Lesson 3.1

What is Light?

What is Light?

- The sun emits large amounts of energy in all directions. Some of this solar energy reaches Earth and heats the Earth's surface.

SOURCES:

a. Natural

ex: sun, fireflies

b. Artificial

- man made/controlled

ex: electric bulb, and flashlight

Light Energy

- Light is a form of energy.
- We use light energy for many things:
  - light our homes/schools
  - techniques converts light energy into thermal energy to heat our homes and water.
- Energy from the Sun is called solar radiation.
- To reach us this radiation has to pass through space, which is a vacuum (there is no matter in a vaccuum not even air).

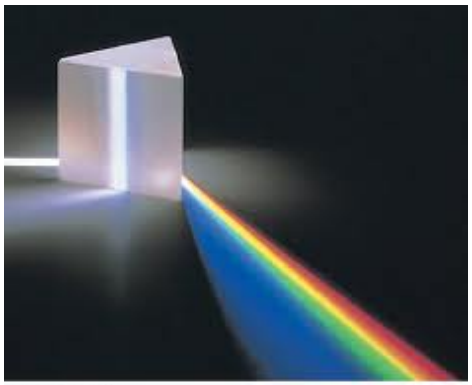
Electromagnetic Waves

- Energy travels through space as electromagnetic waves.
- **Electromagnetic Wave (EMW)** - is a wave of energy associated with electric and magnetic fields.
- EMWs can pass through a medium such as glass, metal, and water.

Visible Light and Colours

- **<u>Visible Light</u> - "EMW that we see"**

  The light we see when we look at a candle flame, a glowing light bulb or the Sun.
- Visible light from the Sun and light bulbs appears to be white.
- **Isaac Newton** – first scientist to separate light into its component colors.



