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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.

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.

Note: Air is introduced in ESS Kindergarten and can be linked to PS and LS.

CONTENT ELABORATION

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.

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 anemometers. Weather events that are related to wind (e.g., tornadoes, hurricanes) are included in this content. 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.

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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 an instrument that can measure wind speed and wind direction. Properties of the chosen materials and design must be evaluated as part of the testing and decision making process. Demonstrate final product to the class.	Plan and implement an experiment to illustrate that air has mass* and takes up space (has volume). *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.	Take measurements of wind speed and wind direction each day for two weeks. Record the measurements and plot results on a graph. Find and interpret patterns (e.g., when the wind comes from the south the speed is lower than when the wind comes from the north).	Recognize that air takes up space and can be weighed.

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 everyday materials to allow students to experiment and make their own **weather instruments**. The process of testing and evaluating the instrument is even more important than the resulting product.
- Connecting students to current weather discoveries and events are ways to generate interest in the science behind the event. Accurate **scientific articles and journals** about weather, air, atmosphere and wind can help students relate what they are learning in the classroom to the world around them.

COMMON MISCONCEPTIONS

- For examples of misconceptions that young children have about air and the atmosphere, and resources to address misconceptions through investigation, visit **http://amasci.com/miscon/opphys.html**.
- A common misconception regarding air and atmosphere is that air is nothing. It is important to provide activities for students that show properties of the atmosphere and air. For ways to allow students to demonstrate that air actually has mass* and takes up space (volume), visit **http://weather.about.com/od/lessonplanselementary/ht/air_volume.html** and **http://weather.about.com/od/lessonplanselementary/ht/air_has_mass.htm**.

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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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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.

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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 community in an aquarium that is enclosed and has soil, plants and water. Test the effects of the sun on evaporation and condensation rates and the air and/or water temperature. Evaluate the findings and discuss with the class.	Plan and implement an experiment to investigate what factors contribute to water evaporating into the atmosphere. Discuss the different results with the class to generate a list of all the possible methods that were tested.	Compare the different appearances of clouds (shapes, sizes, shades of white/ gray). Document the observations over a period of time to find if there is a relationship between the characteristics of the clouds and the weather (storms, precipitation types and/or amounts).	Recognize that clouds, steam, fog, hail, snow, sleet and hail are examples of water in the atmosphere.
	Plan and implement an experiment to investigate what happens when pollution is in a body of water that evaporates. Use a simple model that utilizes sediment, vinegar or vegetable oil as a contaminant.		Recall that water can change from liquid to vapor and/or vapor to liquid.
			Identify clouds as droplets of water and the droplets can combine and form into raindrops.

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INSTRUCTIONAL STRATEGIES AND RESOURCES

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- Providing specific examples that connect air temperature and changes in water prepares students for learning about the water cycle in later grades. Observing and experimenting with water and temperature (student-led exploration) **strategies** can help make this important connection. Though the water cycle itself should not be introduced at this grade level, the example illustrates how water gets into the atmosphere (evaporation) and then what happens when it is in the atmosphere (condensation).

COMMON MISCONCEPTIONS

- It is difficult for young students to understand fully the process of condensation and how clouds form. The misconception that clouds are like cotton and/or have a solid "feel" to them can be addressed by investigations and experiments that are directly related to condensation and cloud formation. For a classroom-exploration example of making clouds in a bottle that can demonstrate cloud consistency, see **http://eo.ucar.edu/kids/images/AtmoExp1.pdf**.

DIVERSE LEARNERS

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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 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.

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Design and construct an **instrument** that can measure wind speed and wind direction. Materials must be evaluated to determine the best material for the specific purpose. Discuss/share findings with the class or as a class.	Plan and implement an investigation to collect and measure **wind-chill data** (or data that calculates the "feels like" temperature in the summer by relating humidity levels and temperature). Compare local results with a different location in the U.S. and discuss the similarities/differences of the data and the possible reasons for the similarities and differences.	Based on student collected data, outline the relationship between wind and cloud changes vs. changes in weather from one season to another season. Outline relationships in writing or through a class discussion, oral presentation or graphic representation.	Recall that weather changes occur due to energy changes.
	Plan and implement an investigation to determine the factors or characteristics that contribute to the changes in day-to-day weather (storms, fronts). Compare average annual temperatures between cites at the same latitude, but at different elevations or proximity to large lakes or the ocean.	Research the long-term or short-term changes in weather that occur at specific weather fronts (e.g., ask: ***What happens when warm, moist air collides with cold, dry air?***) Represent the findings graphically or present findings to the class.	Recognize that a weather front is an area where different air masses collide.

