

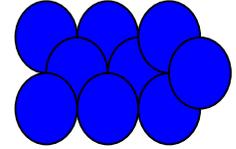
Light & Sound



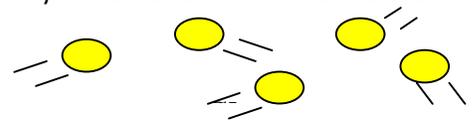
Sound: A form of energy created by **vibrations of matter**.

Matter is anything that has mass and takes up space (that pretty much covers everything you can see or feel here on Earth!). **Vibrations** are the rapid back and forth movements of objects.

- **Sound must have matter (medium) through which to travel.**
- Sound travels **fastest** through **solids** because their molecules are tightly packed together (very dense).



- Sound travels **slowest** through **gasses** (like those in the air) because their molecules are moving around very far apart.



Sound Waves: Sound waves are **compression (longitudinal) waves**. As a sound wave travels through matter, the molecules move forward or backward in the way the wave is traveling. It transfers energy from one object to the next. Parts of the wave are pushed together (**compression**) and some parts are spread out (**rarefaction**).

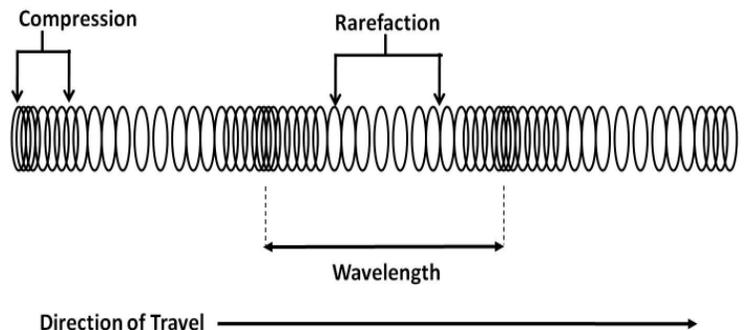
Ex) When you talk, the energy begins with your vocal cords. The vibrations then move to the air around you and continue to travel until they reach someone's ear. Parts of the ear carry the vibrations until it triggers a signal that travels to the brain.

Frequency: The number of wavelengths in a certain amount of time.

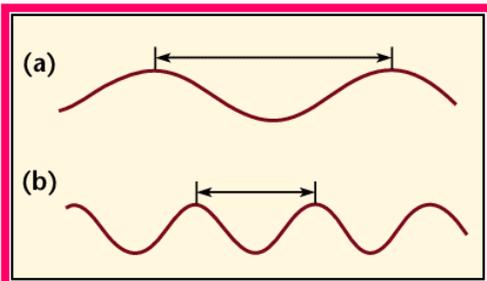
Pitch: The highness or lowness of sound.

- **High Frequency = High Pitch**- this means the more vibrations, the higher the pitch.
- **Low Frequency = Low Pitch**

Compression (Longitudinal) Wave



Wavelength: The distance from one compression to the next, between two rarefactions. A complete wave has both a peak (top, crest) and a trough (low point). The wavelength determines the frequency and pitch.

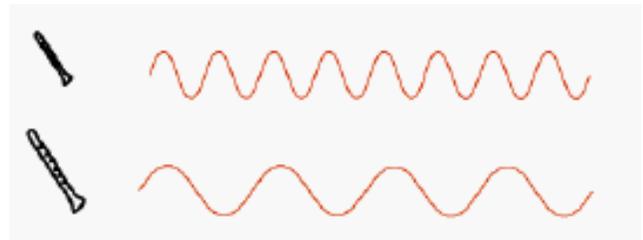


- **Long Wavelength = Low Frequency = Low Pitch**
- **Short wavelength = High Frequency = High Pitch**

Amplitude: The amount of energy in a compression wave. It is related to intensity and volume.

- **High Amplitude:** A loud sound is vibrated with more force
- **Low Amplitude:** A soft sound is vibrated with less force

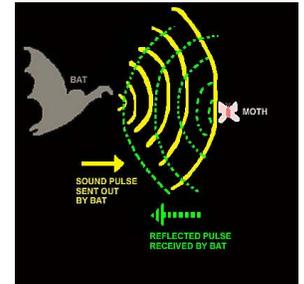
Instruments can have different frequencies and pitches depending on how they are made or how they are played. The small flute has a high pitch because the column of air inside vibrates more quickly than in the long flute.



Ultrasonic Sound Waves: Sound waves with a frequency **too high** for humans to hear.

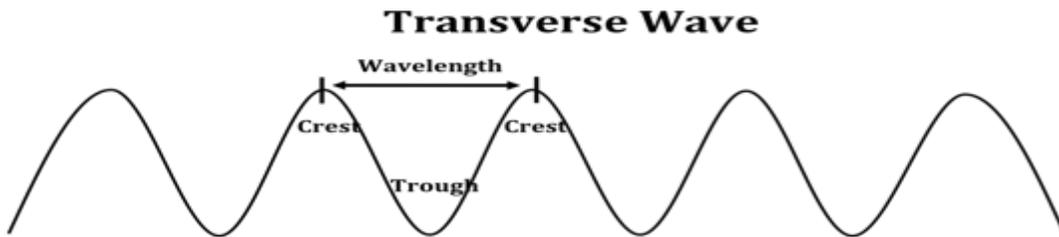


Echolocation: A way that some animals use reflected ultrasonic sound waves to **locate prey** or **communicate**. Bats and dolphins are two animals that use echolocation.

