# Grade 8 Science
# Unit 2: Optics

**Chapter 4**: Many properties of light can be understood using a wave model of light.


Lasers

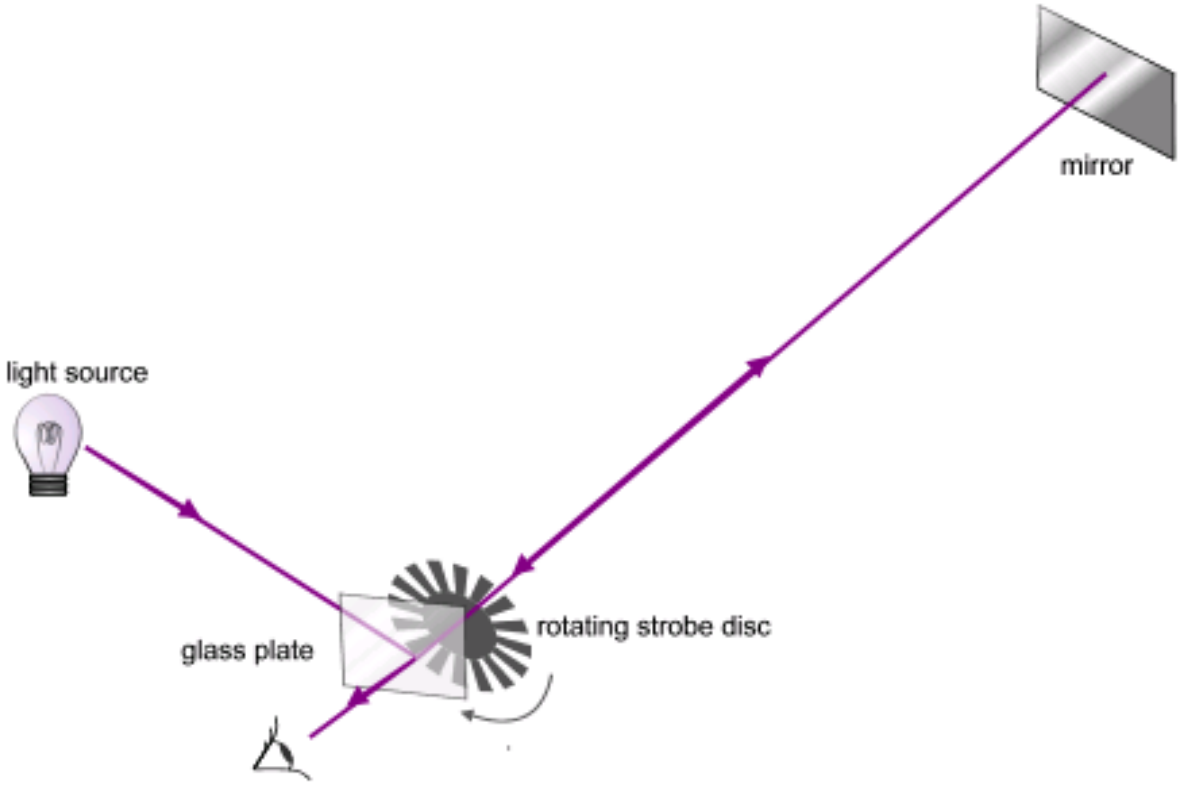
# The History of Light

Pythagoras

- A Greek philosopher
- Believed that beams of light were made of tiny particles.
- The eyes detected these particles and could see the object.

# Albert Michelson

- First person to measure the speed of light ($3 \times 10^8$ m/s)



# Speed: Light vs. Sound

Light

- 1 000 000 000 km/h

Sound

- 1 200 km/h

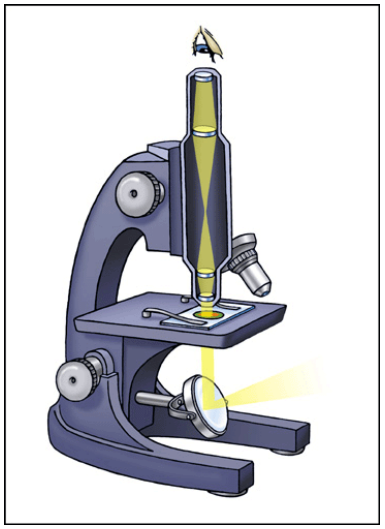
# Thunder & Lightning

- Both the lightning strike and the roar of thunder happen at the same time.
- You see the lightning first.
- If you multiply the time in seconds between the strike and the roar by the speed of sound, you will find the approximate distance.

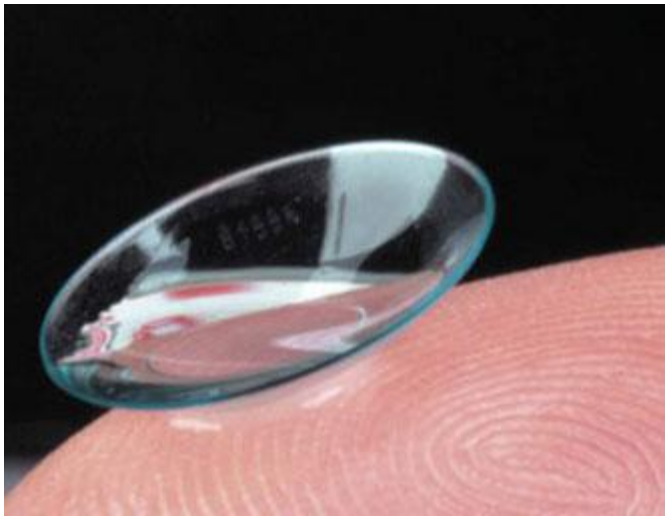
# Orion's Belt

# Light Technologies Include...

- Microscope
- Telescope
- Periscope
- Binoculars
- Fibre optics
- Camera



- Prescription contact lenses
- Laser
- Movie projectors
- Overhead projectors



# Light

Light: a form of energy that can be detected by the human eye.

Visible light: a mixture of all the colors of the rainbow.

