

THE SCIENCE of SOUND

The crowd screams as the home team scores a basket. Thump. Thump. Thump. The basketball echoes as it is dribbled up the court. The loudspeaker system amplifies the announcer's voice as he relays the score. In the next row, a couple talks about their plans after the game. A vendor selling programs walks through the section and calls, "Programs!" The guy in row L gets caught up in the excitement of the last quarter and shares his counsel with the coach, who ignores his advice.

At the basketball game, there are many different types of sounds—some loud and some soft. All of these sounds interact with one another. So, depending on your location, the sounds may be different from the ones a friend across the arena hears. The pitch and volume of the sound vary based on your location. Science can help us understand why sounds are so varied.

What Is Sound?

Guitar strings vibrate, or move quickly back and forth, to produce music. In the same way, when we speak, our vocal cords vibrate, creating the sound of our voices. Sound is a vibration that

travels through matter. The matter can be a solid, liquid, or gas. When an object vibrates, it renders movement in the air particles.

- 20 As the particles bump into one another, they create sound waves. If you are within range, your ears will pick up these vibrations. You hear them as sounds. The closer you are to the root of the sound, the louder the volume will be.

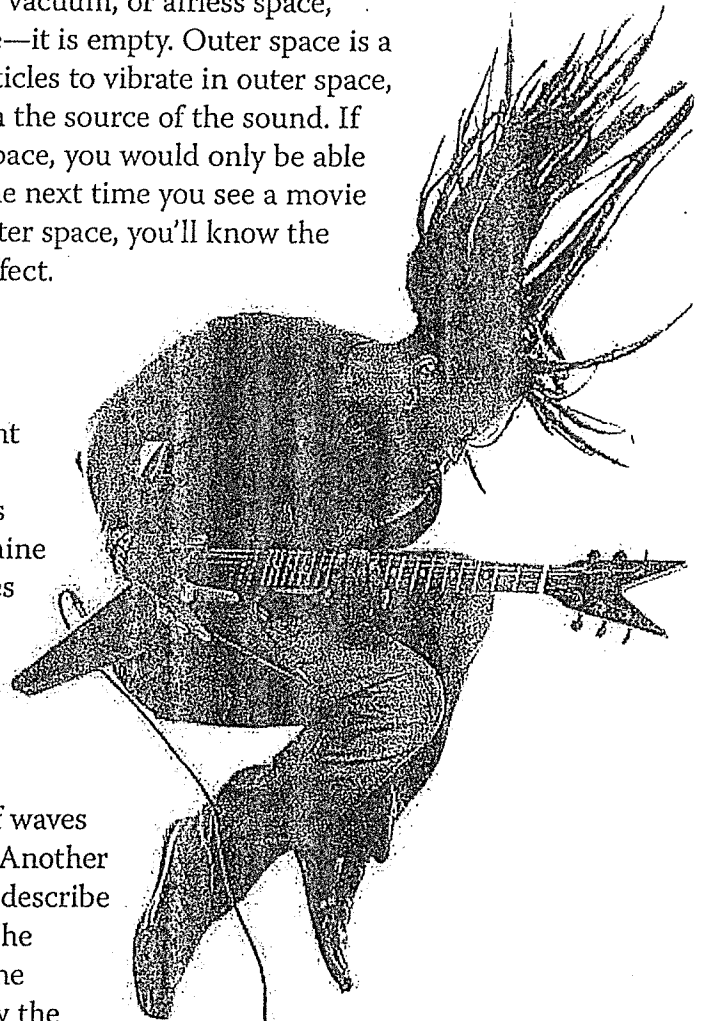
- Sound cannot travel through a vacuum, or airless space, because there is nothing to vibrate—it is empty. Outer space is a vacuum. Because there are no particles to vibrate in outer space, sounds cannot be transferred from the source of the sound. If there were an explosion in outer space, you would only be able to see it. You would not hear it. The next time you see a movie with a battle that takes place in outer space, you'll know the sounds were added for dramatic effect.

