Light & Sound

California ScienCenter
Amgen Center for Science Learning

Contents

Using Think SCIENCE! Pathways

Think SCIENCE! Pathways connect the field trip experience to the classroom. Topics are related to Science Center exhibits and are explored through classroom activities and an in-the-gallery activity sheet. The field trip portion of *Pathways* is self-guided and includes a live demonstration. It is designed for small groups of students that are lead by chaperones and/or teachers.

To Do *Before* the Field Trip

- Make a reservation. While *Pathways* are free to download, you must reserve time at the Science Center for a $20 booking fee. Please call (213) 744-2019 to secure your place.
- Read through the *Pathways* materials and make copies of the Chaperone Sheets (available for download).
- A map of the Science Center and the Creative World Gallery will be provided in your confirmation packet. Share it with your chaperones if you can.
- Visit the Science Center before the field trip, if possible, to preview the exhibits.
- Introduce the topic to your class and complete the Pre-Visit Activities.
- Let your students know what behavior is expected while at the Science Center and the learning objectives of the trip.

To Do *at* the Science Center

- Break students into small groups and assign a chaperone to each.
- Give chaperones copies of the Chaperone Sheets, pencils, and clipboards.
- The Chaperone Sheets are not sequential. Groups can begin where they want, but it may be necessary to assign starting points to avoid overcrowding at one exhibit.
- Visit the live demo. It runs from 10 am - 1 pm Monday - Friday.
- Encourage discussion in the small groups. Students will not have pens/pencils or paper.

To Do *After* the Field Trip

- Review the field trip with your students.
- Complete the Post-Visit Activity.

California ScienCenter
Amgen Center for Science Learning

Introducing the Topic

Light and sound come from energy moving in waves, but their properties are different. Understanding these properties allows scientists and engineers to build devices that enable us to communicate with each other.

Energy in Waves

Light and sound are caused by energy moving in waves. In fact, light itself is a form of energy that behaves like a wave. But – what is a wave?

