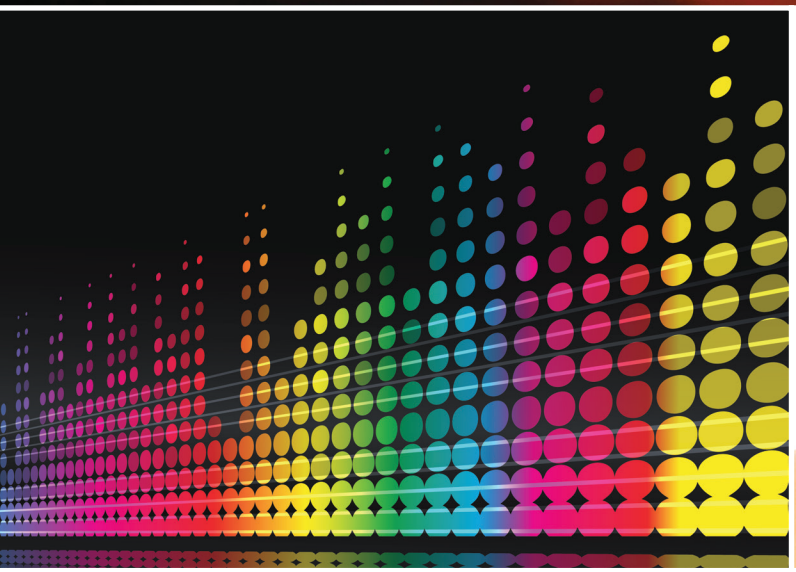
Sample Grade 1
Teacher's Guide
and
Student Literacy



Light and Sound Waves II

A New Generation

Building Blocks of Science®

Materials List

Needed from the kit
1 bottle of washable paint
12 cardboard tubes
12 flashlights with D-cell batteries
12 flexible mirrors
1 inflatable ball
1 Literacy Series Reader: *Light and Sound Waves*
24 paper cups, 6 oz
12 pieces of synthetic skin
12 plastic cups with lids, 1 oz
24 plastic cups, 9 oz
1 roll of waxed paper
1 roll of plastic wrap
1 roll of twine
12 small cardboard boxes
12 rubber bands, #16
24 rubber bands, #32
12 rubber bands, #64
15 sheets of black construction paper

Provided by the teacher
1 air pump with needle
1 box of hand wipes (optional)
12 cardboard shoeboxes
24 cotton balls
12 crayons*
120 grains of rice (approximately one-quarter to one-half cup)
1 knife or pair of scissors
1 measuring tape
12 metal spoons
1 red marker
12 rulers, 12 in
24 pairs of scissors
6 paper plates
1 push pin
1 roll of strong tape
24 small paper clips
12 translucent containers (e.g., plastic milk containers)
1 trashcan or medium-sized box
12 unsharpened pencils
1/2 gallon of water
Assorted classroom items that are transparent, translucent, and opaque (such as pencils, transparency film, books, etc.)
Chart paper
Glue sticks
Markers

Provided by the student

1 science notebook
1 pencil

Light and Sound Waves

A New Generation

Teacher's Guide

Building Blocks of Science®

Unit and Lesson Summaries

Unit Overview

The Building Blocks of Science® unit *Light and Sound Waves* introduces students to the physical science concepts of light and sound, and that both phenomena travel in waves. In the first part of the unit, students use flashlights to explore and then discuss how light travels and how light interacts with different materials. Students collect evidence of these properties and interactions by manipulating the path of light and experimenting with several materials to see how light interacts with each. In the second part of the unit, students investigate sound, and how sound travels. By creating different sounds and examining how the sound is produced, students trace the wave from the point at which it is created to the ear. To conclude the unit, students review what they know about light and sound and compare the similarities and differences.

Assessment

This unit offers several ways to assess students, including a pre- and a post-unit assessment opportunity. Teachers can also use class discussions and charts to assess each lesson. Student activity sheets and science notebook entries—including drawings, writings, and dictated statements—can be used to gauge individual understanding of objectives and key vocabulary throughout the unit. The Assessment Observation Sheets supplied with each lesson help teachers document and measure students' progress and knowledge using informal assessment. A general rubric is provided to help teachers evaluate individual students at any point in the unit. The rubric provides a progression of skills and understanding that covers exploration, vocabulary, concept building, and notebook entries. Finally, a summative assessment gives students the opportunity to demonstrate unit-specific content knowledge by responding to questions in a variety of formats.

