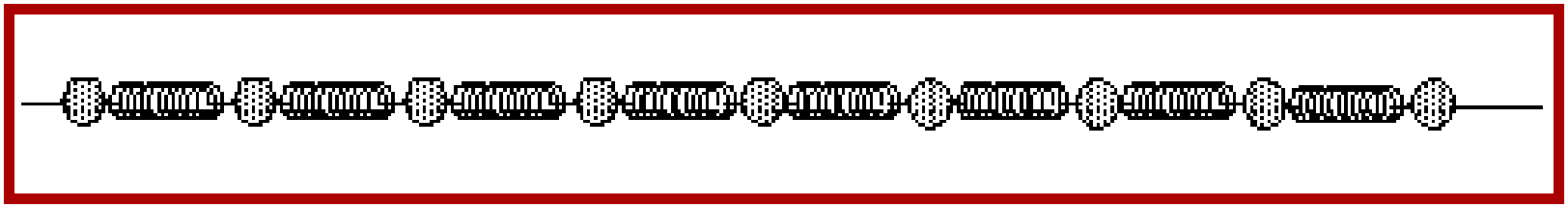
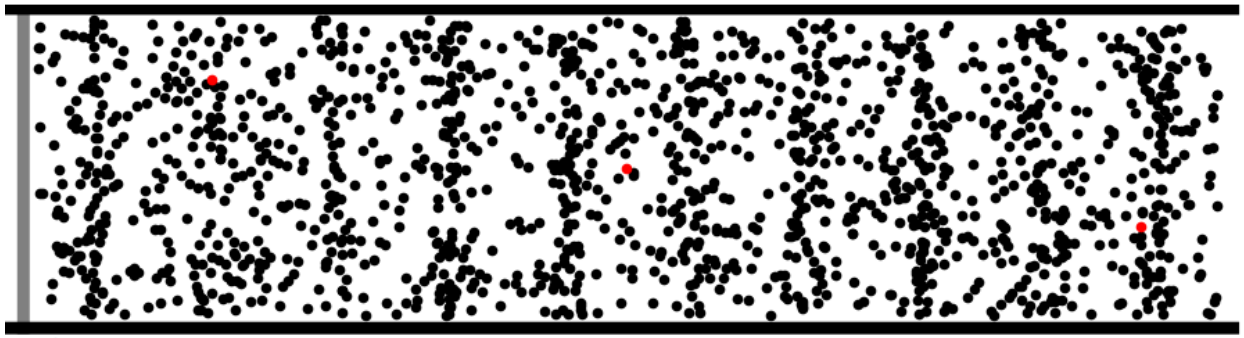
Sound: Amplitude & Pitch

Sound Waves

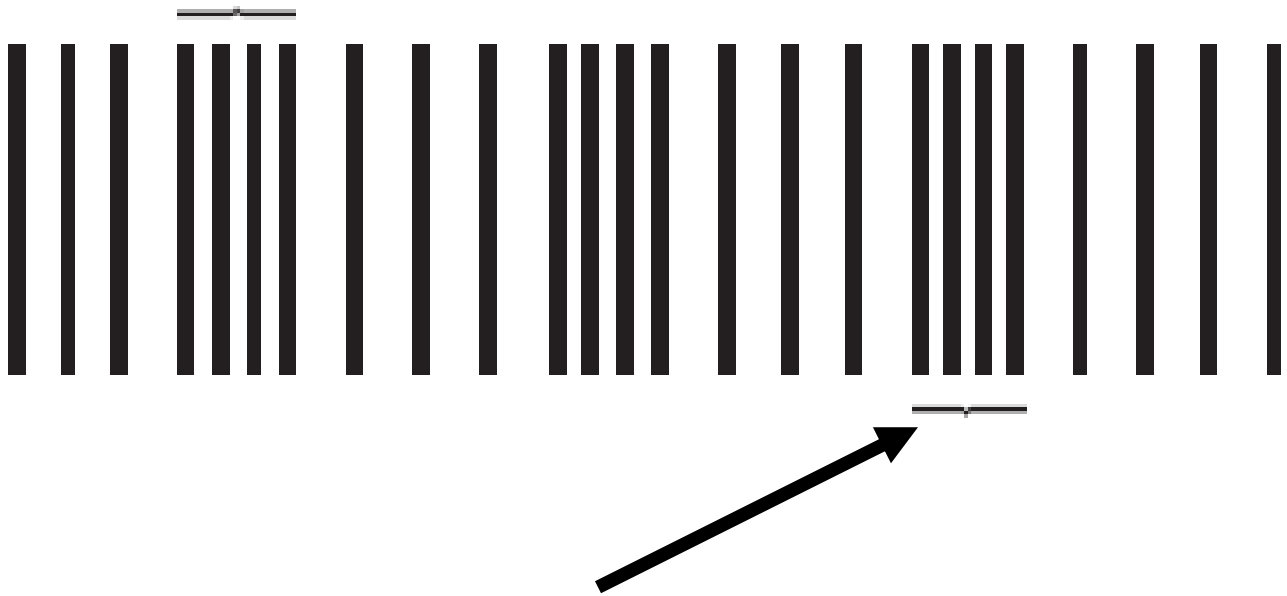
- A Sound wave is a mechanical wave because it has to travel through a medium.
- A Sound wave is also a Compressional wave because matter in the medium moves forward and backward along the same direction that the wave travels.



Let’s Review the Parts of a Compressional Wave

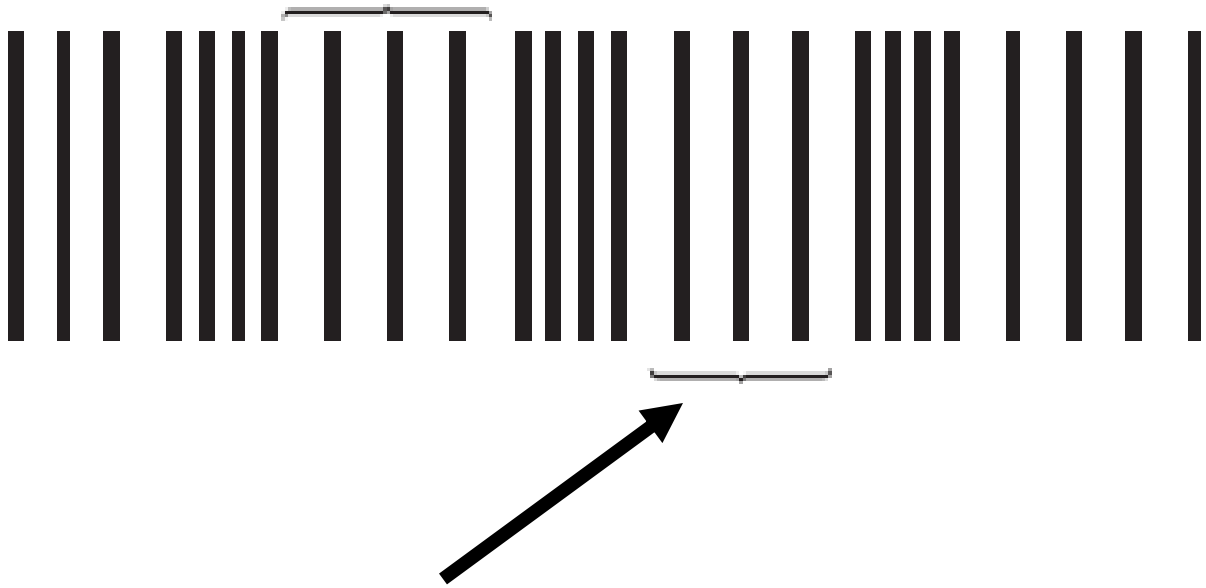


Parts of a Compressional Wave (Longitudinal)



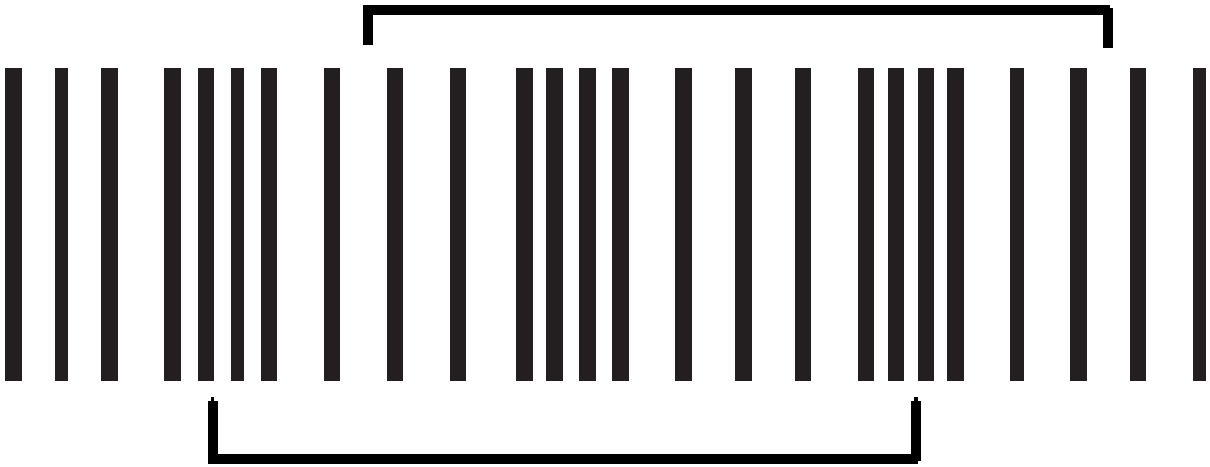
The **compression** is the part of the compressional wave where the particles are crowded together.

