Sound

Preparation

Grade Level: K-3	Group Size: 20-30
Time: 45-60 Minutes	Presenters: 3

Objectives

The lesson will enable students to:

- Identify sources of sound.
- Explain why you can "see" sound waves.
- Change the tone and volume of sound waves.

Standards

This lesson aligns with the following National Science Content Standards:

- Unifying Concepts and Processes in Science, K-12
- Physical Science, K-4

Materials

- Tape recorder
- Tape with sound effects
- Bucket for water
- Rock
- Rope or long spring
- Tuning forks
- Tin can with balloon on one end
- Flashlight or laser pointer
- Small mirror
- Drum
- Cardboard cylinder
- Candle
- Space phones
- 9" balloons
- 1/4" hex nuts
- Sound spinner
- Drinking straws
- String
- Pencil
- Forks
- Thunder Tube
- Four (4) tin cans with holes in the bottom
- Rosin
- Rubber bands of various widths
- Rectangular cake pan
- Two Styrofoam cubes
- Board with nails
- Guitar strings or guitar
- Tin cans with nails or screws in the bottom
- Drinking glasses
- Paper plates
- Dried Beans

Preparation

Arrange each station with the materials and equipment needed. For the introduction, fill the bucket with water.

Divide the class into three groups to participate in various activities that illustrate how sound travels, how it is transferred from one object to another, and how it is amplified and of different pitches. Several activities are outlined, and you may need to select only one or two per each group if time is short.

Two follow-up activities are suggested that could be done on another day and will provide reinforcement of this lesson.

Introduction

Presenters should try to relate sounds to the students' world.

Q: What sounds did you hear today on the way to school?
A: Answers will vary. List the student's answers on the board.

Play a tape with a variety of sounds recorded on it.

Q: What sounds did you hear on the tape that you didn't hear on the way to school?
A: *Answers will vary. Again, list the answers on the board.*

Sounds are important to us in many ways. We can tell from the sound on the tape what activity is taking place even though we cannot actually see it. This is very important when we hear a police siren. We know that someone is going to be driving by quickly and that we need to stay out of the street. If you are riding your bicycle, and you hear a car, you know that you must also be careful and stay out of the street. Sounds alert us to danger and are important to our everyday lives.

Now we are going to talk about how sound is created and how it moves around. When something vibrates, it moves back and forth. *Stretch a large rubber band and show how it vibrates.* As it moves back and forth, the band bumps up against air molecules, which bounce against other air molecules. This bumping of air molecules is what allows sound to carry from one place to another.

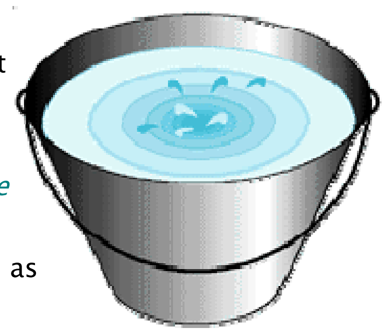
Q: Does sound travel in outer space?

A: No – because there is no air and, therefore, no air molecules to bump against each other and "carry" the sound.

One way to think of sound is as waves traveling through the air.

Q: Has anyone seen what happened when you throw a stone into water?
A: The waves travel out away from where the rock landed. Sound travels in the same way.

Q: Why do you think this happens?
A: It is because of the air molecules bumping into each other.



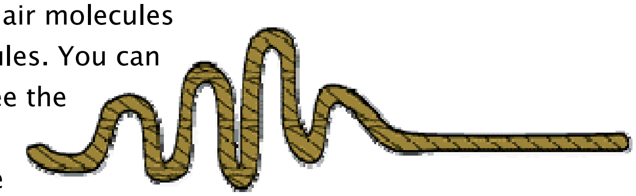
Let's get in a large circle in the middle of the room around the bucket of water. Now everyone put one hand into the middle of the circle. Each of your hands will be like an air molecule. I will start the sound and "bump" the next air molecule. *Make a sound and shake or vibrate your hand. Each student in turn (beginning with the one to your left) should do the same.* Each air molecule (hand) will bump the next one as sound travels around the circle.

In this example, our "sound" is traveling in a circle, but we know that sound actually travels in all directions. Look at the water now as I throw a rock into the middle of the bucket.

Q: What happens?

Q: Why do the waves travel out to the edges?