# Rainbow

# Properties of Visible Light...

1. Light travels in a straight line. (*rectilinear propagation*)

# 2. Light reflects (reflection)

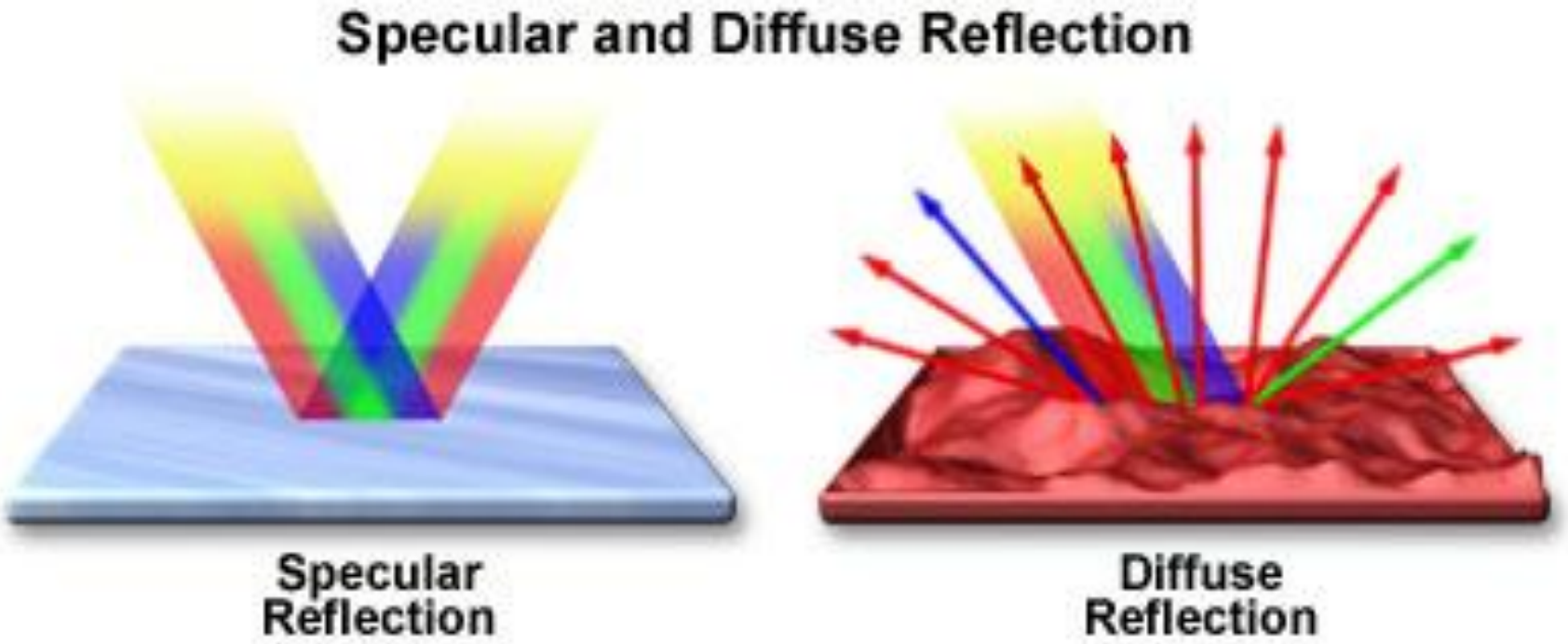



Figure 3

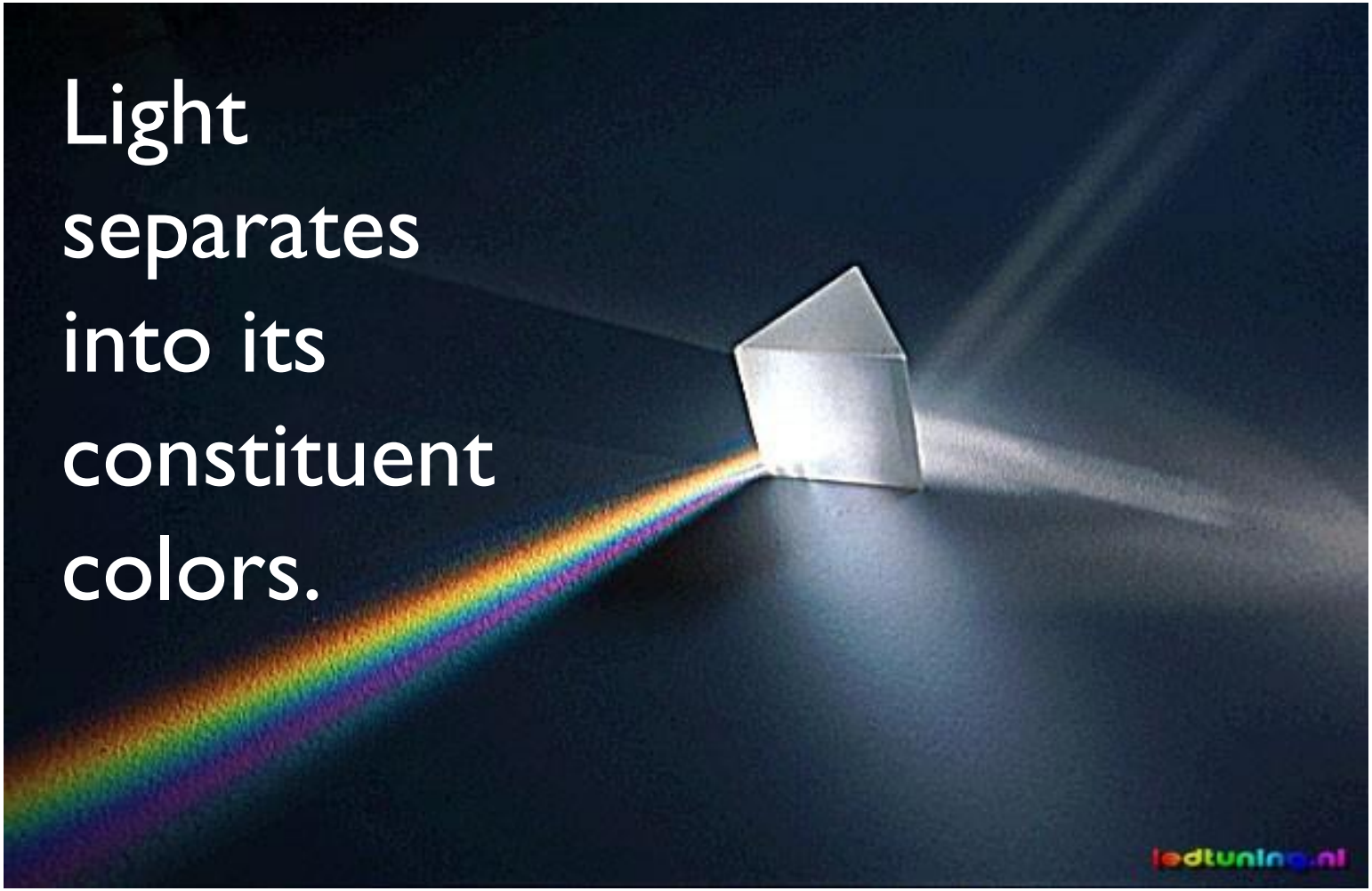
Mirror

Dust

# 3. Light refracts (Refraction)

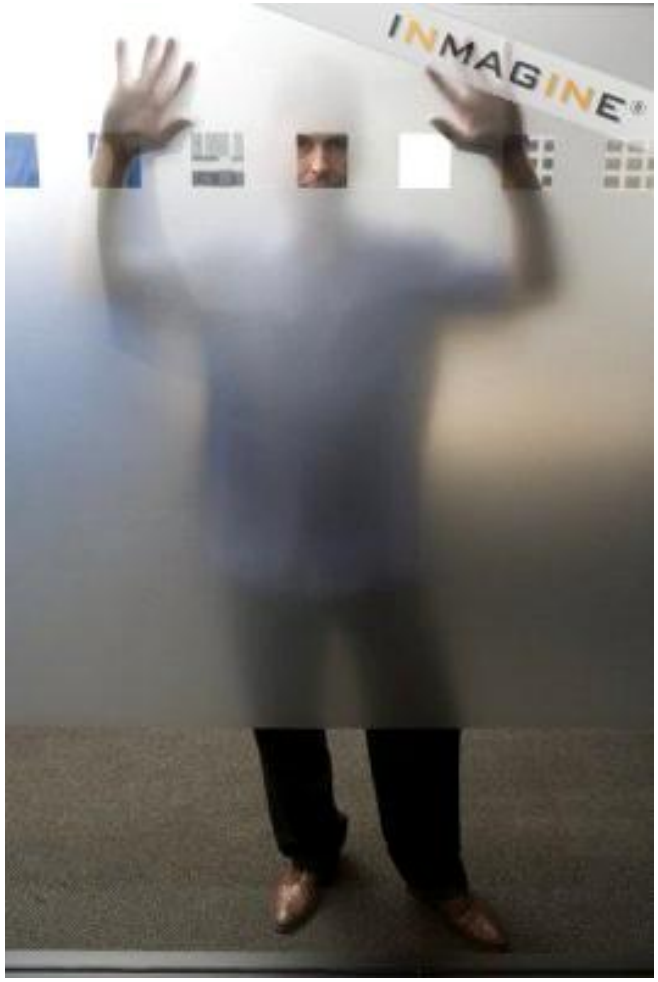
"The Bent Stick Effect"

