
Speed of Sound

Speed of Sound

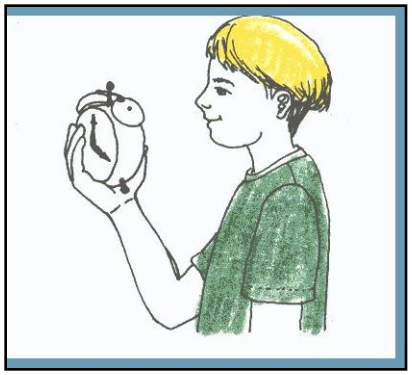
- A pressure wave that can travel through solid, liquid or gas
- The more dense the material the faster the sound travels

Sound Waves

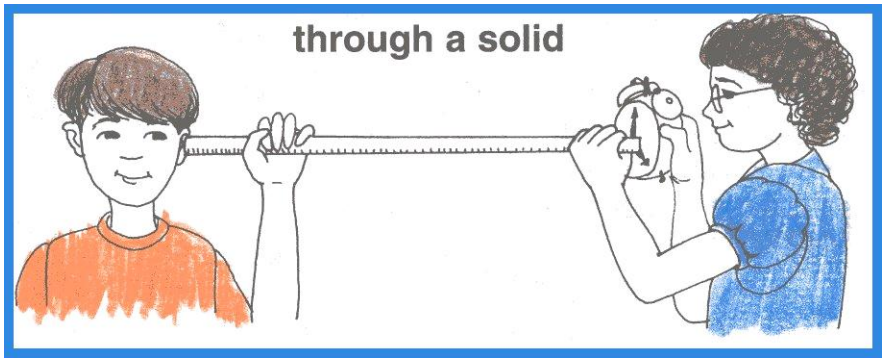
- Sound travels as vibrations moving through the air as a compression wave.
- Sound travels through air, but travels through other materials as well. Whale communicate through long distances by producing sounds under water.

Sound Travels Through

- Gases (air)



- Liquids (sound travels 4 times faster through liquid than it does through air)
- Solids (sound travels the fastest in solids because the molecules are packed tightly together)



Sound Waves

- Air – 330 m/s
- Water – 1500 m/s
- Brick – 4300 m/s
- Iron – 5000 m/s

Speed of Sound

- At normal atmospheric pressure and a temperature of 20 degrees Celsius, a sound wave will travel at approximately 343 m/s

Speed of Sound

- The further away you are from the sound energy the harder it is to hear
- The sound will dissipate or spread out

Behaviour of Waves

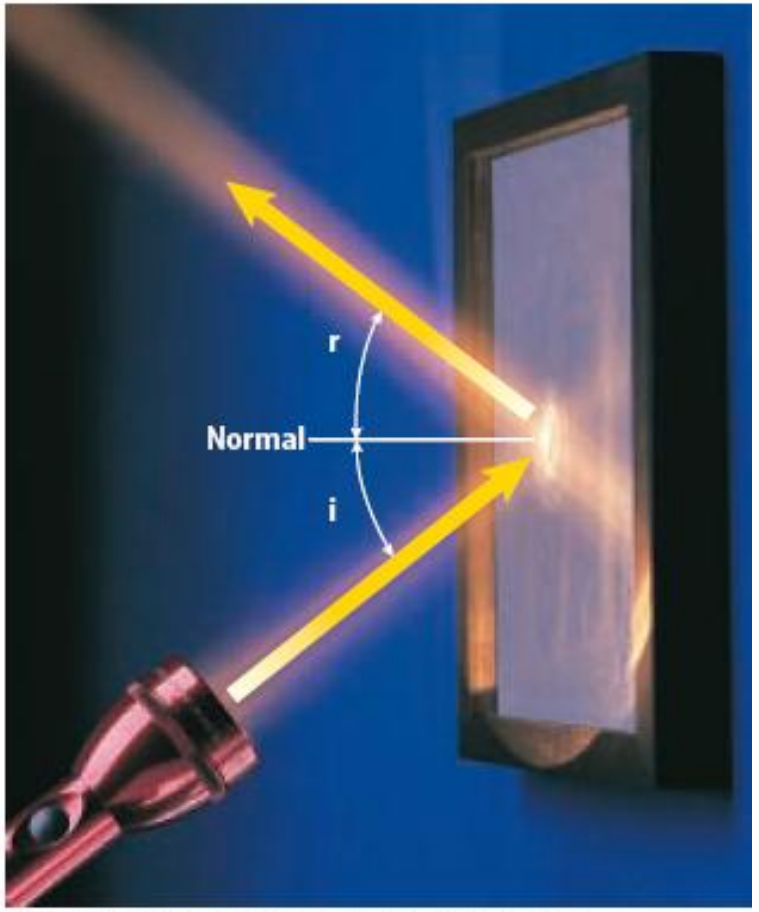
- Reflection of sound waves off of surfaces can lead to one of two phenomenon
  - **Echo**
  - **Reverberation**