Parts of a Compressional Wave (Longitudinal)

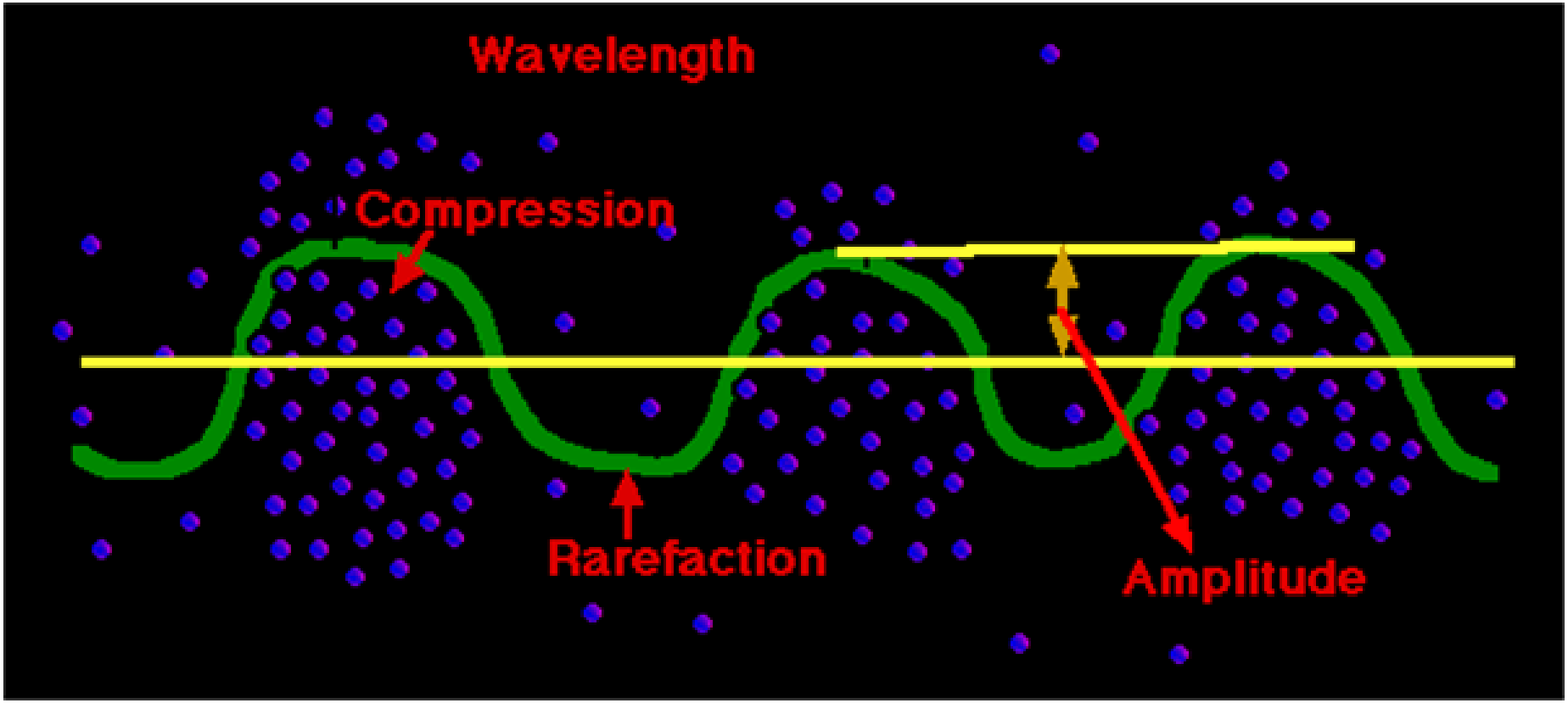


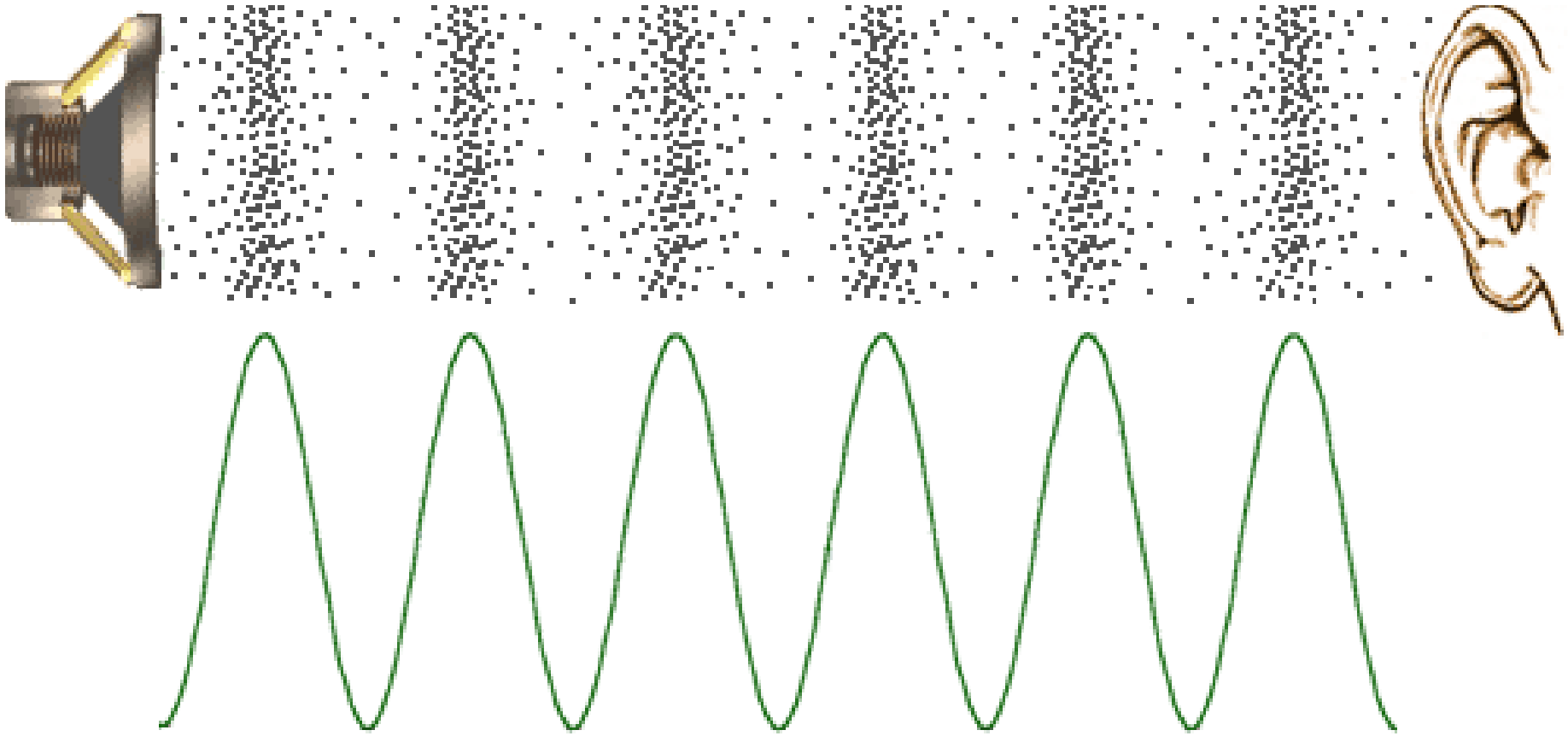
The **rarefaction** is the part of the compressional wave where the particles are spread apart.

