LIGHT AND SOUND

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Benchmark Education

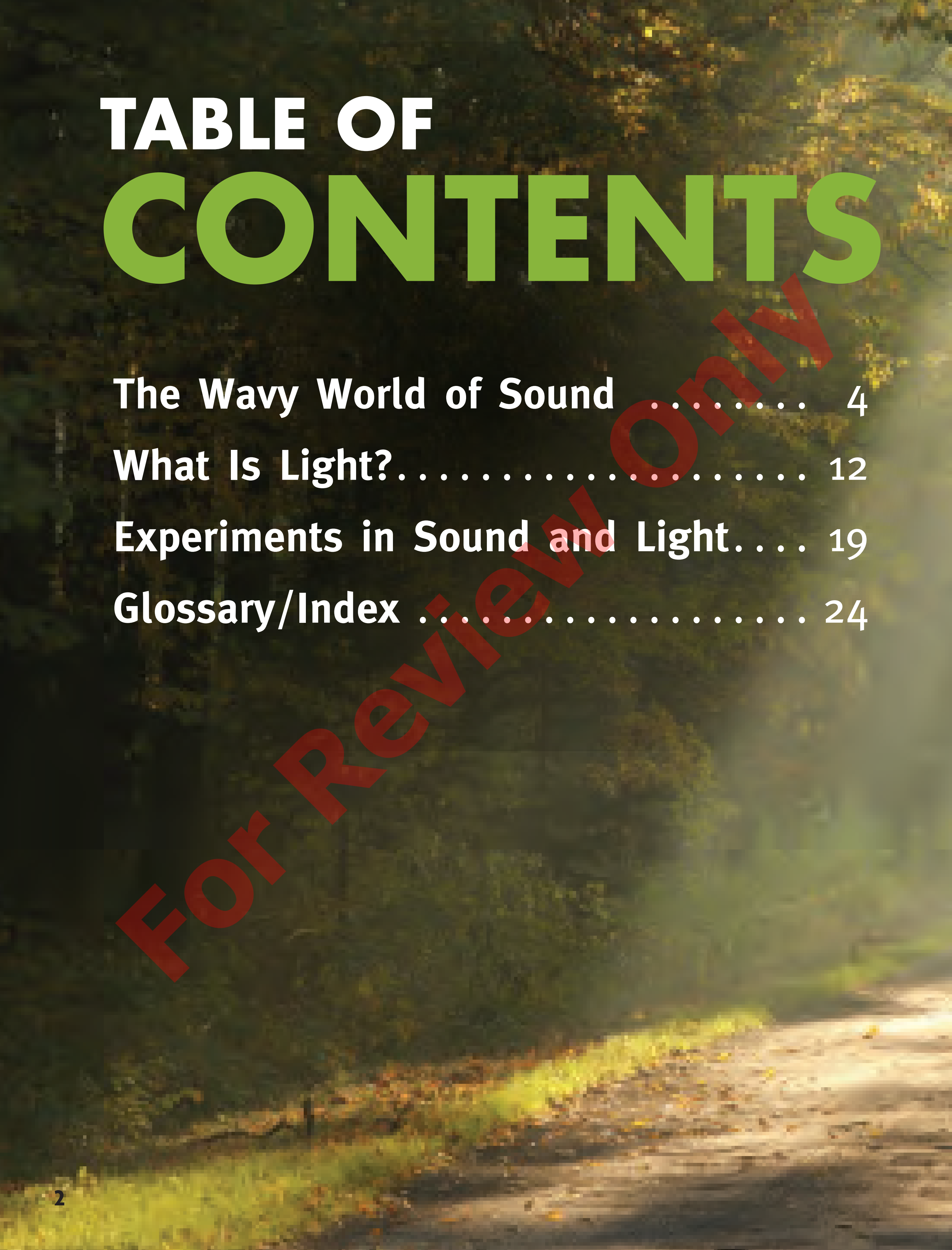


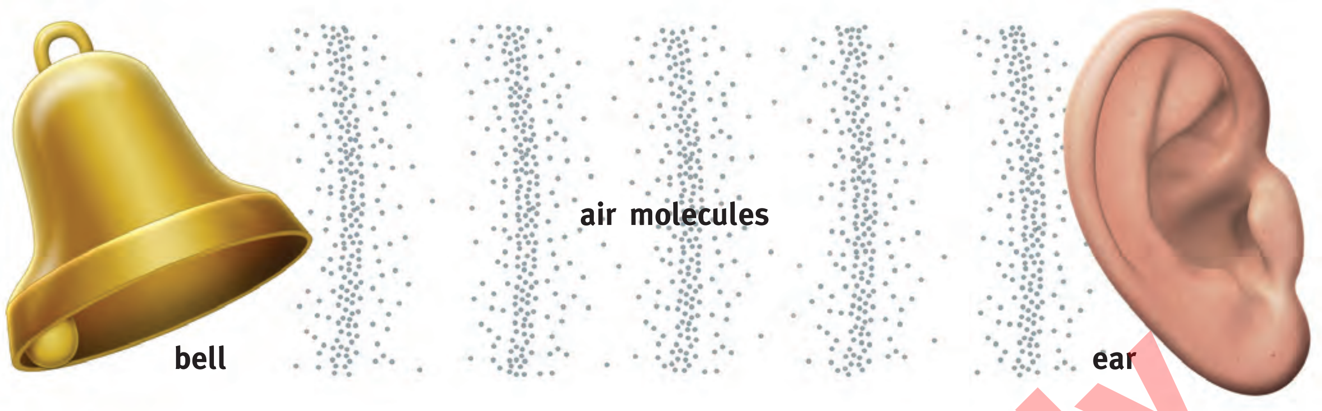
TABLE OF CONTENTS

THE WAVY WORLD OF SOUND

*K**a-BOOM!*** The world is alive with sounds—loud, soft, pleasant, and annoying sounds. There's the *pop…pop* of fireworks, the buzz of lawnmowers, the screech of a braking car, the crash of thunder.