The Behavior of Waves

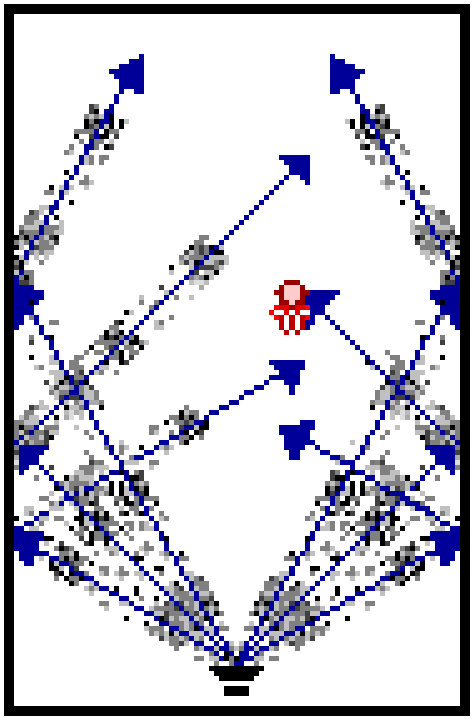
What is reflection?

When a wave bounces off an object and changes direction – this is reflection.

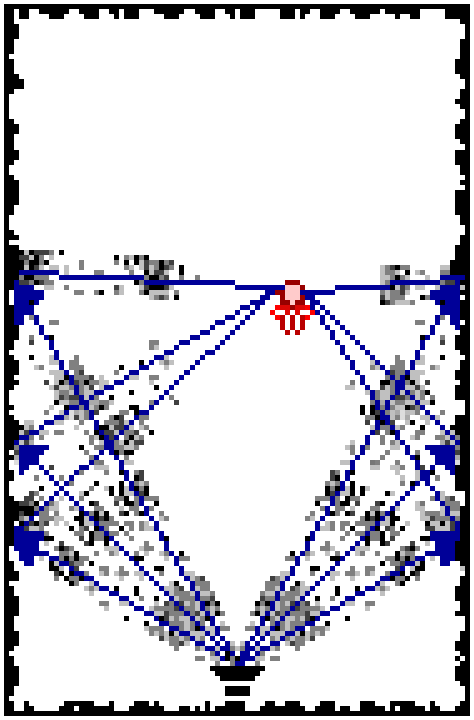
The light that strikes the boy's face is reflected into the mirror. The light then reflects off the mirror into his eyes.



A flashlight beam is made of light waves. When any wave is reflected, the angle of incidence, equals the angle of reflection, *r*.



Smooth walls fail to give the room a feel of full sound.

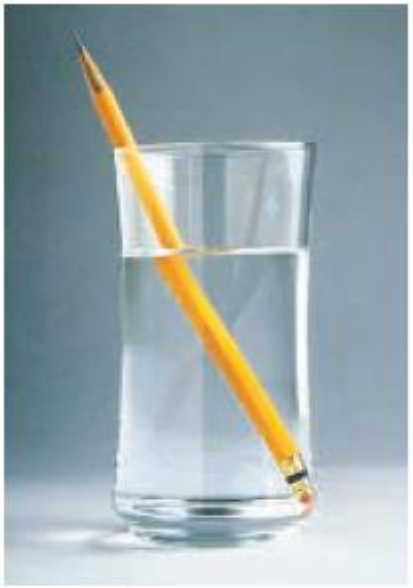


Rough walls give a room a feel of full and lively sound.

What is refraction?

Refraction is the bending of a wave as it passes from one medium to another.

A wave travels at different speeds in different things. When a wave traveling a certain speed moves into another medium, it will either increase in speed or decrease in speed, resulting in a change in direction.