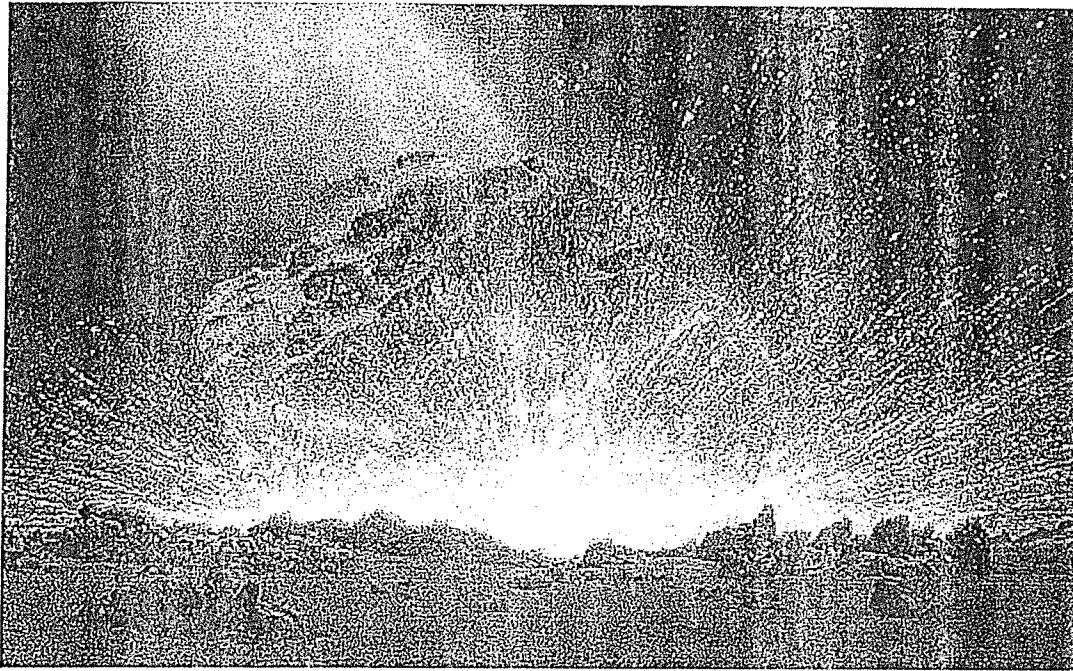
What Causes Different Sounds?

- Why are there so many different sounds? The frequency, amplitude, and wavelength of the sound waves are **factors** that combine to determine which sound you hear. Sound waves travel 340 meters, or about three football fields, per second through air. In water, sound travels more than four times as quickly, at a rate of 1,500 meters per second.

- The frequency is the number of waves that pass a given point per second. Another way to describe the frequency is to describe how quickly the particles vibrate. The faster the waves move, the higher the pitch of the sound. The pitch is how the note or noise sounds compared to other notes or noises. A foghorn renders a low-pitched sound. A dog whistle renders a high-pitched sound.

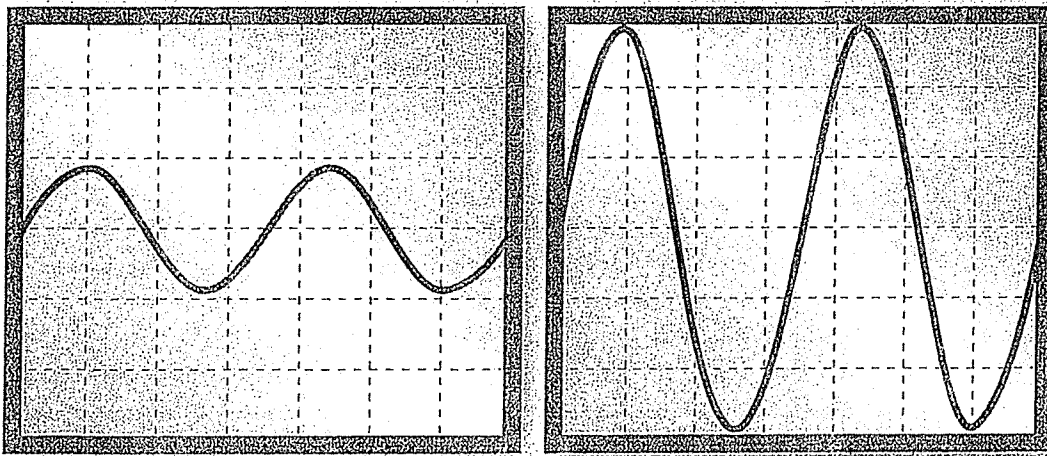
- Wavelength is another factor that affects the pitch. The wavelength is the distance from the top of one wave to the top of the next. Another way to describe it is the distance between matching points on a wave. The slower the frequency, the longer the wavelength will be. Therefore, the longer the wavelength, the lower pitched the sound.