# 4. Light Disperses (dispersion)



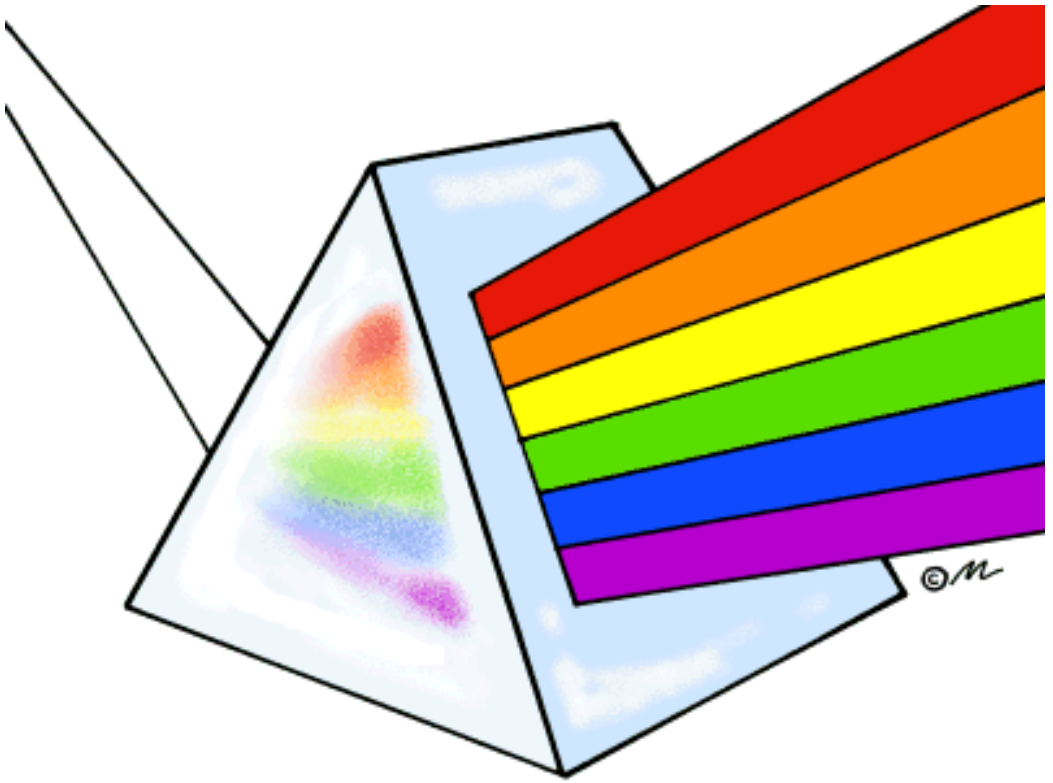
5. Light travels through a vacuum (does not require a medium; no particles involved)

# 6. Travels through objects to different degrees



# Visible Light Spectrum

Can be seen due to the dispersion of light through a prism.



The constituent colors of white light are:

Red

Orange

Yellow

Green

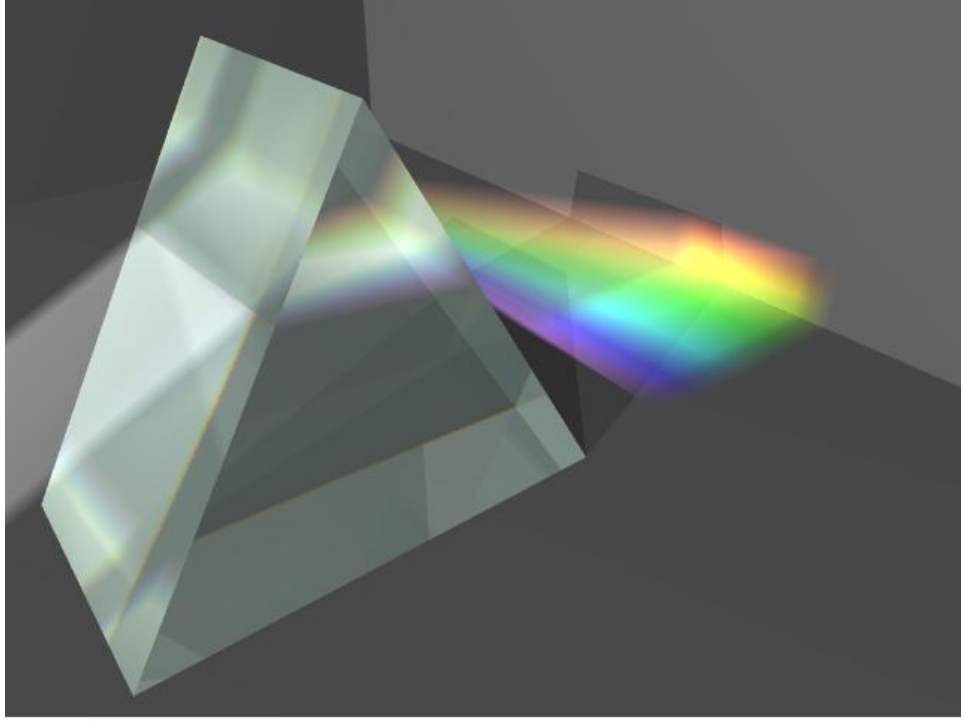
Blue

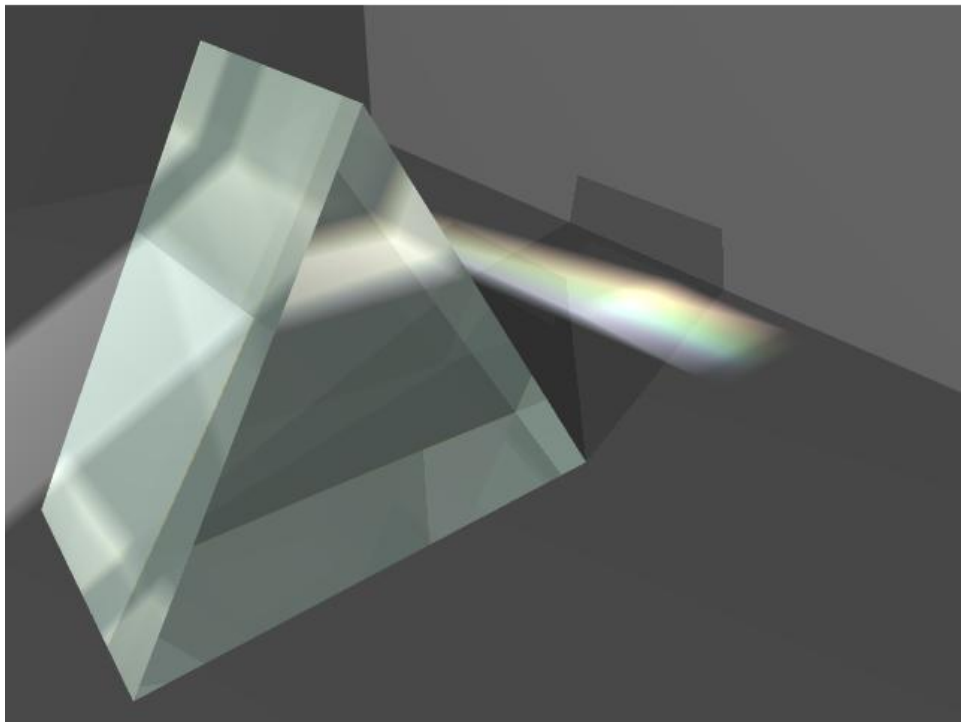
Indigo

Violet

ROY G BIV

**Red has the smallest refraction and violet has the greatest.



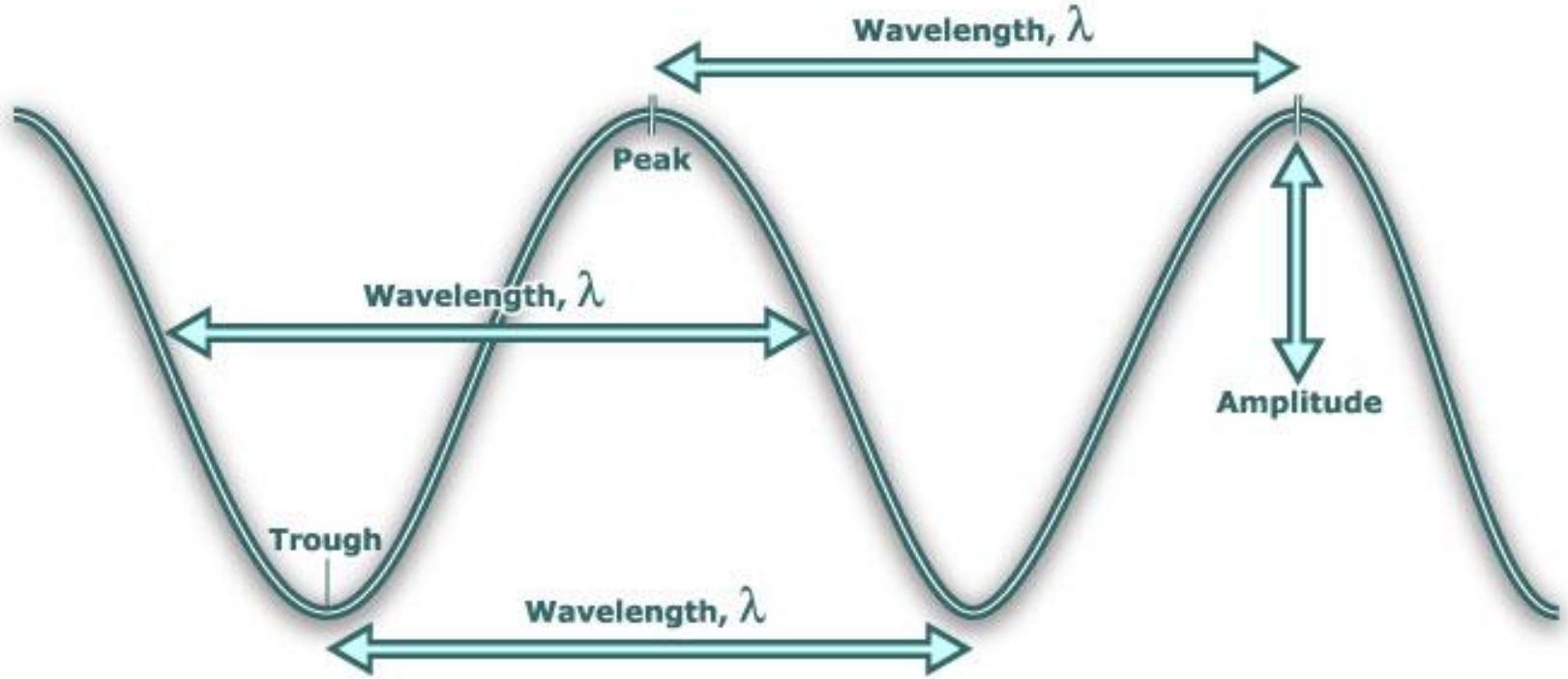


When a laser is shone through a prism, the light will refract but NOT disperse. Why? *A laser light is one color only!*

# The Wave Model

Explains that light is a type of wave that travels through empty space and transfers energy from one place to another

# A Wave…




* A Peak is also called the crest.

Frequency: the number of repetitive motions that occur during a given time.

Ex. The number of wavelengths that pass a point in 1 second.

- Measured in Hertz

Amplitude: the height of a wave crest or depth of a wave trough as measured from the rest position.

- crest height = trough depth
- The larger the amplitude, the greater the energy transported.

Wavelength: the distance from crest to crest, trough to trough or the distance covered by one complete crest and one complete trough.

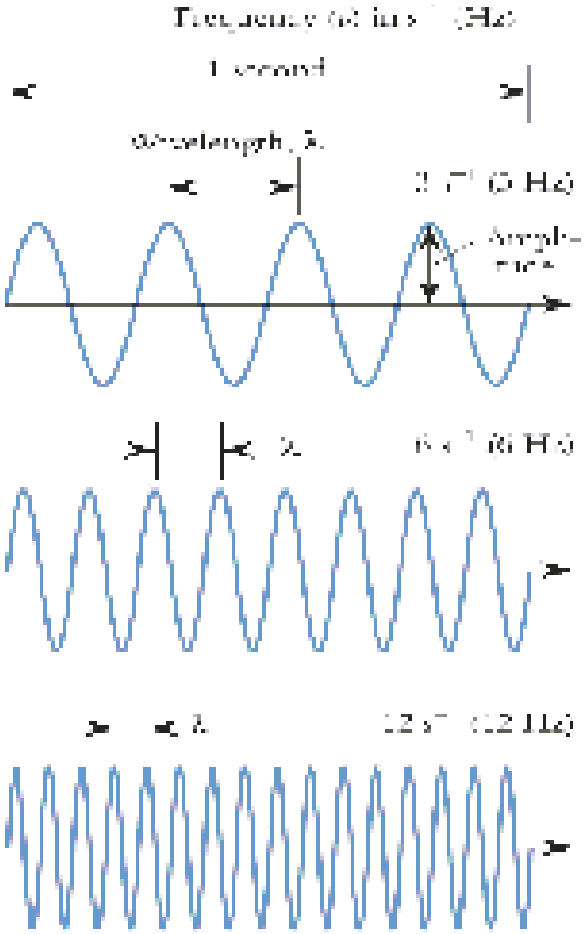
- Measured in meters
- Longer wavelengths refract the least.