Sound waves travel in the same way. We know this to be true because if I stand in the middle of the room you can hear me no matter where you are. The sound even bounces off the walls, just like the water waves in the bucket.



Next, we will use this rope to show how this bumping of air molecules occurs. When I flip the rope, it starts bumping air molecules. You can see how the bumping continues down the rope as you see the flip travel the length of the rope. If I made a sound here, it would travel just like the flip in the rope. One molecule bumps another and another and another and another until the bump ends up at the other end.

Next, we will show you how vibration causes sound. *Illustrate how a tuning fork works.*

Q: Who knows what this is?
Q: How does it make sound?

When you tap the tuning fork, it starts to vibrate. When it vibrates, it bumps up against air molecules and the sound travels to your ears. *Demonstrate by using the tuning fork in different parts of the room.*

When the vibration stops, the sound stops.

Have students put their fingers on their throats and hum or say something.

Q: What does your throat fell like when you do this?
Q: Can you feel the vibration?

That vibration in your throat is what causes the sound you call your voice.

As we are doing experiments today, remember that when something starts to vibrate, you can hear sound, and when it stops vibrating, you can no longer hear the sound. Therefore, sound travels in waves caused by vibration.

Station 1 – Sound Waves

Space Phones

Note: Do not stretch to spring in excess of ten feet.

With another student gently stretch the Space Phones between you. Hold the horn to your ears and brush or tap the spring.

Q: Describe the sounds you are hearing.

Now try talking into the horn as your partner listens to you.

Q: How have the sounds changed when someone is talking into the horn?

Have third person roll the spring in the middle, giving it five or ten turns. Listen when the spring is released.

Q: Describe this sound.
A: It should start very quick then develop into a big whoosh sound.

Without listening in the horn, flick the spring and watch the wave travel, bounce off the far end, and return.

Q: Can you hear the traveling wave bounce back?

Q: What is vibrating on the Space Phones to cause the sounds you hear?
A: As you talk into the Space Phones your voice causes vibrations in the air, making sound waves. The horn focuses the waves on the plastic drum at the end causing it to vibrate. The drum then causes the spring to vibrate. Those vibrations travel to the other drum and horn.

Q: What produces the unique sounds you hear?
A: The sound waves travel both from coil to coil in the spring, and along the length of the spring's wire. Your voice overlaps itself and gives the unique echoing sound.

Thunder Tube

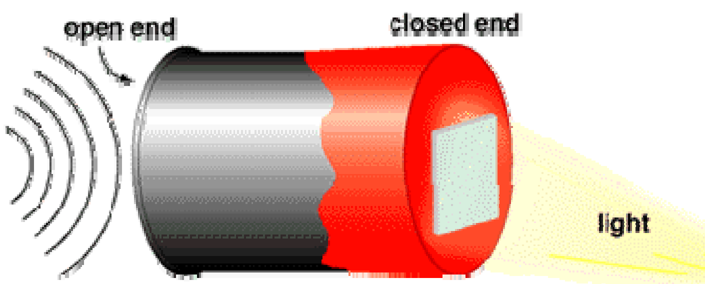
You can hear, see, and feel sound vibrations using the Thunder Tube.

Grasp the Thunder Tube with one hand with the spring hanging down. Gently twist your wrist causing the spring to move. The movement of the spring creates sound waves in columns that are amplified inside the tube.

Q: Does the sound change with different movements of the tube and spring?

Sound waves you can see

Stretch a balloon over the end of a tin can and attach the mirror to the balloon. Set up the tin can so the lamp shines on the small mirror. Make sure the light reflects off the mirror and onto the wall. Use the drum to send sound waves into the open end of the can.



Q: What do you see?

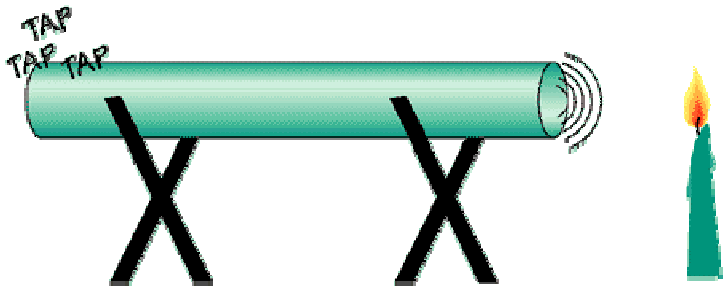
Q: Why does the reflection on the wall move?