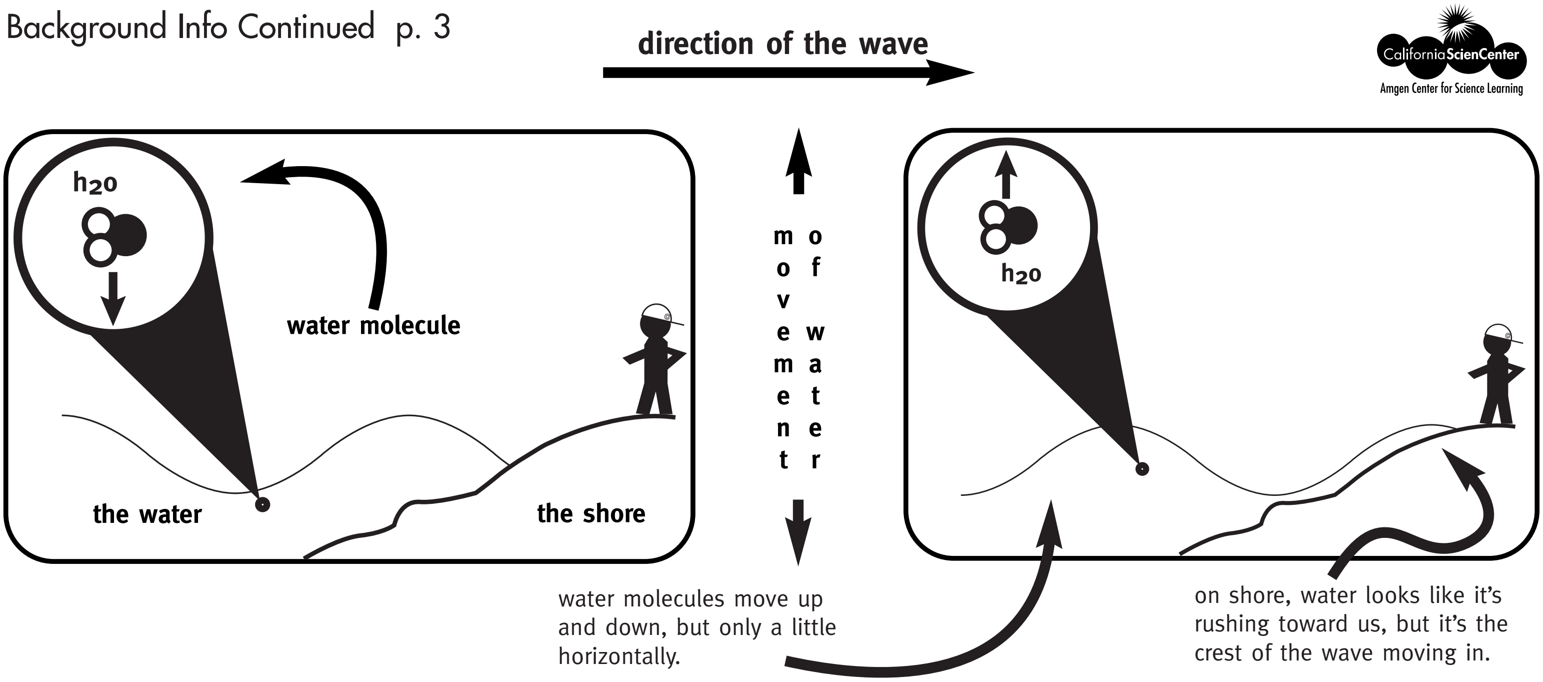
Waves

When you stand on the beach at the Pacific Coast, you see waves crashing into shore; however, the water hitting the sand is not really the actual wave. “WHAT!?!?!?” you ask. Yes, really. A wave is actually like a moving picture of energy, not water. “WHAT!?!?!?!?!?!?!” you ask again, even louder.

Let’s start at the beginning of an ocean wave. A wave in the Pacific could start from a small wind storm over the water way out west from the California coast. The blowing wind has energy that is making the air move. Some of that “blowing wind energy” causes the water below it to move up and down. In other words, the energy of the moving wind is transfered to the water, making it move, too.

The newly transfered energy makes the section of ocean under the wind move up and down. Quickly that original section of water transfers its energy to the next section making it move up and down. The energy keeps moving through the water, from section to section like dominoes, causing successive parts of the ocean to move up and down. It is the energy that is moving horizontally through the ocean, not individual molecules or sections of water. In fact, water molecules move very little horizontally when a wave occurs, but can travel a great deal vertically. We see that up and down motion moving through the water toward the shore as a smooth wave. The up and down motion is like an animated picture of the moving energy.

Check out the illustration on the next page for a visual explanation.



Sound

Sound is produced when something vibrates creating a wave. It can be a short burst or a long, sustained hum. In a short burst, such as the bang of a smashed paper bag, air ripping and leaving the bag quickly compresses a pocket of air around the bag. The energy of that compressed air compresses another area next to it and so on through the air like a wave through water. Finally, the air around your ears is compressed and you hear the bang.

Sound also can be sustained, such as the sound of a guitar string. When it is plucked, the string vibrates very fast, continuously pushing on the air around it and creating many compressions that move quickly. Because they are moving one after another so fast, all of these compressions mix together as they reach your ear and produce one long sound.

A Medium

The waves that produce sound need something to travel through such as air, water or a solid. In fact, waves like sound waves, ocean waves, the wave in a rope or waves that create earthquakes, are a certain kind of wave that can travel through solids, liquids and gases. These waves may just be moving energy, but that energy needs something to travel through. The something through which a wave moves (a solid, liquid or gas) is called a medium.

Light

Light is very difficult to describe. Actually, we do not really know what it is. However, we do know that light is a form of energy that behaves like and travels in waves, but light waves do not need a medium to travel through. Light can travel from the sun to Earth even though there is no medium like air in the space between. Light waves travel in straight lines, but can be reflected, bent and absorbed by objects in its path.

Sight and Hearing

Our senses of sight and hearing, the primary ways we learn about the world, depend on light and sound. The eyes and ears are associated with these senses, but they are not the only organs involved. Eyes collect images of light, but that light would be meaningless without the brain to make sense of it. Seeing does not occur just in the eyes, but is the result of the combined effort of the eyes and brain. The brain takes on the same role in hearing. For example, without the brain, ears would collect sound waves but we couldn't make any sense of them. The ears and brain work together to really hear something.

California Science Content Standards

The following *Light and Sound* activities meet these California State education standards.

Grade	Standards
Kindergarten	Investigation and Experimentation (4a), (4b), (4d), (4e)
Grade One	Investigation and Experimentation (4a), (4b), (4e)
Grade Two	Physical Sciences (1g) Investigation and Experimentation (4a), (4b), (4d)
Grade Three	Physical Sciences (1d), (2a – d) Investigation and Experimentation (5a), (5c), (5e)
Grade Four	Physical Sciences (1g) Investigation and Experimentation (6a – e)
Grade Five	Investigation and Experimentation (6d – f)
Grade Six	Physical Sciences (1g) Investigation and Experimentation (7b), (7c), (7e)
Grade Seven	Life Sciences (5g), (6a – g) Investigation and Experimentation (7b – d)
Grade Eight	Investigation and Experimentation (9a – c)

Additional Resources

Printed Materials

Benchmarks for Science Literacy, Oxford U. Press: NY 1993

Doherty, Paul. The Magic Wand and Other Bright Experiments on Light and Color, J. Wiley & Sons: NY 1995

Glover, David. Sound and Light, Kingfisher: NY 1993

Kaner, Etta. Sound Science, Addison-Wesley: NY 1991

Smith, Alastair. The Usborne Big Book of Experiments, EDC Publishing: Tulsa, OK 1996

Helpful Websites

www.casciencectr.org - for detailed exhibit info

www.howstuffworks.com

Before You Begin the Pre-Visit Activities

The *Think SCIENCE! Pathways* curriculum presents a continuous flow of learning from classroom activities to field trip to culminating activity. Following this plan is suggested for a rich educational experience, but each component can stand alone. Adding other information or activities is encouraged.

