Waves:

Light and Sound

First Grade

Next Generation Science Standards

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Teacher Introduction to Waves: Light and Sound

During the study of light and sound waves students will develop their science skills through inquiry, prediction, observation, exploration, discussion and recording. These lessons focus on students collaboratively problem solving, discovering and investigating to find answers and solutions. They will answer questions such as; What happens when materials vibrate? What objects can be used to communicate over a distance? What happens when light is blocked or when materials of different kinds are placed in the path of a beam of light? Each lesson includes science and engineering practices, disciplinary core ideas and crosscutting concepts which are a part of Next Generation Science Standards.

These lessons were designed to allow students to make their own predictions and observations while testing and recording their findings. Our lessons were planned using the 5-E Learning Cycle Model. Each lesson is broken down into the following categories; Engage, Explore, Explain, Extend and Evaluate. We also chose to break the lessons into sessions. Some lessons may take 1-2 thirty minute sessions. We included suggestions as to how we would break those lessons; please use these lessons as they fit into your schedule. Each lesson contains pertinent information to assure that all of the standards are addressed.

Student journal pages are included after each lesson. There are 3 performance assessments included in the student journal. Make sure to keep the student journals until those have been recorded on the final assessment page.

1.Waves: Light and Sound

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Students who demonstrate understanding can:

1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]

1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated. [Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]

1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.]

1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.* [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [Assessment Boundary: Assessment does not include technological details for how communication devices work.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question. (1-PS4-1),(1-PS4-3)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena (1-PS4-2)
- Use tools and materials provided to design a device that solves a specific problem. (1-PS4-4)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Science investigations begin with a question. (1-PS4-1)
- Scientists use different ways to study the world. (1-PS4-1)

Disciplinary Core Ideas

PS4.A: Wave Properties

- Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)

PS4.B: Electromagnetic Radiation

- Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2)
- Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1-PS4-3)

PS4.C: Information Technologies and Instrumentation

- People also use a variety of devices to communicate (send and receive information) over long distances. (1-PS4-4)

Crosscutting Concepts

Cause and Effect

- Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-1),(1-PS4-2),(1-PS4-3)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science, on Society and the Natural World

- People depend on various technologies in their lives; human life would be very different without technology. (1-PS4-4)

Connections to other DCIs in first grade: N/A

Articulation of DCIs across grade-levels: **K.ETS1.A** (1-PS4-4); **2.PS1.A** (1-PS4-3); **2.ETS1.B** (1-PS4-4); **4.PS4.C** (1-PS4-4); **4.PS4.B** (1-PS4-2); **4.ETS1.A** (1-PS4-4)

Common Core State Standards Connections:

ELA/Literacy –

W.1.2 Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure. *(1-PS4-2)*

W.1.7 Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-PS4-1),(1-PS4-2),(1-PS4-3),(1-PS4-4)

W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-PS4-1),(1-PS4-2),(1-PS4-3)

SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. *(1-PS4-1),(1-PS4-2),(1-PS4-3)*

Mathematics –

MP.5 Use appropriate tools strategically. *(1-PS4-4)*

1.MD.A.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object. *(1-PS4-4)*

1.MD.A.2 Express the length of an object as a whole number of length units, by layering multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. *(1-PS4-4)*

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Dear Family,

Our class is starting to learn about sound and light. My teacher said we're going to be exploring and experimenting with a lot of fun stuff. We get to be scientists!

These are the main ideas of our unit.

- Sounds are made when something vibrates
- Sounds can be loud or soft and high or low
- We use sound and light to communicate
- A shadow is made when something blocks the light.

These are a few of our new vocabulary words.

- Translucent
- Transparent
- Opaque
- Reflective
- Illumination
- Vibration
- Communication

Here are a few fun ways you can help me at home.

- We can put out different sized cooking pans and use spoons to tap on them to hear different sounds.
- We can use a few of the same size drinking glasses and fill them with different amounts of water. Then we lightly tap on them and listen to the different sounds they make.
- Using a flashlight or lamp we can shine it against a blank wall and put different objects in front of it to make shadows.

There are also a couple of good books that we can get from the library.

ZIN! ZIN! ZIN! A Violin by Lloyd Moss
What Makes a Shadow? by Clyde Robert Bulla

One more thing. . . I need to bring a **toilet paper tube** for one of our first activities.

Thanks for helping me be a great student!

Lesson 1*

Focus: 5 Senses

Length: 1- 30 minute session

Materials:

- *My Five Senses* by Aliki
- Student Journal cover and pg. 1

Student Grouping/Class Set Up: Whole Group

Engage: Read the book My Five Senses aloud to the class. Then explain that they will complete the student journal page. They need to draw and label two examples of each of the five senses.

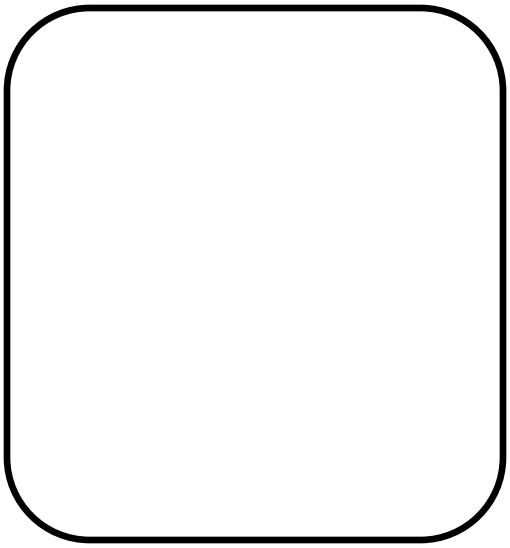
Explore: As students finish their first journal page they can discuss their drawings and explore the journal with their friends.

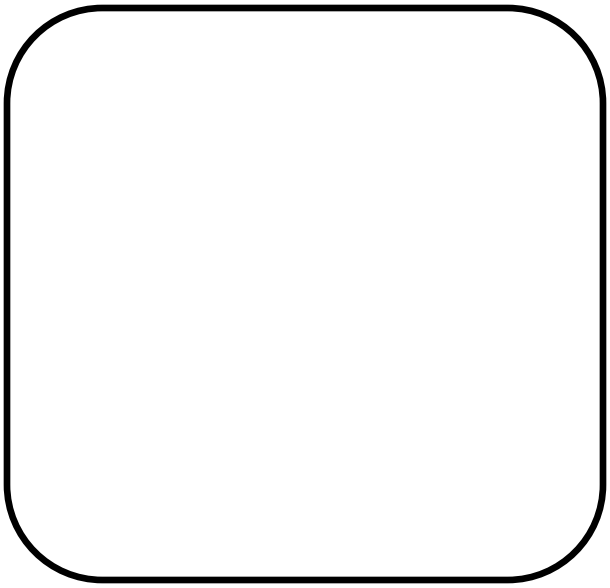
Explain: After the kids explore their journals, see if they can tell you what 2 senses we will be focusing on. Discuss where light and sound come from and then they can do the front cover of the journal.

