

K-4 Science
Grade Level
Content Expectations
Companion Document

v.1.09



Kindergarten Science Content Expectations Companion Document

SCIENCE

- **Unit 1: Observations With Senses**
- **Unit 2: Pushes and Pulls**
- **Unit 3: Basic Needs of Living Things**
- **Unit 4: My Earth**

- **Big Ideas**
- **Clarifications**
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- **Measurements**

- **Instructional Framework**
- **Enrichment**
- **Intervention**
- **Real World Context**
- **Literacy Integration**
- **Mathematics Integration**



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Introduction to the K-7 Companion Document An Instructional Framework

Overview

The Michigan K-7 Grade Level Content Expectations for Science establish what every student is expected to know and be able to do by the end of Grade Seven as mandated by the legislation in the State of Michigan. The Science Content Expectations Documents have raised the bar for our students, teachers and educational systems.

In an effort to support these standards and help our elementary and middle school teachers develop rigorous and relevant curricula to assist students in mastery, the Michigan Science Leadership Academy, in collaboration with the Michigan Mathematics and Science Center Network and the Michigan Science Teachers Association, worked in partnership with Michigan Department of Education to develop these companion documents. Our goal is for each student to master the science content expectations as outlined in each grade level of the K-7 Grade Level Content Expectations.

This instructional framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings and expanding thinking beyond the classroom.

These companion documents are an effort to clarify and support the K-7 Science Content Expectations. Each grade level has been organized into four teachable units- organized around the big ideas and conceptual themes in earth, life and physical science. The document is similar in format to the Science Assessment and Item Specifications for the 2009 National Assessment for Education Progress (NAEP). The companion documents are intended to provide boundaries to the content expectations. These boundaries are presented as “notes to teachers”, not comprehensive descriptions of the full range of science content; they do not stand alone, but rather, work in conjunction with the content expectations. The boundaries use seven categories of parameters:

- a. **Clarifications** refer to the restatement of the “key idea” or specific intent or elaboration of the content statements. They are not intended to denote a sense of content priority. The clarifications guide assessment.
- b. **Vocabulary** refers to the vocabulary for use and application of the science topics and principles that appear in the content statements and expectations. The terms in this section along with those presented

within the standard, content statement and content expectation comprise the assessable vocabulary.

- c. **Instruments, Measurements and Representations** refer to the instruments students are expected to use and the level of precision expected to measure, classify and interpret phenomena or measurement. This section contains assessable information.
- d. **Inquiry Instructional Examples** presented to assist the student in becoming engaged in the study of science through their natural curiosity in the subject matter that is of high interest. Students explore and begin to form ideas and try to make sense of the world around them. Students are guided in the process of scientific inquiry through purposeful observations, investigations and demonstrating understanding through a variety of experiences. Students observe, classify, predict, measure and identify and control variables while doing "hands-on" activities.
- e. **Assessment Examples** are presented to help clarify how the teacher can conduct formative assessments in the classroom to assess student progress and understanding
- f. **Enrichment and Intervention** is instructional examples that stretch the thinking beyond the instructional examples and provides ideas for reinforcement of challenging concepts.
- g. **Examples, Observations, Phenomena** are included as exemplars of different modes of instruction appropriate to the unit in which they are listed. These examples include reflection, a link to real world application, and elaboration beyond the classroom. These examples are intended for instructional guidance only and are not assessable.
- h. **Curricular Connections and Integrations** are offered to assist the teacher and curriculum administrator in aligning the science curriculum with other areas of the school curriculum. Ideas are presented that will assist the classroom instructor in making appropriate connections of science with other aspects of the total curriculum.

This Instructional Framework is NOT a step-by-step instructional manual but a guide developed to help teachers and curriculum developers design their own lesson plans, select useful portions of text, and create assessments that are aligned with the grade level science curriculum for the State of Michigan. It is not intended to be a curriculum, but ideas and suggestions for generating and implementing high quality K-7 instruction and inquiry activities to assist the classroom teacher in implementing these science content expectations in the classroom.

Kindergarten GLCE Companion Document

Unit 1: Observations with Senses

SCIENCE

- **Big Ideas**
- **Clarifications**
- **Inquiry**
- **Vocabulary**
- **Instruments**
- **Measurements**
- **Instructional Framework**
- **Enrichment**
- **Intervention**
- **Real World Context**
- **Literacy Integration**
- **Mathematics Integration**

Kindergarten Companion Document

K-Unit 1: Observations with Senses

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Kindergarten Unit: Observing with Senses

Content Statements and Expectations

Background –

The Kindergarten Unit 1: *Observations with Senses* is the only unit in the K-7 Science Curriculum that focuses entirely on inquiry and science skills rather than science content within inquiry. This unit presents the initial opportunity for young learners to explore their world and concentrate on the skills necessary to make good observations. The importance of the use of the senses for observation continues throughout the curriculum in grades first through fourth. In the Instructional Examples, students are guided in the process of scientific inquiry through purposeful observations, raising questions, making sense of observations, developing vocabulary, investigating, and making meaning of the experience.

Code	Statements & Expectations	Page
S.IP.E.1	Inquiry involves generating questions, conducting investigations, and developing solutions to problems through reasoning and observation.	3
S.IP.00.11	Make purposeful observation of the natural world using the appropriate senses.	3

K-Unit 1: Observations with Senses

Big Ideas (Key Concepts)

- The five senses are sight, sound, touch, smell, and taste.
- The senses aid in observation that helps us to understand our surroundings.
- Not all senses are used for all observations.

Clarification of Content Expectations

Standard: Inquiry Process

Content Statement – S.IP.E.1

Inquiry involves generating questions, conducting investigations, and developing solutions to problems through reasoning and observation.

Content Expectation

S.IP.00.11 Make purposeful observation of the natural world using the appropriate senses.

Instructional Clarifications

1. A purposeful observation is to look closely and carefully at something to learn more about it.
2. The senses include the sense of sight, sound, touch, smell, and taste.
3. Appropriate senses refer to limited and appropriate use of senses in science for safety.
4. The sense of taste is only explored in carefully supervised and controlled investigations. Permission is required to use the sense of taste.
5. The sense of smell is only explored using the “wafting” technique and not a direct smell or inhalation of the material.
6. Students recognize that good observations are not limited to the sense of sight, but include purposeful observations using all the appropriate senses within safety guidelines.

Assessment Clarifications

1. The senses include the sense of sight, sound, touch, smell, and taste.
2. Appropriate senses refer to limited and appropriate use of senses in science for safety.
3. Students recognize that good observations are not limited to the sense of sight, but include purposeful observations using all the appropriate senses within safety guidelines.

**Inquiry Process, Inquiry Analysis and Communication,
Reflection and Social Implications**

Inquiry Processes
S.IP.00.11 Make purposeful observation of the natural world using the appropriate senses.
S.IP.00.12 Generate questions based on observations using the senses.
S.IP.00.13 Plan and conduct simple investigations using the senses.
S.IP.00.14 Manipulate simple tools (hand lens, balances) that aid observation and data collection.
S.IP.00.16 Construct simple charts from data and observations.
Inquiry Analysis and Communication
S.IA.00.12 Share ideas about the senses through purposeful conversation.
S.IA.00.13 Communicate and present findings of observations.
S.IA.00.14 Develop strategies for information gathering (ask an expert, use a book, make observations, conduct simple investigations, and watch a video).
Reflection and Social Implications
S.RS.00.11 Demonstrate science concepts about the senses through illustrations, performances, models, exhibits, and activities.

Vocabulary

Critically Important–State Assessable	Instructionally Useful
senses	hazardous
observation	safety
sight	magnifying glass
sound	microscope
taste	binoculars
touch	telescope
smell	sweet
feel	salty
	bitter
	sour
	eyes
	ears
	nose
	skin
	hands
	feet
	mouth
	tongue

Instruments, Measurements, Representations

Sense	Body Part	Other Tools	Importance
sight	eyes	Magnifying glass Microscope Binoculars Telescope Eye glasses	Helps us to see things in the environment and recognize others
sound	ears	Hearing aid	Helps us receive information by verbal as well as non-verbal communication
taste	mouth, tongue		Helps us select and enjoy food. There are four familiar tastes: sweet, salty, bitter, sour
touch	hands, feet, skin		Helps us learn by feeling the size, texture, shape, temperature
smell	nose		Helps us enjoy pleasant smells and recognize dangerous situations (i.e. smoke from fire)

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Inquiry: S.IP.00.11, S.IP.00.13, S.IP.00.14, S.IP.00.16, S.IA.00.12, S.IA.00.13, S.IA.00.14

Objectives

- Students learn that there are five senses.
- Students use their senses to make purposeful observations about the world.
- Students will sort objects based on observable attributes including shape, size, color, sound, and smell.

Engage and Explore

- Take a walk outside to make purposeful observations. If feasible and the area is safe, have students walk barefoot. Encourage students to share with a partner, while on the walk, some of the things they observe. Ask students questions during the walk to help them focus on their senses. What do you hear, smell, feel, or see? (S.IP.00.11)
- Make purposeful observations from one place by placing a hula-hoop or tied string in a circle and sit very quietly in the middle. Have students cover their ears and make observations, then close their eyes and make observations. (S.IP.00.11)
- Engage the students in a whole group discussion about their observations. Identify the senses they needed to make the observations. (S.IP.01.11, S.IA.00.12, S.IA.00.13)
- Set up science exploration centers with activities that explore the senses. Include objects that make different types of noise; swatches of materials with different textures to feel; plastic bottles with familiar scents to smell by the wafting method and identify; objects of various shapes, colors, and

sizes to sort. (Note: Children should not be allowed to put things in their mouth to taste unless closely supervised.)(S.IP.00.11, S.IP.00.12, S.IP.00.13, S.IA.00.14, S.RS.00.11)

- Give students sets of blocks, toy cars, buttons, shells, or other materials that have various attributes to sort. The attributes include size, color, shape, thickness, flexibility, type of material (i.e. wood, metal, or plastic), number of holes, or others. After sorting objects, ask students to describe how they sorted them. (S.IP.00.11, S.IP.00.12, S.IP.00.13, S.IA.00.14, S.RS.00.11)
- Have students sit quietly for two minutes and listen to all the noises they hear. First have them predict what they think they will hear. Afterwards, make a class list of all the noises and the things they think made them. (S.IP.00.11, S.RS.00.11)

Explain and Define

- With the whole group, share students' ideas for sorting objects. Brainstorm different ways the objects were sorted to show that there is more than one way to sort them. Show students how to use a graphic organizer such as a chart, or a one or two circle Venn diagram to record how they sorted their objects. (S.IP.00.11, S.IA.00.12)
- Go on a blindfolded walk with a partner. Taking turns, one child will lead another through a specified area. After the blindfold walk, have the student re-take the walk without the blindfold. In a large group discussion, let children describe how they felt when they were blindfolded compared to when they were not. Talk about what they are able to observe when they do not have their eyes to see. (S.IP.00.11, S.IA.00.13, S.RS.00.11)
- Read the book, *Through Grandfather's Eyes*, and compare the feelings experienced by John and his Grandpa to the ones they may have experienced in this activity. (S.IP.00.11, S.IA.00.14)
- What color of eyes is the most common in the classroom? Give children a small mirror to look at their eyes. Make a graph of the color of eyes of all the children in the classroom.
- Put various shaped blocks in a bag. Ask the children to find a block with a certain shape or size. Can they find a block of a certain color? Discuss what information the senses can and cannot provide. (S.IP.00.11, S.IA.00.12)
- Identify food by only using the sense of taste. Cut up an apple, pear, and potato. With eyes closed, hold your nose and taste the pieces. Record whether or not you were able to identify the food correctly using only the sense of taste. (S.IP.00.11)
- Identify food with the sense of smell. Pop popcorn and keep it out of sight. Ask students how they know you popped popcorn. Ask for their evidence the popcorn has been popped. (S.IP.00.11, S.IA.00.12)

Elaborate and Apply

- Elaborate on observations with senses by introducing observation tools. Give students hand lenses or simple microscopes to observe small things, like grains of sand, swatches of different materials, leaves, small insects, coins, and other very small objects. Give students binoculars to use when they are outside. Compare how hand lenses can help the eye see things that are small and binoculars can help students see things better when they are very far away. (S.IP.00.11, S.IP.00.14, S.IP.00.15)
- Discuss with the children the size of objects such as an airplane when it is close and when it is far away. Have them draw pictures to show the difference. (S.IP.00.11, S.RS.00.11)
- Working with a partner or small group, one student sorts a small set of objects by an attribute of his/her choice. The partner must guess the attribute his/her partner used to sort the objects. (S.IP.00.11, S.RS.00.11)
- Are two ears better than one? Investigate this by choosing a child to go to the center of a circle. This child will close his eyes while the teacher points to one of the other children in the circle who will snap their fingers or lightly clap. The child in the center points to where he hears the sound coming. Do this two more times. Then try it again, but have the child in the center cover one ear with his hand, thus using only one ear to hear the snap or clap. Is the child as accurate as before? Repeat two more times. (S.IP.00.11, S.IP.00.12, S.IP.00.13, S.RS.00.11)
- The teacher or a student stands behind the door or a screen. Make noises for other students to guess. For example, ring a bell or open the drawer. Include an activity that does not make noise, for example, writing on paper. This will show that sometimes you need to use more than one sense to better interpret an event. (S.IP.00.11, S.RS.00.11)
- Review all five senses and how they help by reading the big book students put together during the unit (see Writing Integration activity). (S.IP.00.11, S.IA.00.14)
- Make a texture graph and select from many articles to glue them into categories that make them similar. After students have classified their articles, label them with color, hard, soft, rough, smooth, etc. (S.IP.00.16)

Evaluate Student Understanding

Formative Assessment Examples

- Evaluate students' use of terms, knowledge of all five senses, and ability to observe with them during the small group activities and whole group discussions. (S.IP.00.11)
- Evaluate students' ability to sort and describe the attribute used to sort objects during sorting activities and discussions about the sorting activities. (S.IP.00.11)

Summative Assessment Examples

- Which sense do you use to identify the color of a Teddy Bear? (sight) (S.IP.00.11)

- Which senses can you use to observe the size of a Teddy Bear? (sight and touch) (S.IP.00.11)
- Which sense do you use to know that something is burning on the stove in the kitchen when you are in another room? (smell) (S.IP.00.11)
- Which sense do you use to observe that your milk is cold? (touch) (S.IP.00.11)
- Which sense do you use to tell if a candy is sweet or sour? (taste) (S.IP.00.11)
- Which senses can you use to tell if a car is coming down the street? (sound, sight) (S.IP.00.11)
- Which sense do you use to know if the water is running in the bathroom sink but you are in the bedroom? (sound) (S.IP.00.11)
- Show a picture of objects in a one-circle Venn diagram. Large 2-D shapes of various kinds are inside the circle and small 2-D shapes of the same various shapes are outside the circle. Circle the way these shapes were sorted. (color, shape, size) (S.IP.00.11)

Enrichment

- Explore the parts of the eye and ear and how they work.
- Describe ways to care for the eyes, ears, and nose.
- Research physical impairments related to the senses and how people learn to cope.

Intervention

- Some students may be color-blind and have difficulty with certain colors. If you notice this in a student, you may wish to discuss this with a parent. Use attributes other than color to evaluate that child's ability to sort.
- When sorting objects by attributes, it helps to have the attribute name or picture (or both) on a card or sentence strip to be placed by that set of objects.
- Word cards and pictures of the sense that is in focus for the lesson posted on the blackboard will help struggling readers relate the word to the concept.

Examples, Observations, and Phenomena (Real World Context)

All the information we receive as humans comes to us through our senses. Each sense is important, but each has its limitations. People who do not have the use of one sense are able to compensate with another. The best way to receive information is by using all the senses together.

All the information we receive from our senses of sight and hearing comes to our brain through special nerve endings. The epidermis, or top layer of the skin, has many nerve endings and these send messages to the brain so that we can tell what we are feeling. We can feel hot or cold, wet or dry, hard or soft, rough or smooth, strange or familiar. Your brain then figures it out and lets us know what to do with it.

In humans, the sense of smell is weak. As humans evolved they developed reasoning skills and did not depend as much on the sense of smell as other animals. Some people develop their sense of smell for a special use, i.e. wine makers and perfume makers. The tongue is covered with taste buds that have many nerve endings. We can only taste four flavors – sweet, salty, sour, and bitter. Different parts of the tongue have receptors for certain flavors. Saliva plays a role in tasting. The food must get wet with the saliva before we can taste it. Our sense of smell helps us taste the food we eat.

Animals have enhanced senses that help them survive. The owl and other nocturnal animals have special eyes that allow them to see in the dark. Deer, rabbits, and foxes are examples of animals with large ears to help them hear predators, prey and other dangers.

Literacy Integration

R.IT.00.04 Respond to individual and multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make meaning, and make connections.

R.CM.00.04 Apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about the individual senses:

The Five Senses, Aiki, 1989

The Five Senses, Margaret Miller, 1998

- After reading or listening to the reading of both texts that describe the five senses, students discuss how they use their senses. They discuss how the two books are the same and how they are different.

Writing

W.GN.00.03 Write a brief informational piece such as a page for a class book using drawings, words, word-like clusters, and/or sentences.

- Students cut and paste magazine pictures of people using their senses. They write a word or phrase about the picture for a classroom big book.

Speaking

S.CN.00.01 Explore and use language to communicate with a variety of audiences and for different purposes including problem solving, explaining, looking for solutions, constructing relationships, and expressing courtesies.

S.DS.00.03 Respond to multiple text types by reflecting, making meaning, and making connections.

- Students explain their thinking during the observation and sorting activities.
- Students engage in conversation about the readings from the suggested books and explain the connections they are making between the activities and the readings.

Mathematics Integration

G.GS.00.01 Relate familiar three-dimensional objects inside and outside the classroom to their geometric name, e.g., ball/sphere, box/cube, soup can/cylinder, ice cream cone/cone, refrigerator/prism

G.GS.00.02 Identify, sort, and classify objects by attribute and identify objects that do not belong in a particular group.

- Students use their senses to sort objects by shape, size, color, texture, etc.

Kindergarten GLCE Companion Document

Unit 2: Pushes and Pulls

SCIENCE

- **Big Ideas**
- **Clarifications**
- **Inquiry**
- **Vocabulary**
- **Instruments**
- **Measurements**
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Kindergarten Companion Document

K-Unit 2: Pushes and Pulls

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Kindergarten Unit 2: Pushes and Pulls

Content Statements and Expectations

Background –

The kindergarten content expectations for physical science are intended to build on observations students have made about motion prior to entering school. The unit uses the early learners' ability to correctly sense some of the behaviors of simple mechanical objects and objects in motion. The young learner can attach appropriate language to observations and investigations into motion, including that objects fall toward the Earth.

Code	Statements & Expectations	Page
P.FM.E.1	Position – A position of an object can be described by locating the object relative to other objects or a background.	5
P.FM.00.11	Describe the position of an object (above, below, in front of, behind, on) in relation to other objects.	5
P.FM.00.12	Describe the direction of a moving object (for example: away from or closer to) from different observers' view.	6
P.FM.E.2	Gravity – Earth pulls down on all objects with a force called gravity. With very few exceptions, objects fall to the ground no matter where the object is on Earth.	6
P.FM.00.21	Observe how objects fall toward the Earth	6
P.FM.E.3	Force – A force is either a push or a pull. Forces can change the motion of objects. The size of the change is related to the size of the force. The change is also related to the mass of the object on which the force is being exerted. When an object does not move in response to a force, it is because another force is applied by the environment.	7
P.FM.00.31	Demonstrate pushes and pulls on objects that can move.	7
P.FM.00.32	Observe that objects initially at rest will move in the direction of a push or a pull.	7
P.FM.00.33	Observe how pushes and pulls can change the speed or direction of moving objects.	7
P.FM.00.34	Observe how the shape and mass of an object can affect motion.	8

K-Unit 2: Pushes and Pulls

Big Ideas (Key Concepts)

- The position of the observer and object affect the description of motion.
- Pushes and pulls are forces that change the motion of objects.
- Change in motion is affected by the shape and mass of an object.
- Objects on Earth fall down toward the Earth unless something holds them up.

Clarification of Content Expectations

Standard: Force and Motion

Content Statement - P.FM.E.1

Position-A position of an object can be described by locating the object relative to other objects or a background. The description of the motion of an object from one observer's view may be different from that reported from a different observer's view.

Content Expectations

P.FM.00.11 Describe the position of an object (above, below, in front of, behind, on) in relation to other objects around it.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words the position of an object in relation to other objects around it.
2. At this level, students increase their describing words to include specific vocabulary that describes the position of an object in relation to other objects.
3. Students recognize that the description of the position of an object differs with the location of the observer.

Assessment Clarification

1. At this level, students increase their describing words to include specific vocabulary that describes the position of an object in relation to other objects.

P.FM.00.12 Describe the direction of a moving object (for example: away from or closer to) from different observers' views.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words the path of moving objects from different perspectives.
2. The description of the direction of a moving object is different when observing from different locations. (Example: A car moving toward a garage is moving toward the observer standing in the garage and away from the observer standing at the street.)
3. The description of the direction of a moving object in reference to another object is the same regardless of the location of the observer. (Example: The car that is moving toward the garage is moving toward the garage regardless of where the observer is standing.)

Assessment Clarification

1. The description of the direction of a moving object is different when observing from different locations.

Content Statement: P.FM.E.2

Gravity- Earth pulls down on all objects with a force called gravity. With very few exceptions, objects fall to the ground no matter where the object is on the Earth.

Content Expectation

P.FM.00.21 Observe how objects fall toward the Earth.

Instructional Clarifications

1. Observe is to look closely at something to learn more about it.
2. At this level, students are not held responsible for defining gravity.
3. Students observe that objects of all shapes and sizes fall down toward the Earth.
4. With few exceptions (helium filled balloons), objects fall to the ground no matter where the object is on Earth.
5. Note: A common misconception is that heavier or more massive objects fall to the Earth at a faster rate. All objects fall to the Earth at the same rate. The rate of falling objects is not appropriate for kindergarteners.

Assessment Clarification

1. Students observe that objects of all shapes and sizes fall down toward the Earth.

Content Statement: P.FM.E.3

Force – A force is either a push or a pull. The motion of objects can be changed by forces. The size of the change is related to the size of the force. The change is also related to the mass of the object on which the force is being exerted. When an object does not move in response to a force, it is because another force is being applied by the environment.

Content Expectations

P.FM.00.31 Demonstrate pushes and pulls on objects that can move.

Instructional Clarifications

1. Demonstrate is to show through manipulation of materials pushes and pulls on objects that make them move.
2. Students demonstrate the difference between a push and a pull.
3. A push is a force that moves an object forward or outward.
4. A pull is a force that moves an object toward the force or separates objects from attachment.

Assessment Clarifications

1. Students demonstrate the difference between a push and a pull.
2. A push is a force that moves an object forward or outward.
3. A pull is a force that moves an object toward the force or separates objects from attachment.

P.FM.00.32 Observe that objects initially at rest will move in the direction of a push or pull.

Instructional Clarifications

1. An object at rest is an object that is not in motion.
2. A push or a pull will cause an object at rest to move in the direction of the push or pull.

Assessment Clarifications

1. An object at rest is an object that is not in motion.
2. A push or a pull will cause an object at rest to move in the direction of the push or pull.

P.FM.00.33 Observe how pushes and pulls can change the speed or direction of moving objects.

Instructional Clarifications

1. Students make purposeful observations of how the speed of an object can be changed by an added push or pull.
2. Students make purposeful observations of how the direction of an object in motion can be changed by a push or a pull.

3. A push or a pull that changes the direction or speed of an object includes an applied push or pull or an incidental push or pull, such as striking another object, friction, or gravity.

Assessment Clarifications

1. Students make purposeful observations of how the speed of an object can be changed by an added push or pull.
2. Students make purposeful observations of how the direction of an object in motion can be changed by a push or a pull.

P.FM.00.34 Observe how the shape and mass of an object can affect motion.

Instructional Clarifications

1. Students make purposeful observations of how the motion of an object can be affected by shape, and mass.
2. Students observe how added mass affects the motion of the object.
3. Heavier objects require a greater force to start it in motion.

Assessment Clarifications

1. Students make purposeful observations of how the motion of an object can be affected by shape, and mass.

**Inquiry Process, Inquiry Analysis and Communication,
Reflection and Social Implications**

Inquiry Process
S.IP.00.11 Make purposeful observations of the movement of objects in response to pushes and pulls.
S.IP.00.12 Generate questions based on observations of objects falling toward the Earth.
S.IP.00.13 Plan and conduct simple investigations about pushes and pulls changing the speed or direction of moving objects.
S.IP.00.14 Manipulate simple tools (pencil) to collect data about the affect of pulls or pushes changing the speed or direction of moving objects.
S.IP.00.16 Construct simple charts from investigations about pushes and pulls changing the speed or direction of moving objects.
Inquiry Analysis and Communication
S.IA.0011 Share ideas through purposeful conversation about how pushes or pulls affect the speed or direction of moving objects.
S.IA.0012 Communicate and present findings of observations about the motion of an object (for example: away from or closer to) from different observer's views.
S.IA.0013 Develop strategies for information gathering (ask an expert, make observations, conduct investigations, watch a video) about forces affecting the motion of objects.
Reflection and Social Implications
S.RS.0011 Demonstrate the effect of pushes or pulls on the motion of objects through various illustrations, performances, models, exhibits or activities.

Vocabulary

Critically Important-State Assessable	Instructionally Useful
push pull direction speed shape size mass at rest above below in front of behind on under between on top away from closer to toward fast, faster slow, slower	north south east west right left different shapes (circle, square, triangle, cone, cylinder, sphere) weight

Instruments, Measurements, and Representations

Measurement	Instruments	Representations
distance a variety of objects travel	non-standard measurement instruments	non-standard units of measurement
mass of objects	comparison using senses	heavier, lighter, same

Measurement and measurement instruments are used in measuring how far an object travels compared to another object under the same conditions.

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Position: P.FM.00.11, P.FM.00.12

Gravity: P.FM.00.21

Force: P.FM.00.31, P.FM.00.32, P.FM.00.33, P.FM.00.34

Objectives

- Make observations of a variety of moving objects, including falling objects and describe the motion and position of the object.
- Focus on pushes and pulls and how they affect the motion of objects.

Engage and Explore

- Before introducing vocabulary that describes motion, make purposeful observations of common objects and brainstorm ways to describe the motion of the object. (P.FM.00.11, P.FM.00.12, P.FM.00.31, P.FM.00.32, P.FM.00.13, S.IP.00.11)
- Explore the motion of different objects by allowing students to work in groups with different sizes of balls, toy cars or trucks, cylinders, blocks, and cubes. Students explore the motion of objects that roll and slide. Students receive little explanation at this time and are allowed to acquire a common set of experiences to draw on as they continue their study into the motion of objects. (P.FM.00.34, S.IP.00.11, S.IP.00.12, S.IP.00.13)
- Encourage students to ask *what would happen if...* questions as they explore the motion of the objects. At this point in their explorations, students ask and answer simple questions and investigate as the opportunity arises. (P.FM.00.31, P.FM.00.32, P.FM.00.33, P.FM.00.34, S.IP.00.11, S.IP.00.12, S.IP.00.13)
- In small groups ask students to describe the motion of the object from their position. Ask is the object moving away from you? Is the object

moving toward you? Are both descriptions accurate? P.FM.00.11, P.FM.00.12, S.IA.00.12, S.IA.00.13)

Explain and Define

- Chart student ideas about words that describe motion and the position of objects. Only after students have brainstormed words that describe motion, sort the words used to describe the motion of objects into words that describe direction, speed, and position. Ask students to use the class chart to make a sentence that describes the motion of an object using a word from all three categories. Model for the students how to make a chart that shows how the list of motion describing words can be sorted. (P.FM.00.34, P.FM.00.11, P.FM.00.12, S.IP.00.16, S.IA.00.12)
- Take this opportunity to have groups share their motion observations with the rest of the class. Listen for vocabulary that describes the motion of each object. (S.IA.00.12)
- Ask students for ideas of how they could organize their observations into a chart. Discuss the different objects and student observations of how each moved. Students at this level are not expected to be able to organize a chart and make data entries, but instead, kindergarteners should be able to volunteer their information from their observations and tell where on the chart their data would best fit. (S.IP.00.12)
- Discuss the description of the direction the object traveled. Ask students to stand in different positions around the room and roll a ball or object across the room. Ask individuals to describe the motion from his/her position. (P.FM.00.11, P.FM.00.12, S.IA.00.13)
- Ask students what started the objects moving. Most students will recognize that in order for the object to start moving it required a push. Write the terms push and pull on the board or chart paper. Discuss the meaning of the terms. Ask students to demonstrate a push and a pull. (P.FM.00.31, S.RS.00.11)
- Brainstorm examples of objects that require a push (balls, swings, toy cars, push door closed, push down lids, etc.) to start moving and objects that require a pull (wagons, tug-of-war, shade pulls, rope on the flag, pull up socks, pull open doors, pull up zipper, etc). (P.FM.00.31, P.FM.00.32, P.FM.00.33, S.RS.00.11, S.IA.00.12)
- Demonstrate pulls with the class by playing a game of tug-of-war and have students explain the difference between pushing and pulling. (P.FM.00.31, S.RS.00.11)

Elaborate and Apply

- Continue student exploration into the path of moving objects and describing motion, have students work in groups with the balls, toy cars and cylinders and ramps. Give students sufficient time to conduct simple investigations into the motion of objects down the ramps. At this stage in their learning, students ask and answer “what would happen if…” questions as they change the angle of their ramps and find other objects to roll down the ramp. (P.FM.00.11, P.FM.00.34, S.IP.00.11, S.IP.00.12, S.IP.00.13)
- Facilitate the student activity by circulating among the groups and listening to their ideas and observing their simple investigations. Add a different shaped item to the students’ objects, such as a wooden block or cube and ask students to describe the motion of the block down the ramp. (P.FM.00.34, S.IP.00.11)
- After students have had considerable time exploring motion with the ramps, ask students to share their observations. Ask students what started the objects moving down the ramp – a push or a pull? Introduce the concept that all objects are pulled toward the Earth. Kindergarten students have an idea that objects fall down. Demonstrate the release of the ball (without a push or pull) at the top of a ramp and have students describe the motion of the ball rolling down the ramp. (P.FM.00.21, S.IP.00.11, S.IA.00.12)
- Change the angle of the ramp and repeat the release of the ball. Place the ramp flat and place the ball on the ramp. Ask students to discuss the push or pull that started the balls in motion when the ramp was at an angle. Students attach language to the concept at this point. Tell students that gravity is a force that pulls objects toward the Earth. (P.FM.00.21, S.IP.00.11, S.IA.00.12)
- Give students the opportunity to demonstrate how things fall down. Have students toss the ball up and observe it change direction and fall down. Students explore different size, shape, and mass of objects and observe and describe the path of motion as the objects fall down. (P.FM.00.21, P.FM.00.34, S.IP.00.11, S.IP.00.12, S.IP.00.13, S.IA.00.13)

Evaluate Student Understanding

Imbedded Assessment Examples

- Use the students’ discussion and trial and error investigations with the motion of different objects and the ramps to assess their ability to make observations of how objects move and fall down, and to plan and conduct simple investigations. (P.FM.00.21, P.FM.00.34)
- Use the class discussion and class chart to assess the students’ ability to describe motion. (P.FM.00.11, P.FM.00.12)
- Use student examples of pushes and pulls to assess their ability to demonstrate a push or pull. (P.FM.00.31)

- Use the students oral descriptions of the motion of the objects to assess their ability to describe the path of a moving object from different observers' views. (P.FM.00.12)
- As students work in groups, circulate among the students and listen to their ideas. Assess students' initial ideas about what started the objects moving. (P.FM.00.32)
- Use student descriptions of motion in different positions in the room. (P.FM.00.11 and P.FM.00.12)

Summative Assessment Examples

- Circle the pictures that demonstrate a push. (P.FM.00.31)
- Place an X on the pictures that demonstrate a pull. (P.FM.00.31)
- Circle the word that best describes the position of the ball. (P.FM.00.11)
- Draw an arrow that shows the path the ball will fall. (P.FM.00.21)

Enrichment

- Students plan and conduct simple investigations into motion of objects down ramps at different angles. The investigations include distance traveled and comparisons of distance of different shaped objects.
- Use a balance and have students make comparisons of motion of same shaped objects with different masses.
- Make observations of falling objects of different shapes and sizes that are dropped from the same distance.

Intervention

- Students are given the opportunity to explore different kinds of motion, rolling, sliding, bouncing, hopping, walking, running, etc.
- Practice left and right in terms of describing the motion and position of objects.

Examples, Observations and Phenomena (Real World Context)

Motion is an everyday phenomenon that develops into scientific knowledge of forces, including friction and gravity. Descriptive language that applies to motion gives students a basis for more detailed descriptions and the ability to describe from different observers' views. An awareness that the description of motion may change if the position of the viewer changes adds a new dimension to understanding motion and descriptions of motion.

The motion of an object does not change due to the description of the viewer. The motion of an object stays the same. It is the point of view that may change. For example, the car moving toward the garage does not change, but the car moving away from or toward the observer changes with a change in the position of the viewer.

The terms mass and weight are often used interchangeably. The term mass refers to the amount of material that makes up an object. Mass is more accurate term in most scientific explorations and applications. Weight is only applicable when discussing the force of gravity.

Literacy Integration

Reading

R.IT.00.02 with teacher guidance, discuss informational text patterns including descriptive and sequential.

R.IT.00.04 respond to individual and multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make meaning, and make connections.

R.CM.00.01 begin to make text-to-self and text-to-text connections and comparisons by activating prior knowledge and connecting personal knowledge and experience to ideas in text through oral and written responses.

R.CM.00.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

I Fall Down, Vicki Cobb, 1004
And Everyone Shouted Pull, Claire Llewellyn, 2001
Move It!, Adrienne Mason, 2005

- Activate prior knowledge of the motion of objects that are falling.
- Connect personal knowledge, experience, and understanding of how things fall down and the first introduction to gravity.
- Discuss and investigate the different experiences in the book.

Writing

W.GN.00.03 write a brief informational piece such as a page for a class book using drawings, words, word-like clusters, and/or sentences.

W.GN.00.04 contribute to a class research project by adding relevant information to a class book including gathering information from teacher-selected resources and using the writing process to develop the project.

- Write about the motion of an object from the observer's view.
- Compare the writing with that of another observer's view.

Speaking

S.CN.00.01 explore the use of language to communicate with a variety of audiences and for different purposes including problem solving, explaining, looking for solutions, constructing relationships, and expressing courtesies.

S.DS.00.03 respond to multiple text types by reflecting, making meaning, and making connections.

- Students use oral language to describe their observations and investigations into motion.
- Students communicate in small groups to solve problems and design a simple investigation.
- Retell an experience of falling down or objects that have fallen down.

Mathematics Integration

G.GS.00.01 Relate familiar three-dimensional objects inside and outside the classroom to their geometric name, e.g., ball/sphere, box/cube, soup can/cylinder, ice cream cone/cone, refrigerator/prism.

- Measurement – measure distance an object travels in non-standard units of measurement.
- Geometry – identify familiar shapes of different objects.

Kindergarten GLCE Companion Document

Unit 3: Basic Needs of Living Things

SCIENCE

- **Big Ideas**
- **Clarifications**
- **Inquiry**
- **Vocabulary**
- **Instruments**
- **Measurements**
- **Instructional Framework**
- **Enrichment**
- **Intervention**
- **Real World Context**
- **Literacy Integration**
- **Mathematics Integration**

Kindergarten Unit 3: Basic Needs of Living Things

Content Statements and Expectations

Background –

The kindergarten content expectations for life science build a greater understanding of the basic needs of all living things and classify living and nonliving things. Through direct classroom experiences of living things and their habitats, students begin to think beyond movement as the defining characteristic of life and recognize characteristics of living things with eating, breathing, and reproducing.

Code	Statements & Expectations	Page
L.OL.E.1	Life Requirements – Organisms have basic needs. Animals and plants need air, water, food and space. Plants also require light. Plants and animal use food as a source of energy and as a source of building material for growth and repair.	4
L.OL.00.11	Recognize that living things have basic needs.	4
L.OL.00.12	Identify and compare living and nonliving things.	4
E.SE.E.1	Earth Materials – Earth materials that occur in nature include rocks, minerals, soils, water, and the gases of the atmosphere. Some earth materials have properties that sustain plant and animal life.	5
E.SE.00.12	Describe how earth materials contribute to plant and animal life.	5

K - Unit 3: Basic Needs of Living Things

Big Ideas (Key Concepts)

- All living things have basic needs (air, water, food and space).
- Nonliving things do not have these basic needs.

Clarification of Content Expectations

Standard: Organization of Living Things

Content Statement – L.OL.E.1

Life Requirements- Organisms have basic needs. Animals and plants need air, water, food and space. Plants also require light. Plants and animals use food as a source of energy and as a source of building material for growth and repair.

Content Expectations

L.OL.00.11 Recognize that living things have basic needs.

Instructional Clarifications

1. Recognize is to identify as by previous experience or perceive as truth that living things have basic needs.
2. The needs of living things are limited to air, water, food and space to survive.
3. Living things include plants and animals.
4. Plants require air, water and sunlight to make their own food.

Assessment Clarifications

1. Living things need air, water, food and space to survive.
2. Living things include plants and animals.

L.OL.00.12 Identify and compare living and nonliving things.

Instructional Clarifications

1. Identify means recognize the differences between living and nonliving things.
2. Students identify living things as plants and animals.
3. Living things need air, water, and food to survive.
4. Nonliving things do not need water, food or air.
5. Nonliving things include things that once lived and things that never lived (logs versus rocks).

Assessment Clarifications

1. Students identify living things as plants and animals.
2. Living things need air, water, and food to survive.

3. Nonliving things do not take in water, food or need air.

Content Statement - E.SE.E.1

Earth Materials – Earth materials that occur in nature include rocks, minerals, soils, water, and the gases of the atmosphere. Some earth materials have properties that sustain plant and animal life.

Content Expectation

E.SE.00.12 Describe how earth materials contribute to plant and animal life.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words how soil and water contribute to plant and animal life.
2. At this level, students describe how plants grow in the soil and need water to grow and survive.
3. At this level, students describe how animals eat plants that grow in the soil, need water, and air to breathe to grow and survive.

Assessment Clarifications

1. At this level, students describe how plants grow in the soil and need water to grow and survive.
2. At this level, students describe how animals eat plants that grow in the soil, need water, and air to breathe to grow and survive.

**Inquiry Process, Inquiry Analysis and Communication,
Reflection and Social Implications**

Inquiry Processes
S.IP.00.11 Make purposeful observation of living and nonliving things using the appropriate senses.
S.IP.00.12 Generate questions about living things based on observations.
S.IP.00.13 Plan and conduct simple investigations into the basic needs of living things.
S.IP.00.14 Manipulate simple tools (hand lens, balances) that aid observation and data collection.
S.IP.00.16 Construct simple charts from data and observations of living things.
Inquiry Analysis and Communication
S.IA.00.12 Share ideas about the needs of living things through purposeful conversation.
S.IA.00.13 Communicate and present findings of observations of living things.
S.IA.00.14 Develop strategies for information gathering (ask an expert, use a book, make observations, conduct simple investigations, and watch a video).
Reflection and Social Implications
S.RS.00.11 Demonstrate science concepts about the needs of living things through illustrations, performances, models, exhibits, and activities.

Vocabulary

Critically Important-State Assessable	Instructionally Useful
living things	space
basic needs	sunlight
nonliving things	once living
air	dead
water	organisms
food	
plants	
animals	
survive	

Instruments, Measurements, Representations

Observation Tools	Representations
hand lens	Observation of living and non-living things.
pencils	Construct simple charts that demonstrate living and nonliving. (T-chart)

Instructional Framework

*The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is **NOT** a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.*

Instructional Examples

Life Requirements: L.OL.00.11, L.OL.00.12

Objectives

- Make observations of plants and animals and their interactions.
- Focus on the needs of each and how they help the organism survive.
- Make observations of the differences of living and nonliving things and the specific needs of living things.

Engage and Explore

- Brainstorm what is needed for organisms that will live in a classroom habitat. (L.OL.00.11)
- Students will set up a habitat to include living and nonliving organisms for example: in a terrarium with soil, seeds, worms, rocks, and bark. (L.OL.00.11, L.OL.00.12, S.IP.00.11, S.RS.00.11)
- An aquarium could be used with appropriate materials.
- Students will observe the habitat over time, taking class notes/pictures/journal entries, on any changes that they see over the course of the unit. (S.IP.00.11, S.IP.00.12)
- Plant need experiments may be done concurrently (for example – watering one seed and not another, or putting some in the dark and some in the light, etc.) (L.OL.00.11, S.IP.00.11, S.IP.00.13)

Explain and Define

- Living things have needs that sustain them and nonliving things do not. Identify living and nonliving things in the habitat. Students identify the needs of living things. (L.OL.00.11, L.OL.00.12)
- Make a T-chart to help organize the living and nonliving characteristics. (L.OL.00.12, S.IP.00.16)
- Address the misconception that seeds need sunlight to sprout and grow. Discuss the results of seeds in the light and seeds in the dark and how seeds do not get direct sunlight when planted in the ground. (L.OL.00.11)

Elaborate and Apply

- Air, water, food and space should be elaborated on. (L.OL.00.11)
- Compare/contrast the basic needs of plants with animals and humans. (L.OL.00.11)
- Discuss the earth materials soil, air, and water and how they contribute to the growth and survival of plants and animals. (E.SE.00.12)
- Determine if other living things would be able to survive in our classroom habitat and what may be the limiting factors. (L.OL.00.11, S.IA.00.12, S.IA.00.13)
- Explore many outside habitats and compare them to the classroom habitat. (S.IP.00.11, S.IP.00.12, S.IA.00.12, S.IA.00.13)

Evaluate Student Understanding

Formative Assessment Examples

- Check student observation/pictures/journal entries to determine if observations are appropriate/applicable. (L.OL.00.11)
- Student conversations in their groups can be used as basis for monitoring understanding. (L.OL.00.11)

Summative Assessment Examples

- Circle the living things. (L.OL.00.12)
- Circle the needs of living things. (L.OL.00.11)
- Choose the thing that is not alive. (L.OL.00.12)
- Choose the thing that does not use food. (L.OL.00.11)
- Choose the thing that does not need air. (L.OL.00.11)

Enrichment

- Students plan and build a habitat using an aquarium, terrarium or other habitat and some different organisms.

Intervention

- Break students into research groups that focus on one aspect of the ecosystem (e.g. plant group, worm group, rock group, soil group) and have students report out on the happenings of their group over observable time.
- Rotate through each group for more experience.

Examples, Observations, and Phenomena (Real World Context)

All organisms have basic needs (air, water, food or nutrition, and space). Young learners have a difficult time relating the basic needs of living things to themselves and other familiar animals. The recognition of plants as living things and the identification of trees as plants are also key at this stage in their understanding of living and nonliving things.

The classification of things as living and nonliving is the first step in classification of organisms. All living things have basic life functions: need food, grow, and have young. Living things include all plants and animals, including humans. Nonliving things include sand, rocks, clouds, and all man-made items. Children's toys are often given characteristics of living things that may add to the confusion of young learners. Media also attach living characteristics to nonliving things that students may site as living.

Parts of living things, such as leaves, branches, and molted skin are examples of once living things that cannot continue living without the whole organism. It does not grow, need food, air, or water, or have young.

Literacy Integration

Reading

R.IT.00.04 respond to individual and multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make meaning, and make connections.

R.CM.00.01 begin to make text-to-self and text-to-text connections and comparisons by activating prior knowledge and connecting personal knowledge and experience to ideas in text through oral and written responses.

R.CM.00.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

There are many good trade books available for learning about living and non-living things and their needs for survival. Many books focus on single organisms or habitats.

One Small Square, Donald Silver, 1997

Under One Rock, Anthony D. Fredericks, 2001

Animals and Their Babies, Melvin Berger, 1993

The Tiny Seed, Eric Carle, 1987

Wonderful Worms, Linda Glaser, 1992

- After reading or listening to the reading of texts that describe living things and their needs to survive, students discuss their experiences with living things, both plants and animals. Students relate how they find their food, water, air, and space in their homes and neighborhoods to that of animals in their habitats.

Writing

W.GN.00.03 write a brief informational piece such as a page for a class book using drawings, words, word-like clusters, and/or sentences.

W.GN.00.04 contribute to a class research project by adding relevant information to a class book including gathering information from teacher-selected resources and using the writing process to develop the project.

- Write a book on your classroom habitat experience.
- Write a fact book about one of the animals or plants observed in the classroom or schoolyard.

Speaking

S.CN.00.01 explore and use language to communicate with a variety of audiences and for different purposes including problem solving, explaining, looking for solutions, constructing relationships, and expressing courtesies.

S.DS.00.03 respond to multiple text types by reflecting, making meaning, and making connections.

- Read your book to the class.
- Students share their observations of living and nonliving things.
- Students engage in conversation about the classroom habitat and the needs for the living organisms in the habitat.

Mathematics Integration

G.GS.00.02 Identify, sort, and classify objects by attribute and identify objects that do not belong in a particular group.

- Students sort things using the criteria of living and nonliving.
- Students make observations of different leaves and sort by similar size, shape, color and other attributes.

Kindergarten GLCE Companion Document

Unit 4: My Earth

SCIENCE

- **Big Ideas**
- **Clarifications**
- **Inquiry**
- **Vocabulary**
- **Instruments**
- **Measurements**
- **Instructional Framework**
- **Enrichment**
- **Intervention**
- **Real World Context**
- **Literacy Integration**
- **Mathematics Integration**

Kindergarten Companion Document

K-Unit 4: My Earth

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Kindergarten Unit 4: My Earth

Content Statements and Expectations

Background –

The essential learning in Earth Science for Kindergarteners is to be able to identify different earth materials and recognize the earth materials necessary to grow plants, linking the common thread of understanding in Life Science and Earth Science.

Code	Statements & Expectations	Page
E.SE.E.1	Earth Materials – Earth materials that occur in nature include rocks, minerals, soils, water, and the gases of the atmosphere. Some earth materials have properties that sustain plant and animal life.	5
E.SE.00.11	Identify earth materials that occur in nature (rocks, sand, soil, and water).	5

K–Unit 4: My Earth

Big Ideas (Key Concepts)

- The Earth is made of materials (rocks, sand, soil, and water) that have many different properties.

Clarification of Content Expectations

Standard: Organization of Living Things

Content Statement – E.SE.E.1

Earth Materials- Earth materials that occur in nature include rocks, minerals, soils, water, and the gases of the atmosphere. Some earth materials have properties that sustain plant and animal life.

Content Expectations

E.SE.00.11 Identify earth materials that occur in nature (rocks, sand, soil, and water).

Instructional Clarifications

1. Identify means to recognize rock, sand, soil and water as earth materials and to recognize their differences.
2. Identification of earth materials is limited to the observations of rocks, sand, soil, and water.
3. Soil consists of once living and never living materials (decomposing plant and animal materials, rock, gravel, sand, and clay).

Assessment Clarification

1. Identification of earth materials is limited to the observation of rocks, sand, soil, and water.

**Inquiry Process, Inquiry Analysis and Communication,
Reflection and Social Implications**

Inquiry Processes
S.IP.00.11 Make purposeful observation of different earth materials (water, soil, sand, rock) using the appropriate senses.
S.IP.00.12 Generate questions based on observations of different earth materials.
S.IP.00.13 Plan and conduct simple investigations into the ability of different earth materials to absorb water.
S.IP.00.14 Manipulate simple tools (hand lens, balances) that aid observation and data collection of different earth materials, including water.
S.IP.00.15 Make accurate measurements with appropriate (non-standard) units of different earth materials.
S.IP.00.16 Construct simple charts from data and observations of earth materials.
Inquiry Analysis and Communication
S.IA.00.12 Share ideas about investigations into the properties of earth materials through purposeful conversation.
S.IA.00.13 Communicate and present findings of investigations into the ability of different earth materials to absorb water.
S.IA.00.14 Develop strategies for information gathering about earth materials. (Ask an expert, use a book).
Reflection and Social Implications
S.RS.00.11 Demonstrate through models and activities how earth materials absorb water.

Vocabulary

Critically important – State Assessable	Instructionally Useful
soil water rock sand	materials air gravel clay particle sieve

Instruments, Measurements, Representations

Measurement	Instruments	Representations
Compare weight of different earth materials	Balance	Heavier, lighter
Observations of texture, color, grain size	Hand lens	Color, larger, smaller, rough, smooth

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Earth Materials: E.SE.00.11

Objectives

- Recognize that the Earth is made up of water and land.
- Make observations and classify earth materials as water, sand, soil, or rock
- Explore how water and earth materials interact when combined.

Engage and Explore

- Engage student thinking by finding evidence that the Earth is made up of water and land. Use an inflatable globe and toss the globe to each student. Have students tell if their thumbs landed on land or water. Collect class data using tally marks. (E.SE.00.11, S.IP.00.16, S.RS.00.11)
- Go on a class rock hunt and ask students to collect samples of rocks for a class collection. (E.SE.00.11, S.IP.00.11, S.IP.00.12)
- Students use observations of class rock collections to generate questions about earth materials. The teacher records the questions on a class chart for future reference. (E.SE.00.11, S.IP.00.12, S.IP.00.16)
- Students observe, sort, illustrate and describe rocks using different properties (size, shape, color, texture, lighter and heavier, sink and float). (E.SE.00.11, S.IP.00.11, S.RS.00.11)
- Students sort, illustrate and classify particles in a soil sample. (E.SE.00.11, S.IP.00.11, S.RS.00.11)
- Students compare texture, particle size, and color of different soil samples. (E.SE.00.11, S.IP.00.11)

- Students plan and conduct investigations to separate mixtures of sand, soil and rocks using a variety of materials (sieve, water, funnels, coffee filters, screens). (E.SE.00.11, S.IP.00.13)
- Students plan and conduct investigations on the properties of sand, soil and rocks such as the ability to absorb water. (E.SE.00.11, S.IP.00.13)

Explain and Define

- Students use observations from investigations to share their findings and describe sand, soil and rock. Students define the terms using their own descriptions and vocabulary at this time. (E.SE.00.11, S.IA.00.12)
- Students use pictures to sequence observation of rocks and soil such as from dark to light (color), small to large (size), etc. (E.SE.00.11, S.RS.00.11)
- Students describe and compare the results when water is mixed with different earth materials. (E.SE.00.11, S.IP.00.13, S.IA.00.12)
- Students describe their methods of separating mixtures of earth materials in sequential order. (E.SE.00.11, S.IA.00.13)
- Students identify earth materials in pictures of different landscapes (desert, forest, beach, etc.) and classify them as soil, rocks, sand or water. (E.SE.00.11, S.RS.00.11, S.IA.00.14)
- Students identify once living materials in soil samples and describe ways that they are different from living things. (E.SE.00.11, S.IP.00.11)

Elaborate and Apply

- Student predict which earth material would be best for plant growth. (E.SE.00.11, S.IP.00.12)
- Students plan and conduct plant growth investigations in different earth materials (sand, soil, water). Observations should consist of simple descriptions using student vocabulary. (E.SE.00.11, S.IP.00.13)
- Students gather information about earth materials from picture books and videos. Students at this age need to see large examples of earth materials such as boulders, lakes, rivers, deserts, and beaches. (E.SE.00.11, S.IA.00.14)

Evaluate Student Understanding

Embedded Assessment Examples:

- Student journal observations and soil classification charts. (E.SE.00.11)
- Student investigations and explanations. (E.SE.00.11)

Summative Assessment Examples:

- Circle the earth material with the smallest parts. (E.SE.00.11)
- Circle the object that would not be a part of soil. (E.SE.00.11)
- Circle the object in the picture made from earth materials. (Picture of a landscape) (E.SE.00.11)
- Circle the place on the map that is made of water. (E.SE.00.11)
- Circle the object that is not an earth material. (E.SE.00.11)

Enrichment

- Students plan and conduct investigations with other types of earth materials such as gravel, clay and peat.
- Students investigate the uses of earth materials such as in building materials. Students can take a walk outside to observe building materials such as bricks, cement and tile. Students can generate questions about the origins of these materials based on their observations.