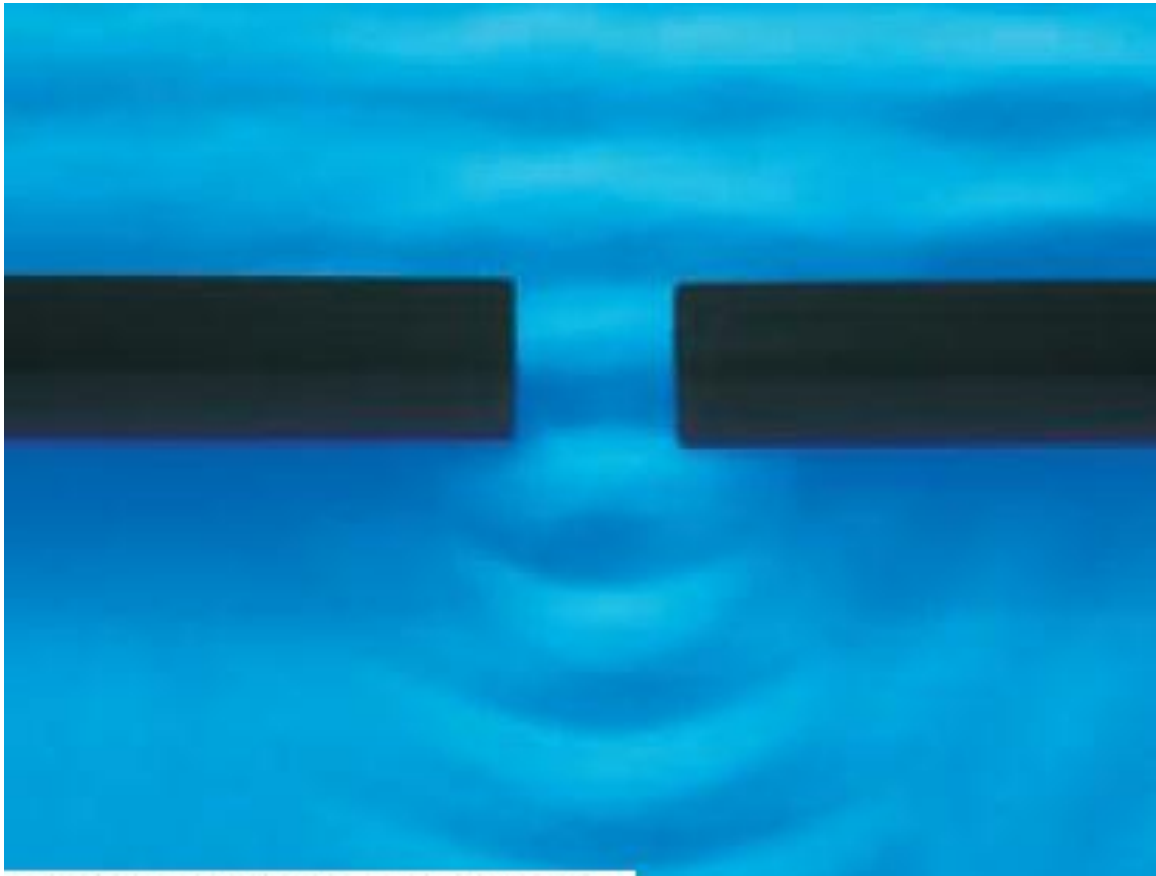
The pencil looks like it is broken at the surface of the water because of refraction.

What is diffraction?

Diffraction occurs when an object causes a wave to change direction and bend around it.

Ocean waves change direction as they pass a group of islands.

