Sound

The Facts

Sound …

1. Is a form of energy produced & transmitted by vibrating matter
2. Travels in waves
3. Travels more quickly through solids than liquids or gases

The Ear

- Sound is carried to our ears through vibrating air molecules.
- Our ears take in sound waves & turn them into signals that go to our brains.
- Sound waves move through 3 parts of the ear; outer ear, middle ear, & inner ear.

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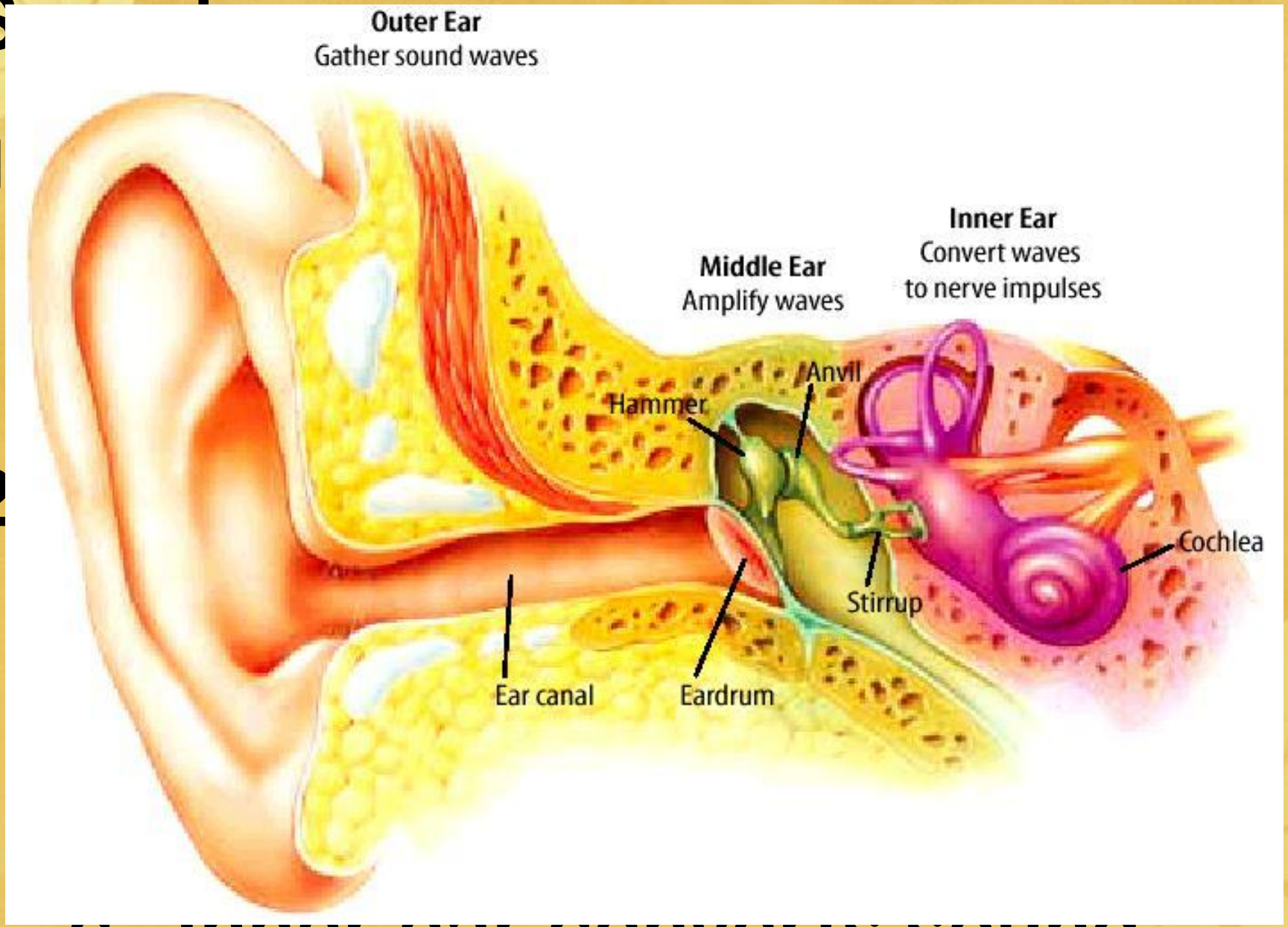
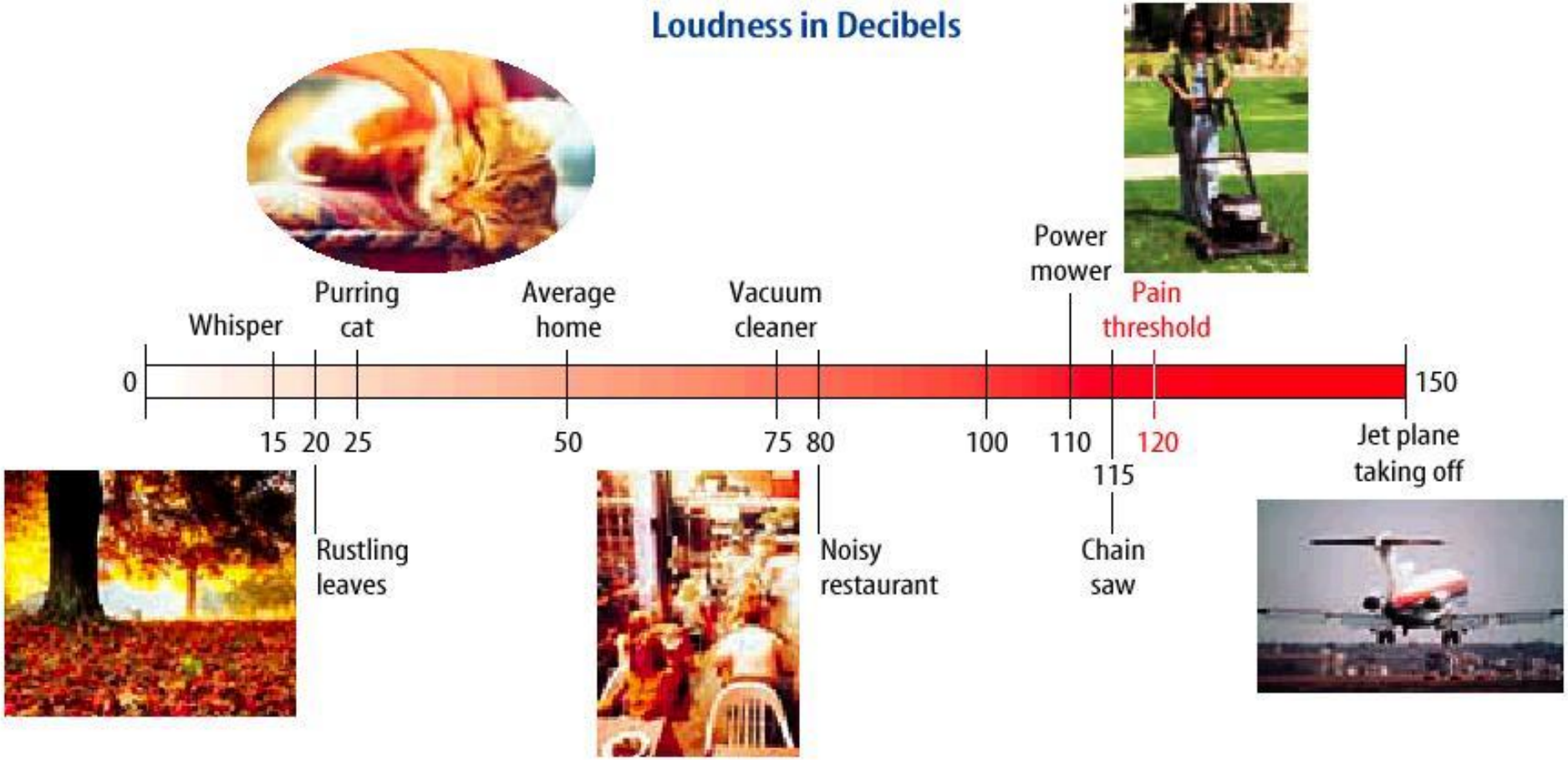


c. Inner ear converts sound.