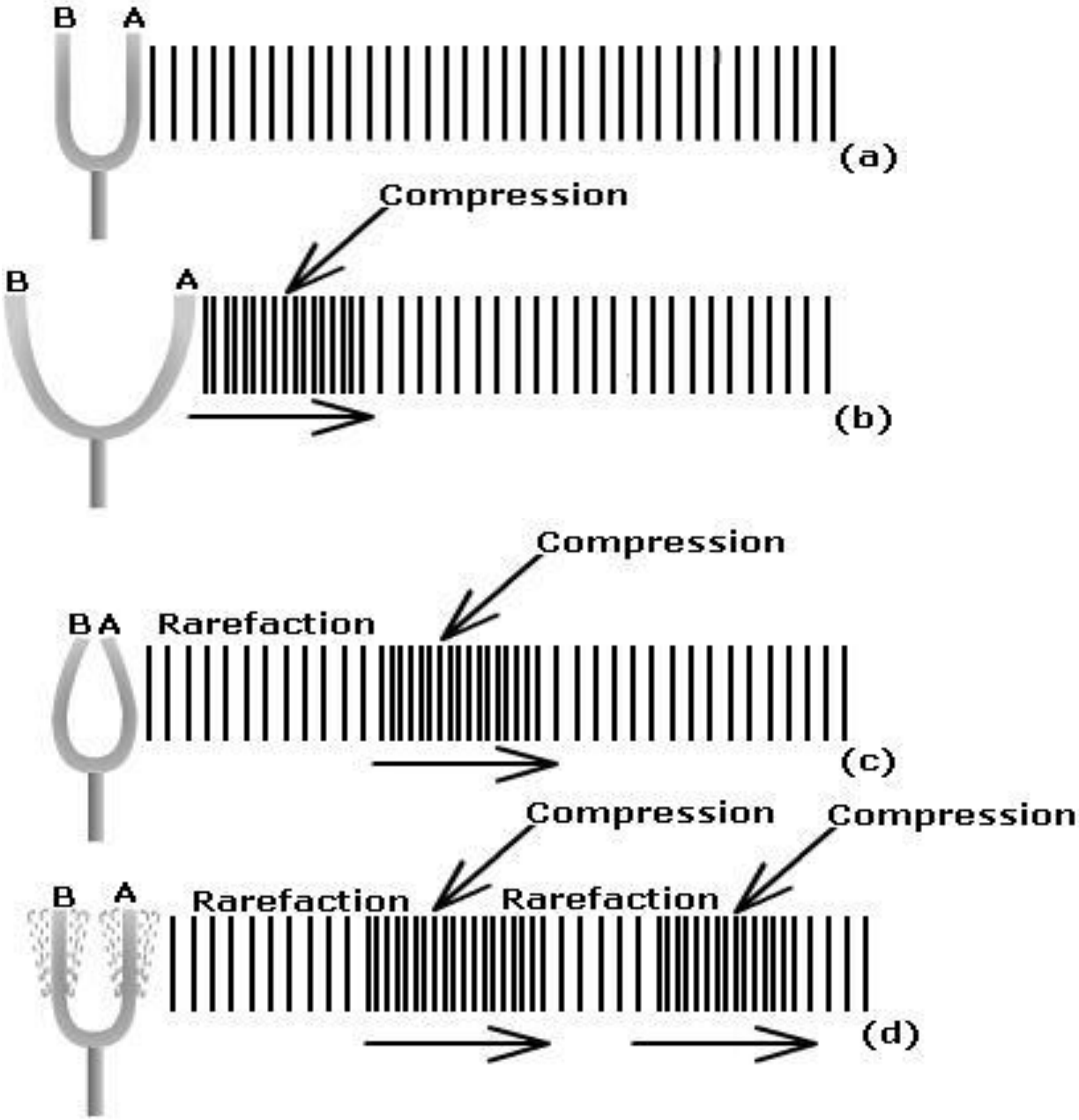
Parts of a Compressional Wave (Longitudinal)



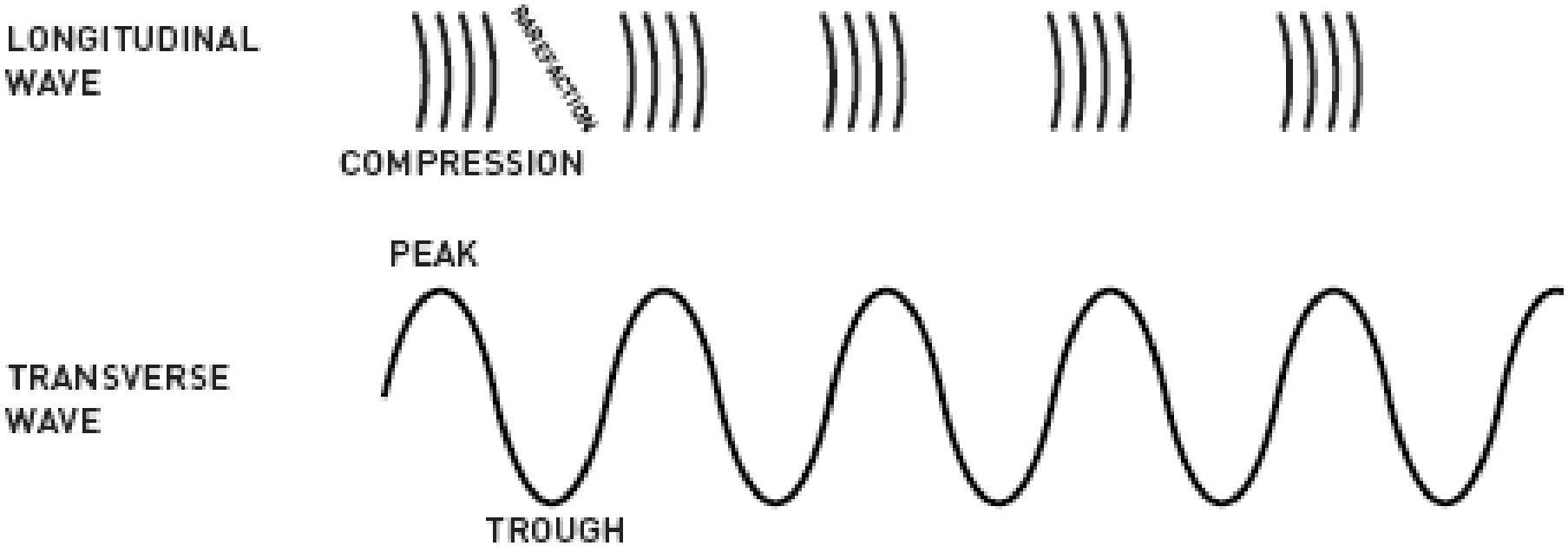
The **wavelength** is the distance from compression to compression or rarefaction to rarefaction in a compressional wave.


Wavelength
Compression
Rarefaction
Amplitude



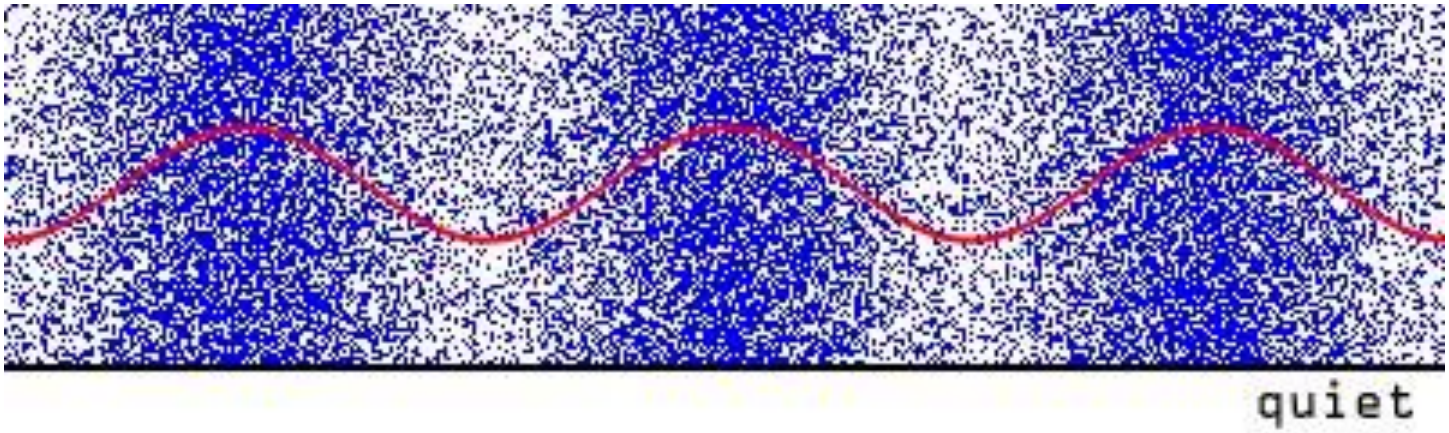

B
A
(a)
Compression
B
A
(b)
Compression
B A
Rarefaction
(c)
Compression
Compression
B
A
Rarefaction
Rarefaction
(d)

Compare Compressional Wave to Transverse Wave

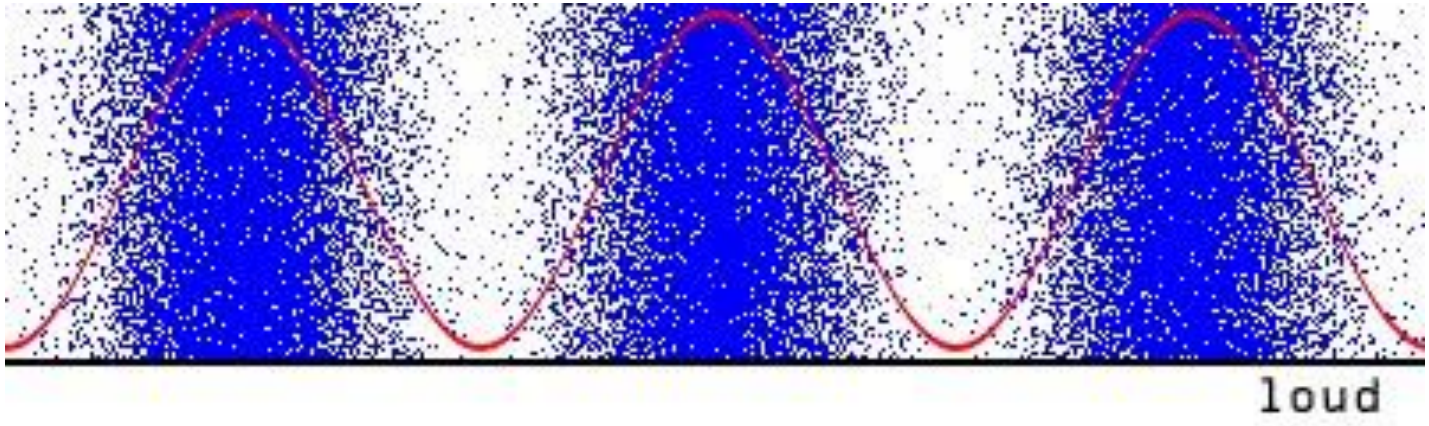


Amplitude and Loudness of Sound

- Loudness is the human perception of how much energy a sound wave carries.
- The greater the amplitude of a wave, the more energy it carries.
- In a compressional wave, the amplitude is greater when the particles of the medium are squeezed closer together in each compression and spread farther apart in each rarefaction.
- Larger amplitude = louder sound
- Smaller amplitude = softer sound