Intervention

- Sorting and classifying other familiar objects by size, texture and color.
- Measuring and comparing familiar objects using nonstandard units.
- Observing globes and identifying land and water on the globe.

Examples, Observations and Phenomena (Real World Context)

Early learners are naturally curious about the objects in their environment – soil, rocks, water, sand, rain, snow, and so on. Children are fascinated by the properties of soil and water at an early age as they make mud pies and observe plants around their home and school. Kindergarteners may enter school with an idea that the Earth is made up of soil, rocks, pebbles, sand, water and living things. They should be encouraged to closely observe materials found on Earth and begin to describe their properties. The essential learning in earth science for the kindergarten student is to be able to identify different earth materials and recognize the earth materials necessary to grow plants, linking the common thread of understanding in life science and earth science. The importance of earth materials (air, water, and soil) in plant growth can be seen in home gardening projects or visits to a farm.

Literacy Integration

Reading

R.CM.00.01 begin to make text-to-self and text-to-text connections and comparisons by activating prior knowledge and connecting personal knowledge and experience to ideas in text through oral and written responses.

R.IT.00.04 respond to individual and multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make meaning, and make connections.

Everybody Needs a Rock, Byrd Baylor and Peter Parnall (1985)

Let's Look at Rocks, Jeri Cipriano (2004)

Dirt: The Scoop on Soil, Natalie M. Rosinsky (2002)

If You Find a Rock, Peggy Christian and Barbara Hirsch Lembe (2000)

- Activate prior knowledge through class observations of rocks before reading the books.
- Use books to extend student thinking related to observing and classifying rocks.

Writing

W.GN.00.03 write a brief informational piece such as a page for a class book using drawings, words, word-like clusters, and/or sentences.

W.GN.00.04 contribute to a class research project by adding relevant information to a class book including gathering information from teacher-selected resources and using the writing process to develop the project.

- Draw pictures and write words to describe properties of rocks, soil and sand.
- Draw pictures to record results from investigations.

Speaking

S.CN.00.01 explore and use language to communicate with a variety of audiences and for different purposes including problem solving, explaining, looking for solutions, constructing relationships, and expressing courtesies.

S.DS.00.01 engage in substantive conversations, remaining focused on subject matter, with interchanges beginning to build on prior responses in literature discussions, paired conversations, or other interactions.

- Engage in substantive conversations generating questions, making claims, using evidence and sharing explanations.

Mathematics Integration

M.PS.00.05 Compare length and weight of objects by comparing to reference objects, and use terms such as shorter, longer, taller, lighter, heavier.

- Compare length and mass using non-standard units of measure.

First Grade Science Content Expectations Companion Document

SCIENCE

- Unit 1: Sorting by Properties
- Unit 2: Animal Life
- Unit 3: Weather
- Unit 4: The Sun Warms the Earth

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements

- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration



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Introduction to the K-7 Companion Document An Instructional Framework

Overview

The Michigan K-7 Grade Level Content Expectations for Science establish what every student is expected to know and be able to do by the end of Grade Seven as mandated by the legislation in the State of Michigan. The Science Content Expectations Documents have raised the bar for our students, teachers and educational systems.

In an effort to support these standards and help our elementary and middle school teachers develop rigorous and relevant curricula to assist students in mastery, the Michigan Science Leadership Academy, in collaboration with the Michigan Mathematics and Science Center Network and the Michigan Science Teachers Association, worked in partnership with the Michigan Department of Education to develop these companion documents. Our goal is for each student to master the science content expectations as outlined in each grade level of the K-7 Grade Level Content Expectations.

This instructional framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings and expanding thinking beyond the classroom.

These companion documents are an effort to clarify and support the K-7 Science Content Expectations. Each grade level has been organized into four teachable units--organized around the big ideas and conceptual themes in earth, life and physical science. The document is similar in format to the Science Assessment and Item Specifications for the 2009 National Assessment for Education Progress (NAEP). The companion documents are intended to provide boundaries to the content expectations. These boundaries are presented as "notes to teachers", not comprehensive descriptions of the full range of science content; they do not stand alone, but rather, work in conjunction with the content expectations. The boundaries use seven categories of parameters:

- a. **Clarifications** refer to the restatement of the "key idea" or specific intent or elaboration of the content statements. They are not intended to denote a sense of content priority. The clarifications guide assessment.
- b. **Vocabulary** refers to the vocabulary for use and application of the science topics and principles that appear in the content statements and expectations. The terms in this section along with those

presented within the standard, content statement and content expectation comprise the assessable vocabulary.

- c. **Instruments, Measurements and Representations** refer to the instruments students are expected to use and the level of precision expected to measure, classify and interpret phenomena or measurement. This section contains assessable information.
- d. **Inquiry Instructional Examples** presented to assist students in becoming engaged in the study of science through their natural curiosity in the subject matter that is of high interest. Students explore and begin to form ideas and try to make sense of the world around them. Students are guided in the process of scientific inquiry through purposeful observations, investigations and demonstrating understanding through a variety of experiences. Students observe, classify, predict, measure and identify and control variables while doing "hands-on" activities.
- e. **Assessment Examples** are presented to help clarify how the teacher can conduct formative assessments in the classroom to assess student progress and understanding
- f. **Enrichment and Intervention** is instructional examples that stretch the thinking beyond the instructional examples and provides ideas for reinforcement of challenging concepts.
- g. **Examples, Observations, Phenomena** are included as exemplars of different modes of instruction appropriate to the unit in which they are listed. These examples include reflection, a link to real world application, and elaboration beyond the classroom. These examples are intended for instructional guidance only and are not assessable.
- h. **Curricular Connections and Integrations** are offered to assist the teacher and curriculum administrator in aligning the science curriculum with other areas of the school curriculum. Ideas are presented that will assist the classroom instructor in making appropriate connections of science with other aspects of the total curriculum.

This Instructional Framework is NOT a step-by-step instructional manual but a guide developed to help teachers and curriculum developers design their own lesson plans, select useful portions of text, and create assessments that are aligned with the grade level science curriculum for the State of Michigan. It is not intended to be a curriculum, but ideas and suggestions for generating and implementing high quality K-7 instruction and inquiry activities to assist the classroom teacher in implementing these science content expectations in the classroom.

First Grade GLCE Companion Document

Unit 1: Sorting By Properties

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

First Grade Companion Document

1-Unit 1: Sorting By Properties

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First Grade Unit: Sorting by Properties

Content Statements and Expectations

Background –

The first grade physical science unit is intended to develop the young learners' skills in using the senses to sort objects according to their observable physical attributes (color, shape, size, sinking, floating, texture and magnetic attraction). They explore the properties of water in its solid and liquid state.

Code	Statements & Expectations	Page
P.PM.E.1	Physical Properties – All objects and substances have physical properties that can be measured.	3
P.PM.01.11	Demonstrate the ability to sort objects according to observable properties such as color, shape, size, sinking and floating.	3
P.PM.E.2	States of Matter – Matter exists in several different states - solids, liquids, and gases. Each state of matter has unique physical properties. Gases are easily compressed but liquids and solids do not compress easily. Solids have their own particular shapes, but liquids and gases take the shape of the container.	4
P.PM.01.21	Demonstrate that water as a solid keeps its own shape (ice).	4
P.PM.01.22	Demonstrate that water as a liquid takes on the shape of various containers.	4
P.PM.E.3	Magnets – Magnets can repel or attract other magnets. Magnets can also attract magnetic objects. Magnets can attract and repel at a distance.	5
P.PM.01.31	Identify materials that are attracted by magnets.	5
P.PM.01.32	Observe that like poles of a magnet repel and unlike poles of a magnet attract.	5

1 – Unit 1: Sorting by Properties

Big Ideas (Key Concepts)

- Objects and substances can be sorted by their observable properties.
- The physical properties of water as a solid and as a liquid are different.
- Magnets can attract and repel other magnets and attract magnetic objects.

Clarification of Content Expectations

Standard: Properties of Matter

Content Statement - P.PM.E.1

Physical Properties – All objects and substances have physical properties that can be measured.

Content Expectation

P.PM.01.11: Demonstrate the ability to sort objects according to observable properties such as color, shape, size, sinking and floating.

Instructional Clarifications

1. Demonstrate is to show through manipulation of materials the sorting of objects according to observable properties.
2. Observable properties at this level are limited to observations using the appropriate senses and non-standard measurements of size.
3. Size descriptions include large, small, medium and larger and smaller and measurements in non-standard units of measurement.
4. Color descriptions include basic colors such as, red, blue, yellow, green, orange, white, black, and purple.
5. Shape descriptions include circle, square, rectangle, and triangle.
6. Sinking or floating is limited to trial and error investigations of objects that sink and objects that float in water.

Assessment Clarifications

1. Observable properties at this level are limited to observations using the appropriate senses and non-standard measurements of size.
2. Size descriptions include large, small, medium and larger and smaller and measurements in non-standard units of measurement.
3. Color descriptions include basic colors, such as red, blue, yellow, green, orange, white, black, and purple.
4. Shape descriptions include circle, square, rectangle, and triangle.
5. Sinking or floating is limited to trial and error investigations of objects that sink and objects that float in water.

Content Statement - P.PM.E.2

States of Matter – Matter exists in several different states: solids, liquids and gases. Each state of matter has unique physical properties. Gases are easily compressed but liquids and solids do not compress easily. Solids have their own particular shapes, but liquids and gases take the shape of the container.

Content Expectations

P.PM.01.21: Demonstrate that water as a solid keeps its own shape (ice).

Instructional Clarifications

1. Water as ice, snow, sleet, is described as a solid or in its solid state.
2. Solid objects, including ice, keep their own shape.
3. Water becomes a solid at temperatures that are below freezing.

Assessment Clarification

1. Solid objects, including ice, keep their own shape.

P.PM.01.22 Demonstrate that water as a liquid takes on the shape of various containers.

Instructional Clarifications

1. Water as a liquid will take on the shape of the container that holds it.
2. Water as a liquid will spread out until it fills the container.
3. Water as a liquid can be poured from one container to another.

Assessment Clarification

1. Water as a liquid will take on the shape of the container that holds it.

Content Statement - P.PM.E.3

Magnets – Magnets can repel or attract other magnets. Magnets can also attract magnetic objects. Magnets can attract and repel at a distance.

Content Expectations

P.PM.01.31: Identify materials that are attracted by magnets.

Instructional Clarifications

1. Identify means to recognize or point out materials that are attracted (pulled) to magnets from trial and error investigations.
2. Materials that are attracted to magnets are limited to trial and error investigations of objects that may or may not be attracted to magnets.

Assessment Clarification

1. Materials that are attracted to magnets are limited to trial and error investigations of objects that may or may not be attracted to magnets.

P.PM.01.32 Observe that like poles of a magnet repel and unlike poles of a magnet attract.

Instructional Clarifications

1. Observe is to look closely at the magnetic attraction and repulsion of the ends of magnets through trial and error investigations.
2. Magnet shapes include bar magnets, horseshoe magnets or disc magnets.
3. Students describe a push (repel) and pull (attract) as exhibited by each pole (end/side) of a magnet.
4. Students explore an introduction into magnetic poles through observation of the attraction and repulsion of a variety of magnets.

Assessment Clarification

1. Demonstrate how some ends of magnets attract (pull) to each other and others repel (push) away from each other.

**Inquiry Process, Inquiry Analysis and Communication,
Reflection and Social Implications.**

Inquiry Processes

S.IP.01.11 Make purposeful observations of the properties of a variety of objects, sink and float objects, and objects that are attracted to magnets using the appropriate senses.

S.IP.01.12 Generate questions regarding objects attracted to a magnet and objects that sink and float based on observations.

S.IP.01.13 Plan and conduct simple investigations into objects that sink and float and objects that are attracted to magnets.

S.IP.01.14 Manipulate simple tools (hand lens) that aids in observation of properties of matter.

S.IP.01.16 Construct simple charts from data and observations regarding objects that sink and float and objects that are attracted to magnets.

Inquiry Analysis and Communication

S.IA.01.12 Share ideas about properties of objects, sink and float investigations, and magnetism investigations through purposeful conversation.

S.IA.01.13 Communicate and present findings of observations of properties of objects; sink and float investigations, and magnetism investigations.

S.IA.01.14 Develop strategies for information gathering (ask an expert, use a book, make observations, conduct simple investigations) about properties of objects, sink and float objects, and objects that are attracted to a magnet.

Reflection and Communication

S.RS.01.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities about describing objects by their properties, sink and float investigations, water as a solid and as a liquid, and objects that are attracted to magnets.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
Sort Properties Poles Solid Liquid Magnet Push Pull Attract Repel	Bar magnet Rod magnet Horseshoe magnet Disc magnet (ring magnet)

Instruments, Measurements, and Representations

Properties:	Size	Shape	Color	Sink and Float
	large small medium	circle round square rectangle oval triangle diamond cylinder	red orange blue yellow white black brown purple	

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Physical Properties: P.PM.01.11

States of Matter: P.PM.01.21, P.PM.01.22

Magnets: P.PM.01.31, P.PM.01.32

Objectives

- Sort objects according to observable properties, such as color, shape, size, texture, sinking or floating.
- Sort materials that can be attracted to a magnet.
- Identify characteristics of water as a solid and a liquid.

Explore and Engage

- Provide a variety of objects for students to observe and describe according to their own criteria. Give students the opportunity to attach their own language to describing objects before introducing the properties of objects.
- Have students describe objects to one another and have their partner guess what the object is by the student's description.
- Add objects to the students' exploration that have a new property to describe, such as objects that are squishy, fuzzy, or wet (cotton balls, wet sponge, cup of water) to increase their observation and vocabulary skills.
- Play the game "I'm Thinking of Something..." and describe a common object in the room by its properties. Have students try to guess what object you are describing. Have students list the different properties you used to describe the object.
- Explore how puddles are formed and how the shape and size of a puddle is determined by the pooling of water that takes the shape of the land.

- Explore, through observation and their own simple trial and error investigations, magnets with a variety of materials that are attracted and not attracted to magnets.
- Explore, through observation and their own simple trial and error investigations, how the ends of magnets can push away from each other or attract to each other.

Explain and Define

- Classify and record terms commonly used by students in their initial descriptions of properties of a variety of objects. Ask students what property they are using when they describe the object as red, or green, etc.
- Ask students to sort a variety of objects according to common properties that they observed using their own sorting process.
- Have students share their sorting procedure with the rest of the class. As a class discuss the difference in different sorting techniques.
- Make a list of basic properties for students to use in their sorting process: color, shape, size, and texture.
- Make a chart of properties and list objects on the chart that can be described with the list of properties.
- Have students repeat the describing and guessing exercise using the properties of color, size, shape, texture, hard or soft, and special markings or features.
- Explain and describe observations with magnets in own terms.

Elaborate and Apply

- Elaborate on the sorting by properties by introducing magnetic and non-magnetic material. Have students sort objects by their ability to be attracted by a magnet.
- Have students make pictographs of objects that are attracted and not attracted to magnets.
- Give students the opportunity to explore the polarity of magnets and experience the “push” and “pull” of like and unlike poles.
- Further the exploration into properties of objects by introducing objects that are solids and liquids. Have students describe solids by their properties and liquids by their properties.
- Make observations of a variety of shapes of ice and describe ice as a solid that keeps its shape. Make observations of liquid water and describe liquid water that takes the shape of its container and can be poured from one container to another.
- Sinking and floating is another way of sorting objects by their properties. Give students a variety of objects to test for sinking and floating. Have students predict which objects will float and which objects will sink.
- Take this opportunity for students to create a simple chart to record their observation and make a statement about the objects regarding the objects that sank and the objects that floated.

Evaluate Student Understanding

Imbedded Assessment

- Use the student presentations and discussion to assess the students' ability to describe objects by their properties.
- Use students' descriptions to assess their use of vocabulary that includes color, size, shape, and texture.
- Use students' descriptions of their exploration of magnets and magnetic material to assess their ability to describe observations.

Summative Assessment

- Circle the objects that have the same shape.
- Choose the terms that best describe the object in the diagram.
- Choose the terms that best describe texture of objects.
- Draw a picture of an object that floats.
- Draw a picture of an object that sinks.

Enrichment

- Introduce measurement tools and units for students to measure different sizes of objects such as weight, length, width, volume, etc.
- Introduce a variety of uncommon shapes and have students describe the shapes and compare them to common shapes.
- Investigate how magnets can move objects when the object is on the other side of different materials.
- Measure the temperature of water as a liquid and water as a solid. Investigate the freezing point of water.
- Investigate the path of liquid water down slopes and over material.

Intervention

- Use matching cards to reinforce the color, size, shape and texture words and color, size, shape and texture of a variety of objects.
- Sort objects by their color, shape, size, and texture.

Examples, Observations, and Phenomena (Real World Context)

Sorting objects such as toys, food items, and crayons is a natural activity for young learners. Children make observations and comparisons of objects they see every day and on outings. The act of sorting objects by their properties is the first introduction into the properties of matter.

Sorting objects using magnets is used in factories and industry. Food packaging companies use large magnets to remove any iron debris from machinery that may have contaminated food, such as cereals and grains. Magnets are also used to sort and transport objects in a junkyard and at the recycling center. At this age, students are engaged in a high interest activity that will lay a foundation for exploration, questioning, and interaction with peers.

Students are familiar with water as a liquid and water as a solid. The introduction of solids and liquids attaches language to observations and provides the opportunity to attach common weather related phenomena (snow, ice, and sleet) to activities in the classroom.

Literacy Integration

Reading

R.WS.01.10 in context, determine the meaning of words and phrases including objects, actions, concepts, content vocabulary, and literary terms, using strategies and resources including context clues, mental pictures, and questioning.

R.IT.01.02 discuss informational text patterns including descriptive, sequential, and enumerative.

R.IT.01.04 respond to individual and multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make connections, take a position, and/or show understanding.

R.CM.01.01 make text-to-self and text-to-text connections and comparisons by activating prior knowledge and connecting personal knowledge and experience to ideas in text through oral and written responses.

R.CM.01.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about the life cycles of animals and animal characteristics:

How Many Snails? Paul Giganti and Donald Crews, 1994

It Could Still Be Water, Allan Fowler, 1993

Magnets: Pulling Together, Pushing Apart, Rosinsky, 2004

What Magnets Can Do, Allan Fowler, 1992

Writing

W.GN.01.03 write an informational piece that addresses a focus question using descriptive, enumerative, or sequence patterns that may include headings, titles, labels, photographs, or illustrations to enhance the understanding of central ideas.

W.GN.01.04 use a teacher-selected topic to write one research question; locate and begin to gather information from teacher-selected resources; organize the information and use the writing process to develop a project.

W.PR.01.01 with teacher support, set a purpose, consider audience, and incorporate literary language when writing a narrative or informational piece; begin to use specific strategies including graphic organizers when planning.

- Students role-play and write a list of properties using the game, “I’m Thinking of Something” and exchange writing with another student to read and locate the object as described by properties.
- Students measure and include and refer to a chart of their measurements in their writing.
- Students read about magnets and write about an investigation into different materials that are attracted to magnets and materials that are not attracted to magnets. Students include and refer to a chart of their data in their writing.

Speaking

S.CN.01.02 explore and use language to communicate with a variety of audiences and for different purposes including making requests, solving problems, looking for solutions, constructing relationships, and expressing courtesies.

S.DS.01.01 engage in substantive conversations, remaining focused on subject matter, with interchanges building on prior responses in literature discussions, paired conversations, or other interactions.

S.DS.01.03 respond to multiple text types by reflecting, making meaning, and making connections.

- Students present and report findings orally.
- Students exchange ideas for magnetic and non-magnetic material.
- Students engage in conversation about the readings from the suggested books and explain the connections they are making between the classroom activities and the readings.

Mathematics Integration

M.UN.01.01 Measure the lengths of objects in non-standard units to the nearest whole units.

M.UN.01.02 Compare measured lengths using the words shorter, shortest, longer, longest, taller, tallest, etc.

D.RE.01.01 Collect and organize data to use in pictographs.

D.RE.01.02 Read and interpret pictographs.

- Measurement is used in describing and elaborating on the size of objects. Size is a property used in describing objects.

First Grade GLCE Companion Document

Unit 2: Animal Life

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

First Grade Companion Document

1-Unit 2: Animal Life

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**First Grade Unit:
Animal Life**

Content Statements and Expectations

Background –

The first grade life science curriculum builds on the students' prior knowledge of living and nonliving things and the basic needs of all living things. Students explore the development of animals through the basic life cycle: egg, young and adult, and egg, larva, pupa and adult. They make connections between young and adult and recognize characteristics that are passed from parent to young.

Code	Statements & Expectations	Page
L.OL.E.1	Life Requirements – Organisms have basic needs. Animals and plants need air, water, and food. Plants also require light. Plants and animals use food as a source of energy for growth and repair.	3
L.OL.01.13	Identify the needs of animals.	3
L.OL.E.2	Life Cycles – Plants and animals have life cycles. Both plants and animals begin life and develop into adults, reproduce, and eventually die. The details of this life cycle are different for different organisms.	3
L.OL.01.21	Describe the life cycle of animals including the following stages: egg, young, adult; egg, larva, pupa, adult	3
L.HE.E.1	Observable Characteristics – Plants and animals share many, but not all, characteristics of their parents.	4
L.HE.01.11	Identify characteristics (for example: body coverings, beak shape, number of legs, body parts) that are passed from parents to young.	4
L.HE.01.12	Classify young animals based on characteristics that are passed on from parents (dogs/puppies, cats/kittens, cows/calves, chickens/chicks).	4

1 – Unit 2: Animal Life

Big Ideas (Key Concepts)

- Animals have needs for life (air, water, food, and space).
- Animals have a life cycle that includes egg, young (larva, pupa) and adult.
- Animals share some, but not all characteristics of their parents.

Clarification of Content Expectations

Standard: Organization of Living Things

Content Statement - L.OL.E.1

Life Requirements - Organisms have basic needs. Animals and plants need air, water, and food. Plants also require light. Plants and animals use food as a source of energy and as a source of building material for growth and repair.

Content Expectation

L.OL.01.13 Identify the needs of animals.

Instructional Clarifications

1. Identify means recognize the things that animals need to stay alive.
2. Animals need air, water, and food to survive.
3. Animals need space to survive.

Assessment Clarification

1. Animals need air, water, and food to survive.

Content Statement - L.OL.E.2

Life Cycles – Plants and animals have life cycles. Both plants and animals begin life and develop into adults, reproduce, and eventually die. The details of this life cycle are different for different organisms.

Content Expectation

L.OL.01.21: Describe the life cycle of animals including the following stages: egg, young, adult; egg, larva, pupa, adult.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words how the life cycle of animals can include various stages.

2. All animals have a life cycle.
3. Life cycle of animals include egg -> young -> adult.
4. Some animals, such as the butterfly, have a life cycle that includes egg -> larva -> pupa -> adult
5. The duration of the stages of the life cycle differ in different species.

Assessment Clarifications

1. All animals have a life cycle.
2. Common Life cycles of animals include egg -> young -> adult.
3. Some animals, such as the butterfly, have a life cycle that includes egg -> larva -> pupa -> adult

Standard: Heredity

Content Statement: L.HE.E.1

Observable Characteristics-Plants and animals share many, but not all, characteristics of their parents.

Content Expectations

L.HE.01.11 Identify characteristics (for example: body coverings, beak shape, number of legs, body parts) that are passed on from parents to young.

Instructional Clarifications

1. Identify means recognize the observable physical features of animals that are passed from parent to young.
2. Characteristics are the observable physical features of animals.
3. At this stage, students compare young animals to their parents and identify the physical features that the adult animals pass on to their young.
4. Common features that pass from parent to young include type of body covering, fur/hair/feather, coloring, beak shape, and eye color.

Assessment Clarifications

1. Characteristics are observable features of animals.
2. Parents pass some physical features to their young.

L.HE.01.12 Classify young animals based on characteristics that are passed on from parents (dogs/puppies, cats/kittens, cows/calves, chicken/chicks).

Instructional Clarifications

1. Classify means to arrange animals based on resemblances and /or differences that are passed on from their parents.
2. Students match common adult and baby animals of the same species.

Assessment Clarification

1. Students match common adult and baby animals of the same species.

**Inquiry Process, Inquiry Analysis and Communication,
Reflection, and Social Implications**

Inquiry Process
S.IP.01.11 Make purposeful observations of the life cycle of an animal and/or characteristics of animals using the appropriate senses.
S.IP.01.12 Generate questions about the life cycle of organisms based on observations.
S.IP.01.13 Plan and conduct simple investigations into the needs of animals in the classroom habitat.
S.IP.01.14 Manipulate the hand lens, pencils, rulers, that aid observation of animals.
S.IP.01.15 Make accurate measurements of the growth of different plants and animals in a classroom habitat.
S.IP.01.16 Construct simple growth charts from observations and data of plants and animals in the classroom habitat.
Inquiry Analysis and Communication
S.IA.01.12 Share ideas about animals and their offspring through purposeful conversation.
S.IA.01.13 Communicate and present findings of observations of life cycles and growth of animals in the classroom habitat.
S.IA.01.14 Develop strategies for information gathering (ask an expert, use a book, make observations, conduct simple investigations, and watch a video) about the life cycle of different animals
Reflection and Social Implications
S.RS.01.11 Demonstrate the life cycle of an animal through various illustrations, performances, models, exhibits, and activities.

Vocabulary

Critically Important-State Assessable	Instructionally Useful
needs of animals life cycle egg young adult larva pupa characteristics parents air water food beak shape body coverings: feathers, fur, skin, hair, scales	inherited metamorphosis insects butterfly moth chrysalis cocoon eye color

Instruments, Measurements, Representations

Instrument	Measurements/Observations	Representation
Metric ruler	Growth of animals	Centimeters
Hand lens	Characteristics of animals	Numbers, shapes and outstanding features

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Life Requirements: L.OL.01.13

Life Cycles: L.OL.01.21

Heredity: L.HE.01.11

Objectives

- Make observations of animals and their interactions within habitats.
- Focus on the needs of each and how they help the organism survive.
- Make observations on the patterns animals follow from being born to growing up and getting old.
- Make observations on parental and young characteristics.
- Compare the physical characteristics of offspring and parent.

Engage and Explore

- Students will study a live animal from egg to egg. L.OL.01.21, S.IP.01.11, S.IP.01.12, S.IA.01.12, S.IA.01.13
- Teacher will read a life cycle book about an animal with the student question - how do animals change. Then lead a discussion on what stages of growth the animal experienced. Characteristics can be used to describe the animal in its various stages of growth. L.OL.01.21, S.IP.01.11, S.IP.01.12, S.IA.01.12, S.IA.01.13, S.IA.01.14

Explain and Define

- Teacher will put on chart paper the student ideas about the growth stages of the organism. L.OL.01.21
- Students identify the needs of living things using evidence. L.OL.01.13,

- Students should be able to talk about characteristics passed from parent to offspring. L.HE.01.11, S.IP.01.11, S.IP.01.12, S.IA.01.12, S.IA.01.13, S.IA.01.14

Elaborate and Apply

- Share multiple examples of passed characteristics and life cycles with the students. L.OL.01.21, L.HE.01.11, S.RS.01.11, S.RS.01.12, S.RS.01.11, S.RS.01.12

Evaluate Student Understanding

Formative Assessment Examples

- Check student observation/picture journal to determine if observations are appropriate/applicable. L.OL.01.21
- Student conversations in their groups can be used as basis for monitoring understanding. L.OL.01.21

Summative Assessment Examples

- Circle the living things. L.OL.01.13
- Circle the needs of living things. L.OL.01.13
- Draw a picture of an animal and its baby. L.HE.01.11,
- Circle the characteristic that is shared by these two animals. L.HE.01.11,
- Draw the next stage of life for this organism. L.OL.01.21

Enrichment

- Students study/research an animal of their choice to share (or turn in) by drawing the life cycle, characteristics passed from parent to offspring; life needs and habitat should be incorporated for their chosen animal.

Intervention

- Break students into research groups that focus on one aspect of the life cycle (e.g., egg group, adult group, young group, old group) and have students cycle through each of these groups studying many different animals. Students will then rotate through the other groups to experience all of them.

Examples, Observations, and Phenomena (Real World Context)

Most young children, at one time have asked for a box or jar to capture an animal from the outdoors to bring home and watch for hours. The natural curiosity about living things has led young children to make observations, inferences, and establish ideas of their own. For example, students may not relate the caterpillar to the adult animal or a stage in an animal's life.

Through their outdoor experiences and observations, students have an understanding that animals eat specific foods and not others. They recognize that the diet of a squirrel includes acorns and other seeds and nuts and does not usually include lettuce leaves or a ham sandwich. It is through their real world experiences that students transfer what they have observed to the classroom models and observations. Young learners build understanding of life science concepts through direct experience with living things, their life cycles, habitats, and long-term observations.

Literacy Integration

Reading

R.WS.01.10 in context, determine the meaning of words and phrases including objects, actions, concepts, content vocabulary, and literary terms, using strategies and resources including context clues, mental pictures, and questioning.

R.IT.01.02 discuss informational text patterns including descriptive, sequential, and enumerative.

R.IT.01.04 respond to individual and multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make connections, take a position, and/or show understanding.

R.CM.01.01 make text-to-self and text-to-text connections and comparisons by activating prior knowledge and connecting personal knowledge and experience to ideas in text through oral and written responses.

R.CM.01.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about the life cycles of animals and animal characteristics:

Life Cycles, Donna Schaffer, 1999

In the Woods: Who's Been Here? Lindsay Barrett George, 1995

Whose Baby is This? Wayne Lynch, 2000

An Earthworm's Life, John Himmelman, 2000

Under One Rock, Anthony Fredericks, 2001

Writing

W.GN.01.03 write an informational piece that addresses a focus question using descriptive, enumerative, or sequence patterns that may include headings, titles, labels, photographs, or illustrations to enhance the understanding of central ideas.

W.GN.01.04 use a teacher-selected topic to write one research question; locate and begin to gather information from teacher-selected resources; organize the information and use the writing process to develop a project.

W.PR.01.01 with teacher support, set a purpose, consider audience, and incorporate literary language when writing a narrative or informational piece; begin to use specific strategies including graphic organizers when planning.

- Students use their research on an organism to write their own life cycle book on their organism.

Speaking

S.CN.01.02 explore and use language to communicate with a variety of audiences and for different purposes including making requests, solving problems, looking for solutions, constructing relationships, and expressing courtesies.

S.DS.01.01 engage in substantive conversations, remaining focused on subject matter, with interchanges building on prior responses in literature discussions, paired conversations, or other interactions.

S.DS.01.03 respond to multiple text types by reflecting, making meaning, and making connections.

- Students present report findings orally.
- Students exchange ideas for habitat set-up, observations, and inferences based on observations.
- Students engage in conversation about the readings from the suggested books and explain the connections they are making between the classroom habitat, observations, and activities and the readings.

Mathematics Integration

M.UN.01.01 Measure the lengths of objects in non-standard units to the nearest whole units.

M.UN.01.02 Compare measured lengths using the words shorter, shortest, longer, longest, taller, and tallest, etc.

D.RE.01.01 Collect and organize data to use in pictographs.

D.RE.01.02 Read and interpret pictographs.

- Sizes and growth of organisms are measured and graphed, also duration of stages such as insect pupae that are counted and graphed.

First Grade GLCE Companion Document

Unit 3: Weather

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

First Grade Companion Document

1-Unit 3: Weather

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**First Grade Unit:
Weather**

Content Statements and Expectations

Background –

This Earth Science unit focuses on the study of weather and how it changes from day to day and over the seasons. The young learners are given the opportunity to observe, record, and measure weather conditions over a period of time.

Code	Statements & Expectations	Page
E.ES.E.2	Weather – Weather changes from day to day and over the seasons.	3
L.ES.01.21	Compare daily changes in the weather related to temperature (cold, hot, warm, cool); cloud cover (clear, cloudy, partly cloudy, foggy); precipitation (rain, snow, hail, freezing rain); wind (breezy, windy, calm).	3
E.ES.E.3	Weather Measurement – Scientists use tools for observing, recording, and predicting weather changes	3
E.ES.01.31	Identify the tools that might be used to measure temperature, precipitation, cloud cover and wind.	4
E.ES.01.32	Observe and collect data of weather conditions over a period of time.	4

1 – Unit 3: Weather

Big Ideas (Key Concepts)

- Weather exhibits short and long term patterns.
- Tools can be used to assist the recording and predicting of weather.

Clarification of Content Expectations

Standard: Earth Systems

Content Statement: E.ES.E.2

Weather – Weather changes from day to day and over the seasons.

Content Expectation

E.ES.01.21 Compare daily changes in the weather related to temperature (cold, hot, warm, cool); cloud cover (clear, cloudy, partly cloudy, foggy) precipitation (rain, snow, hail, freezing rain); wind (breezy, windy, calm).

Instructional Clarifications

1. Compare is to note the similarities and differences in daily weather conditions.
2. Temperature comparisons are limited to cool, warm, cold, and hot.
3. Cloud cover is limited to the classifications of clear, cloudy, partly cloudy, and foggy.
4. Precipitation types are limited to rain, snow, hail, and freezing rain.
5. Wind descriptions are limited to calm, breezy, and windy.

Assessment Clarifications

1. Temperature comparisons are limited to cool, warm, cold, and hot.
2. Cloud cover is limited to the classifications of clear, cloudy, partly cloudy, and foggy.
3. Precipitation types are limited to rain, snow, hail, and freezing rain.
4. Wind descriptions are limited to calm, breezy, and windy.

Content Statement: E.ES.E.3

Weather Measurement – Scientists use tools for observing, recording, and predicting weather changes.

Content Expectations

E.ES.01.31 Identify the tools that might be used to measure temperature, precipitation, cloud cover and wind.

Instructional Clarifications

1. Identify is to recognize the tools used to measure temperature (thermometer), precipitation (rain gauge), and wind (wind vane or sock).
2. Weather measurement tools are limited to thermometers; eyes for cloud cover estimates, rain gauges, and wind vane or sock.
3. Measurements can be made in standard and metric units including: Celsius, Fahrenheit, centimeters, inches, clear, partly cloudy, cloudy, north, south, east, west and calm, breezy, windy.
4. Wind direction indicates the direction from which the wind is coming.

Assessment Clarifications

1. Weather measurement tools are limited to thermometers; eyes for cloud cover estimates, rain gauges, and wind vane or sock.
2. Measurements can be made in standard and metric units including Celsius, Fahrenheit, centimeters, inches, clear, partly cloudy, cloudy, north, south, east, west and calm, breezy, windy.

E.ES.01.32 Observe and collect data of weather conditions over a period of time.

Instructional Clarifications

1. Observe is to look closely at weather conditions and collect data over a period of time.
2. Weather observations include observations over months to show seasonal changes.

Assessment Clarification

1. Weather observations include observations over months to show seasonal changes.

Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implications
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Inquiry Process
S.IP.01.11 Make purposeful observations of the daily weather.
S.IP.01.12 Generate questions about weather events based on observations of temperature, rainfall, cloud cover, and wind speed.
S.IP.01.13 Plan and conduct simple observations into weather related phenomenon such as temperature, rainfall, cloud cover, and wind speed.
S.IP.01.14 Manipulate simple tools that aid in weather observations and data collection (thermometers, rain gauges, wind socks).
S.IP.01.15 Make accurate measurements with appropriate units for the weather observation tools. (Fahrenheit, Celsius, centimeters, north, south, east, west, breezy, windy, and calm)
S.IP.01.16 Construct simple charts from weather data and observations of temperature, rain fall, cloud cover, and wind speed.
Inquiry Analysis and Communication
S.IA.01.11 Share ideas about weather in Michigan through purposeful conversation.
S.IA.01.12 Communicate and present findings of observations and patterns in weather.
S.IA.01.13 Develop strategies for information gathering to find out about weather related phenomenon and events (ask a meteorologist, use a book, make observations, conduct simple investigations, and watch a weather report or video).
Reflection and Social Implications
S.RS.01.11 Recognize that science investigations into weather and data collection are done more than one time.
S.RA.01.12 Demonstrate weather and/or season concepts through various illustrations, performances, models, exhibits, and activities.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
temperature cold warm hot cool weather conditions daily weather pattern cloud clear- sunny cloudy partly cloudy foggy precipitation rain snow hail freezing rain rain gauge wind vane wind sock breezy windy calm	solar percentage centimeters inches north south east west Celsius Fahrenheit

Instruments, Measurements, and Representations

Measurements	Instruments	Representations
temperature	Observation by senses Thermometer	cool, warm, hot, cold Celsius, Fahrenheit
cloud cover	Observation by senses	Clear/sunny, cloudy, partly cloudy, foggy
precipitation	Rain gauge Ruler or meter stick	centimeters, inches
wind	Observation by senses Wind vane Wind sock	calm, breezy, windy north, south, east, west

Instructional Framework

*The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is **NOT** a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.*

Instructional Examples

Weather: E.ES.01.21

Weather Measurement: E.ES.01.31, E.ES.01.32

Objectives

- Make and record daily observations of temperature, cloud cover, precipitation, and wind.
- Use tools to measure temperature, precipitation, and wind.
- Use simple charts and tables to make pictographs to display recorded weather conditions.

Engage and Explore

- Take the class outside to make weather observations using their senses. Engage the students in a talk about what the weather is like today and what it was like yesterday. Ask them how scientists (meteorologists) know what the weather will be like tomorrow. (E.ES.01.21, S.IP.0.11, S.IP.01.12, S.IA.01.12, S.IA.01.13)
- Set up a table or center with weather instruments, including thermometers, rain gauges and pictures of rain gauges, wind vanes, wind socks, and weather events (clouds, rain, clear, snow, etc.). Give students opportunities to explore and ask questions. (E.ES.01.31, S.IP.01.14, S.IA.01.12, S.IA.01.13)
- Record questions students ask on a chart. These will give direction for inquiry activities for the rest of the unit.
- If necessary, explain to the students any safety considerations for the weather instruments. For example, thermometers are made with glass and are easy to break. (E.ES.01.31)

Explain and Define

- In a whole group setting, students discuss what they observed when they explored the weather instruments on the table or in the learning center. Ask students how they think scientists/meteorologists use the instruments. (E.ES.01.31, S.IP.01.12, S.IA.01.12, S.IA.01.13)
- After listening to children's ideas about weather and weather instruments, ask them what they might do to check their ideas. (E.ES.01.21, E.ES.01.31, S.IA.01.14)
- Read picture books that explain concepts about weather and how scientists use tools to measure weather data. Compare their ideas to the scientific ones. (E.ES.01.21, E.ES.01.31, S.IA.01.14)
- Give students opportunities to practice using the thermometers. Let them take temperature measurements inside and outside the classroom. They can place thermometers in bowls of various temperatures of water, in cups of snow, outdoors in sand or soil. Students can place thermometers in bowls of "oatmeal/porridge" to make a connection to the story of *Goldilocks and the Three Bears*. (E.ES.01.31, S.IP.01.14, S.IP.01.15)
- Give students the opportunity to recognize what the thermometer looks like when the material is hot, warm, cool and cold. Role-play the recognition of hot, warm, cool, and cold by having students act like a thermometer and stand up when it is hot and sink as the temperature cools. (E.ES.01.31, S.IP.01.14, S.IP.01.15, S.RS.01.12)
- Let students make some simple weather instruments. For example, rain gauges and wind socks or wind vane. Ideas for constructing these can be found in children's books or on weather for kids Internet sites. Give children opportunities to use wind vanes, windsocks, and rain gauges to measure wind and precipitation. (E.ES.01.31, S.IP.01.14, S.IP.01.15)
- Allow the students to test their ideas through trial and error. When differences in data occur, brainstorm possible reasons for the differences in the class. Let students design an investigation to test their hypotheses. (S.IA.01.12, S.IA.01.13, S.IA.01.14)
- As a class, watch a weather forecast on television or look at one on the Internet. (S.IA.01.14)
- Read books about the different types of clouds and compare the pictures to the clouds they see. At this age, some students only think of the puffy cumulus or wispy cirrus clouds as clouds. Some children do not realize that a gray blanket of low-lying stratus clouds is really a type of cloud too. (E.ES.01.21, S.RS.01.11)

Elaborate and Apply

- Set up a weather station in the classroom with the students. Like meteorologists, they will make and record weather observations over time. (E.ES.01.21, E.ES.01.31, S.IP.01.14, S.IP.01.15)
- Students decide how to collect weather data and what instruments they will need. Students record information on a classroom chart and in their journal. (E.ES.01.31, S.IP.01.14, S.IP.01.15, S.IA.01.14)

- Discuss the collection of temperature, wind, cloud cover, and precipitation amounts with the weather tools. Better procedures for collecting weather will develop over time if children are allowed to make mistakes and then these are discussed in class for a whole group evaluation. (E.ES.01.31, S.IA.01.12, S.IA.01.13, S.IA.01.14)
- Supplement with and compare classroom data to official data from the Internet or weather channel. (S.IA.01.14)
- Teach students how to make a pictograph of their recorded data. At the end of a week or month of data collecting, make a graph and save. Make comparisons between weeks and months. Which month had the most sunny, rainy, or cloudy days? Which month had the fewest? Which month was the sunniest, cloudiest, or rainiest? How many big snowfalls were there during the winter months? What was the total amount of snow that fell in each storm? What was the total amount of rain or snow for a particular month? Which month was the snowiest? Keep these graphs and charts for comparisons over time. (E.ES.01.21, E.ES.01.32, S.IP.01.12, S.IP.01.16)
- Let students communicate their weekly or monthly findings to students in the other grades during morning announcements, in a monthly newsletter, or a weather chart in the hallway outside. (E.ES.01.21, E.ES.01.32, S.IP.01.16, S.IA.01.12, S.IA.01.13)

Evaluate Student Understanding

Formative Student Understanding

- Observe students as they use the weather tools for their ability to make accurate measurements. (E.ES.01.31)
- Observe students as they read weather data from a chart or pictograph.
- Evaluate the students' ability to make accurate comparisons (i.e. There were four more sunny days in March than in April. There were ten fewer inches of snow in January than in February). (E.ES.01.32)
- Evaluate students' ability to use the weather vocabulary correctly and relate the weather instrument with the correct weather event. (E.ES.01.31)

Summative Assessment Examples

- Circle the instrument that is used to measure the wind. (E.ES.01.31)
- Put an X on the instrument that is used to measure the amount of rain that falls.
- (Show pictures of two thermometers with different readings - cold, hot). Which thermometer measured something that was hot? (E.ES.01.31)
- Circle the picture that BEST shows a windy day. (E.ES.01.31)
- Using the pictograph, tell how many days were sunny.
- Sally and Jose' wanted to collect weather for one week. List or draw the weather data they should collect. (E.ES.01.21)

Enrichment

- Lay a transparent hundred square on top of pictures of clouds. Count or estimate the number of squares that have a part of the cloud in them to determine the percentage of cloud cover.
- Explore other weather instruments or concepts not mentioned in the GLCEs but are used in everyday weather forecasts; for example, barometers for air pressure, anemometers for wind speed, wind direction, or humidity.
- Use the Internet to compare the weather in your school to weather in different states or countries.
- Teach children how to use and read an alcohol thermometer in Celsius and Fahrenheit.
- Learn to read weather maps like the ones on TV or the Internet (i.e. Weather Channel) or in the newspaper (i.e. USA Today on the back page of the first section)

Intervention

- Some students will have difficulty reading the scale on the thermometer and/or rain gauge and will need extra practice. Have students practice counting by twos or fives, to match the scale on your instruments. Use a thermometer or rain gauge with an easier scale.
- Place red and blue tape or marker on the thermometers to show where on the scale the temperature is hot and cold.

Examples, Observations, and Phenomena (Real World Context)

Weather is an everyday phenomena and local weather is easy to observe. Patterns over time are easier to notice when observations are recorded and made into graphs or tables. There are many examples of maps, charts, graphs, and tables in the news and on the Internet, but students should make their own. While observations can be made on a daily basis, when certain weather events such as unusually heavy winds, heavy precipitation, or thunderstorms occur, they can be discussed in the classroom and used as special opportunities for learning.

Have students relate weather conditions to the choice of clothing and outdoor activities.

Using tools for collection of weather data helps students to make connections with common weather information and the instrument used to quantitatively report weather.

Literacy Integration

Reading:

R.IT.01.01 Identify and describe the basic form, features, and purpose of a variety of informational genre including simple “how-to” books, science and social studies magazines.

R.CM.01.04 Apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about weather:

Air is All Around You, Franklyn M. Branley, 2006

The Wind Blew, Pat Hutchins, 1993

Clouds, Eric Carle

- Students may read about how the weather instruments they use and explain how they are like the ones the meteorologist uses.
- Students may read an informational text on how to make a weather instrument

Writing:

W.GN.01.03 Write an informational piece that addresses a focus question (e.g., What is a family?) using descriptive, enumerative, or sequence patterns that may include headings, titles, labels, photographs, or illustrations to enhance the understanding of central ideas.

- Students may write an informational piece about a weather tool using a picture with titles, and labels.
- Students may write about a sequence of events during a storm they experienced.

Speaking:

S.CN.01.03 Speak effectively maintaining appropriate posture, eye contact, and position, using props such as photographs or illustrations in narrative and informational presentations.

S.DS.01.01 Engage in substantive conversations, remaining focused on subject matter, with interchanges building on prior responses in literature discussions, paired conversations, or other interactions.

- When having a discussion about their collected weather information, students will listen and respond appropriately to their classmates.
- Students will present what they have written about their weather instrument or storm experiences.

Mathematics Integration

D.RE.01.01 Collect and organize data to use in pictographs.

D.RE.01.02 Read and interpret pictographs.

D.RE.01.03 Make pictographs of given data using both horizontal and vertical forms of graphs; scale should be in units of one and include symbolic representations

N.ME.01.01 Count to 110 by 1's, 2's, 5's, and 10's, starting from any number in the sequence.

N.ME.01.02 Read and write numbers to 110 and relate them to the quantities they represent.

N.ME.01.03 Order numbers to 110; compare using phrases such as "same as", "more than", "greater than", "fewer than"; use = symbol. Arrange small sets of numbers in increasing or decreasing order

N.MR.01.09 Compare two or more sets in terms of the difference in number of elements.

- Students will collect data like the number of sunny days or the amount of precipitation during a storm and organize the data in charts and pictographs.
- Students will be able to read and interpret graphs and to answer questions like: What is the total number of days that were sunny in all the weeks? How many more or how many fewer days were cloudy than sunny?
- Students will read the temperature using the scale on an alcohol thermometer and tell when one temperature is hotter or colder than another.

First Grade GLCE Companion Document

Unit 4: The Sun Warms the Earth

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

First Grade Companion Document

1-Unit 4: The Sun Warms the Earth

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**First Grade Unit:
The Sun Warms the Earth**

Content Statements and Expectations

Background –

This Earth Science unit focuses on the sun providing the light and warmth necessary for plant and animal life, and how plant and animal life are dependent on a variety of earth materials.

Code	Statements & Expectations	Page
E.ES.E.1	Solar Energy – The sun warms the land, air, and water and helps plants grow.	3
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E.ES.E.2	Weather – Weather changes from day to day and over the seasons.	4
E.ES.01.22	Describe and compare weather related to the four seasons in terms of temperature, cloud cover, precipitation, and wind.	4
E.ES.01.23	Identify severe weather characteristics.	4
E.ES.01.24	Describe precautions that should be taken for human safety during severe weather conditions (thunder and lightning, strong winds, and heavy precipitation).	5

1-Unit 4: The Sun Warms the Earth

Big Ideas (Key Concepts)

- The sun warms the Earth.
- It is usually warmer in the daytime than at night.
- It is usually warmer in the summer than in winter.
- Weather is related to the four seasons.
- Severe weather can occur throughout the year.

Clarification of Content Expectations

Standard: Earth Systems

Content Statement: E.ES.E.1

Solar Energy – The sun warms the land, air, and water and helps plants grow.

Content Expectation

E.ES.01.11 Identify the sun as the most important source of heat, which warms the land, air, and water on the Earth.

Instructional Clarifications

1. Identify means to recognize that the sun warms the land, air, and water.
2. The sun can be identified as the primary source of heat on Earth.
3. Air, water, and land are affected differently by the sun's heat.
4. It is usually warmer in the daytime than at night.
5. It is usually warmer in the summer than in the winter.
6. The Earth is just the right distance from the sun to support life.

Assessment Clarification

1. The sun can be identified as the primary source of heat on Earth.

E.ES.01.12 Demonstrate the importance of sunlight and warmth in plant growth.

Instructional Clarifications

1. Demonstrate is to show through manipulation of materials and investigation the importance of sunlight and warmth in plant growth.
2. Plants need sunlight and warmth to grow and survive.

Assessment Clarification

1. Plants need sunlight and warmth to grow and survive.

Content Statement: E.ES.E.2

Weather – Weather changes from day to day and over the seasons.

Content Expectations

E.ES.01.22 Describe and compare weather related to the four seasons in terms of temperature, cloud cover, precipitation, and wind.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words weather related to the four seasons.
2. Compare is to note the similarities and differences between the seasons in terms of temperature, cloud cover, precipitation, and wind.
3. Weather can be described as having seasonal patterns in which cloud cover, temperature, precipitation, and wind follow general observable patterns.
4. Observable weather descriptions can be used to describe and compare spring, summer, fall, and winter.

Assessment Clarifications

1. Weather can be described as having seasonal patterns in which cloud cover, temperature, precipitation, and wind follow general observable patterns.
2. Observable weather descriptions can be used to describe and compare spring, summer, fall, and winter.

E.ES.01.23 Identify severe weather characteristics.

Instructional Clarifications

1. Identify is to recognize severe weather conditions and characteristics.
2. Severe weather events will be limited to thunderstorms, lightning, tornadoes, high winds, and blizzards.
3. Use discretion when teaching young children about severe weather events. Some children can be traumatized by graphic descriptions of these destructive weather phenomena.
4. Descriptions of these severe weather events will be limited to description by wind speed, precipitation type and amount, duration, frequency, and the size of the event.
 - a. Thunderstorm: Thunderstorms are storms with lightning and thunder. They have gusty winds and heavy rain. They can occur in any season, but are more common in spring and summer in Michigan and in the afternoon or evening hours.
 - b. Lightning: Lightning is a bright flash of electricity produced by a thunderstorm.
 - c. Tornado: A tornado is a windstorm that happens over land and has a funnel-shaped cloud that extends and touches the ground. (If it does not touch the ground it is referred to as a funnel cloud, not a

tornado.) Winds can be 40 mph to over 300 mph. Tornadoes usually last five to ten minutes, although some have lasted as long as an hour. They usually happen between the months of March and August in Michigan. There are close to 1,000 thunderstorms in the U.S. every year. Most of them (75%) are weak.

- d. Blizzard: A blizzard is a winter storm with large amounts of falling or blowing snow and very strong winds (greater than 35 mph) for an extended period of time (greater than 3 hours).

Assessment Clarification

1. Severe weather characteristics will be limited to thunder and lightning, strong winds, and heavy precipitation.

E.ES.01.24 Describe precautions that should be taken for human safety during severe weather conditions (thunder and lightning, strong winds, and heavy precipitation)

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words precautions that should be taken during severe weather conditions.
2. Precautions will be limited in description to severe weather events in Michigan.
3. Safety ideas will be limited to safe areas to go and places to avoid in each of these severe weather events as applicable.
 - a. Thunder and lightning - Go inside a sturdy building if you can. If you are in a car, stay in the car. Do not use the telephone or computers. If you cannot go inside, stay away from tall buildings or trees. Do not go into pools, lakes, or other bodies of water.
 - b. Tornadoes or high winds - Go down to a basement or into a room that is in the center of the building. Get under a sturdy piece of furniture. Stay away from windows. Get out of cars or trailer homes.
 - c. Blizzards – At home, stay inside. If outside, get to shelter. In a car or truck, stay inside. Run the car for about 10 minutes each hour for heat. Exercise to stay warm.
 - d. All storms - Flashlights should be used instead of candles when the power goes out. Stay away from fallen power and utility lines. Stay off the phone or computer.
4. Safety in severe weather includes listening to weather media and adults.