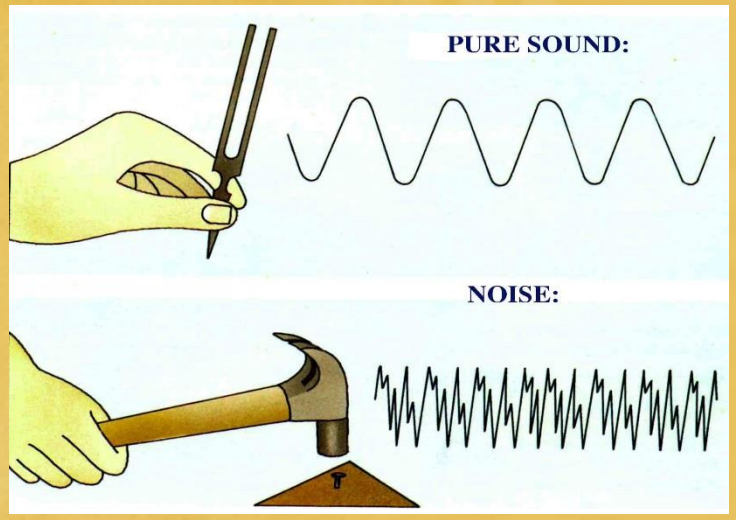


a) Threshold of hearing (0 db)

b) Threshold of pain (120 db)

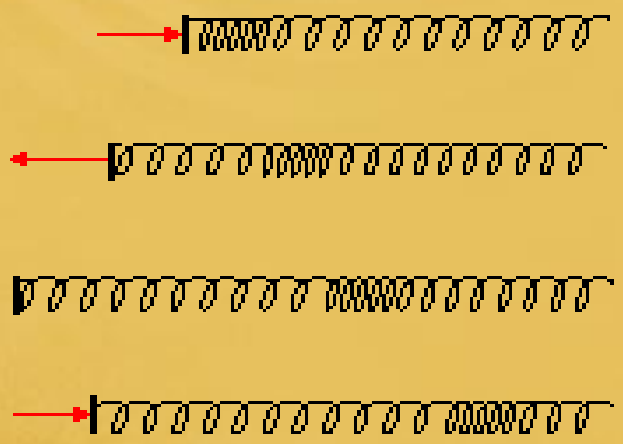
Vibration

- Back and forth movement of molecules of matter
- For example,

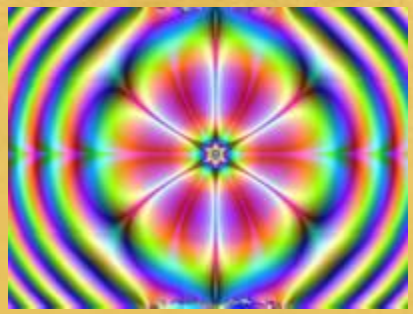


Compression

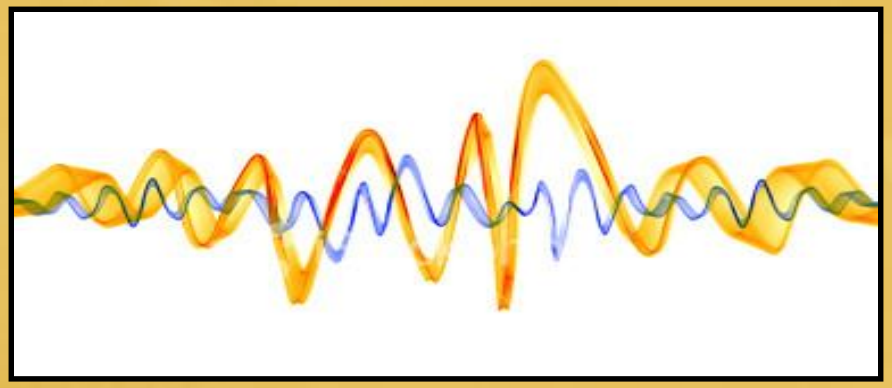
- Where molecules are being pressed together as the sound waves move through matter
- For example,
  - a wave travels through the springs just like sound waves travel through the air
  - the places where the springs are close together are like compressions in the air.



