Tin Can Phones: How we can hear SOUND?

Lesson Plan by Tanya Juarez

Target Grade: 1st
Teacher Prep Time: 20 minutes
Lesson Time: 1-2 hours

Learning Goals:

- Students will know that sound is produced by vibrating materials.
- Students will build and test cup telephones to investigate sound over a distance.

NGSS:

- 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.*
- Disciplinary Core Ideas
    - PS4.A: Wave properties
        - Sound can make matter vibrate, and vibrating matter can make sound.

      PS4.C: Information Technologies and instrumentation- People also use a variety of devices to communicate over long distances.

Cross Cutting Concepts

- Cause and Effect: Simple tests can be designed to gather evidence to support or refute student ideas about causes.
- Patterns: Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Science and Engineering Practice: 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.

MATH:

1.MDA.4 Organize, represent, and interpret data up to three categories; ask and answer questions about how many in each category, how many more and how many less.

Where this lesson fits in:

- This lesson can be taught after students make observations with sound. For example, students can make predictions of what is inside a mystery tube with different items. The following items: beads, paper clips, macaroni, buttons and erasers can be placed inside covered toilet paper rolls and students can shake them to make predictions of what they think they hear inside of them. In kindergarten students learn that energy comes from the Sun, in first grade students learn that sound is a type of energy.

Materials Needed:

- Large coffee tin can open on both ends with plastic wrap cover
- Rice
- Large rubber band
- 3 inch diameter tin cans, 13 oz (need 2 for 1 telephone)
- Yarn
- Paper cups (large and small-Dixie)

- Styrofoam cups
- Paperclips
- Dice
- Poster chart paper and post- its
- Tuning Forks

Teacher Prep:

- Insert a hole with a paperclip through the center of the cups you will be using.
- Cut 3 meters in length of yarn (15 recommended for class pairs)
- To save time, you can have the paper cup telephones pre-made or students can build them by inserting the yarn through the center and tying a knot to the paperclip. Remember not all students will know how to make a knot. For lower grades, pre-made phones are suggested.
- Get 15 dice. One dice will be used for each pair of students.
- Set-up tables directly across or allow for a large space where students can test their telephones across a distance.

5E Lesson Sequence

15-20 minutes	**ENGAGE** 1) Have students seated whole group on rug area for demonstration. • Use the large open coffee tin can that is open on both sides. Cover the top tightly with plastic wrap and a rubber band. Place a spoonful of rice over the plastic wrap. Place a portable wireless speaker inside the tin can. Ask students what do they notice about the rice? • Have students watch for any movement from the rice. Turn up the volume and ask students again what did they notice about the rice? When students mention the rice moving, introduce the word vibrate and vibration if no one made this connection. Using a speaker versus clapping eliminates air as a factor. (Concept-sound makes vibrations, sound can travel through air) 2) Gather students around a plastic tub to observe what happens when you test out different tuning forks and place them in the water. ▪ Use a clear plastic tub and fill it ¾ full of water. Once you hit a fork, quickly place it in the water for precise movement. Ask students what they observe once you hit the fork and what happens when it is placed in the water? Can they still hear the sound produced when it is inside the water? (Concept-vibrating materials can make sound, sound can travel in water) **Give students the **Scientific Practice Worksheet**: Is the sound traveling? Students circle what is making sound. **PRE-LAB** ▪ Use the tin can telephone already made with string to test whole group. ▪ Pass out the 'Whispering through Tin Cans" worksheet for student predictions. ▪ Ask students what they think will happen to the sound when someone whispers through the tin can? Have them circle their prediction. ▪ Call on a one volunteer per table to test out the telephone. ▪ To test different lengths, have a longer or shorter telephone to observe which telephone allows sound to be heard the best.

40 minutes	**EXPLORE-Lab #1 CUP TYPE** • Once students begin to think about variables that can change such as string length, ask what will happen to the amount of sound that we can hear if we change the type of container? • Pass out the sheet with the lab question and variables that can change. • Show students the materials for cups type: Styrofoam cup or paper cup. • At this point, have students agree as a class, which cup type they want to test out first for their lab experiment. Also have students write in and circle which cup type they predict will allow a whisper to be heard louder. (*I predict that a whisper will travel better through a _____.)* • Pass out the **DATA tally sheet** for lab1. Tell students that they will each get three turns to roll a dice and say the number through the telephone. If their partner can hear the correct number said, the first student will record a tally mark on the side that says, "I heard". If they did not hear, the tally marks will be placed on the side that says, "I did not hear". Have students switch after 3 trials. *NOTE: Review to students that a tally mark is only 1 mark and not 5 marks. Some students have misinterpreted a group of five as "a tally mark".* • Once they have completed the first 3 trials, check that all students who rolled the dice have recorded their tally marks on their data sheet. • Pass the dice to the partners across and repeat 3 trials. • After the 3 trials each, have students test the other cup type and repeat the experiment. • At the end of the lab, have students circle which cup type had the most tally marks under "I heard" from their lab experiment. If both cup types had the same amount, have them circle both types. • Students also **graph** their results in a bar graph by coloring the number of tally marks for each cup type. • Pass out the **RESULTS sentence frame strip** and have students circle or write in which cup type worked better based on their tally marks. (*From the tally marks, I understood that the _____worked better than the _____cup for making a telephone.*
15-20 minutes	**EXPLAIN** • Give a post-it to each student to write their name and cup type that they circled from their data results with the most tally marks. On a large poster paper, create a large chart with "Quantity "on the Y-axis and "Cup type" on the X-axis. • Have all students graph their post-it on the bar graph to see the overall classroom results. • Discuss why they think a certain cup type worked better. Discuss how was sound able to travel? ▪ **Read: Readworks.org "How to see sound"** ▪ **Watch https://youtu.be/AGjxfx8sy6s** (kid friendly video) ▪ **Vocabulary: Sound Vibration Sound waves Pitch (medium-air, solid, water)**
30 minutes	**EXTEND/ELABORATE (Lab #2) CUP SIZE** • Pass out the sheet for cup size. "Does the size of the cup make a difference? How can we test that?" Go over the new question with the sentence frame: If we change the _____what will happen to how much sound we can hear? Students write in the variable that will change this time and circle it on the data chart (cup size).