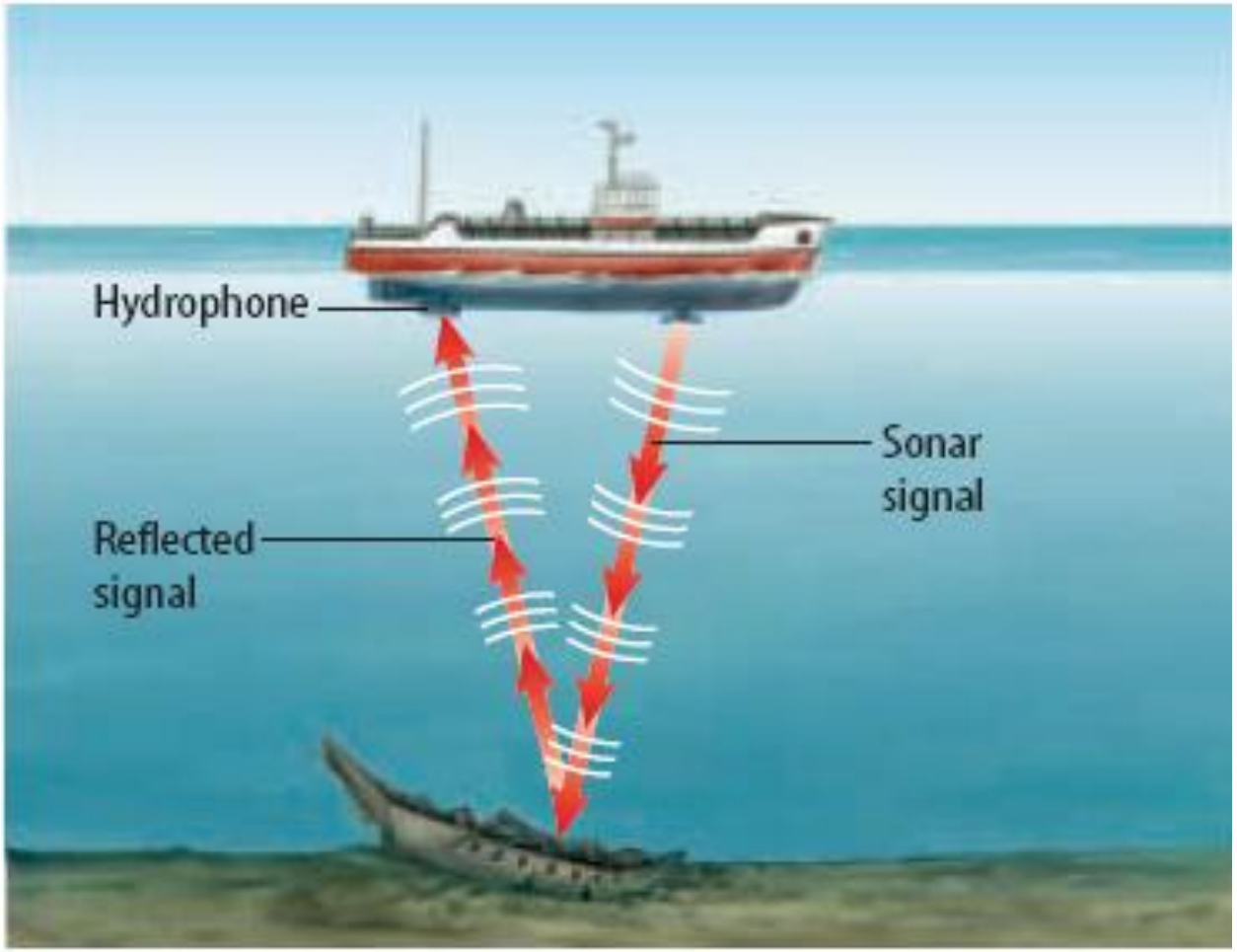
Diffraction also occurs when passing through a small opening. They diffract and spread out as they pass through the hole.



When water waves pass through a small opening in a barrier, they diffract and spread out after they pass through the hole.

What is sonar?

Sonar is a system that uses the reflection of underwater sound waves to detect objects. This has been used to find sunken ships and schools of fish.



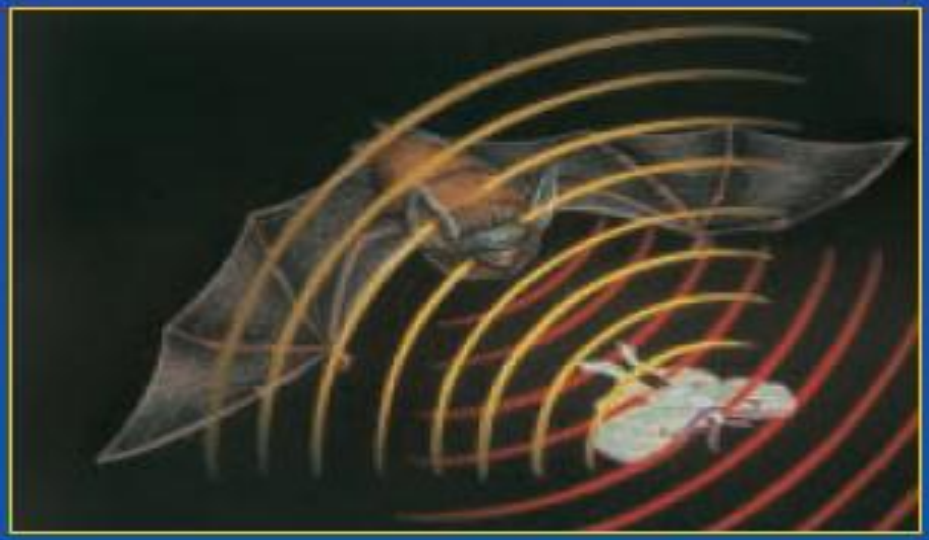
Sonar uses sound waves to find objects that are underwater.

What is echolocation?

Many bats emit ultrasonic—very high-frequency—sounds. The sound waves bounce off objects, and bats locate prey by using the returning echoes. Known as echo-location, this technique is also used by dolphins, which produce clicking sounds as they hunt. The diagrams below show how a bat uses echolocation to capture a flying insect.

A Sound waves of a bat's ultrasonic cries spread out in front of it.

B Some of the waves strike a moth and bounce back to the bat.