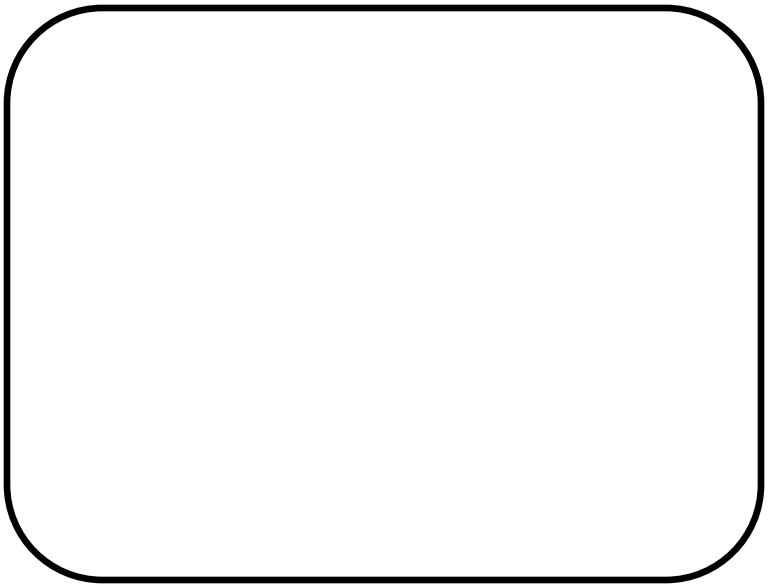
* This lesson is optional and can be used to introduce or review the 5 senses if you think your students need it. If not, please continue to the next lesson.

Name _____

Draw pictures of things that make light or sound.







Student Journal

First Grade- Waves: Light and Sound

Draw two pictures to go with each of the 5 senses.

Lesson 2: The Listening Walk

Length: 1- 30/40 minute session

Materials:

The Listening Walk by Paul Showers

All About Sound by Lisa Trumbauer

Large piece of paper for anchor chart

Student Journal pages 2 & 3

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.

Student Grouping/Class Set Up: Whole Group

Engage: What sounds can we hear in our school? Record answers on anchor chart with the whole group. Read the book *Listening Walk* and add any other ideas the students may have after listening to the book.

Explore: Introduce the Listening Walk (student journal page 2). With a partner the students will walk around the school listening for the sounds on the chart. When they hear a sound they will color the appropriate box. If they hear a sound that is not on the chart they can add it in one of the blank boxes.

Explain: When the class returns from the listening walk, have partners report their findings to the class. Add new sounds to the anchor chart if necessary.

Elaborate: Read the book *All About Sound* and discuss any new words they heard, especially vibration. Introduce the Sound Song (student journal page 3) and sing it a couple of times.

Evaluate: Keep the student journals so that observations can be made at the end of the unit.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
☐ Asking questions (science) and defining problems (engineering) ☐ Developing and using models ☐ Planning and carrying out investigations ☐ Analyzing and interpreting data ☐ Using mathematics and computational thinking ☐ Constructing explanations (science) and designing solutions (engineering) ☐ Engaging in argument from evidence ☐ Obtaining, evaluating, and communicating information	**PS4.A: Wave Properties** - **Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)**	☐ Patterns ☐ Cause and effect: Mechanism and explanation ☐ Scale, proportion, and quantity ☐ Systems and system models ☐ Energy and matter: Flows, cycles, and conservation ☐ Structure and function ☐ Stability and change

Sound

to the tune of "London Bridge"

Sound is made of vibrations,
vibrations, vibrations
Sound is made of vibrations,
hmmm, hmmm, hmmm, hmmm.
(place hand on throat to feel vibration)

Pitch is either high or low,
high or low, high or low,
Pitch is either high or low,
high or low.
(Up on tippy-toes, then down to the floor)

Volume means it's loud or soft,
loud or soft, loud or soft,
Volume means it's loud or soft,
loud or soft.
(LOUD is said loudly, soft is said softly)

Sound is made of vibrations,
vibration, vibrations
Sound is made of vibrations,
hmmm, hmmm, hmmm, hmmm.
(place hand on throat to feel vibration)

The Listening Walk

Listen carefully for each of these sounds.
Color a square for each of the sounds you hear.

cough	singing	footsteps
loud speaker	talking	paper shuffling
door shutting	sneeze	shouting
pencil sharpener	phone ringing	laughing

Lesson 3: What's the Buzz!

Length: 1- 30/40 minute session

Performance Expectations: Make and use a kazoo to discover how vibrations create sound waves that travel through the air to your ear. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. (Standard 1-PS4-1)

Materials:

- Toilet paper tubes (from home per parent letter) with small holes precut
- waxed paper (cut into 4X4 squares)
- aluminum foil (cut into 4x4 squares)
- plastic wrap (cut into 4x4 squares)
- rubber bands

Student Grouping/Class Set Up: Partners to help with creating the kazoo. Each student makes their own kazoo.

Engage: Today we will make an instrument that anyone can play and get the buzz on sound vibrations. Vibrations create sound waves that travel through the air. Have you ever tossed a pebble or stone into the lake or a pool? Did you notice the waves created by your stone? Sound waves travel through the air kind of like the circle of ripples created by tossing a stone into the water. Today we are going to make a Kazoo to investigate vibrations that cause sound wave.

Explore: Students will make a kazoo and experiment with different kinds of sounds to see what causes the loudest buzzing.

Explain: See attached page for directions (What's the Buzz?)

Elaborate: Play it! Place the open end of the kazoo lightly over your mouth and say AHHH! What happens? Now sing or hum a tune into it. Try making different kinds of sound to see what causes the loudest buzzing.
Extensions: Touch the waxed paper with your finger while you play your Kazoo. What do you notice? Now cover the hole with your finger while you play the Kazoo. What happens? Does the hole make it easier or harder to play? Why?

Evaluate: Whole group discussion to determine if students have understood the concept that
Vibrations cause sound waves that our ears convert into noise or voices.

Extension Activity: Make more Kazoos, changing one thing (called a variable). Try using tin foil or plastic wrap instead of waxed paper. Does it change anything? Make a prediction which material you think will make the loudest/quietist sound. Test it out and then check your predictions.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
☐ Asking questions (science) and defining problems (engineering) ☐ Developing and using models ☐ Planning and carrying out investigations ☐ Analyzing and interpreting data ☐ Using mathematics and computational thinking ☐ Constructing explanations (science) and designing solutions (engineering) ☐ Engaging in argument from evidence ☐ Obtaining, evaluating, and communicating information	**PS4-A: Wave Properties** **Sound can make matter vibrate and vibrating matter can make sound. (1-PS4-1**	☐ Patterns ☐ Cause and effect: Mechanism and explanation ☐ Scale, proportion, and quantity ☐ Systems and system models ☐ Energy and matter: Flows, cycles, and conservation ☐ Structure and function ☐ Stability and change

What's the Buzz?

