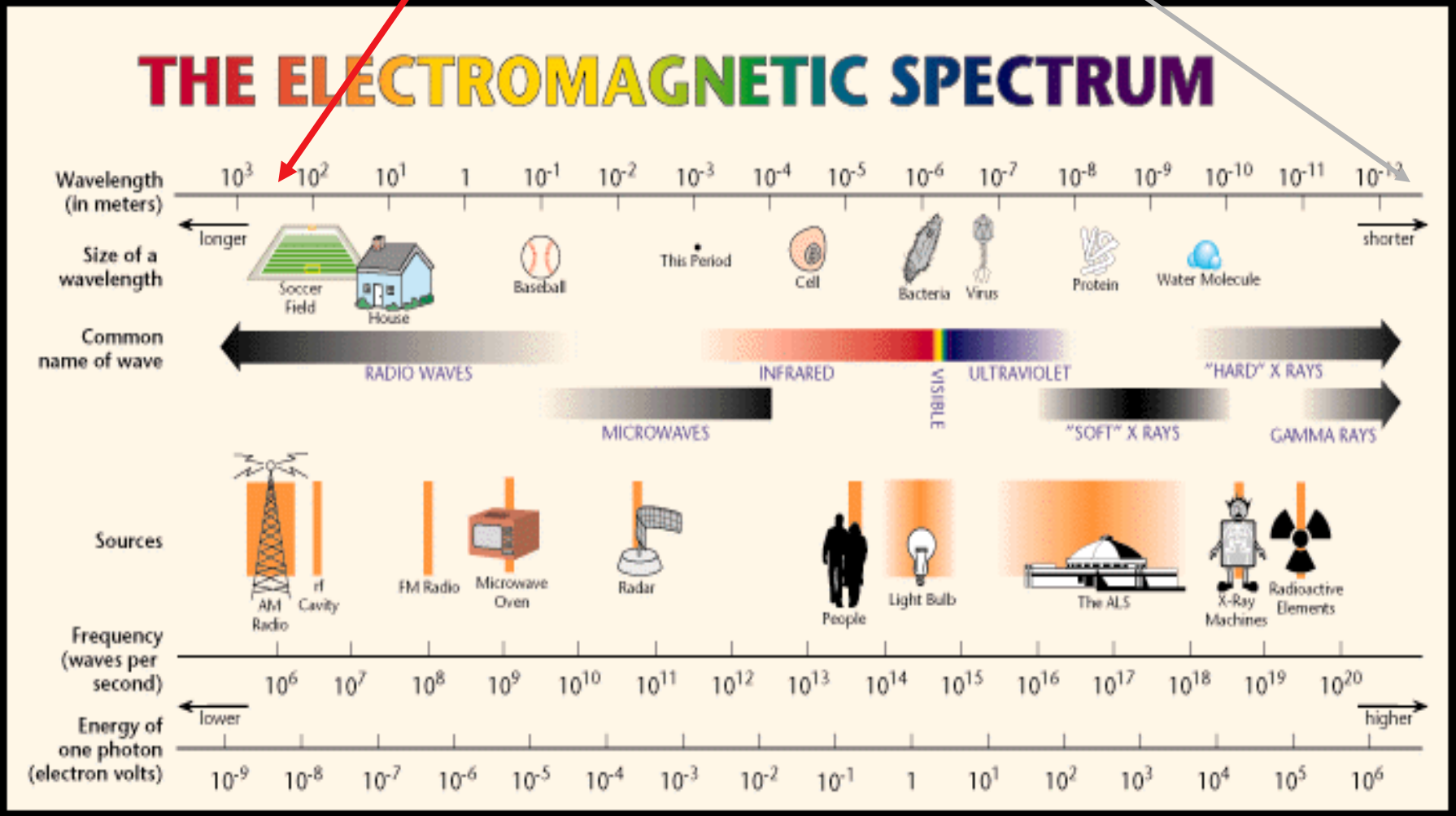
Electromagnetic Spectrum and Visible Light

Remember radio waves are long…
…and gamma rays are small



Radio-TV -Microwave- Infrared – VISIBLE -Ultraviolet -X-rays - Gamma- Cosmic

*Electromagnetic Radiation

Electromagnetic radiation can be described in terms of a stream of photons. Each photon is traveling in a wave-like pattern, moving at the speed of light and carrying some amount of energy.

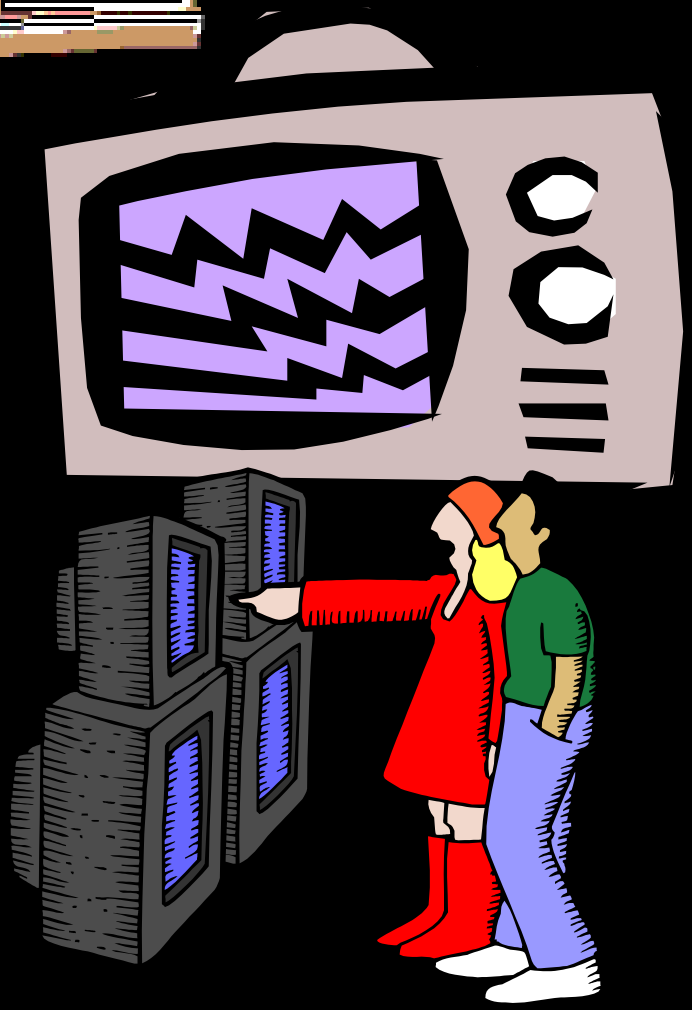
The only difference amongst radio waves, visible light, and gamma-rays is the amount of energy of the photons. Radio waves have photons with low energies. Microwaves have a little more energy than radio waves. Infrared has still more energy.

As we move down the chart we see visible, ultraviolet, X-rays, and gamma-rays whose photon energies gradually increase.

Gamma and Cosmic rays have the highest energy

*Slide info from NASA 2

Television



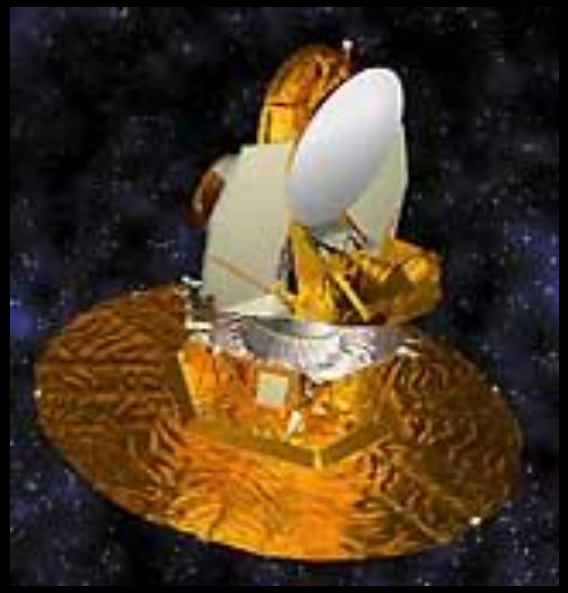
Shorter than radio, also used to carry messages (pictures & sound) to our TV sets.

*We can sense the TV waves around us with our televisions.

Microwave

Emitted by:

- Gas clouds collapsing into stars
- Microwave Ovens
- Radar Stations
- Cell Phones



Detected by

- Microwave Telescopes
- Food (heated)
- Cell phones
- Radar (systems)

Radio
(Longest electromagnetic waves)

Emitted by
- Astronomical Objects
- Radio Station Transmitters

Detected by
- Ground based radio telescopes
- *If you turn on a radio,, it will convert the radio wave energy into sound energy.