Lesson 1: The Properties of Light

Students begin by holding a brainstorming session regarding what they know about light and its sources. They discuss how light is important for many reasons such as providing energy for living organisms and heating the earth. Students then make observations inside a pinhole box to determine that objects can be seen only when illuminated.

Lesson 2: Transparent, Translucent, Opaque

In this lesson, students investigate how light interacts with different materials. Students use a flashlight to compare how light travels through three types of materials and which materials cast a shadow. They record the information that they collect during several investigations in a working vocabulary book and on a Student Activity Sheet titled *Transparent, Translucent, or Opaque?* Students use these tools to assess their understanding of the concepts of clear (transparent), cloudy (translucent), and dark (opaque) objects.

Lesson 3: Reflection: Bouncing Beams

In the opening discussion, students recall that light travels in straight lines, discuss that light must enter the eye in order for an object to be seen, and speculate on how the direction in which a light beam shines might be changed.

Students then participate in several activities to learn about the law of reflection. First, they use flashlights and mirrors to demonstrate reflection. Then, they explore how reflections change when observed using curved, flexible mirrors compared with plane mirrors.

Finally, students begin developing an understanding about the line of reflection and extend this geometric concept using handprints and letters and multiple mirrors.

Lesson 4: Vibrations and Sound

In Lesson 4, the class shifts its focus from light to sound. In this introductory lesson on sound, students will see the relationship between waves and sound by observing vibrations on a drum. After observing that the vibrations cause sound waves, they will experiment and observe that the length of a vibrating object affects the sound that is produced.

Lesson 5: How Does Sound Travel?

To further develop the understanding that sound travels in waves, students use solid objects and string to demonstrate the movement of sound. Students experience a sound being transferred by waves directly to their ears and then listen for the sound of the vibrations from the same object to be transferred to their ear at the other end of a string. Students then use a device through which they can transmit voice waves.

Lesson 6: Communicating with Light and Sound

In this final lesson, students learn about different forms of communication and develop the understanding that all communication requires a transmitter, receiver, and code to transfer information. Students work in pairs to apply what they have learned in the unit to design and build a communication device that uses either light or sound. Once they have constructed their device, they will demonstrate how their device works to the class and describe ways they might improve on their design.

Lesson 5: How Does Sound Travel?

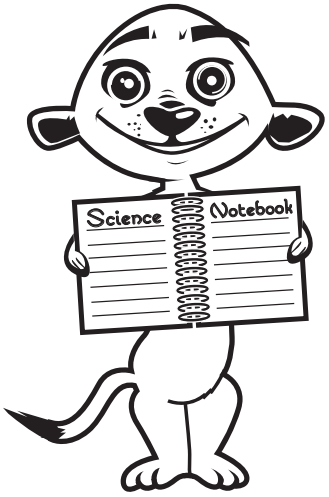
Lesson Essentials	Next Generation Science Standards	Language Arts and Math Standards
Objectives: • Recognize that vibrations create sound waves. • Draw conclusions about how sound travels in waves through solid objects. • Use waves to transmit sound over a distance. **Time Requirements:** **Teacher Preparation** **Part A:** 10 minutes **Part B:** 10 minutes **Lesson** **Part A:** 1 class sessions **Part B:** 1 class sessions **Essential Questions:** • How does sound travel? **Vocabulary:** • Code • Travel • Waves	**Performance Expectations** • **1-PS4-1:** Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. **Disciplinary Core Ideas** • **PS4.A:** Wave Properties **Science and Engineering Practices** • Planning and Carrying Out Investigations **Crosscutting Concepts** • Cause and Effect	**Language Arts** • **L.1.4:** Vocabulary Acquisition and Use • **L.1.5:** Vocabulary Acquisition and Use • **RI.1.7:** Integration of Knowledge and Ideas • **SL.1.2:** Comprehension and Collaboration • **SL.1.5:** Presentation of Knowledge and Ideas • **W.1.8:** Research to Build and Present Knowledge **Math** • **1.G.A.1:** Reason with shapes and their attributes. • **1.MD.A.1:** Measure lengths indirectly and by iterating length units.