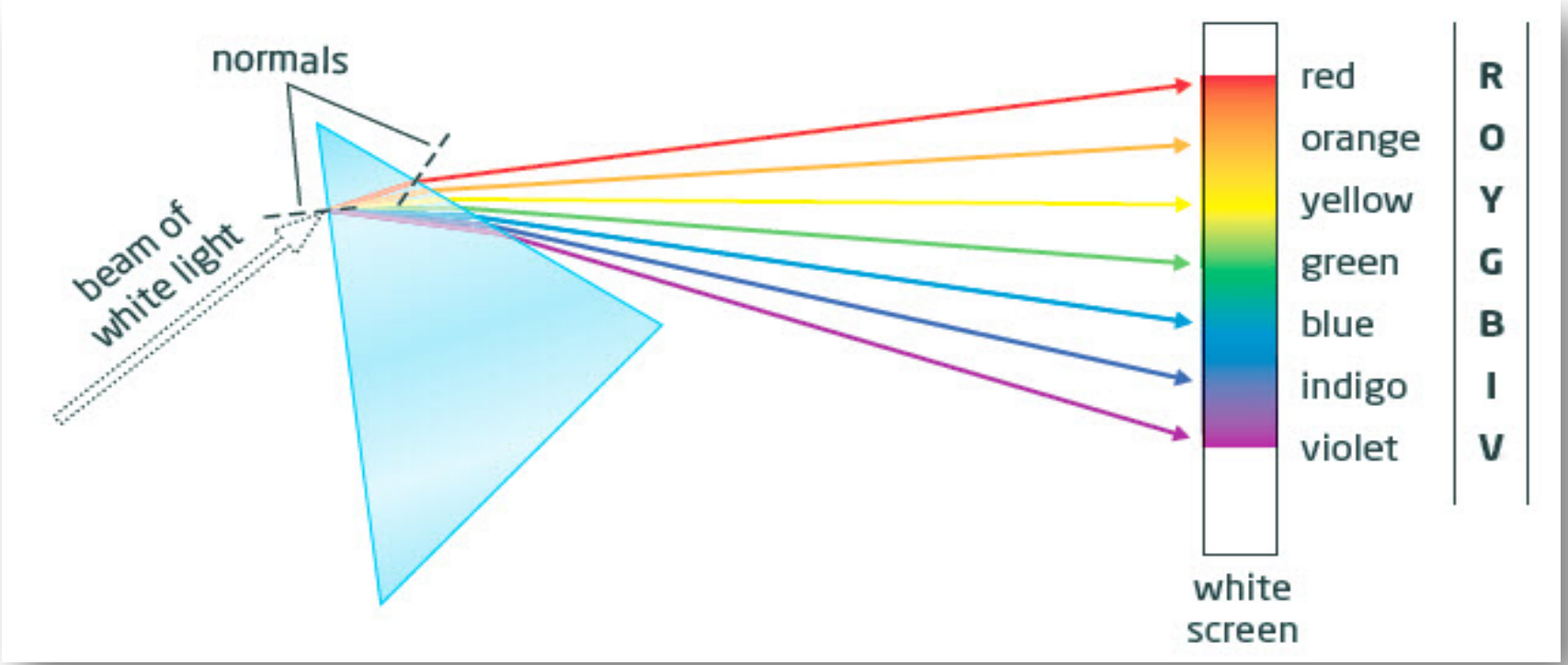
Sun through triangular prism

= ROY.G.BIV

red, orange, yellow, green, blue, indigo and violet

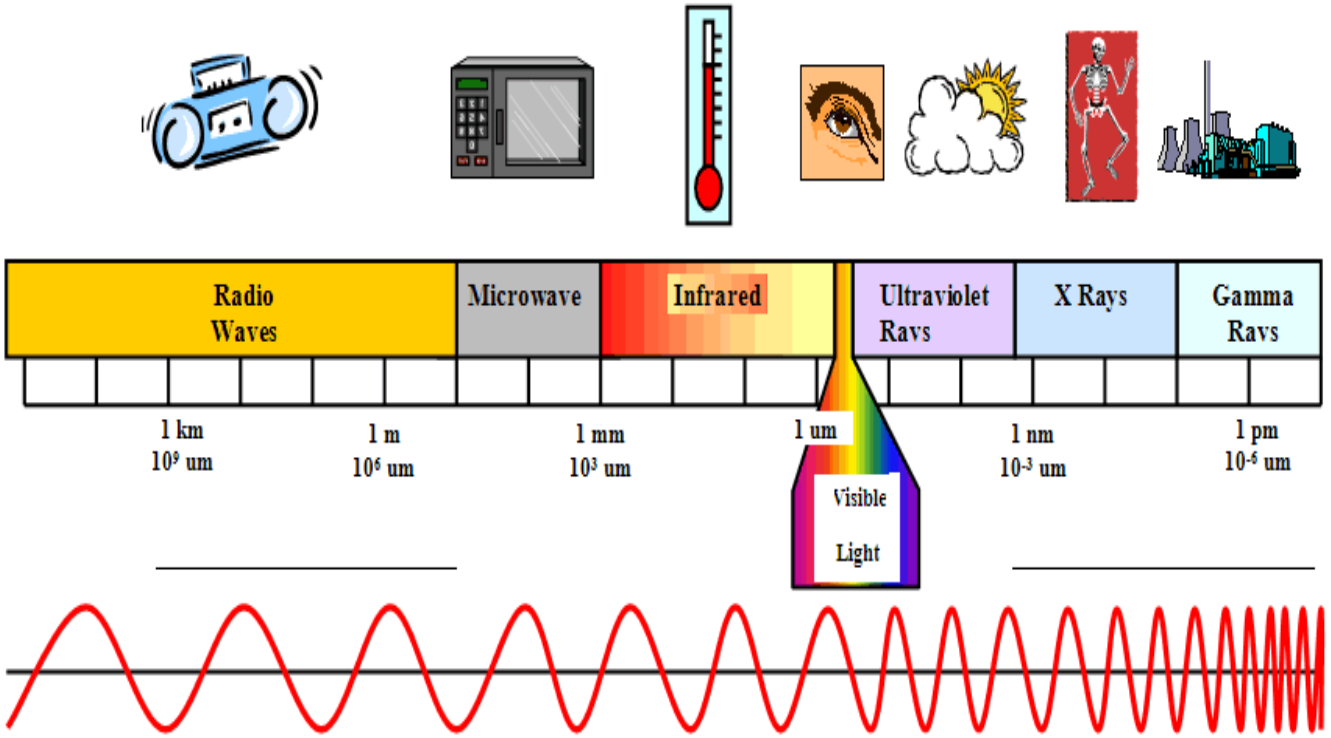
Visible Spectrum

- Visible Spectrum - The continuous sequence of colours that makes up white light.