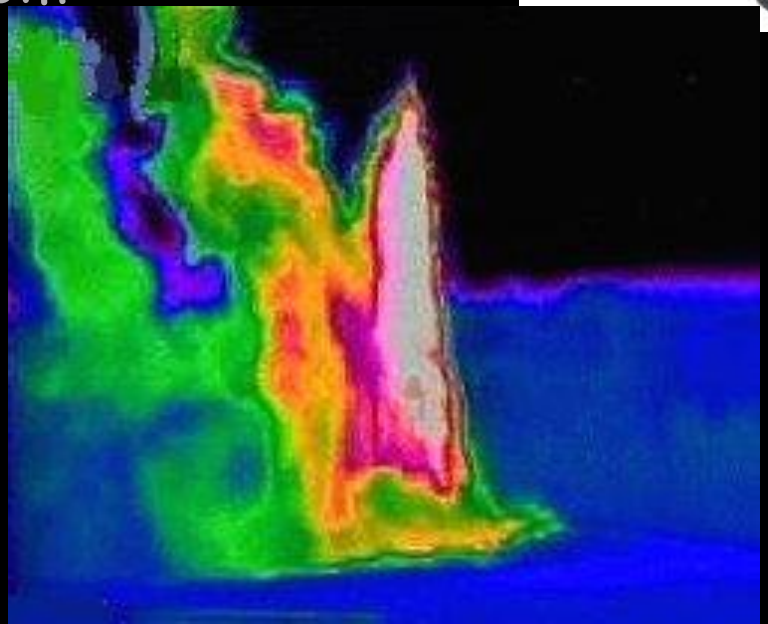
Infrared

(Heat or Thermal)

Are you a source of infrared? YES you are!

Emitted by

- Sun and stars (Near)
- TV Remote Controls
- Food Warming Lights (Thermal)
- *Everything at room temperature or above,=HEAT



Detected by

- Infrared Cameras
- TVs, VCRs,
- Your skin

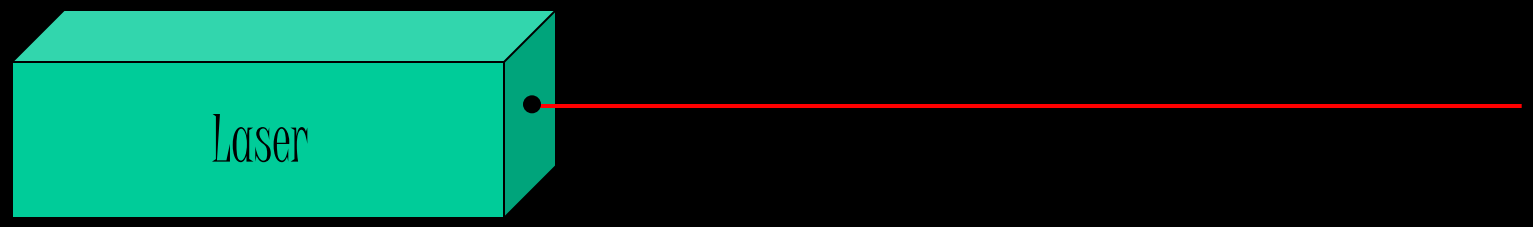
Light

In this unit:

1) *Properties of light*
2) *Reflection*
3) *Colors*
4) *Refraction*
5) *Electromagnetic Spectrum*

Part 1 – Properties of Light

Light travels in <u>straight</u> lines:

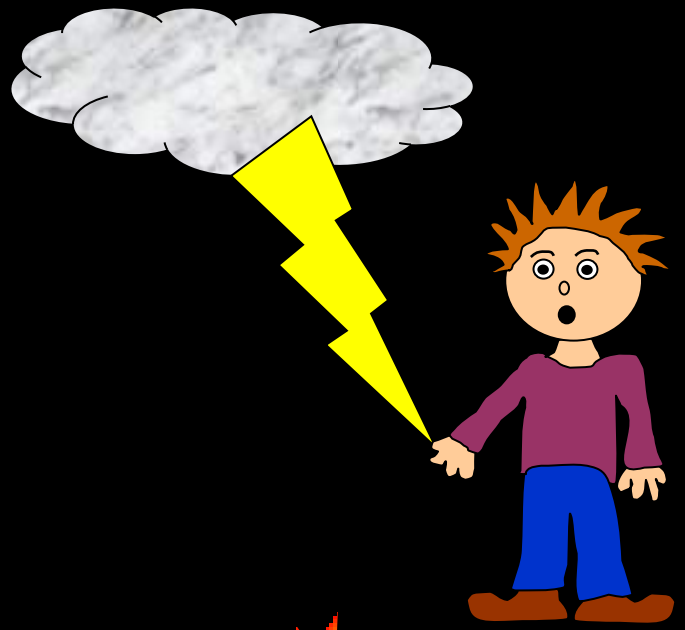


Light travels VERY FAST – around 300,000 kilometres per second or 186,000 miles per second.

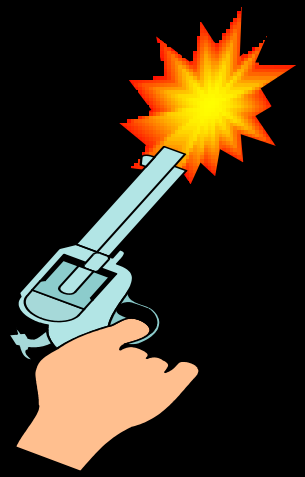
At this speed it can go around the world 8 times in one second.

Light travels <u>much faster</u> than sound. For example:

1) Thunder and lightning start at the same time, but we will see the lightning first.



2) When a starting pistol is fired we see the smoke first and then hear the bang.



Luminous and non-luminous objects

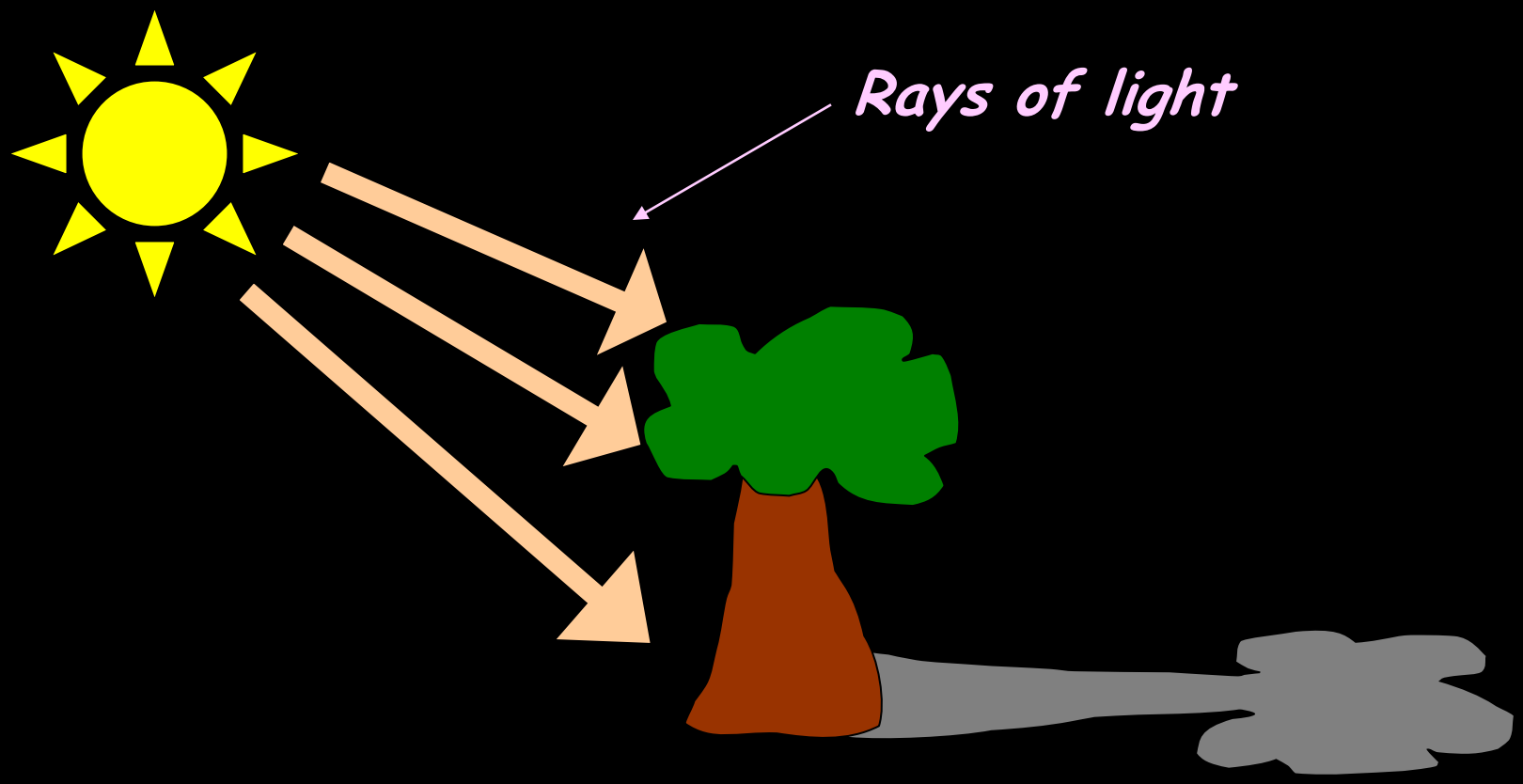
A <u>luminous</u> object is one that produces light.