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INSTRUCTIONAL STRATEGIES AND RESOURCES

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- **The National Center for Atmospheric Research** provides support and educational materials for teachers and students to learn about the connection between the atmosphere and weather.
- Preparing to teach about the atmosphere requires keeping updated on new discoveries and innovative ideas to teach about air, wind and weather. **Science Now** is a free periodical science journal that details the latest atmospheric research for educators.
- Using scientifically accurate resources and data about the atmosphere and weather that is connected to Ohio can add relevancy and meaning to what is going on in the classroom. The **Midwest Climate Center** provides FAQs about weather and climate, on-going research projects and quality resources for elementary teachers.
- Newspapers can be used to provide actual real-time weather data to use in the classroom.

COMMON MISCONCEPTIONS

- NASA lists common misconceptions for all ages about the sun and the Earth, including weather and seasons, at **http://www-istp.gsfc.nasa.gov/istp/outreach/sunearthmiscons.html**.
- For examples of misconceptions that young children have about energy, weather and the sun, and resources to address misconceptions through investigation, visit **http://amasci.com/miscon/opphys.html**.

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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.

Note: At this grade level, discussion is limited to changes that can be easily observed.

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.

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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 build (with teacher help) a working worm composting bin or an ant farm (whichever is most appropriate for the classroom) that can be used to observe activity and actions of the worms or ants. **Note: The project selected should be built based on student ideas not from a readymade kit.**	Plan and conduct an investigation that will compare identical soil samples, one with earthworms and one without earthworms, over an extended period of time. Include data about temperature, amount of moisture, appearance, materials added, materials removed and/ or odor. **Note: For this grade level, the presence of bacteria and fungi are not included. Students may be able to see fungi fruiting bodies, but would not be able to see the fungal cells without using tools and content knowledge that are above this grade level.**	Represent data obtained from classroom investigations or real-world examples in a chart, table or pictograph (e.g., make a table of data obtained from soil samples with earthworms as compared to soil samples without earthworms).	Recognize scientifically accurate facts in stories about environmental change caused by living things.

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INSTRUCTIONAL STRATEGIES AND RESOURCES

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- **Design** build and maintain a **worm-composting bin**. Journal changes in the system and make connections on what is happening in the bin to what is happening in nature.
- **Design** and maintain an **ant farm**. Journal changes in the system and make connections on what is happening in the ant farm to what is happening in nature.
- Observe a plot of land that has been abandoned and make predictions about how the appearance of that property will change if there is no human intervention. If possible, document the changes throughout the year.
- Explore a beaver's habitat in nature or through media. Document observations of the beaver's habitat. Encourage children to ask questions about the impact of the dam on the ecosystem. Ask: *How many other organisms are impacted by the presence of the dam? How does the dam impact the river or stream?*
- **Growing Up WILD: Exploring Nature with Young Children** is a curricular resource that is available only through attending their training sessions; the activities provided are aligned to Ohio's science standards. In *Wildlife is Everywhere*, children make observations and understand that wildlife is all around us. In Field Study Fun, children investigate a field study plot to observe plant and animal interactions over time. In *Wiggling Worms*, children learn about and observe earthworms.
- *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 *Urban Nature Search*, students make observations of habitats that are found around their schoolyard. This activity can be done seasonally to illustrate changes. In *Surprise Terrarium*, students use a classroom terrarium to observe animal behavior and interactions.

COMMON MISCONCEPTIONS

- The Annenberg Media series **Essential Science for Teachers** can be used to provide greater insight to misconceptions children hold about living things and energy. Classroom videos and lessons are provided to help students avoid these misconceptions.
- **AAAS' Benchmarks 2061 Online, Chapter 15**, 5e, *Flow of Matter and Energy*, illustrates that students may think that dead organisms simply rot away. They do not realize that material is converted into other materials by decomposing agents.

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 *Urban Nature Search*, students make observations of habitats that are found around their schoolyard. This activity can be done seasonally to illustrate changes. In *Surprise Terrarium*, students use a classroom terrarium to observe animal behavior and interactions. Information about upcoming *Project Wild* workshops is available on the **ODNR Website**.

CLASSROOM PORTALS

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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 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., Rugosa Coral, Sphenopsids) 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

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Test the durability of fossils made in the Demonstrating Science Knowledge section. Compare the fossils for strength, ease of breakage and resistance to dissolving in water. 	Make "fossils" of animal tracks using different kinds of soils (silt, sand, clay). Plaster of Paris can be used to make a cast or mold. Ask: *Which soil worked best to make the fossil and why?*  For a procedure that can be altered for use by different grades, see **http://geophysics.esci.keele.ac.uk/earthlearningidea/PDF/66_Trailmaking.pdf.**	Compare the macroscopic features of organisms (e.g., an elephant) that are alive today with those of similar extinct organisms (e.g., a mammoth). 	Name an organism that was once abundant in the local area that now is extinct. 