Assessment Clarifications

1. Precautions will be limited to severe weather characteristics in Michigan.
2. Safety ideas will be limited to safe areas to go and places to avoid during severe weather.
3. Safety in severe weather includes listening to weather media and adults.

<p>Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implications</p>

Inquiry Process
S.IP.01.11 Make purposeful observations of the daily weather to relate to the four seasons in terms of temperature, cloud cover, precipitation and wind.
S.IP.01.12 Generate questions about weather events based on observations of temperature, precipitation, cloud cover, and wind speed.
S.IP.01.13 Plan and conduct simple observations into weather related phenomenon such as temperature, precipitation, cloud cover, and wind speed.
S.IP.01.14 Manipulate simple tools that aid in weather observations and data collection (thermometers, rain gauges, wind socks or wind vanes).
S.IP.01.15 Make accurate measurements with appropriate units for the weather observation tools. (Fahrenheit, Celsius, centimeters, north, south, east, west)
S.IP.01.16 Construct simple charts from weather data and observations of temperature, rain fall, cloud cover, and wind speed.
Inquiry Analysis and Communication
S.IA.01.11 Share ideas about weather, severe storms and seasons through purposeful conversation.
S.IA.01.12 Communicate and present findings of patterns in weather and observations of weather related to seasons.
S.IA.01.13 Develop strategies for information gathering to find out about weather related phenomenon, changes in the seasons, and severe weather events (ask a meteorologist, use a book, make observations, conduct simple investigations, and watch a weather report or video).
Reflection and Social Implications
S.RS.01.11 Recognize that science investigations into weather and data collection are done more than one time.
S.RA.01.12 Demonstrate weather and/or season concepts through various illustrations, performances, models, exhibits, and activities.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
severe weather thunderstorm lightning tornadoes blizzards breezy wind windy strong winds safety seasons summer fall winter spring temperature cool warm hot cold cloud cover precipitation rain snow sunny precautions	solar percentage centimeter inches source of heat observations Celsius Fahrenheit

Instruments, Measurements, Representations

Measurements	Instruments	Representations
temperature	observation by senses thermometer	cool, warm, hot, cold Celsius, Fahrenheit
cloud cover	observation by senses	clear, cloudy, partly cloudy, foggy
precipitation	rain gauge ruler or meter stick	centimeter, inches
wind	observation by senses wind vane wind sock	calm, breezy, windy

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Solar Energy: E.ES.01.11

Weather: E.ES.01.22, E.ES.01.23, E.ES.01.24

Objectives

- Plan and conduct simple investigations of the sun's warming of the Earth.
- Make weather observations and manipulate simple tools that aid in weather observations and data collection over time.
- Describe the characteristics of severe weather events and safety precautions related to severe weather.
- Use simple charts, tables, or pictographs to compare monthly and seasonal weather conditions.

Engage and Explore

- Engage students in a variety of opportunities to observe, collect, and record weather phenomena over multiple seasons. (Note: Although this unit is one of four for first grade, it can follow or be combined with the weather unit so that weather observation opportunities can occur throughout the year.) (E.ES.01.21, S.IP.01.11, S.IP.01.14, S.IP.01.15, S.IP.01.16)
- Engage students in a discussion about seasons, the appropriate clothing, and activities they can do during each season. (E.ES.01.22, S.IA.01.12, S.IA.01.13)
- Give students the opportunity to explore the thermometer and discuss their ideas in groups. (S.IP.01.14, S.IP.01.15)
- Take students outdoors to make weather observations using their senses. (E.ES.01.22, S.IP.01.11)

- Generate questions about why the temperature is different in the shade and sun or morning and afternoon. (E.ES.01.11, S.IP.01.12)
- After measuring different earth material with the thermometer, ask the students if the temperature they are taking is that of the air, the land, or water. Students at this age need to come to think of air as a substance too. Often remind them that air is all around, even if you cannot see it. (E.ES.01.11, S.IP.01.13, S.IP.01.15)
- Plan and conduct investigations into the different temperatures they observed outdoors, for example measure the temperature of the air in the sun and shade, measure the temperature of the soil in the sun and shade, or measure the temperature of a container of water in the sun and shade. (E.ES.01.11, S.IP.01.13, S.IP.01.14, S.IP.01.15)

Explain and Define

- Share information from investigations of temperature of air, land, and water in different locations. Discuss the most important source of heat that affected the material. (E.ES.01.11, S.IA.01.12)
- Gather artifacts or pictures to represent the seasons; for example, an umbrella, pictures of snowmen, sand pail and shovel, buds on a twig, pictures of a tornado, pictures of lightning, etc. Have students sort the pictures and/or artifacts by season and explain why they sorted the pictures or objects as they did. (E.ES.01.22, S.IP.01.11, S.IA.01.13)
- Discuss weather patterns and data from classroom weather data collection. Relate the different weather phenomena to different seasons. (E.ES.01.22, S.IA.01.12, S.IA.01.13)
- Read books about the seasons. Connect to the real world by reading the book about a particular season on the first day of the season. Look at weather data collected during the previous season. Of course, weather patterns will overlap the calendar's designation for seasons. (E.ES.01.22, S.IA.01.14)
- It can help students become more aware that air is a substance by waving plastic bags back and forth, filling them with air. Invert a plastic cup and carefully push it down into an aquarium filled with water. If a paper towel is wadded up and placed in the cup first, when you lift the cup out of the water, the towel will be dry. Submerge the cup again, but this time, tip it slightly and watch the bubbles of air come out. (E.ES.01.12, S.IP.01.11)

Elaborate and Apply

- Continue collecting weather observations from the classroom weather station set up in Unit 3 (Weather). (Note: Collecting and recording weather data provides multiple opportunities to practice mathematics skills in the context of real world events. Saving the collected weather data over time in the form of graphs and text can help students see seasonal patterns.)

- Take or draw pictures of a tree located on the school grounds, perhaps one outside the classroom window. Watch how it changes over the school year. (E.ES.01.22, S.IP.01.11, S.RS.01.11)
- Discuss human and other animal activities in different seasons. (E.ES.01.22, S.IA.01.12)
- Engage students in conversations about severe weather. (Note: A good time to do this would be when you practice the safety drills for the weather event or when the weather event is in the news. These discussions can lead to questions about that event and inquiry activities.) (E.ES.01.23, S.IA.01.12, S.IP.01.12)
- Read books about the different types of severe weather. Discuss observations and changes in cloud cover, wind speed, and precipitation during a storm. Compare them to the weather observations before the storm. How did the local observations during the storm compare to the storm's characteristics from the book or other informational text? (E.ES.01.23, S.IA.01.14)
- Share information about safety during storms. This information can be found on Internet sites such as the NOAA's National Weather Service and the American Red Cross. (E.ES.01.23)
- Students can act out a play of things they should do during severe weather. (E.ES.01.23, S.RS.01.11)
- Engage the students in discussion to answer a *what would happen if* question: What would happen if there weren't any sun? (S.RS.01.11, S.IP.01.12)

Evaluate Student Understanding

Formative Assessment Examples

- Observe students as they use the tools to make accurate measurements. (S.IP.01.14, S.IP.01.15)
- Evaluate the students' use of weather vocabulary in their descriptions of weather, seasons and severe weather events. Are they using the measurement terms correctly? Do they understand the differences in seasons? Do they know what to do during severe weather? (E.ES.01.22, E.ES.01.23)
- Use the class discussion to evaluate the students' understanding of the relationship between weather and seasons. (E.ES.01.22)
- Use the investigation presentations and *what would happen if* questions to evaluate the students' understanding that the sun is the most important source of heat. (E.ES.01.11)

Summative Assessment Examples

- Match an activity to the season (swimming outside-summer, playing in snow-winter, playing in or raking fallen leaves-fall, flying kites or planting gardens-spring. (E.ES.01.22)
- Circle the picture of the thermometer that demonstrates summer. (S.IP.01.14)
- Show pictures of rain and snow. Circle the type of precipitation that falls when it is cold. (E.ES.01.22)

- Put an X on what you do not see during a thunderstorm. (Show pictures of clouds, lightning, and sun.) (E.ES.01.23)
- Put an X on the pictures that show what you could do during a thunderstorm if you are home (pictures of a child reading a book, playing a board game, working on a computer, talking on the telephone). (E.ES.01.23)
- Put an X on the pictures of where you should go if you are outside when you hear thunder (pictures of a child inside a garage, picture of a child under a picnic shelter, picture of a child standing under a tree, pictures of kids swimming in a pool or lake). (E.ES.01.23)
- Circle the BEST picture that shows where the Earth gets most of its heat (moon, sun, campfire, oven, volcano). (E.ES.01.11)

Enrichment

- Investigate and compare the length of day and angle of the sun throughout the seasons. Relate the amount and angle of sunlight to temperature and seasons.
- Some students can design another experiment to show how the sun affects water and soil differently
- Although Michigan does not experience hurricanes, they are the world's biggest weather event and they get much attention in the news. Remnants of a hurricane can reach Michigan in the form of clouds and rain. Some students will be interested in learning more about hurricanes as a severe weather event.
- Some students may be interested in learning how the seasons vary in different parts of the country and different parts of the world.

Intervention

- If students have not yet learned to read an alcohol thermometer, use a digital thermometer like one used for cooking or a temperature probe connected to a computer.
- Review the appropriate dress for different seasons.
- Provide resources that demonstrate human and other animal activity in different seasons.

Examples, Observations, and Phenomena (Real World Context)

Weather is an everyday phenomenon. In Michigan, there are many opportunities to observe weather events that will allow students see the connection of classroom learning to the real world. We have four distinct seasons and often experience severe weather events. These weather events or results of weather events (i.e., no power) sometimes close the school. Emergency procedures for severe weather events are practiced in the classroom. Severe weather events that occur outside of Michigan are also in the media when they happen and are other opportunities to learn about the real world outside the classroom.

The changing of seasons in Michigan is evident through observations of trees and animal activity. Students relate seasons to what plants and animals do.

Literacy Integration

Reading

R.IT.01.01 Identify and describe the basic form, features, and purpose of a variety of informational genre including simple “how-to” books, science and social studies magazines.

R.CM.01.04 Apply significant knowledge from grade-level science, social studies, and mathematics texts.

- Students may read about how the severe weather, safety, seasons.
- Students apply their knowledge about seasons to animal behavior and plant growth.
- Students may read an informational text on severe weather events and seasons.

Grade level appropriate informational text to extend the learning in this unit:

Red Leaf, Yellow Leaf, Ehlert, L. (1991)

The Seasons of Arnold's Apple Tree, Gibbons, G. (1984)

Thunder Cake, Polacco, P. (1990)

A New Coat for Anna, Ziefert, Harriet. (1988)

Writing

W.GN.01.01 write a personal narrative using illustrations and transitional words such as before, after, now, or finally to indicate a sequence of events, sense of story (beginning, middle, and end), and physical descriptions.

W.GN.01.03 write an informational piece that addresses a focus question (e.g., What is a family?) using descriptive, enumerative, or sequence patterns that may include headings, titles, labels, photographs, or illustrations to enhance the understanding of central ideas.

W.GN.01.04 use a teacher-selected topic to write one research question; locate and begin to gather information from teacher-selected resources; organize the information and use the writing process to develop a project.

- Students may ask a question about one of the severe weather types and research to answer the question (e.g., What is a blizzard?).
- Students can write a story indicating a sequence of events about their experiences during a severe weather event.
- After learning about safety tips for hurricanes, thunderstorms, blizzards, or tornadoes, students can write an informational text that summarizes what they should do for one type of severe weather.

Speaking

S.DS.01.04 plan and deliver presentations using an informational organizational pattern (e.g., descriptive, enumerative, or sequential) providing several facts and details to make their point while maintaining appropriate posture and eye contact using a prop.

- Students can share what they learned about the weather events or weather safety. They can report their findings from weather data and collection as if they were a weather person on the radio or television.
- Anna needed a new coat, but the war had just ended and people had no money. This story tells how Anna got her wool coat through bartering, starting with shearing of the sheep for wool.

Mathematics Integration

D.RE.01.01 Collect and organize data to use in pictographs.

D.RE.01.02 Read and interpret pictographs.

D.RE.01.03 Make pictographs of given data using both horizontal and vertical forms of graphs; scale should be in units of one and include symbolic representations

N.ME.01.01 Count to 110 by 1's, 2's, 5's, and 10's, starting from any number in the sequence.

N.ME.01.02 Read and write numbers to 110 and relate them to the quantities they represent.

N.ME.01.03 Order numbers to 110; compare using phrases such as "same as", "more than", "greater than", "fewer than"; use = symbol. Arrange small sets of numbers in increasing or decreasing order

N.MR.01.09 Compare two or more sets in terms of the difference in number of elements.

N.MR.01.10 Model addition and subtraction for numbers through 30 for a given contextual situation using objects or pictures; explain in words; record using numbers and symbols; solve.

- Students observe and record the number of sunny, cloudy, rainy or snowy days in a month and make a pictograph. Compare each month's pictographs to see which month has more rainy, cloudy, or sunny days.

- Students collect data from weather reports and record the amount of snow that falls in storms that occur throughout the winter. They use this information to make a pictograph. For example, each snowflake can represent one inch of snow. They can compare the amount of snow from each storm and make an addition and subtraction problem to solve.

Second Grade Science Content Expectations Companion Document

SCIENCE

- Unit 1: Measurement of Properties
- Unit 2: Plant Life
- Unit 3: Earth's Surface Features
- Unit 4: Uses and Properties of Water

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements

- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration



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Introduction to the K-7 Companion Document An Instructional Framework

Overview

The Michigan K-7 Grade Level Content Expectations for Science establish what every student is expected to know and be able to do by the end of Grade Seven as mandated by the legislation in the State of Michigan. The Science Content Expectations Documents have raised the bar for our students, teachers and educational systems.

In an effort to support these standards and help our elementary and middle school teachers develop rigorous and relevant curricula to assist students in mastery, the Michigan Science Leadership Academy, in collaboration with the Michigan Mathematics and Science Center Network and the Michigan Science Teachers Association, worked in partnership with Michigan Department of Education to develop these companion documents. Our goal is for each student to master the science content expectations as outlined in each grade level of the K-7 Grade Level Content Expectations.

This instructional framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings and expanding thinking beyond the classroom.

These companion documents are an effort to clarify and support the K-7 Science Content Expectations. Each grade level has been organized into four teachable units- organized around the big ideas and conceptual themes in earth, life and physical science. The document is similar in format to the Science Assessment and Item Specifications for the 2009 National Assessment for Education Progress (NAEP). The companion documents are intended to provide boundaries to the content expectations. These boundaries are presented as “notes to teachers”, not comprehensive descriptions of the full range of science content; they do not stand alone, but rather, work in conjunction with the content expectations. The boundaries use seven categories of parameters:

- a. **Clarifications** refer to the restatement of the “key idea” or specific intent or elaboration of the content statements. They are not intended to denote a sense of content priority. The clarifications guide assessment.
- b. **Vocabulary** refers to the vocabulary for use and application of the science topics and principles that appear in the content statements and expectations. The terms in this section along with those presented

- within the standard, content statement and content expectation comprise the assessable vocabulary.
- c. **Instruments, Measurements and Representations** refer to the instruments students are expected to use and the level of precision expected to measure, classify and interpret phenomena or measurement. This section contains assessable information.
 - d. **Inquiry Instructional Examples** presented to assist the student in becoming engaged in the study of science through their natural curiosity in the subject matter that is of high interest. Students explore and begin to form ideas and try to make sense of the world around them. Students are guided in the process of scientific inquiry through purposeful observations, investigations and demonstrating understanding through a variety of experiences. Students observe, classify, predict, measure and identify and control variables while doing "hands-on" activities.
 - e. **Assessment Examples** are presented to help clarify how the teacher can conduct formative assessments in the classroom to assess student progress and understanding
 - f. **Enrichment and Intervention** is instructional examples that stretch the thinking beyond the instructional examples and provides ideas for reinforcement of challenging concepts.
 - g. **Examples, Observations, Phenomena** are included as exemplars of different modes of instruction appropriate to the unit in which they are listed. These examples include reflection, a link to real world application, and elaboration beyond the classroom. These examples are intended for instructional guidance only and are not assessable.
 - h. **Curricular Connections and Integrations** are offered to assist the teacher and curriculum administrator in aligning the science curriculum with other areas of the school curriculum. Ideas are presented that will assist the classroom instructor in making appropriate connections of science with other aspects of the total curriculum.

This Instructional Framework is NOT a step-by-step instructional manual but a guide developed to help teachers and curriculum developers design their own lesson plans, select useful portions of text, and create assessments that are aligned with the grade level science curriculum for the State of Michigan. It is not intended to be a curriculum, but ideas and suggestions for generating and implementing high quality K-7 instruction and inquiry activities to assist the classroom teacher in implementing these science content expectations in the classroom.

Second Grade GLCE Companion Document

Unit 1: Measurement of Properties

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
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**Second Grade Unit:
Measurement of Properties**

Content Statements and Expectations

Code	Statements & Expectations	Page
P.PM.E.1	Physical Properties – All objects and substances have physical properties that can be measured.	3
P.PM.02.12	Describe objects and substances according to their properties (color, size, shape, texture, hardness, liquid or solid, sinking or floating).	3
P.PM.02.13	Measure the length of objects using rulers (centimeters) and meter sticks (meters).	4
P.PM.02.14	Measure the volume of liquids using common measuring tools (measuring cups, measuring spoons, graduated cylinders and beakers).	4
P.PM.02.15	Compare objects using a balance.	5
P.PM.E.4	Material Composition – Some objects are composed of a single substance, while other objects are composed of more than one substance.	5
P.PM.02.41	Recognize that some objects are composed of single substances (water, sugar, salt) and others are composed of more than one substance (salt and pepper, mixed dry beans).	5

2 – Unit 1: Measurement of Properties

Big Ideas (Key Concepts)

- Objects and substances can be described by their properties and through measurement.
- Objects and substances can be classified as single substances or mixtures and single substances can be combined to make mixtures.

Clarification of Content Expectations

Standard: Properties of Matter

Content Statement - P.PM.E.1

Physical Properties - All objects and substances have physical properties that can be measured.

Content Expectations

P.PM.02.12 Describe objects and substances according to their properties (color, size, shape, texture, hardness, liquid or solid, sinking or floating).

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words the properties of objects and substances.
2. Properties include color, size, shape, texture, hardness, liquid or solid, sinking or floating.
3. Texture descriptions include rough and smooth.
4. Hardness descriptions are limited to the sense of touch. Words that may be used to describe hardness may include: hard, soft, stiff, and flexible.
5. Second grade description of solids and liquids includes: solids keep own shape and liquids take shape of container.
6. Sinking or floating is limited to trial and error investigations of objects sinking and floating in water.

Assessment Clarifications

1. Properties include color, size, shape, texture, hardness, liquid or solid, sinking or floating.
2. Texture descriptions include rough and smooth.
3. Hardness descriptions are limited to sense of touch. Words that may be used to describe hardness may include: hard, soft, stiff, and flexible.
4. Sinking or floating is limited to trial and error investigations of objects sinking and floating in water.

P.PM.02.13 Measure the length of objects using rulers (centimeters) and meter sticks (meters).

Instructional Clarifications

1. Measure means to use standard units to determine the length of objects.
2. The metric system is the unit of measure most often used in science.
3. This physical science expectation is linked to two Inquiry Process expectations (S.IP.02.14 and S.IP.02.15). The emphasis at the second grade level is the ability to choose the appropriate tool and read the appropriate unit of measurement for the tool.
4. Students' practice of measurement is not limited to measuring the length of objects. Students' measurement abilities expand to measuring the distance something travels, the height of objects, etc.

Assessment Clarifications

1. Assessment is limited to measurement of length in meters and centimeters.
2. Use the appropriate tool (ruler or meter stick) to measure length and link the appropriate unit of measure (centimeter or meter) to the tool.

P.PM.02.14 Measure the volume of liquids using common measuring tools (measuring cups, measuring spoons, graduated cylinders and beakers)

Instructional Clarifications

1. Volume is the measurement of the amount of space taken up by a substance or an object regardless of its shape. All matter has volume.
2. Students at this age have issues with the conservation of liquids – specifically a liquid in a tall thin container versus a short squat container and will not recognize that they could be equal.
3. Common measuring tools for volume include but are not limited to measuring cups and measuring spoons. Students may benefit from the introduction of graduated beakers and cylinders in measuring volume.
4. Measuring the volume of solid objects through water displacement, such as marbles, washers, bolts, etc. is not expected at this grade. However, students can make comparisons and accurate measurement of volume of a liquid and a solid such as sand, sugar, or soil.
5. The expectation does not refer to the unit of measurement for volume. Students are expected to continue to measure in the metric system and measure the volume of substances using milliliters and liters.
6. The emphasis in this expectation is the ability to choose the appropriate tool to measure volume.
7. The expectation provides the opportunity to introduce measurement of volume of a substance using milliliters and liters. (The use of milliliters and liters is addressed in the 4th grade)

Assessment Clarification

1. Assessment is restricted to measurement of volume using graduated measuring cups and measuring spoons.

P.PM.02.15 Compare objects using a balance.

Instructional Clarifications

1. Compare is to note similarities and differences of objects using a balance.
2. The use of the balance as a tool for measurement collection is to compare the mass of different objects
3. The use of the term weight with the balance perpetuates the misconception that weight and mass are interchangeable or are measuring the same thing. A better way to introduce the students to the balance is to introduce the term mass.
4. Mass is defined as the amount of matter in an object. Weight is the force on an object due to gravity.
5. The emphasis in this expectation is the ability to use the balance to compare objects and recognize objects that are heavier (because of more mass), lighter (because of less mass), or the same on the balance.

Assessment Clarification

1. Compare the mass of objects using a balance. (Heavier-more mass, lighter-less mass, the same-equal mass)

Content Statement - P.PM.E.4

Material Composition – Some objects are composed of a single substance, while other objects are composed of more than one substance.

Content Expectation

P.PM.02.41 Recognize that some objects are composed of single substances (water, sugar, salt) and others are composed of more than one substance (salt and pepper, mixed dry beans).

Instructional Clarifications

1. Recognize is to identify or point out single substances or mixtures through observation.
2. Each substance has its own chemical composition and physical properties.
3. Single substances are made up of only one thing, such as water, salt, and sugar.
4. Combining single substances can make mixtures and the substances that make up a mixture keep their physical properties.
5. Mixtures can be separated into their single substances.

Single substances	Mixture
Water	Salt and pepper
Sugar	Beans and peas
Salt	Salt water
Pepper	Sugar water

Assessment Clarification

1. Recognition of objects that are made up of single substances and objects that are made up of more than one substance.

Inquiry Process, Inquiry Analysis and Communication, Reflection, and social Implications

Inquiry Processes
S.IP.02.11 Make purposeful observations of various objects according to their properties.
S.IP.02.12 Generate questions based on observations of objects according to their properties and of single substances and mixtures.
S.IP.02.13 Plan and conduct simple investigations of objects or substances to determine whether they sink or float and to compare objects using a balance.
S.IP.02.14 Manipulate simple tools (metric rulers and meter sticks) to determine the length of objects and the volume of liquids (measuring cups and measuring spoons)
S.IP.02.15 Make accurate measurements of length of objects in appropriate units (meter, centimeter)
S.IP.02.16 Construct simple charts and graphs from data and observations of properties of objects and substances.
Inquiry Analysis and Communication
S.IA.02.12 Share ideas about the properties of objects and the classification of single substances and mixtures.
S.IA.02.13 Communicate and present findings about the properties of objects or substances and the classification of single substances and mixtures.
S.IA.02.14 Develop strategies and skills for gathering information about the properties of objects or substances.
Reflection and Social Implication
S.RS.02.11 Demonstrate a means of classifying objects as single substances or mixtures through various illustrations, performances, exhibits, or activities.
S.RS.02.13 Recognize that when a science investigation on sinking and floating of objects or substances is done the way it was done before, similar results are expected.
S.RS.02.15 Use evidence when communicating ideas about the classification of single substances and mixtures.
S.RS.02.16 Identify technology used to compare objects that is used in everyday life.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
balance classify color liquid mixture properties ruler shape size texture hardness solid sink float length meter stick centimeter (cm) meter (m) volume measuring cup measuring spoon compare single substance mass	chart data observations weight liters (L) milliliters (mL)

Instruments, Measurements, and Representations

Measurement	Tools	Units
length	ruler	centimeter (cm)
	meter stick	centimeter (cm), meter (m)
volume	measuring cup	milliliter* (mL), liter* (L)
	measuring spoon	milliliter* (mL)
mass*	balance	heavier, lighter, same

*To be mastered and assessed in the 4th grade.

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Physical Properties: P.PM.02.12, P.PM.02.13, P.PM.02.14, P.PM.02.15

Material Composition: P.PM.02.41

Objectives

- Make observations of a variety of objects and describe the objects by their physical properties.
- Focus on the property of size and introduce the measurement of length, volume, and mass of objects to add quantitative data for the size of objects.
- Make observations of a variety of objects and classify them as single substances and mixtures.

Engage and Explore

- Before attaching the criteria of properties of matter, students observe, sort, and describe a variety of objects based on their own classification. (P.PM.02.12, S.IP.02.11)
- Only after students have sorted and described the objects on their own, introduce the terms color, size, shape, texture, hardness, liquid or solid, sinking or floating. (P.PM.02.12, S.IP.02.11, S.IA.02.12)
- Students repeat their descriptions using the properties listed by constructing a chart that organizes the objects by their properties, share ideas about properties through purposeful conversation and communicate and present their findings. (P.PM.02.12, S.IP.02.11)
- Students brainstorm the meaning of the term property. (P.PM.02.12, S.IA.02.12)

Explain and Define

- Students will come to consensus on the term property and the descriptive terms used to describe properties of objects (color, size, shape, texture, hardness, liquid or solid, sinking or floating). (P.PM.02.12, S.IA.02.12, S.IA.02.13)
- Students present their sorting and descriptions of a variety of objects to the class. Collectively the class makes sense of identifying objects by their observable properties. (P.PM.02.12, S.IA.02.12, S.IA.02.13)
- Explain the term size and introduce measurement tools and units that give quantitative data to the properties of the objects. (Length, weight, and volume) (P.PM.02.13, S.IP.02.14, S.IP.02.15)
- Demonstrate and practice using the measurement tools to measure a variety of objects and materials. (P.PM.02.13, S.IP.02.14, S.IP.02.15)

Elaborate and Apply

- Organize a measuring scavenger hunt and have students work with a partner to find objects that measure specific lengths in centimeters and meters. (P.PM.02.13, S.IP.02.14, S.IP.02.15)
- Expand the measurement of centimeters and meters and students measure distance of objects that have moved. Construct simple charts and graphs from data and observations through measurement of distance. (P.PM.02.13, S.IP.02.16, S.IP.02.14, S.IP.02.15)
- Using a variety of measurements and measuring tools, students measure the volume of liquids. Expand their measurement of volume to the volume of solids, such as flour, sand, soil, and pebbles. Have students experiment with conservation of liquids by pouring 100mL from a graduated cylinder into a graduated beaker and draw a conclusion about the comparative volume. (P.PM.02.14, S.IP.02.14, S.IP.02.15)
- Make observations comparing objects using a balance. Construct simple charts and graphs from data and observations of the comparison of objects. (P.PM.02.15, S.IP.02.11, S.IP.02.12, S.IP.02.13, S.IP.02.14, S.IP.02.16)
- Introduce the concept of identifying substances as solids and liquids. Explore liquid water as it takes the shape of a variety of containers and solid water keeps its own shape. Elaborate on the concept of liquid and solid. Observe how liquid water takes the shape of its container using a variety of volumes of water. (P.PM.02.14, P.PM.02.15, S.IP.02.11, S.IP.02.14, S.IP.02.15)
- Expand student thinking about the properties to include mixtures and single substances. Students observe substances and objects and classify them as single substances and mixtures. Using a variety of single substances (salt, pepper, beans, peas, paper clips, water, etc.), students combine single substances to make mixtures. (P.PM.02.41, S.IP.02.11, S.IP.02.12, S.IP.02.13)

- Introduce students to soil as a mixture and given the opportunity to observe and identify the single substances that make up soil as a mixture. (P.PM.02.41, S.IP.02.11, S.IP.02.12)
- Students generate questions regarding the separation of mixtures based on their observations of single substances and mixtures. Students plan and conduct simple investigations into separating their mixtures to single substances to answer their questions. Introduce simple tools, such as filter paper, sieves, magnets, and forceps for students to use to separate mixtures. Identify technology used to separate mixtures that is used in everyday situations. (P.PM.02.41, S.IP.02.11, S.IP.02.12, S.IP.02.13, S.IP.02.14, S.IP.02.15, S.IA.02.13)
- Demonstrate the student separation procedures through illustrations and models and communicate and present findings to others. (P.PM.02.41, S.IA.02.12, S.IA.02.13)
- Plan and conduct a sink and float investigation and identify sink or float as a property of objects. Students predict and test their items for the ability to sink or float in water. Students perform multiple trials and recognize that when a science investigation on sinking and floating of objects or substances is done the way it was done before, similar results are expected. (P.PM.02.12, S.IP.02.11, S.IP.02.13, S.IP.02.16)

Evaluate Student Understanding

Formative Assessment Examples

- Use the student presentations and discussion to assess the students' ability to describe objects by their properties. (P.PM.02.12)
- Use the students' sink and float investigations to assess student ability to raise questions and plan simple investigations. (P.PM.02.12)
- Use student investigations into the separation of mixtures to assess their ability to raise questions based on observations. (P.PM.02.41)

Summative Assessment Examples

- Circle the objects that have the same texture. (P.PM.02.12)
- Circle the objects that have similar properties. Write what properties are the same and what properties are different. (P.PM.02.12)
- Jane wanted to measure the length of her desk. Circle the BEST tool for Jane to use. Circle the best unit of measure for Jane to use. (P.PM.02.13, P.PM.02.14)
- Choose the best measuring tool for John to measure the amount of water to place in the pot. (P.PM.02.13, P.PM.02.14)
- Circle the object that is the heaviest. Write how you know which object is heaviest. (P.PM.02.15)
- Circle the picture that BEST shows a mixture. Write how you know that. (P.PM.02.41)
- Choose the tool that you would use to separate the mixture. (P.PM.02.41)

Enrichment

- Students plan and conduct simple investigations into separating mixtures to single substances, including the use of evaporation to separate water from salt.
- Investigate, using the balance, measuring cup, and measuring spoon if different substances with the same volume have the same mass.
- Students combine their measurement skills by measuring the same volume of two substances (water and sand) and making a comparison using the balance.
- Students use magnetic and nonmagnetic to describe properties.

Intervention

- Students are given the opportunity to explore a variety of solids to make mixtures and use different tools to separate a variety of solids of different shapes and sizes.
- Students use non-standard units for measurement to begin thinking in terms of quantitatively measuring objects and then relate to metric units of measurement.
- Set up stations in the classroom for students to continue their explorations into measurement.

Examples, Observations, and Phenomena (Real World Context)

Classification and measurement are everyday skills. Students are involved in measurement of growth (height and weight), recipes, and distance. They classify common objects by color, shape and size at an early age; the stop sign, yield sign, traffic signals, toy blocks, dishes, pencils, crayons, etc., all provide real world opportunities to use their sorting by properties skills. The recognition of sinking and floating as an important property is demonstrated through the material used in life jackets, life rings, and boat building. Students recognize that a rock will sink and a piece of wood will float.

Mixing materials (single substances to make a mixture) is a common activity for young learners. They mix their morning cereal with milk and fruit, mix foods on their plates, make instant fruit flavored drinks, create a mixture of blocks and toys in the toy box, and a mixture of crayons, markers, and pencils in their school supplies.

Literacy Integration

Reading

R.WS.02.11 in context, determine the meaning of words and phrases including objects, actions, concepts, content vocabulary, and literary terms, using strategies and resources including context clues, mental pictures, and questioning.

R.IT.02.02 discuss informational text patterns including descriptive, sequential, enumerative, and compare/contrast.

R.IT.02.04 respond to individual and multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make connections, take a position, and/or show understanding.

R.CM.02.01 make text-to-self and text-to-text connections and comparisons by activating prior knowledge, connecting personal knowledge, experience, and understanding of others to ideas in text through oral and written responses.

R.CM.02.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about properties of matter and measurement:

Measuring Penny, Loreen Leedy, 1998

How Big Is A Foot?, Rolf Myller, 1991

- Activate prior knowledge of measurement before reading the book, *Measuring Penny*.
- Connect personal knowledge, experience, and understanding of measurement to ideas in the text and through oral and written response.
- Retell relevant details of the units of measurement, measuring tools, and length, volume, and weight as described in the book.

Writing

W.GN.02.03 write an informational piece including a magazine feature article using an organizational pattern such as description, enumeration, sequence, or compare/contrast that may include graphs, diagrams, or charts to enhance the understanding of central and key ideas.

W.GN.02.04 use the writing process to produce and present a research project, develop two research questions related to a teacher-selected topic;

gather electronic or print resources and organize the information using key ideas with teacher assistance.

W.GR.02.01 in the context of writing, correctly use more complex complete sentences, nouns, and verbs, commas, contractions, colons to denote time, and capitalization of proper nouns.

- Write about a measuring experience (similar to the experience in *Measuring Penny*) and why the use of measurement helped in understanding a concept or answering a question.
- Include the measuring tool and unit of measurement that were used and display the measurement in the form of a graph. Tell why you chose that tool and unit of measurement.

Speaking

S.CN.02.02 explore and use language to communicate effectively with a variety of audiences and for different purposes including questions and answers, discussions, and social interactions.

S.DS.02.01 engage in substantive conversations, remaining focused on subject matter, with interchanges building on prior responses in book discussions, peer conferencing, or other interactions.

S.DS.02.03 respond to multiple text types by reflecting, making connections, taking a position, and/or showing understanding.

- Engage in substantive conversation remaining focused on the subject matter, with interchange building on prior responses, and in the context of the book discussion and the scientific investigations.

Mathematics Integration

M.UN.02.01 Measure lengths in meters, centimeters, inches, feet, and yards approximating to the nearest whole unit and using abbreviations: cm, m, in, ft. yd.

M.UN.02.02 Compare lengths; add and subtract lengths (no conversion of units).

M.PS.02.10 Solve simple word problems involving length and money.

- Connect the writing experience and math skills (See Writing)

Second Grade GLCE Companion Document

Unit 2: Plant Life

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

Second Grade Companion Document

2-Unit 2: Plant Life

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**Second Grade Unit:
Plant Life**

Content Statements and Expectations

Code	Statements & Expectations	Page
L.OL.E.1	Life Requirements – Organisms have basic needs. Animals and plants need air, water, and food. Plants also require light. Plants and animals use food as a source of energy and as a source of building material for growth and repair.	3
L.OL.02.14	Identify the needs of plants.	3
L.OL.E.2	Life Cycles – Plants and animals have life cycles. Both plants and animals begin life and develop into adults, reproduce, and eventually die. The details of this life cycle are different for different organisms.	3
L.OL.02.22	Describe the life cycle of familiar flowering plants including the following stages: seed, plant, flower, and fruit.	3
L.HE.E.1	Observable Characteristics – Plants and animals share many, but not all, characteristics of their parents.	4
L.HE.02.13	Identify characteristics of plants (for example: leaf shape, flower type, color, size) that are passed on from parent to young.	4

2 – Unit 2: Plant Life

Big Ideas (Key Concepts)

- Plants need air, water, and sunlight to survive.
- Plants have a life cycle that includes seed, seedling or young plant, adult plant, flower, fruit and seed.
- Plants have characteristics that are passed from the parent plant.

Clarification of Content Expectations

Standard: Organization of Living Things

Content Statement: L.OL.E.1

Life Requirements – Organisms have basic needs. Animals and plants need air, water, and food. Plants also require light. Plants and animals use food as a source of energy and as a source of building material for growth and repair.

Content Expectation

L.OL.02.14 Identify the needs of plants.

Instructional Clarifications

1. Identify is to recognize the basic needs of plants as air, water, and light.
2. Plants use air, water, and sunlight to make their own food.
3. Plants store their own food in various plant parts.
4. Plants do not get their food from the soil.

Assessment Clarifications

1. Plants need air, water, and light to survive.
2. Plants use air, water, and sunlight to make their own food.

Content Statement – L.OL.E.2

Life Cycles – Plants and animals have life cycles. Both plants and animals begin life and develop into adults, reproduce, and eventually die. The details of this life cycle are different for different organisms.

Content Expectation

L.OL.02.22 Describe is to tell or depict in spoken or written words the life cycle of familiar flowering plants using the stages of seed, plant, flower, and fruit.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words how the life cycle of plants can include various stages.
2. Plants have a life cycle.
3. The plant life cycle includes seed-> plant -> flower -> fruit -> seed.
4. Seeds need water and temperature to begin to grow.
5. All flowering plants produce seeds and have a fruit.
6. Seeds, fruits, and flowers come in a variety of shapes, sizes, and colors.

Assessment Clarifications

1. Plants have a life cycle.
2. The plant life cycle includes seed-> plant -> flower -> fruit -> seed.

Standard: Heredity**Content Statement – L.HE.E.1**

Observable Characteristics – Plants and animals share many, but not all, characteristics of their parents.

Content Expectation

L.HE.02.13 Identify characteristics of plants (for example: leaf shape, flower type, color, size) that are passed on from parent to young.

Instructional Clarifications

1. Identify means recognize the observable physical features of plants that are passed from parent to young.
2. Plants of the same type have the same leaf shape, flower type, color, and size.
3. Leaf shape, flower type, color and size are passed from the parent plant to the young produce from its seeds.

Assessment Clarifications

1. Plants of the same type have the same leaf shape, flower type, color, and size.
2. Leaf shape, flower type, color and size are passed from the parent plant to the young produce from its seeds.

**Inquiry Process, Inquiry Analysis and Communication,
Reflection and social Implications**

Inquiry Processes
S.IP.02.11 Make purposeful observations of plant growth that include the needs of plants and the plant life cycle.
S.IP.02.12 Generate questions based on observations of plant growth and plant parts.
S.IP.02.13 Plan and conduct simple investigations into plant growth and survival to determine the needs of plants.
S.IP.02.14 Manipulate simple tools (metric rulers and meter sticks) to determine the growth of plants.
S.IP.02.15 Make accurate measurements of the growth of plants in appropriate units (meter, centimeter).
S.IP.02.16 Construct simple charts and graphs from data and observations of plant growth and life cycles.
Inquiry Analysis and Communication
S.IA.02.12 Share ideas about the needs of plants and life cycle stages.
S.IA.02.13 Communicate and present findings about plant investigations and their need for air, water and light.
S.IA.02.14 Develop strategies and skills for gathering information about the life cycle of plants.
Reflection and Social Implication
S.RS.02.11 Demonstrate the life cycle of plants through various illustrations, performances, exhibits, or activities.
S.RS.02.13 Recognize that when a science investigation on the needs of plants is done the way it was done before, similar results are expected.
S.RS.02.15 Use evidence when communicating ideas about the needs of plants and the life cycle of plants.
S.RS.02.16 Identify technology used to enhance the growth of plants that is used in everyday life.

Vocabulary

Critically Important-State Assessable	Instructionally Useful
flowering plants needs of plants air water light food life cycle seed plant flower fruit characteristics leaf shape flower type color size parent young	makes its own food food storage

Instruments, Measurements, Representations

Instruments	Measurements/Observations	Representations
metric ruler/tape	plant growth	centimeters
measuring cup, measuring spoons, graduated cylinders and beakers	soil, water	milliliters
hand lens	plant parts, seeds, plant growth	drawings and observations

Instructional Framework

*The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is **NOT** a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.*

Instructional Examples

Life Requirements: L.OL.02.14

Life Cycles: L.OL.02.22

Heredity: L.HE.02.13

Objectives

- Make observations of plants and their interactions within habitats.
- Focus on their needs and how they help them survive.
- Make observations on the patterns plants follow from being born to growing up and getting old.
- Make observations on parental and young characteristics.
- Compare the physical characteristics of offspring and parent.

Engage and Explore

- Students study a plant's growth from seed to seed. (L.OL.02.22, S.IP.02.11, S.IP.02.12)
- In pairs, have students observe a variety of seeds using the hand lens. Allow sufficient time for students to sort, discuss, and ask questions about the seeds. (S.IP.02.11, S.IP.02.12, S.IP.02.14, S.IA.02.12, S.IA.02.13)
- Go outside on a seed hunt. Using the plants in the schoolyard, observe and collect a variety of seeds in the wild. (S.IP.02.11, S.IP.02.12, S.IP.02.14, S.IA.02.12, S.IA.02.13)
- As a class, brainstorm student ideas of where seeds come from. Ask students to apply what they know about living and nonliving things to seeds. (S.RS.02.15, S.IA.02.14)
- Discuss what the students think seeds need to sprout and grow. (L.OL.02.14, S.IA.02.12, S.IA.02.13)

- Have students choose seeds to plant and grow in the classroom. (S.IP.02.13)

Explain and Define

- Record students' initial ideas about the stages in the growth of a plant on chart paper. Ask students for their ideas of how they can find out if their ideas are correct. (L.OL.02.22)
- Have students plan an observation and recording schedule to observe the growth of their seeds/plants in the classroom. (S.IP.02.13, S.IP.02.14, S.IP.02.15, S.IA.02.12, S.IA.02.13, S.IA.02.14)
- Plant a baggie seed garden to observe and record the growth of a seed. Graphs should be made to display data. (S.IP.02.14, S.IP.02.15, S.IP.02.16)
- Review the needs of plants and have students decide on a watering schedule and where the plants should be located to grow. (L.OL.02.14, S.IP.02.13)
- Write the term life cycle on the board. Brainstorm for student ideas of the meaning of the term. Explain that all living things start from an egg or a seed, grow into an adult, and then have babies or offspring. Note: This may be a review from the life cycle of animals unit in the first grade. (L.OL.02.22)
- Read a book about the life cycle and growth of a plant from seed to seed, such as *The Pumpkin Circle*. (L.OL.02.22)

Elaborate and Apply

- Ask students to compare and contrast the life cycle of a plant to the life cycle of an animal. (L.OL.02.22)
- Share multiple examples of passed characteristics and life cycles with the students. (L.HE.02.13, RS.02.15)
- Students talk about characteristics passed from parent to offspring, such as leaf shape, size and color, flower color, shape, and size, stems, roots, and seeds. (L.HE.02.13, S.RS.02.11)

Evaluate Student Understanding

Formative Assessment Examples

- Check student observation/picture journal to determine if observations are appropriate/applicable. (L.OL.02.14)
- Student conversations in their groups can be used as basis for monitoring understanding. (L.OL.02.14)

Summative Assessment Examples

- Circle the needs of plants. (L.OL.02.14)
- Draw a picture of a plant and its seeds. (L.HE.02.13)
- Circle a characteristic that is shared by these plants. (L.HE.02.13)
- Draw the next stage of life for this plant. (L.OL.02.22)

Enrichment

- Students study another plant of their choice to show in a drawing the life cycle, characteristics passed from parent to offspring, life needs and habitat should be incorporated for their chosen plant.

Intervention

- Break students into research groups that focus on one aspect of the life cycle e.g. seed group, plant group, flower group, fruit group, and have students cycle through each of these groups studying many different plants. Students will then rotate through the other groups to experience all of them.

Examples, Observations, and Phenomena (Real World Context)

Most students, at this time in their education have had some experiences with planting seeds and growing plants. They observe plant life cycle and characteristics of plants without attaching scientific terms or observations. The purposeful study of the plant life cycle in the classroom relates to the planting of gardens and farmland. Through comparison of students' outdoor experiences and observations to the in-class investigations, students gain an understanding of the life cycle of all living things.

In first grade, students learned about the life cycle of animals. Comparison between the life cycle of all living things, plants and animal, is the first introduction into cycles throughout nature. Students recognize that all living things start as a seed or egg, grow to an adult, reproduce, and then die.

Young learners build understanding of life science concepts through direct experience with living things, their life cycles, and long-term observations.

Literacy Integration

Reading

R.WS.02.11 in context, determine the meaning of words and phrases including objects, actions, concepts, content vocabulary, and literary terms, using strategies and resources including context clues, mental pictures, and questioning.

R.IT.02.02 discuss informational text patterns including descriptive, sequential, enumerative, and compare/contrast.

R.IT.02.04 respond to individual and multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make connections, take a position, and/or show understanding.

R.CM.02.01 make text-to-self and text-to-text connections and comparisons by activating prior knowledge, connecting personal knowledge, experience, and understanding of others to ideas in text through oral and written responses.

R.CM.02.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about plants, their life cycle, and characteristics passed from parent to young:

The Pumpkin Circle, George Levenson, 1999

The Tiny Seed, Eric Carle, 1970

Jack's Garden, Henry Cole, 1997

- Activate prior knowledge about plants, seeds, and growing gardens.
- Connect personal knowledge, experience, and understanding of plants and growing plants to ideas in the text and through oral and written response.
- Retell relevant details of the life cycle of a plant as described in the book.

Writing

W.GN.02.03 write an informational piece including a magazine feature article using an organizational pattern such as description, enumeration, sequence, or compare/contrast that may include graphs, diagrams, or charts to enhance the understanding of central and key ideas.

W.GN.02.04 use the writing process to produce and present a research project, develop two research questions related to a teacher-selected topic; gather electronic or print resources and organize the information using key ideas with teacher assistance.

W.GR.02.01 in the context of writing, correctly use more complex complete sentences, nouns, and verbs, commas, contractions, colons to denote time, and capitalization of proper nouns.

- Write about a planting experience and use data from observations in the writing piece.
- Write an article about the importance of plants and how the life cycle of plants ensures the re-growth of plants.
- Write a story about a seed from the time it was planted to the time it produced seeds of its own. Include illustrations and labels. Write the story from the point of view of the seed and describe its surroundings.

Speaking

S.CN.02.02 explore and use language to communicate effectively with a variety of audiences and for different purposes including questions and answers, discussions, and social interactions.

S.DS.02.01 engage in substantive conversations, remaining focused on subject matter, with interchanges building on prior responses in book discussions, peer conferencing, or other interactions.

S.DS.02.03 respond to multiple text types by reflecting, making connections, taking a position, and/or showing understanding.

- Present their stories to different audiences beyond the classroom.
- Write and perform a play about the life cycle of a plant from seed to seed.

Mathematics Integration

M.UN.02.01 Measure lengths in meters, centimeters, inches, feet, and yards approximating to the nearest whole unit and using abbreviations: cm, m, in, ft. yd.

M.UN.02.02 Compare lengths; add and subtract lengths (no conversion of units).

M.PS.02.10 Solve simple word problems involving length and money.

- Measure plant growth in centimeters.

- Measure water and soil in cups and milliliters when planting seeds and seedlings.

Second Grade GLCE Companion Document

Unit 3: Earth's Surface Features

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

Second Grade Companion Document

2-Unit 3: Earth's Surface Features

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**Second Grade Unit:
Earth's Surface Features**

Content Statements and Expectations

Code	Statements & Expectations	Page
E.SE.E.2	Surface Changes –The surface of Earth changes. Some changes are due to slow processes, such as erosion and weathering, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.	3
E.SE.02.21	Describe the major landforms of the surface of the Earth (mountains, plains, plateaus, valleys, hills).	3
E.FE.E.2	Water Movement – Water moves in predictable patterns.	3
E.FE.02.21	Describe how rain collects on the surface of the Earth and flows downhill into bodies of water (streams, rivers, lakes, oceans) or into the ground.	3
E.FE.02.22	Describe the major bodies of water on the Earth's surface (lakes, ponds, oceans, rivers, streams).	4

2 – Unit 3: Earth’s Surface Features

Big Ideas (Key Concepts)

- Earth surface has many major landform types.

Clarification of Content Expectations

Standard: Solid Earth

Content Statement - E.SE.E.2

Surface Changes –The surface of Earth changes. Some changes are due to slow processes, such as erosion and weathering, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.

Content Expectation

E.SE.02.21 Describe the major landforms of the surface of the Earth (mountains, plains, plateaus, valleys, hills).

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words about the major landforms on the Earth’s surface.
2. Major landform descriptions are limited to mountains, plains, plateaus, valleys and hills.

Assessment Clarification

1. Major landform descriptions are limited to mountains, plains, plateaus, valleys and hills.

Content Statement – E.FE.E.2

Water Movement – Water moves in predictable patterns.

Content Expectations

E.FE.02.21 Describe how rain collects on the surface of the Earth and flows downhill into bodies of water (streams, rivers, lakes, oceans) or into the ground.

Instructional Clarifications

1. Describe means to tell or depict in spoken or written words how rain collects and flows on the Earth's surface.
2. Rain collection can become run-off as water flows downhill over impervious surfaces.
3. Rain collection can become ground water as water lands on and enters porous surfaces.

Assessment Clarifications

1. Rainwater flows downhill over parts of the Earth into bodies of water.
2. Rainwater lands on and soaks into the soil.

E.FE.02.22 Describe the major bodies of water on the Earth's surface (lakes, ponds, oceans, rivers, streams).

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words about the major bodies of water on the surface of the earth.
2. Major bodies of water descriptions are limited to lakes, ponds, oceans, rivers and streams.

Assessment Clarification

1. Major bodies of water descriptions are limited to lakes, ponds, oceans, rivers and streams.

<p>Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implications</p>

Inquiry Process
S.IP.02.11 Make purposeful observations of how rain collects on models of major landforms and bodies of water.
S.IP.02.12 Generate questions about the flow of water over land and into the ground based on observations.
S.IP.02.13 Plan and conduct simple investigations into the flow of water downhill into bodies of water, or into the ground.
S.IP.02.14 Manipulate simple tools that aid in observations of models, (hand lens, meter sticks, measuring cups, graduated cylinders).
S.IP.02.15 Make accurate measurements with appropriate units (centimeters, milliliters) for the measurement tool.
S.IP.02.16 Construct simple charts and graphs from data and observations of investigations into the flow of water downhill into bodies of water or into the ground.
Inquiry Analysis and Communication
S.IA.02.11 Share ideas about observations of how water flows downhill through purposeful conversation.
S.IA.02.12 Communicate and present finding of observations and investigations into the flow of water downhill into bodies of water, or into the ground.
S.IA.02.13 Develop strategies and skills for information gathering about landforms, bodies of water, and how water flows downhill into bodies of water or into the ground.
Reflection and Social Implications
S.RS.02.12 Use evidence from their investigations when communicating how rain water collects on the Earth's surface, flows downhill into bodies of water, or into the ground.
S.RS.02.13 Recognize that when a science investigation is done the way it was done before, similar results are expected.
S.RS.02.14 Demonstrate landforms, bodies of water, how rain collects on Earth's surface, and flows downhill into bodies of water or into the ground through models or exhibits.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
plateau valley hill mountain plain lake pond river stream ocean downhill soak	impervious porous flow gravity

Instruments, Measurements, and Representations

Measurements	Instruments	Representations
rate of water flow	senses, stream tables, watersheds models	fast, slow
shape of landforms	3-d models of landforms, relief maps	flat, high, low

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Surface Changes: E.SE.02.21

Water Movement: E.FE.02.21, E.FE.02.22

Objectives

- Describe major landforms (mountains, plains, plateaus, valleys and hills).
- Describe major bodies of water (lakes, ponds, oceans, rivers, streams).
- Describe how water flows over the Earth's surface into bodies of water and into the soil.