Make an instrument that anyone can play—a kazoo—and get the buzz on sound vibrations!

1 Get what you need.

• toilet paper tubes • waxed paper • aluminum foil • plastic wrap • rubber bands • scissors • sharpened pencil • plastic comb (optional—for Dig Deeper activity on back of sheet)

2 Make a kazoo.

- Use a pencil to make a small hole about two inches from one end of the cardboard tube.
- Cut a square of waxed paper that's an inch or two wider than the end of the tube.
- Wrap the waxed paper tightly over the end of the tube where you made the hole. Hold it in place with a rubber band, making sure you don't cover the hole you made. Trim off any excess waxed paper with scissors.

3 Play it!

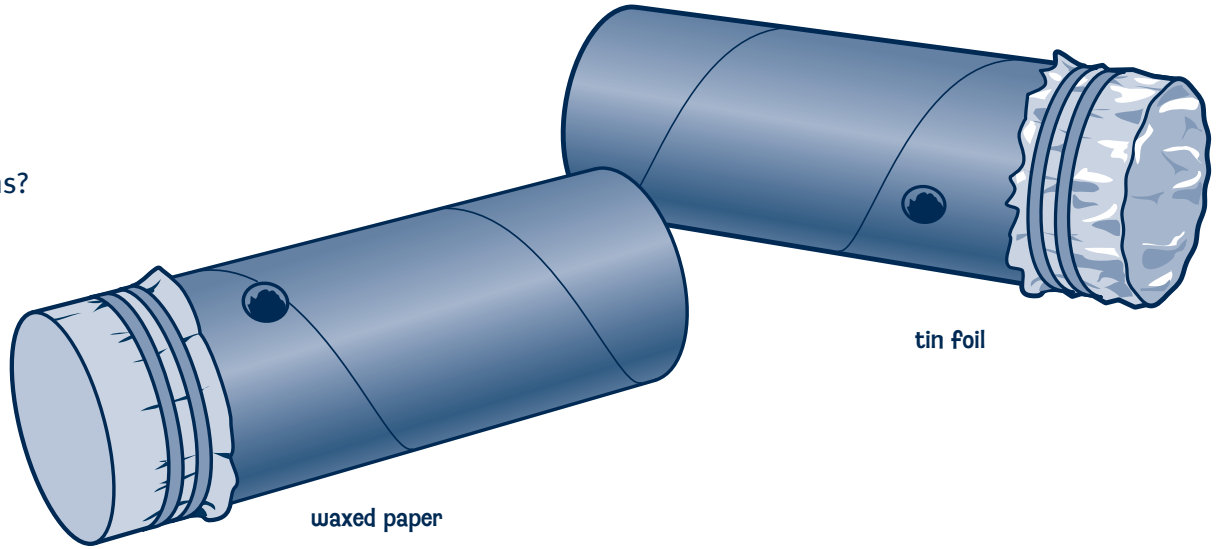
Place the open end of the kazoo lightly over your mouth and say, "AAHHH!" What happens? Now sing or hum a tune into it. Try making different kinds of sounds to see what causes the loudest buzzing.

4 Experiment.

- Touch the waxed paper with your finger while you play the kazoo. What do you notice?
- Cover the hole with your finger while you play the kazoo. What happens? Does the hole make it easier or harder to play it? Why?
- Make more kazoos, changing one thing (called a *variable*). Instead of waxed paper, try tin foil or plastic wrap. Predict which material you think will make the best sound. Test it out. Were your predictions right?

Chew on This!

All sound is made up of *vibrations* (rapid back-and-forth movement), which produce sound waves that travel through the air to our ears. When you play a kazoo, air carries the sound waves from your mouth down the tube, making the waxed paper vibrate. You can feel those vibrations if you touch the waxed paper.



Lesson 4: Making a Splash and Musical Rulers

Length: 2- 30 minute sessions

Performance Expectations: Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. (Standard 1-PS4-1) Students will observe simple objects, patterns and events and report their observations in a simple graph.

Background: All sound it made up of vibrations which produce sound waves that travel through the air to our ears. Vibrating matter can make sound and sound makes matter vibrate causing sound waves to travel through the air.

Materials:

- tuning forks
- bowl of water
- 12 inch plastic rulers

Student Grouping/Class Set Up: Split students into 2 groups (1 adult with each group if possible)

Engage: Today we will experiment with a musical tool called a tuning fork. Prompt students with prior knowledge questions and let them practice using the tuning forks and rulers in an appropriate way. They need to be in 2 groups (Suggestion- 1 group will do "Making a Splash" one day and "Magical Rulers" the next day.)

Explore:
Group #1: Put the bowl of water on a surface where students will be able to make observations. With one of the tuning forks, hit it so it vibrates. Quickly put it in the water and observe what it does. How far did the water splash? Try the same thing with each tuning fork. Using the Making a Splash (student journal page 4) observe patterns, cause and effect and record observations.

Group #2: Using a 12 inch plastic ruler observe the difference in the sounds when the ruler is extended over the table at different lengths. Put the ruler at the edge of the table so half of it hangs over the edge. Hold the ruler down with the palm of one hand on the table. With your other hand push the end of the ruler down and let it go. Observe the vibrations of your ruler and the sound it makes. Write your observations on Musical Rulers (student journal page Keep doing this until you can't press it down any more each time recording your results on your chart.

Elaborate: Compare your observations with a classmate.

Evaluate: Whole group discussion to determine if students have understood the concept that vibrations cause sound waves that our ears convert into noise or voices. Use attached discussion questions to lead and review of the similarities and differences that were observed with each experiment.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
☐ Asking questions (science) and defining problems (engineering) ☐ Developing and using models ☐ Planning and carrying out investigations ☐ Analyzing and interpreting data ☐ Using mathematics and computational thinking ☐ Constructing explanations (science) and designing solutions (engineering) ☐ Engaging in argument from evidence ☐ Obtaining, evaluating, and communicating information	**PS4-A: Wave Properties** **Sound can make matter vibrate and vibrating matter can make sound. (1-PS4-1)**	☐ Patterns ☐ Cause and effect: Mechanism and explanation ☐ Scale, proportion, and quantity ☐ Systems and system models ☐ Energy and matter: Flows, cycles, and conservation ☐ Structure and function ☐ Stability and change

Discussion Questions for Making a Splash:

What did you observe each time you put a tuning fork in the bowl of water?

What are some similarities that you noticed with the tuning forks?

What are some differences that you noticed with the tuning forks?

Why do you think there were changes between the tuning forks?

