Kindergarten Instructional Supports

To meet the goals of *EachChildOurFuture*, Ohio's strategic plan for education, schools and districts will find it essential to have appropriate local curricula supported by high-quality instructional materials. Science is part of providing well-rounded content for students, as *well-rounded content* is one of the four learning domains listed in the strategic plan.

Science is an essential subject for students in grades K-12. It is important to build a strong foundation in science in early elementary years so students are prepared for understanding more complex material in intermediate and middle grades. It is equally important to continue students' science instruction by offering more advanced courses at the high school level. This allows students to better compete for admission to college or other postsecondary programs, as well as jobs. Advanced science courses in high schools also help produce a more scientifically literate public.

The instructional supports are intended to provide resources that can be used by educators to:

- Increase their own content/pedagogical knowledge;
- Choose high-quality materials for use with students;
- Incorporate disciplinary literacy into instruction;
- Make connections within and across disciplines;
- Identify and address common misconceptions/naïve thinking;
- Attend to equity issues in order to address the needs of diverse learners;
- Locate databanks and other primary sources.

The resources listed in this document are provided to enhance planning, instruction and assessment and are not mandatory. Local districts are responsible for crafting their local curricula and identifying appropriate instructional resources and materials. These supports are curated by Ohio educators. This document is intended to be fluid in nature and feedback on the usefulness of any of the materials it contains is greatly appreciated. The Ohio Department of Education encourages educators statewide to submit best practice instructional strategies to be added to the instructional supports. The Department will review these submissions and update the instructional supports on a regular basis. Send suggestions and comments via email to the Department's Science Team.

NATURE OF SCIENCE RESOURCES

The information and resources in this section are intended to enhance understanding of the nature of science and effective science instruction. They are not linked to a specific standard but can be useful to educators as they plan instruction to guide students' developing understanding of science as a discipline and way of knowing.

NATURE OF SCIENCE

- In this Nature of Science video, Paul Andersen of Bozeman Science provides a clear picture of what is and is not science and how scientific knowledge advances. The video provides good background information for educators and also is appropriate for use with older students.

SCIENTIFIC AND ENGINEERING PRACTICES

- Paul Andersen of Bozeman Science has a series of videos that explain each of the eight scientific and engineering practices.
  - Asking questions and defining problems
  - Developing and using models
  - Planning and carrying out investigations
  - Analyzing and interpreting data
  - Using mathematics and computational thinking
  - Constructing explanations and designing solutions
  - Engaging in argument from evidence
  - Obtaining, evaluating and communicating information

INTRODUCTION TO CONTENT STATEMENTS

GRADE BAND THEME: OBSERVATIONS OF THE ENVIRONMENT

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

STRANDS

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

EARTH AND SPACE SCIENCE (ESS)	PHYSICAL SCIENCE (PS)	LIFE SCIENCE (LS)
Topic: Daily and Seasonal Changes This topic focuses on observing, exploring, describing and comparing weather changes, patterns in the sky and changing seasons.	**Topic: Properties of Everyday Objects and Materials** This topic focuses on the production of sound and on observing, exploring, describing and comparing the properties of objects and materials with which the student is familiar.	**Topic: Physical and Behavioral Traits of Living Things** This topic focuses on observing, exploring, describing and comparing living things in Ohio.
CONDENSED CONTENT STATEMENTS		
K.ESS.1: Weather changes are long-term and short-term. **K.ESS.2:** The moon, sun and stars can be observed at different times of the day or night.	**K.PS.1:** Objects and materials can be sorted and described by their properties. **K.PS.2:** Some objects and materials can be made to vibrate and produce sound.	**K.LS.1:** Living things have specific characteristics and traits. **K.LS.2:** Living things have physical traits and behaviors, which influence their survival.

NATURE OF SCIENCE (GRADES K-2)

Nature of Science One goal of science education is to help students become scientifically literate citizens able to use science as a way of knowing about the natural and material world. All students should have sufficient understanding of scientific knowledge and scientific processes to enable them to distinguish what is science from what is not science and to make informed decisions about career choices, health maintenance, quality of life, community and other decisions that impact both themselves and others.	
Categories	**K-2**
Scientific Inquiry, Practice and Applications All students must use these scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas.	• Apply knowledge of science content to real-world challenges. • Plan and conduct simple scientific investigations using appropriate safety techniques based on explorations, observations and questions. • Employ simple equipment and tools to gather data and extend the senses. • Use data and mathematical thinking to construct reasonable explanations. • Communicate with others about investigations and data.
Science is a Way of Knowing Science assumes the universe is a vast single system in which basic laws are consistent. Natural laws operate today as they did in the past, and they will continue to do so in the future. Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise and extend this knowledge.	• The world is discovered through exploration. • Exploration leads to observation. Observation leads to questions. • Natural events happen today as they happened in the past. • Events happen in regular patterns and cycles in the natural world.
Science is a Human Endeavor Science has been, and continues to be, advanced by individuals of various races, genders, ethnicities, languages, abilities, family backgrounds and incomes.	• Everyone explores the world which generates questions. • The answer is not always as important as the process. • Questions often lead to other questions. • Discoveries are communicated and discussed with others. • People address questions through collaboration with peers and continued exploration. • Everyone can see themselves as scientists.
Scientific Knowledge is Open to Revision in Light of New Evidence Science is not static. Science is constantly changing as we acquire more knowledge.	• It is essential to learn how to identify credible scientific evidence. • Ideas are revised based on new, credible scientific evidence.

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

EARTH AND SPACE SCIENCE (ESS)

Topic: Daily and Seasonal Changes

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

CONTENT STATEMENT

K.ESS.1: Weather changes are long-term and short-term.

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

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

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

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

Note: *The focus is on observing the weather patterns of seasons. The reason for changing seasons is not appropriate for this grade level; this is found in grade 7.*

CONTENT ELABORATION

Kindergarten Concepts

Wind, temperature and precipitation are components of the weather that can be observed and measured for kindergarten. The measurements collected and tools used can be nonstandard and must be age appropriate. For example, the temperature may be above or below a given point (warmer or colder) or the amount of snow may be marked on a dowel rod to check the depth.

Weather measurements should be collected on a regular basis throughout the school year and then compared, explained and discussed each week and each month. At the end of the school year, a comparison can be made and seasons can be identified by the patterns that were measured throughout the year. Consistent review and questioning to deepen understanding are essential.

Use technology to study weather events, record classroom data, compare classroom data to local data, communicate and share data with other classrooms.

Future Application of Concepts

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

Grades 3-5: Different states of water are defined in Physical Sciences. Wind and water are recognized as agents that can change the surface of Earth through weathering and erosion. The observed seasons from kindergarten are related to the sun and the tilt and orbit of Earth in grade 7.

