

Interactions of Sound Waves

Terms to Learn

reflection	sonic boom
echo	standing wave
echolocation	resonance
interference	diffraction

What You'll Do

- ◆ Explain how echoes are produced, and describe their use in locating objects.
- ◆ Give examples of constructive and destructive interference of sound waves.
- ◆ Identify three sound-wave interactions, and give examples of each.

Beluga whales, such as those shown in **Figure 11**, communicate by using a wide variety of sounds, including clicks, chirps, whistles, trills, screeches, and moos. The sounds they make can be heard above and below water. Because of the wide range of sounds they make, belugas have been nicknamed “sea canaries.” But belugas use sound for more than just communication—they also use reflected sound waves to find fish, crabs, and shrimp to eat. In this section you’ll learn about reflection and other interactions of sound waves.

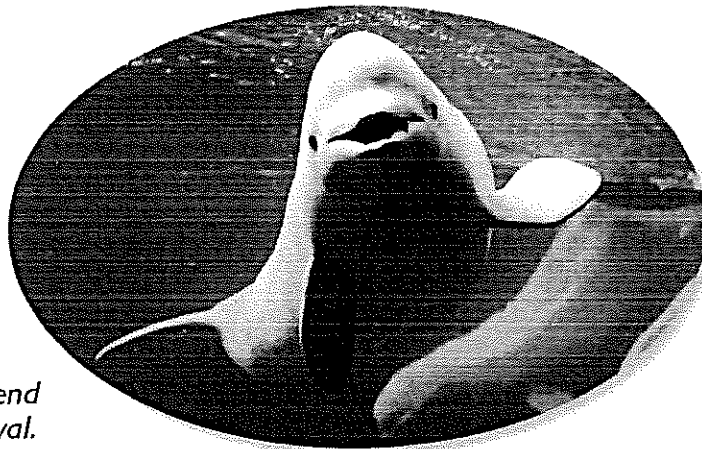
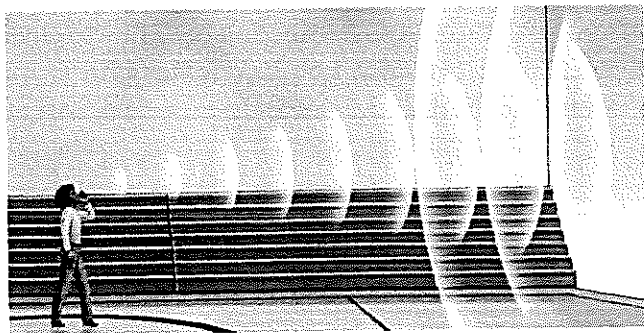


Figure 11 Beluga whales depend on sound interactions for survival.

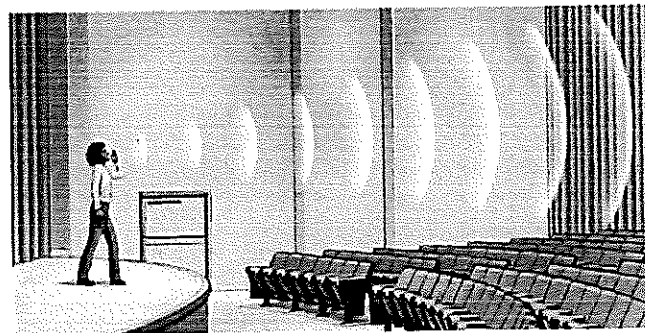
Reflection of Sound Waves

Reflection is the bouncing back of a wave after it strikes a barrier. You’re probably already familiar with a reflected sound wave, otherwise known as an **echo**. The amount a sound wave will reflect depends on the reflecting surface. Sound waves reflect best off smooth, hard surfaces. That’s why a shout in an empty gymnasium can produce an echo, but a shout in an empty auditorium usually does not, as shown in **Figure 12**.

