Resonance – Speed of Sound Teacher's Notes

Main Topic	Sound
Subtopic	Sound
Learning Level	High
Technology Level	Low
Activity Type	Student

Description: Use a tuning fork and resonance tube to find the speed of sound in air.

Required Equipment	Tuning forks (256Hz or more, two per group), 1000mL graduated cylinder, resonance tube, meter stick, rubber band, water
Optional Equipment	Alka-Seltzer tablet

Educational Objectives

- Find the speed of sound in air using resonance in an adjustable column.

Concept Overview

The accepted value for the speed of sound at sea level at 21°C (70°F) is 344m/s. The speed increases 0.6m/s for each increase of 1°C.

Lab Tips

Resonance occurs when an object is made to vibrate at its natural frequency, and the vibrations reinforce themselves, becoming larger. In the case of sound, the object can be a column (or other vessel) of air, and the larger vibrations are observed as a louder sound.

In this lab, students will use a tuning fork to find the resonance point of a column of air. The column will resonate when the wavelength of sound fits in it so that a node is at the closed end (the water) and an antinode is at the open end. The shortest length where this occurs is when the column length is one-fourth of the wavelength.

Students will apply a simple end-correction formula, to find the effective length of the column of vibrating air. It is slightly longer than the length of the tube. Then they will use a simple formula to find the speed of sound.

An extension activity lets them find the speed of sound in carbon dioxide.

Resonance – Speed of Sound

Name: _____

Class: _____

Goal:

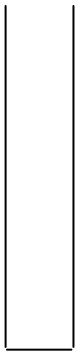
Find the speed of sound in air using resonance in an adjustable column.

Materials:

Tuning forks (256Hz or more, two per group), 1000mL graduated cylinder, resonance tube, meter stick, rubber band, water

Procedure:

1. Fill the cylinder with water, about two-thirds full.
2. Place the resonance tube in the cylinder. Note how you can change the length of air in the tube by moving it up and down in the water.
3. Record the frequency of your tuning fork. _____Hz
4. Strike the tuning fork with a mallet or on the sole of your shoe (NOT on the table or the cylinder!). Hold the tuning fork horizontally just above the top of the resonance tube. Move the tube and fork up until you hear the loudest sound from the tube.
5. Use a rubber band to mark the water level when you heard the loudest sound.
6. Measure and record the distance from the top of the water to the top of the tube. _____
7. The air just past the end of the tube vibrates along with the air in the column. A simple calculation can tell you the effective length of the tube. Measure and record the diameter of the tube. _____ Multiply this diameter by 0.4, and add this distance to find the effective length of the column of air: _____
8. In the column to the right, draw the portion of the longest wavelength that would resonate. That is, a wave that has a node at the closed end and an antinode at the open end, with no other nodes.
9. What fraction of a wavelength did you draw? _____
10. Using the effective column length from #6, calculate the wavelength of the resonating sound you heard.



11. Use the frequency and wavelength of the sound to find the speed of sound in air.

    Speed = frequency * wavelength

12. Repeat the experiment with a different tuning fork. Record the results below, and calculate the speed.

13. Compare your results to the accepted value, given by your teacher.

Name: _____

Class: _____

Extension (Optional)

14. Drop an Alka-Seltzer tablet in the tube and allow the air to be replaced by carbon dioxide. Repeat the experiment and describe the results.