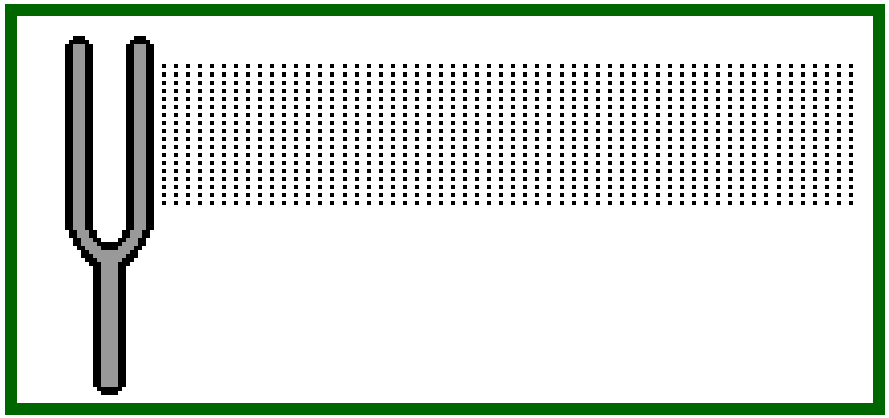


C The bat determines the moth's location by continuing to emit cries, then changes its course to catch the moth.

D By emitting a continuous stream of ultrasonic cries, the bat homes in on the moth and captures its prey.

Making Waves

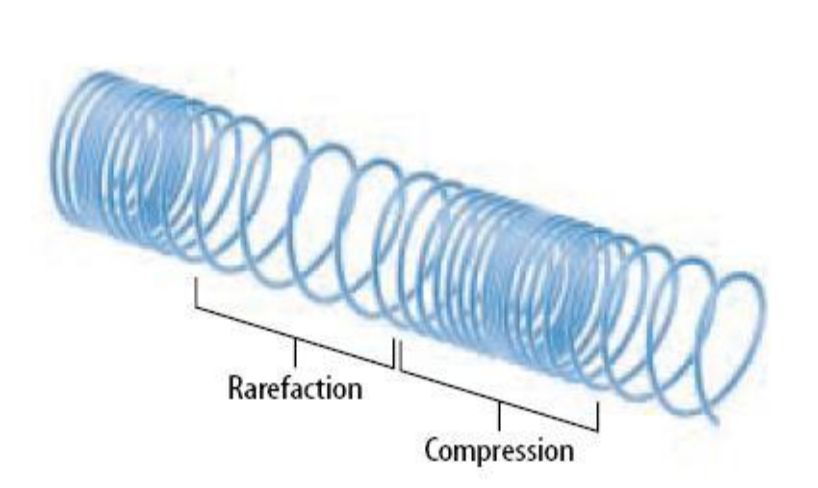
- A wave of compressed air moves along a line
- This is called a push wave or longitudinal wave

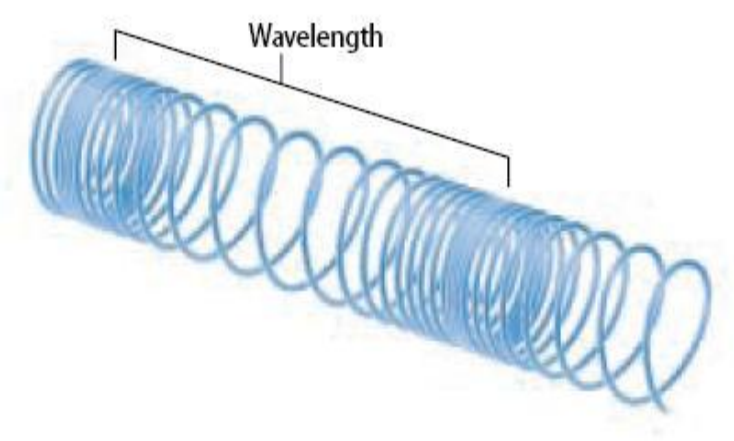


Making Waves

- Some regions air particles are compressed together and other regions air particles are spread apart.
- These regions are known as **compressions** and **rarefactions** respectively.