Sound Waves

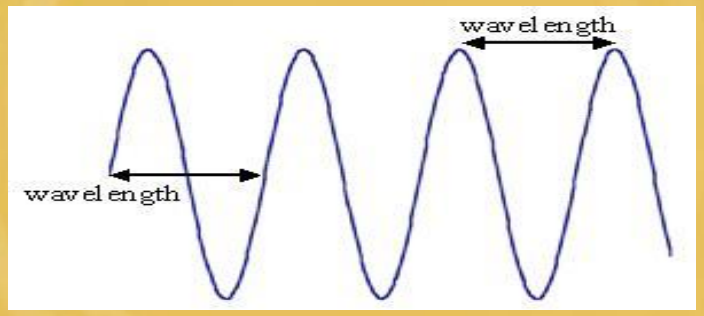


- Alternating areas of high & low pressure in the air
- ALL sound is carried through matter as sound waves
- Sound waves move out in ALL directions from a vibrating object

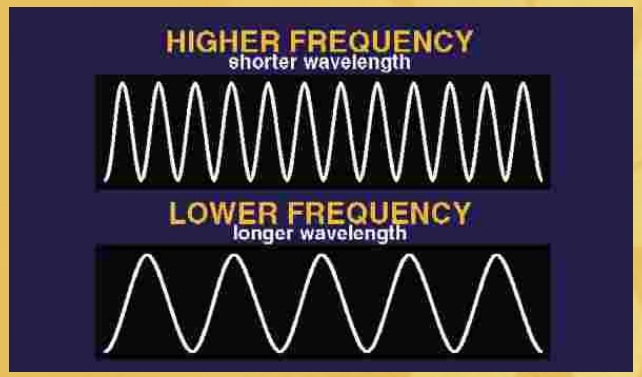


Wavelength & Frequency

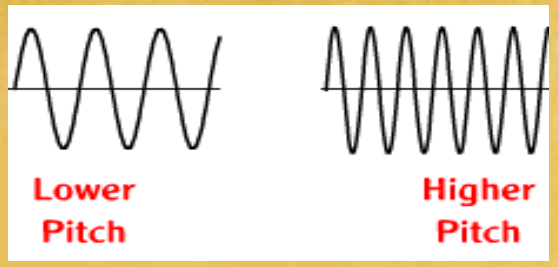
- Wavelength is the distance between one part of a wave and the same part of the next wave



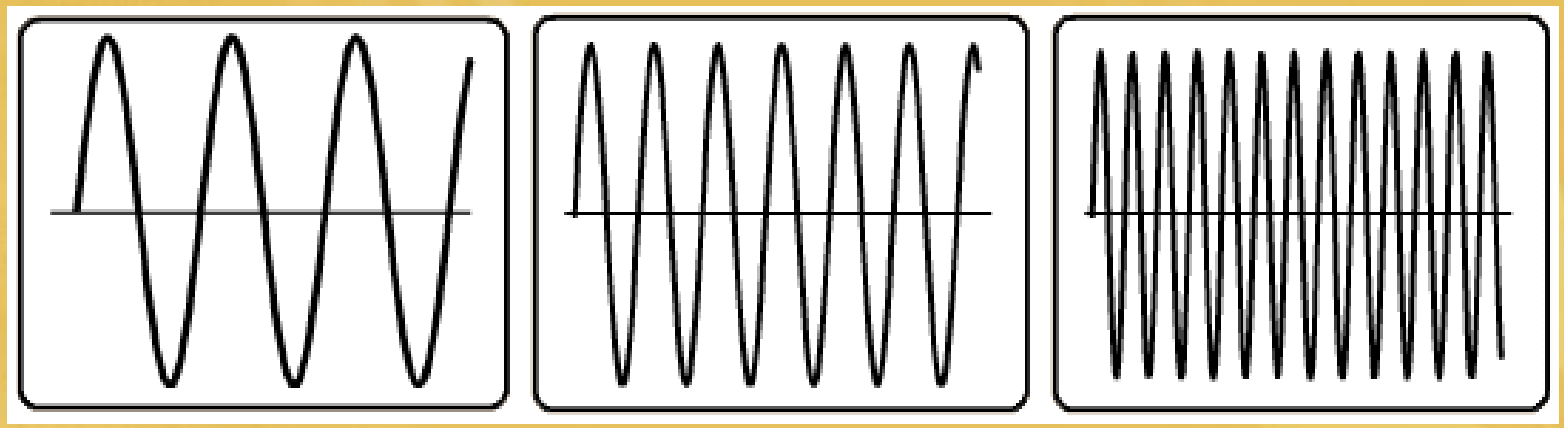
- Frequency is the number of waves moving past a point in one second