Sound is all around us, but what exactly *IS* sound?

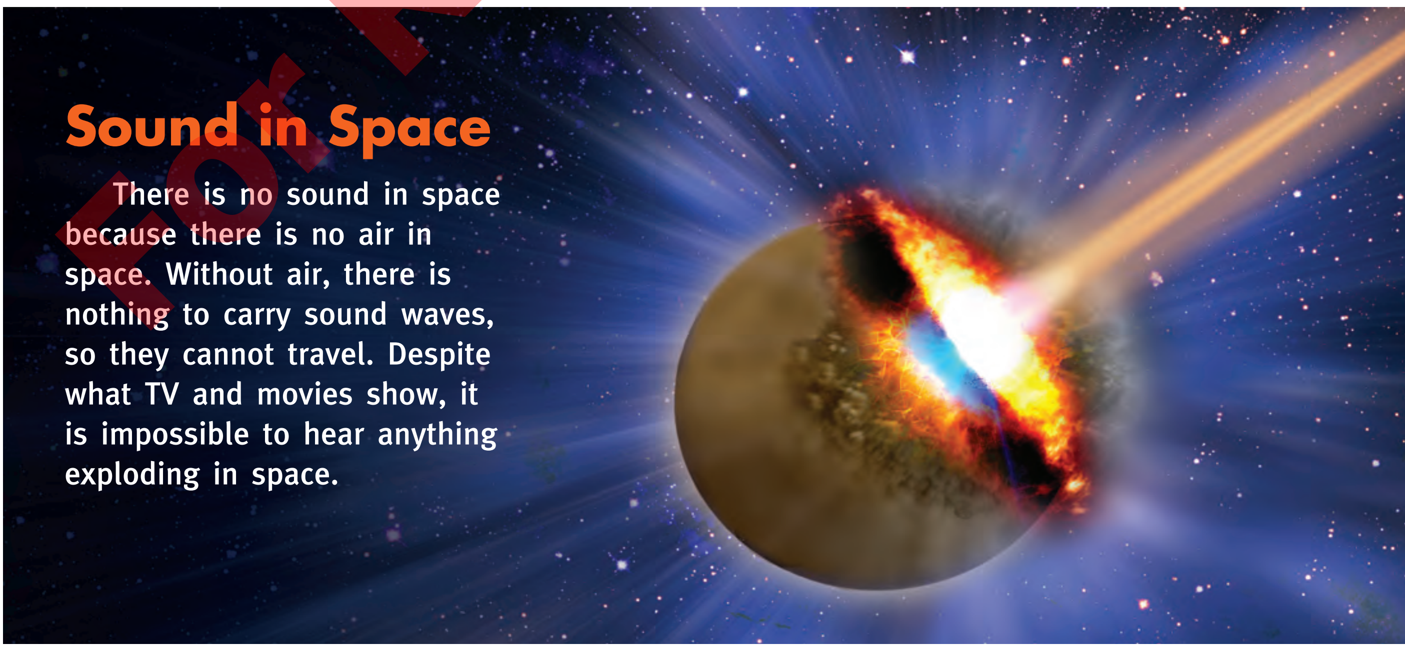
In the simplest terms, sound is a form of energy that is caused by vibrations. This vibrating energy disturbs matter around it, causing the matter to start vibrating. Matter is everything around us that takes up space and has mass, whether it's solid, liquid, or gas. Even air is made up of matter.