Electromagnetic Spectrum

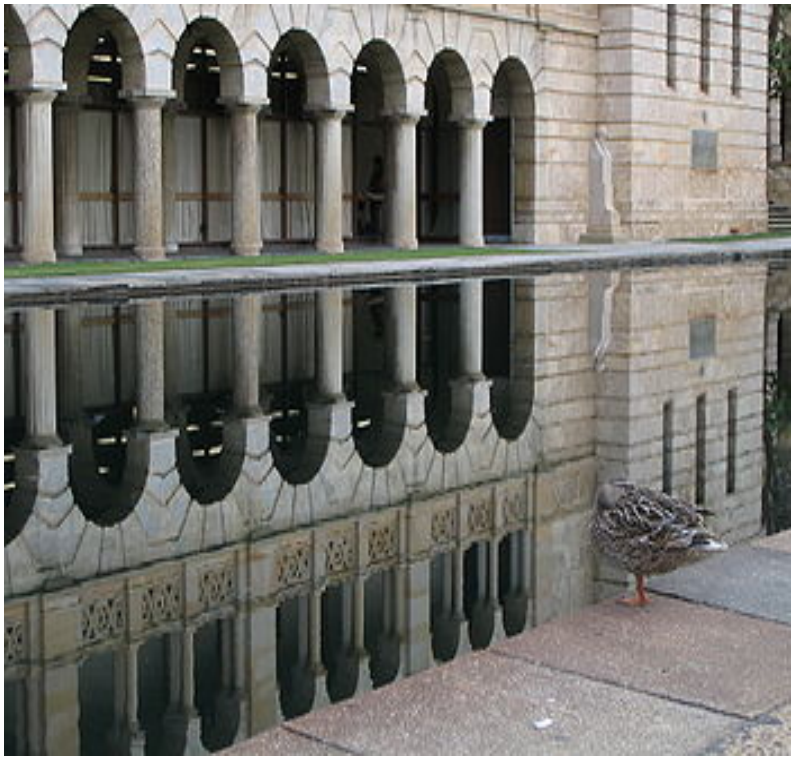
- The classification of electromagnetic waves, arranged from lowest energy to highest energy, which includes visible light.



Properties of Light and Reflection

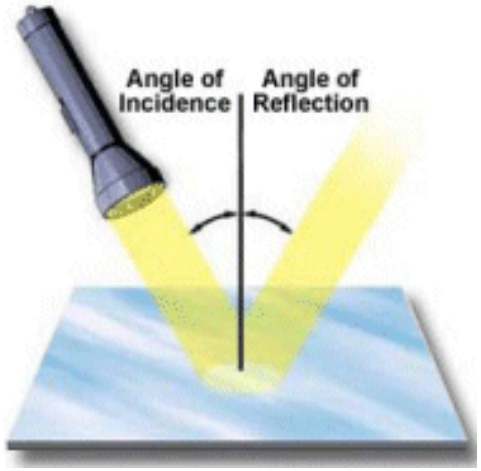
Reflection

Reflection is the change in direction of a light ray when it bounces off a surface



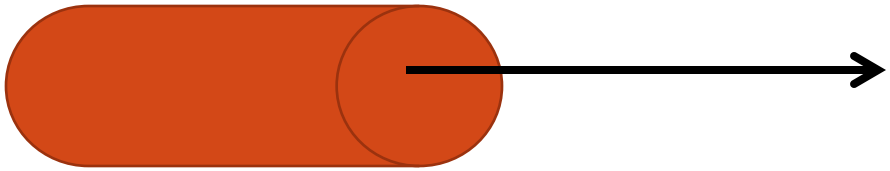
Rays of Light

- Light travels in a straight line (as long as it's moving through the same medium)
  - Medium – the substance through which light travels
- Ray - a straight line with an arrowhead that shows the direction in which light waves are travelling.
- Ray diagrams - can be used to make predictions about appearance of objects

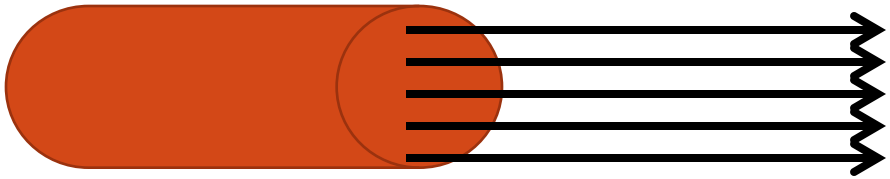


Ray Model of Light

- **Ray –** A single unit of light
  - Represented by 1 arrow



- **Beam –** A bundle of light rays travelling in one direction
  - Represented by many arrows