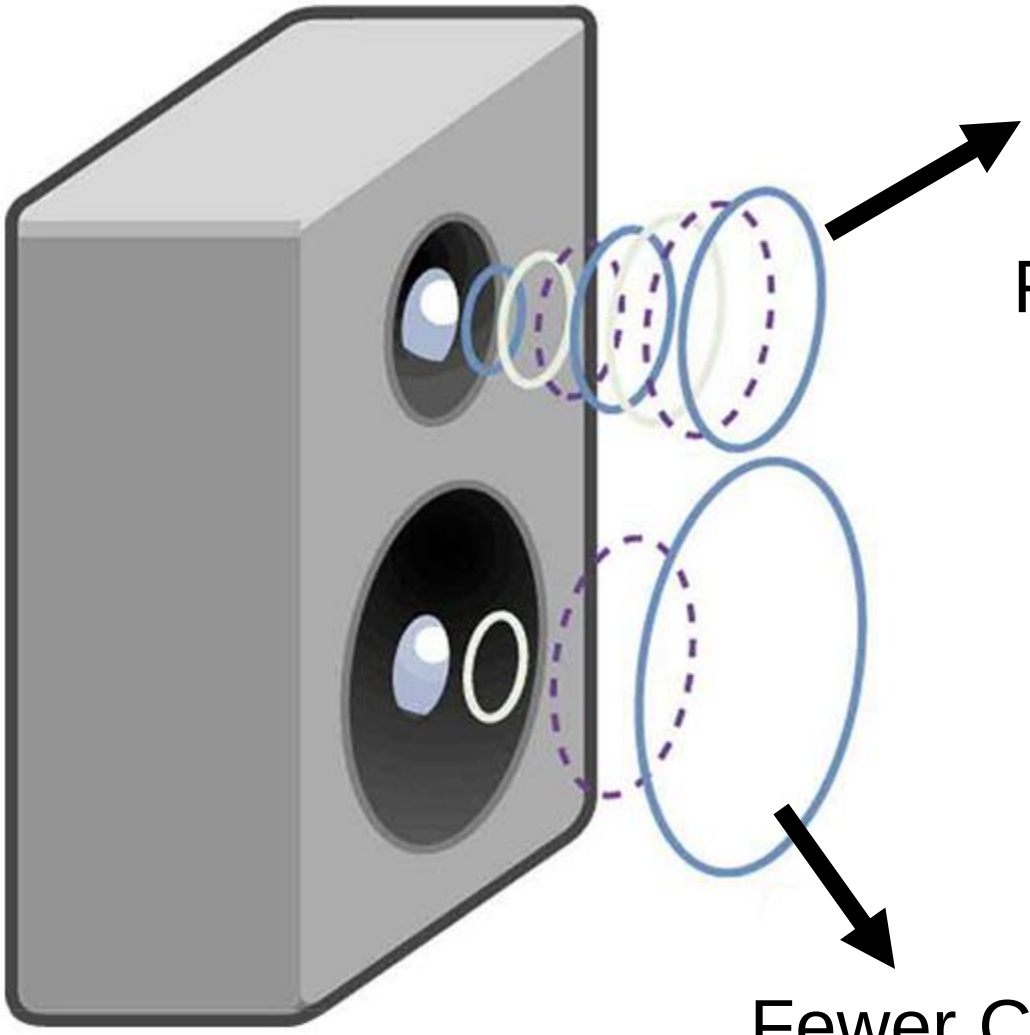
Low Amplitude because particles in compression and rarefaction are more spread out



High Amplitude because particles in compression are more compressed and particles in the rarefaction are more spread out

Pitch and Frequency of Sound

- The pitch of a sound is how high or low it sounds.
- The frequency of a sound wave is the number of compressions that pass by a given point in one second.
- The higher the pitch, the higher the frequency.
- An object that vibrates faster forms a sound wave with a higher frequency.

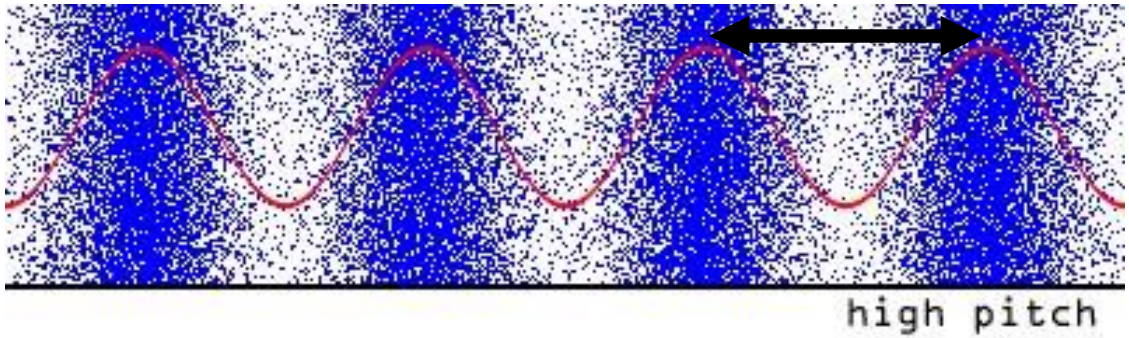


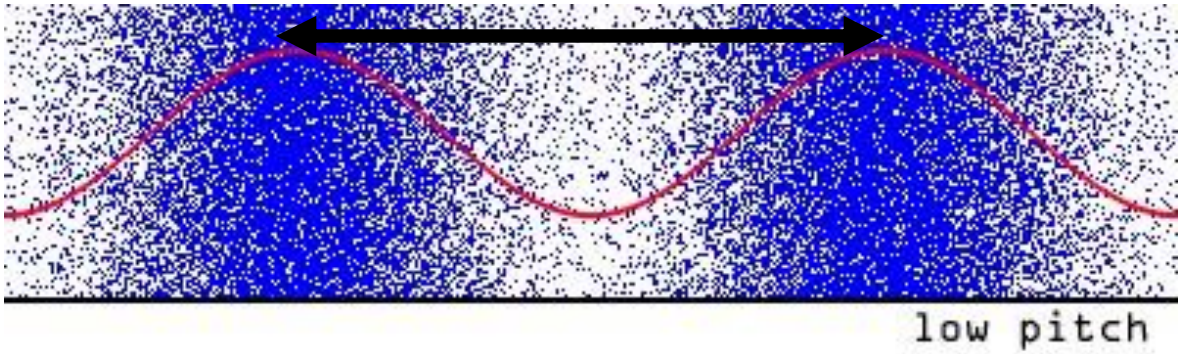
More Compressions in the same amount of time; therefore, higher Frequency, higher Pitch

Fewer Compressions in the same amount of time; therefore, lower Frequency, lower Pitch

