Good Vibrations

OBJECTIVES

Students investigate how sound travels. They observe, feel, and hear vibrations and communicate their observations. They infer and discuss why sound is an effective means of communication and navigation for whales.

MATERIALS

- ❑ tuning fork(s)
- ❑ shallow pan(s) of water
- ❑ blindfold(s)

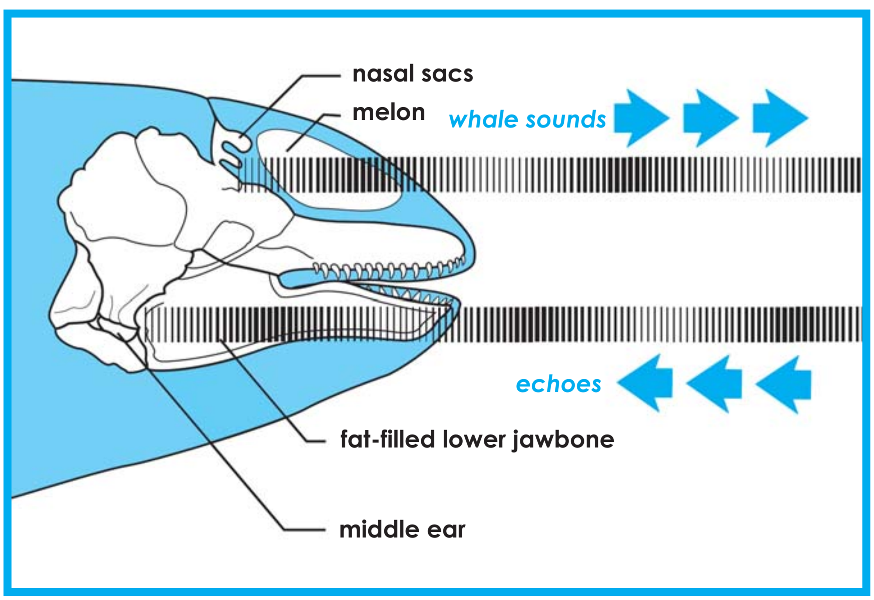
BACKGROUND

Sound is the vibration of molecules. These vibrations travel in waves, and they travel at different speeds depending on what they are traveling through. Sound travels slowest through gases, faster through liquids, and fastest through solids. That's because the molecules of a liquid are closer together than the molecules of a gas, and the molecules of a solid are even more densely packed than the molecules of gases or liquids.

Sound travels through air at a speed of about 340 meters per second (0.2 mile/sec). But under the sea, sound travels at approximately 1,600 meters per second (1 mile/sec).

Some toothed whales (and other animals, such as bats) use sound to navigate and to locate prey. A whale produces sounds that travel through its *melon* and out into the water in front of the whale. The whale listens for the echoes that bounce back. This process of sound navigating is called *echolocation*. Even in dark or murky water, echolocating whales can interpret the echoes they hear to tell the shape, size, speed, and distance of objects in the water.

The soft tissue and bone that surrounds a whale's ear conducts sound to the ear. In toothed whales, the fat-filled lower jawbone is a good conductor of sound.



