Good Vibrations

Objective

By investigating how sound travels through air, solids, and water, the student will be able to explain why sound is an effective means of communication and navigation for whales.

Materials

Per student group:

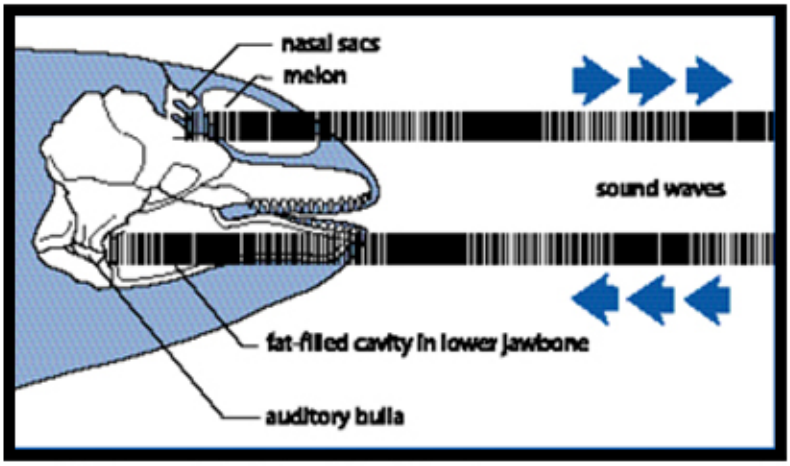
- ❑ Tuning forks
- ❑ Shallow pan of water

Background

Sound travels more than four times faster in water than it does in air. Toothed whales probably receive most sounds through the lower jaw. A whale may also receive sound through soft tissue and bone surrounding its ear.

Scientists have discovered that some toothed whales use sound to navigate and locate prey in dark or murky water. How? By sending sound waves into the water and listening for echoes. This system of sound navigation is called echolocation.

When a toothed whale echolocates, sound waves travel through its melon and out into the water in front of the whale. By interpreting the echoes that bounce back from sounds they've produced, toothed whales can tell the shape, size, speed, and distance of objects in the water.



A killer whale's fat-filled jawbone conducts sound through the jaw to bones in the middle ears.

A vibrating tuning fork produces ripples in a shallow pan of water.

Action

1. Water

   Holding the handle of the tuning fork, strike it on a hard solid surface. Gently move the fork toward the water. Hold the two tines in a shallow pan of water. Ask students to describe what they see. (Movement causes vibrations, and vibrations produce sound waves. These waves move outward from the source. The vibrating tuning fork tines produce ripples in the water. Imagine that the tuning fork is an echolocating whale, and the ripples are sound waves produced by the whale.)

2. Air

   Strike the tuning fork on a hard solid surface. Ask students to describe what they hear. (Even though we can't see the sound waves, striking the tuning fork against a hard solid surface causes the tuning fork tines to vibrate rapidly. As the sound travels through air, students may hear a faint hum.)

3. Solids

   Strike the tuning fork again and hold the tip of the handle to a student's lower jaw. Ask students to describe what they hear or feel. (The hum is more audible. In this case sound is conducted by the bone and tissues of the lower jaw. Since the molecules of solids are more densely packed than in air, sound can actually travel faster and farther through solids than through air.)

4. Speed of Sound Problem

   Propose the following problem to student groups: Sound travels through air at 340 meters per second (0.21 miles/second). Sound travels through water at about 1,600 meters per second (1 mile/second). Now ask these questions to prompt discussion:

   About how much faster does sound travel through water than through air?

   Is the tuning fork easier to hear through air, or through bone and tissue?

   Which one is a better conductor of sound?

   Is water or air a better conductor of sound?

   From this investigation, explain why sound is an effective means of communication and navigation for whales