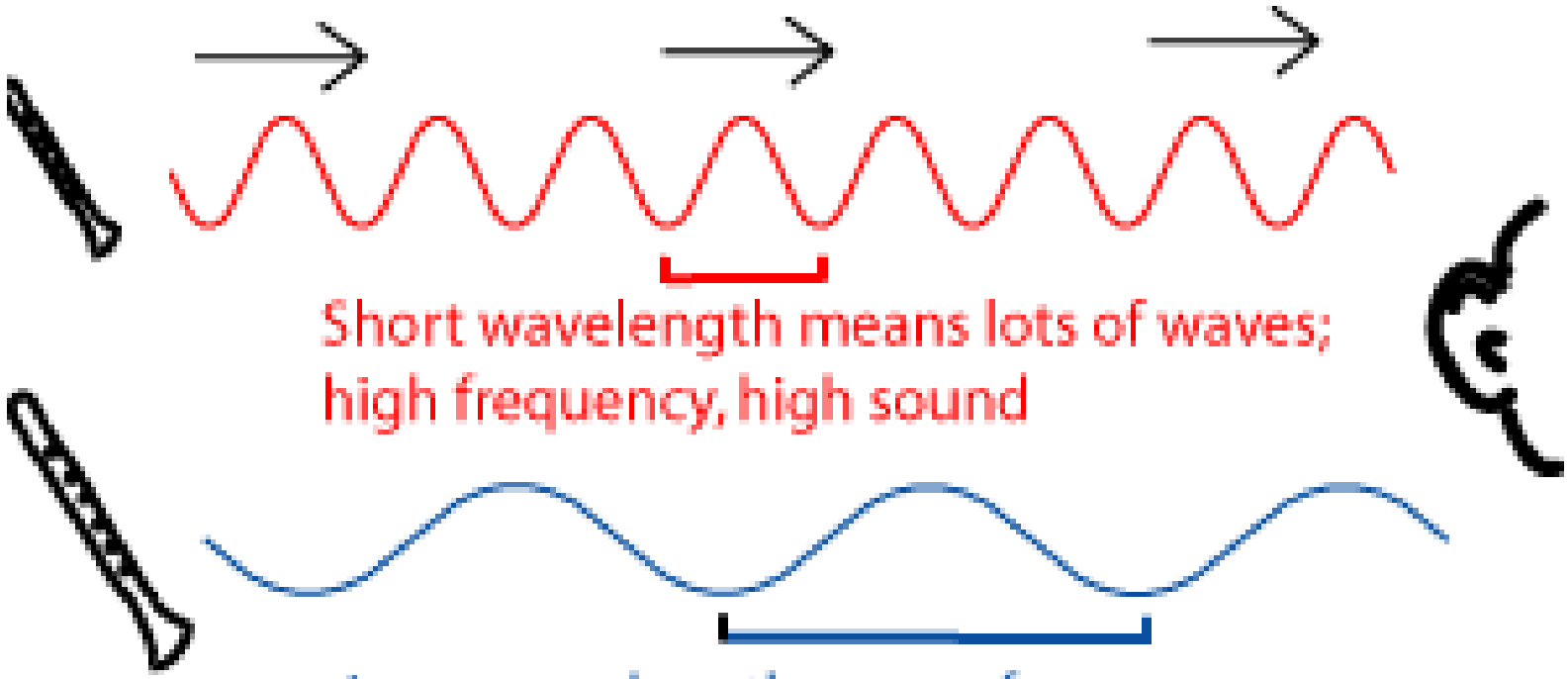
Pitch and Frequency of Sound

- Sound waves with a higher pitch have a shorter wavelength.





The waves are all travelling at about the same speed, so this is the number of each wave that will reach the ear in a hundredth of a second.



Amplitude and Pitch

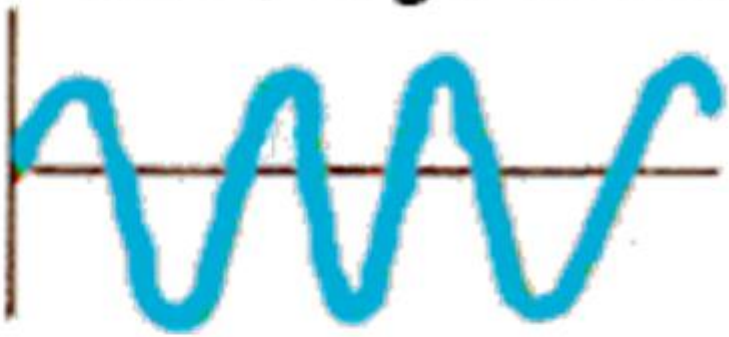
Which of the following waves has high amplitude? High Pitch?

Soft, high note.

1

Loud, high note.

3

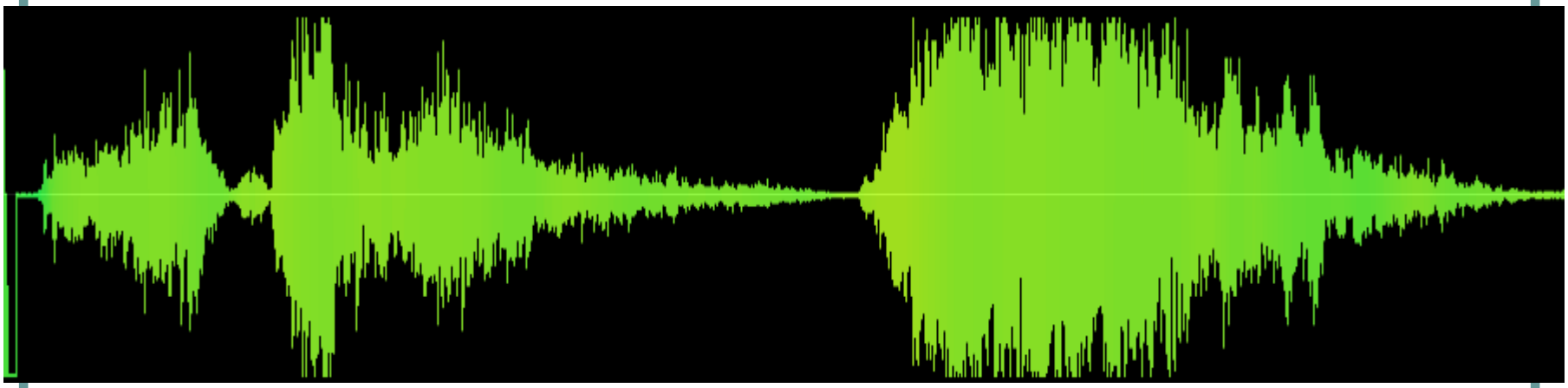


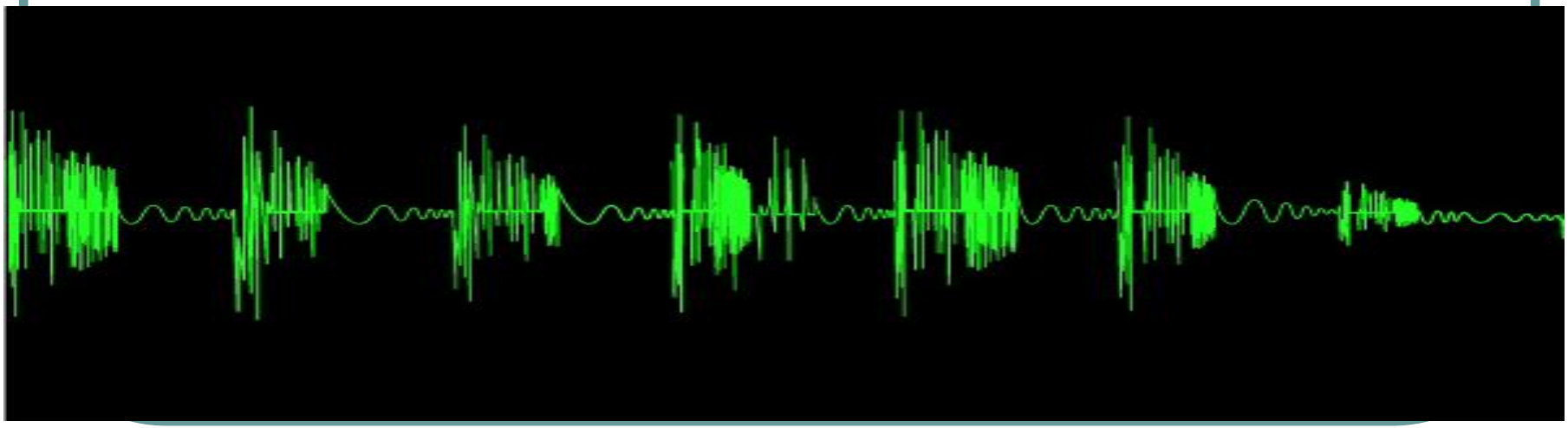
2

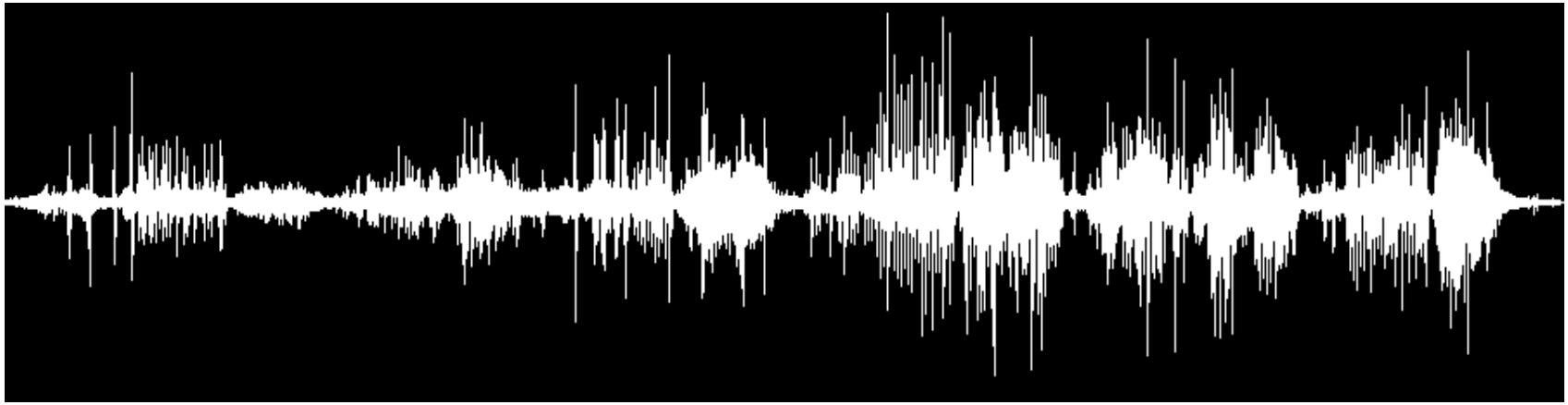
Soft, low note.

4

Loud, low note.



