

21. Determining Sound Levels

How do we make sounds and how do we hear sounds?

Materials

- | | |
|---|--|
| <input type="checkbox"/> Data collection system | <input type="checkbox"/> Scissors |
| <input type="checkbox"/> Sound level sensor | <input type="checkbox"/> Paper clip |
| <input type="checkbox"/> Tin can, open at both ends | <input type="checkbox"/> Square plastic food storage container |
| <input type="checkbox"/> Pliers (teacher use only) | <input type="checkbox"/> Paper or plastic cup, 350-mL (12-oz) |
| <input type="checkbox"/> Can opener (teacher use only) | <input type="checkbox"/> Notebook or copy paper (3–4 sheets) |
| <input type="checkbox"/> Rubber band (2–3) | <input type="checkbox"/> Drinking straw |
| <input type="checkbox"/> Balloon, cut open to make a drumhead | <input type="checkbox"/> Paper towel (2-3 sheets) |
| <input type="checkbox"/> Water, ~300 mL | |

Safety

Always follow your teacher's directions when doing any activity.

Investigation

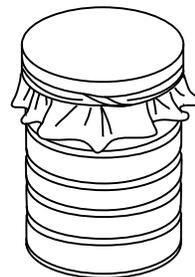
After you complete a step or answer a question, place a check mark in the box () next to that step.

When you see the symbol "♦" with a superscripted number following a step, refer to the numbered Tech Tips listed in the Tech Tips appendix that corresponds to your PASCO data collection system. There you will find detailed technical instructions for performing that step.

Get Started

Sounds come from things that vibrate. A vibration is something moving back and forth in a regular way. Some things vibrate and make sounds that we can hear. All musical instruments have some part of them that vibrates and makes the musical sound. You can see how sounds are vibrations by building a model.

- Build a balloon drum by stretching a balloon over one end of a tin can that has both ends open as shown above. Stretch the balloon tight and hold it in place by putting a rubber band around the edge if necessary.



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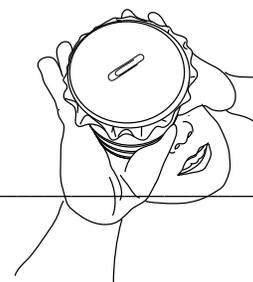
2. Talk into the open bottom of the tin can while touching the balloon.

What does your voice do to the stretched balloon?

Can you feel the vibrations coming from your voice?

How do you think the vibrations get from your mouth to the drum?

3. Talk into the open bottom of the tin can after placing a paper clip on the drumhead. Can you make the paper clip move? Can you make the paper clip jump off the drum?



4. Your voice makes the drumhead vibrate up and down. These vibrations are very fast, and they make sounds that we can hear. How do you think the sound of your voice moves the paper clip?

5. Predict which objects will make a sound by vibrating. Record your prediction in the table below by writing “yes” or “no” in the appropriate column. Be prepared to explain your answers.

➤Predictions

| Objects That Make a Sound | Will Sound Be Made by Vibrations? |
|---------------------------------|-----------------------------------|
| Sheet of paper | |
| Water in a cup | |
| Rubber band | |
| Balloon drum (from Get Started) | |

6. For each of the items listed in the table above, think about how it can be used to make a sound. Will it make a short and quick sound only, or can it be used to make a longer, drawn out sound that lasts for several seconds? Discuss your ideas with the members of your group. Be prepared to share your ideas with the rest of the class.