What conclusions can you make about this exploration?

Discussion Questions for Musical Rulers:

What did you observe each time you moved the ruler?

What are some similarities in sound that you noticed?

What are some differences in sound that you noticed?

Why do you think there were changes each time you moved the ruler?

What conclusions can you make about this exploration?

Making a Splash

Materials:

- Tuning Fork labeled A, B, C
- Bowl of water
- Colored piece of paper

Procedure:

1. Put the bowl of water on a colored piece of paper.
2. With one of the tuning forks, hit it so it vibrated. Quickly put it in the water. Observe what it does. Measure how far the water splashes.
3. Repeat #2 with each tuning fork and record observations below.

	Observations
Tuning Fork A	
Tuning Fork B	
Tuning Fork C	

Musical Rulers

Materials:

- Plastic Ruler marked 1, 2, 3

Procedure:

1. Put the plastic ruler on the table so that the edge is lined up with the first mark on the ruler.
2. Holding the ruler against the table with one hand, push the other side down gently and let go. Feel the vibration? Hear the music?
3. Observe the vibration and sound the ruler is making and record your observations below.
4. Repeat for the 2nd and 3rd mark on the ruler and record observations.

	Observations
Ruler Mark 1	
Ruler Mark 2	
Ruler Mark 3	

Lesson 5: Cup-a-Phone

Length: 2- 30/40 minute sessions

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.

1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.

Materials:

- Paper cups and Styrofoam cups
- Cotton string (precut into 36 inch pieces)
- Fishing line
- bar of soap
- paper clips
- scissors

Student Grouping/Class Set Up: Whole Group and Partner Groups

Engage: Draw a giant web on an anchor chart and write "Communication" in the middle. Ask students for examples of how people can communicate. Examples: calling, texting, sign language, Morse code, social media, light signals, yelling, school bells, barking, movement. (Keep this web for a lesson and journal page later in the unit) Students will then be guided through the making of a cup-a-phone.

> **Directions:** Give each student 1 piece of cotton string and 2 paper cups. The students need to poke a hole in the bottom of their cup with their pencil and put the string through it. Then they need to tie a paper clip to the end of the sting inside the cup. Repeat for the other cup.

Explore: Students need to collaborate with a partner to try out their phones. Let them explore and come up with the answers about how the phones work. Some students may need to go in the hallway to hear each other.

Explain: After students have had a chance to explore with their paper cup-a-phone bring them together as a whole group and discuss what made it possible for them to hear each other. **Key idea: vibrating materials make sound and sound can make materials vibrate.**

Engage/Explore/Evaluate: (Suggestion- 2nd 30-40 minute session) Students are now going to use different materials to design and build a device that allows them to communicate over a distance. They are going to make another phone but need to make their own decisions on materials and record their observations. It's time for them to be scientists!

> **Directions:** Using "I'm a Scientist" (student journal page 6) to guide them, students need to make another cup-a-phone. They will choose one variable; string length, Styrofoam cup or fishing line. Encourage them to only have 1 variable. Then they will make a hypothesis, record their observations and evidence and come to a conclusion. This is going to be used as an assessment so try not to guide students but let them explore and come to their own conclusions.

Evaluate: On the back of student journal page 6 record assessment data.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
☐ Asking questions (science) and defining problems (engineering) ☐ Developing and using models ☐ Planning and carrying out investigations ☐ Analyzing and interpreting data	**PS4.A: Wave Properties ⍰ Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)** **PS4.C: Information Technologies and Instrumentation ⍰ People also use a variety of devices to communicate (send and**	☐ Patterns ☐ Cause and effect: Mechanism and explanation ☐ Scale, proportion, and quantity ☐ Systems and system models ☐ Energy and matter: Flows, cycles, and conservation

☐ Using mathematics and computational thinking ☐ Constructing explanations (science) and designing solutions (engineering) ☐ Engaging in argument from evidence ☐ Obtaining, evaluating, and communicating information	**receive information) over long distances. (1- PS4-4)**	☐ Structure and function ☐ Stability and change

I'M A SCIENTIST!

Circle the variable you used:

Styrofoam cups Fishing Line String length

Draw a picture of your device:

How will this be different than the model we built?

_____

_____

Draw or explain what you observed

Did your new device make a vibration? Yes No

Could you hear the vibration? Yes No

Performance Assessment

Variable Circled and Used	___ / 1
Picture of device	___ / 1
How will this be different	___ / 1
Draw/Explain Observations	___ / 1
Yes circled	___ / 1
Yes circled	___ / 1
Total	**___ / 6**

Lesson 6: In the Dark!

Length: 1- 30/40 minute session

Performance Expectations:

1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated.

Materials:

- *All About Light* by Lisa Trumbauer
- Pinhole boxes
- Small figurine
- Flashlights
- Student Journal pages 7 & 8

Student Grouping/Class Set Up: Partner work and individual work

Engage: Pose a problem about being in a dark room with a friend. The room does not have windows and the lights went out. *Think about what you could use in order to be able to see your friend in the darkness.*

Explore: Have students use student journal page 7 to brainstorm ideas using pictures with labels. The students will share their ideas with the class. *Were there any ideas you didn't have in your journal?*

Explain: Explain that in order to see objects we need light. Read the book *All About Light* aloud to the class.

Elaborate: Working with a partner, the students will use the pinhole boxes to observe that objects need light to be seen. They will record findings and explanations on student journal page 8. Circulate the room as students explore with the pinhole boxes. Verify that they understand the concept that objects can only be seen when they are illuminated.

Directions:

1- **They need to look through into the closed dark pinhole box. Can they see the object?**
2- **Open the top of the box. Can they see the object?**
3- **Shine a flashlight into the pinhole box through the hole. Can they see the object?**

Evaluate: Student journal page 8 "Can you see it?" Follow up with class discussion of findings.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
☐ Asking questions (science) and defining problems (engineering) ☐ Developing and using models ☐ Planning and carrying out investigations ☐ Analyzing and interpreting data ☐ Using mathematics and computational thinking ☐ Constructing explanations (science) and designing solutions (engineering) ☐ Engaging in argument from evidence ☐ Obtaining, evaluating, and communicating information	**Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2)**	☐ Patterns ☐ Cause and effect: Mechanism and explanation ☐ Scale, proportion, and quantity ☐ Systems and system models ☐ Energy and matter: Flows, cycles, and conservation ☐ Structure and function ☐ Stability and change

In the Dark

You and your friend are in a room with no windows. The lights go out! What are some things you could use to be able to see each other?

Draw your ideas below. Don't forget to label them.

Can You See it?

When you look in the pinhole box, can you see the object?

Record your findings. Explain your thinking.

Look in the hole of the closed box.

Can you see the object? YES NO

Explain why or why not_____

_____

Shine a flashlight in the hole of the closed box.