Cross-Curricular Connections	Literacy	Assessment Strategies
Science Notebooks Language Arts Math Science Technology Art Music Movement Education	**Literacy** ***Light and Sound Waves* Literacy Reader*:** • "What Is Sound?" pgs. 10–11 • "Science and Engineering Practices," pg. 14 ** See Appendix E for Literacy Connections for before, during, and after reading.*	**Student Activity Sheets:** • Student Activity Sheet 5: *Spoon Sounds* **Formative Assessments:** **1.** Use Assessment Observation Sheet for this lesson to assess your class and adjust instruction as needed. **2.** Evaluate student understanding through class discussions. **General Rubric:** • Refer to the General Rubric included in Appendix D to assess individual progress.

LESSON NOTES

Lesson 5

How Does Sound Travel?



MATERIALS

Student

1 science notebook*

1 Student Activity Sheet 5: *Spoon Sounds*

Team of two students

1 piece of twine, 2 feet long

1 metal spoon*

1 unsharpened pencil*

1 assembled string phone*

Teacher

1 roll of twine

1 measuring tape*

24 paper cups, 6 oz

24 small paper clips*

1 pair of scissors*

Assessment Observation Sheet: Lesson 5

General Rubric (Appendix D)

*These materials are needed but not supplied.

LESSON OVERVIEW

To strengthen the understanding that sound travels in waves, students use solid objects and string to demonstrate the movement of sound. Students will first observe the sound being transferred by waves directly to the ears by striking a metal spoon tied to a string and listening for the sound of the vibrations at the other end. Students use a device that transmits voice waves through string.

OBJECTIVES

- Recognize that vibrations create sound waves.
- Draw conclusions about how sound travels in waves through solid objects.
- Use waves to transmit sound over a distance.

VOCABULARY

Describing Science

- Bumpy
- Down
- Move
- Up

Science Words

- Code
- Travel
- Waves

TIME CONSIDERATIONS

Teacher Preparation

Part A ..... 10 minutes
Part B..... 10 minutes

Lesson

Part A ..... 1 class session
Part B ..... 1 class session

TEACHER PREPARATION

Part A

1. Make one copy of Student Activity Sheet 5: *Spoon Sounds* for each student.

2. For each pair of students, cut 2-foot long piece of twine from the roll provided in the kit.

3. Obtain a metal spoon for each pair of students.

4. Each pair of students will need a pencil. Be sure these are available.

Part B

For each pair of students, assemble a string phone using the following steps:

A. Make a hole in the bottom of each of two paper cups.

B. Cut a 5-foot long piece of twine from the roll provided in the kit.

C. Thread each end of the 5-foot string through a hole in the bottom of one of the paper cups to assemble the telephone.

D. Secure the string inside each cup by tying each end of the string to a paper clip.

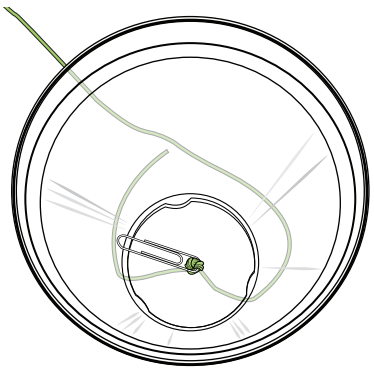


Figure 5.1
Secure the string inside each cup using a small paper clip

BACKGROUND INFORMATION

Sound travels in waves from one place to another, and can be heard when objects vibrate. The middle ear takes sound waves from the outer ear and turns them into vibrations, which are sent to the inner ear. The eardrum is located in the middle ear. It is a tiny, thin piece of skin that is stretched out like a balloon over a wide cup. When sound waves enter the middle ear, they cause the eardrum to vibrate. It is important that students understand that sound is produced by vibrations. To hear a sound, something has to move.