Figure 12
Sound Reflection and Absorption



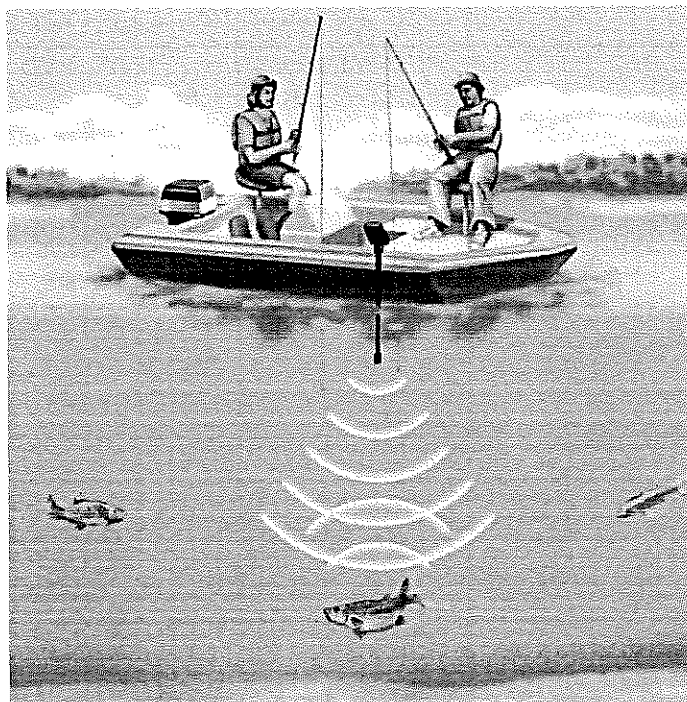
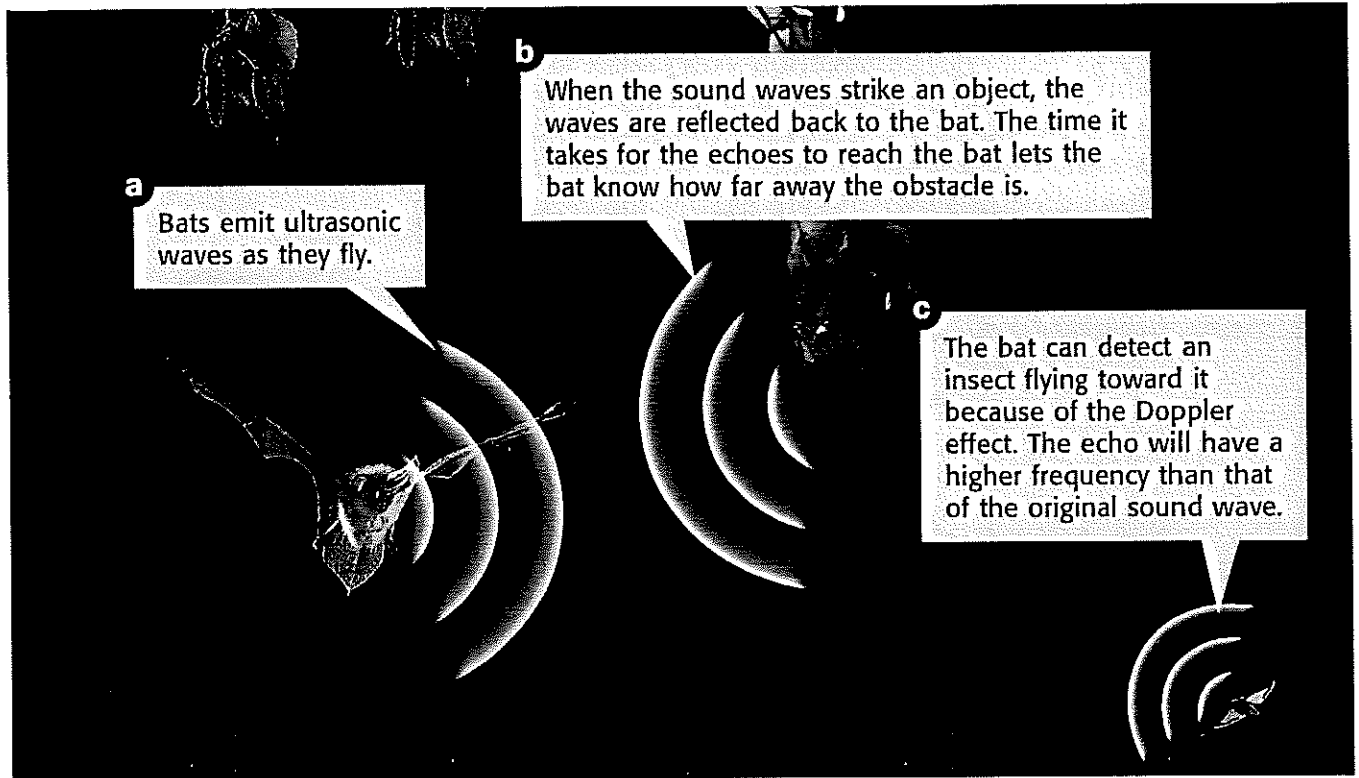
Sound waves easily reflect off the smooth, hard walls of a gymnasium. That’s why you hear an echo.