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

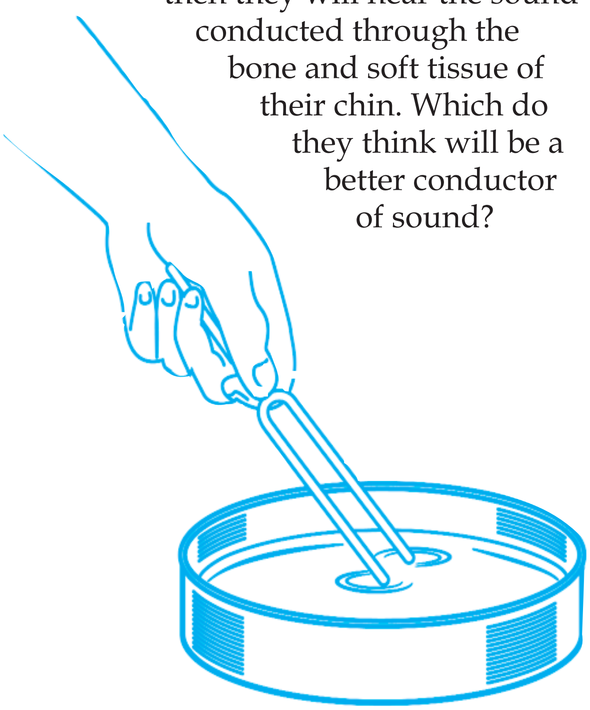
ACTION

Demonstrate the following activities, then divide the class into groups so each student can participate.

1. Holding the handle of the tuning fork, strike it on a hard solid surface. Gently move the fork towards the shallow pan of water and submerge the two tines under the water. Ask students to describe what they see. *(The sound vibrations create ripples in the water.)*

   Explain that the ripples they see are evidence of sound waves that are moving outward from the source (the tuning fork). Describe how sound is the vibration of molecules. As sound waves travel through the water, each water molecule hits another and then returns to its original position.

2. Explain that students will have the opportunity to hear the sound made by the tuning fork. They will hear the sound conducted through air and then they will hear the sound conducted through the bone and soft tissue of their chin. Which do they think will be a better conductor of sound?



Students may be surprised to discover that the bone and soft tissue of their lower jaws conduct sound waves to their middle ears.

   Ask them to predict if there will be a difference in the way they perceive the vibrations. Record their various predictions on the board.

3. Strike the tuning fork on a hard solid surface and hold it a few inches from a student's ear. Ask that student to describe what he or she hears. *(Students may hear a faint hum.)*

4. Strike the tuning fork again and hold the tip of the handle to the student's lower jaw. Ask the student to describe what he or she hears or feels. *(The hum is more audible because the vibration is traveling though the bone and tissues of the lower jaw. Because the molecules comprising these structures are more densely packed than the molecules in air, sounds travel faster and farther.)*

5. When all students have experienced the vibration in water, air, and through their chin, help them to communicate what they observed and experienced. Students write three sentences that describe their observations of the vibrations (1) through air, (2) through water, and (3) through their chin.
6. Review the students' predictions. Did anyone predict that they would be able to hear the sound best through their chin?
7. Write the word *echolocate* on the board and draw a circle around the "echo" and another circle around the "locate." Ask students if they know what each word means. Define the word *echolocate*.

   Describe how whales echolocate. (See BACKGROUND information on page 16.) Explain how some toothed whales (and other animals) find food and each other by listening for echoes.
8. Students discuss why sound is an effective way for whales to communicate and navigate. *(Suggestion: ask the following questions to spur discussion.)*
   - What does it look like when you open your eyes under water?
   - Is ocean water clear or murky? Bright or dark?
   - How do we see when it gets dark at night? (We turn on a light; by moonlight; by firelight).
   - Are there lights in the sea?
   - How would you find your way around if you couldn't see where you were going?
   - How do you think toothed whales find their way around a dark ocean?
9. Play a game that helps students better understand how whales navigate by sound. (This game is similar to the swimming pool game, *"Marco Polo."*)
   - Students hold hands and form a circle.
   - Blindfold a volunteer "dolphin" and steer him or her to the center of the circle.
   - Choose five students to be "fish." "Fish" stand inside the circle.
   - When dolphin calls out "dolphin!" the fish respond by calling out "fish!" (They are representing a dolphin making sounds and the echoes returning to the dolphin.) The dolphin moves around the circle trying to find and tag the fish by following the sounds of their voices. When the dolphin tags a fish, that fish sits outside the circle.
   - After a few minutes, call a time-out. In the ocean, dolphins sometimes hunt together in pods. Add a few more blindfolded dolphins to the center of the circle and see if the hunting gets easier.

Bottlenose dolphins can echolocate to find prey and each other under water.