Engage and Explore

- Students walk around their schoolyard and observe land for changes in shape such as raised flowerbeds, small hills, slope of driveways, etc. (E.SE.02.21, S.IP.02.11)
- Students investigate the flow of water over different surfaces in their schoolyard (driveway, soil, grass, playground, street) based on their questions from observations. (E.FE.02.21, S.IP.02.11, S.IP.02.12, S.IP.02.13)
- Students use observations to generate questions about changes in shape of land and water flow. The teacher will record questions for future reference. (E.SE.02.21, E.FE.02.21)
- Students use observations of pictures, videos, relief maps, or globes to describe characteristics of different landforms and bodies of water. (E.SE.02.21, E.FE.02.22, S.IP.02.11)
- Students build models of different landforms using a variety of materials. (E.SE.02.21, S.RS.02.11)

- Students investigate the flow of water using a watershed model made out of paper crumpled inside of a tin pan and sprayed with water. Students make observations of water flowing over with different shapes and slopes. Students observe the formation of different bodies of water as well as the rate and direction of water flow in the model. (E.SE.02.21, E.FE.02.21, E.FE.02.22, S.IP.02.13)
- Students observe water soaking into the soil using stream tables with mixtures of sand and soil. Students also observe the formation of different landforms as the water moves the soil. Students use observations to generate more questions about the flow of water. (E.SE.02.21, E.FE.02.21, E.FE.02.22, S.IP.02.11, S.IP.02.12)

Explain and Define

- Students use observations and models to compare and contrast different landforms and bodies of water. Students present findings to the class. (E.SE.02.21, E.FE.02.22, S.IA.02.12, S.IA.02.13)
- Students use observations and models to explain how water collects on Earth surfaces after rain to form lakes, streams and rivers. (E.FE.02.21, E.FE.02.22, S.IA.02.13)
- Students use findings from investigations to explain the downhill flow of water using stream tables. (E.FE.02.21, E.FE.02.22, S.RS.02.15)
- Students use findings from investigation to explain how water soaks into the ground. (E.FE.02.21, S.RS.02.15)
- Students draw diagrams to demonstrate the downhill flow of water. (E.FE.02.21, E.FE.02.22, S.RS.02.11)

Elaborate and Apply

- Students investigate the relationship between the shape of landforms and the formation of bodies of water using watershed models. Students will observe the shape of the land where different bodies of water form, such as flat areas forming lakes and ponds and sloped areas forming rivers and streams. (E.SE.02.21, E.FE.02.21, E.FE.02.22, S.IP.02.13)
- Students investigate the relationship between the flow of water and the formation of landforms using stream tables. Students will observe how the speed of the flow of water changes the shape of rivers and streams produced. (E.SE.02.21, E.FE.02.21, E.FE.02.22, S.IP.02.11, S.IP.02.13)
- Students further investigate with stream tables by changing the slant of the stream table. Students can also change the surface that the water is flowing over by adding moss to the stream table for grass or plastic to represent pavement. (E.FE.02.21, S.IP.02.11, S.IP.02.13)
- Students plan and conduct investigations into how water soaks into different earth materials. (E.FE.02.22, S.IP.02.13)

Evaluate Student Understanding

Formative Assessment Examples

- Use the student models, presentations and discussions to assess the students' ability to describe landforms and bodies of water. (E.SE.02.21, E.FE.02.22)
- Use the students' watershed and stream table investigations to assess student ability to raise questions and plan simple investigations. (E.FE.02.21, S.IP.02.12, S.IP.02.13)
- Use student diagrams to assess students' ability to demonstrate the downhill flow of water over the Earth's surface. (E.FE.02.21, S.RS.02.11)

Summative Assessment Examples

- Circle the picture that shows a lake. (E.FE.02.22)
- Circle the picture that shows a plateau. (E.SE.02.21)
- Circle the picture that shows the path of rainwater after it reaches the Earth's surface. (E.FE.02.21)
- Circle the answer that shows bodies of water from biggest to smallest. (E.FE.02.22)

Enrichment

- Students plan and conduct sink and float activities in fresh and salt water to compare oceans to fresh bodies of water.
- Model ways that pollutants and other contaminants can flow through a watershed.
- Students build models of Michigan to show major landforms and bodies of water.

Intervention

- Students are given an opportunity to explore interaction of water, sand and soil.
- Students use songs with hand motions or body movements to describe different landforms and bodies of water.

Examples, Observations, and Phenomena (Real World Context)

Children observe changes in the Earth's surface all the time without realizing it. They watch erosion and deposition take place at the edge of the grass after a rainstorm. They see the flow of water down the street and into the storm drain. They see sand castles at the beach washed away by a wave. Students need to connect these small-scale changes in the Earth's surface to larger scale changes. The Earth's surface features can be investigated during family vacations, by reading books and taking field trips to local parks.

Literacy Integration

Reading

R.WS.02.11 in context, determine the meaning of words and phrases including objects, actions, concepts, content vocabulary, and literary terms, using strategies and resources including context clues, mental pictures, and questioning.

R.IT.02.02 discuss informational text patterns including descriptive, sequential, enumerative, and compare/contrast.

R.IT.02.04 respond to individual and multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make connections, take a position, and/or show understanding.

R.CM.02.01 make text-to-self and text-to-text connections and comparisons by activating prior knowledge, connecting personal knowledge, experience, and understanding of others to ideas in text through oral and written responses.

R.CM.02.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Paddle-to-the-sea, Clancy Holling, 1941

Where The River Begins, Thomas Locker, 1993

Hills, Christine Webster, 2005

Mountains, Christine Webster, 2005

Plains, Christine Webster, 2005

Valleys, Christine Webster, 2005

- Connect personal knowledge, experience, and understanding of rivers and hills to ideas in the text and through oral and written response.
- Retell relevant details of the flow of river water as described in the book.

Writing

W.GN.02.03 write an informational piece including a magazine feature article using an organizational pattern such as description, enumeration, sequence, or compare/contrast that may include graphs, diagrams, or charts to enhance the understanding of central and key ideas.

W.GN.02.04 use the writing process to produce and present a research project, develop two research questions related to a teacher-selected topic; gather electronic or print resources and organize the information using key ideas with teacher assistance.

W.GR.02.01 in the context of writing, correctly use more complex complete sentences, nouns, and verbs, commas, contractions, colons to denote time, and capitalization of proper nouns.

- Write about landforms using data from stream table observations in the writing piece.
- Write a story about a trip on a body of water or visiting a landform. Include illustrations and labels. Write the story from the child's point of view with descriptions of the surroundings.

Speaking

S.CN.02.02 explore and use language to communicate effectively with a variety of audiences and for different purposes including questions and answers, discussions, and social interactions.

S.DS.02.01 engage in substantive conversations, remaining focused on subject matter, with interchanges building on prior responses in book discussions, peer conferencing, or other interactions.

S.DS.02.03 respond to multiple text types by reflecting, making connections, taking a position, and/or showing understanding.

- Present their landforms models to the class.
- Write and perform a skit, rap or song describing different landforms or the flow of water on the Earth's surface.

Mathematics Integration

M.UN.02.01 Measure lengths in meters, centimeters, inches, feet, and yards approximating to the nearest whole unit and using abbreviations: cm, m, in, ft., yd.

M.UN.02.02 Compare lengths; add and subtract lengths (no conversion of units).

M.PS.02.10 Solve simple word problems involving length and money.

- Compare the height of different landforms in student models.
- Compare the length of rivers produced in stream table models.

Second Grade GLCE Companion Document

Unit 4: Uses and Properties of Water

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

Second Grade Companion Document

2-Unit 4: Uses and Properties of Water

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**Second Grade Unit:
Uses and Properties of Water**

Content Statements and Expectations

Code	Statements & Expectations	Page
E.FE.E.1	Water – Water is a natural resource and is found under the ground, on the surface of the Earth, and in the sky. It exists in three states (liquid, solid, gas) and can go back and forth from one form to another.	3
E.FE.02.11	Identify water sources (wells, springs, lakes, rivers, oceans).	3
E.FE.02.12	Identify household uses of water (drinking, cleaning, food preparation).	4
E.FE.02.13	Describe properties of water as a liquid (visible, flowing, shape of container) and recognize rain, dew, and fog as water in its liquid state.	4
E.FE.02.14	Describe the properties of water as a solid (hard, visible, frozen, icy) and recognize ice snow and hail as water in its solid state.	4

2 – Unit 4: Uses and Properties of Water

Big Ideas (Key Concepts)

- Water can come from a variety of sources.
- Water has a variety of uses.
- Water on Earth can be described as a solid or liquid.

Clarification of Content Expectations

Standard: Fluid Earth

Content Statements

E.FE.E.1: Water – Water is a natural resource and is found under the ground, on the surface of the Earth, and in the sky. It exists in three states (liquid, solid, gas) and can go back and forth from one form to another.

Content Expectations

E.FE.02.11: Identify water sources (wells, springs, lakes, rivers, oceans).

Instructional Clarifications

1. Identify means to recognize wells, springs, lakes, rivers, and oceans as sources of water.
2. Water sources should be limited to wells, springs, lakes, rivers and oceans.
3. Water can be identified as being fresh or salty depending on which of these sources it is from.

Assessment Clarifications

1. Water sources should be limited to wells, springs, lakes, rivers and oceans.
2. Water can be identified as being fresh or salty depending on which of these sources it is from.

E.FE.02.12: Identify household uses of water (drinking, cleaning, food preparation).

Instructional Clarifications

1. Identify means to recognize drinking, cleaning and food preparation as uses of water.
2. Possible household uses of water are limited to drinking, cleaning various items and food preparation.
3. Identify what type of water (fresh or salty) would best suit each of these uses.

Assessment Clarifications

1. Possible household uses of water are limited to drinking, cleaning various items and food preparation.
2. Identify what type of water (fresh or salty) would best suit each of these uses.

E.FE.02.13: Describe properties of water as a liquid (visible, flowing, shape of container) and recognize rain, dew, and fog as water in its liquid state.

Instructional Clarifications

1. Describe means to tell or depict in spoken or written words the properties of water as a liquid.
2. The description of liquid water will be limited to its observable properties and where it may be found in nature.

Assessment Clarification

1. The description of liquid water will be limited to its observable properties and where it may be found in nature.

E.FE.02.14: Describe the properties of water as a solid (hard, visible, frozen, icy) and recognize ice, snow and hail as water in its solid state.

Instructional Clarifications

1. Describe means to tell or depict in spoken or written words the properties of water as a solid.
2. The description of solid water will be limited to its observable properties and where it may be found in nature.

Assessment Clarification

1. The description of solid water will be limited to its observable properties and where it may be found in nature.

**Inquiry Process, Inquiry Analysis and Communication,
Reflection and Social Implications**

Inquiry Processes
S.IP.02.11 Make purposeful observations of water in solid and liquid states.
S.IP.02.12 Generate questions about water based on observations.
S.IP.02.13 Plan and conduct simple investigations into the properties of water as a solid and a liquid.
S.IP.02.14 Manipulate simple tools that aid in observations of water and models of sources of water (hand lens, measuring cups, graduated cylinders).
S.IP.02.15 Make accurate measurements with appropriate units (centimeters, milliliters) for the measurement tool.
S.IP.02.16 Construct simple charts and graphs from data and observations of investigations into the properties of water as a solid and liquid.
Inquiry Analysis and Communication
S.IA.02.11 Share ideas about observations of the properties of water as a solid and a liquid through purposeful conversation.
S.IA.02.12 Communicate and present finding of observations and investigations into the properties of water as a solid and liquid.
S.IA.02.13 Develop strategies and skills for information gathering about sources and uses of water.
Reflection and Social Implications
S.RS.02.12 Use evidence from their investigations when communicating the properties of water as a solid and liquid.
S.RS.02.13 Recognize that when a science investigation is done the way it was done before, similar results are expected.
S.RS.02.14 Demonstrate the sources and uses of water through models or exhibits.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
fresh water salt water flow food preparation well spring lake river ocean properties/property describe identify source hard visible frozen icy ice snow hail visible flowing shape of container rain dew fog solid liquid	household uses natural resource states of matter

Instruments, Measurements, Representations

Measurements	Instruments	Representations
volume	graduated measuring cup	milliliter* (mL), liter* (L)
	graduated measuring spoon	milliliter* (mL)

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Water: E.FE.02.11, E.FE.02.12, E.FE.02.13, E.FE.02.14

Objectives

- Make observations and compare sources of water.
- Make observations and compare uses of water.
- Investigate properties of water in the solid and liquid state.

Engage and Explore

- Students brainstorm uses of water in school and at home. Students classify uses as cleaning, food preparation, drinking and other. Students walk through the school making a tally of uses of water that they see in each category. Students discuss reasons for different student results. Students create a class pictograph of the data collected. (E.FE.02.12, S.IA.02.12, S.IP.02.16)
- Students identify household uses of water in different cultures through books and videos. (See Reading Integration) (E.FE.02.12, S.IA.02.14)
- Engage student thinking by finding evidence that the Earth is made up of water and land. Use an inflatable globe and toss the globe to each student. Have students tell if their thumbs landed on land or water. Collect class data using tally marks. (E.FE.02.11, S.IP.02.16, S.RS.02.11)
- Students make observations using maps and globes to identify sources of water on the Earth (lakes, rivers, oceans, snow on mountains, icebergs, rain, sleet, hail). Students classify water found on the earth as salt and fresh and solid and liquid. (E.FE.02.11, S.IP.02.11, S.IA.02.14)
- Students make models of wells and springs. Models can be made from sand and gravel in a clear cup of water, using a clear straw pushed down

in the cup to model a well. Students generate questions from observations of their models. (E.FE.02.11, S.RS.02.11, S.IP.02.12)

- Students explore properties of water by pouring water in different shaped containers and observing the changes in size and shape. Students measure the volume of the water with a measuring cup after each observation. (E.FE.02.13, S.IP.02.15, S.IP.02.14)
- Students plan and conduct an investigation of how water flows over different surfaces such as cloth, plastic, paper, etc. (E.FE.02.13, S.IP.02.13)
- Students plan and conduct investigations in the melting and freezing of water. Students investigate melting with ice cube melting races. Students compare the volume of water before freezing and after melting and share findings from their investigations. (E.FE.02.13, E.FE.02.14, S.IP.02.13, S.IA.02.12, S.IA.02.13)
- Students observe the properties of water as a solid. Students compare different shaped ice cubes, crushed ice, and snow if available. (E.FE.02.14, S.IP.02.11)

Explain and Define

- Students use observations and models to compare and contrast different sources and uses of water. Students present findings to the class. (E.FE.02.11, E.FE.02.12, S.IP.02.11, S.RS.02.11 S.IA.02.13, S.IA.02.12)
- Students use findings from investigation to compare properties of water as a solid and liquid through drawings, written or oral reports. (E.FE.02.13, E.FE.02.14, S.RS.02.15)
- Students share finding from observations and other sources on information regarding household uses of water through drawings, written or oral reports. (E.FE.02.12, S.IA.02.12, S.IA.02.13, S.RS.02.11)
- Students explain data from pictographs and tally sheets regarding the most frequent uses of water and the largest sources of water. (E.FE.02.11, E.FE.02.12, S.IP.02.16)
- Students use observations from investigations to describe melting and freezing. (E.FE.02.13, E.FE.02.14, S.IP.02.11, S.RS.02.15)

Elaborate and Apply

- Students plan and conduct investigations of salt and fresh water, such as sink and float, effects on ice, and effect on plants. (E.FE.02.11, E.FE.02.12, S.IP.02.13)
- Students generate questions through observations of models of the water cycle. (E.FE.02.11, S.IP.02.12, S.IP.02.11, S.RS.02.11)
- Students use observations to describe and classify sources of water as above ground, in the air and underground. (E.FE.02.11, S.IP.02.11)
- Students use observations of properties of water to classify different types of precipitation as solid or liquid. (E.FE.02.13, E.FE.02.14, S.IP.02.11)

Evaluate Student Understanding

Formative Assessment Examples

- Use the student models, presentations and discussions to assess the students' ability to describe sources and uses of water. (E.FE.02.11, E.FE.02.12)
- Use the students' water investigations to assess student ability to raise questions and plan simple investigations. (S.IP.02.12, S.IP.02.13)
- Use student drawings, written and oral reports to assess students' ability to describe properties of water as a solid and liquid. (E.FE.02.13, E.FE.02.14)

Summative Assessment Examples

- Circle the picture that shows hard, visible water. (E.FE.02.14)
- Circle the picture that does not show an everyday use of water. (E.FE.02.12)
- Circle the picture that shows a source of water that flows. (E.FE.02.11, E.FE.12.13)
- Circle the picture that shows an underground source of water. (E.FE.02.11)

Enrichment

- Students investigate other uses of water such as transportation by designing foil boats and measuring their ability to float pennies.
- Students will plan and conduct investigations of the best methods for cleaning materials with water.
- Students will plan and conduct investigations of how water interacts with other materials such as making bubbles, water droplets, freezing different concentrations of saltwater.
- Students investigate and share information about the causes and effects of water pollution on living things.

Intervention

- Students investigate other uses of water such as transportation by designing foil boats and measuring their ability to float pennies.
- Students will plan and conduct investigations of the best methods for cleaning materials with water.
- Students will plan and conduct investigations of how water interacts with other materials such as making bubbles, water droplets, freezing different concentrations of saltwater.
- Students investigate and share information about the causes and effects of water pollution on living things.

Examples, Observations, and Phenomena (Real World Context)

People use water everyday of their lives. Young children are curious about water and play and interact with water in their playtime. Students are not usually aware of all of the different sources of water and do not make careful scientific observations of the properties of water. They make observations in their own environments. They see their parents cook or clean, play in water on trips to lakes and ponds at local parks, observe different forms of water when looking at the weather, and read about water in books. Taking a walk around the block during a rainstorm gives children the opportunity to observe precipitation and flowing water as well as observe the feel and smell of water.

Literacy Integration

Reading

R.WS.02.11 in context, determine the meaning of words and phrases including objects, actions, concepts, content vocabulary, and literary terms, using strategies and resources including context clues, mental pictures, and questioning.

R.IT.02.02 discuss informational text patterns including descriptive, sequential, enumerative, and compare/contrast.

R.IT.02.04 respond to individual and multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make connections, take a position, and/or show understanding.

R.CM.02.01 make text-to-self and text-to-text connections and comparisons by activating prior knowledge, connecting personal knowledge, experience, and understanding of others to ideas in text through oral and written responses.

R.CM.02.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about water:

A Drop of Water, Walter Wick, 1997

Ice, Helen Frost, 2004

Sources of Water, Rebecca Olien, 2005

Water Dance, Thomas Locker, 2002

A Cool Drink of Water, Barbara Kerley, 2002

- Connect personal knowledge, experience, and understanding of water to ideas in the text and through oral and written response.
- Retell relevant details of the sources of water as described in the book.

Writing

W.GN.02.03 write an informational piece including a magazine feature article using an organizational pattern such as description, enumeration, sequence, or compare/contrast that may include graphs, diagrams, or charts to enhance the understanding of central and key ideas.

W.GN.02.04 use the writing process to produce and present a research project, develop two research questions related to a teacher-selected topic; gather electronic or print resources and organize the information using key ideas with teacher assistance.

W.GR.02.01 in the context of writing, correctly use more complex complete sentences, nouns, and verbs, commas, contractions, colons to denote time, and capitalization of proper nouns.

- Write about a cooking experience and how water was used.
- Write about the weather and the forms of water in precipitation.

Speaking

S.CN.02.02 explore and use language to communicate effectively with a variety of audiences and for different purposes including questions and answers, discussions, and social interactions.

S.DS.02.01 engage in substantive conversations, remaining focused on subject matter, with interchanges building on prior responses in book discussions, peer conferencing, or other interactions.

S.DS.02.03 respond to multiple text types by reflecting, making connections, taking a position, and/or showing understanding.

- Engage in substantive conversation regarding the importance of water in our daily lives using information from investigations and other resources.

Mathematics Integration

RE.02.01 Make pictographs using a scale representation, using scales where symbols equal more than one.

D.RE.02.02 Read and interpret pictographs with scales, using scale factors of 2 and 3.

D.RE.02.03 Solve problems using information in pictographs; include scales such as each * represents 2 apples.

- Connect the writing experience and math skills

Third Grade Science Content Expectations Companion Document

SCIENCE

- Unit 1: Changes in Motion
- Unit 2: Light and Sounds
- Unit 3: Structures and Functions of Living Things
- Unit 4: Earth Materials, Change, and Resources

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements

- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration



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Introduction to the K-7 Companion Document An Instructional Framework

Overview

The Michigan K-7 Grade Level Content Expectations for Science establish what every student is expected to know and be able to do by the end of Grade Seven as mandated by the legislation in the State of Michigan. The Science Content Expectations Documents have raised the bar for our students, teachers and educational systems.

In an effort to support these standards and help our elementary and middle school teachers develop rigorous and relevant curricula to assist students in mastery, the Michigan Science Leadership Academy, in collaboration with the Michigan Mathematics and Science Center Network and the Michigan Science Teachers Association, worked in partnership with Michigan Department of Education to develop these companion documents. Our goal is for each student to master the science content expectations as outlined in each grade level of the K-7 Grade Level Content Expectations.

This instructional framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings and expanding thinking beyond the classroom.

These companion documents are an effort to clarify and support the K-7 Science Content Expectations. Each grade level has been organized into four teachable units- organized around the big ideas and conceptual themes in earth, life and physical science. The document is similar in format to the Science Assessment and Item Specifications for the 2009 National Assessment for Education Progress (NAEP). The companion documents are intended to provide boundaries to the content expectations. These boundaries are presented as “notes to teachers”, not comprehensive descriptions of the full range of science content; they do not stand alone, but rather, work in conjunction with the content expectations. The boundaries use seven categories of parameters:

- a. **Clarifications** refer to the restatement of the “key idea” or specific intent or elaboration of the content statements. They are not intended to denote a sense of content priority. The clarifications guide assessment.
- b. **Vocabulary** refers to the vocabulary for use and application of the science topics and principles that appear in the content statements and expectations. The terms in this section along with those presented

within the standard, content statement and content expectation comprise the assessable vocabulary.

- c. **Instruments, Measurements and Representations** refer to the instruments students are expected to use and the level of precision expected to measure, classify and interpret phenomena or measurement. This section contains assessable information.
- d. **Inquiry Instructional Examples** presented to assist the student in becoming engaged in the study of science through their natural curiosity in the subject matter that is of high interest. Students explore and begin to form ideas and try to make sense of the world around them. Students are guided in the process of scientific inquiry through purposeful observations, investigations and demonstrating understanding through a variety of experiences. Students observe, classify, predict, measure and identify and control variables while doing "hands-on" activities.
- e. **Assessment Examples** are presented to help clarify how the teacher can conduct formative assessments in the classroom to assess student progress and understanding
- f. **Enrichment and Intervention** is instructional examples that stretch the thinking beyond the instructional examples and provides ideas for reinforcement of challenging concepts.
- g. **Examples, Observations, Phenomena** are included as exemplars of different modes of instruction appropriate to the unit in which they are listed. These examples include reflection, a link to real world application, and elaboration beyond the classroom. These examples are intended for instructional guidance only and are not assessable.
- h. **Curricular Connections and Integrations** are offered to assist the teacher and curriculum administrator in aligning the science curriculum with other areas of the school curriculum. Ideas are presented that will assist the classroom instructor in making appropriate connections of science with other aspects of the total curriculum.

This Instructional Framework is NOT a step-by-step instructional manual but a guide developed to help teachers and curriculum developers design their own lesson plans, select useful portions of text, and create assessments that are aligned with the grade level science curriculum for the State of Michigan. It is not intended to be a curriculum, but ideas and suggestions for generating and implementing high quality K-7 instruction and inquiry activities to assist the classroom teacher in implementing these science content expectations in the classroom.

Third Grade GLCE Companion Document

Unit 1: Changes in Motion

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

Third Grade Companion Document

3-Unit 1: Changes in Motion

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3rd Grade Unit 1: Changes in Motion

Content Statements and Expectations

Code	Statements & Expectations	Page
P.FM.E.2	Gravity – Earth pulls down on all objects with a force called gravity. With very few exceptions, objects fall to the ground no matter where the object is on the Earth.	3
P.FM.03.22	Identify the force that pulls objects towards the Earth.	3
P.FM.E.3	Force – A force is either a push or a pull. The motion of objects can be changed by forces. The size of the change is related to the size of the force. The change is also related to the mass of the object on which the force is being exerted. When an object does not move in response to a force, it is because the environment is applying another force.	4
P.FM.03.35	Describe how a push or a pull is a force	4
P.FM.03.36	Relate a change in motion of an object to the force that caused the change in motion.	4
P.FM.03.37	Demonstrate how the change in motion of an object is related to the strength of the force acting upon the object and to the weight of the object.	5
P.FM.03.38	Demonstrate when an object does not move in response to a force, it is because another force is acting on it.	6
P.FM.E.4	Speed – An object is in motion when its position is changing. The speed of an object is defined by how far it travels in a standard amount of time.	6
P.FM.03.41	Describe the motion of objects in terms of the path and direction.	6
P.FM.03.42	Identify changes in motion (change direction, speed up, slowing down).	7
P.FM.03.43	Relate the speed of an object to the distance it travels in a standard amount of time.	7

3 Unit 1: Changes in Motion

Big Ideas (Key Concepts)

- The position of the observer and object affect the description of motion.
- Forces are pushes and pulls.
- Gravity is the force that pulls objects to the Earth.
- Motion is affected by the strength of the force and the mass of the object.

Clarification of Content Expectations

Standard: Force and Motion

Content Statement - P.FM.E.2

Gravity – Earth pulls down on all objects with a force called gravity. With very few exceptions, objects fall to the ground no matter where the object is on the Earth.

Content Expectation

P.FM.03.22 Identify the force that pulls objects towards the Earth.

Instructional Clarifications

1. Identify means to recognize that gravity is the force that pulls objects to Earth.
2. Gravity is the force that pulls objects towards the Earth.
3. The term gravity is very abstract. Third grade students do not need to define the term gravity. They need only to observe that dropped or thrown objects eventually fall to the ground. Some exceptions are helium and hot air balloons, or objects rising in water. Third graders may be aware of the exceptions but do not need to understand the science behind it.
4. Gravity is the attraction between all matter; it is the force that pulls objects toward each other. The larger the object, the greater the force. Because of the Earth's size, the pull of gravity is very apparent.
5. The downward force of gravity is called weight. Weight is the measure of the pull, or force, of gravity on an object.
6. Weight is measured using a scale, whereas mass is measured using a balance.
7. The emphasis of this expectation is that gravity is the force that pulls objects to the Earth. Weight is the measure of the pull of gravity.

Students describe objects as having more or less pull by the Earth and more or less weight.

8. A common misconception is that only large objects have gravitational force.
9. A common misconception is that energy and force are interchangeable.

Assessment Clarification

1. Gravity is the force that pulls objects towards the Earth.

Content Statement - P.FM.E.3

Force – A force is either a push or a pull. The motion of objects can be changed by forces. The size of the change is related to the size of the force. The change is also related to the mass of the object on which the force is being exerted. When an object does not move in response to a force, it is because the environment is applying another force.

Content Expectations

P.FM.03.35 Describe how a push or a pull is a force.

Instructional Clarifications

1. Describe means to tell or depict in spoken or written words that a force is a push or pull.
2. Force is a push or a pull on an object or substance by another object or substance.
3. A push is to move an object away.
4. A pull is to move an object toward.
5. Forces can change the shape of an object or speed up, slow down, change the direction, start or stop the motion of an object.
6. Examples of forces are limited to gravity and pushes and pulls caused by people, machines, magnets or nature (wind and water).

Assessment Clarifications

1. Force is a push or a pull on an object or substance.
2. Examples of forces are gravity and pushes and pulls caused by people, machines, magnets or nature (wind and water).
3. A push moves an object away from another object and a pull moves an object toward another object.

P.FM.03.36 Relate a change in motion of an object to the force that caused the change in motion.

Instructional Clarifications

1. Relate means to establish an association or connection between a force and how it causes a change in motion of an object.

2. Forces cause objects to slow down, speed up, change direction, stop and start.
3. A change in motion is to slow down, speed up, stop, or change direction.
4. The emphasis of the expectation is for students to identify the force that causes the change in motion. These forces include gravity; sliding or rubbing (friction) to stop, start or slow things down; pulling, as with a rope; and pushing.
5. Force descriptions are limited to people, machines, wind, and water.

Assessment Clarifications

1. Forces cause changes in motion.
2. Forces cause objects to slow down, speed up, change direction, stop or start.
3. A change in motion is to slow down, speed up, stop, start, or change direction.
4. The emphasis of the expectation is for students to identify the force that causes the change in motion. These forces include gravity; sliding or rubbing to stop, start or slow things down; pulling, as with a rope; and pushing.
5. Force descriptions are limited to people, machines, wind, and water.

P.FM.03.37 Demonstrate how the change in motion of an object is related to the strength of the force acting upon the object and to the mass of the object.

Instructional Clarifications

1. Demonstrate means to show through manipulation of materials, drawings and written and verbal explanations how a change in the motion of an object is related to the strength of the force and the mass of the object.
2. The terms weight and mass are often used interchangeably. However, they are not the same. Mass is the amount of matter in an object, which is a constant amount. Weight is a measure of the gravitational pull of an object. The weight of an object changes if the gravitational pull changes; for example, the weight of an object differs on Earth when compared to the weight of the same object on the moon, yet the mass of the object stays the same. The use of the word mass is more accurate than the word weight in most cases. The use of the word mass is highly recommended.
3. Changes in motion are related to the strength of the force acting on an object. The larger the force the greater the change in motion.
4. Changes in motion are related to the mass of an object. Heavier objects require a stronger force to cause a change in motion. Lighter objects require less force to cause a change in motion.
5. The term mass has not been introduced to students at the third grade level. Third grade students should use the term weight.
6. A common misconception is that large objects always exert a greater force than small objects.

7. Students at the third grade level are not expected to measure force; they make observations of changes in motion due to stronger and weaker forces.

Assessment Clarifications

1. The larger the force the greater the change in motion.
2. Heavier objects need a stronger force to cause a change in motion. Lighter objects need less force to cause a change in motion.

P.FM.03.38 Demonstrate when an object does not move in response to a force, it is because another force is acting on it.

Instructional Clarifications

1. Demonstrate means to show through manipulation of materials, drawings, and written and verbal explanations when an object does not move in response to a force, it is because another force is acting on it.
2. There may be many forces acting on an object at one time. The combination of all the forces result in changes in motion or no motion.
3. A common misconception is that when an object is at rest, there are no forces acting on the object.
4. If forces are equal and opposite, an object will remain at rest.
5. Third grade students do not need to understand these concepts; they simply observe the results of opposing and equal forces and recognize that more than one force acts on an object.
6. At this level, demonstrations include such examples as pushing on a large object such as a boulder (friction is another force) tug-of-war games (equal pulling on opposite ends of the rope) and lifting a heavy object (gravity is the other force).

Assessment Clarifications

1. There may be many forces acting on an object at one time. The combination of all these forces results in changes in motion or no motion.
2. When a heavy object, such as a boulder, is pushed and does not move another force is acting on it.

Content Statement – P.FM.E.4

Speed – An object is in motion when its position is changing. The speed of an object is defined by how far it travels in a standard amount of time.-

Content Expectations

P.FM.03.41 Describe the motion of objects in terms of the path and direction.

Instructional Clarifications

1. Describe means to tell or depict in spoken or written words the motion of objects in terms of path and direction.

2. Motion is described relative to a frame of reference (relative to something else).
3. Motion is a change in position.
4. Motion is the movement of an object from one place to another or physical motion such as twirling and waving.
5. The path of motion can be described as moving away from, toward, around, above, below, behind, between and through an object that is not moving.
6. The terms north, south, east and west describe motion with reference to the Earth.

Assessment Clarifications

1. Motion is movement from one place to another.
2. Motion can be physical movement (twirling, waving, blinking, bending).
3. The path of motion is moving away from, toward, around, above, below, behind, between and through an object that is not moving.
4. Describe the direction of an object as it relates to an object that is not moving. (A girl is walking toward the desk but a boy is walking away from the desk.)

P.FM.03.42 Identify changes in motion (change direction, speeding up, slowing down).

Instructional Clarifications

1. Identify means to recognize changes in motion as changing direction, speeding up or slowing down.
2. Students identify changes in motion as a change in direction, speeding up, or slowing down.
3. A common misconception is that acceleration is speeding up. The term "acceleration" should not be used in the third grade.
4. Changes in direction include north, south, east, west, right, left, up, and down.

Assessment Clarification

1. A change in motion can be identified as a change in direction, speeding up, or slowing down.

P.FM.03.43 Relate the speed of an object to the distance it travels in a standard amount of time.

Instructional Clarifications

1. Relate means to establish an association or connection between distance, time and speed.
2. Third grade students are not expected to calculate speed. Students often confuse speed and distance. Students describe speed as the distance an object travels in a standard amount of time or the amount of time it takes an object to travel a standard distance. For example, if it takes car A 5 seconds longer to travel the same distance as car B, car B is traveling at a faster speed. If car A travels a further distance than car B, in the same amount of time, then car A is traveling at a faster speed.

3. Students' measurement abilities include measuring the distance something travels (kilometers, meters, centimeters) and the amount of time it takes to travel a certain distance (hours, minutes, seconds).
4. Measurement tools include meter sticks, rulers, measuring tapes, stop watches, clocks with a second hand.
5. Speed descriptions include faster and slower.

Assessment Clarifications

1. Speed is the distance an object travels in a certain amount of time.
2. Speed descriptions include faster and slower.

Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implication

Inquiry Processes
S.IP.03.11 Make purposeful observations of motion of objects in terms of direction.
S.IP.03.12 Generate questions based on observations of objects in motion.
S.IP.03.13 Plan and conduct simple and fair investigations to compare and contrast the motion of objects in terms of path and direction.
S.IP.03.14 Manipulate simple tools (for example ruler, meter stick, stop watch/timer) to determine the speed of an object by measuring the time it took to travel a measured distance.
S.IP.03.15 Make accurate measurements with appropriate units (centimeters, meters, seconds, minutes) of the distance an object traveled in a measured time.
S.IP.03.16 Construct simple charts and graphs from data and observations of time and distance of an object's travel.
Inquiry Analysis and Communication
S.IA.03.11 Summarize information from charts and graphs to answer questions about the speed of a moving object.
S.IA.03.12 Share ideas about changes in motion through purposeful conversation in collaborative groups.
S.IA.03.13 Communicate and present findings of investigations that describe the motion of objects in terms of direction.
S.IA.03.14 Develop research strategies and skills for information gathering and problem solving about determining the speed of a moving object.
S.IA.03.15 Compare and contrast sets of data from multiple trials of an investigation on the motion of objects to explain reasons for differences.
Reflection and Social Implications
S.RS.03.11 Demonstrate similarities and differences in the motion of objects in terms of direction through various illustrations, performances or activities.
S.RS.03.14 Use data/samples as evidence to separate fact from opinion about the speed of an object.
S.RS.03.15 Use evidence when communicating, comparing and contrasting the motion of objects in terms of path and direction.
S.RS.03.16 Identify technology used in everyday life to measure speed.
S.RS.03.17 Identify current problems about changes in the motion of objects that may be solved through the use of technology.
S.RS.03.19 Describe how people such as al Jazari, Isaac Newton, the Wright Brothers, Sakichi Toyoda, and Henry Ford have contributed to science throughout history and across cultures.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
force force strength push pull gravity weight mass motion position speed speeding up slowing down faster slower stop start change of motion change of direction moving away from toward around above below behind between through centimeters meters kilometers seconds minutes hours compare and contrast cause stop watches timers clocks with a second hand meter sticks rulers measuring tapes	change of speed measurement of motion relative position north south east west right left up down

Instruments, Measurement, and Representations

Measurement	Instruments	Representations
weight	scale	heavier, lighter, same
mass*	balance	heavier, lighter, same
distance	ruler, meter stick, measuring tape	centimeter, meter, kilometer
time	stop watch, timer, clock with a second hand	seconds, minutes, hours
speed**	ruler, meter stick, measuring tape Stop watch, timer, clock with a second hand	faster, slower

Representations in Charts, Tables and Graphs

With teacher assistance, third grade students label and enter information into a data table that represents multiple trials. Third grade students use the median number for graphing.

With teacher direction, modeling and examples, students construct a simple bar graph with information from a data table that includes appropriate labels (clear title, axis labels, unit labels, scales or standard interval counting beginning at zero).

Third grade students are expected to read and interpret both horizontal and vertical bar graphs.

* To be instructed in the 4th grade.

** Third grade students will not calculate speed.

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Gravity: P.FM.03.22

Force: P.FM.03.35, P.PM.03.36, P.FM.03.37, P.FM.03.38

Speed: P.FM.03.41, P.FM.03.42, P.FM.03.43

Objectives

- Demonstrate that objects fall to Earth due to a force called gravity.
- Make observations of the motion of objects and describe the forces acting on them.
- Demonstrate how a force can change the motion of an object and describe the changes that are taking place.
- Using the measurements of distance and time, explain how speed is the relationship between the distances an object travels in a certain amount of time.

Engage and Explore

- Engage students in a variety of activities that require them to move objects, such as moving the desks, rearranging books, cleaning their desks and discarding unwanted items into a waste container, and playing kickball. Students describe how they were able to move the objects (pushing, pulling, lifting, throwing).
- After students have had an opportunity to discuss the ways in which the objects moved, discuss the cause of the motion. Through collaborative conversations, they conclude that the motions were the result of pushes, pulls, or gravity (forces). Introduce the term *force* to describe pushes and pulls exerted on one object by another object. Reinforce gravity as the force that pulls objects to Earth. (P.FM.03.22, P.FM.03.35, P.FM.03.36)

- Take the students on a *motion walk* to make observations of different forces and the resulting motions in and around the school. (P.FM.03.36)
- In collaborative groups, students participate in a variety of games or sports (floor hockey, paper football, kickball, marbles, basketball, soccer, and baseball) to discover and describe how objects move due to the forces acting on them.
- After students discuss the motion of the objects in their activity, challenge them to evaluate the motion of the objects in terms of path and direction. Organize their observations into a chart with the heading, *Motion*, and subheadings: *Path* and *Direction*.
- Create a list of observations and words that describe the path(s) and direction(s) the objects in their activity were moving. Draw a diagram of the motion of the objects in the games and label the forces and the changes in motion (change in direction, speeding up, slowing down, starting and stopping). Add *Changes in Motion* to the chart and list observations and descriptions of how the objects changed their motion. (P.FM.03.36, P.FM.03.37, S.IP.03.11, S.IA.03.11, S.IA.03.12)

	Descriptions & Observations
Direction	away from, toward, etc.
Path	straight, curvy, zigzag
Changes in Motion	changes in direction, speeding up, slowing down, starting, stopping

- As students discuss and share ideas through purposeful conversation, each group records ideas and questions regarding motion, forces, path, direction, and changes in motion (changes in direction or speed) on word strips or chart paper (for example: How does a lighter ball move differently than a heavier ball? How does the material that the ball is made from make a difference? How does the surface that the ball travels on make a difference?). (P.FM.03.36, P.FM.03.37, P.FM.03.38, S.IP.03.12, S.IA.03.12)

Explain and Define

- Explain and create classroom definitions for the terms *gravity*, *motion*, *force*, *direction* and *speed*. (P.FM.03.35, P.FM.03.36, P.FM.03.43)
- During the discussion, add to the descriptive terms on the chart used to describe direction and changes in motion. (P.FM.03.41, P.FM.03.42, P.FM.03.43)

Elaborate and Apply

- Elaborate on the questions generated during the explore activities by dividing them into questions on path and direction and questions on changes in motion. (P.FM.03.41, P.FM.03.42)
- As a class, choose one question regarding the direction of objects that can be investigated and not answered by yes or no or simple research. For example: How do different observers describe the direction of a moving object? (S.IP.03.12)
- Working in collaborative groups, students plan and conduct a simple investigation, based on the class question, to describe the motion of objects in terms of path and direction. For example, students predict whether classmates standing in different locations around the room will describe direction of a rolling ball in the same way. Four students stand in different locations. As a ball is rolled across the floor, the students individually record their descriptions of the path and direction the ball is moving. The trial is conducted multiple times using different students for each trial. Groups summarize their data in charts. (P.FM.03.41, S.IP.03.13, S.IP.03.16)
- To evaluate understanding, each collaborative group communicates and presents findings using evidence from trials to compare and contrast the motion of objects in terms of direction. Based on evidence, students analyze and summarize the differences in the results. Finally, students create a drawing or performance to further explain the similarities and differences in the motion of objects in terms of direction. (P.FM.03.42, S.IP.03.13, S.IA.03.13, S.IA.03.15, S.RS.03.15)
- To further elaborate and extend understanding of motion, students review their original questions regarding changes in motion focusing on speeding up and slowing down. For example: How can we measure the speed of a toy car?
- After conducting research and gathering information, students discuss the concept of the speed of a moving object and how to describe speed in terms of distance and time. The purpose of this activity is to discover the relationship of distance and time. (P.FM.03.42, P.FM.03.43, S.IA.03.12, S.RS.03.15)
- Elaborate on the term *distance* by giving students the tools, units, and skills to collect quantitative measurements (meter sticks, rulers, measuring tapes, centimeters, meters, kilometers). (P.FM.03.43, S.IP.03.15)
- Elaborate on the term *time* by giving students the tools, units, and skills to collect quantitative measurements (stop watch, clock with second hand, timer, second, minute, hour). (P.FM.03.43, S.IP.03.14)
- Expand on the measurement of speed by measuring the amount of time it takes (using a stopwatch and seconds) a toy car to travel a specified distance down a ramp. Conduct at least three trials and find the median for a more accurate measurement. Further expand on the measurement of speed by measuring the distance (using a meter stick or ruler) a car travels in a specified amount of time. Conduct at least three trials.

Students construct simple charts and graphs from the data and from observations of time and distances of the toy cars' travel. (P.FM.03.42, P.FM.03.43, S.IP.03.14, S.IP.03.15, S.IP.03.16, S.IA.03.11, S.IA.03.14, S.RS.03.14)

Evaluate Student Understanding

Formative Assessment Examples

- Create operational definitions in student language for the terms: gravity, force, motion, direction, and speed. For example: A ball will fall to Earth because of a force called gravity. Speed is how fast or slow an object moves in a certain amount of time. (P.FM.03.22, P.FM.03.35, P.FM.03.36, P.FM.03.43)
- Organize observations of motion into charts. (P.FM.03.36)
- Draw a diagram of the motion of objects in games; label the forces and changes in motion. (P.FM.03.36, P.FM.03.38, P.FM.03.41, P.FM.03.42)
- Summarize data from investigations on motion and direction into charts. (P.FM.03.36, P.FM.03.38, P.FM.03.41, P.FM.03.42)
- Engage in purposeful conversation about motion as it relates to distance and time. (P.FM.03.43)
- Construct simple charts and bar graphs from data on speed investigations. (P.FM.03.43)

Summative Assessment Examples

- Explain and illustrate the forces that are causing the motion in a dropped ball, a rolling ball, a stationary object such as a large boulder, a ball changing direction and a ball slowing down to a stop. (P.FM.03.22, P.FM.03.35, P.FM.03.36, P.FM.03.38)
- Create a drawing or performance to identify and explain the similarities and differences in the motion of objects in terms of path and direction. (P.FM.03.22, P.FM.03.35, P.FM.03.36, P.FM.03.37, P.FM.03.38, P.FM.03.41, P.FM.03.42)
- After analyzing the data, students summarize the information on their charts and graphs to answer the question, "How can we measure the speed of a toy car?" Through purposeful conversation, collaborative groups of students develop a shared understanding of speed utilizing the data gathered as evidence to support their ideas, rather than expressing an opinion. Students use the writing process to summarize their findings in an organized format. (P.FM.03.43)

Enrichment

- Investigate changes in motion due to different forces such as pushing, pulling, and falling. Create models to illustrate forces.
- Plan and conduct simple investigations comparing the speed of toy cars moving down ramps of differing heights and surfaces. Include the mathematical calculations of speed for students with the ability.
- Explore the forces, motion, changes in motion and speed of different objects including hot air balloons, airplanes, rockets, sailboats, surfboards, etc.

Intervention

- Explore direction (forward, backward, toward, away, left, right) by participating in games such as *Mother May I*, *Red Light*, *Green Light*, or *Simon Says*.
- Watch video clips of various sporting events. Describe the motion of the players, objects, etc., and the forces that caused the motion.
- Qualitatively observe, compare and describe the speed of two or more objects using terms such as faster, slower, same speed, slowing down, speeding up, stopping or starting.
- Provide opportunities for students to observe, record and discuss forces and resulting motion in and around the school
- Read informational texts such as *Forces Make Things Move* by Kimberly Brubaker Bradley, 2005. Conduct suggested activities included in the text.

Examples, Observations, and Phenomena (Real World Context)

Observation, measurement, and communicating ideas are everyday skills. Students use their senses to continually learn about their environment. They use measurement of distance and time in everyday activities. They understand that some things move slowly and others move quickly without having an understanding of the algorithm of speed. Students begin to extend the concept of speed as a function of time and distance. They recognize that if the dog runs the same distance in less time than the cat, then the dog is running faster. Similarly, if the cat runs a farther distance than the mouse in the same amount of time, then the cat is running faster.

Throwing balls, running, rolling balls, swinging, and sliding are all common activities for children. Everyday experiences naturally include a description of the direction of motion and the speed at which motion occurs.

Students are familiar with everyday technology used to measure distance, time, and speed. Firsthand experiences include using stopwatches, egg timers, clocks or watches with a second hand. They are also becoming proficient in measuring with rulers and meter sticks. Students understand that the speedometer in the car measures speed. They are aware that speed is described as miles per hour when discussing the speed limit or the speed at which the car is traveling. To further their understanding, attention to miles (distance) per hour (time) can reinforce their experiences in classroom activities involving toy cars. Additionally, students recognize that using technology (timers, speedometers, etc.) to make accurate measurements can avoid or solve problems in such activities as car racing, horse racing, excessive speed, space travel, and scuba diving.

Contributions of scientists throughout history and across cultures have contributed significantly to current scientific thought. Students research and recognize that the contributions of scientists such as al-Jazari, Isaac Newton, Albert Einstein, the Wright Brothers, and Sakichi Toyoda have contributed to the science of forces and motion.

Literacy Integration

Reading

R.CM.03.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.03.02 retell in sequence the story elements of a grade level narrative text and major idea(s) and relevant details of grade-level informational text.

Examples of trade books available for learning about changes in motion:

Forces Make Things Move by Kimberly Brubaker Bradley, 2005

Why Doesn't the Earth Fall Up? By Vicki Cobb, 1989

Mr. Gumpy's Motor Car by John Burningham, 1983

Writing

W.GN.03.03 write an informational piece including a report that demonstrates the understanding of central ideas and supporting details using an effective organizational pattern (i.e. compare/contrast, cause/effect, problems/solutions) with a title, heading, subheading, and a table of contents.

W.GN.03.04 use the writing process to produce and present a research project; initiate research questions from content area text from a teacher-selected topic; and use a variety of resources to gather and organize information.

- Write an informational description of changing motion (changing direction, speeding up, slowing down, starting, or stopping) using cause and effect. Include the measurement tools and units that are used to provide evidence and support for ideas.
- Use the writing process to produce and present research on determining the speed of a moving object. Beginning with a question to investigate, summarize findings about speed from a variety of resources in an organized format.

Speaking

S.DS.03.04 plan and deliver presentations using an effective informational organizational pattern (e.g. descriptive, problem/solution, cause/effect) supportive facts and details, reflecting a variety of resources; and varying the pace for effect.

- Plan and deliver presentations comparing and contrasting the motion of objects in terms of direction using an informational organization pattern (descriptive); and supportive facts and details reflecting data collected from a simple investigation.

Mathematics Integration

Number and Operations

N.ME.03.01 Read and write numbers to 10,000 in both numerals and words, and relate them to the quantities they represent.

N.FL.03.07 Estimate the sum of and difference of two numbers with three digits (sums up to 1,000), and judge reasonableness of estimates.

N.FL.03.08 Use mental strategies to fluently add and subtract two-digit numbers.

Measurement

M.UN.03.01 Know and use common units of measurement in length, weight and time.

M.UN.03.02 Measure in mixed units within the same measurement system for length, weight, and time: feet and inches, meters and centimeters, kilograms and grams, pounds and ounces, liters and milliliters, hours and minutes, minutes and seconds, years and months.

M.PS.03.12 Solve applied problems involving money, length and time.

Data and Probability

D.RE.03.01 Read and interpret bar graphs in both horizontal and vertical forms.

Third Grade GLCE Companion Document

Unit 2: Light and Sound

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

**Third Grade Companion Document
3-Unit 2: Light and Sound**

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3rd Grade Unit 2: Light and Sound

Content Statements and Expectations

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P.EN.E.2	Light Properties – Light travels in straight lines. Shadows result from light not being able to pass through an object. When light travels at an angle from one substance to another (air and water), it changes directions.	4
P.EN.03.21	Demonstrate that light travels in a straight path and that shadows are made by placing an object in a path of light.	4
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P.EN.E.3	Sound – Vibrating objects produce sound. The pitch of sound varies by changing the rate of vibration.	5
P.EN.03.31	Relate sounds to their sources of vibrations (for example: a musical note produced by plucking a guitar string, the sounds of a drum made by striking a drumhead).	5
P.EN.03.32	Distinguish the effect of fast or slow vibrations as pitch.	5
P.PM.E.5	Conductive and Reflective Properties – Objects vary to the extent they absorb and reflect light energy and conduct heat and electricity.	6
P.PM.03.51	Demonstrate how some materials are heated more than others by light that shines on them.	6
P.PM.03.52	Explain how we need light to see objects: light from a source reflects off objects and enters our eyes.	7

3 – Unit 2: Light and Sound

Big Ideas (Key Concepts)

- Light and sound are forms of energy.
- Light and sound can be described by their properties.
- Light travels in a straight path.
- Vibrations produce sound.

Clarification of Content Expectations

Standard: Energy

Content Statement – P.EN.E.1

Forms of Energy – Heat, electricity, light, and sound are forms of energy.

Content Expectation

P.EN.03.11 Identify light and sound as forms of energy.

Instructional Clarifications

1. Identify means to recognize light and sound as forms of energy.
2. The term energy is difficult for third grade students to understand. It is not matter; it does not have mass. It takes energy to make things happen. Energy is the ability to cause change. Evidence of light as a form of energy is through heating. Evidence of sound as a form of energy is through the observation of vibrations.
3. Third grade students need only to observe (using appropriate senses) light and sound energy and describe how they cause change.
4. (Visible) light is necessary for life on Earth. It is essential for photosynthesis and gives colors to objects. Light energy from the sun is changed to heat energy on Earth and is used by plants and all living things. Our primary source of light energy is the sun.
5. Vibrating objects cause sound waves that can then cause other matter to vibrate.

Assessment Clarifications

1. Light is a form of energy. Most light energy comes from the sun.
2. Sound is a form of energy. Vibrating objects cause sound waves.
3. Energy is the ability to cause change. Evidence of light as a form of energy is through heating. Evidence of sound as a form of energy is through the observation of vibrations.

Content Statement – P.EN.E.2

Light Properties – Light travels in a straight path. Shadows result from light not being able to pass through an object. When light travels at an angle from one substance to another (air and water), it changes directions.

Content Expectations

P.EN.03.21 Demonstrate that light travels in a straight path and that shadows are made by placing an object in a path of light.

Instructional Clarifications

1. Demonstrate is to show through manipulation of materials, drawings, and written and verbal explanations that light travels in a straight path and shadows are made by placing an object in a path of light.
2. Light travels in straight paths, which move out from the source until they hit or interact with something. When light strikes an object, it is reflected, passes through or absorbed.
3. A shadow is formed when an opaque object blocks the path of light (does not allow light to pass through).
4. A common misconception is that shadows are independent of the object that causes them and that a light source and its effects are not separate.

Assessment Clarifications

1. Light travels in a straight path that moves out from a source until it hits something.
2. Shadows are made when an object is placed in the path of light.

P.EN.03.22 Describe what happens to light when it travels from air to water (a straw half in water and half in the air looks bent).

Instructional Clarifications

1. Describe means to tell or depict in spoken or written words the path of light when it travels from water to air or air to water.
2. Light travels at tremendous speeds. When it travels through transparent mediums such as glass, air, or water, it slows down. It slows down at different rates for different mediums. When it slows, light rays are bent as they pass through. This change is called refraction.
3. Students' experiences should include observations of objects in water, out of water, half in and half out of water. Students may investigate other transparent substances such as alcohol, oil, corn syrup.
4. Third graders do not need to understand why light bends (refraction). They only need to observe that objects appear to bend when observed through different mediums.

