How does sound travel?

Explore how sound travels using simple materials.

Setting: Indoors
Time: < 10 minutes
Concepts: sound, vibrations
Skills: listening, comparing & contrasting

Subject(s):
- ✓ Physics

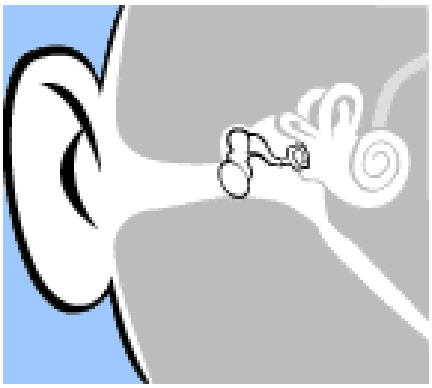
Ages:
- ✓ 6-8
- ✓ 9-11

Materials:
- One wire coat hanger
- 1/2 metre of string
- Metal object (spoon, fork, etc.)

What to do!
1. Wrap one end of a ½ metre long piece of string around one finger several times.
2. Wrap the other end several times around a finger on your other hand.
3. Loop the string under the hook of a wire coat hanger.
4. Pick the coat hanger up by raising your hands. Place the fingers with the string on them into your ears.
5. Have another person hit the coat hanger with your metal object, or lean over and bang the coat hanger against a table. Notice the sound.
6. Remove your fingers from your ears and bang the coat hanger again. How has the sound changed? Why has it changed?

What's happening?
You hear sounds when vibrations get inside your ears and stimulate your nerves to send electrical signals to your brain.

Suppose, for instance, that you are pounding on a drum. The drumhead starts vibrating. As the drumhead vibrates, it bumps into air molecules and starts them bouncing to and fro. Those bouncing air molecules bump into other air molecules and start them moving. This chain reaction of moving air molecules carries sound through the air in a series of pulsating pressure waves that we call sound.



Sound waves carry vibrations from the drum into your ears. Inside your ear, moving air molecules push on your eardrum and start it vibrating. Your eardrum, in turn, pushes on the bones of your middle ear, the tiniest bones in your body. These bones act like a set of levers, pushing against the thin membrane that covers the opening to your inner ear. The movement of this membrane makes pressure waves in the fluid inside the cochlea, where cells with tiny sensing hairs transform the waves into electrical signals. These electrical signals travel along the auditory nerve to your brain. When these electrical signals reach your brain, you hear a sound - the beat of a drum.

The tone of the metal object banging on the coat hanger is produced by the vibrations of the hanger. When you put your hands over your ears, you provide a path that lets more vibrations reach your ears. The sound is louder through the string than listening to the sound traveling through the air to your ears because the solid string transmits sound better than air.

When your hands aren't over your ears, you hear a faint, high-pitched, tinny sound. When you put your hands over your ears, you hear deep, resonant, bell-like tones. The hanger makes the same sound in both situations, but in one you provide a path that lets more of the sound reach your ears.

Why does it matter?
Sound waves travel from the source of the sound to your ears. Sometimes too much noise can be a bad thing! Too much noise can damage the delicate bones and membranes in the ear and thereby damage our ability to hear sound. A term used for unpleasant noise that disrupts daily life is noise pollution. Understanding the way that sound travels can help to reduce noise pollution, with interventions like noise barriers or noise-cancelling headphones.

Noise barriers are usually used to block the sound of highway traffic noise. These tall barriers reduce the sound which enters a community by interfering with the transmittance of sound waves. A noise barrier will absorb some of the sound, reflect the sound back to the highway or force the sound waves to take a longer path over the noise barrier. As sound travels farther, its waves become less and less energetic and therefore, less and less loud.

Investigate further!

- Explore sound vibrations using a tuning fork. How does the tuning fork sound change when you set it on different surfaces?
- Try making some noise-reducing earmuffs using different found materials. Test the earmuffs with different sounds. What materials work the best at reducing the noise?
- Explore the science of sound further by filling three or more glasses with different quantities of water. Tap a spoon gently against the side of different glasses. Try playing a simple song like "Mary Had a Little Lamb" or "Twinkle, Twinkle Little Star". A sound is produced because of the vibrations of the glass; water thickens the glass so that it

vibrates slower. The change in pitch is due to the amount of water in each glass - a glass that is almost full of water produces lower pitched sounds, less water produces higher sounds.