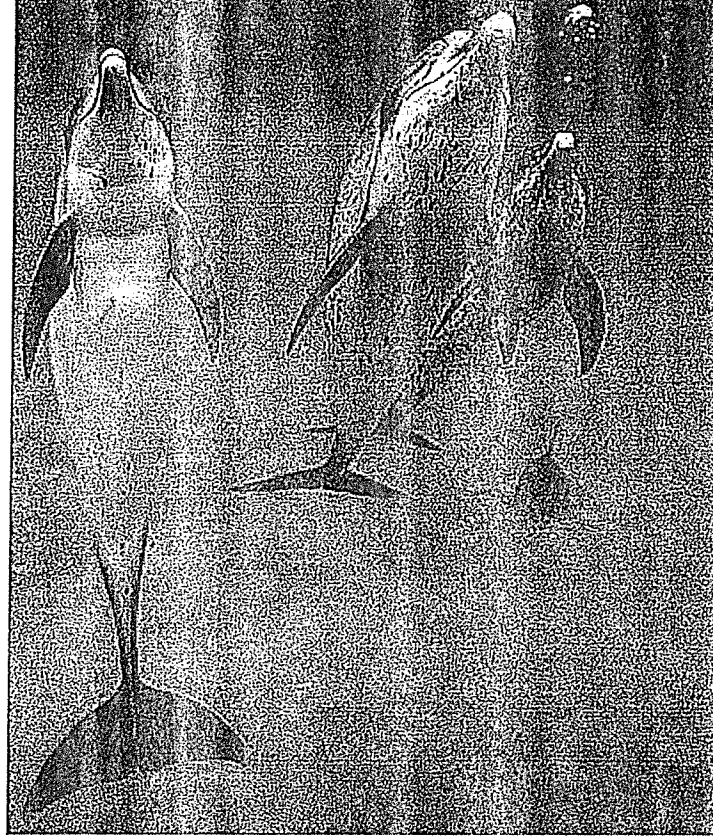


An explosion in space can be seen, but not heard. Why?

Another factor that determines the sound you hear is the amplitude. The amplitude is the amount of energy in a sound wave. The volume of a sound is determined by the amplitude. The height of the wave is used to measure this. The taller the
65 wave, the louder the sound. An amplifier is a device specifically designed to make a sound louder. It does so by increasing the amplitude of a signal. Many electronics products, from computers to televisions, have devices in them that amplify the sound.



The waveform on the left has a smaller amplitude, but the same number of peaks in a given time (frequency). The only difference between the sounds is that the first one is quieter because it has less energy.



Communicating with Sound Waves?

Although they don't have vocal cords or words, dolphins
70 have communicated with one another for centuries using
sound waves. A mother dolphin often whistles to her baby for
several days after giving birth. This allows the calf to identify
its mother simply by the pitch of her whistle. Dolphins also use
sound waves to navigate their way through the dark waters, as
75 well as hunt and communicate.

Recent studies show that teenagers can hear higher pitches
of notes than adults. Some businesses have installed devices
that emit a high-pitched sound to keep teens from loitering.
The inventor says most people who are older than
80 30 cannot hear this sound. Some teens have figured out how
to benefit from this ability. They have created a ringtone, the
mosquito. Now, they can receive text message notifications on
their cell phones without adults knowing.

Sounds are everywhere. They allow us to communicate with
85 one another and take in our surroundings. Sounds also provide
us with entertainment and help us learn. So, the next time you
hear a soothing sound that brings a smile to your face—or a
horrible screech that makes you crazy, stop and think about
how the sound was created.