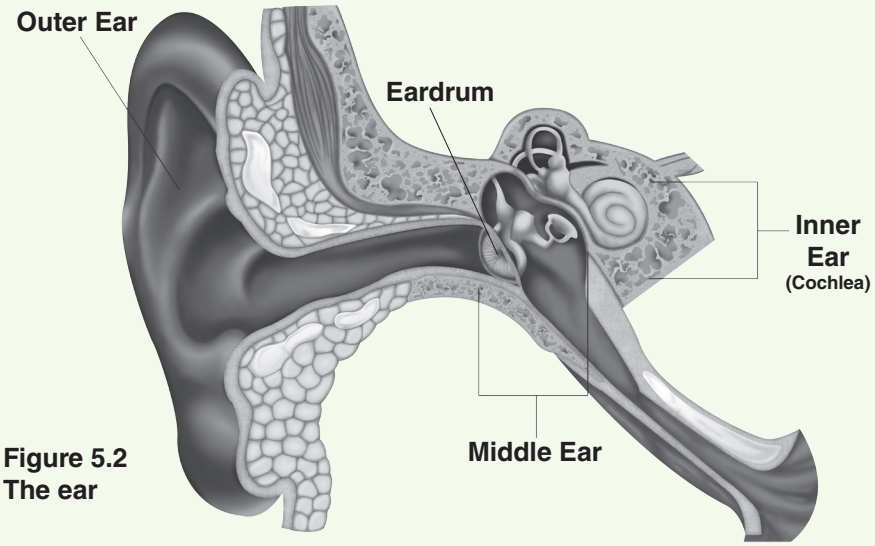


Figure 5.2
The ear

Early telephones were are relatively simple technology where a speaker's voice is transmitted generally through an electric current moving through wires and heard through vibrations in a speaker on the phone of the person on the other end.

The simplicity of this telephone technology can be simulated using two paper cups and a string. The vibrations that occur from the sound waves produced by talking into one cup travel through the string by pulling the string back and forth. The vibrations from the string cause the other cup to vibrate, producing sound waves and allowing the other person hear what the speaker is saying.

High-tech devices, such as computers and cell phones, convert information such as sound waves into a code that allows the sound to move quickly from one device to another. Once the digitized code reaches its destination, it changes form back to sound, enabling the other person to hear the sound clearly.

ACTIVITY INSTRUCTIONS

Part A

Invisible Waves

1. **As a class, discuss what students did to the drums in Lesson 4 to be able to see the vibrations. Ask:**
   - Can vibrations be seen in the air? *(No)*
   - How do vibrations move to our ears? *(Answers will vary.)*

   Based on what they observed and discussed in Lesson 5, students should know that vibrations travel in waves and that they cannot be seen in the air.

2. **Tell students they are going to observe what happens when an object tied to a string makes a sound.**

3. **Distribute a metal spoon to each pair of students. Allow students to tap the spoon with an unsharpened pencil to see the sound it makes. Discuss how the sound moved in waves to their ears and made their ear drums vibrate so they were able to hear the sound the spoon made.**

4. **Distribute a 2-foot piece of twine to each pair of students. Model how to tie the spoon to the middle of the string, then allow students time to tie the spoon to the middle of the string.**

5. **Explain that students will take turns performing the activity. When it is their turn, their partner will tie one end of the string to each of their index fingers, then tap on the spoon with their unsharpened pencil. Model how to tie the string to both index fingers.**

6. **Allow pairs time to set up the first partner. Ask them to discuss with their partners what they think will happen when the spoon is tapped with the unsharpened pencil. Do they think they will they be able to hear the sound? Will it sound the same as it did before the string was tied to it and to their fingers?**

7 Remind students that it is dangerous to put anything in their ears, and they should never put anything in their ears. Model putting your index fingers to cover the hole in your ears. (Tell students they do not need to put their fingers in their ear.) Instruct students to put their fingers right next to the holes in both ears.

8 Instruct the partners without the string to tap the spoon lightly with an unsharpened pencil. Tell students to take their fingers away from their ears, but do not discuss what happened.

9 Have students switch roles and repeat Steps 5–8. Be sure to model all the steps again for the second group of students.

10 After everyone has experienced the spoon experiment, discuss what happened as a group. *(Students might say it was a louder sound, it was muffled, it made a different sound in their ear than from the air, etc.)* Explicitly explain that the sound waves produced by tapping the spoon vibrated the string and their fingers and caused the sound to move directly to their ears.

11 Distribute a copy of Student Activity Sheet 5: *Spoon Sounds* to each student. Allow time for students to draw and write to describe the sounds.