Assessment Clarification

1. Students' experiences should include observations of objects in water, out of water, half in and half out of water.

Content Statement – P.EN.E.3

Sound – Vibrating objects produce sound. The pitch of sound varies by changing the rate of vibration.

Content Expectations

P.EN.03.31 Relate sounds to their sources of vibrations (for example: a musical note produced by plucking a guitar string, the sounds of a drum made by striking a drumhead).

Instructional Clarifications

1. Relate means to establish an association or connection between sounds and their sources of vibration.
2. Vibrating objects produces sound waves.
3. The sound vibrations are transmitted to anything the vibrating object touches, including air.
4. Sound travels through matter; light travels through a vacuum or through matter. Sound cannot travel through outer space where there is no air (matter), but light can travel through outer space.
5. Sound waves travel out in every direction from a source. When a guitar string is plucked, the vibrating string pushes against the adjacent air molecules causing them to vibrate. The air molecules push against neighboring air molecules until the vibrating air molecules reach a receiver such as an eardrum.
6. Vibrations cause sound waves from a source such as guitar string or a drumhead.
7. A common misconception is that sound cannot travel through solids and liquids.
8. A common misconception is that sound can travel through a vacuum, such as space.
9. A common misconception is that sound can be produced without using any materials.
10. A common misconception is that hitting an object harder changes the pitch of the sound produced.

Assessment Clarifications

1. Vibrating objects produces sound.
2. Vibrations cause sound waves from a source such as a guitar string or a drumhead.
3. The source of vibrations can include plucking, striking, hitting, etc.

P.EN.03.32: Distinguish the effect of fast or slow vibrations as pitch.

Instructional Clarifications

1. Distinguish means to recognize or know the difference between a low and high pitch caused by slow or fast vibrations.
2. Sounds can have a high or low pitch.
3. Pitch depends on the speed of vibrations. An object that vibrates very fast sends more vibrations to the ear drum per second, and the brain

interprets it as a high pitch. When an object vibrates slowly, a lower pitch is heard.

4. Students' experiences include the plucking of guitar strings or other stringed instruments (high and low), stretching rubber bands to create high and low pitches.

Assessment Clarifications

1. Sounds can have a high or low pitch.
2. Slow vibrations produce a low pitch; fast vibrations produce a high pitch.

Standard: Properties of Matter

Content Statement – P.PM.E.5

Conductive and Reflective Properties – Objects vary to the extent they absorb and reflect light energy and conduct heat and electricity.

Content Expectations

P.PM.03.51 Demonstrate how some materials are heated more than others by light that shines on them.

Instructional Clarifications

1. Demonstrate is to show through manipulation of materials, drawings, and written and verbal explanations how some materials are heated more than others by light that shines on them.
2. Light energy can be converted to heat or thermal energy when certain materials absorb it.
3. Dark materials absorb more of the visible spectrum of light. The absorbed light energy is converted and is released as heat energy. Since more of the spectrum is absorbed there is more energy that is converted to heat. Light colored materials absorb less and reflect more of the light spectrum (less energy) so less energy is released as heat.
4. Dark materials absorb more light energy; light colored materials reflect more light energy.
5. Student experiences should include multiple opportunities to use light bulbs and sunlight to heat a variety of materials including light colored sand vs. soil, light colored paper vs. dark paper, light colored hat vs. dark hat.
6. Students' experiences include using a thermometer to compare temperatures in degrees Celsius. The emphasis for third graders is warmer and cooler.
7. This content expectation can easily be taught in conjunction with P.EN.03.2 – Light Properties.
8. A common misconception at this age is that while light is reflected by mirrors, it remains on other objects

Assessment Clarifications

1. Dark materials absorb more light energy; light colored materials reflect more light energy.
2. Assessment is restricted to the use light bulbs and sunlight to heat materials such as light colored sand vs. soil and light colored paper vs. dark paper.
3. Assessment is restricted to the use of a thermometer to compare temperatures in degrees Celsius (warmer, cooler, same).

P.PM.03.52 Explain how we need light to see objects: light from a source reflects off objects and enters our eyes.

Instructional Clarifications

1. Explain means to clearly describe by means of illustrations (drawing), demonstrations, written reports or verbally how we need light to see objects.
2. We see objects because they either emit light or reflect light.
3. Light travels in straight lines from a source such as the sun or a light bulb. When light strikes an object, it is reflected, absorbed, or it passes through the object.
4. When light is reflected or bounces off an object, the light waves travel in straight lines until they reach the eye. The light enters the eye through the pupil and we see the object.
5. This content expectation can easily be taught in conjunction with P.EN.03.2 – Light Properties.
6. A common misconception at this grade level is that the eye gathers light.
7. A common misconception is that we can see in a completely darkened room.

Assessment Clarification

1. When light is reflected or bounces off an object, the light travels in straight lines until it reaches the eye. The light enters the eye and we see the object.

<p>Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implications</p>

Inquiry Process
S.IP.03.11 Make purposeful observations concerning sound and light
S.IP.03.12 Generate questions based on observations to understand sound and light.
S.IP.03.13 Plan and conduct simple and fair investigations of sound and light.
S.IP.03.14 Manipulate simple tools that aid observation and data collection in investigations of sound and light.
S.IP.03.15 Make accurate measurements with appropriate units for the measurement tool.
S.IP.03.16 Construct simple charts and graphs from data and observations dealing with sound and light.
Inquiry Analysis and Communication
S.IA.03.11 Summarize information from data tables and graphs to answer scientific questions about sound and light.
S.IA.03.12 Share ideas about sound and light through purposeful conversation in collaborative groups.
S.IA.03.13 Communicate and present findings of observations and investigations about sound and light using evidence.
Reflection and Social Implications
S.RS.03.11 Demonstrate scientific concepts concerning sound and light through various illustrations, performances, models, exhibits, and activities.
S.RS.03.14 Use data/samples as evidence to separate fact from opinion regarding sound and light.
S.RS.03.15 Use evidence in making scientific decisions about sound and light.
S.RS.03.16 Identify technology associated with sound and light.
S.RS.03.17 Identify current problems on sound and light that may be solved through the use of technology.
S.RS.03.17 Describe how people have contributed to the science of sound and light throughout history and across cultures.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
light path of light sound sound source light source forms of energy vibrations thermometer degrees Celsius light absorption light reflection shadow pitch sun as a source of energy effect	energy heat light rays light refraction opaque transparent translucent guitar drumhead

Instruments, Measurements, Representations

Temperature	Thermometer	Celsius Fahrenheit
With assistance third grade students enter information into a data table to keep track of findings throughout the investigations in sound and light. While students are not expected to measure angles in degrees, they should be able to use alternative means to find the size of an angle and compare it to other angles.		

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Example – Light Energy

Light Energy

Forms of Energy: P.EN.03.11

Light Properties: P.EN.03.21, P.EN.03.22

Conductive and Reflective Properties: P.PM.03.51, P.PM.03.52

Objectives

- Make observations about how light travels in straight lines.
- Demonstrate how a shadow is formed.
- Make observations of light traveling through air and water and of light changing direction.
- Measure differences in temperatures of some materials when light shines on them.
- Explain how light is reflected from objects and enters our eyes in order for us to see those objects.

Engage and Explore

- In a discussion, ask students what they already know about light and about sources of light. To guide the discussion, use questions such as: What happens when the lights are turned on in a dark room? How are we able to see objects? Can we see without light? What happens when light hits an object? What is our main source of light? (sun) Record observations and ideas and questions that are generated on chart paper and post for reference during the unit on light. (S.IP.03.12, S.IA.03.12)
- The guiding question for this activity is: How does light travel? Use flashlights and approximately six - 3x5 index cards with holes per group of students. (Punch holes in the same spot through five of the cards. Students use the sixth card as a target and try to line up the cards so that

the light hits the target.) Students discover that the cards need to be lined up in a straight line in order for the light to pass through the holes and hit the target. Students conclude that light does not bend. Light travels in straight lines. Continue to record observation, ideas and questions generated during the activity. Record on chart paper for future reference. (P.EN.03.21, S.IP.03.11, S.IP.03.12)

- Distribute a mirror to each student. Students observe themselves in the mirror. Instruct students to move the mirror to the side until they see the person behind them. Ask: Can the person behind you see your face? Can you see your own face? Students manipulate the mirror and make observations. Record observations on a chart entitled: "Properties of Light." (P.EN.03.21, S.IP.03.11)
- Teacher preparation: Cut a narrow slit (just a few millimeters wide) in the center along one edge of a 3 x 5 index card (note: black cardstock works better). Tape the card over the front of a flashlight so that the open end of the slit just meets the edge of the flashlight. Turn on the flashlight and set it on a sheet of white paper on a flat surface. Adjust the flashlight so there is a narrow beam of light along the length of the paper. Place a mirror without a frame upright at the end of the paper propped up by a book. Lay the flashlight on a table at one end of the white paper.
- Students shine the light through the slit along the white paper onto the mirror. They should see both the incoming and the reflected beam on the paper. Have students make observations about the light as they see it go to the mirror and away from the mirror. What types of things did they notice? Encourage students to manipulate the flashlight and the mirror.
- Trace the incoming and reflected beams of light on the paper. Although students of this age won't be able to measure angles and get an accurate drawing of the path of the light being reflected by the mirror, they should see that it forms angles or triangles that look the same going from the flashlight to the mirror and away from the mirror. Add to the chart entitled "Properties of Light" that light can be reflected. (P.EN.03.21, S.IP.03.11)

Explain and Define

- Students discuss and share their ideas of how light travels in straight lines and what happens when it hits a surface like a mirror. The idea that it travels in straight lines should start to become apparent. Add to the chart entitled "Properties of Light" that light travels in straight lines. (P.EN.03.21)
- Student observations of the light activities are recorded in a lab book or science journal. (S.IP.03.11, S.IP.03.12)
- Explain and create definitions for: *reflection*, *source*, and *path of light*. Give descriptive examples of each of the terms using written words, diagrams and pictures. Record definition examples in student journals. (P.EN.03.21)
- As students move through the unit, add the terms: refraction, transparent, translucent, and opaque to student journals. (P.EN.03.21)

Elaborate and Apply

- Explore the question, How does light behave when it interacts with different objects? Design an investigation to explore how light interacts with various surfaces. Provide groups of students with flashlights, mirrors, aluminum foil, glass or clear plastic, waxed paper, etc. As students explore the materials with their flashlight, they create a chart to record their findings. Through class discussion, students develop an understanding of transparent, translucent and opaque objects and whether or not they create shadows. Add to the “Properties of Light” chart that light can be absorbed or reflected. (S.IP.03.11, S.IP.03.16)
- Cut out a variety of shapes from opaque material or use a variety of opaque objects. Students use the shapes to block light and form shadows. They explore shadows by manipulating the objects on a piece of white paper, using different sources of light. Trace the shadow on the paper and record observations. Predict the shape of a shadow given a source of light and an object. (P.EN.03.21, S.IP.03.11, S.IP.03.12, S.IP.03.13, S.IP.03.14, S.IP.03.16, S.IA.03.12, S.IA.03.13, S.RS.03.11, S.RS.03.14, S.RS.03.15)
- Place a pencil in a cup of water or through a zip type bag full of water and observe what happens to the appearance of the pencil. Use a tank of water and have students view objects in the water from all angles including from under the surface looking up. In collaborative groups, students discuss their observations. As questions arise in their discussions, students research the answers. Students create a graphic organizer or model to demonstrate the path of light as it enters water. Note: Third grade students do not need to understand that the speed of light varies as it travels through different media. Third grade students simply make observations. (P.EN.03.22, S.IP.03.11)
- Introduce the question; Is light a form of energy? With the assistance of the teacher, students use thermometers in dark colored materials and white/light colored materials placed under a lamp or sunlight. Students record observations on charts. The activity is repeated two more times for accurate results. In collaborative groups, students share their ideas about the differences in the temperatures recorded. They communicate their findings. Using the evidence gathered during the activity, they conclude that light is a form of energy because the light energy is transformed to heat energy. There is a change in temperature. (P.PM.03.51, S.IP.03.14, S.IP.03.15, S.IP.03.16, S.IA.03.11, S.RS.03.14)
- Ask: Do we need light to see? How do you know? Students record their ideas in student journals. If appropriate, take students into a room that can be darkened completely. Turn off the lights. Discuss what they can see. Is the room completely dark? In a darkened room with a mirror (a bathroom is perfect), students look at their eyes in the mirror with the flashlight on, then off, then on. They discuss their observations. Students answer the question, How does light get into our eyes? Using the concepts presented in earlier activities, discuss that light travels in

straight lines. Share ideas that when light hits an object it is reflected and enters our eyes. (P.PM.03.52, S.IP.03.11, S.IP.03.12)

- Students design a simple investigation based on a question generated from the “Properties of Light” chart, i.e. can light be reflected more than one time? They use appropriate tools of observation and construct simple charts and graphs from data and observations. Students summarize information and communicate findings. (P.EN.03.21, P.EN.03.22, S.IP.03.13, S.IP.03.14, S.IP.03.16, S.IA.03.11, S.IA.03.12, S.IA.03.13)

Evaluate Student Understanding

Formative Assessment Examples

- Monitor discussions on light for student understanding. (P.EN.03.11, P.EN.03.21, P.EN.03.22, P.PM.03.51, P.PM.03.52)
- Check student lab books or science journals for understanding. Do students make predictions based previous experiences? Are students demonstrating increased application of previous observations to new experiences? Are students making connections? (P.EN.03.11, P.EN.03.21, P.EN.03.22, P.PM.03.51, P.PM.03.52)

Summative Assessment Examples

- Students design a simple investigation to explore the properties of light (light travels in straight lines, light is reflected). (P.EN.03.21, P.EN.03.22)
- Predict and draw the shape of a shadow based on the object and the source of light. (P.EN.03.21)
- Draw a picture of a pencil half in and half out of water. (P.EN.03.22)

Enrichment

- Make sundials on the playground.
- Check shadows at various times of the day, outline in chalk, and compare.
- Investigate natural and man-made sources of light.
- Extend the refraction of light activity by introducing various clear liquids such as oil, vinegar, clear soda.
- Research the structure and function of the eye. Conduct an eye dissection (preserved or web-based).
- Use a prism to refract visible light. Make rainbows.
- Make a periscope.
- Make a kaleidoscope.
- Student science journals, written explanations of investigations, letters to “absent” students explaining the activities of the day all are good ways to integrate writing into this unit.
- Pod cast sessions about light and explain in cooperative groups the ideas associated with this unit.

Intervention

- Investigate light bulbs to explore the concept that light is a form of energy.
- Conduct a scavenger hunt for light sources around the school. Classify as natural or man-made light.
- Create shadow plays with students.
- Using a jar or tank of water, place various objects in, half in, and out of the water. Draw observations. Share ideas at home.
- Using water, a clear cup and a brightly colored sticker, place the sticker on the table. Place the empty cup on the sticker. View the sticker from a 45-degree angle. Slowly pour water into the cup. Record or discuss observations. What does the sticker look like when viewed from the side of the cup? The top of the cup? Explain the differences. Put their thumb in the cup of water. Discuss observations.
- Using thermometers, explore different areas of the playground on a sunny day. Take temperatures in the shade, the sun, under objects. Discuss results.
- Create a word wall with illustrations to assist students with vocabulary.
- Read texts to reinforce concepts.
- Illustrate important concepts for clarification and evidence of understanding.

Examples, Observations, and Phenomena (Real World Context)

Light is all around in many different forms. We use a variety of natural and man-made light sources everyday. Different kinds of lighting such as fluorescent bulbs, mercury-vapor lighting in parking lots, and the multiple uses of laser light are more energy efficient. The sun is the major light source for life on Earth. Scientists have developed technology to capture the light from the sun to be used for solar energy that generates electricity for heating, cooling and lighting. Light energy can also be stored through technology for future use.

Photography and the use of cameras show how light and the human eye behave. Light is necessary for sight. Light strikes an object and is reflected for the eye to perceive the image. Scientists and inventors use the properties of light to make televisions, computer screens, lasers, and many other tools and devices that are used in homes, hospitals, industry, and agriculture. Lewis Howard Latimer and Thomas Edison were pioneers in understanding and applying the properties of light to make useful contributions to society.

Literacy Integration

Reading

R.CM.03.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.03.02 retell in sequence the story elements of a grade level narrative text and major idea(s) and relevant details of grade level informational text.

Examples of trade books available for learning about light are:

Day Light, Night Light, Let's Read and Find Out Series 2, by Branley and Schett, 1998

Bear Shadow, by Asch, 1985

Hatchet by Gary Paulsen, 1987

- Use the chapter in *Hatchet*, where Brian tries to spear fish. He finally figures out that he has to aim differently because of the refraction of the water. Set up a tank and place a weighted plastic frog or fish in the water. Give the opportunity to try spear fishing and make observations of the location of the fish as observed through the water.

Writing

W.GN.03.03 write an informational piece including a report that demonstrates the understanding of central ideas and supporting details using an effective organizational pattern (i.e. compare/contrast, cause/effect, problems/solutions) with a title, heading, subheading, and a table of contents.

W.GN.03.04 use the writing process to produce and present a research project; initiate research questions from content area text from a teacher-selected topic; and use a variety of resources to gather and organize information.

Speaking

S.DS.03.04 plan and deliver presentations using an effective informational organizational pattern (e.g. descriptive, problem/solution, cause/effect) supportive facts and details, reflecting a variety of resources, and vary the pace for effect.

Instructional Framework

Instructional Example- Sound Energy

Energy

Sound: P.EN.03.31, P.EN.03.32

Objectives

- Demonstrate that vibrating objects produce sound energy.
- Distinguish fast and slow vibrations as pitch.
- Explain that pitch and volume are two characteristics of sound.
- Observe that a change in the way an object vibrates affects the pitch and volume of the sound produced.
- Demonstrate that changing the length, tension, or thickness of a string affects the frequency of the vibrations and, therefore, the pitch of the sound produced.

Engage and Explore

- Go outside and have students make observations using their sense of hearing. Have students make a list of all the sounds they hear and then classify the sounds as natural or man-made (manufactured). (P.EN.03.31, S.IP.03.11)
- Ask students to describe their ideas of how sounds are made. (P.EN.03.32)
- Hold a plastic ruler on a table so that half of the ruler hangs out over the edge of the table. Pluck the free end of the ruler lightly and again with more force. The ruler vibrates producing a sound. Students record and discuss observations of the difference in sounds. Move the ruler to a different length, either longer or shorter, and repeat using the same force when plucking. Students make observations and discuss the difference in the sounds. How did the length of the ruler affect the sound? Record observations and create a class chart for questions and ideas about sound. (P.EN.03.31, P.EN.03.32, S.IP.03.11, S.IP.03.12, S.IP.03.13, S.IP.03.16, S.IA.03.11, S.IA.03.12, S.IA.03.13, S.RS.03.11, S.RS.03.14, S.RS.03.15)
- Provide a variety of toys that produce sound such as whirling tubes, clackers, buzzers, etc. Students explore the "Sound Museum" and make observations. Identify how the sounds are produced. (P.EN.03.31, P.EN.03.32, S.IP.03.11, S.IP.03.12, S.IP.03.13, S.IP.03.16, S.IA.03.11, S.IA.03.12, S.IA.03.13, S.RS.03.11, S.RS.03.14, S.RS.03.15)

Explain and Define

- Have students choose one of the toys or an instrument and explain how it produces sound. (P.EN.03.31, P.EN.03.32)
- Create operational definitions for the words sound, vibration, and pitch. (P.EN.03.31, P.EN.03.32)
- Draw a diagram of a high-pitched sound wave and a low-pitched sound wave. Have students make connections between the diagrams and the sounds from different instruments. (P.EN.03.31 and P.EN.03.32)

Elaborate and Evaluate

- Students make own instruments with rubber bands, string, boxes, straws, etc. Students record and share what they observe about the various “instruments” they made. (P.EN.03.31, P.EN.03.32, S.RS.03.11)
- Create drums using different sized containers and materials for the drumhead. Explore tightening and loosening the drumheads. Students record and share what they observe. (P.EN.03.31, P.EN.03.32, S.IP.03.11, S.IP.03.12, S.IA.03.12, S.RS.03.11, S.RS.03.14)
- Create straw whistles of different lengths. Students record the highs and lows of the pitch and compare it with the length of the column of air/straw. (P.EN.03.31, P.EN.03.32, S.IP.03.11, S.RS.03.11)
- Borrow stringed instruments from the music teacher. Students explore the effects of changing the length of strings while plucking. (P.EN.03.31, P.EN.03.32, S.IP.03.11, S.RS.03.11)

Evaluating Student Understanding

Formative Assessment Examples

- Use student investigations and science journals to assess ability to describe sound and sound as energy. (P.EN.03.31, P.EN.03.32)
- Observe students during investigations on sound. Ask questions to probe student understanding while observing cooperative groups. (P.EN.03.31, P.EN.03.32)
- Use student investigations to assess their ability to ask questions based on observations. (P.EN.03.31, P.EN.03.32)

Summative Assessment Examples

- Students create a simple and fair investigation from one of the above activities. Check lab books for accuracy and understanding. (P.EN.03.31, P.EN.03.32)
- Create a concept map that shows the concepts of sound. (P.EN.03.31, P.EN.03.32)

Enrichment

- Choose questions for further investigation and research on sound.
- Challenge students to create a band from a variety of homemade instruments. A good example of how everyday things can be used for composition is the group, STOMP. Video performances of this group can be used to show their interesting way of using sound for performance. Students should be able to show how the objects they chose vibrate and create sound.
- Use a tuning fork and hold it on the surface of a pan of water.
- Fill glasses of the same size with different amounts of water and replicate the musical scale.
- Make plastic cups with plastic wrap rubber banded to the opening. Place salt, sugar, or sand on the drumhead. Place it near the speaker of a stereo. Watch the grains jump to the sound waves.
- Read texts about sound.
- Explore ways to amplify sound.
- Music and fractions are a natural tie-in. Students can explore quarter, half, and whole notes.
- Any performance of bands, orchestras, choirs, or using student made instruments in a composition.
- Create a "Sound Museum."
- Invite an audiologist to bring his/her equipment to share with the class.

Intervention

- Create a skit or game to demonstrate that vibrating objects cause sounds.
- Enlist the music teacher to reinforce concepts of pitch and vibration.
- Repeat experiences with stringed instruments and drums.

Examples, Observation, and Phenomena (Real World Context)

The properties of sound are experienced in everyday activities. Students hear natural and manufactured sounds through play, school, conversations, sports, and recreation. Natural sounds are sounds in nature and help scientists and naturalists identify species of animals. Animals also identify one another through different sounds they make. People and other animals communicate using sounds. Sounds are used as warning signals in nature and society. The use of alarms and sirens are life saving sounds.

Musicians use the properties of sound to create pieces of music that range from rock and roll to jazz and classical symphonies. The vibrations of different instruments are blended to create the desired notes and chords.

People that lose their sense of hearing rely on hearing aids to pick-up or sense the vibrations of sound to help them distinguish different sounds and words. Contributions of scientists such as Thomas Edison, Alexander Graham Bell, Guglielmo Marconi, and Ernest Chladni have used the properties of sound to design different tools and devices that aid in communication and hearing.

Literacy Integration

Reading

R.CM.03.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.03.02 retell in sequence the story elements of a grade level narrative text and major idea(s) and relevant details of grade-level informational text.

Examples of trade books available for learning about sound:

- *Sounds All Around Let's Read and Find Out Series 1* by Pfeffer and Keller, 1998
- *Making Musical Things*, by Ann Wiseman and Ann Wiseman, 1979
- *Ty's One-man Band*, by Mildred Walter and Margot Tomes, 1980
- *Rubber-Band Banjos and a Java Jive Bass* by Alex Sabbeth, 1997
- *Hear! Hear! The Science of Sound* by Barbara Taylor, 1991

Writing

W.GN.03.03 write an informational piece including a report that demonstrates the understanding of central ideas and supporting details using an effective organizational pattern (i.e. compare/contrast, cause/effect, problems/solutions) with a title, heading, subheading, and a table of contents.

W.GN.03.04 use the writing process to produce and present a research project; initiate research questions from content area text from a teacher-selected topic; and use a variety of resources to gather and organize information.

Speaking

S.DS.03.04 plan and deliver presentations using an effective informational organizational pattern (e.g. descriptive, problem/solution, cause/effect) supportive facts and details, reflecting a variety of resources, and vary the pace for effect.

Third Grade GLCE Companion Document

Unit 3: Structures and Functions of Living Things

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

Third Grade Companion Document
3-Unit 3: Structures and Functions of Living Things

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**3rd Grade Unit 3:
Structures and Functions of Living Things**

Content Statements and Expectations

Code	Statements & Expectations	Page
L.OL.E.3	Structures and Functions – Organisms have different structures that serve different functions in growth, survival, and reproduction.	3
L.OL.03.31	Describe the function of the following plant parts: flower, stem, root, and leaf.	3
L.OL.03.32	Identify and compare structures in animals used for controlling body temperature, support, movement, food getting, and protection (fur, wings, teeth, claws, scales).	4
L.OL.E.4	Classification – Organisms can be classified on the basis of observable characteristics.	4
L.OL.03.41	Classify plants on the basis of observable physical characteristics (roots, leaves, stems, and flowers).	4
L.OL.03.42	Classify animals on the basis of observable physical characteristics (backbone, body covering, limbs).	5
L.EV.E.1	Environmental Adaptation – Different kinds of organisms have characteristics that help them to live in different environments.	6
L.EV.03.11	Relate characteristics and functions of observable parts in a variety of plants that allow them to live in their environment (for example: leaf shape, thorns, odor, color).	6
L.EV.03.12	Relate characteristics and functions of observable body parts to the ability of animals to live in their environment (for example: sharp teeth, claws, odor, body coverings).	7

3 – Unit 3: Structures and Functions of Living Things

Big Ideas (Key Concepts)

- Plant and animal structures have specific functions.
- Plants and animals can be classified by observable characteristics.
- Plants and animals have observable characteristics that allow them to live and survive in their environment.

Clarification of Content Expectations

Standard: Organization of Living Things

Content Statement – L.OL.E.3

Structures and Functions – Organisms have different structures that serve different functions in growth, survival, and reproduction.

Content Expectations

L.OL.03.31: Describe the function of the following plant parts: flower, stem, root, and leaf.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words the function of the flower, stem, root, and leaf.
2. Plant parts have specific functions that contribute to the life of a plant.
3. Flowers produce seeds inside fruits and some flowers attract pollinators such as bats, birds and insects.
4. The stem carries water and minerals from the roots to the leaves and flowers. Stems also provide support to the plant and allow the leaves to reach sunlight.
5. The roots provide support by anchoring the plant and absorbing water and nutrients needed for growth. They also store sugars and carbohydrates.
6. Leaves create food in green plants. They are the site of photosynthesis, a process that uses carbon dioxide, water and sunlight to create food (glucose) and oxygen for the plant and other forms of life. Leaves also have openings that allow water and air to come and go.
7. A common misconception is that plants get food from the ground.
8. A common misconception is that plants make food for other organisms and not for themselves.
9. A common misconception is that plants and seeds are not living.

Assessment Clarifications

1. Flowers produce seeds.

2. The stem carries water and nutrients from the roots to the leaves and flowers. They also provide support to the plant and allow the leaves to reach sunlight.
3. The roots provide support by anchoring the plant and absorbing water and nutrients needed for growth.
4. Leaves make food in green plants.

L.OL.03.32 Identify and compare structures in animals used for controlling body temperature, support, movement, food getting, and protection (fur, wings, teeth, claws, scales).

Instructional Clarifications

1. Identify means to recognize the differences between structures in animals used for controlling body temperature, support, movement, food getting, and protection. Compare means to recognize how the structures are alike or similar among animals.
2. Animals have specific structures and body coverings that assist in controlling body temperature such as fur, feathers, skin, and hair.
3. Animals have specific structures that provide support such as a skeleton (bones) or an exoskeleton (no bones) in insects and crayfish.
4. Structures that provide movement for animals include limbs, wings, fins and muscles.
5. Structures used for food getting may include claws, jaws, teeth, beaks, legs, wings, and camouflage.
6. Structures used for protection may include exoskeletons, shells, scales, claws, teeth, legs and wings.

Assessment Clarifications

1. Body coverings such as fur, feathers, skin, and hair help control body temperature.
2. Skeletons provide support.
3. Limbs, wings, fins and muscles help animals move.
4. Animals use jaws, teeth, claws, and beaks for getting food.
5. Animals use scales, shells, claws, teeth, beaks, and wings for protection.

Content Statement – L.OL.E.4

Classification – Organisms can be classified on the basis of observable characteristics.

Content Expectations

L.OL.03.41 Classify plants on the basis of observable physical characteristics (roots, leaves, stems, and flowers).

Instructional Clarifications

1. Classify means to arrange or organize plants by category.
2. Scientists classify organisms (plants and animals) based on physical characteristics.

3. Plants can be classified based on observable physical characteristics such as roots, leaves, stems, and flowers.
4. Seed plants can be classified into two categories: evergreens and broad-leaved.
5. There are generally two types of root systems in green plants. A taproot is a single, prominent root. Examples are carrots and radishes. The other type of root system is branching.
6. Plants leaves can be classified in many ways. Two common ways are by shape and pattern. Green plants can have needle-like leaves or broad flat leaves. It is not important for third grade students to identify the specific leaf structures used for classification. They should be able to recognize that there are different leaf types and classify based on observable characteristics such as leaf type, leaf shape, veins.
7. Plant stems vary considerably and are divided into two groups. Plants may have woody stems such as in trees and shrubs. Plants may have green, non-woody stems such as in flowering plants and grasses.
8. Plants may be classified based on the type of flower. Flowers can be classified by color, shape and number of petals.

Assessment Clarification

1. Plants can be classified based on observable physical characteristics such as roots, leaves, stems, seeds and flowers.

L.OL.03.42 Classify animals on the basis of observable physical characteristics (backbone, body covering, limbs).

Instructional Clarifications

1. Classify means to arrange or organize animals by category.
2. Scientists classify organisms (plants and animals) based on physical characteristics.
3. Observable physical characteristics are the structures that are visible through observations.
4. Animals can be classified into two broad categories: backbone (internal skeleton or vertebrate) which are mammals, fish, birds, reptiles and amphibians or no backbone (external skeleton or exoskeleton or invertebrate) which include animals such as worms, insects and crustaceans. Third grade students will be limited to the general classification of animals with a backbone or no backbone. Animals with no backbone either have a skeletal system in the form of a shell or hard outer covering (insects, crustaceans, mollusks) or no skeletal system (worms, jellyfish).
5. Third grade students should classify animals with a backbone into fish, amphibian, reptile, bird and mammal.
6. Animals with backbones can be classified based on body covering and other observable physical characteristics: fish (scales and gills), amphibians (smooth wet skin), reptiles (dry, rough skin), birds (wings, two feet, feathers), and mammals (hair, feed their young milk).
7. A common misconception is that only large mammals are animals.
8. A common misconception is that humans are not animals.

9. A common misconception is that penguins and turtles are amphibians because they are both in and out of the water.
10. A common misconception is that whales, jellyfish, and starfish (or any animal that lives in the water) are all fish.
11. A common misconception is that behavior and habitat are used as criteria for classifying animals.
12. A common misconception is that animals with no backbone have no skeletal system.
13. A common misconception is that turtles have a shell, no backbone, and can pull out of their shells completely like a hermit crab can.

Assessment Clarification

1. Animals can be classified based on observable physical characteristics (backbone, body covering, limbs).

Standard: Evolution

Content Statement – L.EV.E.1

Environmental Adaptation – Different kinds of organisms have characteristics that help them to live in different environments.

Content Expectations

L.EV.03.11 Relate characteristics and functions of observable parts in a variety of plants that allow them to live in their environment (for example: leaf shape, thorns, odor, color).

Instructional Clarifications

1. Relate means to establish an association or connection between characteristics and functions of observable parts of plants that allow them to live in their environment.
2. Plants have characteristics such as leaf shape, thorns, odor, or color that help them survive in different areas.
3. Leaf shape is important to a plant's survival. In desert areas, leaves may be very small or non-existent to help conserve water. Prairie grasses have long slender leaves that help prevent water loss. In deciduous forests, most trees have thin, broad leaves that can capture a lot of sunlight during the warm months and fall off during the winter to prevent water loss.
4. Some plants such as roses have thorns to prevent animals from eating them.
5. Some flowers such as roses have a strong sweet odor to attract birds and insects for pollination, while other plants such as skunk cabbage or tobacco plants have a strong toxic odor to deter insects or mammals from eating their leaves.
6. Color is another plant characteristic that helps with survival. Certain flower colors attract birds and insects for pollination. Colors may also help camouflage flowers.

7. The emphasis in third grade is characteristics that help an organism survive in its environment.
8. A common misconception is that plants need dirt or soil to grow.

Assessment Clarification

1. Plants have characteristics such as leaf shape, thorns, odor, or color that help them survive in different areas.

L.EV.03.12: Relate characteristics and functions of observable body parts to the ability of animals to live in their environment (for example: sharp teeth, claws, odor, body coverings).

Instructional Clarifications

1. Relate means to establish an association or connection between characteristics and functions of observable body parts to the ability of animals to live in their environment.
2. Animals have different characteristics such as sharp teeth, claws, odor, and body coverings that help them survive in their environment.
3. Sharp teeth help animals catch and hold their prey. Sharp teeth also help an animal defend itself.
4. Claws are used for defense and for catching prey. They can help an animal hold on to its prey and keep other animals from taking its meal. They may help an animal climb a tree or dig a hole.
5. Animals such as skunks and some snakes have a strong odor to keep predators away. Animals also use odor to find animals of the same kind.
6. Body coverings help animals survive in their environment. Color for camouflage and the type of covering are two important characteristics. Polar bears have white, thick fur that helps them live in a cold, snowy climate. Feathers help birds stay warm and fly or swim. Scales help fish and snakes live in their environments. The coloration of zebras and green tree frogs helps them hide or blend into their environments. The thick skin of the rhinoceros and quills of porcupine help them defend themselves. Mimicry and protective resemblance are two additional means of survival.
7. A common misconception is that animals migrate because it is too cold for them to survive.
8. Animals migrate to areas where they can find food, mate, and raise young.

Assessment Clarification

1. Animals have different characteristics such as sharp teeth, claws, odor, and body coverings that help them survive in their environment.

Inquiry Process, Inquiry Analysis and Communication, Reflections and Social Implications

Inquiry Processes
S.IP.03.11 Make purposeful observations of plants and animals using the appropriate senses.
S.IP.03.12 Generate questions based on observations of plants and animals.
S.IP.03.13 Plan and conduct simple and fair investigations.
S.IP.03.14 Manipulate simple tools that aid observation and data collection (hand lens, thermometer, tape measure).
S.IP.03.15 Make accurate measurements with appropriate units (Celsius, centimeters).
S.IP.03.16 Construct simple charts and graphs from data and observations of plants and animals.
Inquiry Analysis and Communication
S.IA.03.11 Summarize information from charts about structures and functions of plant and animal parts.
S.IA.03.12 Share ideas about plant and animal structures and functions through purposeful conversation in collaborative groups.
S.IA.03.13 Communicate and present findings of observations and investigations.
S.IA.03.14 Develop research strategies and skills for information gathering and problem solving about plants and animals.
Reflection and Social Implications
S.RS.03.11 Demonstrate understanding of plant and animal structures and functions through illustrations, descriptions, or discussions.
S.RS.03.14 Use samples as evidence to separate fact from opinion when classifying plants and animals.
S.RS.03.15 Use evidence when communicating about plants and animals.
S.RS.03.16 Identify technology used in everyday life when taking temperatures, making measurements, and making a Power Point presentation.
S.RS.03.17 Identify current problems about plants and animals that may be solved through the use of technology.
S.RS.03.18 Describe the effect invasive species have on the balance of the natural world.
S.RS.03.19 Describe how people such as Barbara McClintock and Jean Lamarck have contributed to science throughout history and across cultures.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
air	habitat
animal features	herbivore
color	living organism
plant	omnivore
backbone/no backbone	pollinators
environment	skeleton
minerals	exoskeleton
organism	crustacean
plant root	evergreens
flowers	broad-leafed plants
stem	woody stems
leaf	tap root
survival of organisms	branching root
temperature	plant adaptations
Celsius	animal adaptations
thermometer	predator
centimeter	camouflage
support	mimicry
movement	protective adaptations
food getting	mammal
protection	fish
structure	bird
function	amphibians
physical characteristics	reptile
compare	insect
classify	worm

Instruments, Measurements, Representations

Measurements	Instruments	Representations
temperature	thermometer	Celsius
length	tape measure	centimeter

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Plants L.OL.03.31, L.OL.03.41, L.EV.03.11

Objectives

- Describe the functions of the basic plant parts.
- Classify plants on the basis of observable physical characteristics.
- Relate how characteristics and functions of observable parts in a variety of plants allow them to live in their environment.

Engage and Explore

- Take a walk outside and observe where plants live and don't live. Discuss reasons why plants might not be able to live in certain areas. (L.EV.03.11, S.IP.03.11, S.IA.03.12, S.RS.03.15)
- Display a variety of plants that show different parts. Students observe the different parts of the plants and try to identify the flowers, stems, roots, and leaves. Note the place where the root changes into the stem if possible. Have hand lenses available. Include some plants that might have some confusing parts such as a cactus, evergreen, moss, etc. (L.OL.03.31, S.IP.03.14, S.IA.03.12, S.IA.03.12, S.RS.03.11, S.RS.03.15)
- In cooperative groups students decide what the function of each plant part is and report out to the class. Record the structures and functions of the parts of the plants on charts or in science journals. (L.OL.03.31, S.IP.03.11, S.IP.03.12, S.IA.03.11, S.IA.03.13, S.RS.03.11, S.RS.03.15)
- Place a celery stalk or a white flower in a glass of colored water. Observe what happens to the leaves or flower petals. (L.OL.03.31, S.IP.03.11, S.IA.03.14)

Explain and Define

- Explain what is meant by the terms structures and functions. Every structure has a function or multiple functions that allow the plant to survive in its environment. Scientists use the structures to sort or classify plants. (L.OL.03.31, L.OL.03.41, L.EV.03.11)
- As a class, organize student thinking about plant parts and their functions into a t-chart.

Plant Part	Function

Elaborate and Apply

- Elaborate on how scientists classify organisms by observable physical characteristics. The leaves can either be broad-leaf or needle-like. Roots can be a single taproot or fibrous and branching. Stems can be woody or green. Flowers can be classified by color, shape, or number of petals. In cooperative groups have students observe various plants, decide how scientists might classify them, and record their ideas using charts. The groups could report out to the class telling their rationale for their choices. (L.OL.03.41, S.IP.03.11, S.IP.03.12, S.IP.03.16, S.IA.03.11, S.IA.03.13, S.RS.03.14)
- Make a plant part salad. Assign each student a different edible plant part (let the student choose) to bring in to put into a salad. As they add their plant part to the salad, they tell the structure and function. (L.OL.03.31, S.RS.03.11)
- Expand on student thinking by deciding how some structures of plants allow them to live in their environment. Leaf shape, thorns, odor, or color are very important to some plants' survival. Students can find examples of these characteristics either in pictures or outside. Record the examples in science journals. Difficulties in understanding arise when students try to describe how a plant part is specially designed to help the plant survive in an area. For instance, all plants have leaves, and all leaves gather sunlight. Just stating that a plant survives in an area because it has leaves to gather sunlight is not enough. Some better explanations are: a plant has extremely large leaves to capture more sunlight than other plants; a plant will put its leaves out very quickly in the spring to gather sunlight as soon as possible; or a plant with needle-like leaves that keep moisture in will keep their leaves all winter so they can gather sunlight all year round. Note: In third grade the term adaptation means how specific characteristics and functions allow a plant to survive in its environment. In fourth grade the emphasis will be on how variations in physical characteristics of individual organisms give them an advantage for survival and reproduction. (L.EV.03.11, S.IP.03.11, S.IA.03.12, S.RS.03.11, S.RS.03.15)

- Using fast growing plants, grow plants from seeds through a full life cycle. Observe and measure the different plant parts as they develop. Record the observations and measurements on a chart or in science journals. (L.OL.03.31, S.IP.03.14, S.IP.03.15, S.IP.03.16, S.IA.03.14, S.RS.03.15, S.RS.03.16)

Evaluate Student Understanding

Formative Assessment Examples

- Use the information students put on charts and their reporting out to the class to assess student understanding of classification of plants. (L.OL.03.41)
- Use the students' pictures and labels in their science journals to assess their ability make and record observations with accuracy. (L.OL.03.31)
- Use the students' observations of plant parts and have further discussion about ways plants can survive in their environment or have multiple adaptations for a single plant part. (L.EV.03.11)

Summative Assessment Examples

- Students plan and create a make-believe plant to demonstrate their understanding of structures and characteristics that help a plant survive in its environment. The make-believe plant has to have all of the plant parts, labels, the plant shown in its correct environment, and an adaptation that will help the plant survive in its environment. (L.OL.03.31, L.EV.03.11)
- Put out plants that have not yet been observed in the classroom. Students identify marked parts, tell the functions of the parts, and group the plants according to specified criteria. (L.OL.03.31)
- Put out plants that have not yet been observed in the classroom. Students sort the plants into groups based on observable physical characteristics. (L.OL.03.41)

Enrichment

- Armed with a camera, students go on a hike to look for specific examples of adaptations that help plants survive in different environments. Make a poster or a Power Point presentation showing the examples.
- Bring in a horticulturalist from a nearby nursery or botanical garden to show exotic plants and tell about their structures, functions and how the plant is designed to survive in its environment.
- Go on a field trip to a nursery or botanical garden.
- Research plants that are invasive species. What adaptations does the plant have that makes it successful in a particular environment?

Intervention

- Match Game: Provide cards that include the plant parts and all of the functions for each plant part: root – 1) provides support by anchoring the plant and 2) absorbs water and nutrients (note: nutrients are not food); stem – 1) carries water and nutrients from roots to leaves and 2) provides support to the plant and allows the leaves to reach sunlight; leaf – makes food; flower – produces seeds. Put each function and each plant part on separate cards. Students match the different functions with each plant part.
- Use pictures of plants and sort them into groups by their roots, leaves, stems, seeds, and flowers.
- Gather as many examples as possible of either real plants and/or pictures that show very specific ways a plant part helps a plant survive in its environment. For instance find as many plants as possible that have a long tap root or thorns.

Examples, Observations, and Phenomena (Real World Context)

The produce department of the grocery store is a place where children can practice identifying the different parts of the plants. Children are often removed from farms and consume prepackaged food and do not always realize where much of the food comes from.

Michigan is faced with many invasive species that have adapted to survive in all areas of the state. Some of the common invasive plant species are: garlic mustard, purple loosestrife, Eurasian milfoil, and hydra.

The rainforest has many new species that scientists are continually classifying. No one knows how many undiscovered species of plants there are because of the alarming rate at which the rainforest is being destroyed.

As gardening, green lawns, and golf courses become more popular, more herbicides and fertilizers are being applied to yards that in turn have a huge affect on the lakes, rivers, ponds, etc.

Contributions of scientists throughout history and across cultures have contributed significantly to current scientific thought. The contributions of scientists such as Barbara McClintock and George Washington Carver have used the parts of plants to advance the use of food plants.

Instructional Framework

Instructional Examples

Animals L.OL.03.32, L.OL.03.42, L.EL.03.12

Objectives

- Identify and compare structures in animals used for controlling body temperature, support, movement, food getting, and protection.
- Classify animals on the basis of observable physical characteristics.
- Relate how characteristics and functions of observable body parts in a variety of animals allow them to live in their environment.

Engage and Explore

- Students use pictures and/or parts of animals (i.e. skulls, teeth, pelts, feathers, etc.) to identify the structures that help the animals control body temperature, provide support, provide movement, get food, and protect themselves. Discuss and record information on a chart or in science journals. (L.OL.03.32, S.IP.03.11, S.IP.03.12, S.IP.03.16, S.IA.03.12, S.IA.03.13, S.RS.03.11)
- Students use pictures of animals and try to group animals using their own criteria. (L.OL.03.42, S.IP.03.11, S.IA.03.14, S.RS.03.14, S.RS.03.15)

Explain and Define

- Explain what is meant by the terms structures and functions. Structures (i.e. fur, wings, teeth, claws, and scales) are used to allow the animal to control its body temperature, support its body, move, get food, and protect itself. Many of the characteristics of the observable body parts enable an animal to survive in its environment. Scientists use structures, not behaviors, to classify animals into groups. (L.OL.03.32, L.OL.03.42, L.EV.03.12, S.RS.03.11, S.RS.03.14, S.RS.03.15)

Elaborate and Apply

- Students use pictures, actual animals, and/or videos to explore ways in which body parts and body coverings help an animal survive in its environment. Difficulties in understanding arise when students try to describe how specific body parts or body coverings help animals survive in their environment. For instance, the sentence, "Teeth are used for eating," tells the structure (teeth) and the function (eating) but not how teeth help an animal survive in its environment. "Flat teeth are used for grinding seeds," or "Sharp teeth are used for tearing meat," explain how the

structure helps an animal survive in its environment more clearly.
(L.OL.03.11, L.EV.03.12, S.IP.03.11, S.RS.03.15)

- To show how body coverings help keep animals warm, students experiment with different ways heat can be kept in cans of warm water by wrapping various materials (fake fur, fiberfill, wool, aluminum foil, etc.) around them, taking their temperatures, and recording the data on a chart.
(L.EV.03.12, S.IP.03.13, S.IP.03.15, S.IP.03.16, S.IA.03.13, S.IA.03.14, S.RS.03.15, S.RS.03.16)
- To show how body coverings protect animals from temperature differences, students make a “blubber glove” out of two zip-top bags (one inside the other). Put vegetable shortening between the two bags so a hand can be inserted into the inner part and remain clean. Put the “blubber gloved” hand and a hand with no glove into both ice water and warm water and see if any temperature differences can be detected. (L.EV.03.12, S.IP.03.13, S.IA.03.13, S.IA.03.14, S.RS.03.11, S.RS.03.15)
- To show how body coverings help an animal hide or blend in with its environment, students use colored pencils, markers, and/or colored paper to design and make small insects or animals that can be placed in the open but camouflaged around the classroom. (L.EV.03.12, S.IP.03.11, S.IA.03.14, S.RS.03.11)
- To show how body parts such as claws and teeth are also used to get food, students use a variety of instruments such as toothpicks, chopsticks, spoons, strainers, etc., to simulate animal body parts. Pick up and/or tear apart different types of foods (beans, water, gelatin, rice, etc.) using the different instruments. Record the findings and report out to the class which types of body parts work best for handling which types of foods.
(L.OL.03.32, L.EV.03.12, S.IP.03.13, S.IP.03.14, S.IA.03.11, S.IA.03.12, S.IA.03.13, S.IA.03.14, S.RS.03.11, S.RS.03.16, S.RS.03.17)
- To show how scientists classify animals, students in cooperative groups cut out pictures to sort animals into groups. First the students sort by skeletons on the outside of the body and skeletons on the inside of the body. Once animals have been divided into these two groups, the animals are grouped further based on observable physical characteristics, i.e., body coverings and limbs. Use large chart paper to glue or record all the mammals together, fish, birds, etc. Students report out to the class.
(L.OL.03.42, S.IP.03.11, S.IP.03.12, S.IP.03.16, S.IA.03.12, S.IA.03.13, S.RS.03.14)
- Note: The expectations are written with plants and animals combined. Although they have been separated in the Instructional Examples for ease of teaching, the intent is for students to make the connection that all organisms (plant and animal) have structures and functions, are classified by observable characteristics, and have characteristics that allow the organism to survive in its natural environment.

Evaluate Student Understanding

Formative Assessment Examples

- Use the information students put on charts and their reporting out to the class to assess student understanding of animal parts and their functions. (L.OL.03.32)
- Use the charts students created to check understanding of classification of animals. (L.OL.03.42)
- Use the students' observations of animal body parts or body coverings to have further discussions about ways animals can survive in their environment. (L.EV.03.12)

Summative Assessment Examples

- Students demonstrate understanding of animal structures and functions by designing a make believe animal that has special body parts and body coverings that help the animal survive in its environment. The body parts and coverings need to match the animal's habitat, and a description of how the structures help the animal survive needs to be given. (L.EV.03.12)
- Students write a paragraph explaining how a scientist would classify a new animal that was found. (L.OL.03.42)
- Using a particular animal, give one or two body parts or body coverings that help the animal survive in its environment. For instance a rabbit has brown fur for camouflage, large hind feet so it can run fast, large ears to hear predators, and large incisors for gnawing. (L.EV.03.12)

Enrichment

- Find other adaptations animals have in order to help them survive in their environment. For instance look at actions or behaviors animals have, such as migration and hibernation or a rabbit running a zigzag pattern to escape a predator; or ways animals can get oxygen through skin or gills.
- Students can study owls and look at all of the structures an owl has to allow it to be such a successful hunter. Then dissect owl pellets to look at what is found in the pellets. Sort the bones, and identify the bones and the animals they come from.
- Research animals that are invasive species. What special adaptations do the animals have that allow them to be successful in an area?

Intervention

- Match Game: Make cards that say: “controlling body temperature”, “support”, “movement”, “food-getting”, and “protection”. Have lots of pictures of animals with various parts marked (i.e. fur, wings, teeth, claws). Students match the pictures with the functions.
- Students practice sorting objects such as buttons or attribute blocks. First they have to sort the objects into two main groups such as buttons with two holes and buttons without two holes or blocks that are round and blocks that are not round. Then sort the two groups further. Students have to set the criteria they use for sorting.

Examples, Observations, and Phenomena (Real World Context)

Michigan is faced with many invasive species that have adapted to survive in all areas of the state. Students need to be aware of how to try to help contain them so they don't travel out of certain areas and take over habitats of native species, and they need to be aware of how to prevent invasive species from coming into an area. Some of the major invasive animal species are: zebra mussels, quagga mussels, rusty crayfish, emerald ash borer, spiny water flea, ruffe, and round gobi.

Children love to watch the nature programs on TV or read nature books. Many of the TV programs and books focus on structures that help animals survive in their environment. By knowing about structures and functions of animals, children can be more aware while watching TV or reading and be able to make text-to-self connections.

The rainforest has many new species that scientists continue to classify. No one knows how many undiscovered species of animals there are because of the alarming rate at which the rainforest is being destroyed.

The application of pesticides has an effect on ecosystems and animals becoming more resistant to them.

Contributions of scientists throughout history and across cultures have contributed significantly to current scientific thought. Students research and recognize the contributions of scientists such as Jean Lamarck, Carolus Linnaeus, and Jane Goodall.

Literacy Integration

Reading

R.CM.03.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.03.02 retell in sequence the story elements of grade-level narrative text and major idea(s) and relevant details of grade-level informational text.

R.CM.03.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

R.MT.03.02 plan, monitor, regulate, evaluate skills, strategies, and processes to construct and convey meaning (e.g. decoding unknown words), and use graphic organizers to deepen understanding of problem/solution and organizational patterns.

Examples of the trade books available for learning about plants and animals:

How Plants Survive by Kathleen Kudlinski, 2003

Plant Parts by Louise Spilsbury, 2008

How Do Animals Adapt by Bobbie Kalman and Niki Walker, 2000

Hatchet by Gary Paulson, 1987

Writing

W.GN.03.03 write an informational piece including a report that demonstrates the understanding of central ideas and supporting details using an effective organizational pattern (e.g. compare/contrast, cause/effect, problem/solution) with a title, heading, subheading, and a table of contents.

W.GN.03.04 use the writing process to produce and present a research project; initiate research questions from content area text from a teacher-selected topic; and use a variety of resources to gather and organize information.

W.PR.03.01 set a purpose, consider audience, and replicate authors' styles and patterns when writing a narrative or informational piece.

- Read the book *Hatchet* to the class. Students will write a literature response about why Brian has so much difficulty shooting wild game.