Pitch



- A measure of how high or low a sound is
- Pitch depends on the frequency of a sound wave
- For example,



- Low pitch

- Low frequency

- Longer wavelength

- High pitch

- High frequency

- Shorter wavelength

Frequency and pitch

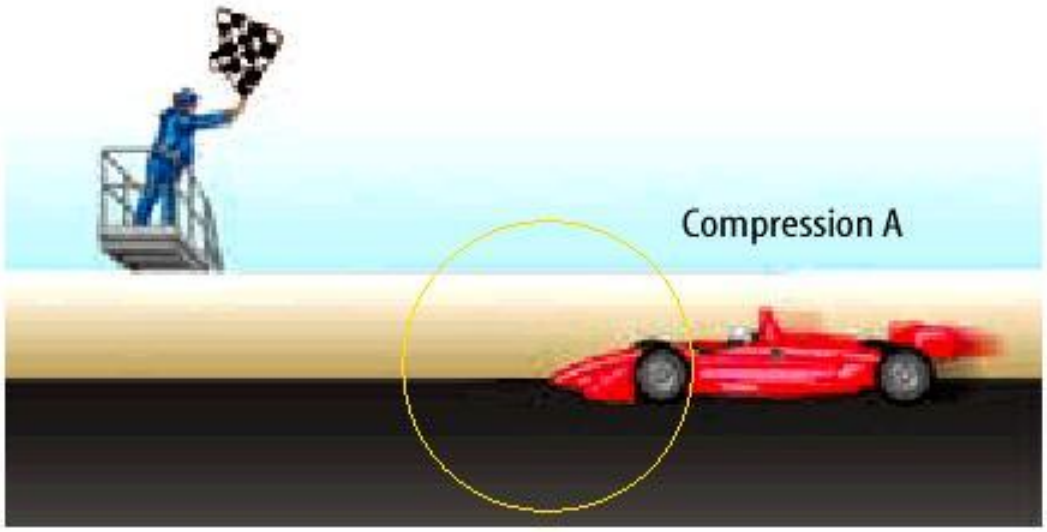
- . 1) High frequency means more vibrations hitting the ear.
- 2) Pitch is how high or how low a sound seems to be.
- 3) Healthy humans can hear from 20 Hz to 20,000 Hz
- 4) We are most sensitive from 440 Hz to 7,000 Hz.

- Ultrasonic sound has a frequency greater than 20,000 Hz.
- a) Dogs (up to 35,000 Hz)
- b) Bats (over 100,000 Hz)
- c) Medical diagnosis
- 6) Infrasonic sound has a frequency below 20 Hz; they are felt rather than heard
- (earthquakes, heavy machinery).