INSTRUCTIONAL STRATEGIES AND RESOURCES

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- The Ohio Department of Natural Resources provides a list of Ohio's **extinct species**. Specific information about sphenopsid fossils is contained in the article **Coal**. These organisms can be compared to organisms that are **living today**. Have children note the differences between the species and compare the differences in each environment.
- Explore organisms that once lived in Ohio and no longer exist. *National Geographic* provides an article on the find of a **giant cockroach** fossil in Ohio. **Science Daily** provides a rich source of information on the relationship between mammoths and elephants.
- Several sites provide instructions for making fossils. The following sites provide background information for construction but do not meet the requirement of the content statement: **http://www.michigan.gov/documents/deq/p06create_304664_7.pdf**; **http://www.geology.siu.edu/outreach/making_fossils.htm**; and **http://www.nps.gov/miss/forteachers/upload/brjfossils.pdf**.

COMMON MISCONCEPTIONS

- **Science Daily** provides a rich source of information on the relationship between mammoths and elephants.
- The Annenberg Media series *Essential Science for Teachers:* **Life Science: Session 2***: Children's Ideas* provides greater insight to misconceptions children hold about classifying living things and strategies to address those misconceptions.
- **AAAS' Benchmarks 2061 Online, Chapter 15**, *The Research Base*, provides a comprehensive list of research findings that served as guidelines for the development of this book. Scroll down to *Classification of Life*.

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DIVERSE LEARNERS

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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.

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 Annenberg video *Richard and Joann–Grade 2* provides examples of ways to integrate science and mathematics in second-grade classrooms. Be careful to check for local food safety rules and student allergies before using food in a classroom.

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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.

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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
	Investigate how noncontact forces can affect motion.		
Design and construct a device to move a matchbox car from one position to another without touching it. Test the device and evaluate the design.	Plan and implement a scientific experiment to explore the effects some objects have on others even when the two objects might not touch (e.g., magnets).	Pictorially represent the design. Compare the designs and their effectiveness from the different groups in the class.	Identify a noncontact force that can affect the motion of an object.
	Investigate ways to change the motion of objects.		
	Plan and implement a scientific experiment to explore how to change how something is moving (e.g., push, pull, speeding up, slowing down, changing direction, stopping).	Represent the observations from the experiment orally and in writing. Explain the relationship between forces and motion.	Give two examples of how a force can be applied to an object.
	Predict the changes in motion that a moving object or an object at rest experiences when acted on by a force (e.g., push, pull, gravity).	Compare what is needed to get stationary objects moving and what is needed to get moving objects to stop.	Identify contact/noncontact forces that affect motion of an object (e.g., gravity, magnetic force, contact). Recognize that greater changes in the motion of an object require larger forces.

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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.

- **Making Objects Move** from NetLinks provides a strategy that emphasizes an inquiry approach to teaching and learning about different motions of objects.
- *Science in Focus: Forces and Energy* produced by Annenberg, is part of a series of videos on demand to help teachers improve their content knowledge about forces and energy. This particular segment **focuses on forces and how they are related to, yet different from, work and energy**. While children do not study work and energy until later, knowledge of these concepts can help teachers avoid perpetuating misconceptions.
- **Magnets and Springs** is an interactive simulation from BBC Schools that demonstrates two important concepts: change in motion depends on the amount of force, and some objects are attracted by magnets and others are not. The size of the magnet, the rotation of the magnet and the types of objects exposed to the magnet and the force that puts the magnet in motion can all be changed.
- *Pushes and Pulls* is an interactive simulation from BBC Schools in which children can investigate the **effects of pushes and pulls on motion**. The subsequent quiz is not aligned to the content statement.
- Observe attractions and repulsions involved with electrical (e.g., static electricity on a balloon or sweater) and magnetic forces (e.g., compass or bar magnet).

Career Connection

Lead a discussion around the types of careers that design vehicles or devices that respond to or are impacted by force (e.g. airplanes, boats, trucks). Students will explore a career related to various types of transportation, including those connected to the military, through available resources in the school or classroom library. Then, they will depict their findings in a drawing.

COMMON MISCONCEPTIONS

- **The only natural** motion is for an object to be at rest.
- If an object is at rest, no forces are acting on the object.
- Only animate objects can exert a force. Thus, if an object is at rest on a table, no forces are acting on it.
- Force is a property of an object.
- An object has force and when it runs out of force, it stops moving.
- A force is needed to keep an object moving with a constant speed.
- **Gravity only acts on things when they are falling.**
- Only animate things (people, animals) exert forces; passive ones (tables, floors) do not exert forces.

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