EXPECTATIONS FOR LEARNING

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

VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

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

Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Weather station			
As a class, make a portable weather station that can measure wind, temperature and precipitation amounts. Test and select the best location for the weather station (so that accurate readings can be collected). Design and build a device to measure rainfall amounts. This can be done individually or as a class.	Test different methods or tools to collect precipitation amounts (rain, snow or ice), and measure the speed (faster or slower) and direction of wind (which way the wind is blowing). Ask questions about what happens next, such as: When the wind increases, what happens to the temperature? **Note:** *Nonstandard measurements can be used to meet this objective (e.g., using a dowel to measure the depth of snow).*	Graph weather measurements over time and discuss any patterns that emerge. Graphs can be saved to compare the weather trends of each season. Create an in-class weather station data display center as a place to document the daily weather.	Recognize that temperature, wind and precipitation are aspects of weather that can be measured. Identify the four seasons and the temperature and precipitation measurements that characterize each season. Dress a character appropriately for the day's weather.
Bubbles in the wind			
	Compare the speed (fast, slow) and direction of the wind in different outside areas. Create an investigation, using bubbles to discover there is wind energy, even though you cannot normally see it.	Create a poster or other graphic demonstrating which way the bubbles were blowing. Compare and discuss what was happening.	Explain the connection between wind energy and bubble movement (i.e., the wind determines the direction and speed the bubbles move).

Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Weather walks Take weather walks during or after different weather events.			
	Create an investigation highlighting different weather events (e.g., sun casting shadows, wind socks to measure wind, puddles of water after a rain)	Keep a journal of observations on the walks. Draw pictures of the weather observations. Discuss and compare different walks (seasonal).	Describe different types of weather (seasonal characteristics).

RESOURCES FOR TEACHERS

Equity/Diverse Learners

- The Ohio Department of Education provides strategies for meeting the needs of all learners, including gifted students, English learners and students with disabilities.
- Resources based on the Universal Design for Learning principles are available at CAST.org.

Connections within and across disciplines

- Weather walks are effective ways to observe local weather. This lesson integrates writing and art activities with science during walks in various weather conditions. Some of the activities connect to the kindergarten life science and physical science standards. A book suggestion is included with each walk. Safety note: There is one art activity that asks students to dab bleach on paper. Judgement should be used as to whether this is appropriate for your particular students. Substituting white paint is a safer alternative.

Content Support: Materials for teacher background that are not at an appropriate level for use with students.

- NASA provides a brief article on weather, climate and the differences between the two.
- Crash Course Kids has a video that can give teachers a quick overview of what is weather and what is climate.

Common Misconceptions

Misconception	Accurate science	Links/resources/suggestions
Climate and weather are the same thing.	**Climate** is the pattern of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological variables in a given region over long periods. **Weather** is the present condition of the same variables over shorter periods.	Kindergarteners are not expected to distinguish weather from climate, but the correct use of these terms by the teacher will build a foundation for later understanding. NASA has a grade appropriate video describing the difference between weather and climate.
Weather has attributes of living things or everyday objects (Old Man winter, raining cats and dogs, raining buckets, fog like pea soup).	Weather is caused by energy transfer and transformation in the atmosphere resulting from uneven heating.	Reading stories that include accurate representation of weather events can be a good start to addressing misconceptions. Collecting and discussing weather data on a regular basis will help clarify weather concepts.

Vocabulary

Science vocabulary is most effectively mastered when it is introduced in the natural course of instruction. Rather than being taught in isolation at the beginning of a lesson or unit, vocabulary should be taught as the need for a term is encountered. Starting instruction by defining vocabulary lists is discouraged. Careful modeling of the correct use of scientific terminology by the instructor, along with the encouragement of rich student discourse, is a better way to integrate the correct usage of scientific vocabulary into students' existing understandings. Teachers should encourage students to use proper terms as they ask questions, design experiments and support claims with evidence. Traditional word walls can be replaced with student-created illustrations of terms or scientific models annotated with proper vocabulary. Refer to STEM Teaching Tools Practice Brief 66 for more information.

RESOURCES FOR USE WITH STUDENTS

Lessons and Classroom Materials

- Children need to be encouraged to experiment with ways to measure weather and how to measure weather accurately. Asking effective questions as children are trying different methods is an important part of understanding what the child knows. Allow children to make their own tools to measure weather using everyday materials. Simple weather tools, such as windmills, windsocks or rain gauges, can be constructed and used to collect data.
- Weather Bug has links to weather cameras in various locations, allowing students to observe weather as it is occurring in other parts of the country.
- This simple pattern lets students have a take-home version of their classroom weather data display, so they can practice weather observations on non-school days. Teachers might want to change the opposite of "wetter" from "better" to "drier" on the precipitation scale to avoid the misconception that dry weather is preferable to rainy weather. A healthy environment needs both.
- If your area typically gets new snowfall on top of earlier snowfalls, a snowboard can be used to measure the amount of new snowfall.
- This tip sheet from Illinois Early Learning suggests some weather activities for young children.

Media

It is important to incorporate a variety of primary and secondary sources of information, so students learn to reflect on and engage in quality discourse around pertinent topics, as well as evaluate the validity of information sources. Using media is a natural way to support disciplinary literacy or integrate science with English language arts. The following materials are relevant to this standard and can be incorporated into lessons. Students and classes have a variety of characteristics and needs. Be sure to always preview materials prior to use to determine appropriateness.

Books

- *The Wind Blew*, by Pat Hutchins
- *Wet World*, by Norma Simon
- *The Snowy Day* by Ezra Keats
- *Whatever the Weather* by Karen Wallace
- *Hello, Sun!* by Dayle Ann Dodds
- *Come on Rain* by Karen Hesse
- *Freddy the Frogcaster* by Janice Dean
- *Hide and Seek Fog* by Alvin Tresselt

CAREER CONNECTIONS

Discuss jobs that depend on weather or are seasonal. Discuss questions such as *Which jobs are done outdoors? Which jobs are done only in summer or only in winter? What do meteorologists do?*

EARTH AND SPACE SCIENCE (ESS)

Topic: Daily and Seasonal Changes

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

CONTENT STATEMENT

K.ESS.2: The moon, sun and stars can be observed at different times of the day or night.

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

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

CONTENT ELABORATION

Kindergarten Concepts

Changes in the position of the sun in the sky can be measured and recorded at different times during the school day. Observations can also be made virtually. This data can be compared from month to month to monitor changes. Stars, groups of stars and different phases of the moon can be observed through books or virtually and documented throughout the month. The names of the stars, constellations or moon phases are not appropriate for kindergarten; only the changes in appearances that can be observed are included. At times, the moon can be observed in the daylight. Drawings, photographs or other graphics can be used to document student observations.