The following hands-on classroom activities introduce students to waves, sound and light. To begin, discuss the topics with your class and let them know that they will be visiting the Science Center on a field trip to find out more about these subjects

Activity 1: Waves

Light and sound result from energy moving in waves. Understanding waves forms a basis for examining the properties of both.

Activity Objective: To enable students to understand waves by demonstrating different kinds.

Materials:

dominoes, enough sets for groups of three
slinky
rope, about 2m length
paper
pens/ pencils

First:
Ask students to list all of the times and places in which they have seen waves. Allow them a minute. Assess their knowledge of waves and discuss their responses. After a quick discussion, introduce the activity.

Note:
This activity has three sections – Dominoes, Rope and Slinky

DOMINOES

Questions

What do students see when the dominoes are in motion?
What does the movement look like?
What do they hear?
Were the students' predictions accurate? Why?

Could the students see a kind of wave move down the line of dominoes?

Directions

- Divide the class into groups of three and pass out the dominoes.
- Give students time to build a pattern of upright dominoes, but before they are set in motion, ask the students to draw their patterns and write a prediction on what will happen. They will have to carefully record their observations of the dominoes in motion.
- Let the groups set off their dominoes and record what they see.
- Discuss their observations.

What's Happening

Students should begin to realize that one domino knocking over the next and so on caused the movement. They should have seen that the individual dominoes did not move very much, except fall over. It was the energy of the original falling domino that was translated down the path.

Continue Next Page

California ScienCenter
Amgen Center for Science Learning

ROPE

Questions

What do the students see in the rope?
How is the rope moving vertically?
How is it moving horizontally?

What was moving down the rope?
What was its shape?
Where do they think it came from?

How did the wave change?
How does the wave relate to the energy of the flip?
How is the rope related to the dominoes?

Directions

- Ask two students to hold each end of the rope in front of the class. One student should hold her end tight while the other student slowly flips the other end. The class should record their observations.
- Discuss the class observations. You may want to repeat the demonstration with other volunteers.
- Ask other students to also flip the rope, but this time, a lot faster.

What's Happening

From their observations, students should begin to understand that pieces of rope are not moving horizontally, but that a wave-like pattern is moving through the rope. That pattern is the energy of the flip. It may look like the up and down motion of the hand when the rope was flipped. Energy is what is moving through the rope.

SLINKY

Questions

What does the class see?
What seems to move through the slinky?

How did the movement change?
How does this kind of wave relate to the energy of the push?
How is the slinky related to the rope and the dominoes?

Directions

- Ask two students to hold each end of the slinky in front of the class and stretch it along the length of a table. Ask one student quickly push her end a short distance toward the other. The class should record what they see.
- Discuss the class observations. You may want to repeat the demonstration with other volunteers.
- Ask other students to push the slinky, but this time, a lot faster.

What's Happening

When the student pushes the end of the slinky, she compresses a small portion of the spring. That push moves down the line from one section to another, compressing small parts of the slinky along the way. The horizontal movement is a wave that looks different than the rope wave. The wave in the sliny is the moving energy of the push and it is called a compression wave.

California ScienCenter
Amgen Center for Science Learning

Activity 2: Sound

Sound is made up of waves created by vibrations.

Activity Objective: To allow students to investigate the causes of sound.

Materials (per pair of students) **:**

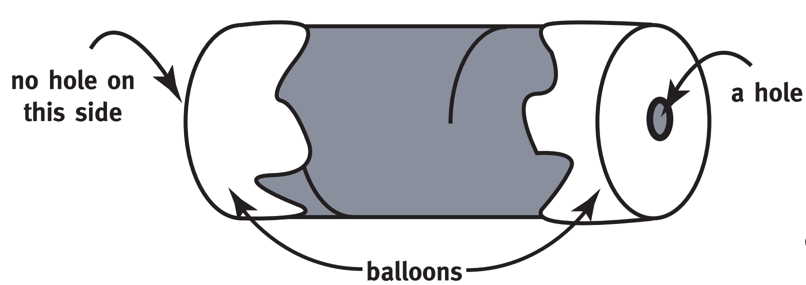
rubberband
large container filled with water
toilet paper tube
large balloon
strip of paper
piece of yarn
scissors
tape
paper
pens/ pencils

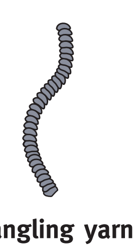
First:
Start the class by letting everyone yell at the top of their lungs for 10 seconds. You may want to close your classroom's door.