Can you see the object? YES NO

Explain why or why not_____

_____

Open the lid of the box. Look in the hole of the box.

Can you see the object? YES NO

Explain why or why not_____

_____

Lesson 7: What's that Glow?

Length: 1- 30/40 minute session

Performance Expectations:

1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated.

Materials: Flashlights

Glow sticks and glow bracelets

Paper bag

Fireflies by Julie Brinckloe

Student Grouping/Class Set Up: Whole Group

Engage: Put the flashlight and glow sticks in a paper bag so the kids can't see them yet. Start by setting the scene for kids. Let's pretend we're going on a camping trip in the deep woods. When night come it gets very dark. What could we use to help us see in the dark? Get the flashlight out of the bag and discuss how a flashlight illuminates and provides light. Ask if there is something else we could use that would give off its own light and help us see.

Explore: Crack the glow stick in the bag without them seeing and hold the bag closed at the top. Call a couple of kids up to peek in the bag (while you're holding it closed) to see if it's illuminated. Ask students what could be in there that caused it to be illuminated and give examples of cause and effect with darkness and lights. Example: I walked in a dark room and couldn't see so I . . . . (Turned on a lamp or waited for my nightlight to light up). After they come to the conclusion that it's a glow stick, give each of them a glow bracelet and let them try to figure out what makes it illuminate.

Explain: Read *Fireflies* and explain that living and nonliving things illuminate in different ways and use their light for different reasons. Example: flashlights need batteries to illuminate, glow sticks break and have a chemical reaction.

Elaborate/Evaluate: Student journal page 9 "Illumination"

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
☐ Asking questions (science) and defining problems (engineering) ☐ Developing and using models ☐ Planning and carrying out investigations ☐ Analyzing and interpreting data ☐ Using mathematics and computational thinking ☐ Constructing explanations (science) and designing solutions (engineering) ☐ Engaging in argument from evidence ☐ Obtaining, evaluating, and communicating information	**Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2)**	☐ Patterns ☐ Cause and effect: Mechanism and explanation ☐ Scale, proportion, and quantity ☐ Systems and system models ☐ Energy and matter: Flows, cycles, and conservation ☐ Structure and function ☐ Stability and change

Illuminations!

Color the sources of light.

Can you think of any other light sources?

Draw and label them on the back.

Lesson 8: Camera Lens Magic

Length: 2- 30/40 minute sessions

Performance Expectations:

1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).]

Materials:

- 15 Cardboard Cameras with different lenses
- 15 flashlights (2 batteries each)
- 4 x 4 in Squares of Transparent, Translucent, Opaque and Reflective Materials
- Die-Cut Paper Cameras- 4 per student
- Glue sticks and scissors
- Student journal pages 10,11,12

Student Grouping/Class Set Up: Whole Group, partners and individual

Engage: Start by showing students an example of each of the 4 (translucent, transparent, opaque and reflective) squares. Discuss how light rays can pass through, reflect off, or are absorbed by an object and model the different materials with light rays. Model with a flashlight.

Explore: Put students into partners and give each pair a flashlight. Turn the lights off and let them explore with their flashlight using prior knowledge of what happens when light hits certain objects. After a couple of minutes pass out the cardboard cameras with different materials. Guide students to collaboratively work to see that some are translucent, transparent, opaque and reflective.

1) translucent objects let some light pass through
2) transparent objects let all light pass through
3) opaque objects let no light pass through
4) reflective objects redirect light and does not allow light to pass through

Explain: Pass out 4 die cut cameras to each student and give students a small piece of wax paper, tin foil, transparency paper and construction paper. Once students have constructed their cameras they will test them with various objects around the room and record their data on the data worksheet in their journal. Reflection is not included on the worksheet.

Elaborate: (Extension Activity) Students can share their data with others. Compare/Contrast and support their data with observations. They should all see the same results.

Explain/Evaluate: (Suggestion- 2nd 30-40 minute session) Performance Assessment in Journal "Picture This!"

> **Directions:** Students will need glue, scissors and 1 small circle of waxed paper, transparent paper, construction paper and tin foil. They need to cut out page 11 in their student journal and put the page together on their own. See the example following this lesson. This is an assessment so other than giving the students directions on where things go, let them match up the vocabulary words with the correct camera. There is an assessment key on the back of student journal page 10. Make sure to fill it out and keep for the final assessment.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
☐ Asking questions (science) and defining problems (engineering) ☐ Developing and using models	**Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them,**	☐ Patterns ☐ Cause and effect: Mechanism and explanation

☐ Planning and carrying out investigations ☐ Analyzing and interpreting data ☐ Using mathematics and computational thinking ☐ Constructing explanations (science) and designing solutions (engineering) ☐ Engaging in argument from evidence ☐ Obtaining, evaluating, and communicating information	**where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1- PS4-3)**	☐ Scale, proportion, and quantity ☐ Systems and system models ☐ Energy and matter: Flows, cycles, and conservation ☐ Structure and function ☐ Stability and change

Picture		**Definition**	
____	Translucent	____	Translucent
____	Transparent	____	Transparent
____	Opaque	____	Opaque
____	Reflective	____	Reflective

Total __/8

Transparent, Translucent, Opaque

Instructional Materials:

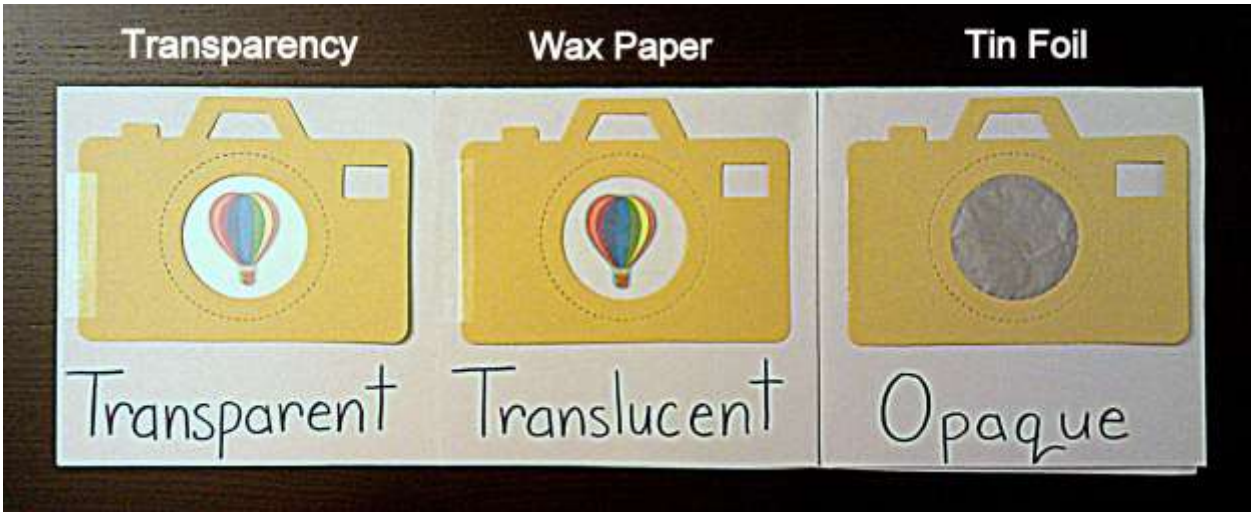
- a flashlight
- translucent, transparent, and opaque materials found in the classroom for modeling
- small squares of transparency paper, wax paper, and tin foil
- die-cut paper cameras with the lenses removed
- large pieces of construction paper
- Data recording page