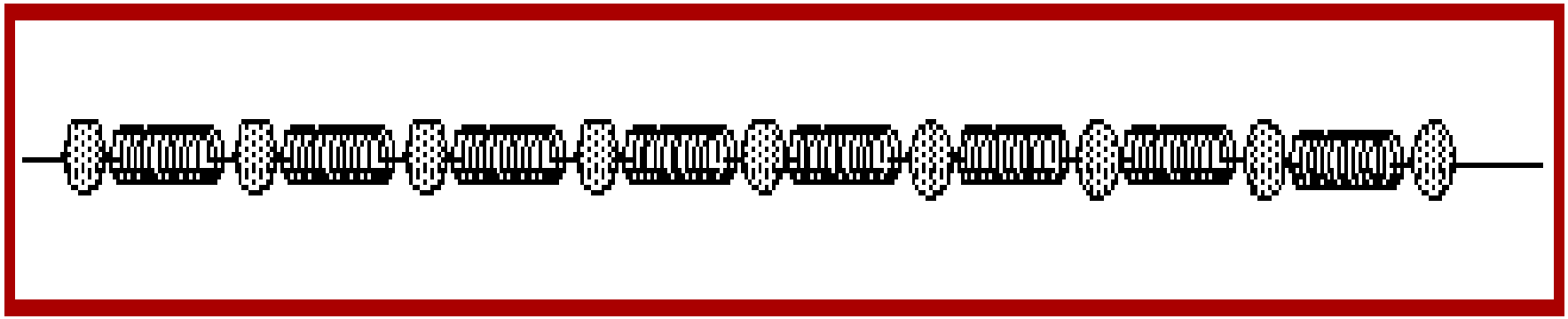
Compressional Longitudinal wave





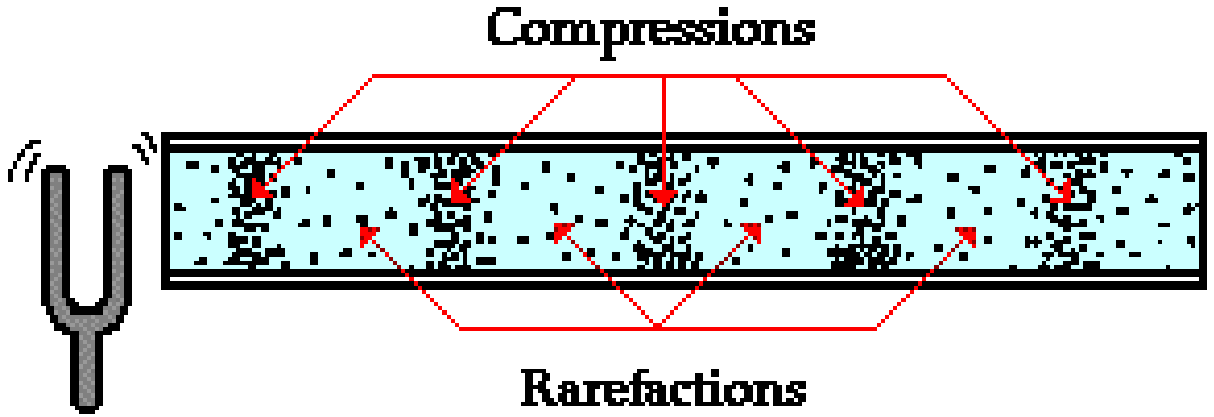
On a compressional wave the area squeezed together is called the compression. The areas spread out are called the rarefaction.

The wavelength is the distance from the center of one compression to the center of the next compression.

