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Date: _____

Unit VII
Mechanical Waves & Sound
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VII

Sound Waves and Pitch

Sounds are produced and transmitted by vibrating matter. You hear the buzz of a fly because its wings vibrate, the air vibrates, and your eardrum vibrates. The sound of a drum is produced when the drumhead vibrates up and down, the air vibrates, and your eardrum vibrates. Sound is a longitudinal wave. In a longitudinal wave, matter vibrates in the same direction as the wave travels. For you to hear a sound, a sound source must produce a longitudinal wave in matter, such as air. The air transmits the longitudinal wave to your eardrum, which vibrates in response to the longitudinal wave.

Longitudinal waves can be described by amplitude, wavelength, and frequency—the same as transverse waves. The pitch of a sound is related to the frequency of a longitudinal wave. You are familiar with high pitches and low pitches in music, but people are also able to hear a range of pitches beyond that of musical sounds. People can hear sounds with frequencies between 25 and 20 000 hertz.

Objectives

In this experiment, you will

- demonstrate that sound is produced by vibrations of matter,
- vary the pitch of vibrating objects, and
- explain the relationship between pitch and frequency of a sound.

Equipment

Part A

- flexible ruler

Part B

- box, such as a shoe box
- 3 rubber bands of different widths but equal lengths

Procedure

Part A—Vibrations

1. Hold a ruler on a tabletop so it hangs over the edge. Hold the end of the ruler tightly on the tabletop.
2. Snap the free end of the ruler, allowing it to vibrate, as shown in Figure 38-1. Listen to the pitch of the vibrating ruler. Predict what you will hear if you shorten the free end of the ruler and snap it. Record your prediction in Part A of the Data and Observations section. Vary the length of the free end of the ruler to create vibrations of different frequencies. Note the changes in pitch with the change of frequency. Record your observations in Part A of Data and Observations.

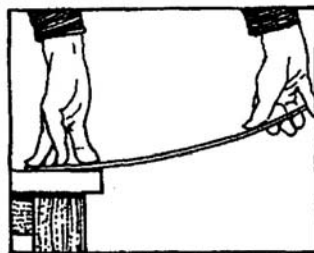


Figure 38-1.

Conclusions

1. Predict how the pitch of the ruler will change as its length decreases:

2. How does length of the ruler affect the frequency of the vibrations (waves) produced?

3. Describe the difference in the pitch of the ruler at various lengths. How does the length of the ruler affect the pitch?

4. Using this knowledge, how are pitch and frequency related?

Part B—Pitch of Sounds

1. Stretch the 3 rubber bands around the box as shown in Figure 38-2.

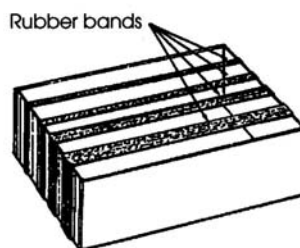


Figure 38-2.

2. Pluck the first rubber band and note the pitch. Predict how the pitches of the other rubber bands will compare with this pitch. Record your prediction below. Pluck the remaining rubber bands. Describe what happens. Do the pitch of the rubber bands vary the way you expected them to? Record your observations below.
3. Remove two rubber bands from the box. Hold the remaining rubber band tightly in the middle with one hand. Pluck it with the other. Move your hand up and down the rubber band to increase or decrease the length of the rubber band that can vibrate. Predict how the pitch will change as you change the length of the vibrating rubber band. Pluck the rubber band for each new length and record your observations of the length of the vibrating rubber band and pitch.

Conclusions

1. How does the thickness of a rubber band affect its frequency of vibration?

2. Prediction of variation in pitch of sounds produced by rubber bands of different thicknesses:

3. Observation of changes in pitch with varying thickness of rubber bands:

4. Observation of changes in pitch with varying lengths of the vibrating rubber band:

Going Further

Design an experiment to determine how *tightness* affects the pitch of the sound produced by a vibrating rubber band. Describe how you will operationally define the tightness of a rubber band. Predict how increasing the tightness will affect the pitch.