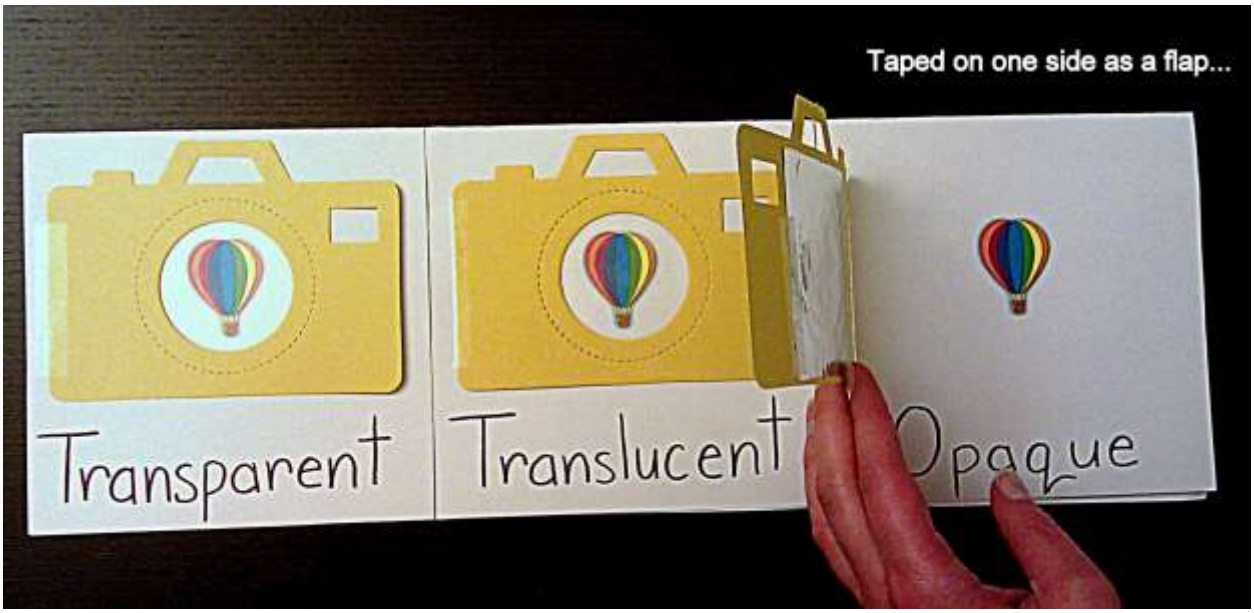
The instructor will start the lesson by having a discussion about how light rays can pass through, reflect off, or be absorbed by an object. Students will also use their prior knowledge and share thoughts about what happens when light hits certain objects. The instructor will introduce the concept of transparency and preview new vocabulary words: transparent, translucent, and opaque.

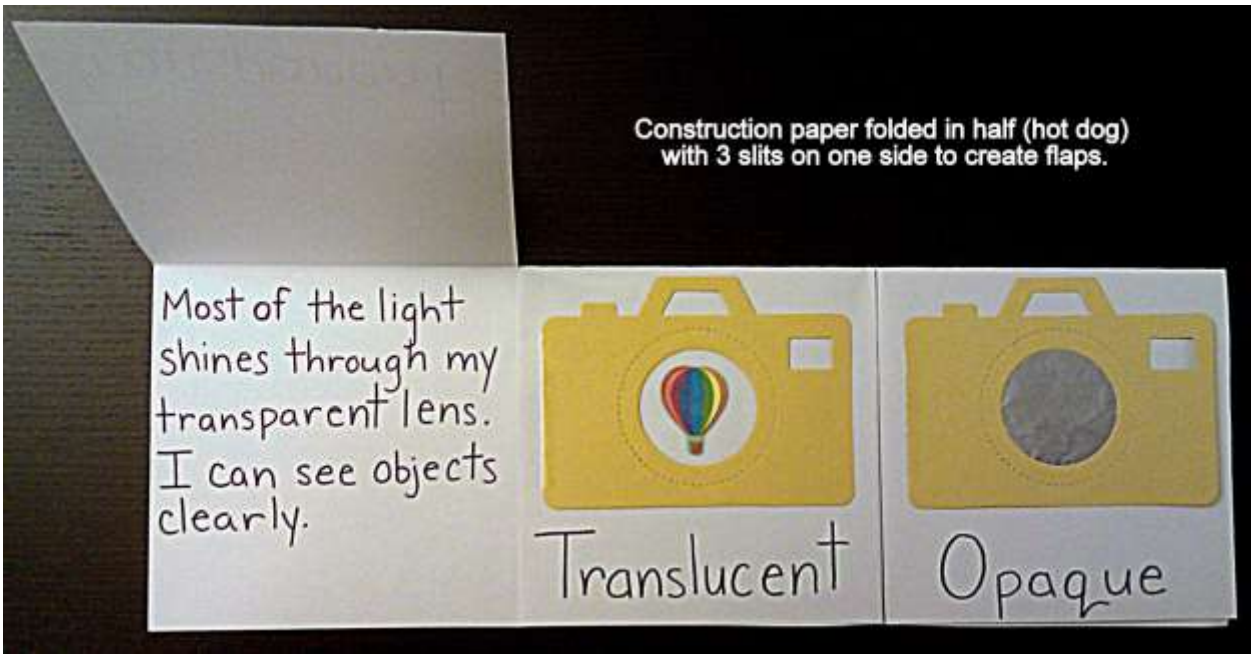
The instructor will then model how light rays react when materials of different transparencies are placed in front of the light source. The instructor will hold a brief discussion to talk about the difference between the materials and what happens when light hits them. The instructor will point out that with the transparent object, all the light passes through it. With the translucent object, some light passes through. With the opaque material, no light passes through.

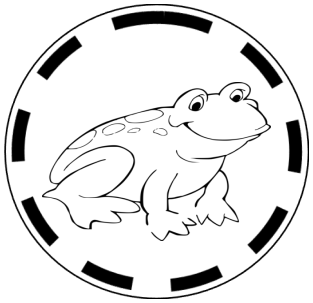
Next, students will get the opportunity to experiment with light and transparency. Student will be given small squares of transparency paper, wax paper, and tin foil to adhere to die-cut cameras. Once the cameras are constructed, student will test their cameras with various objects around the room and record their data on a data worksheet.