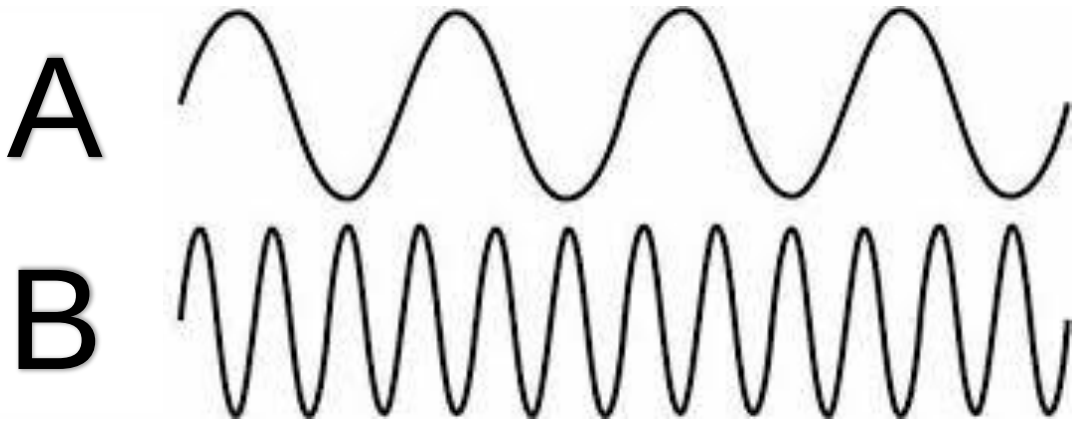




Tuning Fork Lab

Assessment Time

1. Which wave has the highest frequency?

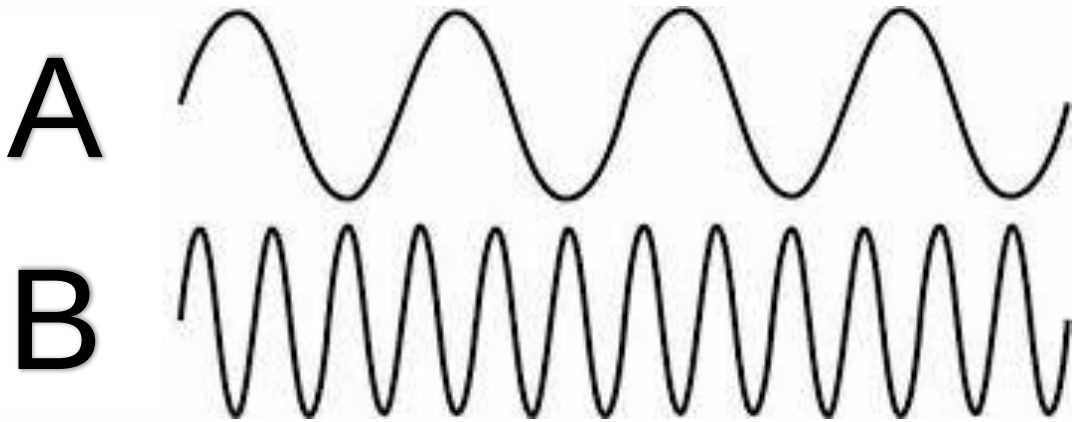


2. Explain how you were able to distinguish the higher frequency.

3. Frequency is the pitch or loudness of a sound wave?

Assessment Time

4. Which wave has the lowest amplitude?



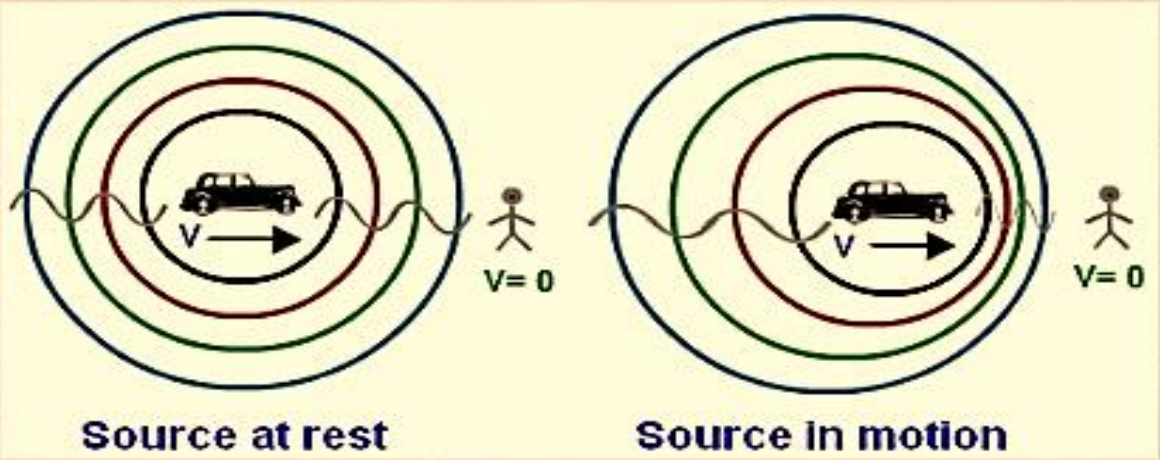
5. Explain how you were able to distinguish the lower amplitude.

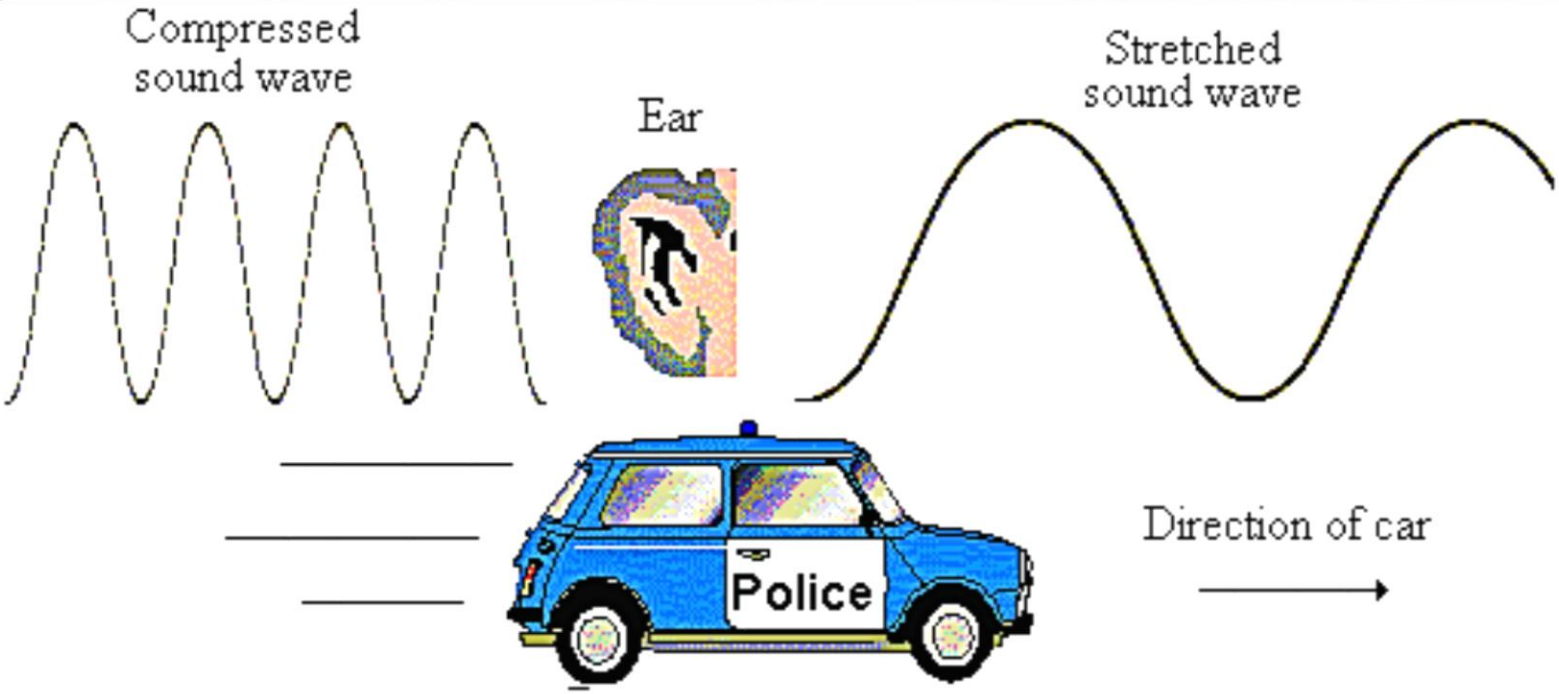
6. Amplitude is the pitch or loudness of a sound wave?