# Frequency and Wavelength

- High frequency waves have short wavelengths
- Low frequency waves have long wavelengths

**Fig 6-2**

**Pg 241**



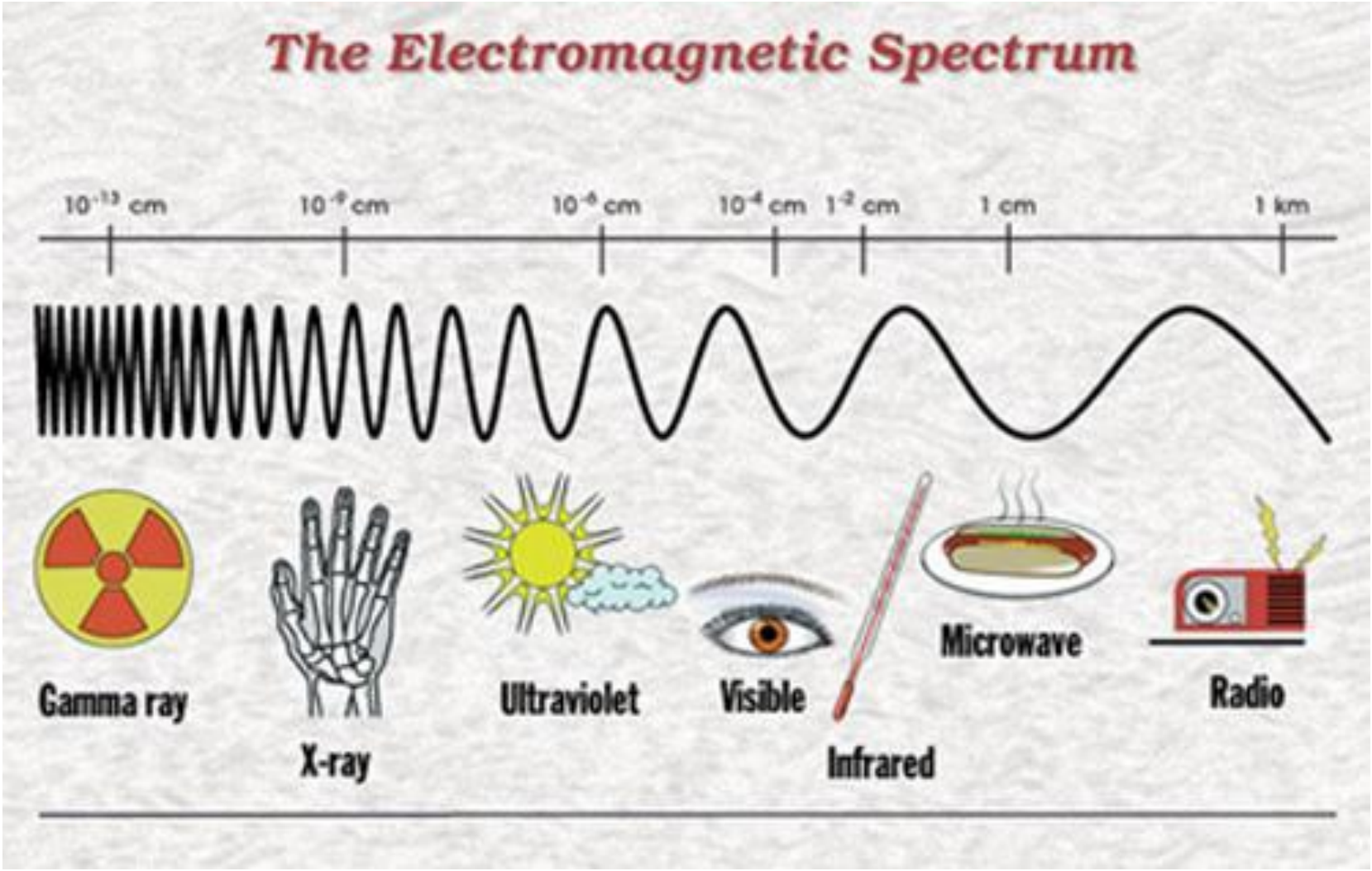
A light wave can be described by its wavelength and frequency. Notice that as the wavelength increases, the frequency of the light decreases.

# Wavelength - Frequency Relationship

# Electromagnetic Radiation

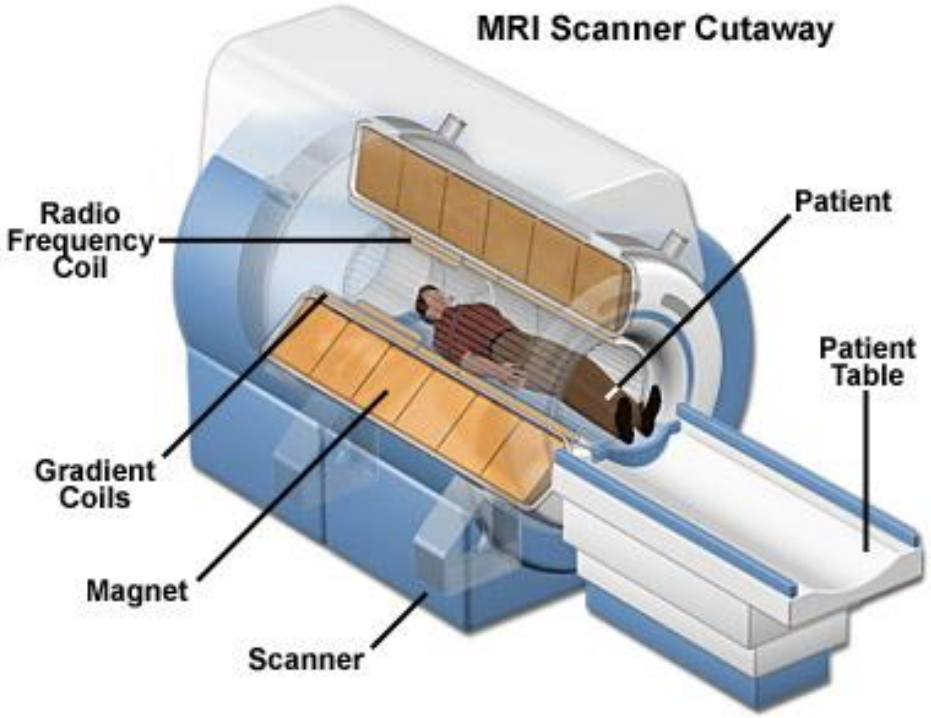
The transmission of energy in the form of waves that extend from the longest radio waves to the shortest gamma rays.