Finally, once they are finished experimenting, the students will paste their cameras on construction paper over 3 identical images/stickers. Then they will be required to label each camera with either transparent, translucent, or opaque. Once labeled, a description of the vocab will be written. For example, the camera with a transparent lens will be labeled transparent and given the description, “When I look through my transparent lens, all light and colors shine through.”


Transparency
Wax Paper
Tin Foil
Transparent
Translucent
Opaque

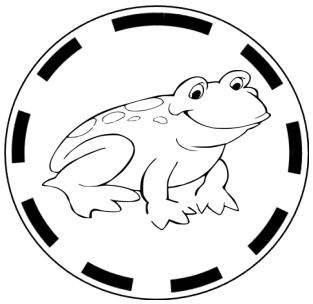

Taped on one side as a flap...
Transparent
Translucent
Opaque


Construction paper folded in half (hot dog)
with 3 slits on one side to create flaps.
Most of the light shines through my transparent lens. I can see objects clearly.
Translucent
Opaque



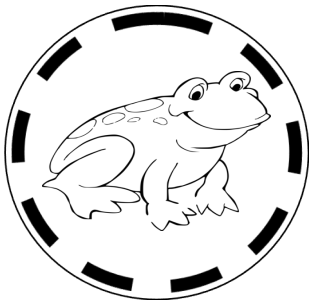
Transparent

I can see it clearly.



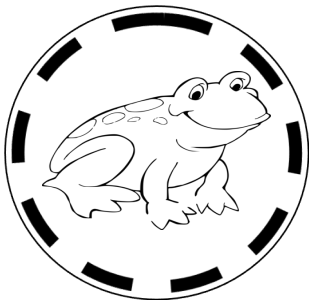
Translucent

I can see it but it looks blurry.



Reflective

I can see it in a mirror.



Opaque

I can't see it.

Picture This!

Name:_____

When I look through my camera lens...

Transparent, Translucent, and Opaque

Transparent Camera Lens

☐ MOST or ALL Light ☐ SOME Light ☐ NO Light

Object	I can see it clearly.	It looks blurry.	I can't see it.

Translucent Camera Lens

☐ MOST or ALL Light ☐ SOME Light ☐ NO Light

Object	I can see it clearly.	It looks blurry.	I can't see it.

Opaque Camera Lens

☐ MOST or ALL Light ☐ SOME Light ☐ NO Light

Object	I can see it clearly.	It looks blurry.	I can't see it.

Lesson 9: Making Shadows

Length: 1- 30/40 minute session

Performance Expectations:

1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.]

Materials: Flashlights

Stick with kids on it

Student journal pages 13 & 14

Nothing Sticks Like a Shadow by Ann Tompert

Shadows by Carolyn B. Otto

Student Grouping/Class Set Up: Whole Group and partners

Engage: What is a shadow?

Read the book *Nothing Sticks like a Shadow*

Pose a problem: What happens when an object blocks a path of light? Discuss

Explore: With a partner students will use the puppet stick and a flashlight as an exploration to answer the question posed; what happens when an object blocks a path of light?

Circulate the room to guide students as they explore. The students will record findings on student journal page 13.

Explain: Have a whole group discussion to share what the students found and what happens when an object blocks a path of light.

Read the book *Shadows.* This nonfiction text will provide a formal explanation of shadows. It also explains how they change with the direction of the light.

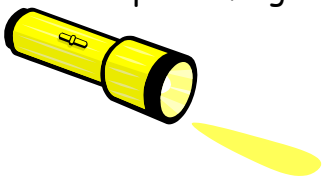
Elaborate: Have the students use the flashlights and puppet sticks again to explore what happens when they change the position of the flashlight and the position of the puppet stick.

Evaluate: Students will cut out and complete student journal page 14. This page could be sent home if there is limited time. Make sure to come together to discuss their findings from page 13 and to share their mini books.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
☐ Asking questions (science) and defining problems (engineering) ☐ Developing and using models ☐ Planning and carrying out investigations ☐ Analyzing and interpreting data ☐ Using mathematics and computational thinking ☐ Constructing explanations (science) and designing solutions (engineering) ☐ Engaging in argument from evidence ☐ Obtaining, evaluating, and communicating information	**Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1- PS4-3)**	☐ Patterns ☐ Cause and effect: Mechanism and explanation ☐ Scale, proportion, and quantity ☐ Systems and system models ☐ Energy and matter: Flows, cycles, and conservation ☐ Structure and function ☐ Stability and change

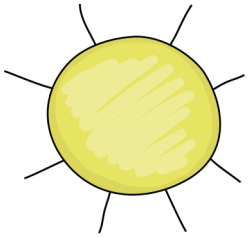
Making Shadows

Make a sketch showing the shadows you made for **short**, **long**, and almost **invisible**. Put the flashlight and the path of light in the picture!



Short Shadow
Long Shadow
Almost Invisible Shadow

My Light and Shadow Mini– Book



Written and Illustrated by:

_____

I go outside and stand with the sun behind me. My shadow is in _____ of me.

I play until 12:00 noon. My shadow is very _____.

When I go inside the sun is in front of me, so my shadow is _____ me.

Lesson 10: Reflections

Length: 1- 30/40 minute session

Performance Expectations: Plan and conduct an investigation to determine the effect of placing objects made of different materials in the path of a beam of light. (1-PS4-3)

Materials:
- 15 Mirrors with stands
- Laser pointers

Student Grouping/Class Set Up: Partners

Engage: Opening activity. Hand out the mirrors to each set of partners. Explain that these are tools and to be gentle. Let them look at them and play with them for a few moments.

Explore: Ask partners to face each other with the mirror between them. One student should be facing the shiny side of the mirror: the other student should be facing the blank side of the mirror. Ask students to raise their hands if they can see themselves in the mirror. Draw everyone's attention to the fact that only one can see the reflection in the mirror.

Explain: Use the following questions to guide their exploration.

- If you can see yourself in the mirror, describe the mirror properties you observe. *Shiny, silver, very smooth.*
- If you cannot see yourself in the mirror describe what you see. *Dull, gray, slightly textured.*
- Can you always see yourself if you are facing the shiny side of the mirror?
- Could you see yourself in the mirror if it were very dark, such as if it were night or if you were in a dark closet?

Next Dim the lights in the room and ask student to look in their mirrors. After a few seconds, turn the lights back on.

- Could you see yourself in the mirror clearly when the lights were off?
- In addition to looking at the shiny side of the mirror what else is needed to see your reflection in a mirror? (Answer should be light)
- What are some other sources of light?
- Why do we turn on a light on at night? (Because our eyes need light to see)

Repeat these steps after handing out laser pointers. They will need to be in bigger groups and can use the mirrors to bounce the laser from one mirror to the next. Remind them that lasers should not be pointed at their friends at any time.