The Doppler Effect

The Doppler Effect

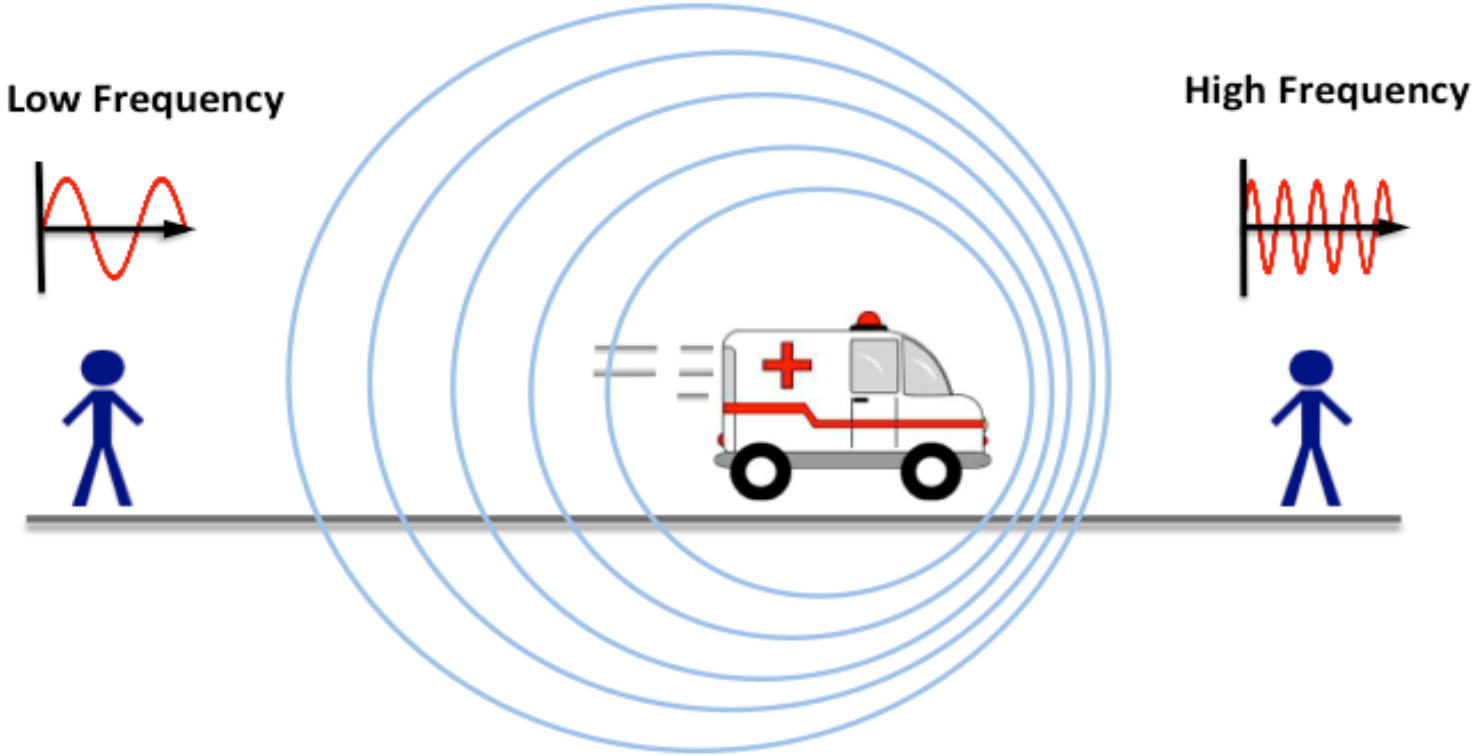
- As illustrated by this image, when an object emitting waves moves, it changes the frequency. The waves in front get pushed closer together while the ones behind get more spread out.



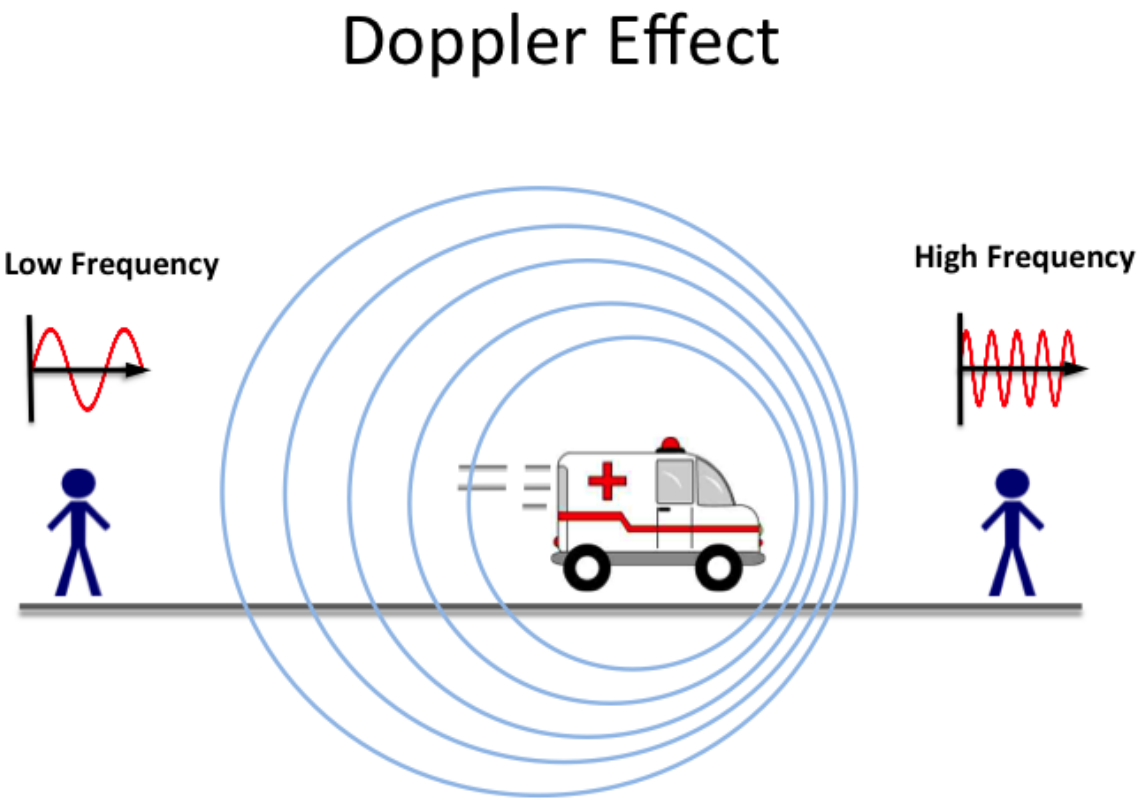


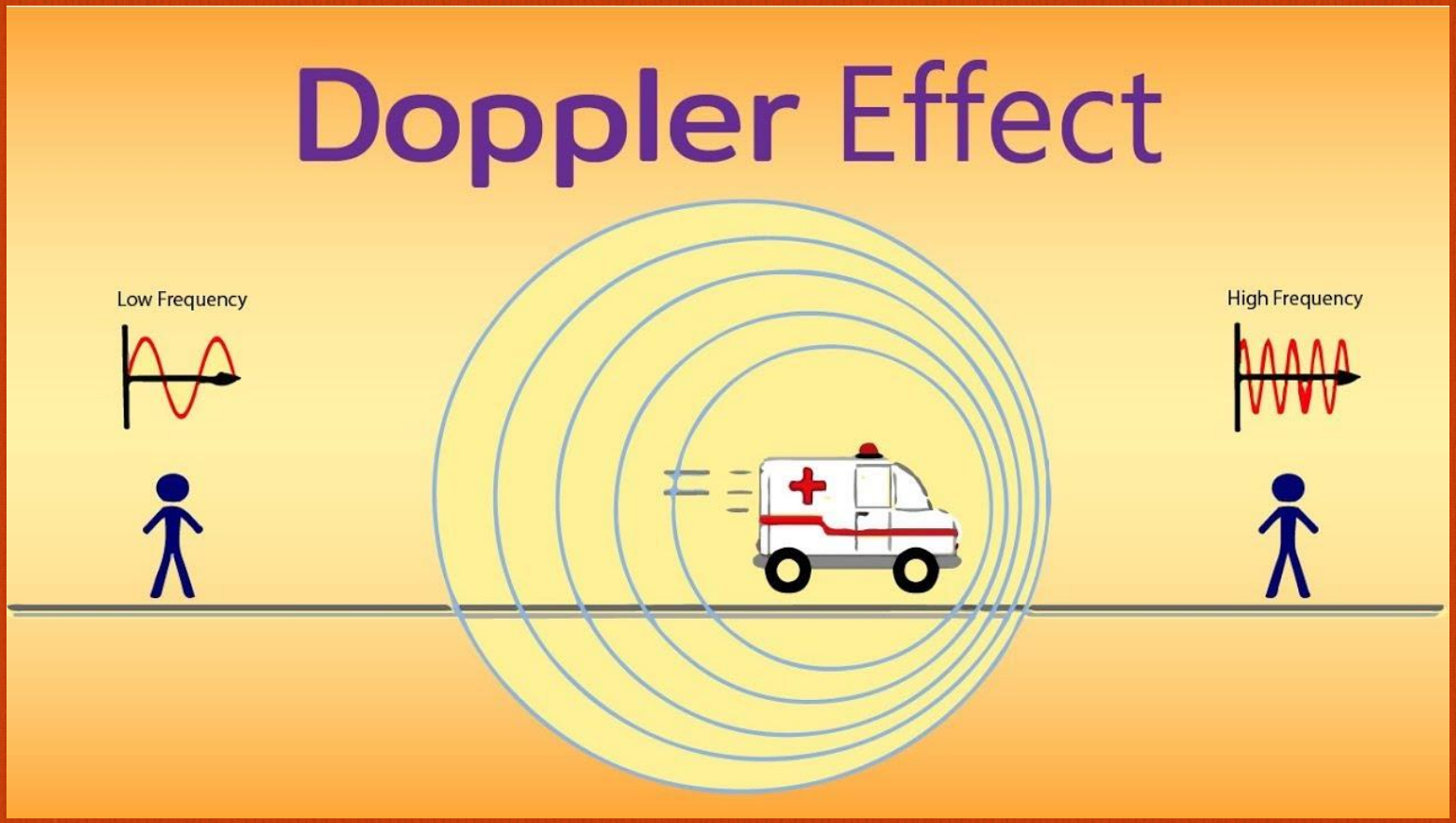
The Doppler effect:
As the police car approaches the sound waves are compressed and the pitch rises.
As it recedes the sound waves are stretched and the pitch decreases.