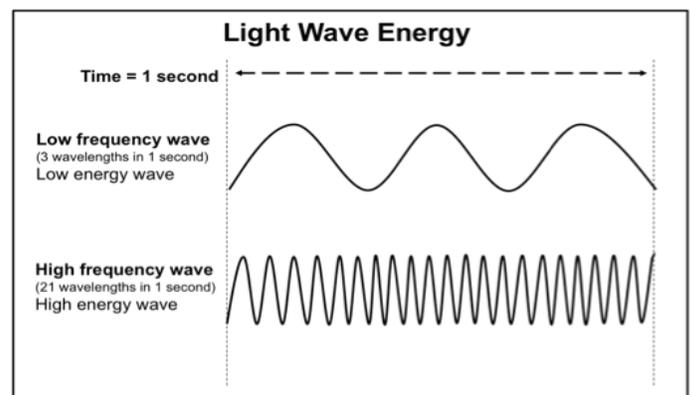


SONAR: A way that ships and submarines use reflected ultrasonic sound waves to **locate objects** or **find the depth of the ocean**. Sound waves are sent out from the ship. The sound waves bounce off the object or ocean floor and reflect back up to the ship's receiver. The time it takes to return helps determine depth or the object's location.

Light: Made of small particles called photons. A form of energy that travels in **straight lines (rays)** in the form of **transverse waves**. It travels much **faster than sound**. This is why you **SEE Lightning before you hear thunder**. Light does **NOT** need to travel through matter (it travels through the vacuum of space). A **light beam** is a group of parallel rays.



- **Light** is characterized by **wavelength** and **frequency**
- **High frequency** = **high energy**
- **Low frequency** = **low energy**



Light can be **reflected**, **refracted** or **transmitted** by objects.

- **Transparent:** Materials that transmit **all** or almost all light- glass, clean water, air
- **Translucent:** Materials that transmit **some light**, but the light is scattered to make a blurry image- plastic, tissue paper
- **Opaque:** Objects that **do not transmit light** (create shadows) - wood, metal, bricks

Reflected: When light is **bounced** back. A mirror or aluminum foil will reflect light. **Light is always reflected back at the same angle it hit the mirror** (Law of Reflection).

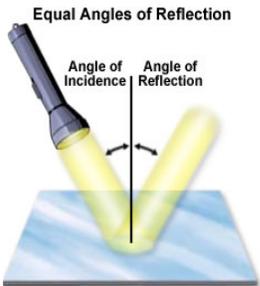
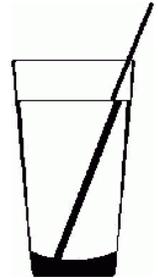


Figure 2

Refracted: When light is **bent** as it passes from one substance to another. Light will be refracted when it travels from air (less dense) to water (more dense). **The greater density causes the light waves to bend.**

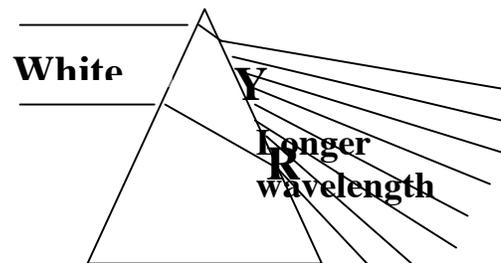
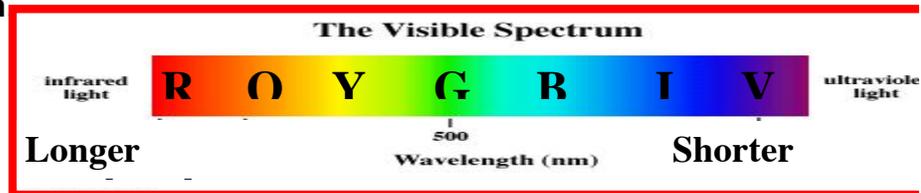
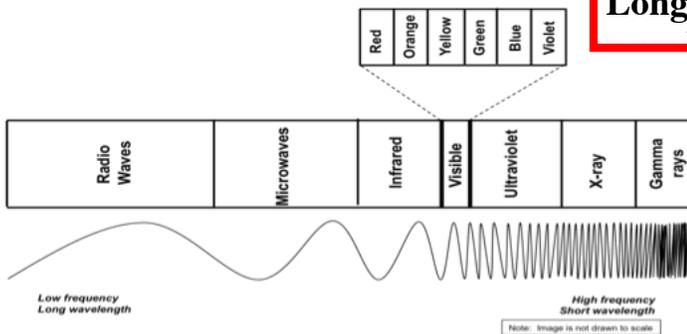


Transmitted: When light passes through an object

Visible Light Spectrum: The part of the Electromagnetic Spectrum that humans can see. Light is known as **white light**, but **white light actually contains all of the colors of the rainbow**. These colors always appear in the same order because each color bends depending on its wavelength: Red, orange, yellow, green, blue, indigo, and violet. **Each color travels at a different wavelength**

- Red = longest
- Violet = shortest

Electromagnetic Spectrum



Prism: A triangular piece of glass that **refracts** light. It **separates white light into the colors of the rainbow**.

Each light wave bends a different amount (as you can see in the picture).

- **Red** = bends **least (least energy)**; **Violet** = bends the **most (most energy)**
- **Black and white not spectral colors.** **Black** is when a material absorbs all visible light and no light is reflected back
- **White** is a reflection of all visible light together

