

Main Topic	Sound & Waves
Subtopic	Sound
Learning Level	Middle
Technology Level	Low
Activity Type	Student

Description: Use echoes to find the speed of sound in air.

Required Equipment	Stopwatch, Trundle Wheel
Optional Equipment	10m measuring tape, clapper or drum

Educational Objectives

- Experimentally determine the speed of sound in air.

Concept Overview

Students will measure the amount of time for a series of echoes, and calculate the time for one echo. (The entire time divided by 20.) They will then experimentally determine the speed of sound in air. (The speed of sound in air at 20°C is 340 m/s, and it increases approximately 0.6m/s per degree C.)

An extension activity asks students to compare the speed of sound in air to that in concrete or another solid material. Sound travels more quickly in solids (and liquids) because of the proximity of particles in the material. The longitudinal sound wave travels more efficiently through solids. (This is why very old movies sometimes show people listening for distant trains by putting their ears directly on the tracks.)

Lab Tips

A simple clapper is made with two blocks of wood connected at one end. If the environment is quiet, regular hand-clapping may suffice. A snare drum may also be used as the sound source.

The distance to the echoing surface must be at least 20 meters to produce measurable results. Longer is better.

Rather than directly measuring the distance, you may wish to show students how to estimate long distances by measuring their pace length, and pacing the distance. (Students in marching band may already be good at pacing out ten-yard increments.)

Speed of Sound

Name: _____

Class: _____

Goal:

Experimentally determine the speed of sound in air.

Materials:

Stopwatch, Trundle Wheel or long measuring tape

Procedure:

1. Find a location at least 20 meters away from a solid wall outdoors.
2. Clap the clapper and listen for an echo. You may hear echoes from multiple surfaces. Be sure you can identify the echo from the correct surface.
3. Clap again, repeating in a rhythm so that the claps and echoes are evenly separated. You will hear clap --- echo --- clap --- echo --- clap --- echo --- etc...
4. Start the stopwatch, and measure the time to make ten echoes. What is the total time? _____
5. What is the time for one clap/echo? (The time for the sound to travel down and back one time.)

6. Measure, using a trundle wheel, measuring tape, or consistent pace, the distance to the wall. _____ What is the distance the sound traveled during the time you found in #5? _____
7. Find the speed of the sound in your experiment.

Extension - Optional

8. Position two students at opposite ends of a long sidewalk or hallway (50m or more). One student places an ear on the ground, and the other strikes the ground with a hammer. Which sound is heard first? Repeat until you can be sure which sound is heard first. (If the sounds appear to be simultaneous, go farther away.) Explain your observation, in terms of the transmission media for sound waves.