

Investigating Sound Waves

Sound is produced when a vibrating source causes a medium to vibrate. In this lab, you will investigate how the vibrating source affects characteristics of the sound produced.

Problem What determines the frequency and amplitude of the sound produced by a vibrating object?

Materials

- meter stick
- 2 cardboard tubes
- scissors or scalpel
- 2 rubber bands
- wax paper
- balloon
- small mirror
- transparent tape
- flashlight

Skills Observing, Inferring, Drawing Conclusions, Controlling Variables

Procedure

Part A: Investigating How Length Affects Pitch

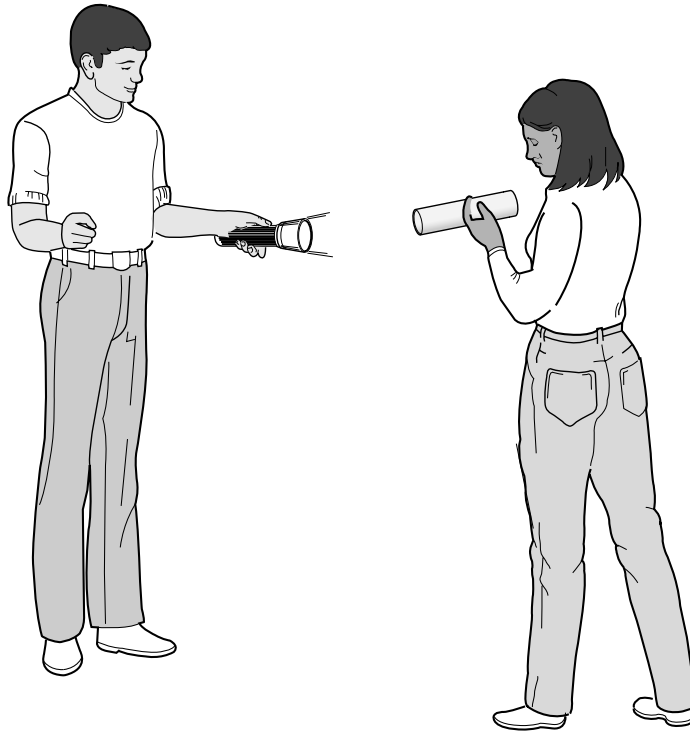
1. Hold one end of a meter stick down firmly on a table so that 20 centimeters of the meter stick extends past the edge of the table. Pluck the end of the meter stick that extends past the table to produce a vibration and a sound. Observe the vibration and sound of the meter stick.
2. Repeat Step 1, but this time allow 40 centimeters of the meter stick to extend past the edge of the table. Observe and record how the length of the vibrating part of the meter stick affects the pitch.

3. Repeat Step 1, but this time allow 60 centimeters of the meter stick to extend past the edge of the table. Record your observations.

- Investigate the relationship between length and frequency for a vibrating column of air, as you did with the vibrating meter stick. Make a kazoo by cutting a hole in the middle of one of the cardboard tubes. Make the hole approximately 1 centimeter in diameter. Use a rubber band to fasten the piece of wax paper over one end of the tube. **CAUTION:** *Be careful when cutting with sharp instruments; always cut away from yourself and away from nearby people.*
- Make a second kazoo by cutting the second tube 10 centimeters shorter than the first tube. Using the short tube, repeat Step 4.
- Hold the shorter kazoo in front of your mouth and hum into the open end, keeping your pitch steady. Repeat this action with the longer kazoo, making sure to hum exactly as you did before. Observe and record how the length of the kazoo affects the pitch of the sound.

Part B: Investigating How Frequency Affects Pitch and How Amplitude Affects Loudness

- Cut the neck off of the balloon. Replace the wax paper on the longer kazoo with the cut-open balloon. Wrap the rubber band several times around the end of the cardboard tube. The rubber band should hold the balloon tightly stretched over the end of the tube. Use tape to attach the small mirror onto the balloon on the end of the tube.
- Have a classmate shine a flashlight on the mirror, as shown, while you hum into the kazoo. Your classmate should position the flashlight so that a spot of light is reflected on the wall. It may be necessary to darken the room. Observe how the spot of light moves when you hum into the kazoo. Make a note of your position and the position and angle of the kazoo and the flashlight.



9. Without changing how loudly you hum, use your voice to raise the pitch of your humming. Observe and record how the movement of the spot of light differs from your observations in Step 8. Make sure you do not change your distance from the wall or the angle at which the light from the flashlight strikes the mirror attached to the kazoo.

10. Repeat Step 9, but this time hum at a lower pitch than you did in Step 8.

11. Repeat Steps 9 and 10, but this time vary the loudness of your humming while keeping the pitch constant.

Analyze and Conclude

1. **Observing** What happened to the frequency of the meter stick's vibration when you made the overhanging part longer?

2. **Inferring** How did the frequency of the meter stick's vibration affect the pitch of its sound?

3. **Inferring** How did the kazoo's length affect its pitch?

4. **Analyzing Data** When you changed the pitch of your humming, how did it affect the frequency of vibration of the mirror?

5. **Analyzing Data** How is the amplitude of the kazoo's vibration related to its loudness?

6. **Controlling Variables** Explain why it was important to keep loudness constant when you changed the pitch of your humming in Step 9.