▲ This is what sound waves would look like if the air molecules were visible.

Imagine a large bell ringing. When the brass ball inside the bell strikes the inside of the bell, it causes the bell to vibrate. The vibrations produce energy, and this energy causes changes in the air matter around the bell. The energy moves outward in the air in waves, similar to the ripples on a pond.

When these sound waves reach the human ear, they cause the inner parts of the ear to vibrate. The brain then translates the vibrations into sound—the ringing of a bell. Of course, the same is true for the plucking of a guitar, the roar of a jet plane, a human voice, and any other sound.

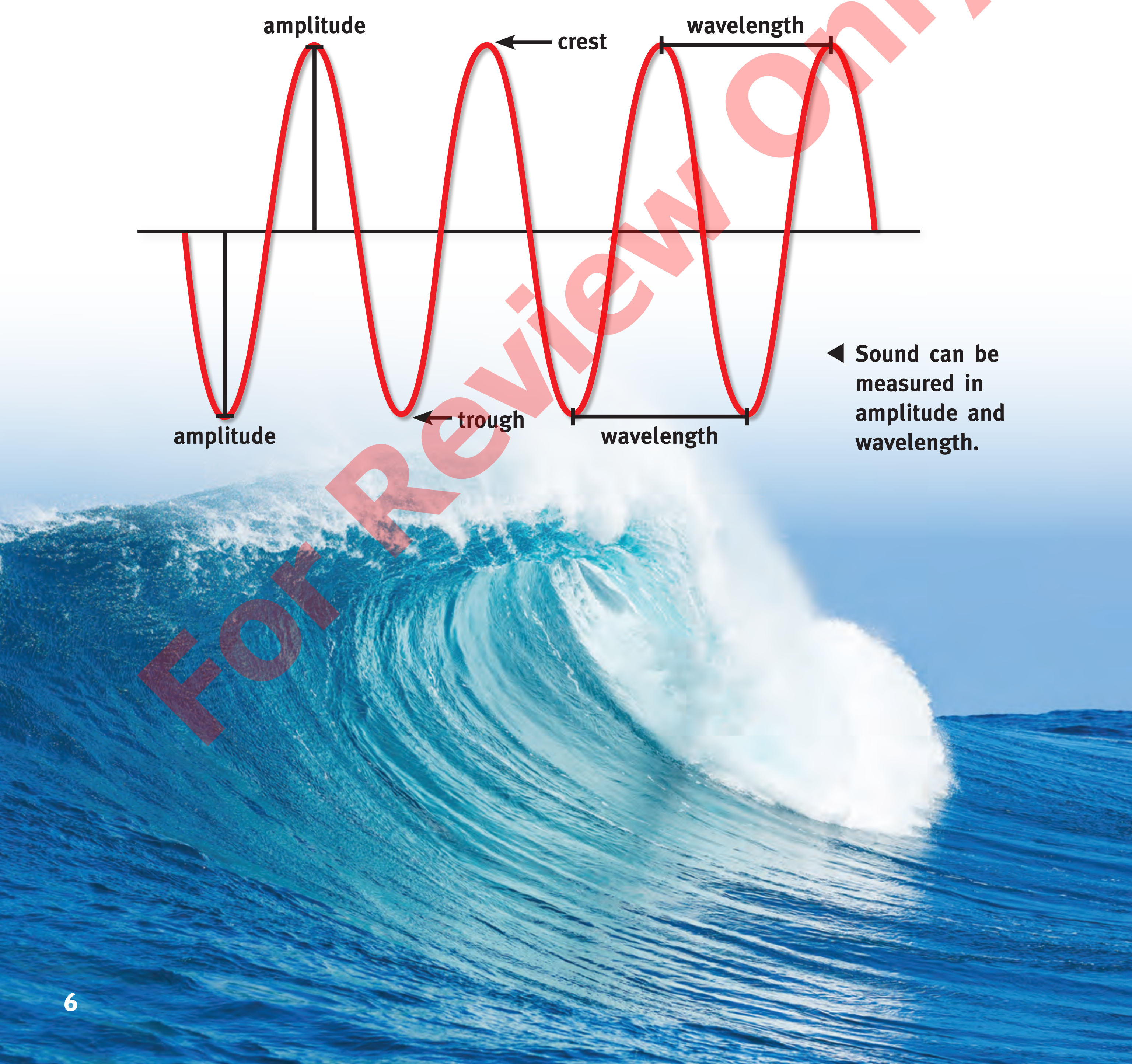


Sound in Space

There is no sound in space because there is no air in space. Without air, there is nothing to carry sound waves, so they cannot travel. Despite what TV and movies show, it is impossible to hear anything exploding in space.

THE SHAPE OF SOUND

Since scientists can't see sound waves, they use diagrams to represent them. A typical sound wave diagram looks like a wavy line going up and down. The top of each wave is called a crest and the bottom is called a trough. The distance between two crests is called a wavelength. The longer the distance between crests, the longer the sound's wavelength.



◀ **Sound can be measured in amplitude and wavelength.**

A sound wave's amplitude is measured as one-half of the distance between the trough and the crest. Amplitude measures the power of the wave's energy. One way to see this is to imagine a wave in the ocean. It could be a little ripple or a giant 43-meter (140-foot) wave. Both might have the same wavelength, but their energy, or amplitude, would be very different. In the same way, a dog's bark and the crash of thunder might have the same wavelength. But the amplitude of their sound waves would be quite different.

A Humming Planet

Many years ago, scientists discovered that Earth hums constantly. Now scientists believe they have found the cause: giant ocean waves which can extend all the way down to the seafloor. The waves crash into one another as they tumble over underwater mountains and ridges. This shakes Earth and creates a very low humming sound. Though Earth is always humming, we can't hear it. That's because the hum is infrasonic—too low for human ears to hear it.