# Electromagnetic Radiation

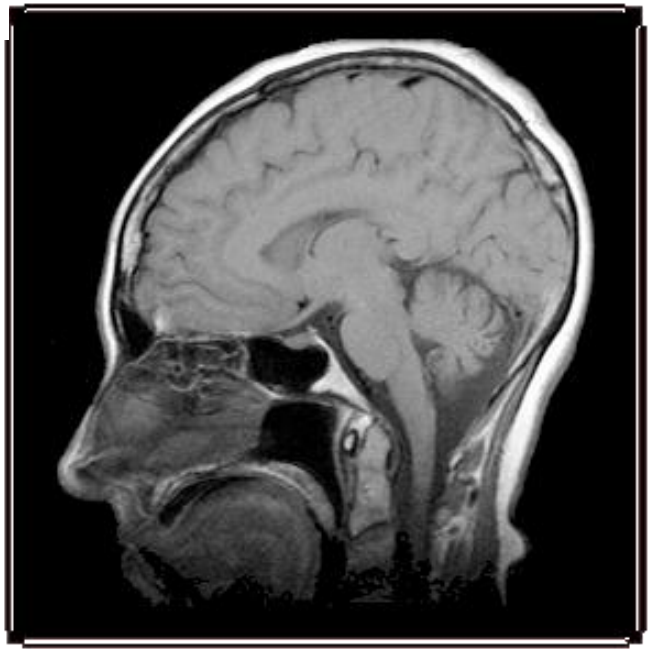


# Types of Electromagnetic Radiation

1. Radio waves: the longest wavelength and lowest energy and frequency.
   - Can be used to help us see the inside of our bodies to diagnose illness. Ex. MRI



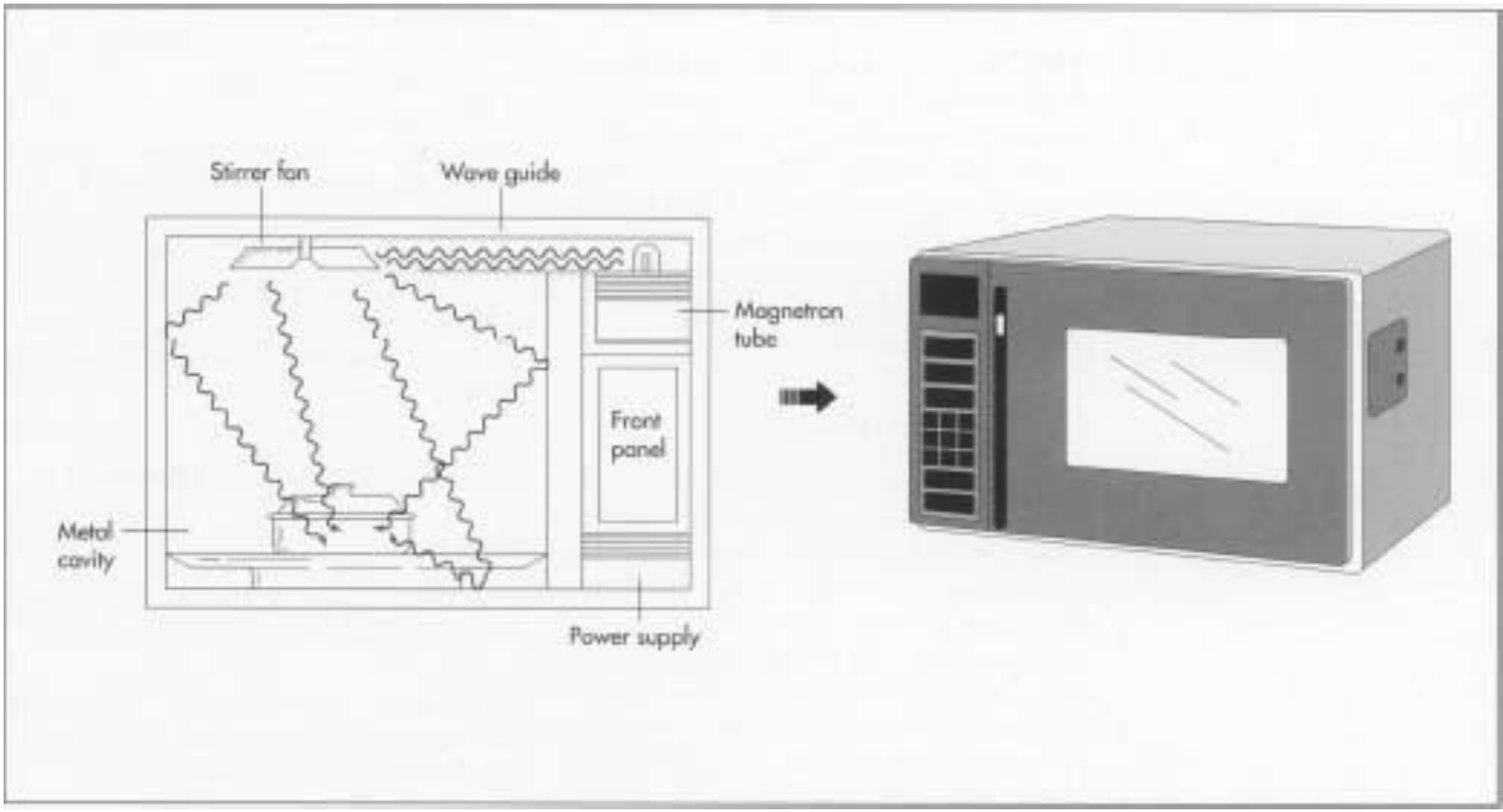

# Magnetic Resonance Imaging



2. Microwaves: have the shortest wavelength and the highest frequency of all radio waves.

- Ex. Microwave ovens, telecommunication satellites, radio telescopes, radar (remote sensing)