Part B

Good Sound Travels Fast

1 Review how vibrations moved the sound through the string in Part A.

2 Explain: Those vibrations are waves moving along the string. When you speak, sound waves are created by vibrations. When a friend speaks to you, the sound waves created by his or her voice cause vibrations in the air and these vibrations cause vibrations in your eardrums when they reach your ear, enabling you to hear the sounds. Just like when you tapped the spoon without the string you could still hear it because the vibrations traveled through the air.

3 Ask students to stand about five feet away from a partner to test whether they can hear each other speak softly or whisper (Model the voice level students should use—they should not be able to hear well.)

4 **Tell students they are going to work with a partner to use string phones to test whether the vibration of their voice can travel through a piece of string.**

5 **Distribute a prepared string phone to each pair. Ask students to predict whether they will be able to hear someone speak quietly through the string, and to defend that prediction. Discuss students' predictions as a class.**

6 **Have each pair of students stand far apart, face each other, and pull the string to make a tight, straight line. Direct one partner to whisper, as before, but this time into the paper cup at their end of the phone, while the other partner holds the other cup to his or her ear and listens.**

7 **Direct students to do the same thing a second time, but this time, to allow the string to sag a bit between them. Model for students how to take turns speaking quietly into the cup while their partner listens with his cup on his ear. Point out that students need to speak quietly for this step, as yelling will enable them to hear what their partner is saying without the string phone.**

8 **Allow an ample amount of time for pairs to investigate. Make sure both members are the listener and the speaker for both setups. When everyone is done, ask students to return to their seats to discuss what happened. Students should understand that the sound vibrated through the string so the other person could hear.**

9 **Have students answer the following questions in their science notebooks:**

- What happens if you don't hold the string tight?
- Why does the string need to be tight in order for the sound waves to vibrate through it?

EXTENSIONS

Sound and Hearing

Visit the BBC website on sound and hearing as a class. Have students explore the games on the site in small groups to sort sounds by loudness and softness.

- www.bbc.co.uk/schools/scienceclips/ages/5_6/sound_hearing.shtml

Long Distance Call

Have students measure and then test different lengths of string between the string phones to see which size makes the clearest sound. Graph the data to report which length of string is the best.

Classroom Sounds

Invite students to test the vibrations of different objects around the classroom. Have them select three items and pluck or tap them to see what type of sounds they make.

Stand Up Sound

Have one student sit and one student stand when talking on the string phones to see if it sounds different, and then switch.

Literacy Series Reader: *Light and Sound Waves*

As a class, in small groups, or in pairs, have students explore the informational text in the literacy reader for this unit. Refer to Appendix E for strategies for before, during, and after reading the lesson-specific chapters or for exploring the literacy reader as a whole after the unit.

EVALUATION/ASSESSMENT

1. Refer to the General Rubric included in the Appendix D to assess individual progress.

2. Use the included Assessment Observation Sheet for this lesson to formatively assess your class and adjust instruction as needed.

3. Evaluate student understanding through class discussions.

Assessment Observation Sheet

Lesson 5—How Does Sound Travel?

Consider the following observations/talking points during student exploration activities, quiet conversations, learning centers, and class discussions.

A. Can students demonstrate an understanding that solid objects make a sound?

B. Can students demonstrate an understanding that vibrations can move through string (solid matter)?

C. Have students used appropriate vocabulary when describing the way sound moves?

D. Talk informally about vibrations and sound. Listen for an intuitive understanding that students can identify that sound can travel in waves in the air and through a string.

E. Note students who seem to be having difficulty understanding that sound moves in waves. Provide enrichment and remediation as needed (e.g., learning centers, additional small-group instruction, etc.).

F. Additional Considerations:

Teacher Notes

Name: _____ Date: _____

What happened to the sound when your partner tapped the spoon?

Draw here.

Write to describe what happened to the sound.

The sound of the spoon was _____

when I heard it through the string. _____

The sound waves moved through the _____

and the _____.