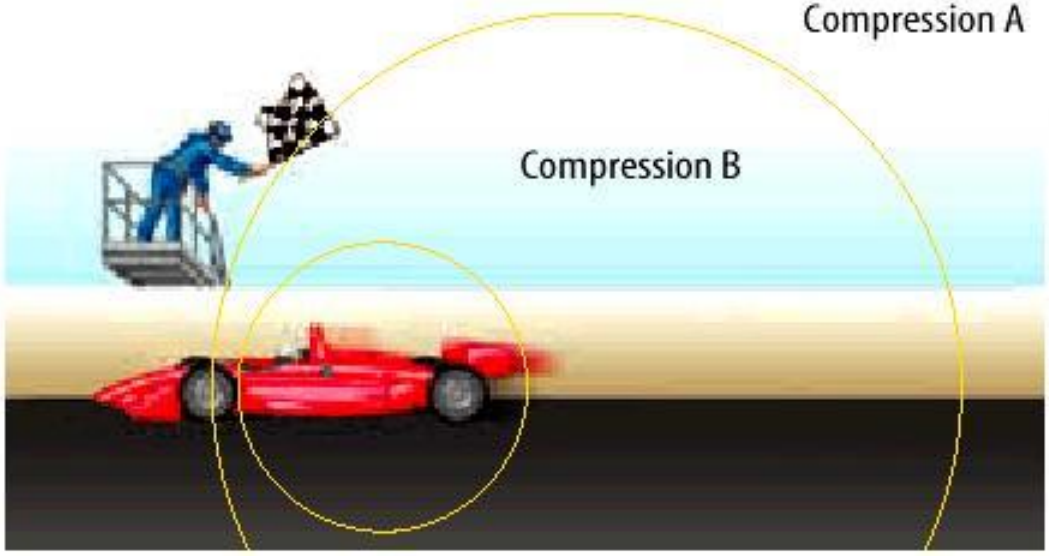
The Doppler Effect

- the change in pitch due to a moving wave source.
- 1) Objects moving toward you cause a higher pitched sound.
- 2) Objects moving away cause sound of lower pitch.
- 3) Used in radar by police and meteorologists and in astronomy.

The Doppler effect occurs when the source of a sound wave is moving relative to a listener.



A The race car creates compression A.



B The car is closer to the flagger when it creates compression B. Compressions A and B are closer together in front of the car, so the flagger hears a higher-pitched sound.

Musical Sound

- **a. Noise has no pattern.**
- **b. Music has a pattern and deliberate pitches.**
- **c. Sound quality describes differences of sounds that have the same pitch and loudness.**
- **d. Every instrument has its own set of overtones.**