# How a Microwave Works

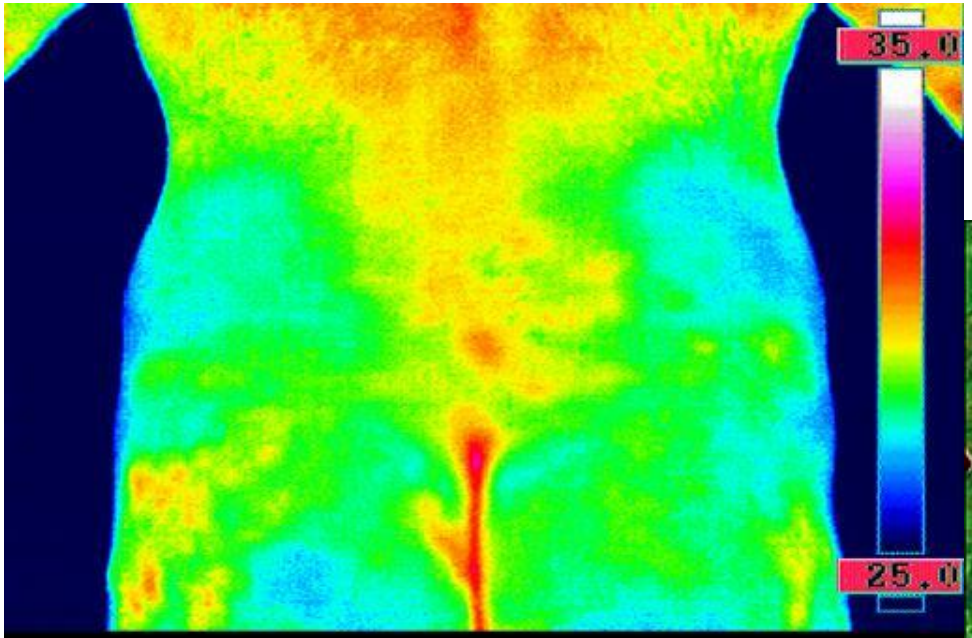


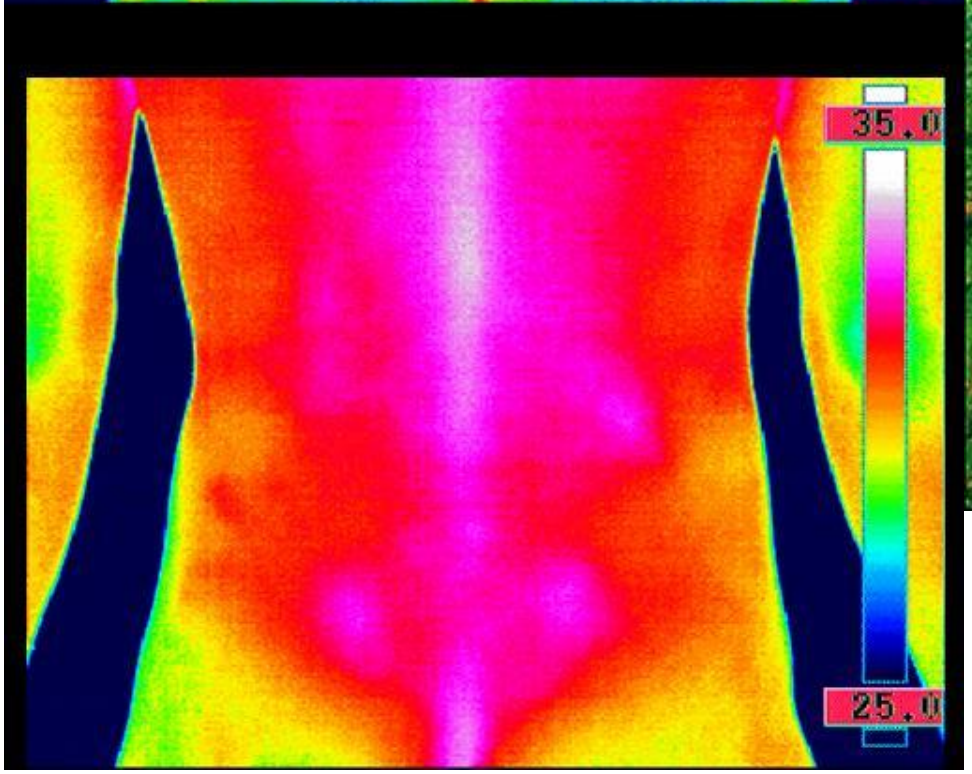

Microwave ovens use a specific frequency that is strongly absorbed by water molecules in food.

3. Infrared Waves: longer wavelength and lower energy and frequency.

- Infrared means below red
- Also called heat radiation
- Ex. Remote controls, computer, heat lamps, motion sensors

# Infrared Radiation

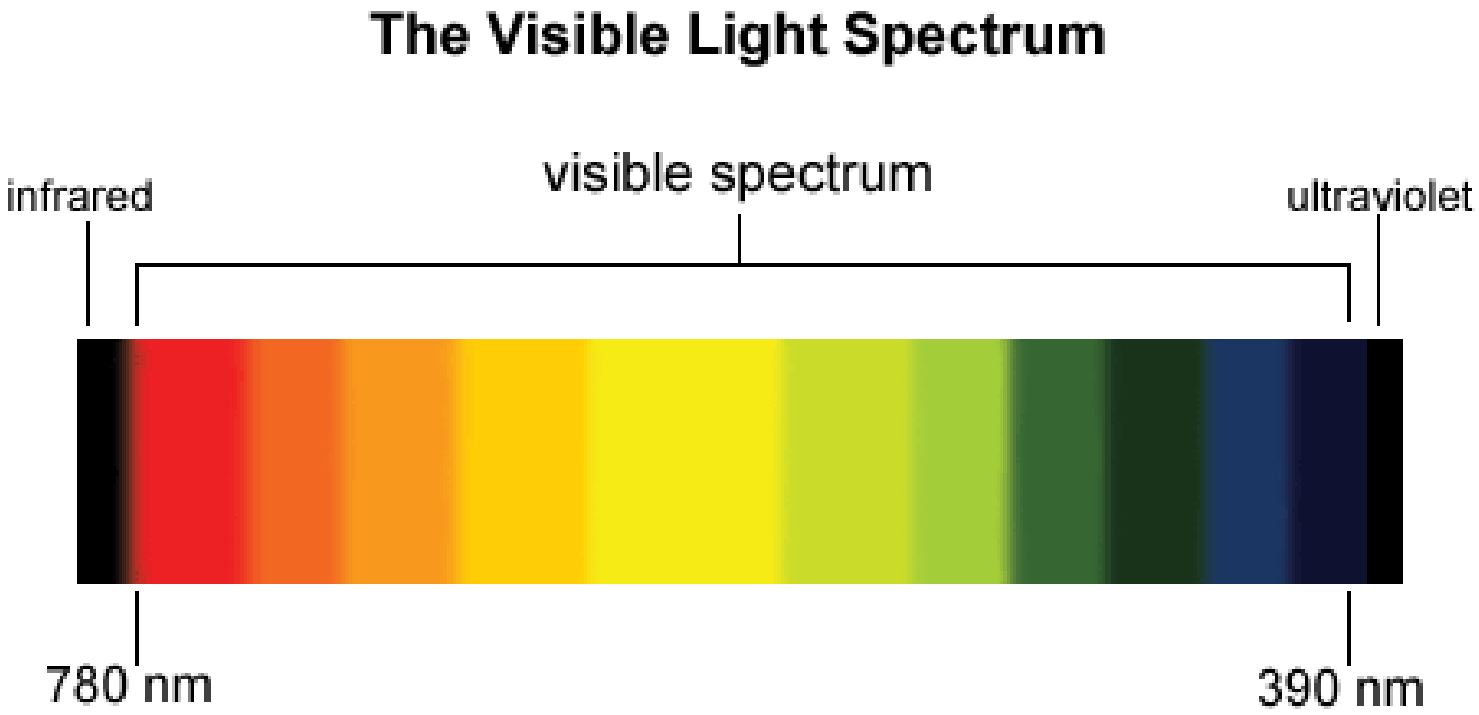



LANDSAT
Image of Fire

# 4. Visible Light Spectrum

- Can be continually detected by our eyes.



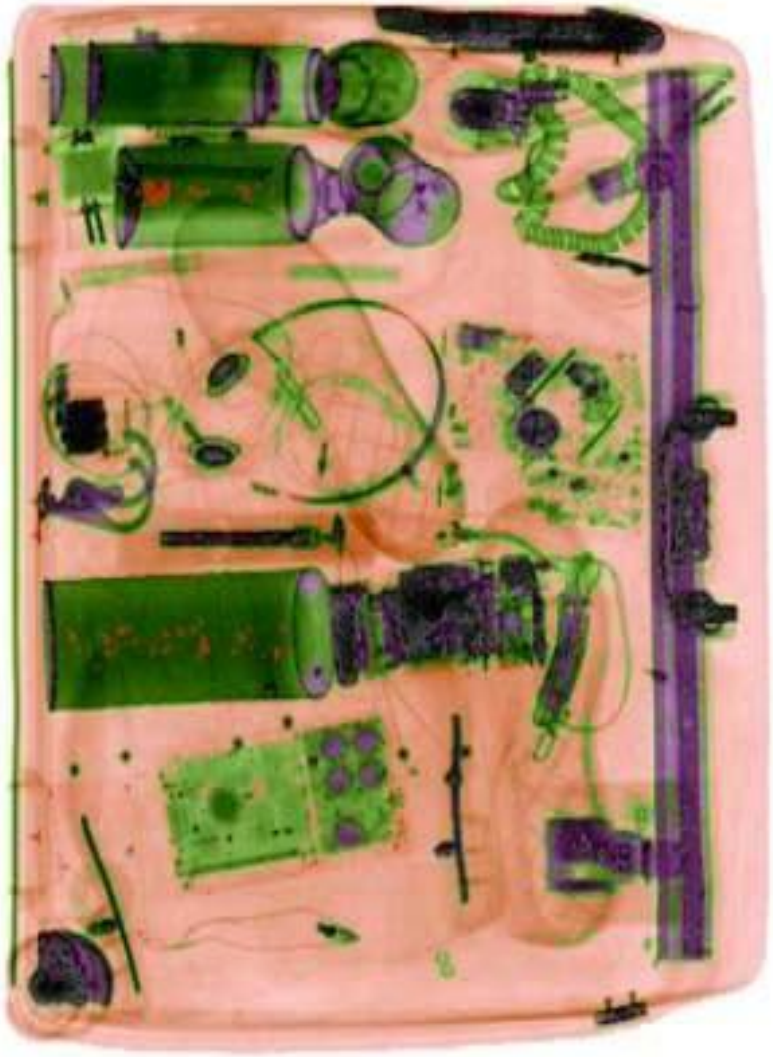
5. Ultraviolet Waves: shorter wavelength and higher energy and frequency.