Talk into the can and see if the light moves on the wall—you can "see the sound" on the wall as you talk. The sound waves from the drum and our voice cause the air molecules to move, and they in turn cause the balloon to vibrate. As the balloon vibrates, the mirror vibrates. This causes the reflection on the wall to move.

Candle Flame

Sound can be very powerful. We are going to show you how powerful sound waves can be.

Set up a cradle to hold the cardboard cylinder. Point the hole in the cardboard cylinder toward a candle. Make sure that the hole is the same height as the candle flame and is pointed directly at the flame. Tap on the opposite end of the cylinder.



Q: What is happening?
A: The taping on the tube causes the air inside it to vibrate. The waves created by the vibration are powerful enough to cause the flame to flicker.

Q: Does the flame go out?

If you think it is from wind, try to blow the candle out from the same distance as the cardboard cylinder. *If it is properly lined up, the cylinder should be able to blow out the candle from a distance of 5 or 6 inches.*

The sound created by the tap on the end is focused as it comes out of the hole. These "sound rings" can be very powerful. Scientists have created sound rings that can knock a person down at a distance of twenty feet.

Station 2 – Sound Vibrations

Screaming Balloons

Insert 2-3 hex nuts into the balloon. Make sure they go all of the way to the bottom of the balloon. Carefully inflate the balloon. Do not over inflate it. Tie the balloon. Hold the balloon in the palm of your hand and swirl it in a circular motion. As the speed is increased the hex nuts will produce a wonderful sound.

The energy generated by the hex nuts coming in contact with the balloon helps generate vibrations which create the sounds. This is also an example of centripetal force – an inward or center seeking force.

You can see and feel the vibrations as the nuts move around the inside of the balloon.

NOTE: The nuts will cause the balloon to deteriorate and pop – launching the nuts. It is best to use new balloons with each group.

Sound Spinner

Have the students stand in an open space and rotate the sound spinners. Have them adjust the speed they are spinning them.

Q: What do you hear?

Q: Do you get different pitches of sound?
A: Twirling (spinning) the tube fast creates higher pitches and slower spinning creates lower notes.

By spinning the tube forces the air inside to resonate (vibrate) and forces the air molecules out the ends. The faster the air flows through the tube the higher the frequency of the sound.

Straw Kazoo

Demonstrate and explain how to make a straw kazoo. Have the students complete the steps with you.

1. Flatten one end of a straw and cut the corners off the ends.
2. Place the cut end in your mouth. Close your mouth around the straw and blow until you produce a sound.
3. Remove the straw from your mouth and cut a small piece off the end of the straw.
4. Put the straw in your mouth and try it again.

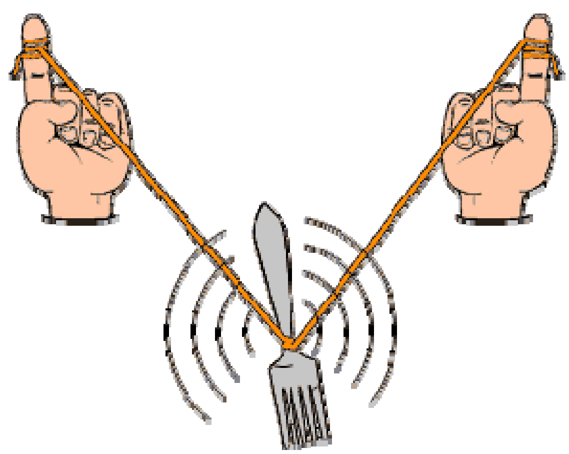
Q: What do you hear?

Q: What did you feel?
A: The entire straw vibrates and produces the sound. This is just like several instruments in the band or orchestra – namely the oboe, English horn, and bassoon.

Q: What happened when you cut the straw?
A: The pitch of the sound produced will change based on the length of the column the air travels through. With instruments, the length of the column is adjusted with pads, stops, holes, and the instrument itself. (An oboe is shorter then an English horn, which is shorter then a bassoon.) *Show the photos of the instruments.*

Vibrating Fork

Each student should have a piece of string (about 3 feet long) with a fork attached tightly to the middle.



Take one end of the string in each hand. Wrap the string over your pointer fingers, dangling the fork in the middle of the string. Swing the fork and hit a hard object with the fork to start it vibrating.

What do you hear when you hit the fork?

Now put your fingers in your ears. Swing the fork again and hit a hard object with the fork to start it vibrating.