In well-designed auditoriums, echoes are reduced by soft materials that absorb sound waves and by irregular shapes that scatter sound waves.

Echolocation Beluga whales use echoes to find food. The process of using reflected sound waves to find objects is called **echolocation**. Other animals—such as dolphins, bats, and some species of birds—also use echolocation to hunt food and detect objects in their paths. **Figure 13** shows how echolocation works.

Figure 13 Bats use echolocation to navigate around barriers and to find insects to eat.



Echolocation Technology Humans use echoes to locate objects underwater and underground by using sonar (sound navigation and ranging). *Sonar* is a type of electronic echolocation. **Figure 14** shows how sonar works. Ultrasonic waves are used because their short wavelengths provide more details about the objects they reflect off. Sonar can also help navigators on ships detect icebergs and can help oceanographers map the ocean floor.

Figure 14 A depth finder sends ultrasonic waves down into the water. The time it takes for the echo to return helps the fishermen determine the location of the fish.

APPLY

Insightful Technology

Many people who are blind use a cane to help them detect obstacles while they are walking. Now engineers have developed a sonar cane, shown at right, to help blind people even more. The cane emits and detects sound waves. Based on your knowledge of echolocation, explain how you think this cane works.



Ultrasonography Another type of electronic echolocation is used in a medical procedure called *ultrasonography*. Ultrasonography uses echoes to “see” inside a patient’s body without performing surgery. A device called a transducer produces ultrasonic waves, which reflect off the patient’s internal organs. These echoes are then converted into images that can be seen on a television monitor, as shown in **Figure 15**. Ultrasonography is used to examine kidneys, gallbladders, and other abdominal organs and to check the development of an unborn baby in a mother’s body. Ultrasonic waves are safer than X rays because sound waves are less harmful to human tissue.

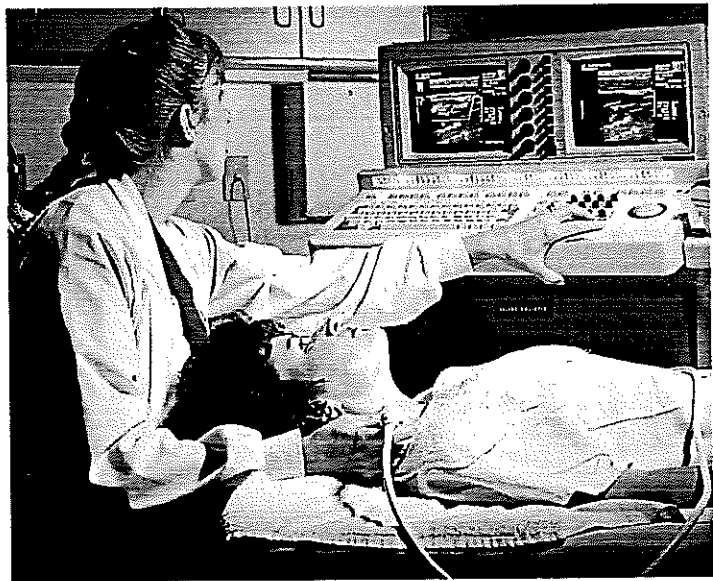


Figure 15 Images created by ultrasonography are fuzzy, but they are a safe way to see inside a patient’s body.

SECTION REVIEW

1. Describe a place in which you would expect to hear echoes.
2. How do bats use echoes to find insects to eat?
3. **Comparing Concepts** Explain how sonar and ultrasonography are similar when used to locate objects.