gases** through playful explorations. Before the activities, she conducts a class discussion and journal writing to determine what the children already know. After the activities, she surveys children's thoughts about their experiences in a class discussion to come to a consensus about the important properties of solids, liquids and gases.

Essential Science for Teachers: Physical Science Session 1: Matter is another video on demand produced by Annenberg. It explores the concept of matter with elementary children and teachers. The segment from a time of 32:40 to 54:40 shows individual interviews with children about states of matter. Classroom activities show that categories between the states of matter are not always clear-cut. Demonstrations show the differences between liquids and gases.

Jean, a veteran teacher who feels ill prepared to teach science, is featured on this video on demand produced by Annenberg. The beginning of the video shows her leading a classroom lesson in which students **explore different states of matter**. Notice her questioning strategy: ***What do you think about that? and Give me reasons for your thinking.*** The remainder of the video does not align to this standard but shows how she develops multi-sensory approaches to learning science to help a diversity of students, including ESL, inclusion students and other special needs students. Jean talks about classroom management and organization for messy lab activities and the benefits of cooperative learning. The video also shows how an inclusion teacher can be used in this lesson.

Select Video 10, *Linda–Grades 2-4*, to see a resource teacher who models **inquiry-based science lessons** for teachers in her large urban district. Although not all of the content is directly aligned to this content statement, the strategies could be applied to any content.

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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 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.

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.

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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 CONCEPT	DEMONSTRATING SCIENCE KNOWLEDGE	INTERPRETING AND COMMUNICATING SCIENCE CONCEPTS	RECALLING ACCURATE SCIENCE
Investigate ways a pot of warm water can cause motion or create change.			
	Explore ways that a pot of warm water can cause change (e.g., warm water can cause butter to melt, pouring water on a sand structure can cause the structure to change shape).	Explain how warm water can cause motion or create change.	Recognize that energy can cause motion or create change.
Design, construct and test a small boat or aircraft that can move in different directions (or against the flow of air/water) in nature. Document the forms of energy and resulting motion as the boat or aircraft is being demonstrated to an authentic audience.		Explain how a magnet can cause motion or create change. Examples of possible answers include: a magnet can cause other magnets and some metallic items to move toward it, a magnet can cause other magnets to move away from it.	Identify objects with energy in the environment (e.g., moving water, windmill, water wheel, sunlight) and determine what types of energy they have.

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INSTRUCTIONAL STRATEGIES AND RESOURCES

This section provides additional support and information for educators. These are strategies for actively engaging students with the topic and for providing hands-on, minds-on observation and exploration of the topic, including authentic data resources for scientific inquiry, experimentation and problem-based tasks that incorporate technology and technological and engineering design. Resources selected are printed or Web-based materials that directly relate to the particular Content Statement. It is not intended to be a prescriptive list of lessons.

- *Science in Focus: Energy* is a series of videos on demand produced by Annenberg to help teachers **understand children's preconceptions about energy** and what is important to understand about energy. Some of the content, like forces and work, are not directly related to this content statement. However, teachers need a good understanding of the differences and relationships between these important concepts.
- Write and illustrate a children's book about energy. Use observable forms of magnetic energy, electrical energy, light, sound and heat. Include descriptions and illustrations. Share the finished product with students at a different grade level.
- Combine and integrate the ESS grade 3 Energy Resources section. Building a solar oven can be used to illustrate that light energy can cause changes in temperature.

COMMON MISCONCEPTIONS

- Do not use resources that claim "free energy" or "perpetual motion machines" since these perpetuate myths that violate the law of conservation of energy. These are especially common when dealing with magnetic energy.
- Students do not realize that light, heat and sound are forms of energy and can cause things to happen.
- **Energy is a thing**, an object or something that is tangible.
- **Energy is confined** to some particular origin, such as what we get from food or what the electric company sells.
- Energy is a thing. This is a fuzzy notion, probably because of the way we talk about the amount of energy; it is difficult to imagine an amount of an abstraction.
- The terms "energy" and "force" are interchangeable.
- **Heat is a substance.**
- Heat is not energy.
- *Science in Focus: Energy* is a series of videos on demand produced by Annenberg dealing with energy. This segment deals with **heat**. The video series is designed to make teachers aware of common student misconceptions. While not all the concepts addressed are appropriate to be taught at this grade level, being aware of them can help avoid perpetuating common misconceptions.

DIVERSE LEARNERS

Strategies for meeting the needs of all learners including gifted students, English Language Learners (ELL) and students with disabilities can be found at **this site**. Resources based on the Universal Design for Learning principles are available at **www.cast.org**.

CLASSROOM PORTALS

These are windows into the classroom through webcasts, podcasts or video clips to exemplify and model classroom methods of teaching science using inquiry.

Jean, an **inclusion teacher**, helps third-grade students who are having difficulties during classroom inquiry activities in this video on demand, produced by Annenberg. She has been trying to develop multi-sensory approaches to learning science to help a diversity of students, including ESL, inclusion students and other special needs students. Jean talks about classroom management and organization for messy lab activities and the benefits of cooperative learning. The video shows how an inclusion teacher can be used in this lesson.

Select Video 10, *Linda–Grades 2-4*, to see a resource teacher who models **inquiry-based science lessons** for teachers in her large urban district. Although not all of the content is directly aligned to this content statement, the strategies could be applied to any content.