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

Future Application of Concepts

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

Grades 3-5: The sun is the only star in the solar system and celestial bodies orbit the sun.

Grades 6-8: The tilt and orbit of Earth and position of the sun are related to the seasons.

EXPECTATIONS FOR LEARNING

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

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Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Sun and shadows			
As a class, design and make a sun garden. The garden may contain rocks or other objects that reflect or react to sunlight, such as sundials, solar-powered lights or chimes that require sunlight for movement. Place the garden based on sun-shadow data (see demonstrating science knowledge). The design should be drawn on a map and discussed by the class.	Experiment with shadows from the sun. Questions to explore include: What happens to a shadow throughout the day? Can the length of a shadow be measured? How does the shape of the shadow change? Can shadows be made inside? Use light bulbs, overhead projectors, virtual investigations or combinations of the above to explore inside shadows.	Collect and record sun-shadow data on a regular basis throughout the school day and school year. Interpret the changes (length, position) in the shadows. Discuss the changes that are observed, the relationship between the changes in the shadows and the positions of the sun throughout day and in the different seasons. Present findings orally and/or graphically.	Recognize that the sun changes position in the sky during the day.
Sundial clock			
Design and create a sundial to place outside.	Using a sundial clock, create an experiment or activity to discover and interpret changes in the shadow.	Create a table or chart (e.g., sundial plot, shadow plot) to document changes in shadows throughout the day. Discuss the reasons for the changes.	
Day and night			
	Create an investigation to discover why the sun is only visible in the day (e.g., globe and flashlight).	Observe the sky during the day and night and record what is observed. Compare and discuss similarities and differences of the daytime sky and nighttime sky. Make drawings of the sky at different times during the day and year. Monthly, discuss changes and compare charts from fall, winter, spring and summer. Make a table or chart to document the changes in the observable (lit) part of the moon throughout a month. Compare the differences throughout the month and then determine if the same pattern exists the next month.	Identify the season with the most and least amount of daylight hours. Discuss how and why the daytime and nighttime skies are different.

RESOURCES FOR TEACHERS

Equity/Diverse Learners

- The Ohio Department of Education provides strategies for meeting the needs of all learners, including gifted students, English learners and students with disabilities.
- Resources based on the Universal Design for Learning principles are available at CAST.org.

Connections within and across disciplines

- Like the apparent motion of the sun, time zones are a result of Earth's rotation. Discussing the fact that it is different times in different areas of the world may be one way to introduce students to the concept of Earth's rotation. The book *Nine O'Clock Lullaby* by Marilyn Singer illustrates what might be happening at various locations around the world simultaneously. In addition to supporting this standard, the book can be a starting point to introduce students to the cultures of other areas of the United States or world. This supports social studies standards 1. Time can be measured and 3. Heritage is reflected through diverse cultures and is shown through the arts, customs, traditions, family celebrations and language. It also addresses world languages and cultures standards, intercultural competence for novice low, 1. Recognize a few typical products and practices related to familiar, everyday life in native and other cultures and 2. Recognize a few very simple behaviors in other cultures.

Common Misconceptions

Misconception	Accurate science	Links/resources/suggestions
The moon looks the same every night.	Half of the moon is lit by sunlight at any time, but as the moon orbits Earth, we view it from different angles. This causes the portion of lighted moon that we see from Earth to change throughout the month.	Have students observe and draw the moon shape at home and then share their findings as a group the next day. This allows you to create a picture sequence of the observed moon phases. Students may have better luck seeing the moon in the months when it is dark for more of the hours a kindergartener is awake. Aim for a month when your area generally has clearer weather.
The moon rises when it gets dark and sets at daylight.	The time period when the moon is visible changes gradually throughout the month. Near the new moon, the moon is mainly up in the daytime. Near the full moon, the moon rises in the evening and sets in the morning. Near first and third quarters, it rises and sets noon to midnight or midnight to noon.	Challenge the students to see who can find the moon in the daytime.
It gets dark because: • The sun goes behind hills. • Clouds covers the sun. • The moon covers the sun. • The sun goes behind Earth. • Earth goes around the sun once a day.	The day/night cycle is the result of Earth turning on its axis once in each 24-hour period.	

Misconception	Accurate science	Links/resources/suggestions
The shape of the moon changes because: ● Clouds cover part of the moon. ● The moon is in the shadow of a planet. ● The moon is in the shadow of the Sun. ● The moon is in the shadow of the Earth.	Changes in the shape of the moon are the result of the moon's reflection of sunlight and its revolution around the Earth. The half of the moon facing the sun always reflects light but, from Earth, we sometimes see all the lit half, part of the lit half or only the unlit half. This is because the alignment of Earth, the sun and the moon changes throughout the month.	Project 2061 Benchmarks indicate that is too early to explain moon phases at this level. Students will learn the mechanics involved in grade 7. At this level, it is enough to teach that the changing shapes are caused because the moon orbits the Earth.
The moon looks the same every night.	Half of the moon is lit by sunlight at any time, but as the moon orbits Earth, we view it from different angles. This causes the portion of lighted moon that we see from Earth to change throughout the month.	Have students observe and draw the moon shape at home and then share their findings as a group the next day. This allows you to create a picture sequence of the observed moon phases. Students may have better luck seeing the moon in the months when it is dark for more of the hours a kindergartener is awake. Aim for a month when your area generally has clearer weather.
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Vocabulary

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RESOURCES FOR USE WITH STUDENTS

Lessons and Classroom Materials

- An online planetarium program is a good way to observe the stars since school is not in session at night and the rotation of Earth is slow. There are many choices available. This site lets you set any location, date and time. Clicking animate allows you to watch the movement of constellations and other objects across the sky. Labels can be turned off. At kindergarten, the general idea that the entire sky is "moving" because of Earth's rotation is all that is expected. Naming objects, such as constellations or moon phases, is not expected.
- There are many different ways to explore how shadows are formed and what factors affect the size/direction of shadows. It is important to allow children to ask questions and test their own ideas as they experiment. Student-led investigation and discourse support utilizing the scientific practices. For this standard, the primary focus is the effect the apparent motion of the sun has on shadows.

Media

It is important to incorporate a variety of primary and secondary sources of information, so students learn to reflect on and engage in quality discourse around pertinent topics, as well as evaluate the validity of information sources. Using media is a natural way to support disciplinary literacy or integrate science with English language arts. The following materials are relevant to this standard and can be incorporated into lessons. Students and classes have a variety of characteristics and needs. Be sure to always preview materials prior to use to determine appropriateness.