A <u>non-luminous</u> object is one that reflects light.

Luminous objects	*Reflectors*

Shadows

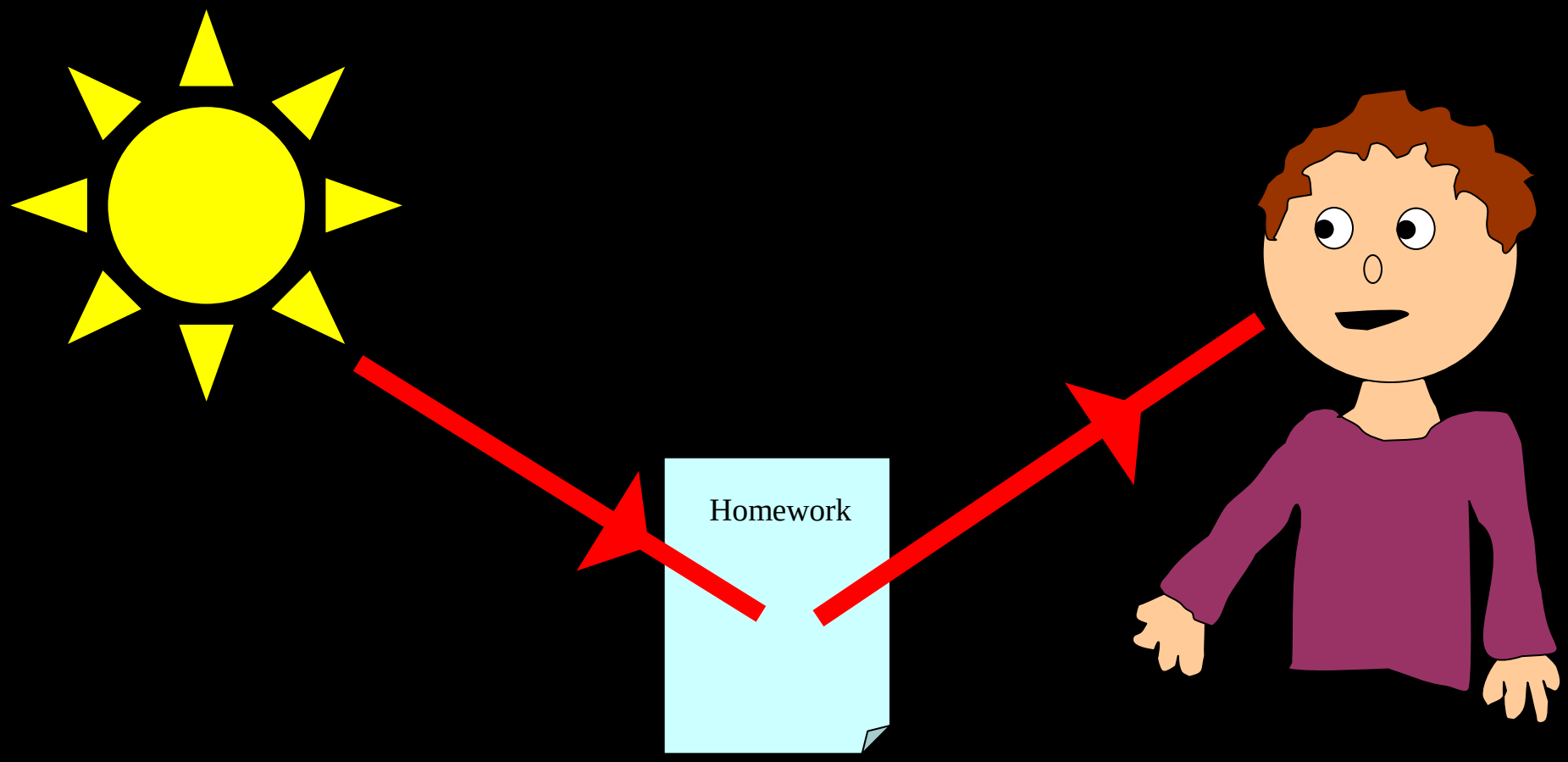
Shadows are places where light is "blocked":



Properties of Light summary

1) *Light travels in straight lines*
2) *Light travels much faster than sound*
3) *We see things because they reflect light into our eyes*
4) *Shadows are formed when light is blocked by an object*

We see things because they <u>reflect</u> light into our eyes:



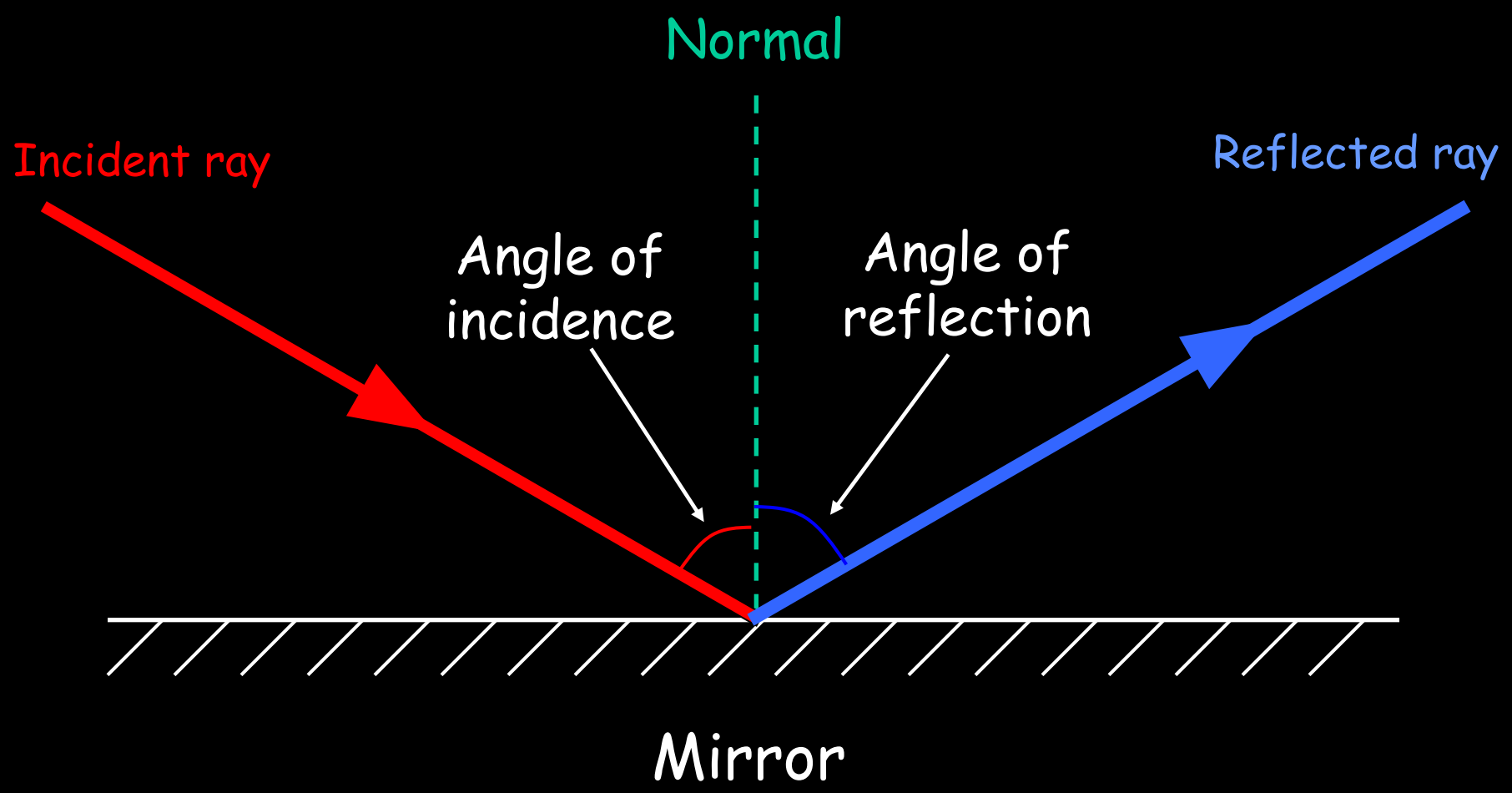
Vocabulary

Reflection: the bouncing of light from a surface

Refraction: the bending of light as it passes through one material to another

Part 2 - Reflection

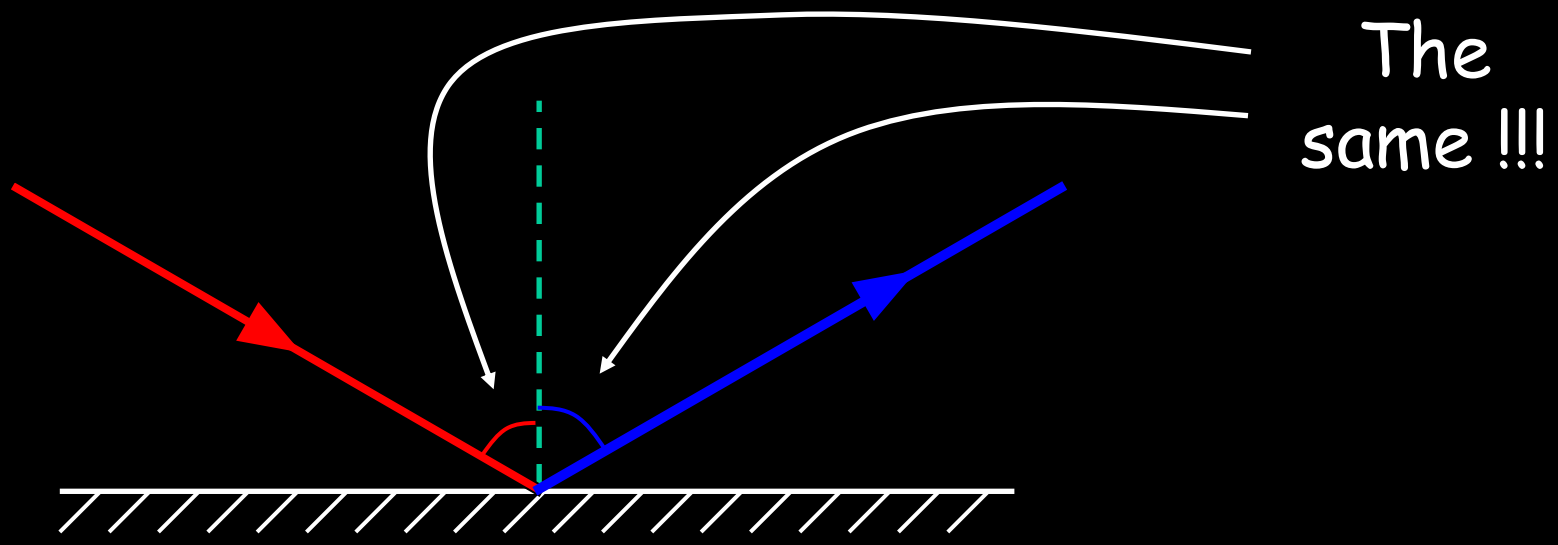
Reflection from a mirror:



The Law of Reflection

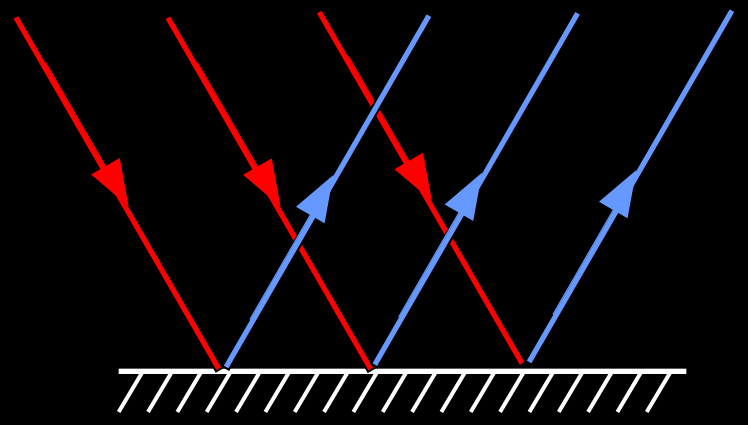
Angle of incidence = Angle of reflection

In other words, light gets reflected from a surface at _____ angle it hits.



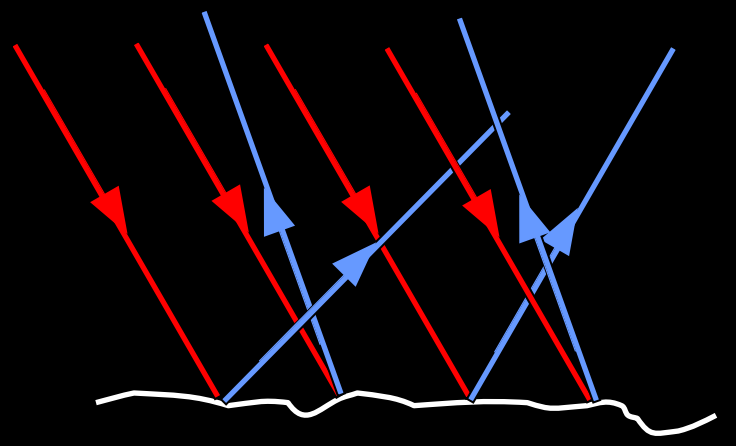
Clear vs. Diffuse Reflection

Smooth, shiny surfaces have a *clear* reflection:



Rough, dull surfaces have a *diffuse* reflection.

Diffuse reflection is when light is scattered in different directions



Explain the terms transparent, translucent, and opaque, and give an example of each.

Plastic wrap **Wax paper** **Aluminum Foil**

Transparent **Translucent** **Opaque**

Vocabulary

Transparent: materials that allow all light to pass through

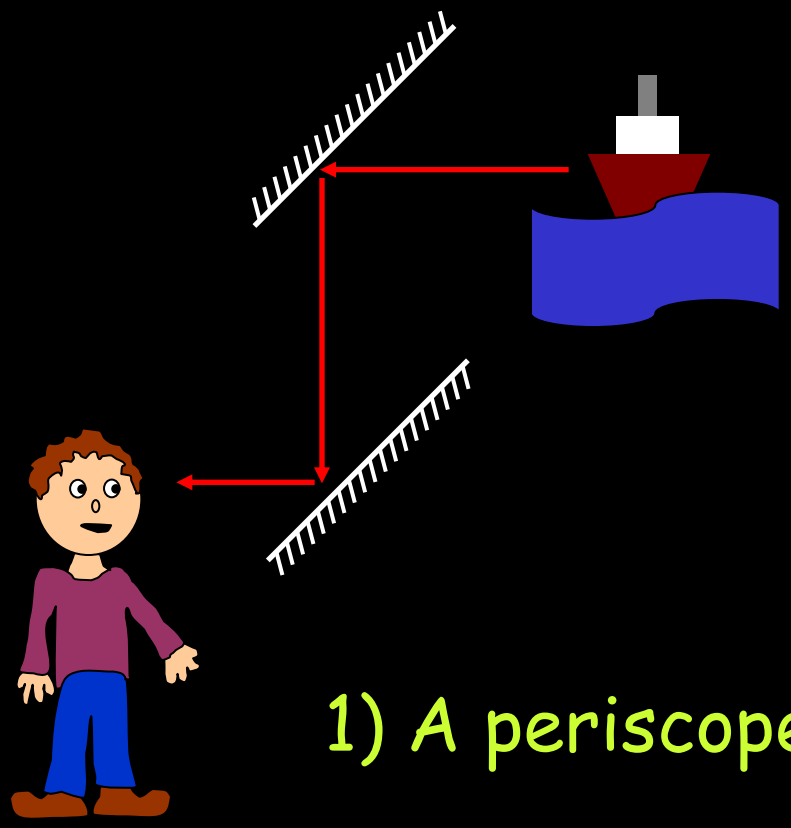
Translucent: letting light through but scattering it

Opaque: materials that do not let light through

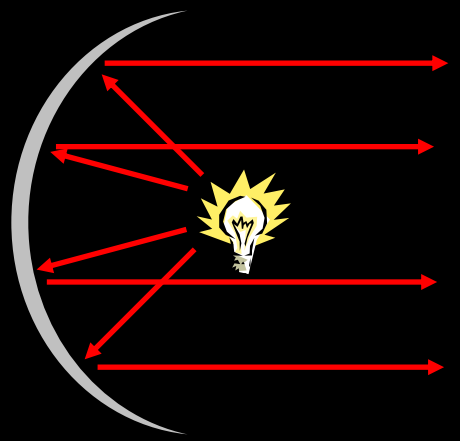
Transmit: to send (as in sound or light). It also means light passing through an object.

