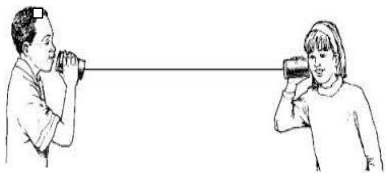
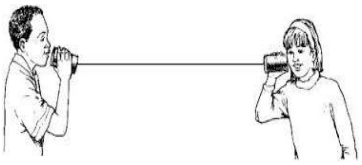
2 – Exploring Sound: Plastic Cup Telephones (Teacher Pages)

Activity Overview	The goal of this activity is to investigate sound as a mechanical wave which requires a medium to be conducted. Students will use kite string to conduct sound from one plastic cup to another as we explore sound as a mechanical wave with plastic cup telephones. We have established sound as a mechanical wave with tuning forks in other activities. This activity relies upon string as the medium for conducting sound as one student speaks into the cup and the other listens.
Materials	Plastic cups Kite string [15 ft. per plastic cup telephones] Paper clips
Guiding Question	Can string connecting two plastic cups serve as the medium for conducting sound from one cup to the other?

Exploring Sound
 	
Can string conduct sound waves when students speak into plastic cups connected by kite string?
	Station 4: Plastic Cup Telephones
	 
	• Poke a small hole in the bottom of two plastic cups.
	• Pull each end of a 15 ft. length of string through the hole in the bottom of the cup.
	• Attach each end of the string to a paper clip so that the two cups are connected by the string secured to each cup with a paper clip.
	• Ask students: What if you did not have a cell phone or even a land-line telephone. Could you design a simple telephone from cups and string?
	  o Note that students are likely to respond by saying texting the other person would be a solution. Respond by indicating that there are no smart phones.
	  o Could students use two cups connected by a length of string to relay a spoken message to one another? Would the string conduct the sound waves from the speaker to the other person holding the cup over his/her ear?
	• Pair students and ask students if they think the sound of their voice will be conducted by the string so that their partner can hear what they are saying.
	  o Instruct students to stand far enough apart from one another so that the string is stretched between the two cups.
	• Instruct the students to move closer together so that the string is slack or no longer stretched tight between the two cups.
	  o Can the students still hear one another? Why? Why not?
	• Next, when one person is speaking, ask a third student to hold the string with his/her hand. Ask the student listening to the message if he/she can still hear when someone is holding the string.
	  o Can you still hear the other person when someone is holding the string? Explain your answer.

Something to think about	• Statement: Sound is a mechanical wave.
	  ○ The sound of the human voice is created by the vibration of our vocal cords when we speak. During this activity, the vibration of vocal cords causes the air inside the cup to vibrate. The vibrating air caused the cup to vibrate and eventually the vibration is conducted to the string connecting the two cups. Sound waves generated by one student are conducted to the second cup by the string to become a detectable sound.
	  ○ In this activity, the cup, air, and the kite string were the media conducting the vibrations created by the vocal cords of the student speaking. When the string was stretched between the two cups, the vibrations were easily conducted by the string from one cup to the other. However, when the string was slack or sagged between the cups, the vibrations were less likely to reach the second cup.
	  ○ When the string was held by another student, the vibrations could no longer travel along the string from one cup to the other. The string ceased to vibrate at the point where it was held.

Linking to the Standards	Next Generation Science Standards: **4-PS4-1.** Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. <u>Disciplinary Core Ideas:</u> • Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. <u>Science and Engineering Practices:</u> • Develop a model using an analogy, example, or abstract representation to describe a scientific principle. <u>Crosscutting Concepts:</u> • Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena.
Assessment	Formative assessment is suggested: • Use the questions suggested at each step as a means to assess students' understanding. ○ Challenge students collaborating in teams to analyze their observations and interpret their data to develop supporting evidence to describe sound as a mechanical wave. • The questions listed on the student pages can also be used as a means of assessment



Sound Science: Can you see sound? [Teacher page: Answer sheet]

Name: _____

Plastic Cup Telephones:

1. During this activity you and your partner used two plastic cups connected by a string a very basic telephone. You and your partner should each hold one of two plastic cups connected by a length of kite string. Stand far enough apart [approximately 15 ft.] so that the string is stretched between the two cups. Next, take turns speaking and listening to one another.
    a. When your partner spoke into his/her cup, could you hear what was being said?

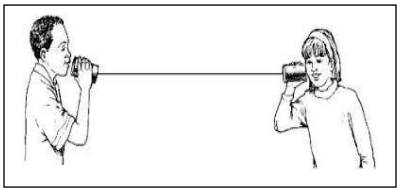
Yes, your partner's voice could be heard because the vibration resulting from his voice [created by vibrating vocal cords] was conducted by the string from one phone to the other. Sound travels very fast [approximately 1,126 ft/sec] so you were not likely to see the string vibrate or notice a delay in the time it took for the sound of your partner's voice to reach your cup.

    b. Do you think the string conducted the vibrations created by your partner as he/she spoke into the cup? _**Yes**__ What evidence from your experience with sound could you use to explain your observations during this investigation?

Sound is a mechanical wave which means that sound can actually cause other things or materials to vibrate. For instance, the sound created by a vibrating tuning fork can cause ripples in the surface of water. Sugar crystals placed on plastic wrap over a plastic cup will bounce when a vibrating tuning fork is held close to the mouth of the cup.

In this investigation, the string functions to conduct the vibration from one cup to another when a student speaks into one of the cups. When the string is slack or no longer stretched tight between the two cups, the vibrations are not conducted as efficiently and it is no longer possible to hear your partner speak.

When the string is held by a third person, the vibrations can no longer move freely over the string. Just as when you grasp the prongs of a vibrating tuning fork, the vibrations cease, the same outcome results when the string is held by a third person.



Science: Can you see sound? [Student page]

Name: _____

Plastic Cup Telephones:

1. During this activity you and your partner used two plastic cups connected by a string a very basic telephone. You and your partner should each hold one of two plastic cups connected by a length of kite string. Stand far enough apart [approximately 15 ft.] so that the string is stretched between the two cups. Next, take turns speaking and listening to one another.
    a. When your partner spoke into his/her cup, could you hear what was being said?

    b. Do you think the string conducted the vibrations created by your partner as he/she spoke into the cup? ___ What evidence from your experience with sound could you use to explain your observations during this investigation?