Doppler Effect



Doppler Effect Activity Sheet



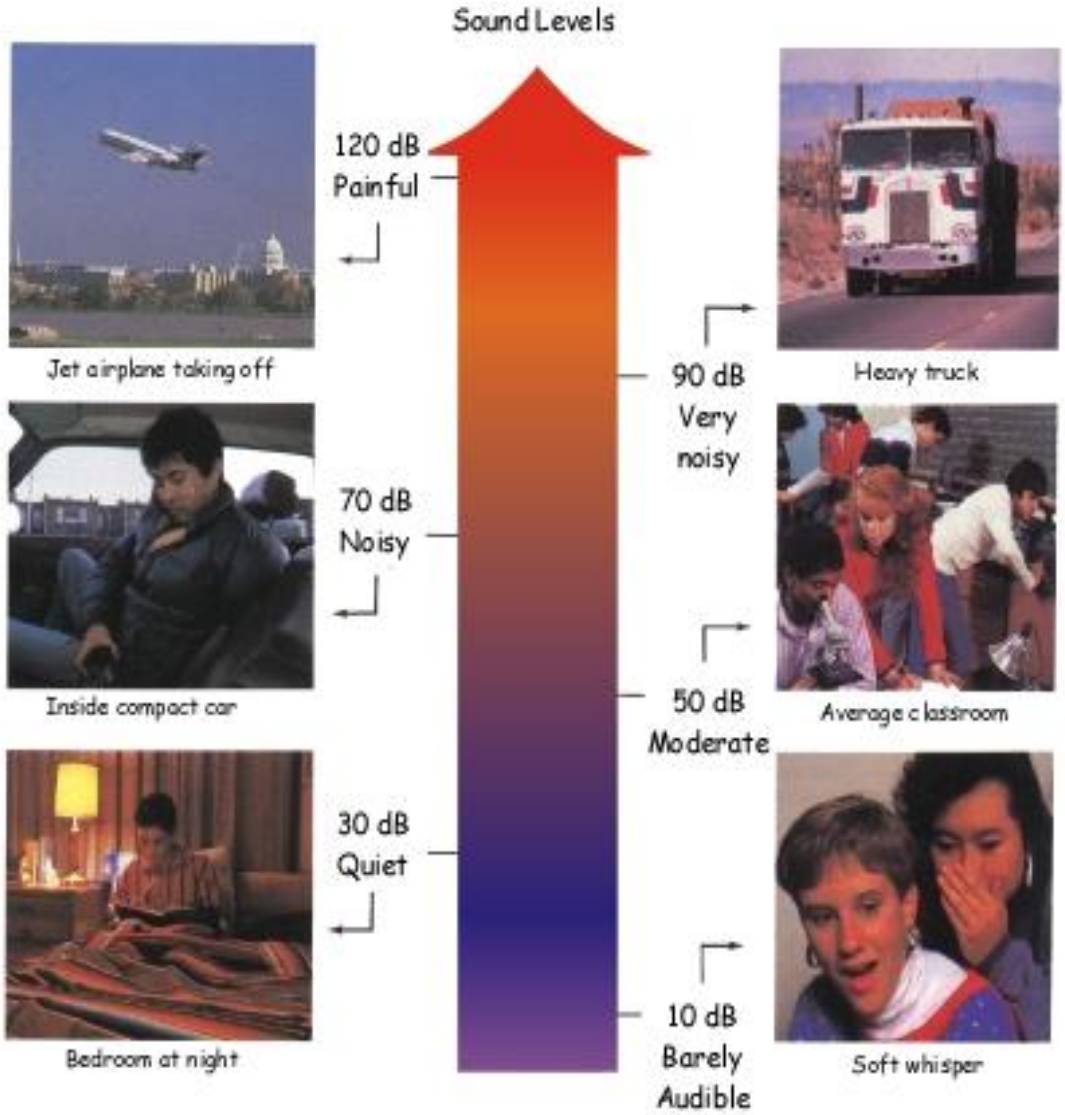


Give an example of how you could demonstrate the Doppler Effect in a classroom.

What materials would you need? How would you use the materials?

Measuring Sound

- The energy carried in a sound wave can be described in decibels (dB).
- Hearing damage begins at about 85dB.



Decibel scale showing the intensity level of some familiar sounds.

How normal hearing works

1. Sound waves move through the ear canal and strike the eardrum.
2. These sound waves cause the eardrum, and the three bones/ossicles within the middle ear, to vibrate.
3. The vibrations move through the fluid in the spiral shaped inner ear – known as the cochlea – and cause the tiny hair cells in the cochlea to move. The hair cells detect the movement and change it into the chemical signals for the hearing nerve.
4. The hearing nerve then sends the information to the brain with electrical impulses, where they are interpreted as sound.

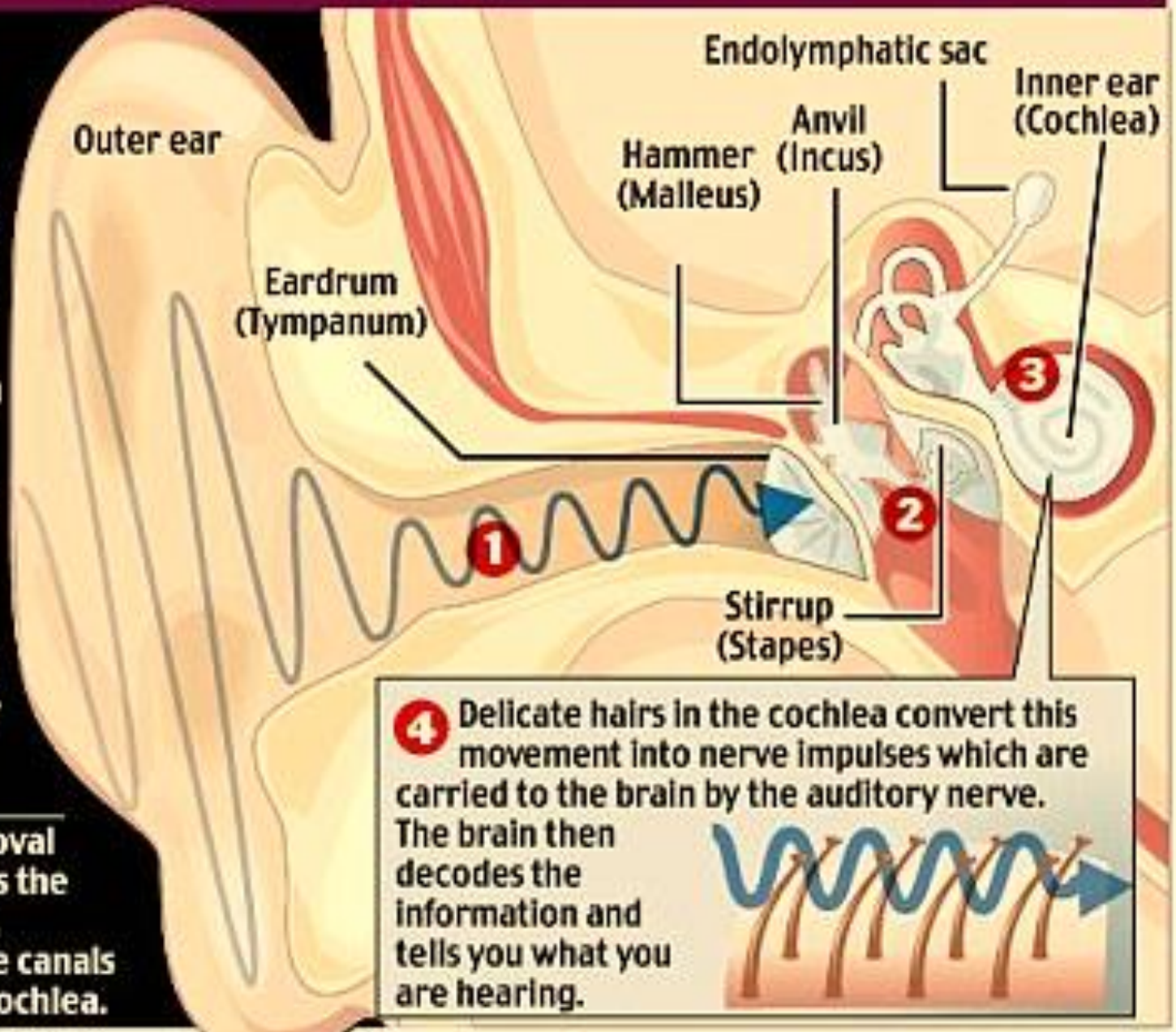
Image courtesy of Cochlear

HOW YOUR EARS WORK

1 Sound waves travel through the funnel of the outer ear to the eardrum, making it vibrate, and setting off a chain reaction.

2 The three smallest bones in the body - the hammer, anvil and stirrup of the middle ear - start moving, passing the vibrations to a thin layer of tissue at the entrance of the inner ear called the oval window.

3 Pressure on the oval window squashes the fluid in the inner ear, creating waves in the canals of the snail-shaped cochlea.



4 Delicate hairs in the cochlea convert this movement into nerve impulses which are carried to the brain by the auditory nerve. The brain then decodes the information and tells you what you are hearing.