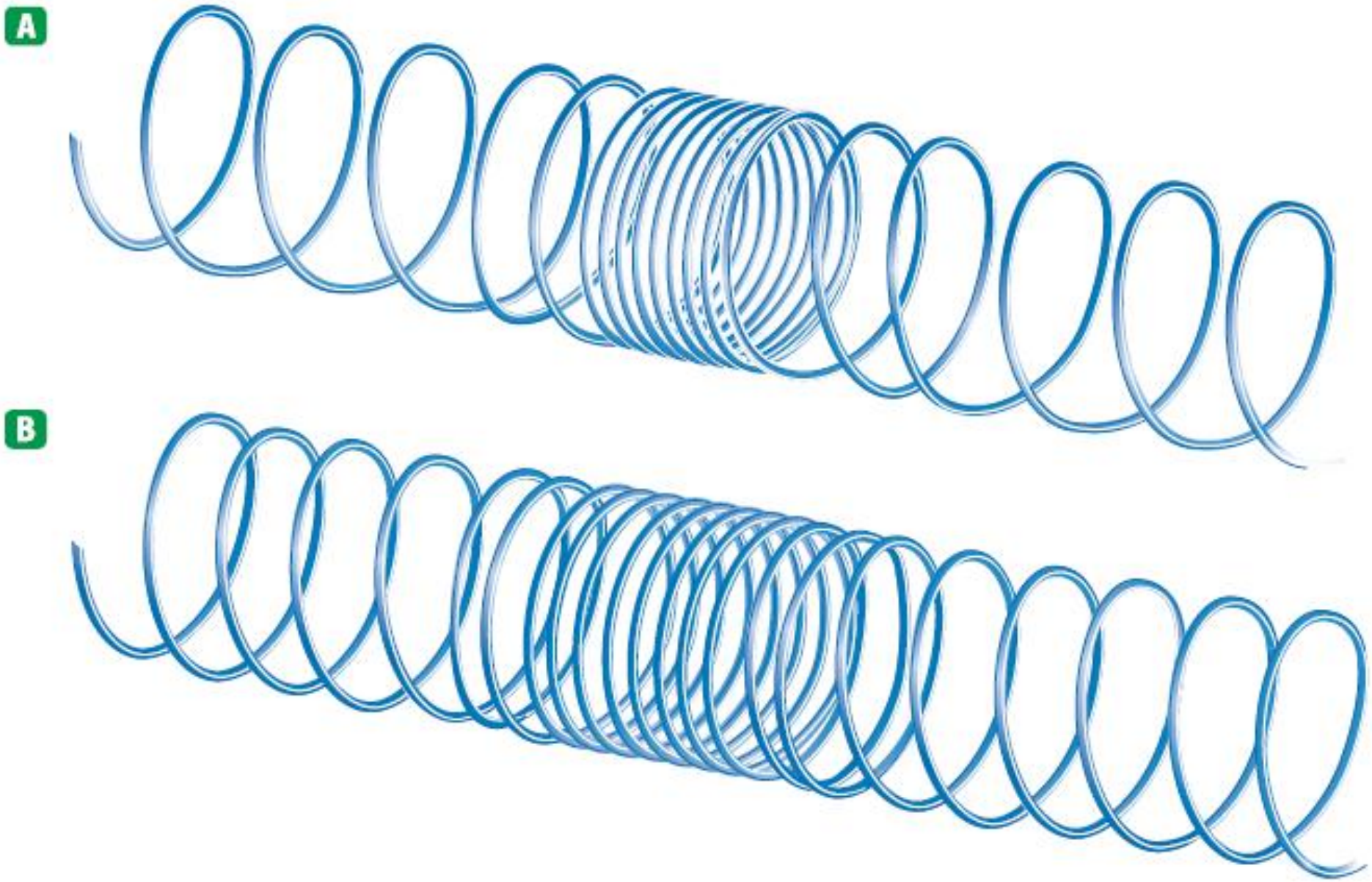


Sound Waves

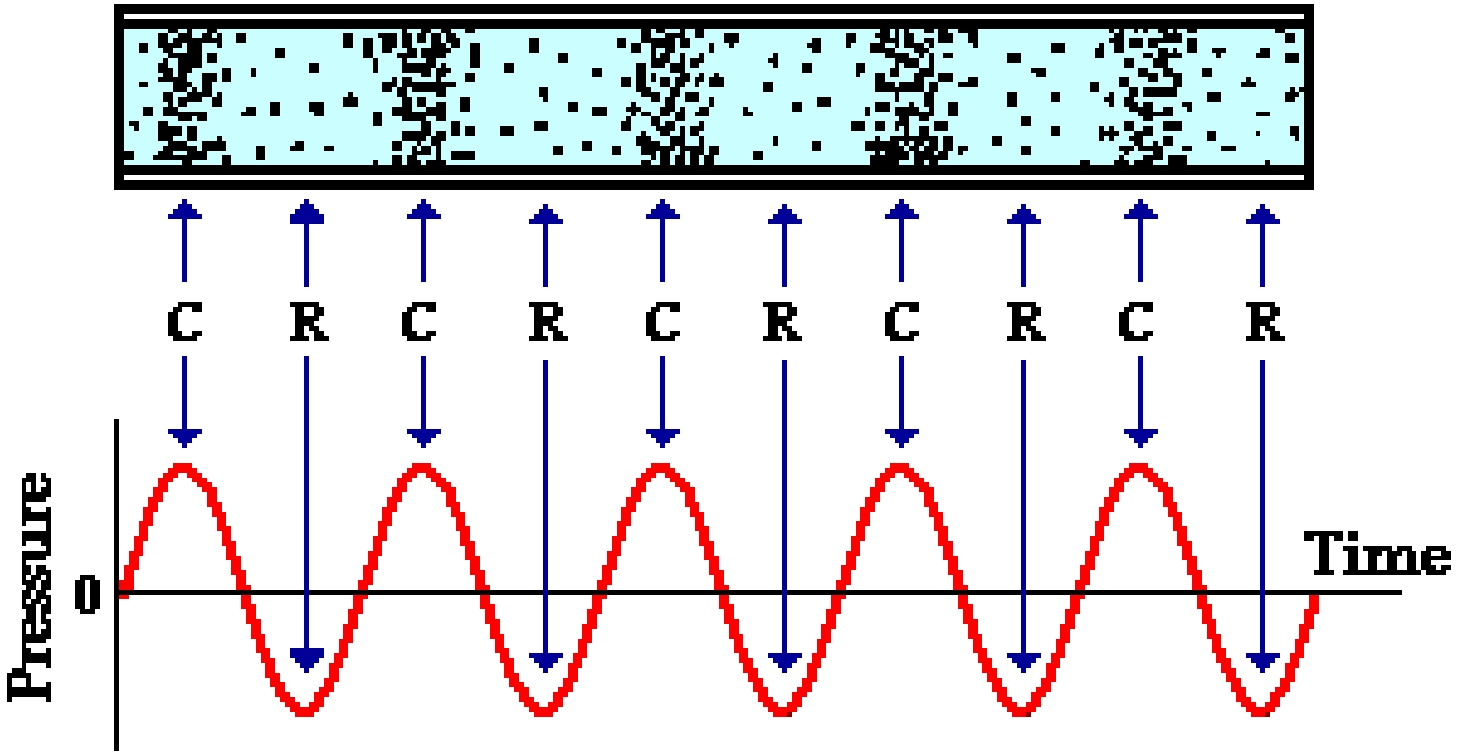
- The **wavelength** of a wave is merely the distance which a disturbance travels along the medium in one complete wave cycle