	• Next have students complete the sentence frame for their prediction. "I predict that a whisper will travel better through a _____(larger/smaller) cup." • Pass out the data tally sheet where students will record their trials. • Each student will roll the dice again 3 times for each cup size and record their results with tally marks. • Graph the results by coloring in again. • Have students complete their RESULTS summary: "Based on the tally marks, I understood that the _____phone worked better." • Have students circle the cup size that had the most tally marks. Each student will write the cup size with the most tally marks on separate post-it along with their name. • Prepare a large data chart with quantity on the Y-axis and Cup size on the X-axis. Include an area titled, "the same" for students who had the same number for both. • Have students graph their results on the bar graph. Count the total for each and discuss why one size had more than the other? Why do they think sound was heard louder through a certain size? **HOME EXTENSION PROJECT** • Have students build a telephone using materials they have at home to explain the lab experiment and how sound can travel to a parent or adult.
20 minutes	**EVALUATE** ▪ Review the variables that changed during each experiment and ask what other things could they have changed to make a telephone? ▪ Go over the vocabulary they learned though the process. For example, vibration, sound waves, length, variable and tie back to the standards. ▪ Students can also share a presentation on how sound travels. **Additional resources:** https://www.youtube.com/watch?v=GkNJvZINSEY (Build teacher background)

Exploration Stations with Visible Thinking Strategies
(Other ways to ENGAGE students)

1) **Rice Can**- Use the large open coffee tin can; cover the top tightly with plastic wrap and a rubber band. Place a spoonful of rice over the plastic wrap.
Ask students what do they observe about the rice?
Ask for a volunteer to clap underneath the tin can without touching it. Have students watch for any movement from the rice. Ask students again what did they observe about the rice? Ask for different volunteers to clap closer or louder near the can. When clapping, the movement does have something to do with the air. Therefore, you can use a wireless speaker to eliminate the air.
(Concept-Sound makes vibrations; sound can travel through air)

2) **Tuning Forks**- Use a clear plastic tub and fill it ¾ full of water. Once you hit a tuning fork, quickly place it in the water for precise movement. Ask students what they observe once you hit the fork and what happens when it is placed in the water? Can they still hear the sound produced when it is inside the water? (Concept-Vibrating materials can make sound; sound can travel in water)

3) **Cans with different string length**- use different tin can telephones with different string lengths. Which string length allows sound to be heard the loudest?

4) **Hand bells**- Get 8 colored hand bells (purchased from Lakeshore) and place them on a table out of order. Have students test each one to hear the different sounds produced. Have students compare two colored bells. The _____bell has a higher pitch than the _____bell.
The _____bell has a lower pitch than the _____bell.
Have students order the bells from lowest to highest pitch.

5) **Water Music-** Fill 4 to 5 glass bottles with different amounts of water. Use a wooden beater made with a macramé bead with an about 7inch dower from the hole. Have students hit the side of the bottles and test which bottles produce the higher and lower sounds. (Concept- pitch can be changes by increasing or decreasing the size of a column of air, regulating the height of vibrating column can produce a musical scale).

6) **Can sizes-** Set-up 4 tin cans of different sizes. Use a wooden beater made with a macramé bead with an about 7inch dower from the hole. Have students hit the side of the cans and test which can produces the highest and lowest pitch. Which can has the lowest sound? (Concept- size affects pitch. The smaller the instrument, higher the number of vibrations per second that occur. Therefore, producing a higher pitch).

7) **Radio and plastic**- Set up a small radio and place a piece of plastic wrap on top of the speaker. Observe any movement from the plastic when the volume is on low. Turn up the volume on the radio and observe what happens to the plastic. What caused the plastic to vibrate? (Concept-sound travels through waves and makes vibrations, air is limited)

8) **Table sounds**- Do this experiment in pairs. Have one student place their ear on the table while the second student taps the table 2 feet away. Can sound be heard through wood? Test further distances away. (Concept- sound can travel through a solid)