L.CN.03.01 ask substantive questions of the speaker that will provide additional elaboration and details.

L.CN.03.02 listen to or view knowledgeably while demonstrating appropriate social skills of audience behaviors (e.g. eye contact, attentive, supportive) in small and large group settings.

Mathematics Integration

M.UN.03.01 Know and use common units of measurements in length, weight, and time.

D.RE.03.01 Solve problems using information in bar graphs, including comparison of bar graphs.

D.RE.03.02 Read scales on the axis and identify the maximum, minimum, and range of values in a bar graph.

Third Grade GLCE Companion Document

Unit 4: Earth Materials, Change, and Resources

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

Third Grade Companion Document
3-Unit 4: Earth Materials, Change, and Resources

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**3rd Grade Unit 4:
Earth Materials, Change, and Resources**

Content Statements and Expectations

Code	Statements & Expectations	Page
E.ES.E.4	Natural Resources – The supply of many natural resources is limited. Humans have devised methods for extending their use of natural resources through recycling, reuse, and renewal.	4
E.ES.03.41	Identify natural resources (metals, fuels, fresh water, soil, and forests).	4
E.ES.03.42	Classify renewable (fresh water, forests) and non-renewable (fuels, metals) resources.	5
E.ES.03.43	Describe ways humans are protecting, extending and restoring resources (recycle, reuse, reduce, renewal).	5
E.ES.03.44	Recognize that paper, metal, glass, and some plastics can be recycled.	6
E.ES.E.5	Human Impact – Humans depend on their natural and constructed environment. Humans change environments in ways that are helpful or harmful for themselves and other organisms.	7
E.ES.03.51	Describe ways humans are dependent on the natural environment (forests, water, clean air, earth materials) and constructed environments (homes, neighborhoods, shopping malls, factories, and industry).	7
E.ES.03.52	Describe helpful or harmful effects of humans on the environment (garbage, habitat destruction, land management, renewable and non-renewable resources).	8

Code	Statements & Expectations	Page
E.SE.E.1	Earth Materials – Earth materials that occur in nature include rocks, minerals, soils, water, and the gases of the atmosphere. Earth materials have properties that sustain plant and animal life.	9
E.SE.03.13	Recognize and describe different types of earth materials (mineral, rock, clay, boulder, gravel, sand, soil).	9
E.SE.03.14	Recognize that rocks are made up of minerals.	10
E. SE.E.2	Surface Changes – The surface of the Earth changes. Some changes are due to slow processes, such as erosion and weathering, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.	10
E.SE.03.22	Identify and describe natural causes of change in the Earth’s surface (erosion, glaciers, volcanoes, landslides, and earthquakes).	10
E.SE.E.3	Using Earth Materials – Some earth materials have properties that make them useful either in their present form or designed and modified to solve human problems. They can enhance the quality of life as in the case of materials used for building or fuels used for heating and transportation.	12
E.SE.03.31	Identify earth materials used to construct some common objects (bricks, buildings, roads, glass).	12
E.SE.03.32	Describe how materials taken from the Earth can be used as fuels for heating and transportation.	12

3 – Unit 4: Earth Materials, Change, and Resources

Big Ideas (Key Concepts)

- The Earth has natural resources that are renewable or non-renewable.
- Humans are dependent on and affect their environments in helpful and harmful ways.
- The Earth's surface changes through slow processes and fast processes.
- Earth materials have useful properties and can enhance the quality of life.

Clarification of Content Expectations

Standard: Earth Systems

Content Statement – E.ES.E.4

Natural Resources – The supply of many natural resources is limited. Humans have devised methods for extending their use of natural resources through recycling, reuse, reduce, and renewal.

Content Expectations

E.ES.03.41 Identify natural resources (metals, fuels, fresh water, soil, and forests).

Instructional Clarifications

1. Identify means to recognize metals, fuels, fresh water, soil, and forests as natural resources.
2. Natural resources are naturally occurring materials and include metals, fuels, fresh water, soil, and forests.
3. Natural resources have different properties and help to sustain plant and animal life.
4. People use natural resources to make or produce the things that they need.
5. Natural resources can originate from living organisms (forests) or from nonliving things (fuels, metals, freshwater).

Assessment Clarifications

1. Natural resources are naturally occurring materials and include metals, fuels, fresh water, soil, and forests.
2. Natural resources come from living organisms (forests) or from nonliving things (fuels, metals, fresh water).

E.ES.03.42 Classify renewable (fresh water, forests) and non-renewable (fuels, metals) resources.

Instructional Clarifications

1. Classify means to arrange or order natural resources as renewable or non-renewable based on the ability of the natural resource to be replaced by nature in a reasonable amount of time.
2. Natural resources are materials or things that people use from the Earth.
3. A renewable resource is one that can be replaced in a reasonable amount of time. It can be used again or made again by people or nature; or never run out. Fresh water and forests are examples. Other examples include plants and animals. Solar, wind, wave, or geothermal energies are renewable because they are based on renewable resources.
4. A non-renewable resource is one that cannot be replaced, renewed or re-grown by nature or people. It exists in a fixed amount in nature. Most non-renewable resources come from the Earth; they are found in the ground. Fuels taken from the Earth (fossil fuels) and metals are considered non-renewable because the Earth cannot replenish them at a rate fast enough for sustainability. They take longer than a person's lifespan to be replaced.
5. A common misconception is that all natural resources are renewable and can be replaced by nature.

Assessment Clarifications

1. Classify natural resources as renewable and non-renewable based on the ability of the resource to be replaced by nature in a reasonable amount of time.
2. A renewable resource is one that can be replaced in a reasonable amount of time. It can be used again or made again by people or nature; or never run out. Water and forests are examples. Other examples include plants and animals.
3. A non-renewable resource is one that cannot be made again by nature or people. Most come from the ground. Fuels and metals taken from the Earth are considered non-renewable because it takes millions of years for the Earth to produce more.

E.ES.03.43 Describe ways humans are protecting, extending and restoring resources (recycle, reuse, reduce, renewal).

Instructional Clarifications

1. Describe means to tell or depict in spoken or written words how humans are protecting, extending and restoring resources.
2. Resources should be conserved and protected. This is especially true for non-renewable resources but renewable resources can also be killed (plants and animals) or overused (over-forestry, over-fishing the Great Lakes).
3. Some natural resources can be recycled. Recycled is to collect and return items or material to be manufactured into a new product. Materials that

are easily recycled include: glass, some plastics, paper, and aluminum, cardboard and steel.

4. Reuse is to use an object or item again or find new uses for items instead of throwing them away. Products that can be used again are paper bags, plastic jugs, jars, coffee mugs, plastic containers and flatware, etc.
5. Reduce is to produce less waste by choosing to buy fewer products or buying less wasteful products to conserve natural resources. Some examples are turning out the lights, using less water, reusing grocery bags, riding bikes, carpooling, using mass transportation, and considering the packaging before purchasing a product.
6. Renewal of resources includes activities such as replanting, reforestation, and composting.
7. A common misconception is that students cannot make a difference.

Assessment Clarifications

1. Resources should be conserved and protected. This is especially true for non-renewable resources but renewable resources can also be killed (plants and animals) or overused (over-forestation and over-fishing the Great Lakes).
2. Some natural resources can be recycled. Recycled is to collect and return items or material to be manufactured into a new product. Materials that are easily recycled include: glass, some plastics, paper, aluminum, cardboard and steel.
3. Reuse is to use an object or item again or find new uses for items instead of throwing them away. Products that can be used again are paper bags, plastic jugs, jars, coffee mugs, plastic containers and flatware, etc.
4. Reduce is to produce less waste by choosing to buy fewer products or buying less wasteful products to conserve natural resources. Some examples are turning out the lights, using less water, reusing grocery bags, riding bikes, carpooling, using mass transportation, and considering the packaging before purchasing a product.
5. Renewal of resources includes replanting, reforestation, and composting.

E.ES.03.44 Recognize that paper, metal, glass, and some plastics can be recycled.

Instructional Clarifications

1. Recognize is to identify or perceive that some materials can be recycled.
2. Many materials that are used everyday can be recycled. This reduces the waste of natural resources, reduces energy usage, and reduces pollution and greenhouse gas emissions.
3. Almost all materials can be recycled but some of the most common are paper, metal, glass, and some plastics.
4. Recycled paper is made into new paper.
5. Recycled glass is made into new glass products.
6. Recycled metal is used in sheet metal for cars, bridges and even new cans.
7. Recycled plastic can be made into new plastic containers, clothing, furniture, and building products.

8. A common misconception is that all items can be recycled.

Assessment Clarifications

1. Many materials that are used everyday can be recycled.
2. Almost all materials can be recycled but some of the most common are paper, metal, glass, and some plastics.

Content Statement – E.ES.E.5

Human Impact – Humans depend on their natural and constructed environment. Humans change environments in ways that are helpful or harmful for themselves and other organisms.

Content Expectations

E.ES.03.51 Describe ways humans are dependent on the natural environment (forests, water, clean air, earth materials) and constructed environments (homes, neighborhoods, shopping malls, factories, and industry).

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words how humans are dependent on their natural and constructed environments.
2. A natural environment is the surroundings of an animal that include the living and nonliving elements or conditions that occur in nature, such as the air, water, plants, animals, climate, soil, rocks, and light.
3. A constructed environment is the surroundings, tools, and structures that include items that are manufactured or built and/or used by inhabitants of the environment, such as homes, stores, factories, neighborhoods, vehicles, and appliances.
4. Living things needs include air, water, food, space and shelter.
5. Living things depend on their environment to help meet their needs.
6. Living things depend on their natural environment for clean air, clean water, forests, food, and earth materials such as soil, sand, rocks and minerals.
7. Humans depend on their constructed environments to meet their basic needs and for shelter, work and recreation. Constructed or man-made environments include homes, neighborhoods, shopping malls, factories and industry.

Assessment Clarifications

1. Humans depend on their environment to help meet their needs.
2. A natural environment is the surroundings of an animal that include the living and nonliving elements or conditions that occur in nature, such as the air, water, plants, animals, climate, soil, rocks, and light.
3. A constructed environment is the surroundings, tools, and structures that include items that are manufactured or built and/or used by inhabitants of the environment, such as homes, stores, factories, neighborhoods, vehicles, and appliances.

4. Humans depend on their natural environment for clean air, clean water, food, forests, and earth materials such as soil, sand, rocks and minerals.
5. Humans depend on their constructed environments to meet their basic needs and for shelter, work and recreation. Man-made (constructed) environments include homes, neighborhoods, shopping malls, factories and industry.

E.ES.03.52 Describe helpful or harmful effects of humans on the environment (garbage, habitat destruction, land management, renewable and non-renewable resources).

Instructional Clarifications

1. Describe means to tell or depict in spoken or written words how humans affect the environment.
2. Changes that humans make to their environment can have helpful or harmful effects.
3. Harmful effects include garbage, habitat destruction, resource depletion, and pollution.
4. The average American produces approximately 1500 pounds of garbage per year. Very little is recycled. Waste management and the 4 R's (reduce, reuse, recycle, renewal) are critical to resource conservation.
5. Farming, mining, logging, pollution and urban sprawl are the main causes of habitat destruction. The main effects of habitat destruction are species extinction and loss of a diverse community of plants and animals.
6. Helpful effects include land management and conservation of renewable and non-renewable resources.
7. Land management is the process of managing natural resources in a sustainable way. By improving agricultural practices, reclaiming wasted land, protecting the environment, conserving soil, water, and air quality, humans contribute to positive land management practices.
8. The management and conservation of renewable and non-renewable resources are essential for sustainability. Alternative energy sources, land management, reducing, reusing and recycling programs, and waste management are all ways to conserve our natural resources.

Assessment Clarifications

1. Changes that humans make to their environment can have helpful or harmful effects.
2. Harmful effects include garbage, habitat destruction, poor use of resources, and pollution.
3. Helpful effects include land management and the management of non-renewable and renewable resources (reduce, reuse, recycle, renew).

Standard: Solid Earth

Content Statement – E.SE.E.1

Earth Materials – Earth materials that occur in nature include rocks, minerals, soils, water, and the gases of the atmosphere. Earth materials have properties that sustain plant and animal life.

Content Expectations

E.SE.03.13 Recognize and describe different types of earth materials (mineral, rock, clay, boulder, gravel, sand, soil).

Instructional Clarifications

1. Recognize is to identify or perceive minerals, rock, clay, boulders, gravel, sand and soil as different types of earth materials.
2. Describe means to tell or depict in spoken or written word the properties of different earth materials.
3. Earth materials are naturally occurring materials taken from the earth such as minerals, rocks, clay, boulders, gravel, sand and soil.
4. The solid material of the Earth's crust is rock.
5. Natural processes break down the Earth's crust, which form earth materials.
6. Most rocks are made of two or more minerals. Rocks are classified based on how they were formed: igneous, metamorphic, and sedimentary.
7. Minerals are naturally occurring inorganic substances. Inorganic means that they are made up of things that are not alive. Diamonds (carbon) are considered to be a mineral but originate from organic materials. Some minerals consist of only one element, but most are compounds. They are identified based on their physical properties such as hardness, color, and density. It is difficult for third grade students to distinguish between rocks and minerals. They need to know that rocks are made up of two or more minerals.
8. Rocks can be broken by weathering and breakage. Most of the Earth's surface is covered with broken rock materials that include boulders, sand, gravel, silt and clay. Rocks sizes vary from boulders to gravel to soil to sand to clay.
9. Clay is a naturally occurring material composed mostly of fine-grained minerals. When dried or fired, it becomes hardened.
10. Soil makes up the outermost layer of the Earth's surface. Soil is a combination of organic materials (living and dead organisms), and minerals/rocks of differing sizes and nutrients. The different sized materials (sand, silt and clay) give soil texture.
11. Based on their composition, soils have different properties such as color, texture, particle size and ability to hold water.
12. A common misconception is that rocks and minerals are the same thing.
13. A common misconception is that soil has always been in its present form.

14. A common misconception is that dirt and soil are different.
15. A common misconception is that soil is broken down rocks.
16. A common misconception is that sand is only made from broken down rocks.

Assessment Clarifications

1. Earth materials are naturally occurring materials taken from the Earth such as minerals, rocks, clay, boulders, gravel, sand and soil.
2. Rocks and minerals are solid materials that make up the Earth.
3. Most rocks are made of two or more minerals.
4. Rocks can be many different sizes such as boulders, gravel and sand.
5. Clay is a naturally occurring material. When dried or fired, it becomes hardened and used to make bricks.
6. Soil makes up the outermost layer of the Earth's surface. Soil is a combination of dead plants and animals; minerals; different sized rock materials (sand, silt, clay); and nutrients.
7. Based on their composition, soils have different properties such as color, texture, and particle size.

E.SE.03.14 Recognize that rocks are made up of minerals.

Instructional Clarifications

1. Recognize is to identify or perceive that rocks are made of minerals.
2. Minerals are made of one or more element, neatly stacked together to form crystals. A mineral is inorganic, is naturally occurring, has a chemical composition, and has a crystalline structure.
3. Rocks are made of two or more minerals. Minerals give color, hardness and sparkle to rocks.
4. A common misconception is that rocks and minerals are the same thing.

Assessment Clarifications

1. Minerals are natural solid substances found in the Earth's crust.
2. Rocks are made of two or more minerals. Minerals give color, hardness and sparkle to rocks.

Content Statement – E. SE.E.2

Surface Changes – The surface of the Earth changes. Some changes are due to slow processes, such as erosion and weathering, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.

Content Expectation

E.SE.03.22 Identify and describe natural causes of change in the Earth's surface (erosion, glaciers, volcanoes, landslides, and earthquakes).

Instructional Clarifications

1. Identify means to recognize natural causes of change in the Earth's surface.
2. Describe means to tell or depict in spoken or written word the changes in the Earth's surface.
3. There are many changes that occur on the Earth's surface or crust. Some happen rapidly and some take millions of years.
4. Weathering is the breaking of rocks. Erosion is the movement of weathered material.
5. Erosion is the wearing away of the Earth's surface by wind, water, ice, or other geologic processes. Water is the most powerful agent of erosion, which is the movement of weathered rocks and soil. Erosion is sometimes a slow process that is difficult to see because it happens over thousands of years (Grand Canyon). Erosion may also be seen as a rapid process as when rainwater runs down a slope.
6. Glaciers are moving masses of ice and snow that change the land. When glaciers move they carry trees, soil, rock along causing erosion. When glaciers melt, they leave behind soil and rock. Glaciers are an example of a slow process. The State of Michigan is an excellent example of glacial movement.
7. A volcano is an opening in the Earth's surface through which lava and other materials (rock fragments, gases, ash) erupt. Volcanoes are associated with the movement of tectonic plates. As plates move and make contact, magma (melted rock) forms, rises to the surface and erupts through weak areas in the Earth's surface. Magma that has reached the Earth's surface is called lava. Volcanic ash is full of nutrients and enriches the soil. Volcanoes are an example of a rapid process.
8. Landslides are the movement of a mass of rock, soil or debris down a slope. It can start with an earthquake, volcano, rainfall, or a man-made activity. Landslides are an example of a rapid process.
9. Earthquakes are one of the most destructive natural events. Earthquakes occur when two tectonic plates slip and release the tension or energy between them. Scientists believe that there are certain areas on Earth that are more likely to experience earthquakes but they can happen anywhere. Earthquakes cause the Earth's surface to tremble and shake, which causes a little or a lot of destruction. It is a very rapid process.
10. A common misconception is that mountains are created rapidly.
11. A common misconception is that glaciers do not move.
12. A common misconception is that volcanoes do not help the Earth.

Assessment Clarifications

1. There are many changes that occur on the Earth's surface or crust. Some happen rapidly and some take millions of years.
2. Erosion is the wearing away of the Earth's surface by wind, water, ice. It is also the movement of weathered rocks and soil. Erosion is a slow process (Grand Canyon).
3. Glaciers are moving masses of ice and snow that change the land. The changes made by glaciers are a slow process.

4. A volcano is an opening in the Earth's surface through which lava and other materials erupt. This process happens quickly.
5. Landslides are the movement of a large amount of rock, soil and other materials down a slope. It can start with an earthquake, volcano, rainfall, or a man-made activity. Landslides are an example of a rapid process.
6. Earthquakes are one of the most destructive natural events. Earthquakes cause the Earth's surface to tremble and shake, which causes a lot of destruction. It is a very rapid process.

Content Statement – E.SE.E.3

Using Earth materials– Some earth materials have properties that make them useful either in their present form or designed and modified to solve human problems. They can enhance the quality of life as in the case of materials used for building or fuels used for heating and transportation.

Content Expectations

E.SE.03.31 Identify earth materials used to construct some common objects (bricks, buildings, roads, glass).

Instructional Clarifications

1. Identify means to recognize the earth materials used to construct some common objects.
2. Earth materials are naturally occurring materials taken from the Earth's crust.
3. Some earth materials have properties that make them useful in building or construction.
4. Bricks are made from a variety of earth materials including clay and rock (shale).
5. Earth materials (rock and sand) are used in building construction.
6. Sand, rock (limestone) and petroleum are used in road construction (concrete and asphalt).
7. Sand and limestone are used to make glass and glass products.

Assessment Clarifications

1. Bricks are made from a variety of earth materials including clay and rock.
2. Earth materials such as rock and sand are used in building construction.
3. Sand and rock are used in road constructions (concrete and asphalt).
4. Sand is used to make glass and glass products.

E.SE.03.32 Describe how materials taken from the Earth can be used as fuels for heating and transportation.

Instructional Clarifications

1. Describe means to tell or depict in spoken or written word how materials taken from the Earth are used as fuels for heating and transportation.

2. A fuel is any material that can burn.
3. Fossil fuels or fuels taken from the Earth include crude oil, natural gas and coal. A fossil fuel contains the remnants of plants and animals, forms over millions of years, and can be burned to release energy.
4. Oil is formed within the Earth's crust from the remains of organisms that lived millions of years ago. It is contained in porous, sedimentary rock along with water and natural gas. Machines must drill down through the rock to reach the oil.
5. Crude oil can be separated and processed into different fuels at refineries for automobiles, airplanes, heating homes, and construction.
6. Coal is a fossil fuel that was formed millions of years ago. As plants in swampy areas died, they formed peat. The peat became buried under the Earth's surface and through heat and pressure it changed into coal. Coal is used to produce electricity and as a heating fuel for homes.
7. Natural gas is a mixture of flammable gases, mostly methane and ethane. Natural gas usually occurs beneath the surface of the Earth in the same area as petroleum (oil). Natural gas is processed to make it more useful as a fuel for heating or generating electricity.
8. The movement toward alternative fuels is increasing because of concern about what to use for energy when there are no longer any fossil fuels or they are too expensive.
9. A common misconception is that humans will never run out of natural fuels.
10. A common misconception is that fuels are manufactured.

Assessment Clarifications

1. Fuels taken from the Earth include oil, natural gas and coal.
2. The different fuels are used for transportation (automobiles, trains, airplanes), heating and cooling buildings, and construction.

**Inquiry Process, Inquiry Analysis and Communication,
Reflection and Social Implications**

Inquiry Process
S.IP.03.11 Make purposeful observations of earth materials to describe them in terms of color, particle, size, texture, and ability to hold water.
S.IP.03.11 Make purposeful observations of rocks and minerals to determine that rocks are made up of minerals.
S.IP.03.12 Generate questions based on observations of earth materials.
S.IP.03.13 Plan and conduct simple and fair investigations to determine the ability of earth materials to hold water.
S.IP.03.14 Manipulate simple tools that aid observation and data collection (hand lens, balance, scale, graduated cylinder, stop watch/timer).
S.IP.03.15 Make accurate measurements with appropriate units (grams, centimeters, milliliters, minutes, seconds) for the measuring tool.
S.IP.03.16 Construct simple charts and graphs from data and observations generated in Earth material investigation.
Inquiry Analysis and Communication
S.IA.03.11 Summarize information from charts and graphs to determine the ability of a variety of earth materials to hold water.
S.IA.03.12 Share ideas about earth materials through purposeful conversation in collaborative groups.
S.IA.03.13 Communicate and present findings of observations and investigations into earth materials.
S.IA.03.14 Develop research strategies and skills for information gathering to find out about a variety of earth materials that are used to construct common items and used as fuels for heating and transportation.
S.IA.03.15 Compare and contrast sets of data from multiple trials of the earth material investigation to explain reasons for differences.
Reflection and Social Implications
S.RS.03.11 Use data/samples as evidence to separate fact from opinion regarding the ability of different earth materials to hold water.
S.RS.03.12 Use evidence when communicating findings from earth material investigations.
S.RS.03.13 Demonstrate how earth materials are used to construct some common objects and are taken from the Earth as fuels for heating and transportation through illustrations and models.
S.RS.03.14 Identify technology used to find and remove earth materials to be used for building and fuel.
S.RS.03.16 Describe the effect humans have on the balance of the natural world through the used of earth materials.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
boulder Earth materials rock clay sand gravel soil soil texture soil color water wind ice helpful change changes in the Earth’s surface harmful change earthquake erosion landslide glacier metal mineral oil recycle reduce reuse renewal rock breakage volcanic eruptions weathered rock weathering natural resources renewable resources non-renewable resources metals fuels freshwater forests natural environment constructed environment garbage habitat destruction land management crude oil natural gas coal	habitat pollution rock cycle fossil fuels sustainability farmland solid rock Earth materials’ ability to hold water crude oil natural gas coal nutrients particle size

Instruments, Measurements, Representations

Measurement	Instruments	Representation
weight	scale	ounces, pounds
mass*	balance	grams
time	stop watch, timer, clock with a second hand	seconds, minutes, hours
volume	graduated cylinder	milliliters
<p>Observation Tools: hand lens</p>		
<p>Representations in Charts, Tables, and Graphs With teacher assistance, third grade students label and enter information into a data table that represents multiple trials. Third grade students use the median number for graphing. With teacher direction, and the use of information from a data table, students construct a simple bar graph that includes appropriate labels (clear title, axis labels, unit labels, scales or standard interval counting beginning at zero). Third grade students are expected to read and interpret both horizontal and vertical bar graphs.</p>		

*To be instructed in fourth grade.

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Earth Systems

Natural Resources: E.ES.03.41, E.ES.03.42, E.ES.03.43, E.ES.03.44

Human Impact: E.ES.03.51, E.ES.03.52

Objectives

- Understand that the Earth's natural resources are renewable and non-renewable.
- Describe how humans can protect, extend and restore natural resources through recycling and renewal programs, by reusing materials and reducing the amount of resources used.
- Relate how humans are dependent on and affect their natural and constructed environments.

Engage and Explore

- Invite students to look around and identify different materials they see in the classroom. Create a list on the board that includes items such as wood, metal, paper, glass, cotton, wool, cloth, leather, plastic, rubber, etc. Working in small groups, challenge students to classify the materials into two groups: items found in nature or man-made (manufactured). Create a class list for future use. (S.IA.03.12)
- Within collaborative groups, students review the lists of previously classified objects: *Items Found in Nature* or *Man-made or Manufactured*. Based on their discussions, students modify the list.
- Have students research the man-made products to discover that man-made materials are made from natural materials on Earth (plastics from petroleum, glass from sand, and ceramics from minerals).

- Introduce students to the term *natural resource* to describe materials from the Earth that are useful to people. After students identify the earth material or natural resource found in each of the classroom items, challenge them to classify the natural resources into items that are *renewable* and *non-renewable*. Which items can be grown again or replaced by nature? Which items cannot be replaced or take many years to replace? Are there natural resources missing from the lists?
- In groups, students research renewable and non-renewable resources and organize findings into a chart or other graphic organizer to share with the class. (E.ES.03.41, E.ES.03.42, S.IA.03.12, S.IA.03.13)

Explain and Define

- Groups share their charts/graphic organizers of renewable and non-renewable resources with the class. (E.ES.03.42, S.IA.03.11, S.IA.03.12)
- Create a class definition of the terms *natural resource*, *earth material*, *renewable resource*, *non-renewable resource*. (E.ES.03.41, E.ES.03.42)

Elaborate and Apply

- Extend student understanding of renewable and non-renewable resources by exploring how humans protect, extend, and restore natural resources within the school, homes, and the community. Students create a survey on practices to protect, extend and restore natural resources to be completed as a class, within the school, at home. (E.ES.03.43, S.IS.03.14)
- Pull out clean, discarded objects (paper, cardboard, milk containers, plastic containers and bags, etc.) from a trash bag to sort into recyclable, reusable, renewable or reducible categories. (E.ES.03.43, E.ES.03.44)
- Elaborate on student understanding by engaging them in activities such as building a mini-landfill, creating a classroom recycling program, creating art from junk, etc. (E.ES.03.43)
- Challenge students to reduce, reuse and recycle in the classroom (using half sheets of paper, using wooden rather than plastic pencils, using reusable lunch bags and drink containers [no plastic bottles], using paper rather than Styrofoam plates in the cafeteria, etc.) and keep a classroom record of ideas, activities, and solutions to share with other classrooms. (E.ES.03.43, E.ES.03.44, S.IA.03.12)
- Divide students into four groups. Provide each group with a topic: forests, clean water, clean air, and earth materials. Research human dependence on the natural environment and resources. Develop a game, chart, or other performance to share findings. (E.ES.03.51, S.IA.03.13)
- Elaborate further by defining the term, *constructed environment*. Create a list of constructed environments (homes, neighborhoods, shopping malls, factories, and industry). Divide the class into groups to explore human dependence on constructed environments. In groups, create a chart that describes the natural resources (renewable and non-renewable) used in a constructed environment and how human (animal, plant) needs are met

within each environment. Students create an imaginary environment designed to meet all human needs, i.e., build a house, create a town, draw a factory, etc. (E.ES.03.51, S.IA.03.12)

Evaluate Student Understanding

Formative Assessment Examples

- Classify lists of classroom items into two groups: items found in nature and man-made items. (E.ES.03.41)
- Classify and graphically organize natural resources into renewable and non-renewable. (E.ES.03.42)
- Create and conduct surveys of individual, class, school, and home activities to protect, extend, and restore natural resources. Use the information to make suggestions and recommendations for more responsible practices. (E.ES.03.43)
- Develop a program to reduce, reuse, and recycle natural resources in the classroom. (E.ES.03.44)
- Develop a game or chart that depicts human dependence on the natural environment. (E.ES.03.51)

Summative Assessment Examples

- Define and illustrate the terms natural resource, renewable resource, non-renewable resource, recycle, reuse, reduce, renewal, habitat destruction, land management. (E.ES.03.41, E.ES.03.43, E.ES.03.52)
- In a paper grocery bag, each student collects his/her individual "clean" trash for a specified number of days. Students examine the trash and divide it into categories: reduce, reuse, recycle, renew, other. Students identify and graphically display ways to reduce the amount of trash produced and improve their impact on the environment. (E.ES.03.43)
- Design a doghouse that uses all renewable materials. (E.ES.03.42)
- Using the topics: land management, clean air, clean water, garbage, renewable resources, non-renewable resources create a conservation law that protects, extends or restores resources. (E.ES.03.41, E.ES.03.42, E.ES.03.43, E.ES.03.44, E.ES.03.52, E.ES.03.53)

Enrichment

- Write letters to the principal, city manager, or mayor explaining the importance of improving the current recycling program.
- Create books to teach younger students about protecting, extending and restoring natural resources.
- Create issue/solution cards. Place a title on 3x5 cards with helpful or harmful effects of humans on the environment (garbage, waste management, habitat destruction, land management, renewable resources, non-renewable resources, etc.). Give each student a card. On the cards, students describe ways they are individually directly or indirectly involved in the topic. On the reverse, students describe solutions or ways that they can enhance or improve their relationship with the environment. As a class, students create class lists/charts defining the positive and negative effects humans have on the environment with solutions/improvements for each.

Intervention

- Conduct a home study project regarding ways to reduce energy use and the use of natural resources.
- Identify and draw a diagram of natural resources found and used in the classroom. For each natural resource, identify one way to reduce its use.
- Read books such as *The Three R's: Reduce, Reuse, Recycle* by Nuria Roca and Rosa Curto, 2007, and discuss ways that an individual can make a difference.
- Take a field trip to a recycling center.

Examples, Observations, and Phenomena (Real World Contexts)

This unit lends itself to real world contexts because of the importance of conserving, appreciating, and protecting our natural resources. Energy conservation is in the media on a daily basis. Newspaper and magazine articles regarding positive and negative conservation practices are real world sources for what is happening to the natural resources and climate on Earth.

Classification and measurement are everyday skills. Classification of earth materials as natural and man-made; renewable and non-renewable; recyclable and non-recyclable is useful classification for environmental awareness. As students explore earth materials they are discovering the importance of conserving natural resources at home, at school, in the community and globally. They examine their personal practices of recycling, reusing, and reducing natural resources in the paper they use, water consumption, energy use, recycling, avoiding the use of plastics, and reusing products. Students discover that natural resources are contained in all products: clothing, bicycles, toys, computers, games, sporting equipment, etc.

Literacy Integration

Reading

R.CM.03.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.03.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about natural resources:

How the Earth Works by Michelle O'Brien Palmer, 2002

Planet Earth/Inside Out by Gail Gibbons, 1998

50 Simple Things Kids Can Do To Save the Earth by The Earthworks Group, 1990

Don't Know Much About Planet Earth by Kenneth Davis and Tom Bloom, 2001

The Three R's: Reduce, Reuse, Recycle by Nuria Roca and Rosa Curto, 2007

Writing

W.GN.03.03 Write an informational piece including a report that demonstrates the understanding of central ideas and supporting details using an effective organizational pattern (i.e., compare/contrast, cause/effect, problem/solution) with a title, heading, subheading, and a table of contents.

- Write an informational piece that demonstrates understanding of natural resources with supporting details comparing and contrasting renewable and non-renewable resources.

W.GN.03.04 use the writing process to produce and present a research project, initiate research questions from content area text from a teacher-selected topic; and use a variety of resources to gather and organize information.

Speaking

S.CN.03.03 speak effectively emphasizing key words and varied pace for effect in narrative and informational presentations.

S.DS.03.04 plan and deliver presentations using an effective information organizational pattern (e.g., descriptive, problem/solution, cause/effect); supportive facts and details reflecting a variety of resources; and varying the pace for effect.

Listening

L.CN.03.01 ask substantive questions of the speaker that will provide additional elaboration and details.

Instructional Framework

Instructional Examples

Solid Earth

Earth Materials: E.SE.03.13, E.SE.03.14

Surface Changes: E.SE.03.22

Using Earth Materials: E.SE.03.31, E.SE.03.32

Objectives

- The surface of the Earth changes through slow and rapid processes.
- Earth materials have properties that make them useful.
- Earth materials are used in common objects and for fuels in heating/cooling and transportation.

Engage and Explore

- Engage students in an outdoor Earth exploration. Give each student a clipboard and a reusable container to collect observations and examples of earth materials observed and found on the playground. This should be an “unguided” activity in which students share ideas among themselves rather than receiving direction from the teacher. Students draw and describe findings and locations of earth materials on the playground. Students collect small samples of earth materials such as soil, pebbles, sand, rocks, etc. (no plants or animals). (E.SE.03.13, S.IA.03.12)
- Working in small, collaborative groups, students sort the earth materials (rocks, sand, soil, clay, pebbles, etc.) into student-selected groups. As students observe the materials, encourage them to write questions or ideas to explore during the unit. (E.SE.03.13, S.IP.03.11, S.IP.03.12)

Note: The teacher should supplement the earth materials students found on the playground so that each student group has an adequate sample of minerals, rocks, clay, gravel, sand, and soil.

- Using a hand lens, scale or balance, and ruler, students explore and record observations of the different earth materials found on the playground or provided by the teacher. Within groups, then as a class, determine categories or classifications for each earth material. Student observations should be recorded in drawings and written descriptions. Create a chart to record findings. (E.SE.03.13, E.SE.03.14, S.IP.03.11, S.IP.03.14, S.IP.03.15, S.IP.03.16, S.IA.03.12)

EARTH MATERIALS							
	Minerals	Rocks	Pebbles	Sand	Soil	Clay	Drawing
Color							
Texture							
Particle Size							
Ability to hold water							

- Give each student a rock. Using a hand lens, examine each rock carefully. Compare with other rocks within their group. What are the similarities and differences? Within their group, discuss properties and add to the Earth Materials chart. Put the rocks in water. Observe changes in color. Discuss the color of the rocks (One color? More than one color?) And texture (smooth, rough, grainy). (E.SE.03.13, E.SE.03.14, S.IP.03.14)
- Give each student a sample of a mineral. Using a similar format as their rock discovery, students will describe the color and texture of their minerals. (E.SE.03.14)
- Within groups, students will describe the similarities and differences between the rocks and minerals. Conclude that minerals appear to have one color and texture while rocks appear to be made from different colors and textures. Groups of students will develop a definition of rocks and minerals. (E.SE.03.13, E.SE.03.14, S.IP.03.14)
- Give students samples of pebbles, clay, soil, and sand. Using a hand lens, encourage students to make observations of color, texture and particle size of each sample and record findings on their chart. Place drops of water on each sample and observe. Place a small amount of each sample on the surface of a glass of water and observe the interaction of the Earth material and the water. Record findings on their charts or in a student journal. In groups, describe the similarities and differences of each. (E.SE.03.13, E.SE.03.14, S.IP.03.11, S.IP.03.16)
- Explore the ability of earth materials to hold water by conducting a simple investigation. While working in collaborative groups, challenge students to find out: Are all earth materials able to hold the same amount of water? Students design and conduct a simple and fair investigation. Using hand lenses, balances, scales, graduated cylinders, and timers; students make accurate measurements of the weight and volume of water before and after it is filtered through the various earth materials. They collect and summarize their data and observations on simple bar graphs or charts. (E.SE.03.13, S.IP.03.11, S.IP.03.12, S.IP.03.13, S.IP.03.14, S.IP.03.15, S.IA.03.11, S.IA.03.12, S.RS.03.11)

- In collaborative groups, students share evidence from their charts, graphs and communicate findings regarding the ability of various earth materials to hold water. (S.IA.03.13, S.IA.03.15, S.RS.03.11, S.RS.03.12)

Explain and Define

- Students communicate and present their findings to complete the Earth Materials chart. (E.SE.03.13, S.IA.03.11, S.IA.03.15, S.RS.03.12)
- Classroom definitions based on color, texture, particle size, and ability to hold water will be developed for minerals, rocks, boulders, pebbles, sand, and soil. (E.SE.03.13)

Elaborate and Apply

- Elaborate on earth materials by challenging students to identify and demonstrate how they are used in common objects and purposes. Through research and interviews, students explore and discover the use of earth materials in construction, road building, fuels, heating, and transportation. As students gather ideas and information from research, discussions, and interviews, they complete a flip chart, step book or other graphic organizer to display information that includes 1. Purpose 2. Earth Material 3. Source 4. Renewable? Non-Renewable. (E.SE.03.31, S.IA.03.14)
- Challenge the students with the question: Have the Earth and earth materials stayed the same throughout our history? Using maps and globes, students collaborate to identify processes that cause changes in the Earth's surface. Students explore erosion as a slow change and glaciers, volcanoes, landslides and earthquakes as rapid changes. Students create a graphic organizer to record information and findings from research. (E.SE.03.22)
- Demonstrate the effects of erosion by pouring or sprinkling water on a sandy slope and a grass slope. Using a fan to blow air across the slopes demonstrates wind erosion. Record observations in a graphic organizer. (E.SE.03.22)
- Create a glacier using a scoop of ice cream, waxed paper and chocolate sandwich cookies. Allow the ice cream to move across a piece of waxed paper lined with crushed chocolate sandwich cookies. Discuss the effect of the movement of the glacier. What happened to the ice cream, waxed paper, and cookie? How is this similar to and different than a real glacier? (E.SE.03.22)
- Visit the FEMA for Kids website to learn about volcanoes. (Note: The baking soda and vinegar activity is a poor model of a volcano.) (E.SE.03.22)
- Landslides can be modeled using the earth materials. (E.SE.03.22)
- Students explore earthquakes by pushing hands together. Slowly begin to slide one hand across the other. The burst of energy when the two hands separate is an example of the energy burst in earthquakes. Students can research recent earthquakes. (E.SE.03.22)

- Recall the classroom earth materials search that was used to engage the students at the beginning of the unit. Review the earth materials that students identified in the classroom. Conduct an earth materials search outside the school building. As students walk around the school building, they record materials used in construction. Divide students into groups to investigate the composition of construction materials. Create a class chart of earth materials used in construction. (E.SE.03.31)
- Provide newspaper articles, magazine ads, or commercial clips to demonstrate the current trends in fuel costs and availability. Students share ideas related to fuels. Where do fuels come from? What is a fossil fuel? How do they get into our homes? The gas station? Do we all use the same kinds of fuels? What is alternative energy? How can we use alternative energy at home? At school? (E.SE.03.32)
- Students select a fuel to investigate and create a display, illustration or model to share information on the source, method to extract fuel from the Earth, impact on environment, alternative solutions, and the importance of conserving earth materials. (E.SE.03.32, E.SE.03.13, E.SE.03.14)

Evaluate Student Understanding

Formative Assessment Examples

- Create a chart of earth materials' observations. (E.SE.03.13)
- Summarize findings from an earth materials investigation on charts and graphs. (E.SE.03.13, E.SE.03.14)
- Create a flipbook to record research findings on earth materials used in common objects and purposes. (E.SE.03.31, E.SE.03.32)
- Write thank you letters to companies for their green practices and products. (E.SE.03.31)
- Share information from research on fuels and alternative energy sources. (E.SE.03.32)

Summative Assessment Examples

- Create a poster, demonstration, book or other product that explores a boulder as it breaks down and turns into soil. (E.SE.03.13, E.SE.03.14)
- Create a display that illustrates the slow and rapid changes in the Earth's surface. (E.SE.03.22)
- Design a green building using renewable earth materials in the construction and alternative fuels for heating and cooling. (E.SE.03.31, E.SE.03.32)

Enrichment

- Investigate the growth of seeds in soil, clay, and sand. Create a potting soil based on findings.
- Assign groups of students to research construction materials (glass, lumber, bricks, asphalt, concrete, etc) and associated manufacturers/companies. Investigate current “green” practices that companies use to protect, extend and restore resources. Write thank you letters to the companies, thanking them for their efforts to protect the environment.
- Divide students into groups to investigate fuels used for transportation (gasoline, diesel fuel, jet fuel, other) and fuels used for heating/cooling (natural gas, propane, oil, coal, other). Students investigate the source, the projected supply, and the environmental impact. What will make the demand for fossil fuels greater in the future? What could change the projections?
- Investigate alternate energy sources. Design a mode of transportation that uses an alternative energy source and renewable resources in its construction.
- Investigate geothermal energy as an alternate for fuels for heating and cooling. How does geothermal energy relate to volcanoes and other earth processes?

Intervention

- Collect various earth materials from the schoolyard and backyard. Identify the material. Investigate how the materials can be used in common objects.
- Create a rock, mineral, or earth material collection. Encourage students to collect samples while on vacation or while visiting other locations. Discover the similarities and differences of the collected samples.
- Investigate different kinds of sand from various beaches. Use a magnifying lens to observe the similarities and differences. Explore the samples with a magnet (students may find magnetite or micro-meteorites). Discuss findings.
- Investigate different soils from areas in the schoolyard or ask students to bring samples from home. Discuss reasons for the similarities and differences. Using a magnifying lens, divide soil into its various components.
- As a class, design and conduct an investigation that explores a student-developed question on earth materials.
- Read selected informational texts on topics such as natural resources, Earth’s surface changes, protecting Earth resources.
- Invite a construction engineer or builder to speak to the students about building homes and the materials used in construction. Emphasize natural resources, green building practices, and alternative energy sources.

Examples, Observations and Phenomena (Real World Contexts)

This unit lends itself to real world contexts because of the importance of conserving, appreciating, and protecting our natural resources. The real world application is evident in the media with reference to shortages of resources, pollution, forest fires, habitat destruction, climate change, and extinction of organisms.

Classification and measurement are everyday skills. Students classify and examine materials to identify properties. As students explore earth materials they are discovering the importance of earth materials in common objects. As they discover that natural resources are used in all products, their appreciation of conserving natural resources at home, at school, in the community and globally is reinforced.

Rock and mineral collections are high interest for young learners. The study of the make-up of rocks and minerals and how they are formed and found sparks an interest in the make-up of the surface of the Earth. Students are familiar with the clearing of land for building of homes, shops, malls, etc., yet may not be aware of the earth materials that are removed and discarded to make way for the development of properties. Changes in the surface of the Earth are not all due to natural occurrences. Many are due to activities of humans.

The news media and magazines are excellent sources of information regarding recent occurrences of earth changes. Volcanoes, earthquakes, landslides are evidence that the Earth is dynamic. Erosion and other Earth changes are apparent as students travel across the country and within their own towns. Large examples include the Rocky Mountains, Grand Canyon, Appalachian Mountains, Niagara Falls, Sedona, Arizona, the Bad Lands, etc. Local examples of earth changes include river valleys, moraines, hills, valleys, etc.

Students discover the importance of alternate fuels (wind, solar, biofuel energy) as they investigate the non-renewable energy sources currently used for transportation (oil, natural gas, coal). The current energy crisis is evidence of the need for alternate energy.

Literacy Integration

Reading

R.CM.03.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.03.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about natural resources:

How the Earth Works by Michelle O'Brien Palmer, 2002

Planet Earth/Inside Out by Gail Gibbons, 1998

Don't Know Much About Planet Earth by Kenneth Davis and Tom Bloom, 2001

Writing

W.GN.03.03 write an informational piece including a report that demonstrates the understanding of central ideas and supporting details using an effective organizational pattern (i.e., compare/contrast, cause/effect, problem/solution) with a title, heading, subheading, and a table of contents.

- Write an informational piece that demonstrates understanding of natural resources with supporting details comparing and contrasting renewable and non-renewable resources.

W.GN.03.04 use the writing process to produce and present a research project; initiate research questions from content area text from a teacher-selected topic; and use a variety of resources to gather and organize information.

- Use the writing process to prepare and present information on the ability of earth materials to hold water, beginning with a research question and using a variety of resources including evidence from investigations to organize information.

Speaking

S.CN.03.03 speak effectively emphasizing key words and varied pace for effect in narrative and informational presentations.

S.DS.03.04 plan and deliver presentations using an effective information organizational pattern (e.g., descriptive, problem/solution, cause/effect); supportive facts and details reflecting a variety of resources; and varying the pace for effect.

Listening

L.CN.03.01 ask substantive questions of the speaker that will provide additional elaboration and details.

Mathematics Integration

Measurement

M.UN.03.01 Know and use common units of measurements in length, weight and time.

M.UN.03.02 Measure in mixed units within the same measurement system for length, weight, and time: feet and inches, meters and centimeters, kilograms and grams, pounds and ounces, liters and milliliters, hours and minutes, minutes and seconds, years and months.

- Know and use common units of measurement in weight and volume when conducting simple investigations.
- Measure in mixed units with the same measurement system in weight (kilograms, grams) or volume (liters, milliliters).

Data and Probability

D.RE.03.01 Read and interpret bar graphs in both horizontal and vertical forms.

D.RE.03.02 Read scales on the axis and identify the maximum, minimum and range of values in a bar graph.

D.RE.03.03 Solve problems using information in bar graphs, including comparison of bar graphs.

- Create, read and interpret bar graphs in both vertical and horizontal forms when recording data from an investigation.
- Create and read scales and axis and identify the maximum, minimum, and range of values on a bar graph.
- Solve problems and interpret evidence, using information in bar graphs, including comparison of bar graphs.

Fourth Grade Science Content Expectations Companion Document

SCIENCE

- Unit 1: Heat, Electricity, and Magnetism
 - Unit 2: Properties and Changes of Matter
 - Unit 3: Relationships and Requirements of Living Things
 - Unit 4: Sun, Moon, and Earth
-
- Big Ideas
 - Clarifications
 - Inquiry
 - Vocabulary
 - Instruments
 - Measurements
 - Instructional Framework
 - Enrichment
 - Intervention
 - Real World Context
 - Literacy Integration
 - Mathematics Integration



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Introduction to the K-7 Companion Document An Instructional Framework

Overview

The Michigan K-7 Grade Level Content Expectations for Science establish what every student is expected to know and be able to do by the end of Grade Seven as mandated by the legislation in the State of Michigan. The Science Content Expectations Documents have raised the bar for our students, teachers and educational systems.

In an effort to support these standards and help our elementary and middle school teachers develop rigorous and relevant curricula to assist students in mastery, the Michigan Science Leadership Academy, in collaboration with the Michigan Mathematics and Science Center Network and the Michigan Science Teachers Association, worked in partnership with Michigan Department of Education to develop these companion documents. Our goal is for each student to master the science content expectations as outlined in each grade level of the K-7 Grade Level Content Expectations.

This instructional framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings and expanding thinking beyond the classroom.

These companion documents are an effort to clarify and support the K-7 Science Content Expectations. Each grade level has been organized into four teachable units- organized around the big ideas and conceptual themes in earth, life and physical science. The document is similar in format to the Science Assessment and Item Specifications for the 2009 National Assessment for Education Progress (NAEP). The companion documents are intended to provide boundaries to the content expectations. These boundaries are presented as “notes to teachers”, not comprehensive descriptions of the full range of science content; they do not stand alone, but rather, work in conjunction with the content expectations. The boundaries use seven categories of parameters:

- a. **Clarifications** refer to the restatement of the “key idea” or specific intent or elaboration of the content statements. They are not intended to denote a sense of content priority. The clarifications guide assessment.
- b. **Vocabulary** refers to the vocabulary for use and application of the science topics and principles that appear in the content statements and expectations. The terms in this section along with those presented

within the standard, content statement and content expectation comprise the assessable vocabulary.

- c. **Instruments, Measurements and Representations** refer to the instruments students are expected to use and the level of precision expected to measure, classify and interpret phenomena or measurement. This section contains assessable information.
- d. **Inquiry Instructional Examples** presented to assist the student in becoming engaged in the study of science through their natural curiosity in the subject matter that is of high interest. Students explore and begin to form ideas and try to make sense of the world around them. Students are guided in the process of scientific inquiry through purposeful observations, investigations and demonstrating understanding through a variety of experiences. Students observe, classify, predict, measure and identify and control variables while doing “hands-on” activities.
- e. **Assessment Examples** are presented to help clarify how the teacher can conduct formative assessments in the classroom to assess student progress and understanding
- f. **Enrichment and Intervention** is instructional examples that stretch the thinking beyond the instructional examples and provides ideas for reinforcement of challenging concepts.
- g. **Examples, Observations, Phenomena** are included as exemplars of different modes of instruction appropriate to the unit in which they are listed. These examples include reflection, a link to real world application, and elaboration beyond the classroom. These examples are intended for instructional guidance only and are not assessable.
- h. **Curricular Connections and Integrations** are offered to assist the teacher and curriculum administrator in aligning the science curriculum with other areas of the school curriculum. Ideas are presented that will assist the classroom instructor in making appropriate connections of science with other aspects of the total curriculum.

This Instructional Framework is NOT a step-by-step instructional manual but a guide developed to help teachers and curriculum developers design their own lesson plans, select useful portions of text, and create assessments that are aligned with the grade level science curriculum for the State of Michigan. It is not intended to be a curriculum, but ideas and suggestions for generating and implementing high quality K-7 instruction and inquiry activities to assist the classroom teacher in implementing these science content expectations in the classroom.

Fourth Grade GLCE Companion Document

Unit 1: Heat, Electricity, and Magnetism

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

Fourth Grade Companion Document
4-Unit 1: Heat, Electricity, and Magnetism

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Fourth Grade Companion Document

4-Unit 1: Heat, Electricity, and Magnetism

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**Fourth Grade Unit 1:
Heat, Electricity, and Magnetism**

Content Statements and Expectations

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P.PM.04.34	Demonstrate that magnetic objects are affected by the strength of the magnet and the distance from the magnet.	9

Unit 4-1: Heat, Electricity, and Magnetism

Big Ideas (Key Concepts)

- Heat and electricity are forms of energy.
- Evidence of energy is change.
- Electrical circuits demonstrate a transfer of energy.
- Magnetism is a physical property of matter.
- Heat can be transferred from one substance or object to another.

Clarification of Content Expectations

Standard: Energy

Statement – P.EN.E.1

Forms of Energy – Heat, electricity, light, and sound are forms of energy.

Content Expectation

P.EN.04.12 Identify heat and electricity as forms of energy.

Instructional Clarifications

1. Identify means to recognize heat and electricity as forms of energy.
2. Energy is an abstract concept. Fourth graders need only to observe forms of energy and describe what they can do.
3. Electricity can produce light, heat, sound, and magnetic effects.
4. Heat can change temperature, change matter from one state to another, and move from one object to another by conduction.
5. Temperature change is measured by using the thermometer (Celsius and Fahrenheit).
6. A common misconception is that energy is a thing.
7. A common misconception is that heat and temperature mean the same thing.
8. A common misconception is that thermometers measure heat.
9. A common misconception is that all thermometers use the same scale (count by ones or twos).
10. The scale is often misread when reading temperatures that are below zero.
11. A common misconception is that things use up energy.
12. Note: Students identified light and sound as forms of energy in the third grade. At this stage they should identify light, sound, heat, and electricity as forms of energy.

Assessment Clarifications

1. Heat is a form of energy.
2. Electricity is a form of energy.

Statement – P.EN.E.4

Energy and Temperature – Increasing the temperature of any substance requires the addition of energy.

Content Expectations

P.EN.04.41 Demonstrate how temperature can be increased in a substance by adding energy.

Instructional Clarifications

1. Demonstrate is to show through manipulation of materials, drawings, and written and verbal explanations how temperature increases when adding energy.
2. Adding some forms of energy to a substance increases its temperature. This means that the speed of the movement of the molecules within the substance is increased.
3. Heat energy can move from one object to another. It is not necessary for fourth graders to understand how this happens. Rather they need to observe the effects of temperature increasing when energy is added.
4. It is difficult for fourth graders to distinguish between heat and temperature; therefore, investigating heat should just focus on changes in temperature.
5. Adding heat to a substance increases its temperature, and allowing heat to escape (transfer to another substance) decreases its temperature.
6. Temperature is measured in degrees Celsius or degrees Fahrenheit using a thermometer.
7. Fourth graders have multiple experiences reading temperatures on a variety of thermometers with different scales. They discover heat transfer in different substances by observing and reading temperature change.