Discuss what happened. Students should record their responses. What did they just produce? How did it feel in their mouths, throats and heads? How do they think the sound was produced?

Divide the students into groups of two and start the rest of the activity. One student should record the group's observations at every stage of the activity.

Questions	Directions
What do the students hear? What do they see happening to the rubberband or air around it while they hear the sound?	• Ask one student per group to string a rubberband between her fingers and pluck it. Students should record what they hear and see.
What do students see on the surface of the water? How could the waves they see relate to the sound they hear?	• Again, one student should pluck the rubberband, but this time, quickly plunge the vibrating band into the container of water.
	• As a class, discuss the observations so far.
What's Happening	*Students should be able to see the correlation between the vibrations and the sound produced and also the vibrations and the waves produced in the water.*
	• Now the groups are going to build a drum to use sound to move a piece of yarn. **See instructions below.**
What do the students hear? What do they feel coming out of the hole when the sound is produced? What made the yarn move? How might the movement be related to the sound they are making?	• Let students tap the covered ends of their drums and record their observations. Then, one student should dangle a piece of yarn in front of the drum hole while the other student taps the covered end.
What do students see on the water? What do they think is the relationship between the moving air, vibrations, waves and sound?	• Allow students to hold the end of the tube with the pencil hole just over the water while they tap on the other end.
What's Happening	*Students should relate the sound of the drum to air moving.*





Instructions for drum:

1) Cut the balloon so that there are two squares large enough to cover the ends of the tube.
2) Tape the squares tightly over the ends of the tube. With a sharp pencil, poke a hole the diameter of the pencil into the center of a balloon at one end.

Activity 3: Light

Light has several properties that allow it to be manipulated.

Activity Objective: To familiarize students with some properties of light.

First:
Set up the following 4 investigation stations. Allow small groups of students to circulate around the room to each station, spending about 10 minutes at each. As the teacher, you can circulate with them asking the suggested questions or you can write the questions on cards placed near the activities. You also may want to write the directions for each station on cards. Because these activities examine light, a dark room is helpful.

Students should carefully record all of their observations and answers to the questions. They should be discussed at the end.

Materials	Directions	Questions
Station 1 white paper black paper a mirror a flashlight	• With a flashlight, students will try to bounce a beam of light onto a piece of white paper using a piece of black paper, another sheet of white paper and a mirror.	• How well did each material bounce light? • If no light was bounced, where did it go?
Station 2 large transparent container 1/2 filled with water a flashlight magnifying lens white paper small amount of milk	*Before students begin, drop a few drops of milk into the water.* • From one side of the container, shine light through the water. • While shining through the water, angle the flashlight up until the beam of light hits the underside of the water's surface. Hold a piece of white paper above the surface of the water and try to see some of the light hit the paper. • While still shining the light through the water, hold a magnifying lens into the beam in the water and record how the light changes.	• What does the light look like in the water? • What path does the light take when angled? Draw it. • What happens to the beam in the water and the light on the paper as the flashlight is moved? • What does the lens do to the beam?
Station 3 a flashlight various small objects of various transparency	• Pick up the objects and shine light onto them. Notice how well light passes through them. Label the objects as letting light go through: **all**, **a little** or **not at all**. *At the end, gather the class together and create a chart that classifies the items. Introduce the terms transparent, translucent and opaque.*	Why do you think some objects are better at letting light through than others?
Station 4 3 cardboard squares with with small holes punched in their centers a flashlight	• Line up the three cardboard squares so that light shines through their holes.	• What happens if the middle square is moved around? • Why can light be seen through all three squares only when they are lined up? • Do you think light travels in a straight line? Why?

After all groups have visited each station, wrap-up in a class discussion allowing students to share their observations.

The Field Trip Musical

After the field trip to the Science Center, ask students to reflect on the day and summarize what they learned through a live musical performance. Students should write a song or story set to music then perform it for the class using instruments that they make. The song or story should talk about their day, the field trip, their experiences at the Science Center and at least five items they discovered about light and sound. The musical performance should be highlighted by a light show also created by the students.
Way Cool.

Suggested Instruments

- Make reed instruments, such as flutes, from different-sized drinking straws taped together or straws and plastic cups.
- Make stringed instruments, like guitars, using rubberbands strung across hollow cardboard boxes or margarine tubs.

Students should be able to explain, based on what they learned about sound from the activities and field trip, how their instruments work.

Suggested Light Shows

- Tape colored cellophane over flashlights to create a colored light show.
- Place mirrors around the classroom to reflect light all around the stage.
- Animate the song or story with a musical shadow puppet play.

Ask students to explain how they are using the properties of light to produce their effects.