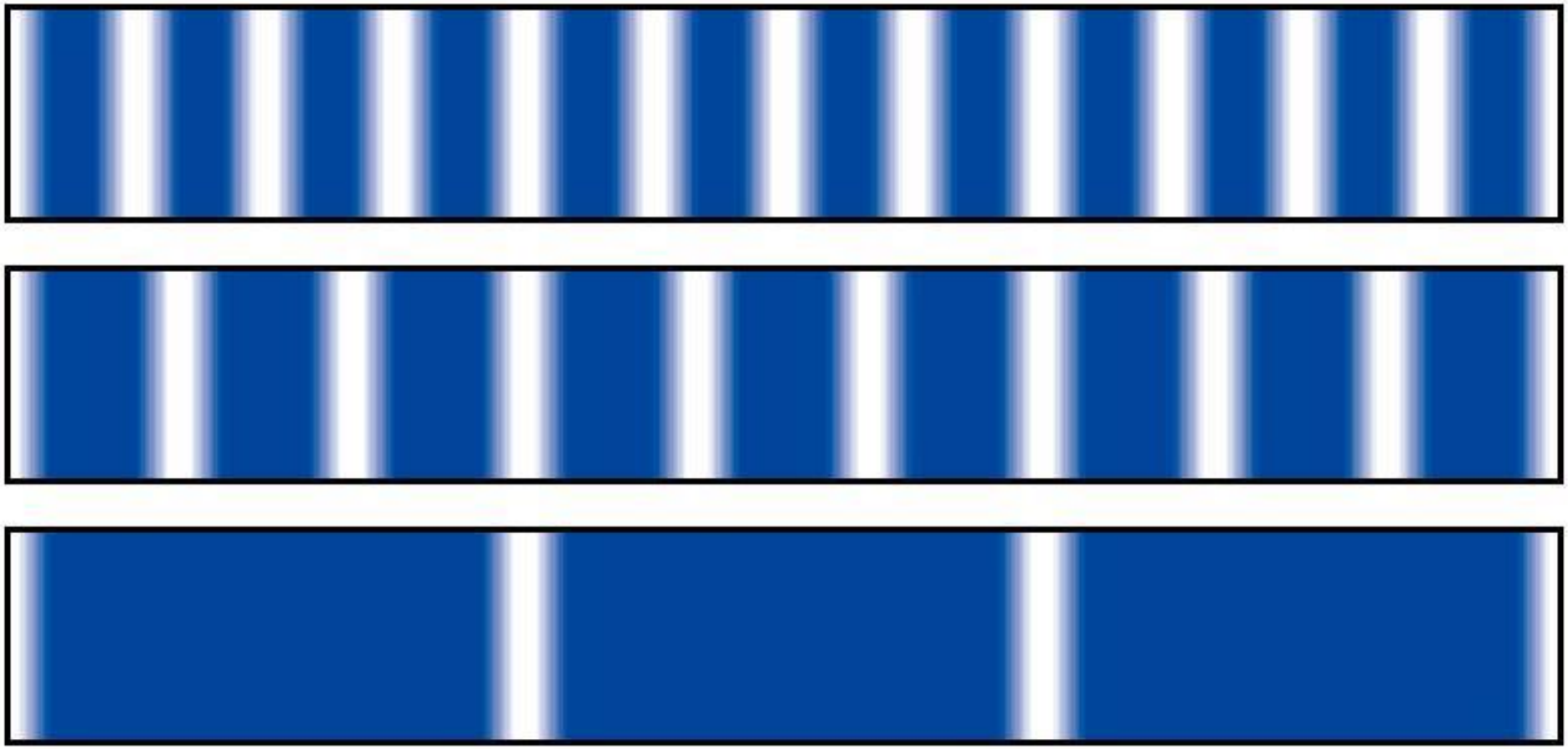
Sound and Instruments

- Instruments can be played at different pitches by changing lengths of different parts.

- For example,
- Another way to make different pitches is to change the thickness of the material that vibrates.
- For example,

A trombone's mute absorbs some of the sound waves produced, thus producing a softer note when played.

e) Beats are pulsing variations of loudness caused by interference of sounds of slightly different frequencies.



Uses of sound

a. Acoustics – the study of sound.

Soft materials dampen sound; hard materials reflect it (echoes and reverberations).

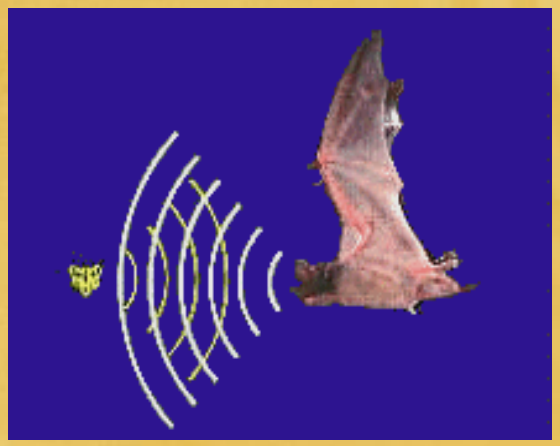
b. SONAR – Sound Navigation and Ranging (echolocation).

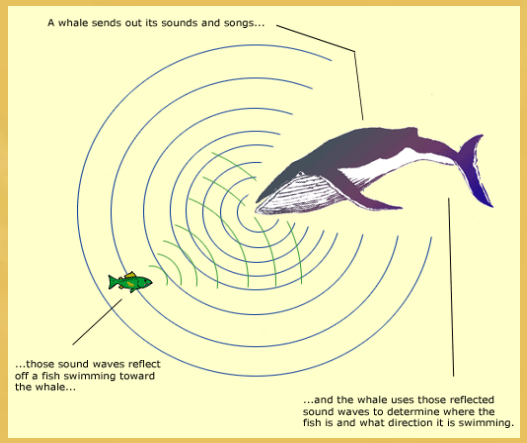
c. Ultrasound imaging

d. Kidney stones & gallstones.

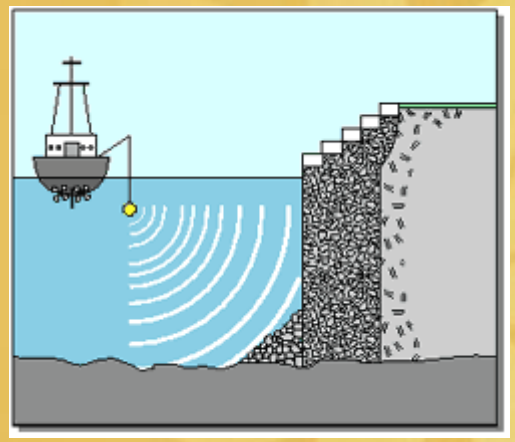
Sonar

- An instrument that uses reflected sound waves to find underwater objects
- For example,





Humans use sonar to locate or map objects



Animals use sonar or echo location to find their prey; these sounds have such a high pitch or frequency that the human ear cannot hear