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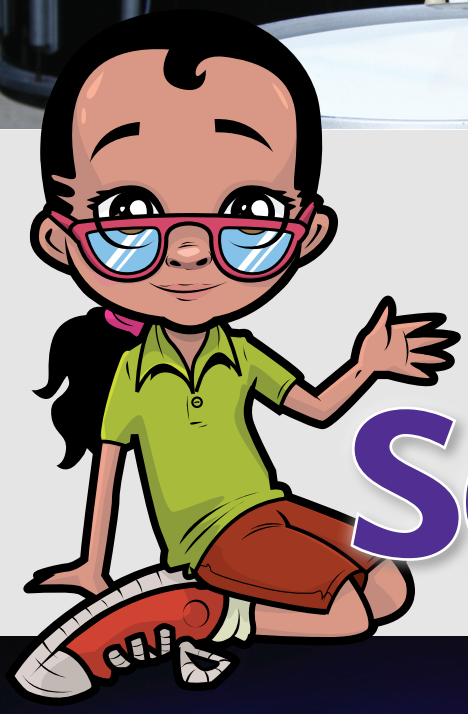
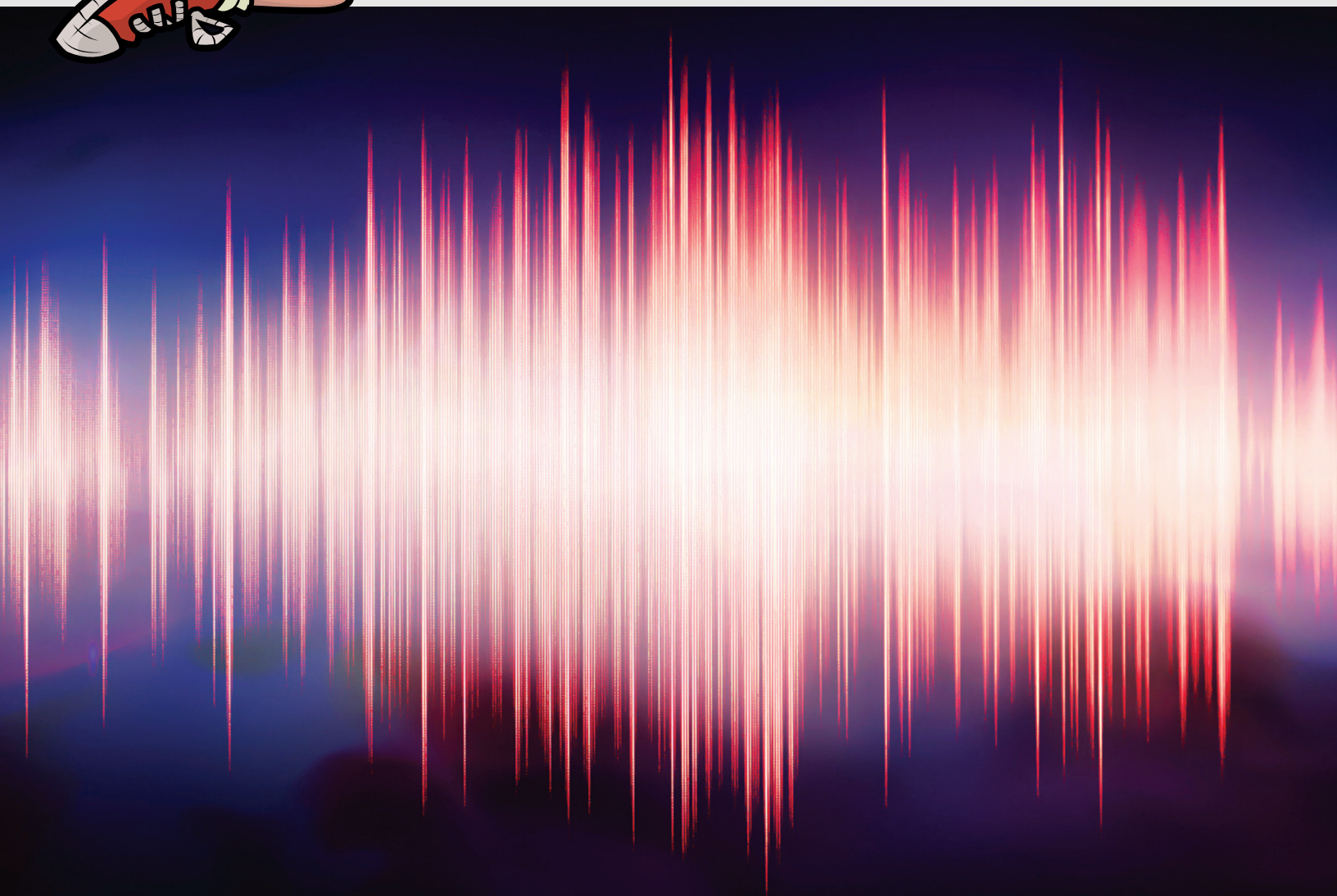