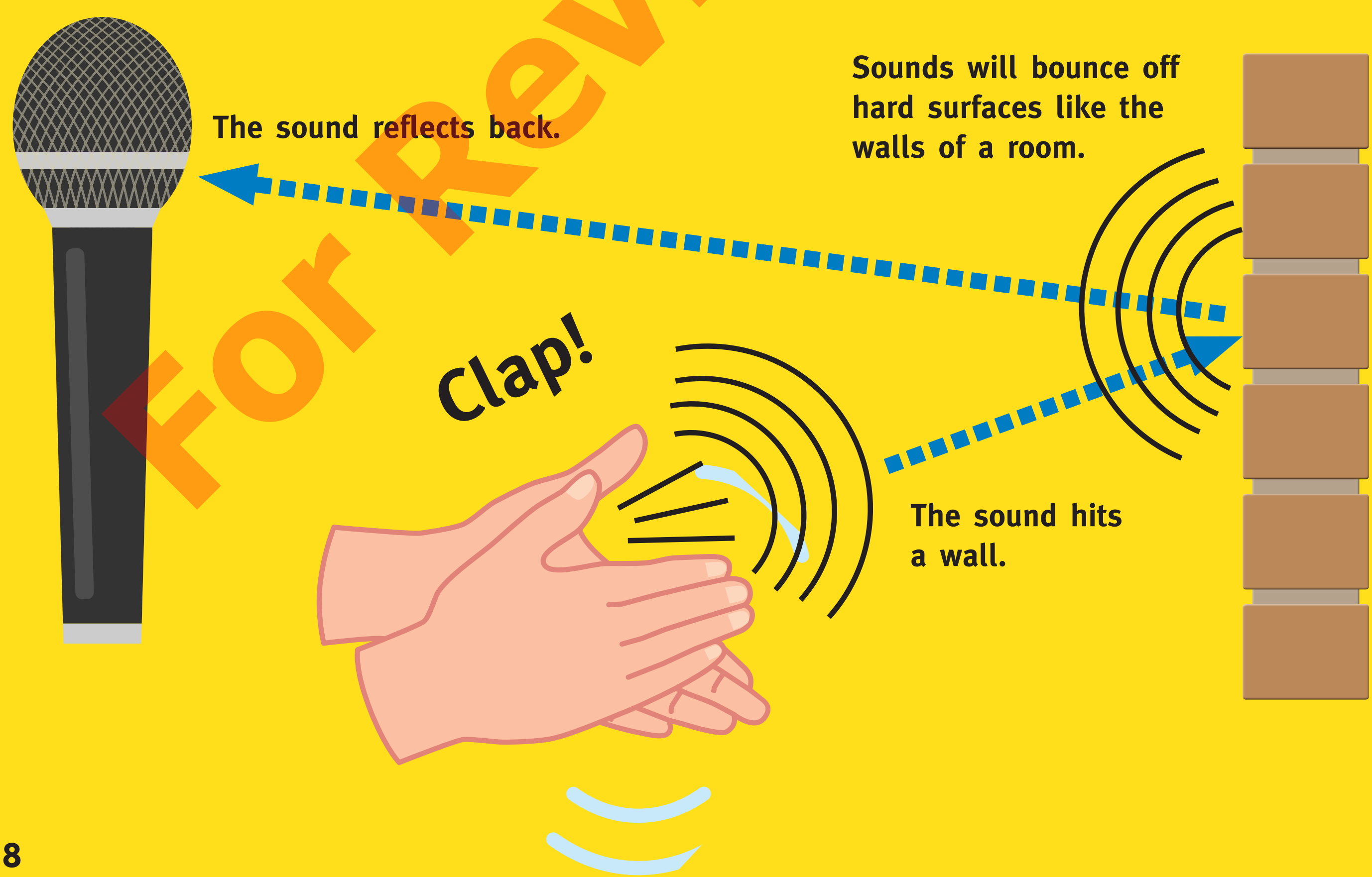
Understanding why Earth hums will help scientists discover more details about the planet's structure.

