Third Grade Companion Document

3-Unit 1: Changes in Motion

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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 the 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.

3rd Grade Unit 1:
Changes in Motion

Content Statements and Expectations

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).
7. Note: The third grade unit focuses on the motion of objects on Earth and refers only to weight. Mass is introduced at a later grade level.

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 weight 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 weight 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	change of speed
force strength	measurement of motion
push	relative position
pull	north
gravity	south
weight	east
mass	west
motion	right
position	left
speed	up
speeding up	down
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	

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, axes 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)

Motion		
	Observations	Descriptions
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); 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 Companion Document
3-Unit 2: Light and Sound

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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 the 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.

3rd Grade Unit 2:
Light and Sound

Content Statements and Expectations

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 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.

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 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.

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

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 investigation 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 more than one source of light, 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 as a more energy efficient source mercury-vapor lighting in parking lots, and the multiple uses of laser light. 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 spearfish 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 varying the pace for effect.

Instructional Example- Sound Energy

Energy
Sound: P.EN.03.31, P.EN.03.32

Objectives

- Demonstrate that vibrating objects produces 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 causes 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 songs to 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 varying the pace for effect.

Third Grade Companion Document
3-Unit 3: Structures and Functions of Living Things

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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 the 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.

3rd Grade Unit 3:
Structures and Functions of Living Things

Content Statements and Expectations

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. They 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-leafed.
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 Clarifications

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

Measurement	Instrument	Representation
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 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(s) have that makes it so 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 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. 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. 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 in formational 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 axes and identify the maximum, minimum, and range of values in a bar graph.

Third Grade Companion Document
3-Unit 4: Earth Materials, Change, and Resources

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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 the 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.

3rd Grade Unit 4:
Earth Materials, Change, and Resources

Content Statements and Expectations

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, 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 non-living 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 non-living 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. There is a certain amount of them in nature and can be used up. Most come from the ground. Fuels taken from the Earth and metals 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-foresting, 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, reforesting, 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-foresting 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, and 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, reforesting, 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 non-living 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 non-living 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), 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 material that makes 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, a mineral is naturally occurring, a mineral has a chemical composition, and a mineral 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 things.

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

13. There are many changes that occur on the Earth's surface or crust. Some happen rapidly and some take millions of years.
14. 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).
15. Glaciers are moving masses of ice and snow that change the land. The changes made by glaciers are a slow process.

16. A volcano is an opening in the Earth's surface through which lava and other materials erupt. This process happens quickly.
17. 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.
18. 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 though 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	habitat
Earth materials	pollution
rock	rock cycle
clay	fossil fuels
sand	sustainability
gravel	farmland
soil	solid rock
soil texture	Earth materials' ability to hold water
soil color	crude oil
water	natural gas
wind	coal
ice	nutrients
helpful change	particle size
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	

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
Observation Tools: hand lens		
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, axes 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 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 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 3 x5 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 and 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 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)

Explore

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 materials. 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, AZ, 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 and 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 axes 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 axes 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.