10. WAVES AND ENERGY

What is the relationship between sound waves, sound and energy?

Objectives

- Investigate objects that create sounds.
- Relate sound waves to energy, frequency, pitch, amplitude and loudness.
- Measure, record, and interpret data.
- Examine evidence and data to draw conclusions that relate vibrations to sound and energy.

Materials and Equipment

- Data Collection System
- Sound sensor
- Tin can, open at both ends
- Rubber bands, 2 - 3
- Balloon cut open to make a drumhead
- Water
- Paper or plastic cup
- Scissors
- Paperclip
- Square plastic food storage container
- Notebook or copy paper, 3 - 4 sheets
- Drinking straw
- Paper towel, 2 - 3 sheets

Safety

Follow your regular classroom safety procedures.

Procedure

Part 1 - Investigating Vibrations

1. Build a balloon drum by stretching a balloon over one end of a tin can that has both ends open as shown in Figure 1. Stretch the balloon tight and hold it in place by putting a rubber band around the edge if necessary.

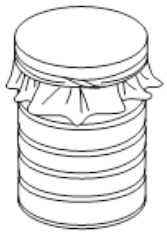

Figure 1: Model drum

2. Talk into the open bottom of the tin can while touching the balloon. Speak softly, and speak loudly. Record your observations in table 1.

3. Talk into the open bottom of the tin can after placing a paper clip on the drumhead. Have a partner observe so they can tell you if and how the paperclip is moving. If you speak loudly can you make the paperclip behave differently? Record your observations in Table 1.

4. Using your observations from this investigation, answer questions 1 - 4 in the Questions and Analysis section of the lab.

Part 2 - Determining Sound Levels

1. Select Sensor Data in SPARKvue.

2. Connect your sound sensor to your device.

3. Turn off the Sound Wave measurement and turn on the Sound Level measurement. Make sure only Sound Level A is selected.

4. Select the Graph template. The graph will be Sound Level A (dBA) vs time.

5. Start recording data.

6. 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.

7. Stop recording data.

8. What was the maximum sound level you were able to record? Record your data in Table 2.

9. Fill a paper or plastic cup about halfway full with water, and place a straw in the water.

10. Start recording data.

11. Use the straw and the cup of water to make sounds for 30 seconds. Be sure to hold the cup near the sound sensor as you make sounds. Try as many different ways to make sounds with the cup of water as you can think of but be careful that your do not make sound with your voice.

12. Stop recording data.

13. What was the maximum sound level you were able to record? Record your data in Table 2.

14. Stretch two rubber bands around a plastic food container, as shown in Figure 2 below.

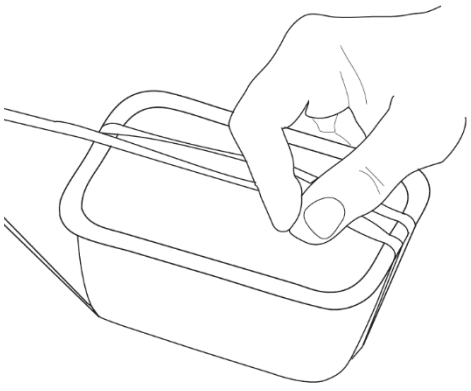

Figure 2: Rubber bands on plastic food container

15. Start recording data.

16. Use the rubber bands to make repeated, quick sounds for 30 seconds. Be sure to hold the stretched runner bands near the sound sensor as you make sounds.

17. Stop recording data.

18. What was the maximum sound level you were able to record? Record your data in Table 2.

Data Collection

Table 1: Sound observations

	Observations
Soft and loud voice vibrations	
Soft and loud voice on paperclip behavior	

Table 2: Sound levels

Material	Maximum Sound Level (dBA)	Observations
Paper		
Cup with water and straw		
Model guitar		

Questions and Analysis

1. What did your voice do to the stretched balloon? Why do you think it did this? What difference did you notice between soft and loud speaking?

2. What property of a wave accounts for the difference in the vibrations?

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

4. Were you able to get the paperclip to move on your model drum? How do you think the sound of your voice moves the paperclip? Why is there a difference between soft and loud voice?

5. In Part 2 you investigated sound levels of various objects. Which object created the greatest sound level? Which objects created waves with the greatest energy? How is wave energy measured?

6. When you tested the model guitar, did each rubber band have the same sound level? Did they appear to vibrate differently from each other? The pitch of a sound is our ear's response to the frequency of sound. Whereas loudness depends on the energy of the wave as defined by amplitude. Did you notice a difference in frequencies and amplitudes?

7. Create a drawing of the following: (1) Two waves with the same pitch but different loudness, (2) two waves with different pitch but same loudness and (3) two waves with different energies.