Assessment Clarifications

1. Adding heat energy to a substance increases its temperature.
2. The temperature of a substance or object is determined using a thermometer and read in degrees Celsius.

P.EN.04.42 Describe heat as the energy produced when substances burn, certain kinds of materials rub against each other, and when electricity flows through wire.

Instructional Clarifications

1. Describe means to tell or depict in spoken or written words how heat is produced.
2. As heat is transferred to an object, the molecules of the object move more rapidly. The motion of the molecules is directly related to the temperature of the object and its state of matter.
3. When a substance burns, heat energy is produced.
3. When two materials rub together (friction), heat energy is produced.
4. When electric current flows through materials, heat energy can be produced.

Assessment Clarifications

1. When a substance burns, heat energy is produced.
2. When two materials rub together (friction), heat energy is produced.
3. When electric current flows through materials, heat energy can be produced.

P.EN.04.43 Describe how heat is produced through electricity, rubbing and burning.

Instructional Clarifications

1. Describe means to tell or depict in spoken or written words how heat is produced through electricity, rubbing and burning.
2. Electric current flows through materials and produces heat. The flow of electrical current meets resistance in the materials and is changed into heat energy. Some materials have greater resistance than others, and produce a greater amount of heat (incandescent light bulb filaments, toaster element, oven and range elements).
3. Friction occurs when one object rubs against another object (two hands rubbing together briskly) and heat is produced.
4. When a substance burns, heat energy is produced through the chemical change in the substance (wood to ash, gases, and smoke).
5. Fourth graders do not need to understand the chemical change that is occurring when substances burn.

Assessment Clarifications

1. Electric current flows through materials and produces heat (light bulb, toaster).
2. Friction occurs when one object rubs against another object (two hands rubbing together briskly) and heat is produced.
3. When a substance burns, heat energy is produced.

Statement – P.EN.E.5

Electrical Circuits – Electrical circuits transfer electrical energy and produce magnetic fields.

Content Expectations

P.EN.04.51 Demonstrate how electrical energy is transferred and changed through the use of a simple circuit.

Instructional Clarifications

1. Demonstrate is to show through manipulation of materials, drawings, and written and verbal explanations how energy is transferred and changed through the use of a simple circuit.
2. The general characteristics of a circuit include a power source (battery or generator), conductor (wire), and a device, which uses electricity (bulb, motor, buzzer, appliance).

3. At this level, students should demonstrate the completion of a simple circuit using batteries, wires, and bulbs accompanied by a diagram using arrows and/or descriptions to show the flow of energy transfer or change.
4. Familiar forms of energy involved in a simple circuit include a battery, which changes chemical energy to electrical energy that is then transferred to a light bulb that changes the electrical energy to light and heat.
5. When the flow of electricity is interrupted, the circuit is not complete. A closed simple circuit is necessary for the transfer of energy.
6. Stored energy in a battery becomes electrical energy, and electrical energy is transferred to heat and light energy when it encounters resistances. (A wire in a light bulb heats up and glows when electricity travels through it.)
7. Observations and demonstrations of energy transfer in an electrical circuit include heating wires, lighting bulbs, ringing bells, and powering small motors.
8. Students recognize that the greater number of batteries will produce a greater amount of energy (If the voltage rating of the bulb is not compatible with total voltage output of the batteries, it will burn out).
9. The observation of a change provides evidence that an energy transfer has taken place.
10. A common misconception is that bulbs store the energy produced by the battery.
11. A common misconception is that if the bulb is far away from the battery, it will be dimmer.

Assessment Clarifications

1. The general characteristics of a circuit include a power source (battery or generator), conductor (wire), and a device, which uses electricity (bulb, motor, buzzer, appliance).
2. Observations of how energy is transferred and changed in an electrical circuit include heating wires, lighting bulbs, ringing bells, and powering small motors.

P.EN.04.52 Demonstrate magnetic effects in a simple electric circuit.

Instructional Clarifications

1. Demonstrate is to show through manipulation of materials, drawings, and written and verbal explanations the magnetic effects in a simple circuit.
2. A wire carrying an electric current creates a weak magnetic field. A magnetic compass will show the effects of the magnetic field.
3. A simple electromagnet has the same general characteristics of a circuit, including a power source (battery or generator), conductor (wire), and a wire wrapped core.
4. An electromagnet is produced by wrapping a wire around a core (nail) and attaching the ends of the wire to a battery.
5. The strength of an electromagnet is increased by wrapping more coils of wire around the nail or increasing the amount of current.

6. An electromagnet is a temporary magnet. The magnetic field usually stops when the current is no longer flowing through the wire.
7. A simple electromagnet provides evidence that electricity flowing through wires produces magnetic effects in the wires.

Assessment Clarification

1. A wire carrying an electric current creates a weak magnetic field. The compass will show the effects of the magnetic field.

Standard: Properties of Matter

Statement – P.PM.E.5

Conductive and Reflective Properties – Objects vary to the extent they absorb and reflect light energy and conduct heat and electricity.

Content Expectation

P.PM.04.53 Identify objects that are good conductors or poor conductors of heat and electricity.

Instructional Clarifications

1. Identify means to recognize good conductors and poor conductors of heat and electricity.
2. An electric charge can flow easily through certain materials. Examples of good conductors of electricity are salt water, copper, aluminum and other metals.
3. An electric charge does not flow easily through certain materials. Examples of poor conductors (insulators) are rubber, cork, wood, cloth, plastic, and air.
4. A good conductor of heat is a material that allows heat to move through it easily. All metals are good conductors of heat (copper, steel, and iron).
5. A poor conductor of heat (insulator) is a material that does not allow heat to move through it easily. Some insulators are wood, paper, wax, and air.
6. Heat can move from one object to another by conduction.

Assessment Clarifications

1. Good conductors of electricity are copper and aluminum.
2. Poor conductors of electricity are rubber, cork, wood, cloth, plastic, and air.
3. All metals are good conductors of heat (copper, steel, and iron).
4. Some poor conductors of heat are wood, paper, wax, and air.

Statement – P.PM.E.3

Magnets – Magnets can repel or attract other magnets.

Magnets can also attract certain magnetic objects at a distance.

Content Expectations

P.PM.04.33 Demonstrate magnetic field by observing the patterns formed with iron filings using a variety of magnets.

Instructional Clarifications

1. Demonstrate is to show through manipulation of materials, drawings, and written and verbal explanations of magnetic field patterns made by iron filings using magnets.
2. Magnetism is the force of attraction or repulsion by magnets as well as the force of attraction between magnets and magnetic materials.
3. When iron filings are sprinkled around a magnet, they demonstrate the shape of the magnetic field. Demonstrations on a flat surface do not fully show the three-dimensional magnetic field.
4. Each end of a magnet is called a magnetic pole. Every magnet has two poles – north and south. The opposite poles will attract and like poles will repel.
5. The magnetic lines of force can be seen between two unlike poles and two like poles.
6. A common misconception is that the size of the magnet determines its strength.
7. A common misconception is that all metals are attracted to magnets.
8. A common misconception is that all silver-colored items are attracted to a magnet.
9. A common misconception is that only magnets can produce magnetic fields.
10. A common misconception is that a magnetic field is a two-dimensional pattern of lines surrounding a magnet, not a three-dimensional field or force.

Assessment Clarifications

1. When iron filings are sprinkled around a magnet, they demonstrate the shape of the magnetic field.
2. The magnetic lines of force can be seen between two unlike poles and two like poles.

P.PM.04.34 Demonstrate that magnetic objects are affected by the strength of the magnet and the distance from the magnet.

Instructional Clarifications

1. Demonstrate means to show through manipulation of materials, drawings, and written and verbal explanations that magnetic objects are affected by the strength and distance from the magnet.
2. Some magnets have a stronger magnetic field than others.

3. The stronger a magnet, the more magnetic objects (paper clips, nails) can be attracted to the magnet.
4. The closer an object is to a magnet the stronger the attraction. The farther a magnetic object is from a magnet the weaker the attraction.

Assessment Clarifications

1. The stronger a magnet, the more magnetic objects (paper clips, nails) can be attracted to the magnet.
2. The closer an object is to a magnet the stronger the attraction. The farther a magnetic object is from a magnet the weaker the attraction.

Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implications
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Inquiry Processes
S.IP.04.11 Make purposeful observations of heat, electricity and magnetism.
S.IP.04.12 Generate questions based on observation of heat, electricity and magnetism.
S.IP.04.13 Plan and conduct simple and fair investigations to compare and contrast heat, electricity and magnetism.
S.IP.04.14 Manipulate simple tools (for example, thermometer, stop watch/timer) to measure temperature.
S.IP.04.15 Make accurate measurements with appropriate units (degrees, Celsius, Fahrenheit, minutes, seconds) in.
S.IP.04.16 Construct simple charts and graphs from data information collected about fuel types.
Inquiry Analysis and Communication
S.IA.04.11 Summarize information from charts and graphs to answer questions about kinds of fuel that are used to heat buildings.
S.IA.04.12 Share ideas about heat, electricity and magnetism through purposeful conversation in collaborative groups.
S.IA.04.13 Communicate and present findings of investigations that describe the strength of magnets and their uses.
S.IA.04.14 Develop research strategies and skills for information gathering and problem solving about heat energy, electricity sources, global climate changes and uses of electromagnets.
S.IA.04.15 Compare and contrast sets of data from multiple trials of an investigation on magnets and their strengths to explain reasons for differences.
Reflection and Social Implications
S.RS.04.11 Demonstrate similarities and differences in uses of heat, electricity and magnetism through various illustrations, performances or activities.
S.RS.04.14 Use data/samples as evidence to separate fact from opinion about electricity and magnetism.
S.RS.04.15 Use evidence when communicating, comparing and contrasting the types of heat uses of electricity and uses of magnetism.
S.RS.04.16 Identify technology used in everyday life to measure temperatures.
S.RS.04.17 Identify current problems about heat and electricity sources that may be solved through the use of technology.
S.RS.04.19 Describe how people such as Michael Faraday, Thomas Edison, and Enrico Fermi have contributed to science throughout history and across cultures.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
heat electricity energy evident temperature thermometer Celsius Fahrenheit increase decrease substance electric current friction simple circuit open circuit closed circuit battery wire bulb power source energy transfer conductor compass magnet magnetic field magnetic poles lines of force iron filings attract repel generator device appliance	conduct conduction resistance electromagnet three dimensional

Instruments, Measurements, Representations

temperature	thermometer	Fahrenheit, Celsius
Students are not required to convert from Fahrenheit to Celsius or Celsius to Fahrenheit. They do need to be able to read a thermometer using either Fahrenheit or Celsius.		
Know benchmark temperatures such as freezing (32°F, 0°C); boiling (212°F, 100°C); room temperature (70°F, 21°C); body temperature (98.6°F, 37°C); and compare temperatures to these, e.g., cooler, warmer.		

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Energy

Forms of Energy: P.EN.04.12,

Energy and Temperature: P.EN.04.41, P.EN.04.42, P.EN.04.43

Objectives

- Identify heat and electricity as forms of energy.
- Use a thermometer to measure heat added to a substance and observe the results.
- Describe ways that heat is produced.

Engage and Explore

- Engage students in a variety of activities that use energy, such as running in place, rubbing hands together, feeling heat come out of the blower unit, turning the lights or the fan on and off, etc. In pairs or small groups, students discuss the concept of energy. What is energy? What form of energy was used in each one of these, and where did the energy come from? What change occurred as a result of these actions? Note: Students are not expected to know the answers or understand the concepts presented in this activity. This is intended to introduce the concept of energy to students. (P.EN.04.12, S.IP.04.11)
- Students run in place for 1-3 minutes. Discuss with students that energy is required to perform this activity. As a result, students discuss that they became hot. Their bodies give off heat as they use energy. What sports and games require more energy? Do they give off heat while playing the games? What is the fuel source their bodies use for energy? (P.EN.04.12, S.IP.04.11)

- Discuss the heat given off by the heating system in the classrooms. What kinds of fuels are burned to provide heat for schools and homes? How is the heat energy controlled in a home or school? Talk to the custodian about the heating/cooling system in the school. (P.EN.04.12, P.EN.04.41, S.IP.04.11, S.IP.04.12, S.IA.04.12)
- If appropriate, build a small campfire to cook marshmallows. The teacher measures the temperature of the air close to the fire and a distance away from the fire. Discuss the difference in temperature. Challenge students to diagram the evidence that heat is produced through burning. (P.EN.04.41, P.EN.04.42, P.EN.04.43, S.IP.04.15, S.IA.04.13, S.RS.04.11)
- Each student is given an ice cube. The goal is to make the ice cube melt as quickly as possible without using any outside heat sources except their bodies. Discuss the methods they used to melt the ice cube. Many students use a form of rubbing motion or friction. A transfer of heat melts the ice cube. Students record findings in a science journal or graphic organizer. (P.EN.04.41, P.EN.04.42, S.IP.04.11, S.IP.04.12)
- Examine various types of thermometers and scales on both Celsius and Fahrenheit thermometers. Practice reading both types of thermometers. Students need to be able to read the temperature, not convert between Celsius and Fahrenheit. Read and compare temperatures in warm and cold water, inside and outside, in different parts of the classroom, etc. (P.EN.04.41, S.IP.04.14, S.IP.04.15)

Explain and Define

- Have students explain their investigations into the melting ice cube to the rest of the class. Ask students what they can conclude from their data and what form of energy was involved in the change from solid water to liquid water.
- Students create classroom definitions for the words energy, fuel, and friction.

Elaborate and Apply

- As a homework assignment, students find out the type of energy used to heat their homes. This information is used to make a classroom data table. The table is used to make a bar graph. Students generate questions and comparisons that can be answered using the bar graph. (P.EN.04.42, S.IP.04.12)
- Students hold a thermometer gently in one hand and record the temperature. Put the thermometer down and create friction by rubbing hands together. Again measure the temperature by holding the thermometer gently. (Students think holding the thermometer tighter will raise the temperature.) Discuss the temperature difference and the cause by using the data. Compare the class results. (P.EN.04.41, P.EN.04.42, S.IP.04.14, S.IP.04.15, S.IA.04.11, S.IA.04.12, S.IA.04.13, S.IA.04.14, S.IA.04.15)

- Students read and compare temperatures using a glass of cold water and adding warm water or using a glass of warm water and adding an ice cube. (P.EN.04.41, S.IP.04.14, S.IP.04.15)
- Bring in a small appliance that uses electricity to produce heat. In collaborative groups, demonstrate and discuss how the heat is generated. It may be necessary to do some initial research before the discussion. Share information with the class. (P.EN.04.41, P.EN.04.42, P.EN.04.43, S.IP.04.11, S.IP.04.12, S.IP.04.16, S.IA.04.12, S.IA.04.13, S.IA.04.14, S.RS.04.11, S.RS.04.14, S.RS.04.15, S.RS.04.16, S.RS.04.17)

Evaluate Student Understanding

Formative Assessment Examples

- Use a data table for temperature readings and compare their data with the class. (P.EN.04.41)
- Use a data table and then use this information to make a line graph. (P.EN.04.41)
- Use student graphs and discussions to assess the students' abilities to describe heat as a form of energy. (P.EN.04.12).
- Use students' ice cube investigation to assess students' ability to explain how heat is produced while performing a simple investigation. (P.EN.04.41, P.EN.042, P.EN.04.43)

Summative Assessment Examples

- Given real world examples, identify heat and electricity as forms of energy. (P.EN.04.12)
- Demonstrate the use of a thermometer to measure the temperature of a variety of substances. (P.EN.04.41)
- Create a simple investigation to give evidence that when heat or electrical energy is added to a substance, the temperature increases. (P.EN.04.41)
- In a quiz, identify burning, rubbing and electricity as ways that heat is produced. Explain through definition or example, how heat is produced by electricity, burning or rubbing. (P.EN.04.42, P.EN.04.43)

Enrichment

- Discuss other types of energy that are used to produce heat for homes. Individually or in small groups, students do research on other types of energy used for homes and businesses. What are the advantages and disadvantages of the different types? What kind of alternative energy is being studied for future use?
- Research how heat is removed from large concrete structures such as dams to allow the concrete to cool and harden more quickly.
- Research and explain why the column of liquid (alcohol, water) rises or falls in a thermometer as it heats or cools.
- Create a solar oven as an alternative way to cook food.

Intervention

- Practice reading thermometers when adding 1 ice cube and then 2 ice cubes to a glass of warm water. Students practice reading a thermometer when adding increments of hot water to a glass of cold water.
- Compare the accuracy of classroom thermometers.
- Practice reading thermometers daily in many different settings.
- Create collages or graphic organizers to demonstrate how heat is produced through electricity, rubbing, or burning.
- Create a school scavenger hunt in which students identify and describe examples of energy produced through burning, rubbing, and electricity.
- Invite the custodian to visit the classroom to discuss how electricity is used in the school and how the school is heated and cooled.

Examples, Observations and Phenomena (Real World Context)

Examples of temperature changes that occur in nature are the temperatures of air, land and water. The changes in temperature of the air that surrounds the Earth, land, and water affect the weather and climate. The students are familiar with the daily changes in temperature and changes within a day, such as day and night. The temperature changes are due to the position of the heat source. The primary heat source for Earth is the sun. A real world application is for students to relate the changes in temperature and the affect humans have on global warming and the melting of the glaciers.

Electricity is used and transformed in everyday experiences (toasters, hair dryer, televisions, video games, ovens, fans, water heaters, dryers, washing machines, etc.). Students make observations of electrical energy from the time the alarm clock sounds in the morning, through the use of electrical devices throughout the day to the turning off of lights at night. A common misconception about electricity in their homes and schools is that the electricity comes from the wall. Students can research the generator or source of electricity for their hometown to their neighborhood and homes.

People control the temperature in their own environments through different heating and cooling sources. The control of temperature has become a major factor on the use of natural resources and carbon emissions. Students make connections between their actions and the effect on the environment. Discuss the impact of global climate issues, the changes that are occurring and human impact on the climate.

Scientists who have contributed to the study and use of energy are Michael Faraday and his work on the generator, Thomas Edison and his development of the light bulb, and Enrico Fermi and his work in nuclear energy.

Literacy Integration

R.CM.04.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.04.02 retell through concise summarization grade-level narrative and informational text.

R.CM.04.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about heat and energy:

Exploring Energy by Scholastic Books, 1995

Heat and Energy by Steve Parker, 2004

Turning up the Heat: Energy by Anne Fullick, 2004

Writing

W.PR.04.01 set a purpose, consider audience, and replicate authors' styles and patterns when writing a narrative or informational piece.

W.PR.04.02 apply a variety of pre-writing strategies for both narrative and informational writing (e.g., graphic organizers such as maps, webs, Venn diagrams) in order to generate, sequence, and structure ideas (e.g., plot, setting, conflicts/resolutions, definition/description, or chronological sequence).

W.PR.04.03 draft focused ideas using a variety of drafting techniques composing coherent and mechanically sound paragraphs when writing compositions.

Mathematics Integration

Measurement

M.UN.04.01 Measure using common tools and select appropriate units of measure.

M.PS.04.02 Give answers to a reasonable degree of precision in the context of a given problem.

M.TE.04.03 Measure and compare integer temperatures in degrees.

Data and Probability

D.RE.04.01 Construct tables and bar graphs from given data.

Instructional Framework

Instructional Examples

Energy and Properties of Matter

Electrical Circuits: P.EN.04.51, P.EN.04.52

Conductive and Reflective Properties: P.PM.04.53

Objectives

- Build a simple circuit and explain the transfer and change of energy through the circuit.
- Design a working electromagnet to demonstrate the magnetic effects in a simple circuit.
- Identify objects that are good conductors and poor conductors of heat and electricity.

Engage and Explore

- Turn the classroom lights on and off. Where does the energy for the lights come from? What is occurring behind the switch that turns the light on and off? Note: students are not expected to know the answers; they are to generate ideas and questions to explore during the unit. (P.EN.04.51, S.IP.04.11, S.IP.04.12, S.RS.04.11)
- Give students a battery, bulb, and wire and allow them time to explore how to light the bulb. Students record and draw pictures of observations in a journal. Challenge students to find additional ways to light the bulb using a wire, battery and bulb. (P.EN.04.51, S.IP.04.11, S.IP.04.14)
- Use an electrical circuit to demonstrate how energy is transferred and changed from a battery to wire to bulb. Students draw a simple diagram and use arrows to show energy transfer and change. Note: fourth graders describe that energy flows between the two terminals in the battery. The stored energy in the battery transforms into electrical energy in the wire, which is transformed into heat and light energy in the bulb. It is transformed back to electrical before returning to the battery. (P.EN.04.51, S.IP.04.16, S.IA.04.12)

Explain and Define

- As the concepts are introduced throughout the unit, students create an operational definition for the words circuit, transfer of energy, change of energy, electromagnet, and conductors.

Elaborate and Apply

- Using a battery, wires and a light bulb, students demonstrate an open and closed circuit. Students make a labeled diagram that shows the energy source (battery), wires (conductors) and device using the electricity (bulb) with arrows that show the flow of electricity. After students have shown a basic understanding of the electric circuit, the light bulb can be changed to a motor, buzzer, bells, appliance, etc. Students write a paragraph explaining how electrical energy is transferred and changed through an electrical circuit. (P.EN.04.51, S.RS.04.11, S.RS.04.15, S.RS.04.16)
- Students explore the magnetic effects in a simple circuit. Using the simple circuit from previous activities, students place a small magnetic compass near the wire. They move the compass closer to and from the wire. Students record their observations in journals. Students place compasses at intervals around the circuit. They record observations as the circuit is opened and closed. In collaborative groups, students discuss their observations of the magnetic needle's movement and draw conclusions that simple circuits have magnetic effects. (P.EN.04.52, S.IA.04.12, S.IA.04.13, S.RS.04.15)
- Make an electromagnet by wrapping wire around a core (nail) and attaching the ends of the wire to a battery. Use a compass to determine the magnetic effect. What happens when the flow of electricity is reversed? (P.EN.04.52, S.IP.04.13, S.IP.04.13, S.RS.04.12, S.RS.04.13)
- Test the strength of the electromagnet by using paper clips. How can the strength of the electromagnet be increased? Does the number of coils around the core affect the strength of the electromagnet? Make a data chart. Communicate the findings of your group to the class. (P.EN.04.52, S.IP.04.13, S.IP.04.13, S.RS.04.12, S.RS.04.13)
- Students design an investigation to test the electrical conductivity of common materials. They build a circuit tester with three pieces of wires (battery, wire, light bulb, wire, test object, wire to battery). Test objects such as aluminum, cork, penny, plastic, cloth, eraser, rubber band, salt and pencil. Make a chart with a prediction for each object. Test and classify each object as a good conductor or poor conductor. Students record their findings on charts. In collaborative groups, students share ideas and communicate findings. Using class data, as multiple trials, they generate explanations for similarities and differences in their investigations. Groups create an exhibit, diagram, or graphic organizer to present their findings about good and poor conductors. (P.PM.04.53, S.IP.04.11, S.IP.04.16, S.IA.04.11, S.IA.04.12, S.IA.04.13, S.IA.04.14, S.RS.04.11, S.RS.04.14, S.RS.04.15)
- Students touch a series of objects on a table (wood, cloth, paper, metal, and plastic). Rank the materials from coolest to warmest. A thermometer is placed on each material with the bulb touching the surface of the material. Leave the thermometers in place for two minutes and then note the temperatures. Rank the materials again, but this time according to their actual readings. What conclusion about the

conductivity of these materials can be drawn? Note: all materials will be at room temperature. (P.PM.04.53, S.IP.04.11, S.IP.04.16, S.IA.04.11, S.IA.04.12, S.IA.04.13, S.IA.04.14, S.RS.04.11, S.RS.04.14, S.RS.04.15)

Evaluate Student Understanding

Embedded Assessment Examples

- Observe the student trials and depth of conversation while investigating electrical circuits. (P.EN.04.51)
- Record observations of simple electrical circuits in journals. (P.EN.04.51)
- Make a data chart showing the number of coils around a nail and communicate findings to the group or class. (P.EN.04.52)
- Create a graphic organizer to present findings of a simple investigation of good and poor conductors. (P.PM.04.53)

Summative Assessment Examples

- Diagram energy flow and transfer in an electrical circuit. (P.EN.04.51)
- Design and construct an electromagnet. (P.EN.04.52)
- Students make a chart showing good conductors and poor conductors of heat and electricity. (P.PM.04.53)
- Design and construct a flashlight. (P.EN.04.51, P.PM.04.53)
- Use diagrams of batteries, bulbs and wires illustrating configurations of circuits and non-circuits. Students identify the circuits. (P.EN.04.51)

Enrichment

- Build parallel and series circuits.
- Create a quiz game circuit board. Materials needed are aluminum foil, masking tape, light bulb, wire, battery, and file folder. Punch 6 holes on each side of the file folder. Cut 6 aluminum strips $\frac{1}{4}$ inch wide that are long enough to connect the holes on opposite sides of the file folder. The holes should be randomly connected. Lay the foil strips, shiny side up, on the sticky side of masking tape that is the same length as the foil. The shiny-sided foil side must connect the holes on opposite sides of the folder. Close the folder. Using a battery, wires and light bulb, test your circuit. If the circuit is complete the light bulb will light. Questions can be used with the correct answer completing the circuit to cause the light bulb to light consequently the board is self-checking.
- Investigate switches. Build circuits containing a variety of switches.
- Investigate light bulbs. Students create an advertisement promoting the use of one bulb over another.
- Design an investigation to explore how common materials are good conductors or poor conductors of heat.

Intervention

- Provide a diagram of a simple circuit with all parts labeled. Students construct the circuit and label the parts.
- Explain and demonstrate open and closed circuits.
- Act out how energy is transferred and changed in an electrical circuit.
- Create a song or poem to explain how energy is transferred and changed in an electrical circuit.
- Use a magnetic compass to show magnetic effects in a variety of circuits. Explain why the magnetic needle moves when the compass is held near the circuit.
- Provide students with a circuit tester to test conductors and insulators. Students predict then test each item. Record observations and results on a chart.
- Provide students with an electromagnet. As students explore the effects of an electromagnet encourage them to explore the number of coils, different sized batteries, and different wires.

Examples, Observations and Phenomena (Real World Context)

Electrical circuits are an integral part of a students' life. Appliances, electronics, equipment, etc. all use electrical circuits. Different kinds of circuits can be explored such as parallel circuits in home wiring. An investigation into the sources of electrical power has important implications for energy conservation.

Investigate how industry uses electromagnets. Discover practical applications of electromagnets such as in generators and speakers. Electromagnets are used for picking up scrap metal, metal detectors, separating aluminum cans from steel food cans at recycling centers, magnetic resonance imager (MRI), electric guitars and the bullet train in Japan. What is the impact of a power outage on your home and community?

Students are familiar with good and poor conductors of heat and electricity. They understand that a down coat will keep them warmer than a light nylon jacket. They notice the difference between walking barefoot on asphalt and concrete. Cooking utensils have plastic or rubber coated handles. Electricity runs through wires that are insulated with rubber, vinyl or plastic.

As students make observations of everyday activities they discover multiple examples of good and poor conductors.

Literacy Integration

R.CM.04.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.04.02 retell through concise summarization grade-level narrative and informational text.

R.CM.04.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about electricity:

All About Electricity by Melvin Berger, 1995

Electricity by Steve Parker and Laura Buller, 2005

Electricity and Magnetism by Peter Adamczyk and Paul-Francis Law, 1994

Writing

W.PR.04.01 set a purpose, consider audience, and replicate authors' styles and patterns when writing a narrative or informational piece.

W.PR.04.02 apply a variety of pre-writing strategies for both narrative and informational writing (e.g., graphic organizers such as maps, webs, Venn diagrams) in order to generate, sequence, and structure ideas (e.g., plot, setting, conflicts/resolutions, definition/description, or chronological sequence).

W.PR.04.03 draft focused ideas using a variety of drafting techniques composing coherent and mechanically sound paragraphs when writing compositions.

Instructional Framework

Instructional Examples

Properties of Matter

Magnets: P.PM.04.33, P.PM.04.34

Objectives

- Demonstrate magnetic fields using iron filings.
- Demonstrate that magnetic forces are affected by the strength of the magnet and distance from the magnet.

Engage and Explore

- Magnet Hike: Students list or draw a picture of 10-15 items in the room or on the playground that a magnet will be attracted to. Students test their predictions, record their findings and report to the class. (P.PM.04.33, S.IP.04.11, S.IP.04.16, S.RS.04.14, S.RS.04.15)
- Using a variety of magnets, explore the attraction and repulsion between them. (P.PM.04.33, S.IP.04.11)
- Compare the strength of magnets based on how many paper clips a magnet will pick up. Use a variety of magnets. Make a chart showing a prediction and the actual number of clips picked up for each magnet. Does the kind, shape, size or weight of the magnet determine its strength? (P.PM.04.34, S.IP.04.11, S.IP.04.13, S.IP.04.14, S.IP.04.16)
- In collaborative groups, design a simple investigation to determine the effect distance has on magnetic attraction. Record results and share findings with class. Draw conclusions based on evidence. (P.PM.04.34, S.IP.04.11, S.IP.04.13, S.IP.04.14, S.IP.04.16)

Explain and Define

- Students define attraction and repulsion.
- Explain that magnets with like poles will repel and unlike poles will attract.
- Explain that stronger magnets attract an object from a greater distance. Weaker magnets attract at a much shorter distance.
- Create an operational definition for materials that are attracted to magnets.

Elaborate and Evaluate

- Place two bar magnets inside a large transparent, plastic bag with enough distance between them so they do not attract or repel. Put a piece of paper over the bag. Sprinkle iron filings on the paper over the space

between the two magnets and observe the lines of force. Repeat the activity by repositioning one of the magnets in the opposite direction. Students draw a picture of each observation and label if the magnets are showing attraction or repulsion and whether they are like or unlike poles. (P.PM.04.33, S.IP.04.11, S.RS.04.11)

- Place one bar magnet in a plastic bag. Put a piece of paper over the magnet. Sprinkle iron filings on top of the paper. Observe the magnetic field demonstrated by the iron filings. Students draw a picture showing the magnetic field. Note: Look at the section on misconceptions of the magnetic field. (Do not have the students place the magnet directly on the iron filings as it will be difficult to remove and reuse all the iron filings.) (P.PM.04.33, S.IP.04.11, S.RS.04.11)

Evaluate Student Understanding

Formative Assessment Examples

- Make a chart comparing the number of clips picked up by a magnet. (P.PM.04.34)
- Record results and share findings of a simple investigation exploring the strength and distance of magnets. Draw conclusions based on evidence. (P.PM.04.34)

Summative Assessment Examples

- Draw a diagram of the magnetic effects of two magnets. Diagrams should show like and opposite poles and arrows to indicate how the magnets move toward or away from each other. (P.PM.04.34)
- Draw a picture showing the magnetic field on bar magnets. (P.PM.04.33)
- Design a simple investigation that demonstrates the effect of magnets on materials that are attracted to a magnet. (P.PM.04.34)
- Create a game using magnets. (P.PM.04.34)

Enrichment

- Explore how magnetic fields can be demonstrated using materials other than iron filings.
- Use iron filings to demonstrate the magnetic field of different types of magnets.
- Research the magnetic field of the Earth. How does a magnetic compass interact with the Earth's magnetic field?
- Compare the Earth with a magnet.
- Investigate permanent and temporary magnets. What are their practical uses? Why is one used over the other?
- Research Maglev trains to find out how they use electricity to produce a magnetic field. Would a Maglev train be an asset to the community?

Intervention

- Give students a bag of objects. Sort them as attracted to or not attracted to a magnet. Test the items and record findings on a chart.
- Create a magnet by stroking an iron or steel nail with a magnet. Explore how the number of strokes affects the strength of the magnet.
- Play a game to reinforce the concept that opposite poles attract. Using tape, students mark their hands with N and S. Mark the ends of paper tube or baton with N and S. Form teams. Each team will have a baton. Each team passes the baton down the line and back up the line as quickly as possible but grab it only using the opposite pole hand. After completing the game several times, have students predict what would happen if the baton were grabbed with the same pole hand.

Examples, Observations and Phenomena (Real World Context)

Magnets are used in games, refrigerator magnets, motors, closures, etc. The use of magnetic properties is used in Magnetic Resonance Imaging (MRI) for medical diagnoses.

Orienteering uses a map and compass. Explore how a magnetic compass works.

What is the advantage of using electromagnets in industry, recycling centers, and scrap metal yards?

Literacy Integration

R.CM.04.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.04.02 retell through concise summarization grade-level narrative and informational text.

R.CM.04.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about magnets:

Janice Van Cleave's Magnets by Janice VanCleave, 1993.

Opposites Attract: Magnets by Steve Parker, 2005

The Science of Electricity and Magnetism by Steve Parker, 2005.

Writing

W.PR.04.01 set a purpose, consider audience, and replicate authors' styles and patterns when writing a narrative or informational piece.

W.PR.04.02 apply a variety of pre-writing strategies for both narrative and informational writing (e.g., graphic organizers such as maps, webs, Venn diagrams) in order to generate, sequence, and structure ideas (e.g., plot, setting, conflicts/resolutions, definition/description, or chronological sequence).

W.PR.04.03 draft focused ideas using a variety of drafting techniques composing coherent and mechanically sound paragraphs when writing compositions.

Fourth Grade GLCE Companion Document

Unit 2: Properties and Changes of Matter

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

Fourth Grade Companion Document

4-Unit 2: Properties and Changes of Matter

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**Fourth Grade Unit 2:
Properties and Changes of Matter**

Content Statements and Expectations

Code	Statements & Expectations	Page
P.PM.E.1	Physical Properties - All objects and substances have physical properties that can be measured.	3
P.PM.04.16	Measure the weight (spring scale) and mass (balances) in grams or kilograms of objects.	3
P.PM.04.17	Measure the volume of liquids in milliliters and liters.	4
P.PM.E.2	States of Matter – Matter exists in several different states: solids, liquids, and gases. Each state of matter has unique physical properties. Gases are easily compressed, but liquids and solids do not compress easily. Solids have their own particular shapes, but liquids and gases take the shape of the container.	4
P.PM.04.23	Compare and contrast the states (solid, liquid, and gas) of matter.	4
P.CM.E.1	Changes in State – Matter can be changed from one state (solid, liquid, gas) to another and then back again. Heating and cooling may cause changes in state.	5
P.CM.04.11	Explain how matter can change from one state (solid, liquid, and gas) to another by heating and cooling.	5

4 – 2: Properties and Changes of Matter

Big Ideas (Key Concepts)

- All objects have physical properties that can be measured.
- Matter exists in different states.
- Matter can change from one state to another by heating and cooling.

Clarification of Content Expectations

Standard: Properties of Matter

Content Statement – P.PM.E.1

Physical Properties - All objects and substances have physical properties that can be measured.

Content Expectations

P.PM.04.16 Measure the weight (spring scale) and mass (balances) in grams or kilograms of objects.

Instructional Clarifications

1. Measure means to determine the dimensions, quantity, or capacity of the weight and mass of objects.
2. Mass is defined as the amount of matter in an object. Weight is the force on an object due to gravity.
3. Weight is measured using a spring scale. The metric unit of measure is grams or kilograms. This is not to be confused with measuring force in Newtons using the spring scale.
4. Mass is measured using a balance. The metric unit of measure of mass is also grams or kilograms.
5. Fourth graders should be able to use simple measurement devices to make simple measurements for weight and mass.

Assessment Clarifications

1. Weight is measured using a spring scale. The metric unit of measure is grams or kilograms.
2. Mass is measured using a balance. The metric unit of measure of mass is also grams or kilograms.

P.PM.04.17 Measure the volume of liquids in milliliters and liters.

Instructional Clarifications

1. Measure means to determine the dimensions, quantity, or capacity of volume of liquids in milliliters and liters.
2. Liquid is measured in terms of volume. Volume is how much space matter takes up. The metric units of measure for liquid volume are milliliter and liter.
3. The tools used to measure the volume of liquid are a graduated cylinder or a measuring cup.

Assessment Clarifications

1. Liquid is measured in terms of volume. The metric units of measure for liquid volume are milliliter and liter.
2. The tools used to measure the volume of liquid are a graduated cylinder or a measuring cup.

Content Statement – P.PM.E.2

States of Matter – Matter exists in several different states: solids, liquids, and gases. Each state of matter has unique physical properties. Gases are easily compressed, but liquids and solids do not compress easily. Solids have their own particular shapes, but liquids and gases take the shape of the container.

Content Expectation

P.PM.04.23 Compare and contrast the states (solid, liquid, and gas) of matter.

Instructional Clarifications

1. Compare and contrast means to note similarities and differences between the states of matter.
2. Matter is anything that has mass and takes up space.
3. States of matter are the forms matter can take. The three most familiar forms are solid, liquid, and gas.
4. Solids have a definite shape and size (volume).
5. Liquids have a definite size (volume), but no definite shape. Liquids take the shape of a container, but the volume always stays the same. A liter of milk cannot fit into a half-liter bottle.
6. Gases have no definite shape or size (volume). Gases will also take the shape of the container, but the container is always completely full. Air will take the shape of a basketball, football, balloon, etc.
7. Compress is to press or squeeze together, to reduce the volume by pressure. Solids and liquids are not easily compressed. Gases are easily compressed, reducing the volume of the gas.

8. A common misconception is gases are not matter because they are invisible.
9. A common misconception is that air and oxygen are the same thing.
10. A common misconception is very tiny things are not matter because they don't weigh enough.
11. A common misconception is all liquids mix.
12. A common misconception is light objects float and heavy ones will not. Larger pieces of ice will sink and a small one will float, for example.
13. A common misconception is objects will float on any liquid.
14. A common misconception is you need the sun for things to evaporate.

Assessment Clarifications

1. States of matter are the forms matter can take. The three most familiar forms are solid, liquid, and gas.
2. Solids have a definite shape and size.
3. Liquids have a definite size, but no definite shape. Liquids take the shape of a container, but the volume always stays the same.
4. Gases have no definite shape or size. Gases will also take the shape of the container, but the container is always completely full (Air will take the shape of a basketball, football, and balloon.).

Content Statement - P.CM.E.1

Changes in State – Matter can be changed from one state (solid, liquid, gas) to another and then back again. Heating and cooling may cause changes in state.

Content Statement

P.CM.04.11 Explain how matter can change from one state (solid, liquid, and gas) to another by heating and cooling.

Instructional Clarifications

1. Explain means to clearly describe by means of illustrations (drawing), demonstrations, written reports, or verbally how matter can change from one state to another by heating and cooling.
2. Students should be able to identify matter as being the same even after a physical change, such as melting, freezing, or mixing.
3. Heating matter will usually change it from a solid to a liquid or a liquid to a gas or a solid to a gas.
4. Cooling matter will usually change it from a gas to a liquid or a liquid to a solid.
5. Water is the most common type of matter used to show the three states of matter. Other types of matter that change state mostly go from solid to liquid and liquid to solid, such as a candy bar getting soft when sitting in the sun, a popsicle melting on a hot day, or making flavored gelatin. Anything we smell is matter in a gaseous state (gasoline, perfume).
6. Changes in size and shape are not changes in states of matter.

Assessment Clarifications

1. Heating matter will usually change it from a solid to a liquid or a liquid to a gas or a solid to a gas, such as water to water vapor, ice to water.
2. Cooling matter will change it from a gas to a liquid or a liquid to a solid (water vapor to water, water to ice).

Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implications
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Inquiry Process
S.IP.04.11 Make purposeful observations concerning properties and changes in matter.
S.IP.04.12 Generate questions based on observations to understand properties and changes in matter.
S.IP.04.13 Plan and conduct simple and fair investigations of properties and changes in matter.
S.IP.04.14 Use metric measurement devices in an investigation of properties and changes in matter.
S.IP.04.15 Make accurate measurements with appropriate units for the measurement tool.
S.IP.04.16 Construct charts and graphs from data and observations dealing with properties and changes in matter.
Inquiry Analysis and Communication
S.IA.04.11 Summarize information from data tables and graphs to answer scientific questions on properties and changes in matter.
S.IA.04.12 Share ideas through discussion in collaborative groups about properties and changes in matter.
S.IA.04.13 Communicate and present findings of observations and investigations about properties and changes in matter using evidence.
Reflection and Social Implications
S.RS.04.11 Use data/samples as evidence to separate fact from opinion regarding properties and changes in matter.
S.RS.04.12 Use evidence in making scientific decisions about properties and changes in matter.
S.RS.04.13 Demonstrate scientific concepts concerning properties and changes in matter through various illustrations, performances, models, exhibits, and activities.
S.RS.04.14 Identify technology associated with properties and changes in matter.
S.RS.04.15 Use evidence when communicating about the properties and changes in matter.
S.RS.04.16 Design solutions to problems on energy and changes in matter using technology.
S.RS.04.17 Describe how people have contributed to society through the discovery and research into properties and changes in matter.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
weight spring scale grams kilograms balance volume liter (L) milliliter (mL) matter states of matter solid liquid gas definite (as related to shape) compare contrast mass	metric unit of measure space (related to volume)

Instruments, Measurements, Representations

Measurements	Instruments	Representations
weight	spring scale	grams (g), kilograms (kg)
mass	balance	grams (g), kilograms (kg)
volume	graduated cylinders, metric measuring cups	milliliters (mL), liters (L)
temperature	thermometer	Celsius, Fahrenheit

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Physical Properties: P.PM.04.16, P.PM.04.17

States of Matter: P.PM.04.23

Changes in State: P.CM.04.11

Objectives

- Measure the weight and mass of objects.
- Measure the volume of liquids.
- Explain the similarities and differences among solids, liquids, and gases.
- Explain how matter can change from one state to another by heating and cooling.

Engage and Explore

- Students have many different experiences finding the weight, mass, and volume of various objects. When using balances, it is best to find the mass of an object three times and find the median, as there will often be discrepancies. (P.PM.04.16, P.PM.04.17, S.IP.04.14, S.IP.04.15)
- Students look around the room and categorize objects by solid, liquid, and gas. In cooperative groups students share their lists to see if they agree on the placement of things. (P.PM.04.16, S.IP.04.11)
- In a whole group discussion share their ideas and then add to the list other things they can think of outside of the classroom setting. If students disagree about the placement of something, have them give support or reasoning for their ideas. Students design activities or investigations that use everyday materials to try to provide evidence their ideas. For example, students design an investigation to find evidence that air is or is not matter, they can use balloons, balls, zip-type bags, balances, etc., to

prove that air does have mass and takes up space. (P.PM.04.16, P.PM.04.23, S.IP.04.11, S.IP.04.12, S.IP.04.13, S.IP.04.14, S.IP.04.15, S.IA.04.12, S.IA.04.13, S.IA.04.14, S.RS.04.14)

- Set up a variety of the activities or investigations that students have generated and have them work in cooperative groups to test their ideas. Students revisit their lists to see if they need to make adjustments in any of the items they have included. Most of the discrepancies will involve whether or not gases or very small things are matter. For example, students may not agree on whether a piece of paper is matter. A student comes up and holds out a hand. Lay one sheet of paper on his/her hand, and then keep adding more paper. Even though one sheet of paper doesn't seem to have mass to fourth graders, many sheets of paper do! If it had no mass you could stack paper all day, and they wouldn't feel it. (P.PM.04.16, P.PM.04.23, S.IP.04.11, S.IP.04.12, S.IP.04.13, S.IP.04.14, S.IP.04.15, S.IA.04.12, S.IA.04.13, S.IA.04.14, S.RS.04.11, S.RS.04.14, S.RS.04.15)

Explain and Define

- Students present their findings from their investigations and compare data from similar investigations. (S.IA.04.11, S.IA.04.12, S.IA.04.13, S.RS.04.11)
- Students create definitions of solids, liquids, and gases by the properties that they have observed and measured. (P.PM.04.16, P.PM.04.17, P.PM.04.23)

Elaborate and Apply

- Students compare different liquids and find new properties. What makes them all a liquid even if they are different types of liquids such as dish soap, syrup, water, etc? Use cylinders and measuring cups with metric units to measure volumes. (P.PM.04.16, P.PM.04.17, P.PM.04.23, S.IP.04.14, S.IP.04.15)
- Distribute new tea candles on a metal pie pan to students in cooperative groups. Each group creates a 3-column chart that is labeled, *before/during/after*. Give safety precautions about open flame before lighting the tea candles and specific directions about how to observe a burning candle without putting it out or causing injury. After students have had adequate time to record observations on the *before* portion of the chart, light the candles. Give students approximately 5 minutes to make silent, recorded observations about the candle while it is burning. Instruct students on how to gently blow out the candles and make observations for the next few minutes on the candle after the flame is extinguished. (P.PM.04.23, P.CM.04.11, S.IP.04.11, S.IP.04.12, S.IP.04.13, S.IP.04.16, S.IA.04.11, S.IA.04.12, S.IA.04.13, S.IA.04.14, S.IA.04.15, S.RS.04.11, S.RS.04.14, S.RS.04.15)
- Make ice cream in a zip bag (liquid mixture) inside another zip bag (with ice and rock salt) to show change of state from liquid to solid. Students

have an opportunity to use thermometers to measure temperature of the ice cream before and after, as well as the ice before and after.

(P.CM.04.11)

- Place water in a variety of containers that have different sized openings. Leave the open containers out in the classroom to observe what happens over time. (P.CM.04.11, S.IP.04.16)
- In the winter months, use snow to build a snow person or object and record size and properties. Record temperature of the air and the snow object each day. Predict how long it will take to melt completely. (P.CM.04.11, S.IP.04.16)
- Demonstrate how gases are easily compressed by opening a soda can or bottle and having students describe the sound of the escaping gas. (P.PM.E.2)
- Have students explore how gases are compressed into canisters for a variety of uses. (P.PM.E.2)
- Compare and contrast the ability of solids, liquids, and gases to be compressed. (P.PM.E.2)

Evaluate Student Understanding

Formative Assessment Examples

- Check the results of the weight, mass, and volume measurements. (P.PM.0416, P.PM.04.17)
- Use student investigations and science journals to assess ability to describe properties of matter and changes of state. (P.PM.04.23, P.CM.04.11)
- Observe students during investigations, ask questions to probe student understanding of states of matter while observing cooperative groups. (P.PM.04.23, P.CM.04.11)
- Use student investigations to assess their ability to ask questions based on observations of properties of matter. (P.PM.04.23, P.CM.04.11)

Summative Assessment Examples

- Students will find the weight, mass, and volume of objects not yet measured. (P.PM.0416, P.PM.04.17)
- Create a concept map that shows properties and states of matter. (P.PM.0416, P.PM.04.17, P.PM.04.23, P.CM.04.11)

Enrichment

- Have students look at solids that don't seem like solids and liquids that don't seem like liquids. Some materials like Slime, Goo Yuck, Silly Putty, and gelatin are a few that could be explored.
- Students can plan additional investigations to answer questions that come up during the unit.
- Research glass to see if it is a solid or a liquid.
- Is it possible for matter to change from a solid directly to a gas? What is an example and what is the process called?

Intervention

- Provide students with a set of balls that are different sizes and compositions. First have students put the balls in order from lightest to heaviest. Next, use scales and/or balances to find the actual weight and/or mass.
- Match game: have a set of cards with different objects written on them. Make a large chart with the words "solid", "liquid", and "gas" at the top. Students sort the cards and put them in the correct column.
- Brainstorm a class list of examples of gases changing to liquids and liquids changing to gases, and examples of liquids changing to solids and solids changing to liquids.
- Make finger gelatin. Students measure the ingredients using metric measures and explain changes in states of matter.

Examples, Observations, and Phenomena (Real World Context)

Classifying and measurement are everyday skills. Weight and volume are common measurements for students at this age. Students recognize the volume of liquids from beverage containers, baking and cooking measurements, paint, liquid soaps and detergents. They recognize the measurement of weight from their own measurements and when moving and lifting objects.

Making fudge is an example of watching a change in state of matter. The fudge mixture begins as different solids that are melted to a liquid then stirred and cooled to become a solid again. Baking and cooking activities demonstrate how changes in temperature produce changes in states of matter. Baking and cooking involves making mixtures from solids and liquids and sometimes creating a chemical change for a final product.

The weather provides the opportunity for observations in changes in states through temperature changes and precipitation. Storms may produce rain

and hail due to the difference in the temperature on the ground and up in the air at cloud level. Winter weather can bring a wintry mix that ranges from rain to ice to snow as the temperature decreases.

Literacy Integration

Reading

R.CM.04.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.04.02 retell through concise summarization grade-level narrative and informational text.

R.CM.04.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about states of matter:

- *Eyewitness Matter* by C. Cooper, 1999
- *What's the World Made Of? All About Solids, Liquids, and Gases* by Zoehfeld and Meisel, 1998
- *It's Science! Solid, Liquid, or Gas?* By Sally Hewitt, 1998

Writing

W.PR.04.01 set a purpose, consider audience, and replicate authors' styles and patterns when writing a narrative or informational piece.

W.PR.04.02 apply a variety of pre-writing strategies for both narrative and informational writing (e.g., graphic organizers such as maps, webs, Venn diagrams) in order to generate, sequence, and structure ideas (e.g., plot, setting, conflicts/resolutions, definition/description, or chronological sequence).

W.PR.04.03 draft focused ideas using a variety of drafting techniques composing coherent and mechanically sound paragraphs when writing compositions.

Mathematics Integration

Measurement

M.UN.04.01 Measure using common tools and select appropriate units of measure.

M.PS.04.02 Give answers to a reasonable degree of precision in the context of a given problem.

Data and Probability

D.RE.04.01 Construct tables and bar graphs from given data.

Fourth Grade GLCE Companion Document

Unit 3: Relationships and Requirements of Living Things

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

Fourth Grade Companion Document
4-Unit 3: Relationships and Requirements of Living Things

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**Fourth Grade Unit 3:
Relationships and Requirements of Living Things**

Content Statements and Expectations

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L.OL.04.15	Determine that plants require air, water, light, and a source of energy and building material for growth and repair.	4
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L.EC.E.1	Interactions – Organisms interact in various ways including providing food and shelter to one another. Some interactions are helpful; others are harmful to the organism and other organisms.	6
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Code	Statements & Expectations	Page
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4 – Unit 3: Relationships and Requirements of Living Things

Big Ideas (Key Concepts)

- Plants and animals have basic requirements for maintaining life, which include the need for air, water and a source of energy (food).
- Organisms have observable traits and physical characteristics that help them survive and reproduce in their environments.
- Organisms are a part of a food chain or food web where food/energy is supplied by plants, which need light to produce food/energy.
- Plants and animals can be classified by observable traits and physical characteristics.
- Fossils provide evidence that life forms have changed over time and were influenced by changes in environmental conditions.

Clarification of Content Expectations

Standard: Organization of Living Things

Content Statement – L.OL.E.1

Life Requirements – Organisms have basic needs. Animals and plants need air, water, and food. Plants also require light. Plants and animals use food as a source of energy and as a source of building material for growth and repair.

Content Expectations

L.OL.04.15 Determine that plants require air, water, light, and a source of energy and building material for growth and repair.

Instructional Clarifications

1. Determine means to conclude or ascertain, as after reasoning, observation, etc., the requirements of plants.
2. Plants and animals have almost the same requirements for growth and repair. The one difference is light. Light is necessary for plants to be able to produce their own food. Sunlight is the initial energy source.
3. Fourth graders do not need to know or understand the process of photosynthesis. They need to know that plants are capable of producing their own food and animals are not. The food that the plant produces is its source of energy and building material.
4. Building materials include the food that the plant makes in its leaves plus the nutrients taken in by the plant's roots.
5. A common misconception is that stronger organisms have more energy.
6. A common misconception is that plants get food from the ground.

7. A common misconception is that plants make food for other organisms and not for themselves.
8. A common misconception is that plants need dirt or soil to grow.