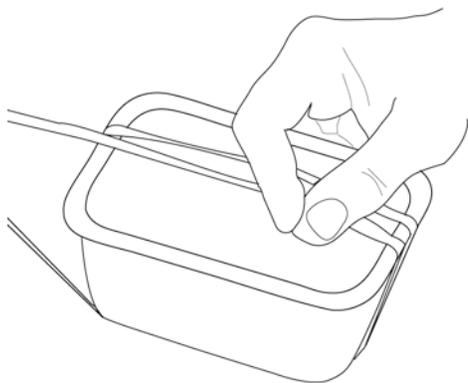
Let's Explore

7. Start a new experiment on the data collection system. ♦^(1.2)
8. Connect a sound level sensor to the data collection system. ♦^(2.1)
9. Display the data in a graph display with Sound Level on the y -axis and Time on the x -axis. ♦^(7.1.1)
10. Begin data recording. ♦^(6.2)
11. Use a sheet of paper to make sound for 30 seconds. Be sure to hold the paper near the sound sensor as you make sounds. Try as many different ways to make sound with one sheet of paper as you can think of.
12. Stop data recording. ♦^(6.2)
13. What was the maximum sound level you were able to record?
Maximum sound level: _____ dBA
14. Fill a paper or plastic cup about half full with water, and place a straw into the water.
15. Begin data recording. ♦^(6.2)
16. Use the straw and the cup of water to make sound for 30 seconds. Be sure to hold the cup near the sound sensor as you make sounds. Try as many different ways to make sound with the cup of water as you can think of, but be careful that you do not make sound with your voice.
17. Stop data recording. ♦^(6.2)
18. What was the maximum sound level you were able to record?
Maximum sound level: _____ dBA
Why was it important not to make sound with your voice?

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19. Stretch two rubber bands around a plastic food container, as shown in the illustration below.

Note: Make sure the rubber bands are far enough apart so you can touch one without disturbing the other.



20. If you have data runs on your graph display, you may choose to hide them. $\diamond^{(7.1.7)}$
21. Begin data recording. $\diamond^{(6.2)}$
22. Use the rubber bands to make repeated, quick sounds for 30 seconds. Be sure to hold the stretched rubber bands near the sound sensor as you make sounds.
23. Stop data recording. $\diamond^{(6.2)}$
24. Describe how you made the sounds you just recorded.

25. Begin data recording. $\diamond^{(6.2)}$
26. Use the balloon drum to make repeated, quick sounds for 30 seconds. Be sure to hold the drumhead near the sound sensor as you make sounds. Be careful to avoid breaking or tearing the balloon drumhead.
27. Stop data recording. $\diamond^{(6.2)}$
28. Review your data. You may need to show hidden runs of data, $\diamond^{(7.1.7)}$ or adjust the scale of the graph. $\diamond^{(7.1.2)}$ Describe what your sounds look like on the graph.

29. You recorded sound level data for several sounds. Which of the sounds were made by vibrating objects? Which of the objects disturbed the air and caused the air to vibrate?

Explain It

In this part of the activity you will use the rubber bands, the balloon drum, and a sheet of paper to make sounds that last for several seconds.

30. Review with your group members your ideas about how the rubber bands, the balloon drum, and a sheet of paper can be used to make sound that lasts for several seconds.
31. When you have decided how to make sound with the objects, begin data recording. ♦^(6.2)
32. Use the rubber bands to make long, drawn out sounds for 30 seconds. Be sure to hold the rubber bands near the sound sensor as you make these sounds.
33. Stop data recording. ♦^(6.2)
34. Begin data recording. ♦^(6.2)
35. Use the balloon drum to make long, drawn out sounds for 30 seconds. Be sure to hold the drum near the sound sensor as you make these sounds.
36. Stop data recording. ♦^(6.2)
37. In your investigation of how we make and hear sounds, you learned some new scientific ideas. These ideas have their own terms. In science it is important to be able to discuss your results using these words and terms correctly.

Write the meaning of the following terms in your own words using what you have learned from the activity.

➤ Vocabulary and definitions

| | |
|--------------------|--|
| Vibration | |
| Sound level sensor | |
| Decibels | |
| Loudness | |
| Sound | |

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38. Illustrate two terms of your choice in the spaces below.