Using mirrors

Two examples:

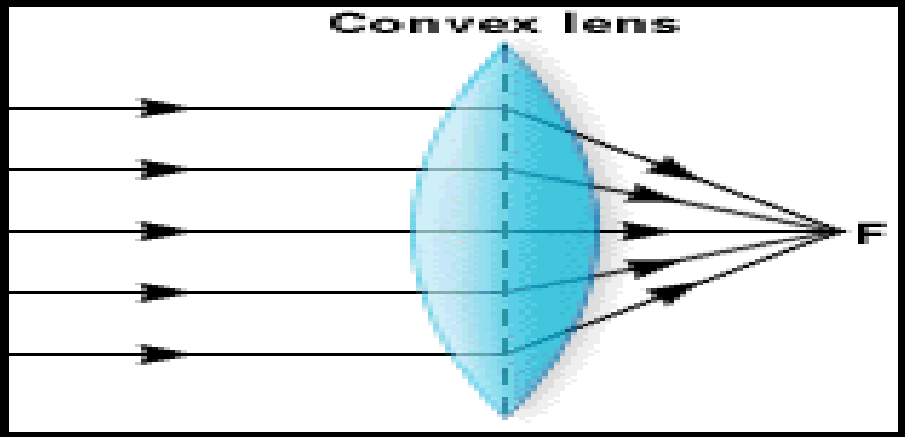


1) A periscope



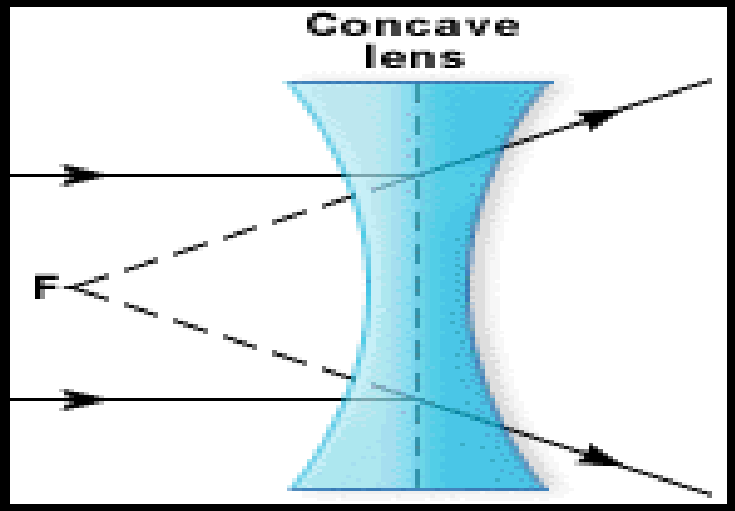
2) A car headlight

A convex lens is thicker in the middle than on the ends. It bends light waves toward a point. Your eye is a convex lens.



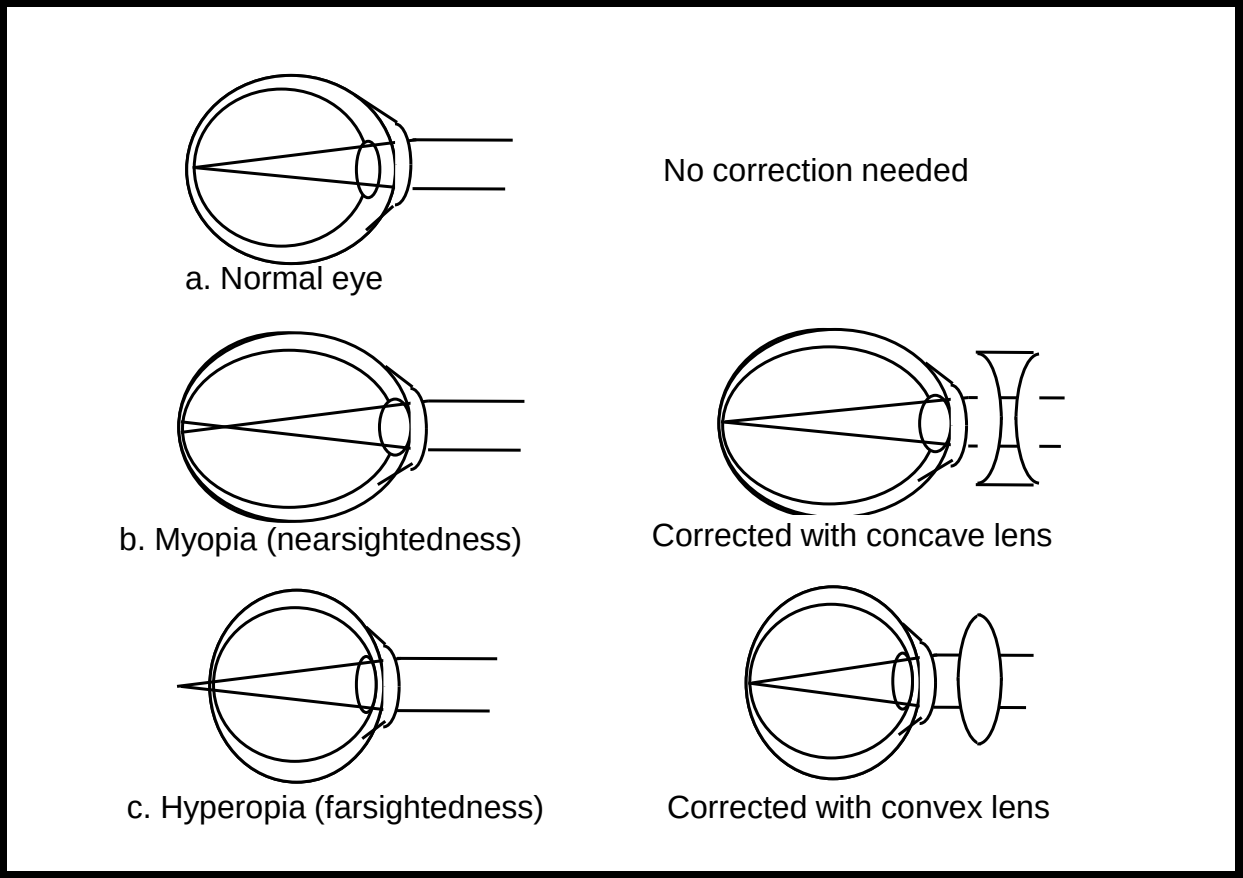
A convex lens causes light to converge, or focus, producing an image that is smaller than the original object.

A concave lens is thinner in the middle than on the ends.



A concave lens causes light to diverge, or spread out, producing a larger image than the original.