Books

- *What Makes a Shadow* by Clyde Robert Bulla
- *How Many Stars in the Sky?* By Lenny Hort
- *Moonbear's Shadow* by Frank Asch
- *Our Stars* by Anne Rockwell
- *Sun Up, Sun Down* by Gail Gibbons
- *The Sun is Always Shining Somewhere* by Allan Fowler
- *The Sun is My Favorite Star* by Frank Asch

CLASSROOM PORTALS

- This blog showcases how one kindergarten teacher has adapted her classroom to a student-led learning environment. It contains many creative ideas for teaching this standard and for incorporating English language arts, art, mathematics and social studies into the study of astronomy. Student-generated questions are used to deeply explore topics while still supporting standards from the various content areas. This is a public blog; responses to the posting are not part of the recommended content.

PHYSICAL SCIENCE (PS)

Topic: Properties of Everyday Objects and Materials

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

CONTENT STATEMENT	CONTENT ELABORATION
K.PS.1: Objects and materials can be sorted and described by their properties. Objects can be sorted and described by the properties of the materials from which they are made. Some of the properties can include color, size and texture.	**Kindergarten Concepts** In kindergarten, the concept that objects are made of specific materials (e.g., clay, cloth, paper, metal, glass) is reinforced. Objects have certain properties (e.g., color, shape, size, temperature, odor, texture, flexibility) that can be described, compared and sorted. Students should not use the sense of taste as a way of observing an unknown substance. Observations are limited to descriptors such as hot, warm, cold, heavy and light. Comparisons of objects are a precursor to measurement. Comparisons are used to sort and describe objects (e.g., is the wooden block heavier or lighter than the plastic block?). Standard and nonstandard measuring tools can give additional information about the environment and can be used to make comparisons of objects and events. Magnifiers can be used to see detail that cannot be seen with the unaided eye. Familiar objects from home, the classroom or the natural environment can be explored and investigated. **Future Application of Concepts** **Grades 1-2:** Changes in objects are investigated, including temperature changes, solid-liquid phase changes and possible changes in amount of liquid water in open and/or closed containers. **Grades 3-5:** Matter is defined. Measurements of weight and liquid volume are made. The mass and kind of material remains the same when an object is reshaped or broken into pieces. The properties of solids, liquids and gases (air) and phase changes are explored. Differentiating between mass and weight is not necessary at this grade level.

EXPECTATIONS FOR LEARNING

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

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Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Properties of materials			
Design and create a house that can survive strong winds (e.g., the big bad wolf). Provide building materials (e.g., tape, different sized craft sticks, cardboard, pipe cleaners, cereal boxes, feathers, straws). Compare classroom designs and determine which design feature can withstand the strongest winds (fan speed).	Use standard or nonstandard measurements to compare and order objects (e.g., heavier, longer).	Use observable (touch, sight, hearing, smell) information to categorize items by creating a system of organization using one or more physical properties such as size, shape, color, texture, smell and weight. Create a visual representation, using pictures and/or words to explain the sort.	Describe different properties of objects.

RESOURCES FOR TEACHERS

Equity/Diverse Learners

- The Ohio Department of Education provides strategies for meeting the needs of all learners, including gifted students, English learners and students with disabilities.
- Resources based on the Universal Design for Learning principles are available at CAST.org.

Connections within and across disciplines

- These sorting lessons from the Utah Education Network are based on the book *3 Little Firefighters* by Stuart J. Murphy. Customized sorting activities could be added to explore more attributes related to this standard (e.g., texture, weight, odor). Observing and categorizing living organisms and their parts ties to K.LS.2. In addition to the language arts connection, mathematics standards K.G.2, K.CC.4, K.CC.5, and K.MD.3 are reinforced.
- This mathematics lesson models the type of sorting activities expected by this standard. The student-centered approach used supports mastery of *Nature of Science* skills. Linking the descriptive words to the attributes they describe sets the stage for later understanding of measurement. The existing lesson could be modified or extended to include additional attributes linked directly to science topics in other kindergarten standards. For example, sorting items or pictures collected on nature walks relates to the life science standards. Traditional or homemade musical instruments could be categorized by sound, shape or other attributes to tie in with K.PS.2. Identifying the attributes of different clouds relates to K.ESS.1.

Common Misconceptions

Misconception	Accurate science	Links/resources/suggestions
Measurement is only linear.	Various quantities can be measured (e.g., weight, time, area, volume, temperature).	
Any quantity can be measured completely accurately.	No measurement is completely accurate. Every measuring tool has limited accuracy and there is an uncertainty level to every measurement.	
The five senses are infallible.	Human senses have limitations. Different people perceive the same information in different ways. If two people are asked to repeat what they heard, saw, tasted, smelled or touched, they often give different accounts.	Children at this level are dependent on observable information. If the information cannot be observed with the senses, students do not believe it exists (Kind, 2004).
Size and weight are equivalent (e.g., big means heavy, bigger means taller).	Most quantities that can be measured are independent of one another.	

Vocabulary

Science vocabulary is most effectively mastered when it is introduced in the natural course of instruction. Rather than being taught in isolation at the beginning of a lesson or unit, vocabulary should be taught as the need for a term is encountered. Starting instruction by defining vocabulary lists is discouraged. Careful modeling of the correct use of scientific terminology by the instructor, along with the encouragement of rich student discourse, is a better way to integrate the correct usage of scientific vocabulary into students' existing understandings. Teachers should encourage students to use proper terms as they ask questions, design experiments and support claims with evidence. Traditional word walls can be replaced with student-created illustrations of terms or scientific models annotated with proper vocabulary. Refer to STEM Teaching Tools Practice Brief 66 for more information.

RESOURCES FOR USE WITH STUDENTS

Media

It is important to incorporate a variety of primary and secondary sources of information, so students learn to reflect on and engage in quality discourse around pertinent topics, as well as evaluate the validity of information sources. Using media is a natural way to support disciplinary literacy or integrate science with English language arts. The following materials are relevant to this standard and can be incorporated into lessons. Students and classes have a variety of characteristics and needs. Be sure to always preview materials prior to use to determine appropriateness.

Books

- 3 Little Firefighters by Stuart J. Murphy
- Sorting by Henry Arthur Pluckrose
- The Button Box by Margarette S Reid

Videos

- In *Super Fab Lab! Sound Symphony*, Sid the Science Kid and his friends explore the different sounds produced by banging metal, plastic and wooden objects. This content also directly supports standard K.PS.2.