Q: What do you hear this time?

Q: Why is there a difference?

The fork makes the same noise both times it vibrates. The first time the vibration from the fork caused the air molecules to vibrate, and that is how most of the sound reached your ears. The second time the vibrations came straight up the string and were much louder. It is much easier for vibrations to travel in solid objects than it is for vibrations to travel through the air.

String Gunfire

Cut a piece of string about 6 feet long. Tie one end tightly around a pencil. Make a loop with about 2 feet of string at the other end of the string. Have one student hold the pencil and another student hold both hands inside the loop. The two students should stand, facing each other, far enough apart to stretch the string tight. Have the student holding the pencil rotate the pencil.

Q: What sound do you hear?

Now have the student with hands in the loop place the loop over his or her head. The student's hands should remain in the loop and should cover the ears. Have the other student rotate the pencil again.

Q: What sound do you hear now?

Q: Why was there such a big difference?

Have the student holding the pencil flick the string again.

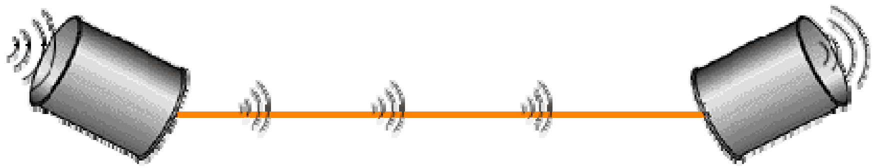
Q: What sound do you hear now?

Q: Why is there such a big difference?

The string makes the same noise both times it vibrates. The first time the vibration from the string caused the air molecules to vibrate, and that is how most of the sound reached your ears. The second time the vibration came straight up the string and was much louder. It is much easier for vibration to travel in solid objects than it is for vibrations to travel through the air.

Tin Can Telephone Line

Have students stand on opposite sides of the room. Each student should take turns talking into the two cans attached to each other with string. Make sure that students stand far enough apart to keep the string taut.

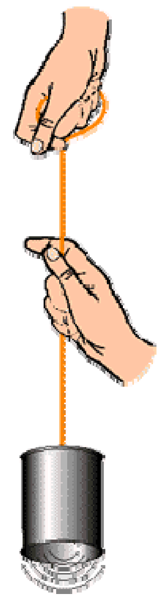


Why can you hear each other even though you are standing so far apart?

The can captures the vibrations created by the sound of your voice and sends them into the string. The vibrations travel along the string to the other can where the vibrations are amplified and transferred to your ear.

Station 3 – Sound Amplification

Vibrating Can



Place a string through the center of a can. Tie a knot in one end large enough so that the string will not pull through. In the other end of the string, tie a loop that will function as a handle. Put resin on the string. Have a student hold the loop in her hand with the can dangling below.

Use your free hand to pull downward on the string, letting it slip between your fingers.

Q: What sound do you hear?

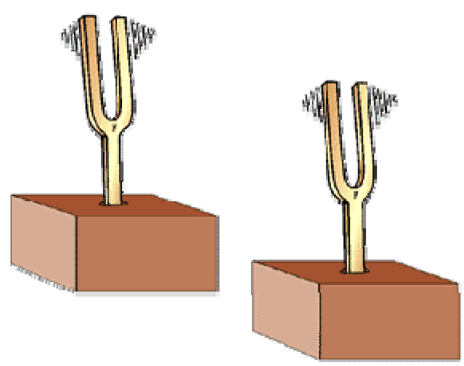
Q: Why is the sound so loud?

The vibration in the string is transferred to the end of the can and amplified by the shape of the can.

Tuning Forks

Set up the tuning forks attached to the boxes about 6 inches from each other at a 90 degree angle. Start one tuning fork vibrating. Wait 30 seconds and stop the first tuning fork from vibrating. The second fork is now vibrating.

Q: Why do you think the second turning fork is vibrating?



We didn't even touch it. The vibration waves caused by the first fork are transferred to the box below it and are sent to the other box through the air. The second box begins to vibrate, causing the second tuning fork to vibrate.

Have each student use a tuning fork to listen to the sound created when the tuning fork is vibrating (making sure that the students use a rubber mallet to strike the tuning fork—a hard object will break it).

Guitar Strings

Attach several guitar strings to a board with strings or use a guitar. Pluck the strings and listen for a difference in the pitch of the sound.

Q: What strings have the lowest pitch?