Light and Sound Waves

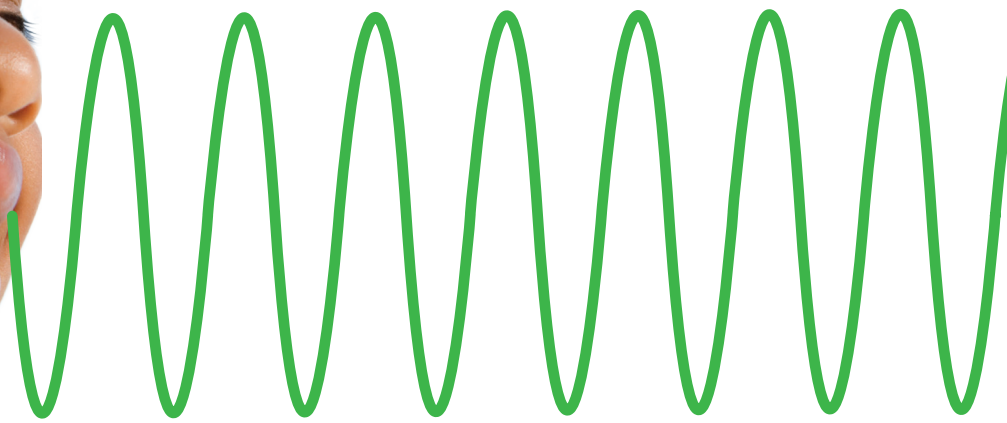


What Is Sound?

Sounds let us know what happens around us. Think about what you learn when you hear a loud bark.

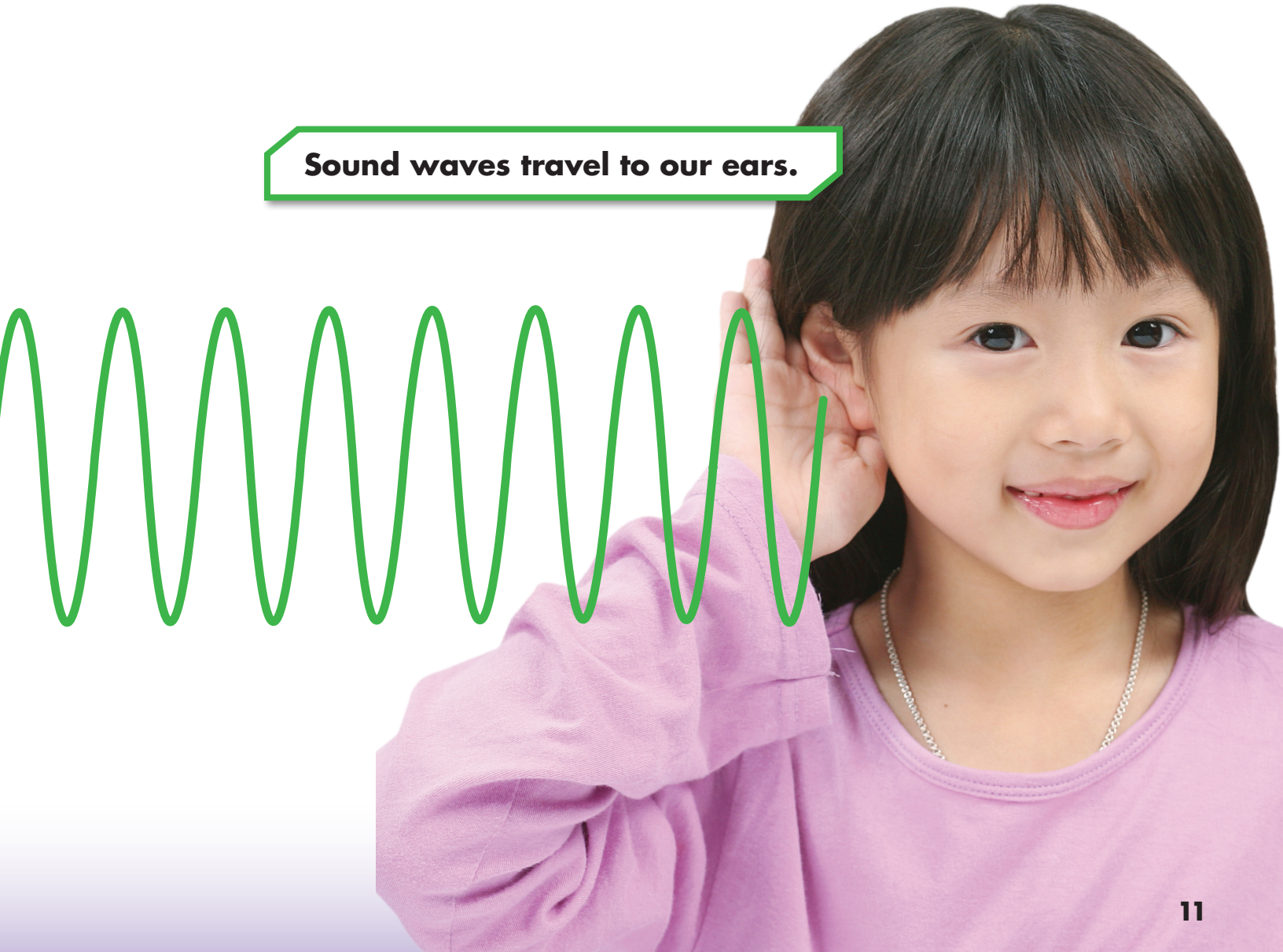
Things are made of **matter**. Matter is anything that takes up space. When matter vibrates, it makes sound. To **vibrate** means to move back and forth quickly. **Sound** is a type of energy that comes from things that vibrate.