The amplitude of a compressional wave depends on how dense its medium is at each compression. **A** This coiled spring has the greater amplitude. **B** This coiled spring has the smaller amplitude.

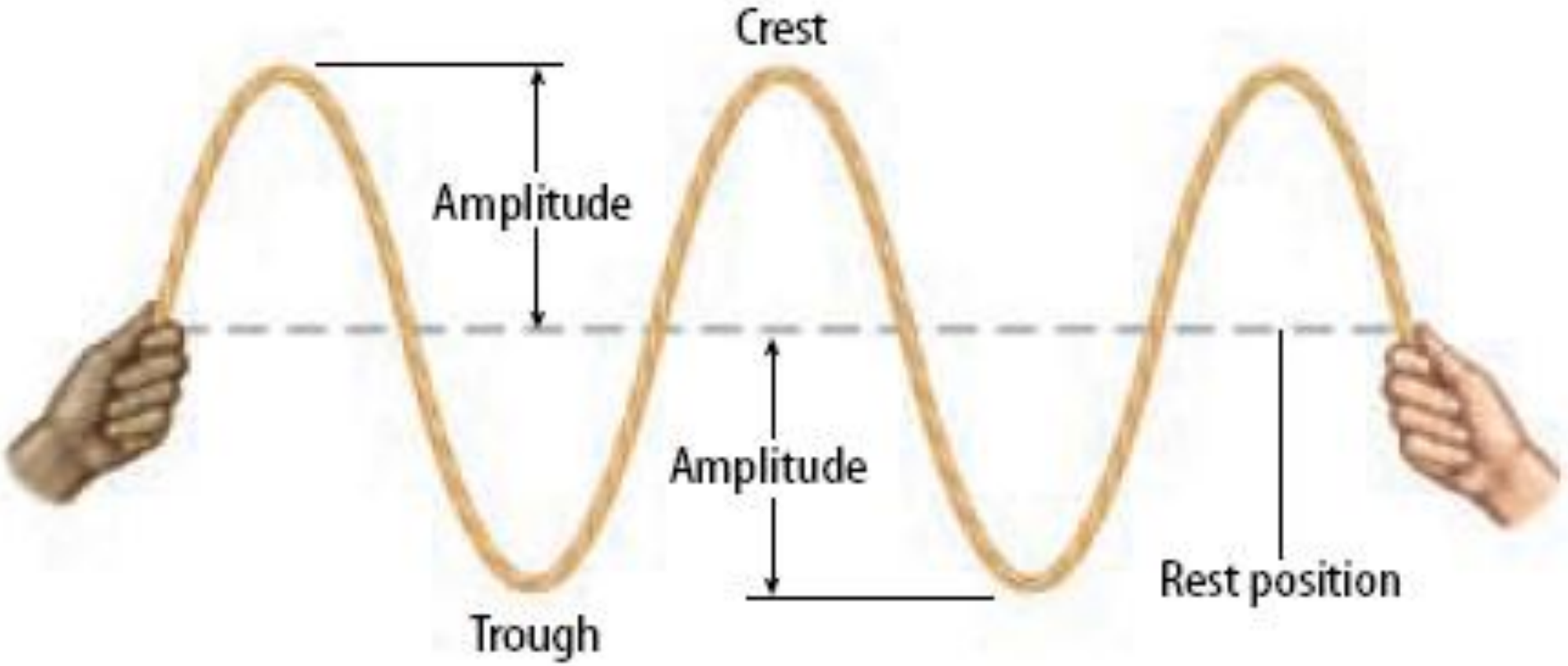


Sound is a Pressure Wave



NOTE: "C" stands for compression and "R" stands for rarefaction

The ***amplitude*** of a transverse wave is determined by the height of the crest or depth of the trough



The amplitude of a transverse wave is the distance between a crest or a trough and the position of the medium at rest.

Sound Wave

- Every time the cycle repeats a new sound wave is produced