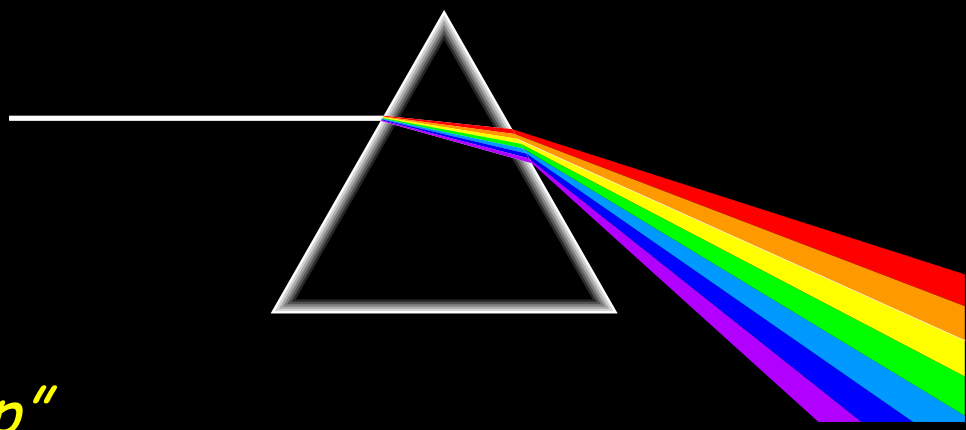
Eyeglasses: have lenses



Color

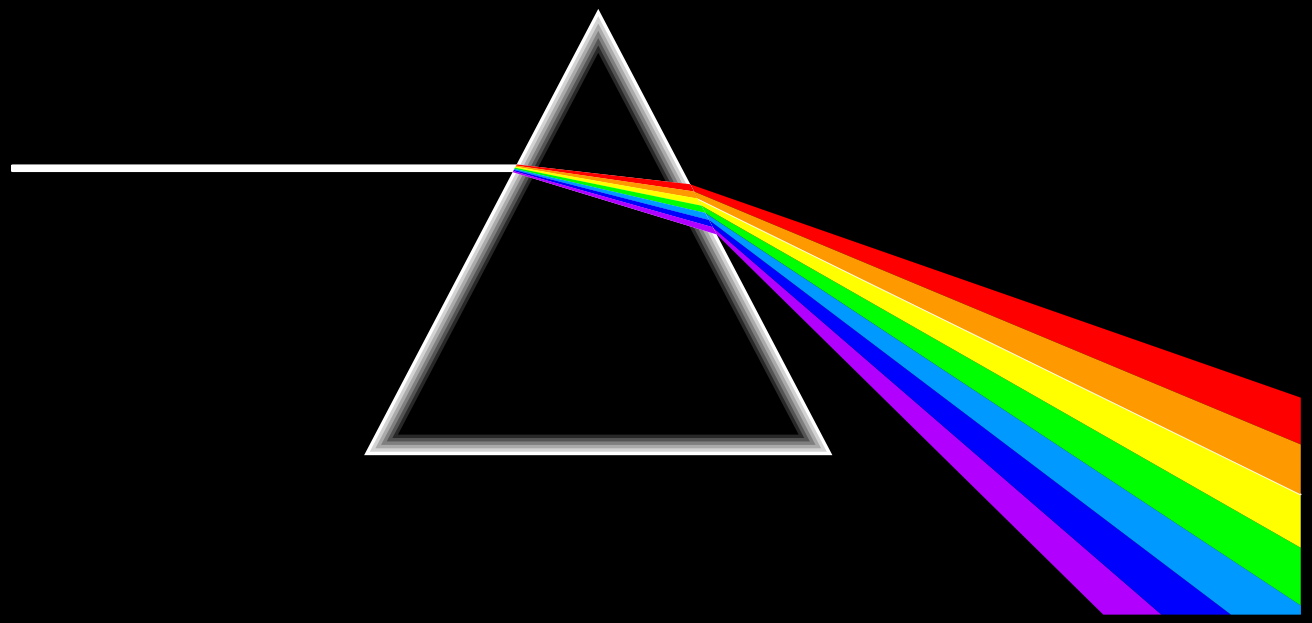
White light is not a single color; it is made up of a mixture of the seven colors of the rainbow.

We can demonstrate this by splitting white light with a prism:



This is how rainbows are formed: sunlight is "split up" by raindrops.

The colors of the rainbow:



Red
Orange
Yellow
Green
Blue
Indigo
Violet

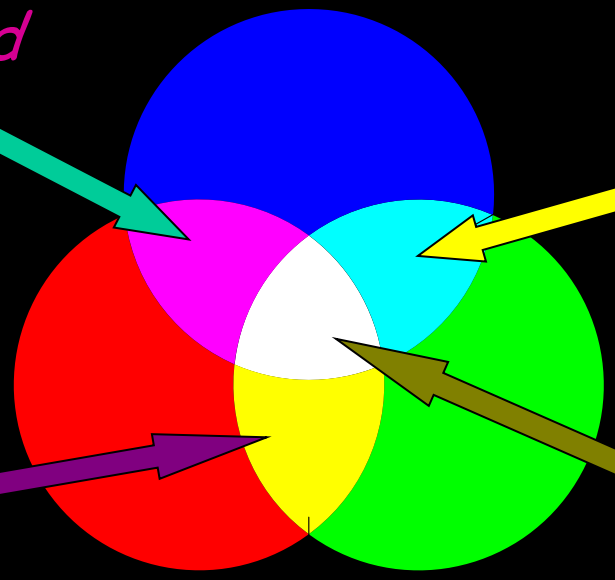
Adding colors

White light can be split up to make separate colors. These colors can be added together again.

The primary colors of light are red, blue and green:

Adding blue and red makes magenta (purple)

Adding blue and green makes cyan (light blue)



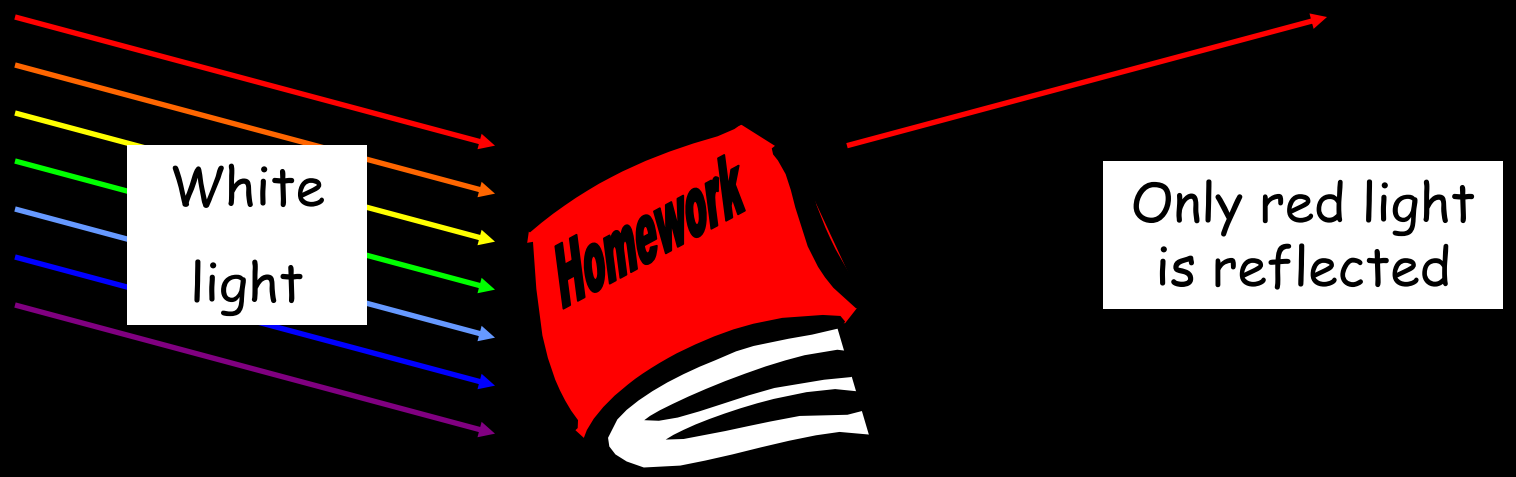
Adding red and green makes yellow

Adding all three makes white again

Seeing color

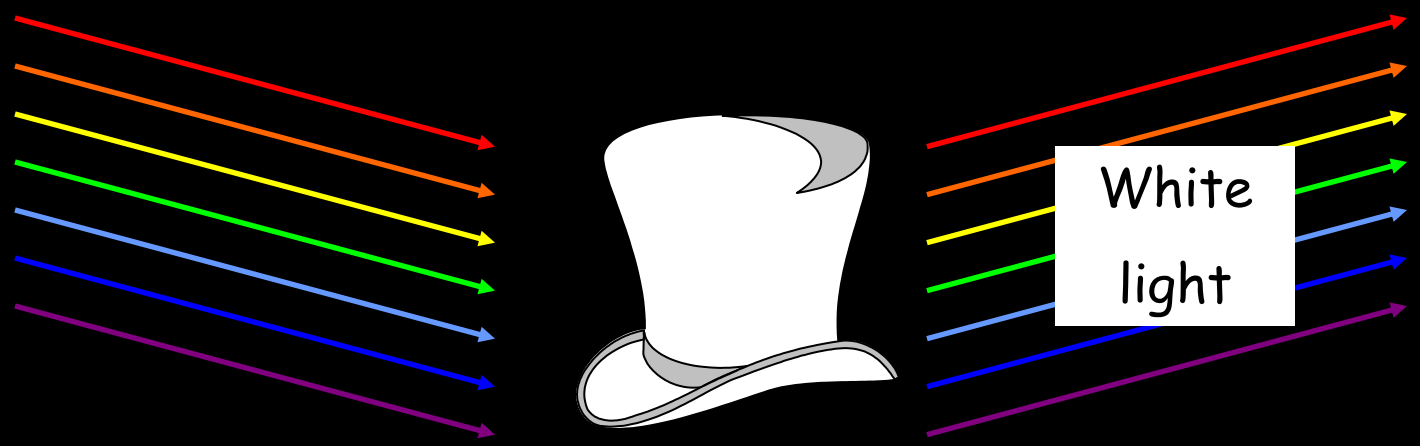
The color an object appears depends on the colors of light it reflects.