Elaborate: Use the laser course game for more exploration if there is time. This game can also be out in a station after kids see a model of how it is appropriately used.

Evaluate: Discuss results and why they occurred after collecting the materials.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
☐ Asking questions (science) and defining problems (engineering) ☐ Developing and using models ☐ Planning and carrying out investigations ☐ Analyzing and interpreting data ☐ Using mathematics and computational thinking	**Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through**	☐ Patterns ☐ Cause and effect: Mechanism and explanation ☐ Scale, proportion, and quantity ☐ Systems and system models ☐ Energy and matter: Flows, cycles, and conservation

☐ Constructing explanations (science) and designing solutions (engineering) ☐ Engaging in argument from evidence ☐ Obtaining, evaluating, and communicating information	**experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1- PS4-3)**	☐ Structure and function ☐ Stability and change

Lesson 11: Go Away! Come Here!

Length: 2- 30/40 minute sessions

Performance Expectations:

1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.

Materials:

- Flashlights
- Lasers
- Tuning forks
- Kazoos
- -Student Journal page 15 & 16
- - Communication anchor chart from Lesson 5
- - crayons
- - basket of all books from the unit

Student Grouping/Class set up: Students will be working with a partner (Teacher may want to assign partners because this is going to be used as an assessment)

Engage: Begin with teacher giving nonverbal signs to students. For example: Baseball sign (tap head, hold up 3 fingers and tap both knees), Flashlight sign (flash the light on 3 times), Kazoo signal (make 2 long sounds and 2 short sounds). Tell them that all of those were signs for saying "Hi!" Ask students different ways they can say hi to their friends. Examples: Hey, Good Morning, Howdy, Friendly smile, friendly wave, sign language for hi. Discuss how we can use different signs and signals to communicate over a distance.

Review different ways to communicate using the Communication anchor chart/web from Lesson 5.

Explore: Working with partners, students need to come up with and test a way to communicate two things; "Go Away!" and "Come Here!" They can use any of the provided materials but guide them to use light or sound in some way.

Explain: Give students enough time to collaborate with their partner and decide on a code that communicates each of the commands. The teacher needs to encourage and guide them to test and practice a code for each command. They also need to record their plan in the student journal.

Elaborate: Bring the students together and choose a couple of partners to model their codes. One partner needs to communicate using the code and the other needs to be able to model the cue. Ask students to explain how they worked together and decided on the codes they have.

Evaluate: (Session 2- 30 minutes) Give them time to work for a few more minutes with their partners to practice and finish their journal page.

Evaluate: Partners need to model their way of communicating and be observed by the teacher. On the back of their "Go Away! Come Here!" journal page is a recording sheet for this assessment observation.

***Extension Activity (Suggested to be used for whole group while assessing partners**)- Ask students if they remember all of the different ways someone can communicate. Show them the web from the last session and ask them to choose 6 of those words and illustrate them in their Student Journal page 16. They can also browse the books from the theme if they finish and you are still assessing.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
☐ Asking questions (science) and defining problems (engineering) ☐ Developing and using models ☐ Planning and carrying out investigations ☐ Analyzing and interpreting data	**PS4.C: Information Technologies and Instrumentation ☐ People also use a variety of devices to communicate (send and receive information) over long distances. (1- PS4-4)**	☐ Patterns ☐ Cause and effect: Mechanism and explanation ☐ Scale, proportion, and quantity ☐ Systems and system models

☐ Using mathematics and computational thinking ☐ Constructing explanations (science) and designing solutions (engineering) ☐ Engaging in argument from evidence ☐ Obtaining, evaluating, and communicating information		☐ Energy and matter: Flows, cycles, and conservation ☐ Structure and function ☐ Stability and change

Go Away! Come Here!

Materials: _____

_____

_____

Go Away Code:

_____

_____

Come Here Code:

_____

_____

Draw a picture of what it looks like when you communicate with your partner.

<u>Materials</u>- Check all that were used

____ Flashlight

____ Laser

____ Tuning Fork

____ Kazoo

____ Other _____

__/1

<u>Communication</u>

__/1 Able to communicate “Go Away”

__/1 Able to communicate “Come Here”

__/1 Able to understand “Go Away”

__/1 Able to understand “Come Here”

Total __/5

Waves: Light and Sound Name _____

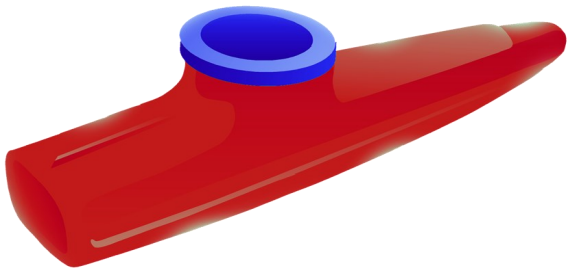
Unit Assessment

1. A kazoo is a toy that makes a sound when a person hums into it.
   Why does sound come from the kazoo?

   A. It can vibrate.

   B. It heats up.

   C. It makes light.



2. A tuning fork is struck and starts to vibrate. Which of these could happen next?

   A. The tuning fork becomes heavier.

   B. The tuning fork makes light.

   C. The tuning fork makes sound.

3. Why can these kids hear each other?

   A. The string vibrates.
   B. The string lights up.
   C. The string is black.

4. How is a shadow formed?

   A. When light passes through a window.
   B. When the path of light is blocked.
   C. When the light is turned off.

5. Where is a place you would be able to see your friend?

   A. A dark room
   B. A cave
   C. A room with a nightlight

6. In the box below draw the sun in the sky. Make sure to place the sun so that it will make the boy cast a shadow. Then draw the shadow of the boy.

7. Circle the materials that make sound by vibrating.

Assessment Recording Sheet **Name _____**

Multiple Choice

#1 ___/1

#2 ___/1

#3 ___/1

#4 ___/1

#5 ___/1

#6 ___/2 (Draw a sun and draw the shadow on the correct side)

#7 ___/3 (Circled the kazoo, tuning fork and guitar)

Total __/10

<u>Performance Assessment for "I'm a Scientist!"</u> **Total __/6**

<u>Performance Assessment for "Picture This!"</u> **Total __/8**

<u>Performance Assessment for "Go Away! Come Here!"</u> **Total __/5**

Assessment Total: ___ / 29

Notes and Observations:

_____

_____

_____

Optional Resources

www.sciencekids.co.nz

- Computer Games:

  How We See
  Sunlight and Shadows

- Video Clip

  Cool Sound Vibrations (33 seconds)

www.youtube.com

- Video Clip

  The Magic School Bus: In the Haunted House-Sound is Vibration (3:07)