PHYSICAL SCIENCE (PS)

Topic: Properties of Everyday Objects and Materials

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

CONTENT STATEMENT	CONTENT ELABORATION
K.PS.2: Some objects and materials can be made to vibrate to produce sound. Sound is produced by touching, blowing or tapping objects. The sounds that are produced vary depending on the properties of objects. Sound is produced when objects vibrate.	**Kindergarten Concepts** Sound can be made in many ways. Objects like cymbals, the tabletop or drums can be tapped to produce sound. Objects like a rubber band or a guitar string can be plucked to produce sound. Objects like a bottle or a trumpet can be blown into to produce sound. A wide variety of sounds can be made with the same object (e.g., a plastic bottle could be tapped or blown into). The connection between sound energy and the vibration of an object must be made. Vibrations can be made visible as water splashes when a cymbal or triangle is placed in water or when rice vibrates on the top of a banging drum. The concepts of pitch (low vs. high notes) and volume (loudness) are introduced. Sound needs to be experienced, investigated and explored through observations and experimentation. Standard, virtual and student-constructed instruments can be used to explore sound. Wave descriptions of sound and the propagation of sound energy are not appropriate at this grade level. **Future Application of Concepts** **Grades 1-2:** Exploring sound provides an experiential basis for the concepts of motion and energy. A variety of motions is explored. Forces are needed to change the motion of objects. **Grades 3-5:** Energy is introduced as something that can make things move or cause change. The concept of a medium for sound is introduced and disturbances in liquid and solid media are observed. **Grades 6-8:** The wave nature of sound is introduced.

EXPECTATIONS FOR LEARNING

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

VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

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

Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Sound			
Design and make an instrument that can produce different sounds by tapping, plucking or blowing. Evaluate the set of instruments created and make suggestions on how the instruments may make different types of sounds. Design and create a sound garden (e.g., wind chime) using a variety of materials such as plastic, wood and metal.	Explore different ways sounds can be made from an object (e.g., horn, cymbals, rubber band, guitar, plastic bottle). Investigate different amounts of water in cups of the same size and shape to illustrate different sounds. Investigate how the amount of stretch of plucked rubber bands affects the sound. Investigate how different materials or combinations of materials make different sounds.	Compare different ways to make loud and soft sounds by tapping, blowing or plucking objects. Compare different sounds and describe how the tones are different. Observe and listen to a sound garden on a rainy day, windy day and sunny day. Discuss any differences.	Identify three ways to make sounds from objects. Explain that vibrating materials make sounds. Describe ways to change the loudness of a sound (e.g., blow more air through a whistle, bang harder on a drum).

RESOURCES FOR TEACHERS

Equity/Diverse Learners

- The Ohio Department of Education provides strategies for meeting the needs of all learners, including gifted students, English Learners (EL) and students with disabilities.
- Resources based on the Universal Design for Learning principles are available at CAST.org.

Connections within and across disciplines

- Children often think music is strictly an art form and has nothing to do with science. Work with the music teacher to reinforce lessons about how sound is produced and/or use science lessons to tie in additional learning about music (e.g., instruments, history, types of music, music in different cultures)
- Listening carefully to sounds in nature links this standard with the kindergarten life science standards. Creating sound maps is a good way to have kindergartners make and record observations, an important inquiry skill. Discussing how the sounds on the sound maps were produced, as well as the loudness or pitch of each, aligns the activity tightly to the expectations of this standard
- The read aloud of *Zin! Zin! Zin A Violin* by Lloyd Moss includes sounds produced by various instruments. Recognizing the variety of sound addresses music standards 4CE and 5CE. Naming groups of musicians as the instruments are added one-by-one supports mathematics standard K.CC.4. Although the book does not directly discuss how each instrument produces sound, this could be explored in the classroom or by working with the music teacher.

Common Misconception

Misconception	Accurate science	Links/resources/suggestions
Sounds can be produced without using any material objects.	Sound is produced when an object vibrates sending compressional waves into the surrounding material (solid, liquid or gas). Sound cannot move without material to travel through. This is why we cannot hear sounds from space.	
Hitting an object harder changes the pitch of the sound produced.	Pitch is controlled by the rate of vibrations. Hitting an object harder produces a louder sound.	
In wind instruments, the instrument itself vibrates (not the internal air column).	An internal column of air acts as an acoustic resonator. Pitch is controlled by making changes to the air column by modifying the length of the column (such as by sliding or engaging valves) or by changing the frequency of vibration by opening or closing holes along the side of the tube. Some wind instruments use a reed to produce vibrations.	
Loudness and pitch are the same thing.	Pitch is how high or low the sound is. This is changed by vibration rate. Loudness is the number of decibels produced. Both high and low pitches can be either loud or soft.	

Misconception	Accurate science	Links/resources/suggestions
Human voice sounds are produced by a large number of vocal cords that all produce different sounds.	Human have one set of vocal cords (or vocal folds) which vibrate in different ways to produce a range of sounds. Muscles change the elasticity and tension of the vocal folds to change the pitch of sounds.	

Vocabulary

Science vocabulary is most effectively mastered when it is introduced in the natural course of instruction. Rather than being taught in isolation at the beginning of a lesson or unit, vocabulary should be taught as the need for a term is encountered. Starting instruction by defining vocabulary lists is discouraged. Careful modeling of the correct use of scientific terminology by the instructor, along with the encouragement of rich student discourse, is a better way to integrate the correct usage of scientific vocabulary into students' existing understandings. Teachers should encourage students to use proper terms as they ask questions, design experiments and support claims with evidence. Traditional word walls can be replaced with student-created illustrations of terms or scientific models annotated with proper vocabulary. Refer to STEM Teaching Tools Practice Brief 66 for more information.

RESOURCES FOR USE WITH STUDENTS

Lessons and Classroom Materials

- This PBS site describes how to construct a simple device from a bowl and plastic wrap to show energy transferred by sound waves to make sand bounce. This activity can be easily done at home during virtual or hybrid instruction or as a homework activity.
- The Ohio Environmental Protection Agency's' Project WET program offers training and resources for K-12 teachers that promote deep understanding about all aspects of water and the interconnectedness of all of Earth's spheres (Earth Systems). The early childhood education guide *Getting Little Feet Wet* includes two activities, *Thunderstorm* and *Rainstick* that relate sound to weather events. Each links to ELA standards and includes suggested book lists. Check the Project WET website for training dates and information.
- Have students design their own musical instruments, test the instruments and explain how each produces sound. Incorporate the technological and engineering cognitive demand by providing simple materials and allowing students to design from scratch. Students could also be asked to improve on existing designs (such as to change pitch or loudness). If you need a starting point, here are some examples.

Media

It is important to incorporate a variety of primary and secondary sources of information so students learn to reflect on, and engage in, quality discourse around pertinent topics, as well as evaluate the validity of information sources. Using media is a natural way to support disciplinary literacy or integrate science with English language arts. The following materials are relevant to this standard and can be incorporated into lessons. Students and classes have a variety of characteristics and needs. Always preview materials before use to determine appropriateness.