For example, a red book only reflects red light:



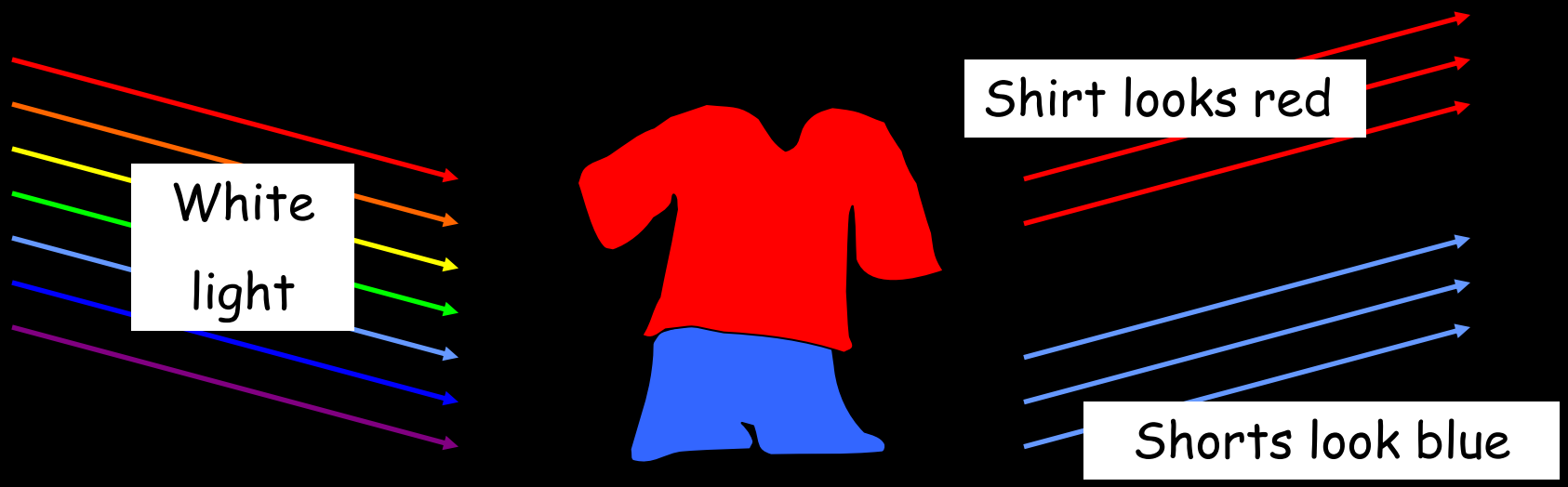
A pair of purple trousers would reflect purple light
(and red and blue, as purple is made up of red and blue):

A white hat would reflect all seven colors:

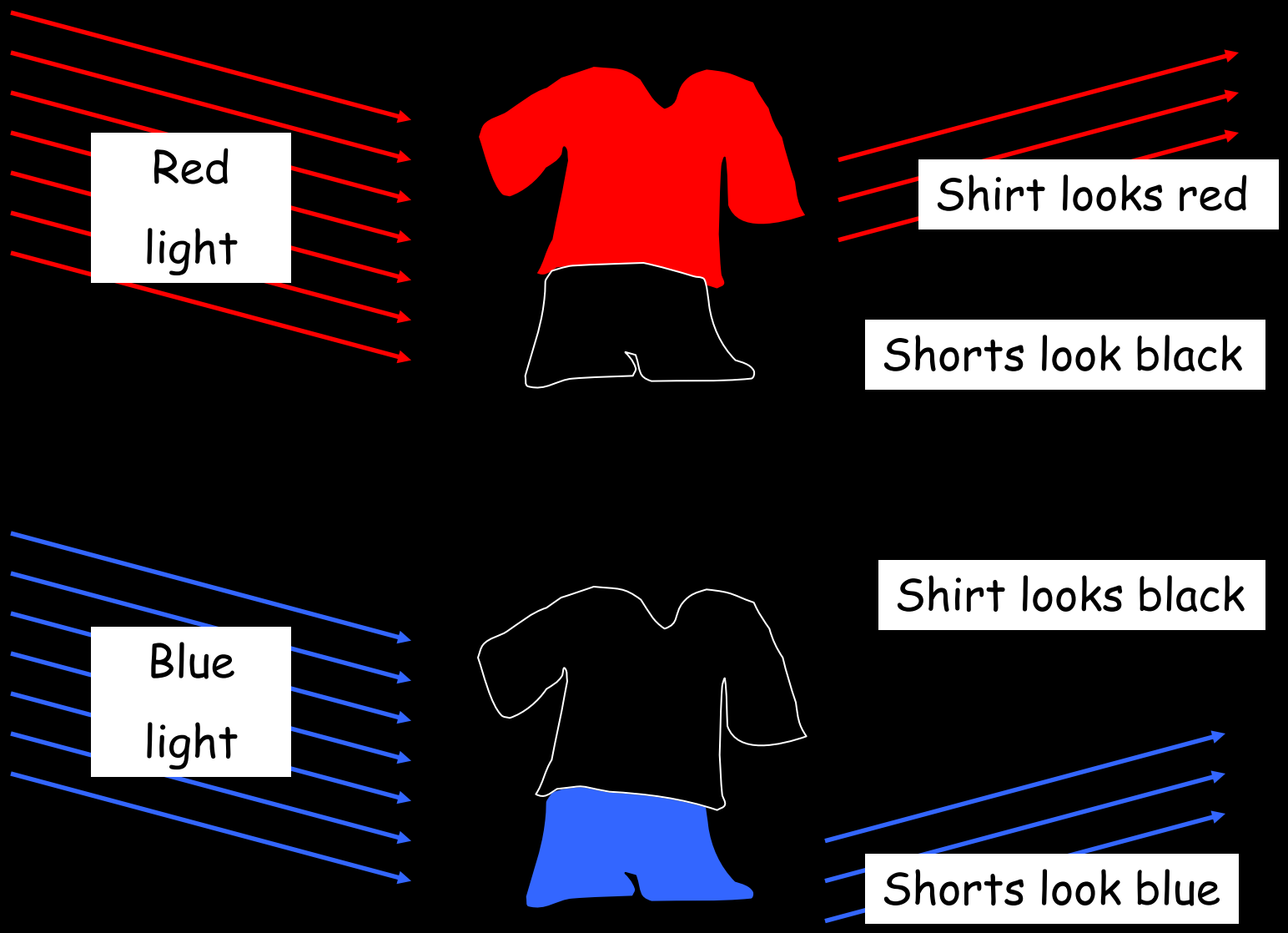


Using colored light

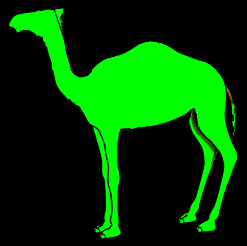
If we look at a colored object in colored light we see something different. For example, consider a football kit:

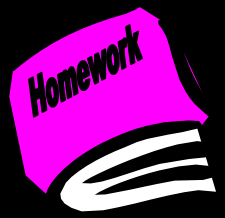


In different colors of light this kit would look different:



Some further examples:

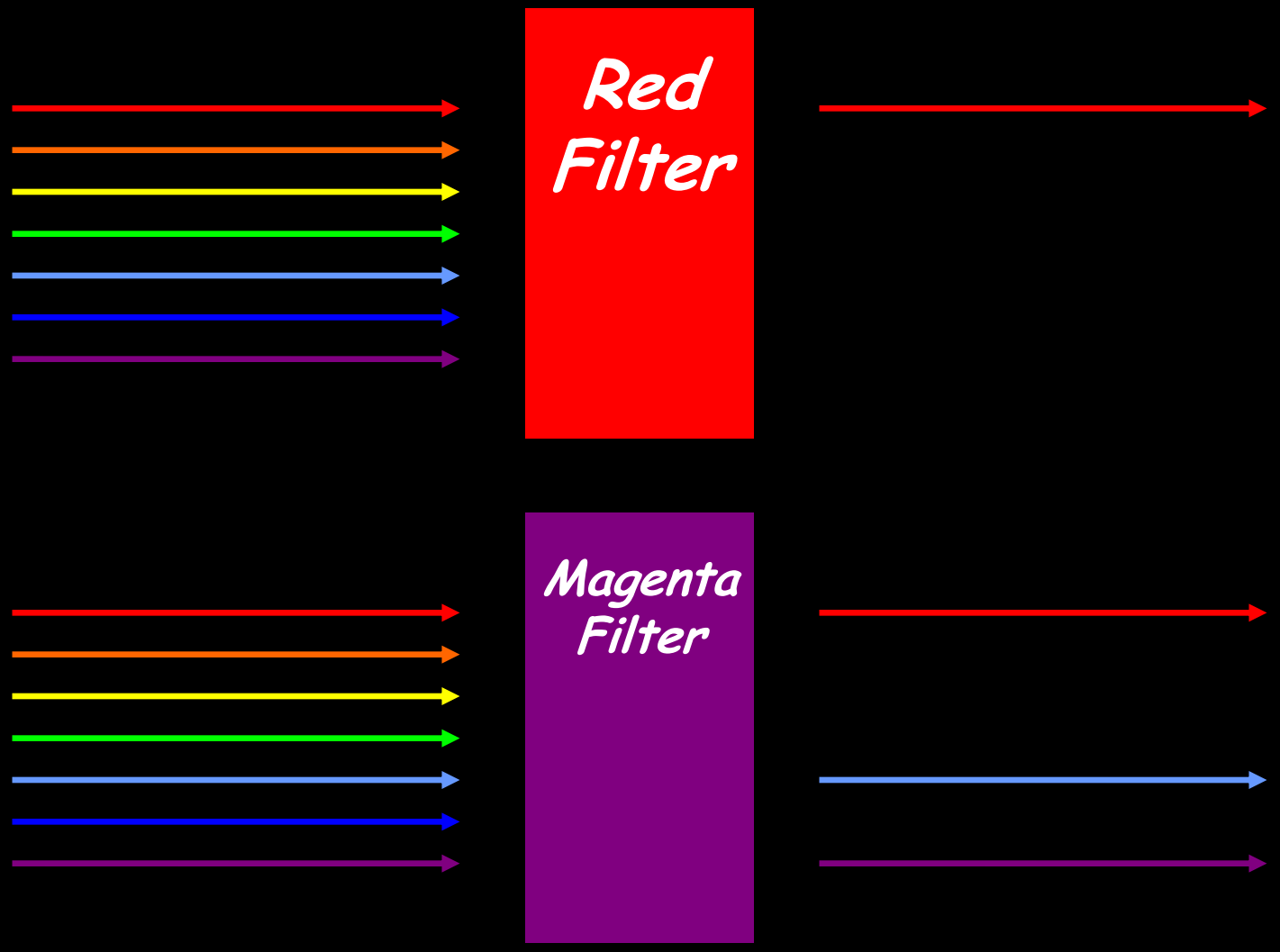




Object	Color of light	Color object seems to be
Red socks	Red	Red
	Blue	Black
	Green	Black
Blue teddy	Red	Black
	Blue	
	Green	
Green camel	Red	
	Blue	
	Green	
Magenta book	Red	
	Blue	
	Green	

Using filters

Filters can be used to "block" out different colors of light:



Investigating filters

Colour of filter	*Colours that could be "seen"*
Red	
Green	
Blue	
Cyan	
Magenta	
Yellow	

Red

Blue

Green

White

Yellow

Cyan

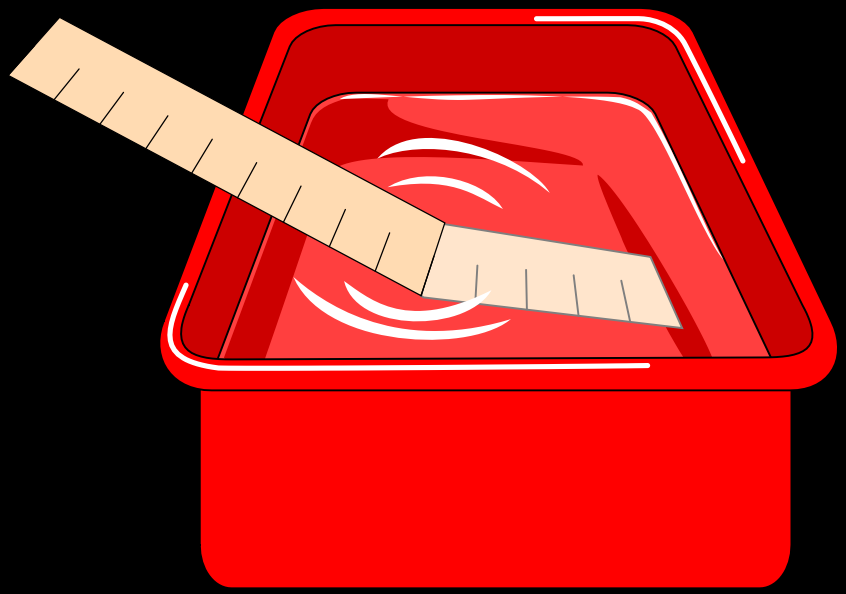
Magenta

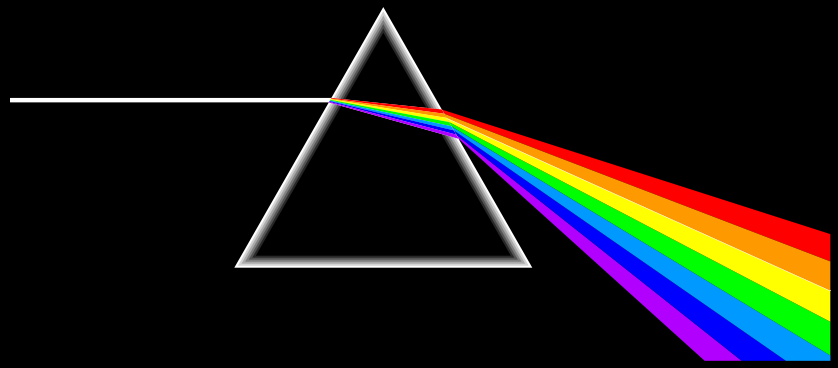
Refraction

Refraction is when waves _____ __ or slow down due to travelling in a different _____. A medium is something that waves will travel through. When a pen is placed in water it looks like this:

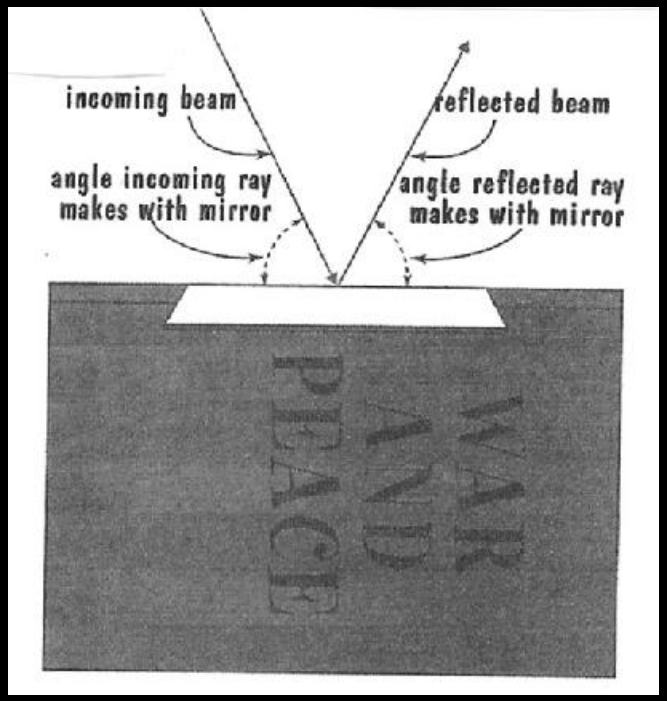
In this case the light rays are slowed down by the water and are _____, causing the pen to look odd. The two mediums in this example are _____ and _____.

Words – speed up, mediums, bent. air ,water

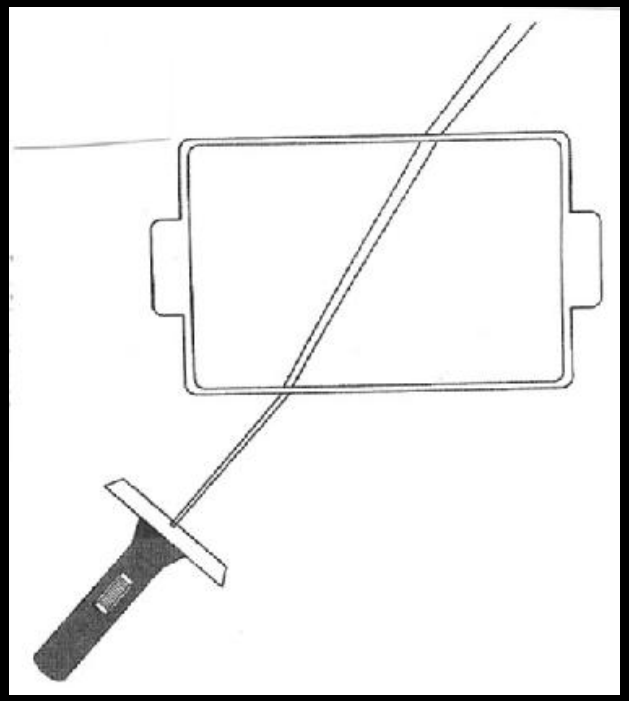




Compare and contrast reflection and refraction



Reflection



Refraction