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.