Books

- Ah, Music by Aliki
- All About Sound by Lisa Trumbauer
- Sound Loud, Soft, High, and Low By Natalie M Rosinsky
- Sounds all Around by Wendy Pfeffer

LIFE SCIENCE (LS)

Topic: Physical and Behavioral Traits of Living Things

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

CONTENT STATEMENT

K.LS.1: Living things have specific characteristics and traits.

Living things grow and reproduce. Living things are found worldwide.

CONTENT ELABORATION

Kindergarten Concepts

The emphasis of this content statement is to build a grade-appropriate understanding of what it means to be living, not to distinguish living and nonliving. Nonliving things often share some characteristics with living things (e.g., a fire uses energy and grows). Simply listing the characteristics that distinguish living things from nonliving things is not appropriate at this grade level.

There are different kinds of living things. The focus is on familiar organisms (e.g., grass, trees, flowers, cats, dogs, horses). Some grade-appropriate characteristics include that living things grow, reproduce, require energy and respond to stimuli. Animals need food for energy; plants acquire energy from the sun.

Living things respond to stimuli (e.g., fish in an aquarium respond to the addition of food). Living things grow (e.g., seedlings placed in soil grow). Conduct experiments and explorations to observe what happens when plants are placed in different classroom habitats (e.g., on the floor, in a closet, on a desk). Some observations can also be done virtually.

When studying living things, ethical treatment of animals, safety procedures and proper hygiene 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.

Future Application of Concepts

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

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

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

Page Break

EXPECTATIONS FOR LEARNING

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

VISIONS INTO PRACTICE: CLASSROOM EXAMPLES

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

Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Nature investigations			
	Observe nature in a variety of ecosystems, multiple times a year. Record the different plants and animals found and patterns that emerge throughout the year. Design an investigation to document plant growth.	Draw or take pictures as a plant grows (e.g., draw pictures each day of a bud of a flowering plant to document its growth). Document and describe the living things found in an area.	Describe characteristics and traits of a living thing in the home or school habitat.
Classroom living organism			
Design a habitat that will support a classroom pet or plant. Provide for all its needs including, but not limited to food, water, air, shelter, cleanliness and safety.		Keep a classroom journal or graph documenting the growth of a plant or animal. Alternatives to a classroom pet could include webcams and visits to zoos or parks.	Describe how a chosen organism changes as it grows.
Living things grow and reproduce			
	Design an investigation, using student heights, a class pet or webcams, where students watch and document living things as they grow (e.g., find a webcam watching a nest or baby animals and, as a class, take sequential screenshots of the babies).	Create a collage of animals connecting adults and offspring. Create a class book of animals and their babies. **Note:** *Neither of these should focus on different life cycles.*	Explain that living things grow and reproduce.
Characteristics of plants			
Design and plant a native pollinator garden. Make observations of the changes that occur. Observe what animals come to visit and make predictions about the purpose of their visits (e.g., food, shelter).	Design an investigation to observe how plants grow (e.g., bean seed on a paper towel or dampened cotton). • How does location affect plant growth? • Which direction do a plant's roots and leaves grow? • How will seeds grow after being turned upside down (e.g., after planting seeds in plastic baggies, let them sprout for a few days then turn half the baggies upside down to determine which direction the plants now grow)?	Draw pictures to document different plants' growth patterns. Use either classroom plants or a flower garden. Create a graph and document growth on a regular basis. Discuss and compare differences among plants.	Describe how a plant grows. Explain that a plant's stem and leaves grow toward the sun and its roots grow down.

Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Living things are found all over the world			
	Explore the different types of plants and animals that are found around the world (e.g., visit local zoos, use worldwide webcams or computer sites like National Geographic Kids). Research different animals and plants to determine where they naturally live. Using results from the research, create a classroom map to illustrate that living things are found all over the world.	Create a class book for regions of the world and document what plants and animals can be found there.	Explain that living things can be found all over the world.

RESOURCES FOR TEACHERS

Equity/Diverse Learners

- The Ohio Department of Education provides strategies for meeting the needs of all learners, including gifted students, English Learners (EL) and students with disabilities.
- Resources based on the Universal Design for Learning principles are available at CAST.org.

Connections within and across discipline

- Africam has streaming webcams showing live views of African animals in native habitats. In addition to the live stream, there are a variety of still photos and video highlights available. Carefully listening to the sounds heard allows students to practice making auditory observations and provides a link between this standard and K.PS.2. Recording descriptions of the sounds lets students practice data collection skills. Similarities and differences in sounds can be explored. Students also can discuss whether each sounds like tapping, blowing or plucking. The site could be shared with parents for at home activities.
- Project Learning Tree (PLT) helps students learn basic concepts about trees and forest ecosystems and the kinds of ecological services they provide. The activity *Signs of Fall* has students explore the changes trees experience during the fall. This is a good example of plants responding to stimuli from the environment (changes in light and temperature). It can also tie to K.PS.1 as students collect, sort, classify and count fall leaves and seeds. The *Environmental Experience for Early Childhood guide, Section Two* has students make observations as trees change throughout the year. The activities in this section also support K.ESS.1, seasonal changes in weather, and K.PS.1, sorting and classifying. Many of the activities in this section develop reading, writing, math and art skills. PLT's professional development helps teachers learn how to teach environmental concepts and be comfortable teaching outdoors—in urban, suburban, and rural settings. To attend (low cost in-person/online) workshops and access PLT resources visit their website or Ohio Department of Natural Resources Division of Forestry PLT website.

Content Support

- Rules and regulations for wild animal collections in Ohio are published by the Department of Natural Resources, Wildlife Division. *Animals in the Classroom* provides guidance, explains legally which organisms may be collected and offers advice on the use of animals in the classroom.
- Projects that involve the collection/monitoring/tagging of native Ohio wildlife require a legal collection permit. Information and applications for a Scientific Collection Permit and an Education Permit can be found under the "Wild Animal Collection" tab at this link. Permits require a $25 annual fee, along with reporting about your projects.

Common Misconceptions

Benchmarks 2061 outlines common understanding students have about living things at various grade bands.