- Very energetic
- Have the ability to kill bacteria in food and water and medical supplies.
- Ex. Sun, detect fingerprints


# Using Ultraviolet Radiation

6. X-Rays: have a shorter wavelength, and higher energy and frequency than UV.

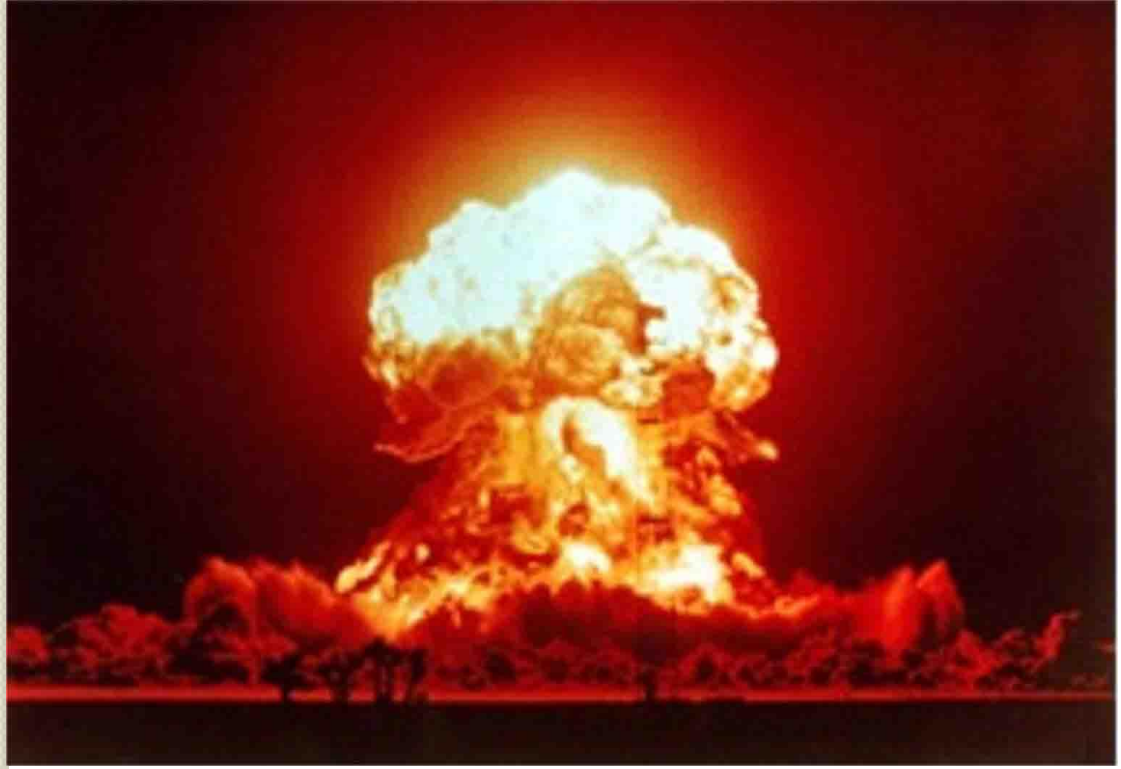
- Used to photograph teeth, bones and the inside of machines, security screening



# X-Ray Imaging

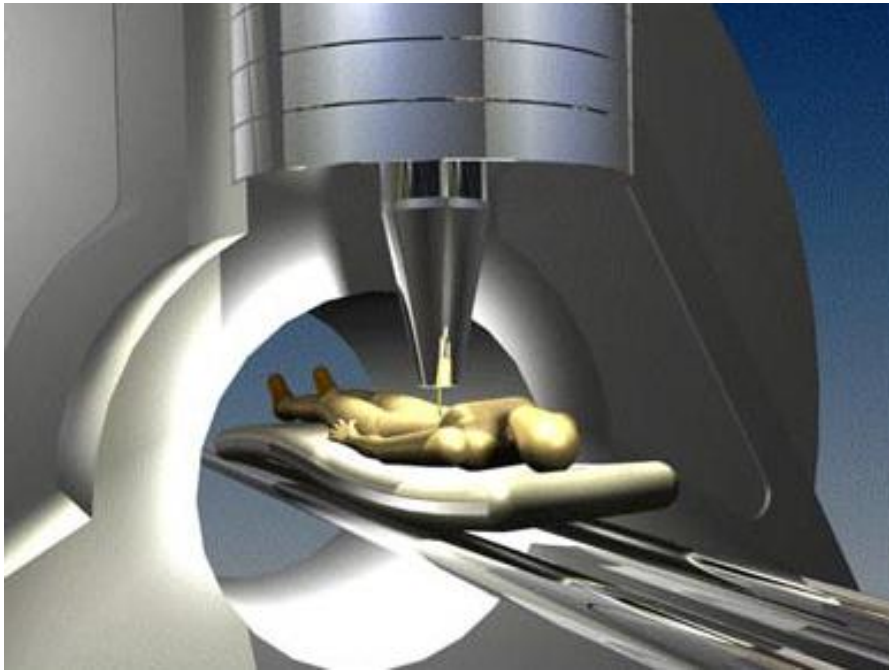
7. Gamma Rays: have the highest energy and frequency and the shortest wavelength.

- Result from nuclear reactions.
- Produced by the hottest regions of the universe.



Gamma Rays: Nuclear Explosion

Gamma Rays: Medical Treatment



# Electromagnetic Radiation…A Safety Concern?

Generally, higher energy electromagnetic radiation is more harmful to humans.

The Earth's atmosphere is able to protect us from some of the more dangerous electromagnetic radiation present in space, making the Earth a safe place for humans.

Changes to present conditions may comprise our safety.

# Positive and Negative Effects to Exposure to Electromagnetic Radiation

| | X-Rays | Ultraviolet | Radio Waves |
|---|---|---|---|
| Positive Effects | Medical detection | Used to treat jaundice in babies | Improved tele-communication |
| Negative Effects | Over-exposure can lead to cancer | Skin cancer | Uncertain of long-term exposure |