Q: What stings have the highest pitch?

Put a block over the strings and pluck the strings again.

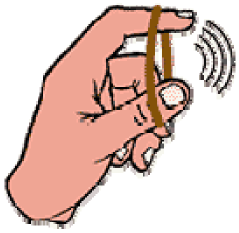
Q: What happened to the sound?

Q: Was it higher or lower than the sound you heard without the block?

The strings vibrate and create a sound. The smaller strings create higher notes because they tend to vibrate faster than the bigger strings. As the length of the vibrating wire is shortened, the strings also vibrate faster, causing a higher pitched sound than the longer strings.

Rubber Band Can

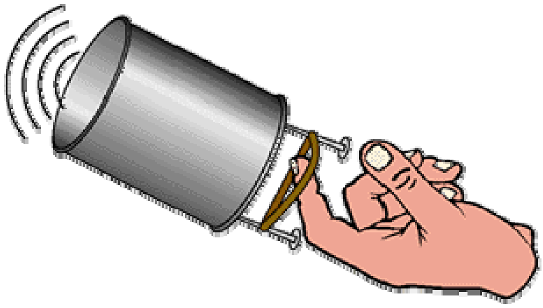
Have each student put a rubber band between two fingers and pluck the rubber band.



Q: What do you hear?

Q: How loud is the sound?

Put two nails on opposite sides of a tin can. Stretch a rubber band between the nails. Have each student pick up the can, hold it to his or her ear, and pluck the rubber band.

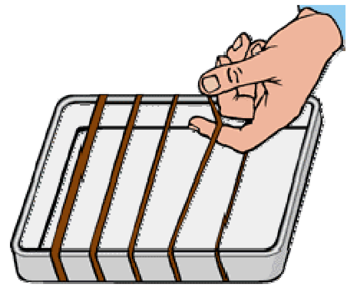


Q: What do you hear when you pluck the rubber band?

Q: Why is the sound louder than when you plucked the rubber band on your fingers?

The vibrations from the rubber band are transferred to the can, and the can also begins to vibrate. The vibrating can with the open end creates a natural amplifier, which makes the sound louder than with the rubber band alone.

Rubber Band Harpsichord



Put rubber bands of various widths around a cake pan.

Q: What happens when you pluck the rubber bands?

Q: Which rubber bands create which sounds?

Q: Why is the sound different for small rubber bands and large rubber bands?

The smaller bands vibrate faster and make a higher pitched sound. The larger and thicker rubber bands vibrate slower and make a lower pitched sound.

Conclusion

Review with the students the concepts from each station.

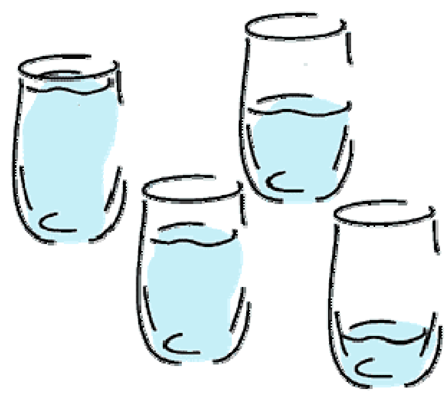
Q: How does sound travel through air?
A: Sound vibrations cause molecules in the air to bump against one another, which carries the sound.

Q: Does sound move more easily through air or through solids?
A: Sound travels more easily through solids.

Q: Why do you think this is?
A: Because the sound energy is more easily passed through the densely pack molecules of the solids.

Follow-up Activities

Musical Glasses/Bottles

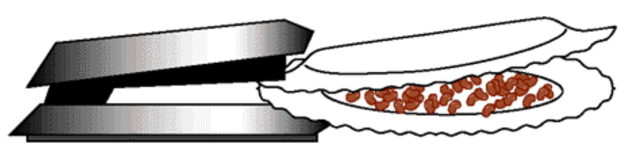


Fill several bottles or drinking glasses with different amounts of water. Use identical containers to show that it is the water level that makes the difference, not the size or shape of the container.

Tap on the bottles and listen for the differences in sound. Try adjusting the water levels so you can play a simple tune.

Q: What causes the sound to change with each glass?

Shaker



Have each student decorate the bottom of two paper plates. Put dried beans on one plate and place the other on top. Staple the plates together and use as a tambourine. Discuss with the students how the sounds are created and why their shakers sound different from each others.