Assessment Clarification

1. Plants need air, water, light, a source of energy, food and nutrients for growth and repair.

L.OL.04.16 Determine that animals require air, water and a source of energy and building material for growth and repair.

Instructional Clarifications

1. Determine means to conclude or ascertain, as after reasoning, observation, etc., that animals have requirements for growth and repair.
2. Animals have similar requirements to plants. The major difference is that animals do not require light because they do not make their own food. Animals have to get their energy and building materials from the food they eat.
3. Animals can only survive in environments in which their needs can be met.

Assessment Clarification

1. Animals need air, water, and food for growth and repair.

Content Statement – L.EV.E.2

Survival – Individuals of the same kind differ in their characteristics, and sometimes the differences give individuals an advantage in surviving and reproducing.

Content Expectations

L.EV.04.21 Identify individual differences (color, leg length, size, wing size, leaf shape) in organisms of the same kind.

Instructional Clarifications

1. Identify means to recognize individual differences in organisms of the same kind (species).
2. Organisms have individual differences within their own kind. Examples of these differences include: color, leg length, size, wing size and leaf shape.

Assessment Clarification

1. Organisms have individual differences within their own kind. Examples of these differences include: color, leg length, size, wing size and leaf shape.

L.EV.04.22 Identify how variations in physical characteristics of individual organisms give them an advantage for survival and reproduction.

Instructional Clarifications

1. Identify means to recognize physical characteristics for survival and reproduction.
2. Plants and animals have a variety of physical characteristics that enable them to survive and reproduce.
3. Some kinds of organisms and individuals have advantages in particular environments.
4. One animal whose coloring is more similar to its environment is better camouflaged and therefore less likely to be eaten. An animal with longer legs may be able to run faster than another and therefore is able to catch more prey or escape being caught. The larger babies in a litter are stronger and can get more food than smaller litter mates and therefore have a stronger chance of survival. The tree that grows the tallest in a crowded forest receives the most sunlight.
5. When the environment changes, variations in physical characteristics allow some organisms to survive and reproduce while others die or move to new locations.

Assessment Clarifications

1. Plants and animals have a variety of observable characteristics that help them survive and reproduce.
2. One animal whose coloring is more similar to its environment is better camouflaged and therefore less likely to be eaten. An animal with longer legs may be able to run faster than another and therefore is able to catch more prey or escape being caught. The larger babies in a litter are stronger and can get more food than smaller litter mates and therefore have a stronger chance of survival. The tree that grows the tallest in a crowded forest receives the most sunlight.

Content Statement – L.EC.E.1

Interactions – Organisms interact in various ways including providing food and shelter to one another. Some interactions are helpful; others are harmful to the organism and other organisms.

Content Expectation

L.EC.04.11 Identify organisms as part of a food chain or food web.

Instructional Clarifications

1. Identify means to recognize that organisms are part of a food chain or food web.
2. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.

3. The sun's energy is the basis for almost all life on Earth. The producers, or plants, use the sun's energy to make their own food.
4. Some animals eat only plants (herbivores), some eat only animals (carnivores), and some eat both plants and animals (omnivores). All of these animals are called consumers. Consumers cannot make their own food.
5. Dead plants and animals are broken down into materials that are returned to the soil, air and water. Organisms that break down waste or plant and animal remains are called decomposers.
6. Energy and building materials from food are moved through food chains and food webs.
7. The arrows in a food chain diagrams can be confusing to students. Arrows show the energy flow in the system from producers to consumers.
8. Some animals (predators) hunt other animals (prey).
9. Some interactions between organisms are beneficial and some are detrimental.
10. A common misconception is that there are more herbivores because they have more offspring.
11. A common misconception is that not all animals need plants for survival.
12. A common misconception is that soil is not made from dead plants and animals.
13. A common misconception is that decomposition occurs naturally without the help of other organisms.

Assessment Clarifications

1. The sun's energy is the basis for almost all life on Earth. The producers, or plants, use the sun's energy to make food.
2. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.
3. Some animals eat only plants, some eat only animals, and some eat both plants and animals. All of these animals are called consumers. Consumers cannot make their own food.
4. Dead plants and animals need to be broken down into materials that are returned to the soil, air and water. Organisms that break down waste or plant and animal remains are called decomposers.

Content Statement: - L.EC.E.2

Changed Environment Effects – When the environment changes, some plants and animals survive to reproduce; others die or move to new locations.

Content Expectation

L.EC.04.21 Explain how environmental changes can produce a change in the food web.

Instructional Clarifications

1. Explain means to clearly describe by means of illustrations (drawing), demonstrations, written reports, or verbally that environmental changes can produce a change in the food web.
2. Changes in the environment (temperature, shelter, light, food sources, and water) can affect survival of plants and animals. A forest fire destroys shelter and food for animals but also encourages the reproduction of some plants such as the jack pine.
3. The introduction of a new plant or animal species may become invasive and disrupt the food chain/web, if there is not a natural competitor and/or predator present (zebra mussels, quagga mussels, emerald ash borer, purple loosestrife).
4. Human interaction or interference can have both positive and negative effects on the food chain or web. Human interaction, such as a factory dumping wastes, can raise the temperature of a lake that will affect the amount of oxygen in the water needed by the fish and other animals for survival.
5. When a change is severe a species may become threatened, endangered or extinct.
6. When the environment changes, some plants and animals survive and reproduce and others die out or move to new locations.

Assessment Clarifications

1. Changes in the environment (temperature, shelter, light, food sources, and water) can affect the survival of plants and animals.
2. When the environment changes, some plants and animals survive and reproduce and others die out or move to new locations.

Content Statement – E.ST.E.3

Fossils – Fossils provide evidence about the plants and animals that lived long ago and the nature of the environment at that time.

Content Expectations

E.ST.04.31 Explain how fossils provide evidence of Earth's past.

Instructional Clarifications

1. Explain means to clearly describe by means of illustrations (drawing), demonstrations, written reports, or verbally that fossils provide evidence of Earth's past.
2. Fossils are important because scientists cannot actually observe the Earth's past. Fossils provide evidence that change has occurred in life forms over a time span of millions of years.
3. Fossils are just a sample of plants and animals that existed long ago.
4. A common misconception is that dinosaurs and cavemen lived at the same time.
5. A common misconception is that humans are responsible for the extinction of dinosaurs.
6. A common misconception is that all fossils were created at the same time in history.

Assessment Clarifications

1. Fossils provide evidence that change has occurred in life forms over a time span of millions of years.
2. Fossils are just a sample of plants and animals that existed long ago.

E.ST.04.32 Compare and contrast life forms found in fossils and organisms that exist today.

Instructional Clarifications

1. Compare and contrast means to note similarities and differences between fossils and present day organisms.
2. Fossils provide evidence that change has taken place over time in organisms.
3. There are many similarities in life forms found in fossils and organisms that exist today (cockroaches, crocodiles, ferns).
4. There are many differences in life forms found in fossils and organisms that exist today (horses, elephants). Some life forms are not alive today (dinosaurs).
5. The fossil record is incomplete and represents only a small sample of life forms that existed.

Assessment Clarifications

1. There are many similarities in life forms found in fossils and organisms that exist today (cockroaches, crocodiles, ferns).
2. There are many differences in life forms found in fossils and organisms that exist today (horses, dinosaurs). Some life forms are not alive today (dinosaurs).

Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implications

Inquiry Processes
S.IP.04.11 Make purposeful observations of plant and animal requirements and relationships.
S.IP.04.12 Generate questions based on observations of living things, their requirements and relationships.
S.IP.04.13 Plan and conduct simple and fair investigations to compare and contrast the needs of plant and animal requirements and their relationships.
S.IP.04.14 Manipulate simple tools (for example ruler, meter stick, balance scales) to determine the growth and change of living things.
S.IP.04.15 Make accurate measurements with appropriate units (centimeters, meters, grams, kilograms) of the growth and change of living things.
S.IP.04.16 Construct simple charts and graphs from data and observations of living things.
Inquiry Analysis and Communication
S.IA.04.11 Summarize information from charts and graphs to answer questions about plants and animal requirements and their relationships.
S.IA.04.12 Share ideas about plants and animals and their relationships through purposeful conversation in collaborative groups.
S.IA.04.13 Communicate and present findings of investigations that describe plants and animal requirements and their relationships.
S.IA.04.14 Develop research strategies and skills for information gathering and problem solving about plants and animal requirements and their relationships.
S.IA.04.15 Compare and contrast sets of data from multiple trials of an investigation about plants and animal requirements and their relationships to explain reasons for differences.
Reflection and Social Implications
S.RS.04.11 Demonstrate similarities and differences of plants and animal requirements and their relationships through various illustrations, performances or activities.
S.RS.04.14 Use data/samples as evidence to separate fact from opinion about plants and animal requirements and their relationships.
S.RS.04.15 Use evidence when communicating, comparing and contrasting plants and animal requirements and their relationships.
S.RS.04.16 Identify technology used in everyday life to help plant and animal requirements and their relationships.
S.RS.04.17 Identify current problems about changes in plant and animal requirements and their relationships that may be solved through the use of technology.
S.RS.04.19 Describe how people such as Charles Darwin, Rachel Carson, Luther Burbank, George Washington Carver, Ibn Al-Baitar, Charles Turner and others have contributed to science throughout history and across cultures.

Vocabulary

Critically Important – State Assessable	Instructional
plants animals source of energy building material requirements for life repair individual differences organisms observable features enable obtain coloring similarities and differences in organisms camouflage predator prey litter food chain food web producers consumers decomposers populations environment affect survival reproduce fossil evidence variations physical characteristics survival reproduction advantage location compare contrast	produce food nutrients physical characteristics advantages beneficial detrimental mold cast imprint

Instruments, Measurements, Representations

The study of plants and animals in this unit relies closely on observation skills using the hand lens and possibly microscopes. Plants and animals are best observed in their natural environment over a period of time. In the classroom and laboratory setting, models of habitats provide a means to observe the growth, behavioral characteristics and structural or physical characteristics that help them to survive. The controlled environment of the model habitat gives the observer the opportunity to determine the balance in the food web within the environment through manipulation of the needs of organisms.

Representations of the food chain or food web within an environment are made using diagrams that demonstrate the direction of the flow of energy in the environment. For example: plant -> rabbit -> owl.

Measurements within an ecosystem include collecting data on population shifts within different species, measurement of food consumption, and growth of organisms.

Instructional Framework

Instructional Examples

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Organization of Living Things

Life Requirements: L.OL.04.15, L.OL.04.16

Evolution

Survival: L.EV.04.21, L.EV.04.22

Ecosystems

Interactions: L.EC.04.11

Changed Environment Effects: L.EC.04.21

Objectives

- Determine that plants require air, water, light, and a source of energy and building material for growth and repair.
- Determine that animals require air, water, light, and a source of energy and building for growth and repair.
- Identify individual differences in organisms of the same kind.
- Identify variations in physical characteristics that help individual animals survive and reproduce.
- Identify plants and animals as part of a food chain or food web.
- Explain how changes in an environment can produce a change in the food web.

Engage and Explore

- Walk around the playground. Students create a list of living things. (L.OL.04.15, L.OL.04.16, S.IP.04.11, S.IP.04.12)

- Using a plant (real or artificial), an animal (real or artificial) and a book, have students brainstorm how the plant and animal are alike and the book is different. (L.OL.04.15, L.OL.04.16, S.IP.04.11, S.IP.04.12)
- Using the schoolyard, a garden, park or nature area, identify plants and animals living there. How are the plants used (food and shelter)? How do the animals survive (food and shelter)? (L.OL.04.15, L.OL.04.16, S.IP.04.11, S.IP.04.12)
- Using the lists of plants and animals living in the nearby schoolyard, garden, park or nature area, brainstorm reasons why some of these plants and animals might not survive (loss of habitat, too many predators, pollution, drought, flooding, etc.). Choose one plant or animal and write paragraph explaining what it needs to survive in its environment. (L.EV.04.21, L.EC.04.21, S.IP.04.12, S.IA.04.12, S.RS.04.12)
- Role-play a simple food chain such as a water flea, sunfish and heron. Have 1/2 of the class be water fleas, 3/8 of the class be sunfish and 1/8 of the class be herons. Scatter small pieces of paper on the floor that represent food. Half of the pieces should have an **X** on the back that represents food with toxins. First have the water fleas collect the food in a baggy. Then have the sunfish eat the water fleas (and food pieces) by taking their baggy. Last the herons can eat the sunfish (food pieces and water fleas). Students examine the herons' baggies, which represent their stomachs. The more papers with an **X** the more toxins they have eaten. Have a class discussion about how the toxins were passed through the food chain. What effects could they have on each species? Could humans also be getting toxins through our foods? (L.EC.04.21, S.IP.04.12, S.IA.04.12, S.RS.04.12)

Explain and Define

- Students identify the basic needs of plants and animals: air, water, light and a source of energy. Create a two-column list entitled "Needs of Living Things" with the subheadings: "Plants" and "Animals". Students list the needs of plants and animals.
- Students create a graphic organizer to compare and contrast the needs of plants and animals.

Elaborate and Apply

- In collaborative groups, students conduct a simple plant investigation. Each group is given four plants of the same kind. For each plant take away one requirement: light, water, soil and one plant that has all three taken away. Make a chart showing each plant and daily record observations. Compare and contrast the plants. Generate questions about the plants needs and other ways to meet these needs. How could students prove a plant's need for air? (L.OL.04.15, S.IP.04.13, S.IP.04.15, S.IP.04.16, S.IA.04.11, S.IA.04.12, S.IA.04.13, S.RS.04.12, S.RS.04.14, S.RS.04.15.)

- Students review the needs of a plant (air, water, light and materials for growth and repair). Each group is given a picture a different mammal. Discuss and present how this animal has these same needs and how they take care of these needs. Use animals from other groups such as reptile, amphibian, insect, bird, etc. Do these animals have the same needs? (L.OL.04.16, S.IP.04.11, S.IP.04.12)
- Make observations of the students in the classroom. List observable traits or physical characteristics that all fourth grade students have in common. Create a list of individual differences in traits and characteristics such as height, arm length, hand size, finger length, foot size, etc. Discuss that every species of animal has individual traits. Which student would be better at reaching the top shelf in the closet? Which student would be better at holding a large ball? Discuss the how individual differences may give an animal an advantage in its environment. (L.EV.04.21, L.EV.04.22, S.IP.04.11, S.IA.04.13)
- Teacher prep: Create die-cut butterflies from newspaper, wrapping paper, construction paper, and lined paper. The majority will be cut from newspaper. Tape sheets of newspaper to the board. Tape the butterflies to the newspaper. Cover the newspaper before students enter the room. Instruct students that they will have five seconds to count the number of butterflies hidden under the paper. Uncover the butterfly-covered newspaper for five seconds. Students record the number and color of the butterflies they observed. Discuss their findings as a group. Create a chart, then a graph, of the number and color of observed butterflies. As a class, uncover the butterflies and count how many and the color of butterflies present. Discuss the variations in observations. Relate the activity to a bird preying on butterflies. How does coloration give the butterflies an advantage or disadvantage? Conclude that individual differences or variations in physical characteristics give organisms an advantage for survival. (L.EV.04.21, L.EV.04.22, S.IP.04.11, S.IP.04.22, S.IP.04.16, S.IA.04.11, S.IA.04.13)
- Students understand a plant's needs. Next, they discuss that a plant makes its own food in its leaves and is called a producer. Plants produce or make their own food. Animals depend on plants and other animals for food and are called consumers. Students use pictures or word cards of common plants and animals to construct food chains first and show the interconnections through food webs, using arrows to show the flow of energy (seeds, grasses, trees, mice, rabbits, moles, raccoons, deer, coyotes, house cat, owls, etc.). Most food chains have 3-4 links. Draw pictures or develop an exhibit to show the food chain or food web. Note: the arrows show the direction that the energy flows through a food chain. (L.EC.04.11, S.IA.04.13, S.RS.04.13)
- Research different kinds of animals using books and Internet sources to find out the foods they eat. Determine from the foods if the animal is an herbivore, omnivore or carnivore. Make a poster showing the animal, its foods and a food chain or web that it is part of. (L.EC.04.11, S.IA.04.14, S.RS.04.12, S.RS.04.13, S.RS.04.14)

- In a cooperative group, research Michigan plants and animals that are on the threatened and endangered list. Using a chart, list the plant or animal and the reason or reasons it is on this list. What are the most common reasons? What is the human role in this plant or animal's reason for being on this list? Rank the list in order of importance to save. Have a class discussion to compare the rankings and the reasons. (L.EC.04.21, S.IA.04.12, S.IA.04.13, S.IA.04.14, S.RS.04.12)
- Using information on invasive species of Michigan (zebra mussels, quagga mussels, round goby, ruffe, purple loosestrife, emerald ash borer, spiny water flea, sea lamprey, etc.) write and act out a simple play that shows the cause that brought these species and the effect on food chains. (L.EC.04.21, S.IA.04.14, S.RS.04.12)

Evaluate Student Understanding

Formative Assessment Examples

- Chart of results from an investigation of plants and their requirements. (L.OL.04.15)
- Draw a picture of an animal and plant comparing their basic needs. (L.OL.04.15, L.OL.04.16)
- Choose one plant or animal and write paragraph explaining how it is adapted to survive in its environment. (L.EV.04.21, L.EV.04.22)
- Create a food chain and a food web that includes water flea, sunfish and heron. (L.EC.04.11)
- Write a paragraph explaining the affects of a change in a food chain. (L.EC.04.21)

Summative Assessment Examples

- Draw or construct an environment for an imaginary plant or animal that meets all of its needs. Identify and describe how the organism's needs are met. (L.OL.04.15, L.OL.04.16)
- Draw food chains that include all levels (producers, consumers and decomposers) and indicate energy flow using arrows. Describe and draw the results of a flood, drought, fire, subdivision, etc. (L.EC.04.11)
- Write a paragraph explaining how individual differences among organisms give them an advantage for survival. (L.EV.04.21, L.EV.04.22)

Enrichment

- Research scientists such as Charles Darwin, Luther Burbank, Charles Turner and George Washington Carver to understand their contributions to scientific knowledge.
- Research Rachel Carson to understand how she discovered disruptions in our food chains and their effects.
- Visit the zoo or a botanical garden. Observe and describe how the animals/plants needs are met within the constructed environment. How is this different and the same as their natural environment? What are the advantages and disadvantages of each?
- Research the work of Dr. Robert Ballard and his investigations of ecosystems at the bottom of the ocean that do not use the sun as a source of energy.
- Study other ecosystems (rain forest, desert, mountain, prairie, tundra) and make a poster or diorama that shows the food chains or food web of that ecosystem.
- Investigate color phases among some animal species (squirrels, fox, etc.) to determine the advantages or disadvantages of coloration.
- Research the effects that global climate change, urban sprawl, deforestation, off shore drilling, etc., have on plant and animal populations.

Intervention

- Give students pictures of one plant and one animal. Students research their organisms on the Internet or media. Students draw a picture of one environment that meets the needs of both the plant and the animal.
- Observe a tank of different colored goldfish. Discuss the variation in color. Discuss how the color variations would affect their survival in certain environments, i.e. muddy pond, white pool, etc.
- Sort pictures of organisms into herbivores, omnivores, carnivores, producers, consumers, and decomposers. Create a match game.
- Make food chains and food webs with animals in the area or with pictures cut from magazines.
- Students look at different ecosystems and make simple food chains and food webs based on the ecosystem.

Examples, Observations, and Phenomena (Real World Context)

The National Wildlife Federation and Environmental Protection Agency work together to keep track of populations and changes in populations of plants and animals. Organisms that become threatened by changes in the environment, hunting or poaching, disease, and other outside factors are placed on *threatened* or *endangered species* list. For example, the polar bear is an endangered species. The habitat of the polar bear is threatened by global warming. The main food source, the seal, is more difficult for the polar bear to hunt due to the shifting and melting ice. There are dozens of endangered species. Some animals and plants have become extinct due to the destruction of habitat and interruption of the food web.

Human activities, such as land development, pollution, hunting and poaching, and careless use of natural resources are the main threat to habitats and environments that support diverse species on Earth.

The term “survival of the fittest” is a real world application of the survival of animals and plants in their environment. Organisms with the strongest features that help them to get food, maintain body temperature, escape danger, build homes or nests, and reproduce survive at a greater rate in their environment. Organisms that display weakness in their physical characteristics that help them to survive become prey to other animals or die from lack of nutrition.

Scientists who have contributed to the study of plants and animals are Luther Burbank, Ibn Al-Baitar, Charles Turner and George Washington Carver.

Literacy Integration

Reading

R.CM.04.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.04.02 retell through concise summarization grade-level narrative and informational text.

R.CM.04.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about plants and animals:

Woods Walk, Henry W. Art and Michael W. Robbins, 2003

Food Chains and Webs: What are They and How Do They Work?, Andrew Solway, 2007.

Forest Food Chains, Bobbie Kalman, 2004

Food Chains, Peter Riley, 1999

How Animals Live, Bernard Stonehouse and Esther Bertram, 2004

Can We Save Them?, David Dobson, 1997

Writing

W.PR.04.01 set a purpose, consider audience, and replicate authors' styles and patterns when writing a narrative or informational piece.

W.PR.04.02 apply a variety of pre-writing strategies for both narrative and informational writing (e.g., graphic organizers such as maps, webs, Venn diagrams) in order to generate, sequence, and structure ideas (e.g., plot, setting, conflicts/resolutions, definition/description, or chronological sequence).

W.PR.04.03 draft focused ideas using a variety of drafting techniques composing coherent and mechanically sound paragraphs when writing compositions.

Mathematics Integration

Measurement

M.UN.04.01 Measure using common tools and select appropriate units of measure.

M.PS.04.02 Give answers to a reasonable degree of precision in the context of a given problem.

Data and Probability

D.RE.04.01 Construct tables and bar graphs from given data.

Instructional Framework

Instructional Examples

Earth in Space and Time

Fossils: E.ST.04.31, E.ST.04.32

Objectives

- Explain how fossils provide evidence of Earth's past.
- Compare and contrast life forms found in fossils and organisms that exist today.

Engage and Explore

- Draw sets of tracks on the board, such as dog, cat, a bicycle, two children, an adult. The tracks cross each other and go in different directions. Students make up scenarios to fit the tracks and defend their versions. (S.IP.04.11, S.IP.04.12)
- Students look at two different rocks. One of the rocks has clear fossil evidence and the other rock has no fossil evidence. Students make observations and generate questions about the pictures of the fossils in the rock. (E.ST.04.31, E.ST.04.32, S.IP.04.11, S.IP.04.12)
- Students make their own fossil by using plaster of Paris or drywall plaster. First flatten a circle of clay of 3-4 inch diameter. Cover the clay with a light coat of petroleum jelly and press shells into the clay leaving the print. Remove the shell and put a ring of poster board around the clay. Fill the clay with the plaster mix to about 1- inch thickness. Mix the plaster in small amounts as it will solidify quickly and be difficult to pour into the mold. Let the plaster set for at least a day. Remove the clay and ring and see the shell prints left in the plaster. Which is the mold and which is the cast? Discuss how the print of the shell is left, not the real shell. Discuss how finding shell fossils tell us that at one time water covered that area. (E.ST.04.31, E.ST.04.32, S.IP.04.11, S.IP.04.12, S.RS.04.12)
- Find a spot where students are able to dig in the ground. Look for examples of dead leaves, twigs and insects. Remove them carefully and clean up with a toothbrush. Did the things leave an imprint in the soil? Discuss how this is similar to what a paleontologist does as he/she studies fossils in rocks. (E.ST.04.31, E.ST.04.32, S.IP.04.11, S.IP.04.12)

Explain and Define

- Students develop a definition that a fossil is evidence of what lived in the past. Students develop an understanding that some animals are similar

to what exists today such as shellfish; and other animals, such as dinosaurs, no longer exist. Evidence of their existence is shown in fossils.

Elaborate and Evaluate

- Use the chart to complete the activity. Footprint size gives a good idea of overall size and height. Scientists have determined that the length of a footprint is generally equal to one-quarter the length of the hind-leg bone of the animal that made it. The length of the bone gives a good idea of the animal's overall size. In this activity, use numbers to determine the approximate lengths of dinosaur leg bones. (E.ST.04.31, E.ST.04.32, S.IA.04.11, S.IA.04.12, S.IA.04.13, S.RS.04.12)

Name of Dinosaur	Length of footprint	Probable length Of Hind-leg Bone (4 X footprint)	Probable Rank in Probable Size
<i>Triceratops</i>	15 inches (1 1/2 feet)		
<i>Tyrannosaurus</i>	30 inches (2 - feet)		
<i>Stegosaurus</i>	18 inches (1 - feet)		
<i>Velociraptor</i>	6 inches (1/2 foot)		
<i>Compsognathus</i>	3 inches (1/4 foot)		
<i>Ultrasaurus</i>	78 inches (6 - feet)		

- Fossil teeth are evidence of the animal's size and diet. Using pictures of different sizes and kinds of teeth, students identify whether the teeth belonged to an herbivore, omnivore, or carnivore and whether the animal was small, medium, or large. Write a paragraph supporting each decision. (E.ST.04.31, E.ST.04.32, S.IP.04.11, S.IP.04.12, S.RS.04.12)
- Use fossil prints or pictures of plants that show different types of ecosystems (ferns-wetland, pine cone-coniferous forest, maple leaves-deciduous forest, coral-ocean, etc.). Match the picture with the kind of ecosystem. (E.ST.04.31, E.ST.04.32, S.IP.04.11, S.IP.04.12, S.RS.04.12)
- Students draw an underground picture showing what might be found in the schoolyard by a future paleontologist. Plants, animals and humans would leave what items? What could they tell about the environment? (E.ST.04.31, E.ST.04.32, S.IP.04.11, S.IP.04.12, S.RS.04.12)

Evaluate Student Understanding

Formative Assessment Examples

- Discuss the scenario based on animal interaction evidenced through tracks. (E.ST.04.31)
- Discuss the difference between mold and cast fossils. (E.ST.04.31)
- Review the numbers on the table from the dinosaur size activity; and review the dinosaur ranking by size. (E.ST.04.31)
- Match plant fossil print and the kind of ecosystem in which it would be found. (E.ST.04.32)

Summative Assessment Examples

- Paragraph using supporting evidence about teeth to determine the size and type of consumer. (E.ST.04.31)
- Picture and a paragraph that has supporting details describing future evidence of today's environment. (E.ST.04.31, E.ST.04.32)

Enrichment

- Using animal footprints, students create their own story on a slab of clay. Have another student or group of students interpret the picture.
- Take a field trip to a natural history museum that has displays of dinosaurs.
- Research the Michigan state fossil, the mastodon, and the Michigan state stone, the Petosky stone.
- Research the dinosaur fossil, Sue, at the Chicago Field Museum. Write a report telling about the finding and restoration of this dinosaur.
- A paleontologist studies fossils. Find out the kind of tools needed to recover fossils from rocks.
- A baby mammoth was found preserved in ice in Siberia. Find current information on this type of fossil.
- The Tuatara Lizard is a living fossil. Research this lizard.
- Research crocodiles, cockroaches and ferns to discover the similarities and differences between ancient and present life forms.

Intervention

- Make a handprint or footprint in plaster. Discuss how this is similar to finding a footprint fossil of an animal. This fossil can be used to identify the kind of animal that lived in that area.
- Bury artifacts, bones, etc., in sand. Students act as paleontologists to uncover evidence. Students create a story based on the evidence.
- Using a fossil collection, students determine whether the fossil originated from a plant or animal. Support ideas with evidence.

Examples, Observations and Phenomena (Real World Context)

Fossils are evidence that dinosaurs existed. Natural history museums preserve and display dinosaur skeletons. The information archeologists and paleontologists learn from fossils gives evidence of once living organisms and the changes in climate over long periods of time.

Fossils of similar species of animals were found on different continents. Scientists use this evidence to show the continents were once connected.

Literacy Integration

Reading

R.CM.04.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.04.02 retell through concise summarization grade-level narrative and informational text.

R.CM.04.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about fossils:

A Dinosaur Named Sue by Fay Robinson, 1999

My Life as an Explorer (Hunt for the Past), Sue Hendrickson, 2001

New Dinos, Shelley Tanaka, 2003

Fossils, Melissa Stewart, 2002

Evolution, Linda Gamlin, 2000

Writing

W.PR.04.01 set a purpose, consider audience, and replicate authors' styles and patterns when writing a narrative or informational piece.

W.PR.04.02 apply a variety of pre-writing strategies for both narrative and informational writing (e.g., graphic organizers such as maps, webs, Venn diagrams) in order to generate, sequence, and structure ideas (e.g., plot, setting, conflicts/resolutions, definition/description, or chronological sequence).

W.PR.04.03 draft focused ideas using a variety of drafting techniques composing coherent and mechanically sound paragraphs when writing compositions.

Mathematics Integration

Data and Probability

D.RE.04.01 Construct tables and bar graphs from given data.

Number and Operations

N.MR.04.14 Solve contextual problems involving whole number multiplication and division.

Fourth Grade GLCE Companion Document

Unit 4: Sun, Moon, and Earth

SCIENCE

- Big Ideas
- Clarifications
- Inquiry
- Vocabulary
- Instruments
- Measurements
- Instructional Framework
- Enrichment
- Intervention
- Real World Context
- Literacy Integration
- Mathematics Integration

Fourth Grade Companion Document

4-Unit 4: Sun, Moon, and Earth

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**Fourth Grade Unit 4:
Sun, Moon, and Earth**

Content Statements and Expectations

Code	Statements & Expectations	Page
E.ST.E.1	Characteristics of Objects in the Sky – Common objects in the sky have observable characteristics.	3
E.ST.04.11	Identify the sun and moon as common objects in the sky.	3
E.ST.04.12	Compare and contrast the characteristics of the sun, moon, and Earth, including relative distances and abilities to support life.	4
E.ST.E.2	Patterns of Objects in the Sky – Common objects in the sky have observable characteristics and predictable patterns of movement.	5
E.ST.04.21	Describe the orbit of the Earth around the sun as it defines a year.	5
E.ST.04.22	Explain that the spin of the Earth creates day and night.	5
E.ST.04.23	Describe the motion of the moon around the Earth.	6
E.ST.04.24	Explain how the visible shape of the moon follows a predictable cycle, which takes approximately a month.	6
E.ST.04.25	Describe the apparent movement of the sun and moon across the sky through day/night and the seasons.	7

4 – Unit 4: Sun, Moon, and Earth

Big Ideas (Key Concepts)

- The moon and the Earth move in a predictable pattern around the sun.
- The predictable patterns of the Earth and moon define a day, year, and moon phases.
- The sun appears to move in a predictable pattern across the sky.

Clarification of Content Expectations

Standard: Earth in Space and Time

Content Statement – E.ST.E.1

Characteristics of Objects in the Sky – Common objects in the sky have observable characteristics.

Content Expectations

E.ST.04.11 Identify the sun and moon as common objects in the sky.

Instructional Clarifications

1. Identify means to recognize the differences between the sun and moon and other objects in the sky.
2. The moon is the closest object to Earth, and while many other objects are larger, the moon appears prominent in the sky because it is so close to Earth.
3. The sun is the closest star to Earth, and while many other stars are larger, the sun appears prominent in the sky because it is so close to Earth.

Assessment Clarifications

1. The moon is the closest object to Earth, and while many other objects are larger, the moon appears prominent in the sky because it is so close to Earth.
2. The sun is the closest star to Earth, and while many other stars are larger, the sun appears prominent in the sky because it is so close to Earth.

E.ST.04.12 Compare and contrast the characteristics of the sun, moon, and Earth, including relative distances and abilities to support life.

Instructional Clarifications

1. Compare and contrast means to note the similarities and differences of the sun, moon, and Earth.
2. The moon is the closest object in the sky to the Earth.
3. The sun is the closest star to the Earth.
4. The moon is a natural satellite of the Earth, and the Earth is a natural satellite of the sun.
5. The sun is capable of producing its own light, but the Earth and the moon reflect the sun's light.
6. The Earth is capable of supporting life, as we know it, because Earth has water, a breathable atmosphere, and light from the sun.
7. The moon is not capable of supporting life, as we know it, because it does not have breathable atmosphere.
8. The sun, moon, and Earth are nearly spherical.
9. Although the sun is much larger than the moon, they appear to be the same size because the sun is much farther away.
10. The Earth and moon are solid spheres and the sun is gaseous.
11. A common misconception is the sun and moon are the same size.
12. A common misconception is the sun is not a star.
13. A common misconception is the sun orbits the Earth.
14. A common misconception is the stars go away during the day, and the sun goes away at night.
15. A common misconception is the moon is not a satellite.
16. A common misconception is the moon can only be seen at night.
17. A common misconception is the moon has no gravity.
18. A common misconception is wind blows on the moon.

Assessment Clarifications

1. The moon is the closest object in the sky to the Earth.
2. The sun is the closest star to the Earth.
3. The moon is a natural satellite of the Earth and the Earth is a natural satellite of the sun.
4. The sun is capable of producing its own light, but the Earth and the moon reflect the sun's light.
5. The Earth is capable of supporting life, as we know it, because Earth has water, a breathable atmosphere, and light from the sun.
6. The moon is not capable of supporting life, as we know it, because it does not have breathable atmosphere.
7. The sun, moon, and Earth are spheres.
8. Although the sun is much larger than the moon, they appear to be the same size because the sun is much farther away.

Content Statement – E.ST.E.2

Patterns of Objects in the Sky – Common objects in the sky have observable characteristics and predictable patterns of movement.

Content Expectations

E.ST.04.21 Describe the orbit of the Earth around the sun as it defines a year.

Instructional Clarifications

1. Describe means to tell or depict in spoken or written words how the orbit of the Earth around the sun defines a year.
2. It takes the Earth approximately 365.25 days or one year to make a complete revolution around the sun. Leap year occurs every fourth year to accommodate the extra 0.25 day per year.
3. Revolution is the movement of one object on a path (orbit) around another object.
4. The path the Earth follows is called an orbit. The Earth follows the same imaginary path every year.

Assessment Clarifications

1. It takes the Earth approximately 365 days or one year to make a complete revolution around the sun.
2. The path the Earth follows is called an orbit. The Earth follows the same imaginary path every year.

E.ST.04.22 Explain that the spin of the Earth creates day and night.

Instructional Clarifications

1. Explain is to clearly describe by means of illustrations (drawing), demonstrations, and/or verbally tell how the spin of the Earth creates day and night.
2. The Earth spins on its axis. It takes the Earth approximately 24 hours or one day to make one complete rotation.
3. Rotation is the turning of an object on its axis.
4. Axis is an imaginary line through the center of an object around which that object turns.
5. The side of the Earth facing the sun is experiencing daytime and the side not facing the sun is experiencing night.

Assessment Clarifications

1. The Earth spins on its axis. It takes the Earth approximately 24 hours or one day to make one complete rotation.
2. The side of the Earth facing the sun is experiencing daytime and the side not facing the sun is experiencing night.

E.ST.04.23 Describe the motion of the moon around the Earth.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words the path the moon travels around the Earth.
2. The moon travels on a path around the Earth called a revolution.
3. The moon rotates on its axis.
4. The moon takes approximately 28 days to both rotate and revolve thus causing the same side of the moon to always face the Earth.
5. A common misconception is the moon does not rotate on its axis as it revolves around the Earth.

Assessment Clarification

1. The moon travels on a path around the Earth called a revolution.

E.ST.04.24 Explain how the visible shape of the moon follows a predictable cycle, which takes approximately a month.

Instructional Clarifications

1. Explain is to clearly describe by means of illustrations (drawing), demonstrations, and/or verbally tell how the visible shape of the moon follows a predictable cycle that takes approximately a month.
2. The moon shines by reflecting light from the sun.
3. The observable shape of the moon changes from day to day in a cycle that lasts about a month. The different shapes of the moon are called phases.
4. No matter where the moon is in space, half is lighted and half is dark. As the moon revolves around the Earth, we see different amounts of the moon's lighted side. So, the moon seems to change shape.
5. The cycle of phases is new moon, waxing crescent, first quarter, waxing gibbous, full moon, waning gibbous, last quarter, and waning crescent. Note: Although the quarter moon looks like a "half moon," the word quarter refers to the moon being one fourth of its way through its cycle.
6. A common misconception is the moon gets bigger and smaller.
7. A common misconception is the phases of the moon are caused by shadows cast on its surface by other objects in the solar system.
8. A common misconception is the phases of the moon are caused by the shadow of the Earth on the moon.
9. A common misconception is the moon moving into the sun's shadow cause the phases of the moon.
10. A common misconception is clouds cause the phases of the moon.
11. A common misconception is the same side of the moon is always dark.

Assessment Clarifications

1. The moon is visible because it reflects light from the sun.
2. The moon seems to change shape from day to day in a cycle that lasts about a month.
3. The different shapes of the moon are called phases.

E.ST.04.25 Describe the apparent movement of the sun and moon across the sky through day/night and the seasons.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words the apparent movement of the sun and moon across the sky through day/night and the seasons.
2. The sun appears to move across the sky every day from the eastern part of the sky to the western part of the sky. The apparent motion of the sun across the sky is due to the Earth's rotation.
3. The path of the sun changes slowly with the seasons getting higher in the summer and lower in the winter.
4. The moon also appears to move across the sky from east to west on a daily basis due to the Earth's rotation, however the time of the rising and setting varies throughout its cycle.
5. A common misconception is the sun rises exactly due east and sets exactly due west every day.
6. A common misconception is the sun is directly overhead at 12:00 noon everyday.

Assessment Clarifications

1. The sun appears to move across the sky in the same way from east to west every day.
2. The path of the sun changes slowly with the seasons getting higher in the summer and lower in the winter.
3. When visible, the moon also moves across the sky from east to west on a daily basis.

Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implications
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Inquiry Processes
S.IP.04.11 Make purposeful observations of the sun and the moon using the appropriate senses.
S.IP.04.12 Generate questions based on observations of the sun and the moon
S.IP.04.14 Manipulate simple tools that aid observation and data collection (ruler, thermometer).
S.IP.04.15 Make accurate measurements with appropriate units (centimeters, Celsius).
S.IP.04.16 Construct simple charts and graphs from data and observations of the movements of the sun and the moon.
Inquiry Analysis and Communication
S.IA.04.11 Summarize information from charts of the Earth, sun, and moon.
S.IA.04.12 Share ideas about the Earth, sun, and moon through purposeful conversation in collaborative groups.
S.IA.04.13 Communicate and present findings of observations and investigations.
S.IA.04.14 Develop research strategies and skills for information gathering about the sun and the moon.
Reflection and Social Implications
S.RS.04.11 Demonstrate understanding of the relationship of the Earth, sun, and moon through illustrations and models.
S.RS.04.14 Use samples as evidence to separate fact from opinion when classifying the Earth, sun, and moon.
S.RS.04.15 Use evidence when communicating about the Earth, sun, and moon.
S.RS.04.16 Identify technology used in everyday life when taking shadow readings of the sun's movement in the sky.
S.RS.04.18 Describe the effect the sun has on the balance of the natural world.
S.RS.04.19 Describe how people such as Ptolemy, Copernicus, Galileo, Hubble, and Hawking have contributed to science throughout history and across cultures.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
Earth sun moon star observe reflect ability to support life produce light breathable atmosphere revolution orbit rotation Earth's axis phases of the moon day night cycle seasons year natural satellite relative distance capable visible shape predictable cycle apparent movement	seasonal change sun's position planet relative position solar system compare contrast approximately

Instruments, Measurements, Representations

temperature	thermometer	Celsius
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Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Characteristics of Objects in the Sky: E.ST.04.11, E.ST.04.12

Patterns of Objects in the Sky: E.ST.04.21, E.ST.04.22, E.ST.04.23, E.ST.04.24, E.ST.04.25

Objectives

- Make observations and describe the apparent movement of the sun and moon across the sky.
- Determine why there is day and night and a year.
- Observe the phases of the moon.

Engage and Explore

- Students are fascinated with the skies but often have misconceptions and a difficult time understanding the concept of size and distance. In the hallway, outside, or in the gym, a student stands and holds a baseball about 10 feet away from the class. Another student stands about 40 feet away and holds a basketball. Discuss the relative sizes of the balls and the distances between them. Students measure the relative sizes of the two balls by fully extending their arm and aligning their thumb between their eye and each ball. Note: the distances may need to be adjusted. Repeat the activity with the sun and a full moon. Each object will be about the size of your thumbnail. (E.ST.04.11, E.ST.04.12, S.IP.04.11, S.IP.04.14, S.IA.04.14, S.RS.04.11, S.RS.04.15)
- Students predict the sizes of the Earth and moon relative to the sun. Using play clay, the students create Earth and moon models based on an eight-inch diameter ball representing the sun. After comparing their models, discuss the sizes the clay balls should be relative to the eight-inch diameter

- ball. (The actual size of the Earth should be about the size of a peppercorn and the moon $1/4^{\text{th}}$ of the Earth.) (E.ST.04.12, S.RS.04.11)
- Relative sizes and distances between the sun, moon, and Earth are shown outside. Use an eight-inch diameter ball to represent the sun, a peppercorn to represent the Earth, and a very small pinhead to represent the moon. It helps to attach the moon and Earth to cards so they don't get lost. Place the sun at one end of the playground. Use a yardstick and count out 26 lengths from the sun to the Earth. The moon is 2 inches from the Earth. This model is accurate both in size and distance. Pluto would be another 974 yardstick lengths away. Have the students reflect on the fact that the moon is the farthest man has been in space. Other fun facts are 109 Earths lined up equal the diameter of the sun and a million Earths can fit into the sun. (E.ST.04.11, E.ST.04.12, S.IP.04.11, S.IA.04.14, S.RS.04.12, S.RS.04.15)
 - Time needs to be spent outside making observations of the sun. On a sunny day put out a piece of chart paper with a stick standing up vertically in the center. Record the shadow the stick makes by tracing it. Repeat this every half hour for five hours. Allow the students time to measure the lengths of the shadows and have substantive conversation about the data they recorded. (E.ST.04.22, E.ST.04.25, S.IP.04.11, S.IP.04.14, S.IP.04.15, S.IP.04.11, S.IP.04.12, S.IP.04.14, S.RS.04.16)
 - The sun produces heat and light that is reflected by the Earth and moon. Take the temperatures of two cups of cold water. Cover one with aluminum foil and leave the other uncovered. Put them in the sun for 15 minutes and take the temperatures again. The foil reflects the radiation while the water absorbs it. (E.ST.04.12, S.IP.04.14, S.IP.04.15, S.IP.04.14, S.RS.04.14, S.RS.04.16)
 - The moon is more difficult to track but the students can create an observation chart and keep track of the shape of the moon for a month. (E.ST.04.23, E.ST.04.24, E.ST.04.25, S.IP.04.11, S.IP.04.12, S.IP.04.16, S.IP.04.11, S.IP.04.14, S.RS.04.11)
 - Demonstrating the spinning of the Earth on its axis needs to be reinforced many times. Students put their index finger on top of their heads and spin counterclockwise showing the Earth's rotation on its axis. A flashlight shining at them can simulate the sun. When they are facing the "sun", it is day for them; and when they aren't facing the "sun", it is night for them. The moon also rotates on its axis, but it is very slow compared to the Earth. A helpful way for students to remember the concept of rotation and day and night is that the words "rotation", "day", and "axis" all have the letter "A". In pairs students can have substantive conversation about the words day and night. (E.ST.04.22, S.IP.04.14, S.RS.04.15)
 - Demonstrating the Earth or moon traveling on an imaginary path also needs to be reinforced many times. Students walk around another object or use balls and flashlights to simulate revolution. A helpful way for students to remember revolution is that the words "revolution" and "orbit" have the letter "O" in them, and the letter O looks like an orbit. In pairs students can have substantive conversation about the definition of a year. (E.ST.04.21, S.IP.04.14, S.RS.04.15)

Explain and Define

- The difference between revolution and rotation can be clarified with many class discussions and demonstrations. The definitions for axis, orbit, day, night, and year are a natural fit while discussing rotation and revolution. Pictures should be made along with the definitions. Differences in sizes of the sun and moon and the phases of the moon also can be discussed. (E.ST.04.11, E.ST.04.21, E.ST.04.22, E.ST.04.23, E.ST.04.24, S.IP.04.12, S.IP.04.12)

Elaborate and Apply

- The Earth, sun, and moon can be compared and contrasted on a chart. While in cooperative groups, students use reference books to find various characteristics about the Earth, sun, and moon. (E.ST.04.12, S.IP.04.16, S.IP.04.11, S.RS.04.14)

	Size (diameter)	Distance from sun	Length for 1 rotation	Length for 1 revolution	Can support life	Fun facts
Sun		---	---	---		
Moon						
Earth						

- Students make a two or three-dimensional model of the Earth, sun, and moon. The model should show the rotations and revolutions of the Earth and moon, give the length of time it takes for these movements, and demonstrate day and night. (E.ST.04.11, E.ST.04.12, E.ST.04.21, E.ST.04.22, E.ST.04.23, S.IP.04.13, S.RS.04.11, S.RS.04.15)
- Use hands to easily recognize the different phases of the moon. The start of the moon cycle is the new moon when no moon is observed. By cupping the right hand into a backwards "C" shape, the moon phase that fits into the curve is the first quarter or the time when the moon appears to be getting bigger (waxing). When the left hand is cupped and the moon phase fits into the curve, it is the last quarter or time when the moon appears to be getting smaller (waning). A full moon is halfway through the cycle. Understanding what causes the phases is very difficult for fourth grade students and is not something they are required to learn.
- Show the phases using chocolate sandwich cookies. When they are carefully pulled apart, the frosting stays on one cookie and looks like a full moon. Using a toothpick, the frosting is scraped off to show the phases. The cookie without frosting looks like a new moon. Students can lay out the cookies, and then draw pictures of the phases of the moon while looking at the cookies and using their hands in the "C" shapes to help. (E.ST.04.24, S.IP.04.13, S.RS.04.11)
- A long-term project can be used to note how high the sun is in the sky through different seasons. At the start of each month, students measure

the height of the sun at noon using fists. Students clench both hands into fists, and put their arms out straight in front. Starting at the horizon, they continuously put one fist on top of the other until they get to the height of the sun. Count how many fists it takes. Each fist represents approximately 10 degrees. (Three fingers equal five degrees and the pinky finger is one degree if a fractional part is needed.) Record the data on a graph. Note: the time. *Warning: Do not look directly at the sun.* (E.ST.04.25, S.IP.04.16, S.IP.04.11, S.RS.04.11)

- To determine that the moon rises in the eastern part of the sky like the sun, the students need to make observations of the moon. If the moon is seen in the east, it is rising; and if it is seen in the west, it is setting. The time of day the moon is observed can be recorded on a chart. Unfortunately the moon does not always rise or set at approximately the same time like the sun does due to the fact that it's revolving around the Earth. It does, however, always rise in the east and set in the west. Fourth graders only need to know that it does rise in the east and set in the west. The best time to see the moonrise is during the full moon. (E.ST.04.25, S.IP.04.16, S.IP.04.11, S.RS.04.15)

Evaluate Student Understanding

Formative Assessment Examples

- Organize facts about the sun, moon, and Earth on a chart. (E.ST.04.11, E.ST.04.12)
- Draw diagrams and pictures to show understanding of the terms rotation, revolution, day, night, year, orbit, and phases of the moon. (E.ST.04.21, E.ST.04.22, E.ST.04.23, E.ST.04.24)
- Keep ongoing graphs and/or charts showing the data collected about the sun and the moon. (E.ST.04.24, E.ST.04.25)

Summative Assessment Examples

- Explain the difference between the words rotation and revolution. (E.ST.04.21, E.ST.04.22)
- Explain the difference between the time it take the Earth to rotate and revolve and the moon to rotate and revolve. (E.ST.04.21, E.ST.04.22, E.ST.04.23)
- Put pictures of phases of the moon in the correct order. (E.ST.04.24)
- Create a model of the Earth, sun, and moon that has labels showing: rotation and revolution of the Earth and moon, day and night, a year, and the relative sizes of the Earth, sun, and moon. (E.ST.04.21, E.ST.04.22, E.ST.04.23, E.ST.04.24)

Enrichment

- Research about craters on the moon and what causes them. Set up an investigation making craters by dropping clay balls into flour and observing the patterns and sizes of the craters. Try different heights to see if the size of the crater changes. A toothpick inserted into the clay ball makes it easier to drop the ball and remove it from the flour without disturbing the crater.
- Do research about the missions to the moon and what it was like for the astronauts. Students plan a make-believe mission to the moon. What would be the 10 most important items they would need to take and why?
- Research about possible missions to the sun.
- Take a field trip to a planetarium.
- Answer the question, "Why does it look like the American flag the astronauts planted is waving on the moon?" (Answer: there is a bar across the top to hold it out. Remember there is gravity on the moon and there is no atmosphere so no wind.)
- Research other moons around other planets.
- Contributions of scientists throughout history and across cultures have contributed significantly to current scientific thought. Knowledge about space is constantly changing. Scientists such as Ptolemy, Copernicus, Galileo, Steven Hawking, Neil deGrasse Tyson, Henrietta Leavitt, and Maria Mitchell can be studied.

Intervention

- Several times per day students get up and demonstrate rotation and revolution.
- Have students in groups of three play act the sun, moon, and Earth. Repeat all the vocabulary words while acting them out.
- Use many flashlights and Styrofoam balls to demonstrate day and night and a year.
- Find examples of rotation and revolution in everyday life.
- Make a flipbook showing the phases of the moon.
- Use a calendar that shows the phases of the moon. Put up a phase once a week on the class calendar.
- In art class do a lesson on perspective and draw pictures with things in the foreground and things in the background.

Examples, Observations, and Phenomena (Real World Context)

Many misconceptions are found when observing objects in the sky. Our knowledge of space is constantly changing; however, our understanding of the phenomena discussed in this unit is and has been stable for a very long time. Scientists have understood the rotation of the Earth on its axis and the revolution of the Earth around the sun and moon around the Earth for centuries.

Discuss why pictures are drawn or models are made either incorrectly or are misleading. For example, the sun is always represented as a small object in a picture of the solar system simply because it isn't possible to draw its accurate size and distance relative to the Earth and moon. The paper would have to be the size of the classroom. If a model shows the correct relative sizes of the sun, moon, and Earth, then the relative distances are often shown incorrectly or vice versa because the model has to be a useful size. The news sometimes has reporters giving incorrect information or updates on new findings by astronomers. Cartoon pictures or even pictures in textbooks can be incorrect or misleading. What was true 10 years ago may no longer be correct. Students need to be aware of misinformation and new information in their everyday lives.

NASA is once again planning a mission to the moon. Encourage students to visit the NASA website to view current information about space and simulations of the movement of the Earth and moon.

The sun is often in the news from solar power to causing skin cancer to solar flares disrupting computers.

Literacy Integration

Reading

R.CM.04.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.04.02 retell through concise summarization grade-level narrative and informational text.

R.CM.04.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of the trade books available for learning about the sun, moon, and Earth are:

Postcards From Pluto: A Tour of the Solar System by Loreen Leedy, 1996

The Moon by Seymour Simon, 2003

The Sun by Seymour Simon, 2003

Earth: Our Planet in Space by Seymour Simon, 2003

George's Secret Key to the Universe by Steven and Lucy Hawking, 2007

Writing

W.PR.04.01 set a purpose, consider audience, and replicate authors' styles and patterns when writing a narrative or informational piece.

- Using the same format as the book *Postcards from Pluto* and the chart that was made comparing and contrasting the Earth, sun, and moon, write postcards from the moon and the sun that include facts.

W.PR.04.02 apply a variety of pre-writing strategies for both narrative and informational writing (e.g., graphic organizers such as maps, webs, Venn diagrams) in order to generate, sequence, and structure ideas (e.g., plot, setting, conflicts/resolutions, definition/description, or chronological sequence).

W.PR.04.03 draft focused ideas using a variety of drafting techniques composing coherent and mechanically sound paragraphs when writing compositions.

Mathematics Integration

M.UN.04.01 Measure using common tools and select appropriate units of measure.

M.PS.04.02 Give answers to a reasonable degree of precision in the context of a given problem.

D.RE.04.01 Construct tables and bar graphs from given data.