Misconception	Accurate Science	Links/Resources
All living things move from place to place.	Many living things do not move about freely under their own power. Examples include plants, coral, anemones.	Show students that plants have basic characteristics of living things (grow, respond, reproduce).
Plants do not move	Plants do move through various mechanisms, but the movement is often very slow. For example, when a plant is placed such that it is getting sunlight from one direction only, it will grow towards the light. The cells on the side with no light lengthen, pushing the plant towards the light. This is an example of a plant responding to a stimulus.	Show a video of a Venus fly trap catching frogs or yellowjackets. Preview before using with students; some kindergartners could be disturbed by this predator-prey relationship, particularly with the frog. This video shows Mimosa Pudica (touch me not plant) reacting to touch. You can find videos showing time-lapse movement of plants bending towards light (phototropism) or the growth of roots towards Earth (geotropism). Have students grow seedlings in a box with only one opening to observe phototropism firsthand.
All living things breathe.	All living things require energy and, in most cases, need oxygen to metabolize energy from nutrients. However, not all living things get oxygen by "breathing." Plants exchange gases through their leaves. Animals obtain oxygen by various means from either air or water. Humans and other mammals, birds and reptiles breathe with lungs to get oxygen into the body and remove carbon dioxide. Fish use gills for the same purpose.	At this grade level it is enough to know that living things require energy and that different organisms get energy in different ways. Plants convert light energy to food and animals get energy from eating plants or other animals.
Trees, grass, vegetables and weeds are not plants.	Plants have many different characteristics. There are many different types of plants throughout the world. Not all plants have the same structures (stems, leaves, flowers, roots).	Some common misconceptions student have about plants can be found at this site. Some formative assessment probes related to plant misconceptions are also listed under Probing for Understanding.
Living organisms are only those organisms that are currently alive.	In science a living organism refers to anything that has been alive. This includes organisms that have died (dead log, decaying carcass) as well as types of organisms that are extinct (dinosaurs).	

Vocabulary

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RESOURCES FOR USE WITH STUDENTS

Lessons and Classroom Materials

- Webcams can be used to observe animals not found in the local environment. Below are links to some webcams but there are many others in operation. Be sure to check the availability of local webcams which can help make the animals more relevant to young observers.
  - Explore.org provides links to hundreds of webcams showing a variety of animals
  - Monterey Bay Aquarium
  - Africam.com has various live safari cams as well as photo and video resources and sound walks
  - The Cornell Lab of Ornithology has various bird cams
  - Here is a list of clickable links to zoos with webcams
- *Growing Up WILD* 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 at low cost or free of charge when they attend a workshop. Information about upcoming workshops are available on the Ohio Department of Natural Resources website.
  - The *Growing Up WILD* activity *Field Study Fun* has students investigate a field study plot to observe plant and animal interactions over time.
  - The *Growing Up WILD* activity *Grow As We Go* has children explore the life cycles of familiar wildlife and understand that living things grow and change.
  - The *Growing Up WILD* activity *Seed Need* has children explore seeds and how animals spread seeds.
  - The *Growing Up WILD* activity *Wildlife Is Everywhere* has children make observations to understand that wildlife is all around us.
- The Ohio Environmental Protection Agency's' Project WET program offers training and resources for K-12 teachers that promote deep understanding about all aspects of water and the interconnectedness of all of Earth's spheres (Earth Systems). The early childhood education guide *Getting Little Feet Wet* (GLFW) includes an activity, *Living Water,* where students explore the water content of living things. Supporting resources are available on the GLFW tab at the website; the book of actual activities is available in the Project WET store or by attending a training session. Contact the state coordinator for GLFW training dates and information.
- In this activity students sprout three types of seeds and use observations over time to compare the characteristics and growth of beans, corn and radishes. Worksheets for sequencing and labeling are available.
- Although actual plants and plant parts are best, picture cards of plants can be used for students to make observations or comparisons. There are many other sources of pictures, including personal photos taken in the local area, that can provide additional variety. Giving human traits to nonhuman living things can lead to misconceptions. This personification should be avoided during science lessons. Consider not using pictures such as the one with a bee wearing a hat. Since personification is widely encountered in literature of many genres, it could be helpful to discuss with students that stories often include this, but that organisms do not actually possess these human traits or behaviors.
- The Ohio Department of Natural Resources provides information about observing animals in the wild while promoting safety for children and wildlife. The Division of Wildlife's Search for Species has photos and information about Ohio's wild plants and animals.

Media

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Books

- *Do You Know Which Ones Will Grow?* by Susan Shea
- *Each Living Thing* by Joanne Ryder
- *I am a Living Thing* by Bobbie Kalman

LIFE SCIENCE (LS)

Topic: Physical and Behavioral Traits of Living Things

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

CONTENT STATEMENT	CONTENT ELABORATION
K.LS.2: Living things have physical traits and behaviors, which influence their survival. Living things are made up of a variety of structures. Some traits can be observable structures. Some of these structures and behaviors influence their survival.	**Kindergarten Concepts** At this grade level, providing exposure through personal observation and stories to a large variety of living things is required. The focus is not on naming the structures of living things but associating through interaction and observation that living things are made of structures, and because of those structures, living things can do specific activities. Identify and discuss examples, such as: birds having wings for flying and beaks for eating; dogs having eyes for seeing, teeth for chewing and legs for moving; trees having leaves to capture sunlight and trunks for support. Concrete experiences are necessary to deepen knowledge of the traits and behaviors of living things. Technology can be used to compare data on the number of honeybees observed in the schoolyard with other schools. Additional inquiry investigations include conducting observations of pond water (focusing on macroscopic organisms), raising a classroom pet (check for student allergies), bird watching, noting differences between different types of plants and planting seeds and watching them grow. **Future Application of Concepts** **Grades 1-2:** The physical environment is identified as the source for what organisms need to survive. **Grades 3-5:** Plants and animals have certain physical or behavioral characteristics that improve their chances of surviving in specific environments. **Grades 6-8:** Changes in environmental conditions can affect how beneficial a trait will be for survival and reproductive success of an individual or an entire species.

EXPECTATIONS FOR LEARNING

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

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Designing technological/engineering solutions using science concepts	Demonstrating science knowledge	Interpreting and communicating science concepts	Recalling accurate science
Nature observations			
Design and create an animal-proof structure (e.g., raccoon proof garbage can, squirrel proof bird feeder).	Choose a focus for observation (e.g., trees, birds, insects). Take note of the physical structures of that living organism and discuss how those structures influence the organism's survival (e.g., wings for flight, placement of eyes, thorns).	Sort collections or drawings of organisms by similar structures. Discuss similarities with classmates. Compare the human heart with the heart shape. Explain what job the heart does. Explore the human sensory system including sight, touch, taste, smell and hearing. Identify the sensory organs and their functions. Identify ways each of these senses helps humans survive.	Give an example of a structure and tell how it helps an organism survive. Identify the major parts of the human body using appropriate names. Describe their functions.
Insect observations			
	Create a plate of food to attract insects. Take the plate outside and observe what types of insects are attracted. Observe the insects' structures and behaviors. Explore what happens if the plate contains different foods or is placed in a new location.	Observe and document body structure, behavior and numbers of insects visiting an insect food plate. Discuss questions such as: What do insects' bodies look like? How do they move and communicate?	Describe an insect's structure and behavior.
Bird observations			
	Place birdfeeders around the schoolyard with different types of seed/food in each. Observe which birds are attracted to each feeder. Observe the birds' structures and behaviors.	Observe and document body structure, behavior, and numbers of birds visiting a feeder. Discuss questions such as: How are the beaks of different birds similar or different? How do birds react to one another? Is the feeding behavior the same in different seasons?	Describe a bird's structure and behavior.