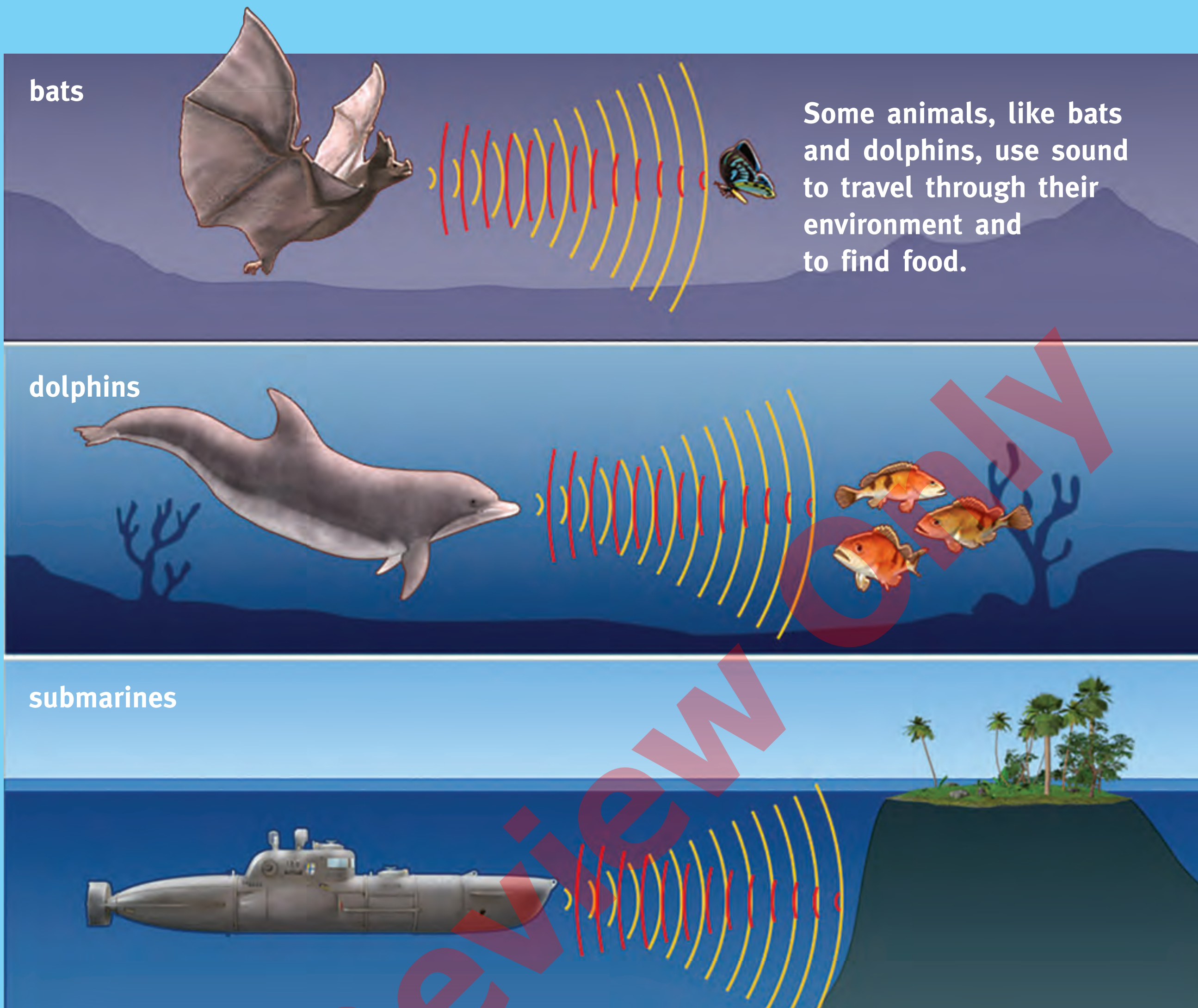
BOUNCING OFF THE WALL

When sound waves reach an object in their path, they don't just stop. Sometimes the waves bounce off the object and return back to their source. When sound waves do this, it is called reflection.

When sound waves continue forward but bend in a different direction, it is called refraction. Refraction takes place when the wave enters a new medium, such as water from air.

Sound waves react differently when they strike different types of surfaces. This is especially dependent upon the texture of the surface. For instance, if the sound strikes a soft surface, part or all of the sound will likely be absorbed. Builders use soft material to "soundproof" a room. If the sound strikes a relatively hard and flat surface, however, the sound waves are more likely to bounce back as an echo.





Echolocation

Echolocation is a method of detecting objects using sound waves. It is used by a number of animals to find food and locate objects in the dark. Dolphins, for example, "see" underwater by producing high-frequency clicks. The clicks create sound waves that bounce off objects and return to the dolphins as echoes. Echolocation enables dolphins to find food and navigate in murky waters.

Bats are the champions of navigating and capturing food using echolocation. Bats emit high-pitched sound waves that bounce off objects and return as echoes. The bat's brain instantly determines the size of the object and how far away it is by the amount of time it takes for the sound to echo back.

Modern submarines use sonar (sound navigation and ranging) for echolocation underwater. Like dolphins, sonar uses sound waves to detect and determine the location, size, and motion of underwater objects. Inside the submarine, operators use echoes from sound waves to help navigate the ship.