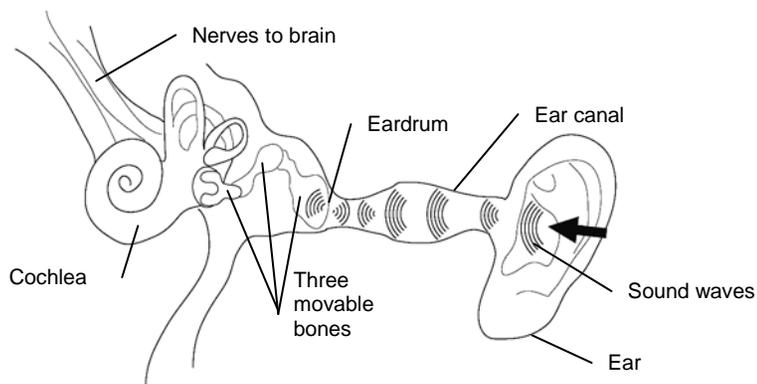
➤ Word: _____.

➤ Word: _____.

| | |
|--|--|
| | |
|--|--|

Tell Me More

39. Your eardrum is a piece of skin just like a stretched balloon. It vibrates when sounds reach your ear. Bones that touch the eardrum carry the vibrations to your inner ear, where they are detected and translated into signals to the brain. Here is a diagram of the ear.



■ Why are sounds not as loud when you cover your ears?

40. Cup your hands behind your ears. What do you notice about the sounds you hear with your hands cupped behind your ears, compared to what you hear normally? Why do you think this is the case?

41. Imagine yourself as a deer, grazing for your meal in the forest or in a field. You need to be constantly alert for any sounds of danger. Fortunately, nature has equipped you with large ears which you can swivel around to help you hear sounds from all directions.

Experiment with your “deer ears” as follows:

- Use your cupped hands to point your deer ears behind you.
- Point one deer ear in front of you and one behind you.
- Slowly turn in a circle with your deer ears pointing in front of you.

42. What did you hear? Describe your “deer hearing” results.

Sum It Up

43. Imagine that you are sitting in a large room with many people, and it is supposed to be very quiet. Then, from across the room, you hear the faint sound of a piece of candy being unwrapped. Who ever is unwrapping the candy must not want to be noticed, because he tries to do it as quietly as possible.

Describe this sound using the words “intensity” and “vibration” in your description.

44. Which of the objects in your prediction in the Get Started section of the activity caused vibrations that traveled through the air and into your ears where it vibrated your ear drums?

45. Which of the objects most resembles a musical instrument? Which instrument does it resemble?

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46. Which of the objects least resembles a musical instrument? Explain why you think this.

47. How do we make sounds?

47. How do we hear sounds?

Assessment

Multiple Choice

Darken the circle of the best answer to each of the questions below. Be prepared to give the reasons for your choices.

- A vibration is a
 - Regular, repeated back and forth motion
 - Random motion
 - Repeated but unpredictable motion
 - Back and forth motion that happens once
- We used the _____ to measure the sound level made by crumpling paper and blowing into water with a straw.
 - Sound level sensor
 - Vibrations
 - Deer ears
 - Decibels

3. The intensity of sound, or its loudness, is measured in units called
- Ⓐ Vibrations
 - Ⓑ Disturbances
 - Ⓒ Decibels
 - Ⓓ Intensities
4. We hear sound when
- Ⓐ Vibrations are not allowed to reach our ear drums
 - Ⓑ Vibrations are able to reach our ear drums
 - Ⓒ Sound levels are below zero decibels
 - Ⓓ There are no vibrations of any kind
5. Which of the following has measurements in order from quietest to loudest?
- Ⓐ 50 decibels, 25 decibels, 100 decibels
 - Ⓑ 100 decibels, 33 decibels, 71 decibels
 - Ⓒ 80 decibels, 15 decibels, 0 decibels
 - Ⓓ 3 decibels, 40 decibels, 80 decibels
6. Suppose you measure two sounds with a data collection system, and find the level of one sound to be 5 decibels and the level of the second sound to be 75 decibels. Which of the following may be true?
- Ⓐ The first sound could be a dog barking loudly, and the second sound could be a leaf falling from a tree
 - Ⓑ The first sound could be a leaf falling from a tree and the second sound could be a whispering voice.
 - Ⓒ The first sound could be a hair dryer and the second sound could be a whispering voice.
 - Ⓓ The first sound could be a leaf falling from a tree and the second sound could be a hair dryer.