Sound travels as sound waves.



You can feel your throat vibrate when you speak. Put a finger on the front of your throat. Say something. You feel your throat vibrate. There is no sound unless something vibrates.

Sound moves through air. Sound travels to our ears.



Sound waves travel to our ears.

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Integrate opportunities to explore mathematics, technology, engineering, reading, and writing.

	Physical	Life	Earth & Space
Kindergarten	**Push, Pull, Go** *K-PS2-1; K-PS2-2*	**Living Things and Their Needs** *K-LS1-1; K-ESS2-2; K-ESS3-1; K-ESS3-3*	**Weather and Sky** *K-PS3-1; K-PS3-2; K-ESS2-1; K-ESS3-2*
1st Grade	**Light and Sound Waves** *1-PS4-1; 1-PS4-2; 1-PS4-3; 1-PS4-4*	**Exploring Organisms** *1-LS1-1; 1-LS1-2; 1-LS3-1*	**Sky Watchers** *1-ESS1-1; 1-ESS1-2*
2nd Grade	**Matter** *2-PS1-1; 2-PS1-2; 2-PS1-3; 2-PS1-4*	**Ecosystem Diversity** *2-LS2-1; 2-LS2-2; 2-LS4-1*	**Earth Materials** *2-ESS1-1; 2-ESS2-1; 2-ESS2-2; 2-ESS2-3*
3rd Grade	**Forces and Interactions** *3-PS2-1; 3-PS2-2; 3-PS2-3; 3-PS2-4*	**Life in Ecosystems** *3-LS1-1; 3-LS2-1; 3-LS3-1; 3-LS3-2; 3-LS4-1; 3-LS4-2; 3-LS4-3; 3-LS4-4*	**Weather and Climate Patterns** *3-ESS2-1; 3-ESS2-2; 3-ESS3-1*
4th Grade	**Energy Works!** *4-PS3-1; 4-PS3-2; 4-PS3-3; 4-PS3-4; 4-PS4-1; 4-PS4-3; 4-ESS3-1*	**Plant and Animal Structures** *4-LS1-1; 4-LS1-2; 4-PS4-2*	**Changing Earth** *4-ESS1-1; 4-ESS2-1; 4-ESS2-2; 4-ESS3-2*
5th Grade	**Structure and Properties of Matter** *5-PS1-1; 5-PS1-2; 5-PS1-3; 5-PS1-4*	**Matter and Energy in Ecosystems** *5-PS3-1; 5-LS1-1; 5-LS2-1; 5-ESS2-1; 5-ESS2-2; 5-ESS3-1*	**Earth and Space Systems** *5-PS2-1; 5-ESS1-1; 5-ESS1-2*
	Science	**Science**	**Science**