RESOURCES FOR TEACHERS

Equity/Diverse Learners

- The Ohio Department of Education provides strategies for meeting the needs of all learners, including gifted students, English Learners (EL) and students with disabilities.
- Resources based on the Universal Design for Learning principles are available at CAST.org.

Connections within and across disciplines

- The NFTI (NonFiction Texts in Inquiry-based Science) activity Whose Track is That uses 5 nonfiction texts to explore animal structures and their functions to investigate how specific parts help an animal survive in its environment. The animal track rubbing plates suggested are available at low cost through a variety of retail establishments.
- The Cornell Lab *Building Literacy Through Nature* integrates literacy and science. They provide a free download of Lesson 4 which uses the book *On Duck Pond* by Jane Yolen as part of a study of bird behavior in habitats.
- Readworks.org is free to educators and hosts a variety of texts and supporting materials that align to this standard.

Content Support

- Ohio Department of Natural Resources Division of Wildlife's WILD School Sites program provides resources, grants, and workshops to help schools create habitat projects on their school grounds.
- The Cornell Lab website has a variety of resources and professional development related to citizen science and authentic investigations.

Common Misconceptions

Misconception	Accurate Science	Links/Resources
Plants have human behaviors such as eating, drinking or breathing.	Plants have structures that allow them to take in water, nutrients and energy. These structures are different from the human structures which perform similar functions. The process for obtaining energy is different in plants and animals. Animals eat to obtain energy. Plants take up water and minerals from soil, but not "food." Chloroplasts plants absorb the sun's energy for use in photosynthesis. The products of photosynthesis are later used by the plant as an energy source.	
Plants need things provided by people.	While people often care for plants (especially those indoors), plants as a whole are not dependent on people for their needs.	

Vocabulary

Science vocabulary is most effectively mastered when it is introduced in the natural course of instruction. Rather than being taught in isolation at the beginning of a lesson or unit, vocabulary should be taught as the need for a term is encountered. Starting instruction by defining vocabulary lists is discouraged. Careful modeling of the correct use of scientific terminology by the instructor, along with the encouragement of rich student discourse, is a better way to integrate the correct usage of scientific vocabulary into students' existing understandings. Teachers should encourage students to use proper terms as they ask questions, design experiments and support claims with evidence. Traditional word walls can be replaced with student-created illustrations of terms or scientific models annotated with proper vocabulary. Refer to STEM Teaching Tools Practice Brief 66 for more information.

RESOURCES FOR USE WITH STUDENTS

Lessons and Classroom Materials

- *Growing Up WILD* 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 at low cost or free of charge when they attend a workshop. Information about upcoming workshops are available on the Ohio Department of Natural Resources website.
  - The Growing Up WILD activity *Field Study Fun* has students investigate a field study plot to observe plant and animal interactions over time.
  - The Growing Up WILD activity *Bird Beak Buffet* has children learn about the special functions of bird beaks
  - The Growing Up WILD activity *Owl Pellets* has children dissect an owl pellet and learn what owls eat.
  - The Growing Up WILD activity *Ants on Parade* has students go outside to observe ant behavior and learn insect characteristics.
  - The Growing Up WILD activity *Hiding in Plain Sight* has children play a game of hide and seek to learn about important adaptations in many wild animals.
- Project Learning Tree (PLT) helps students learn basic concepts about trees and forest ecosystems and the kinds of ecological services they provide. The activities in *Environmental Experiences for Early Childhood guide, Section Three* have students become familiar with their local trees to explore tree parts, products, and benefits. To use most PLT materials teachers need to attend a workshop (in person or online). Information about upcoming workshops is available on the ODNR Division of Forestry website.
- *STEM from the Start* has an Awesome Animals unit that explores structures of animals. Answers to student generated questions are discovered as they watch video segments punctuated by a wide range of activities. The unit culminates in designing an orthotic for an injured animal. A detailed discovery guide and printable support materials can be downloaded after a free sign up. Most of the activities listed support this standard, but there are a few materials related to inheritance of traits that are better aligned to Grade 3. For kindergarten, these sections could be minimized or skipped. It is important that students recognize the term "animal" includes much more than vertebrate animals. While there are some invertebrate animals used in the activities, the video focuses mainly on domesticated animals. Be sure to expose students to a wide variety of local animals such as worms, insects, snails, slugs, pill bugs, and other invertebrate animals during outdoor walks and investigations.
- The Cincinnati Zoo's Bird Beak Bonanza explicitly relates structure to function for bird beaks. Although listed for grades 1-7 it could be adapted for use with kindergarteners.
- Observe the physical characteristics of plants and animals and determine how those traits are involved in each organism's survival. Have students generate and discuss a variety of questions based on the animals seen in the schoolyard or local outdoor space. Questions might include: *How do animals capture prey? How do birds get insects from a tree? Why do some birds have webbed feet and others do not? Those birds that do have webbed feet live in what type of environment? How do flowers help plants? What structure keeps a tree from falling over in the wind? What structure helps grass get the water that it needs? What traits does a squirrel have and how do these traits help the squirrel? Would it help a worm to have legs and feet?*

Media

It is important to incorporate a variety of primary and secondary sources of information so students learn to reflect on, and engage in, quality discourse around pertinent topics, as well as evaluate the validity of information sources. Using media is a natural way to support disciplinary literacy or integrate science with English language arts. The following materials are relevant to this standard and can be incorporated into lessons. Students and classes have a variety of characteristics and needs. Always preview materials before use to determine appropriateness.

Books

- *What Do You Do with A Tail Like This?* by Steve Jenkins and Robin Page
- *Best Foot Forward-Exploring Feet, Flippers, and Claws* by Norma Simon
- *Amazing Animals* by Robin Bernard
- *Big Tracks, Little Tracks-Following Animals Prints* by Millicent Selsam
- *On Duck Pond* by Jane Yolen

CLASSROOM PORTALS

- This video highlights the power of improving work based on effective feedback. Careful observation skills are critical to science and this activity helps develop those observational skills. The video also showcases how capable young students are of providing useful feedback on the work of others. It is important to foster these habits of mind beginning in kindergarten so that students become independent learners. This lesson also reminds us, as educators, of the importance of providing specific actionable feedback and not accepting first attempts as students' best work.