Definitions You Need to Know

- **Incident ray** – a ray of light that travels from a light source towards a surface
- **Angle of incidence** – angle between the incident ray and the normal in a ray diagram
- **Normal** - a line that is perpendicular to a surface where a ray of light meets the surface
- **Reflected ray** – a ray that begins at the point where the incident ray and the normal meet
- **Angle of reflection** – the angle between the reflected ray and the normal in a ray diagram
- **plane mirror** – a mirror with a flat reflective surface

Laws of Reflection

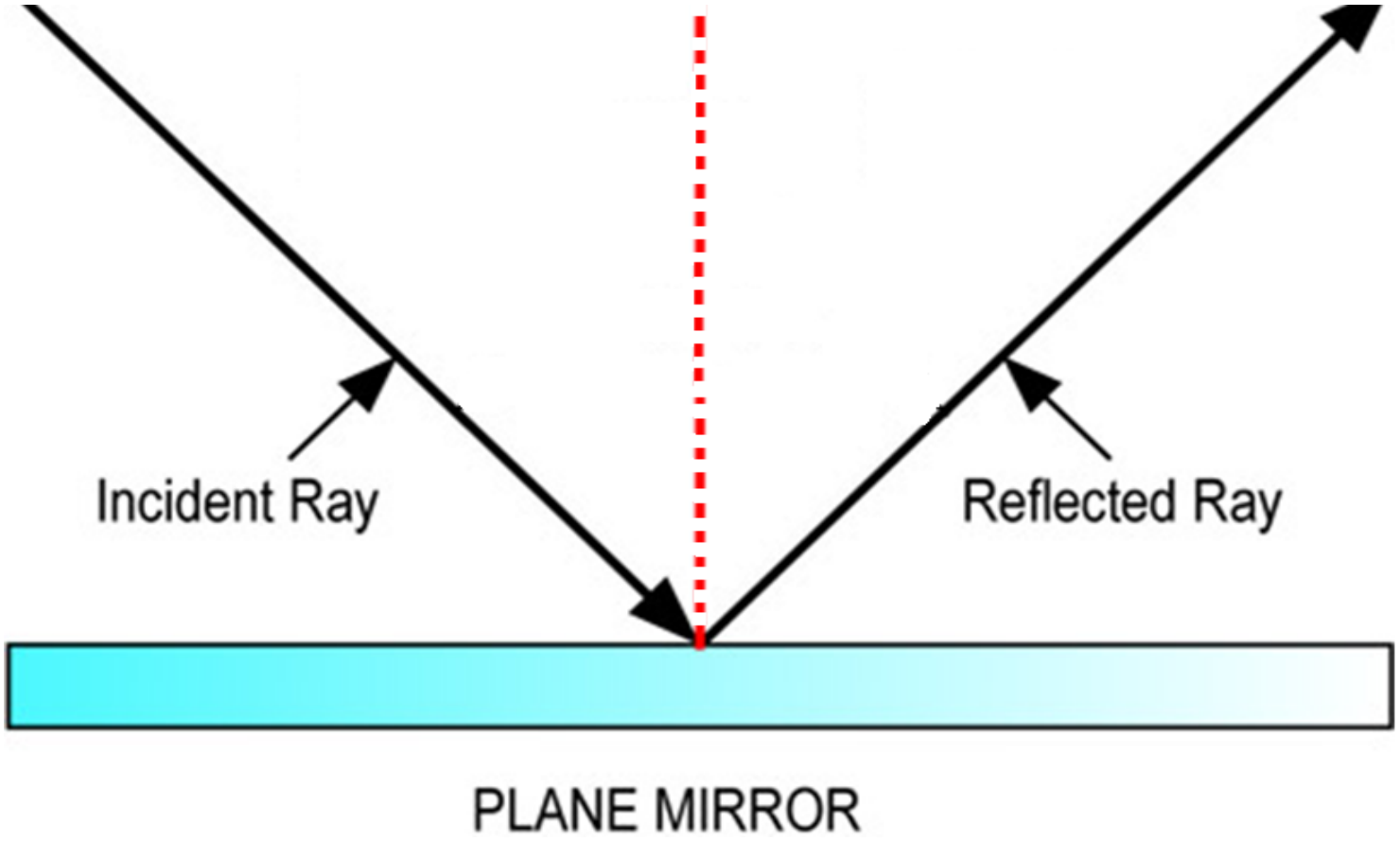
1. The incident ray, the reflected ray, and the normal always lie on the same plane.
2. The angle of reflection is equal to the angle of incidence.

$$\angle r = \angle i$$

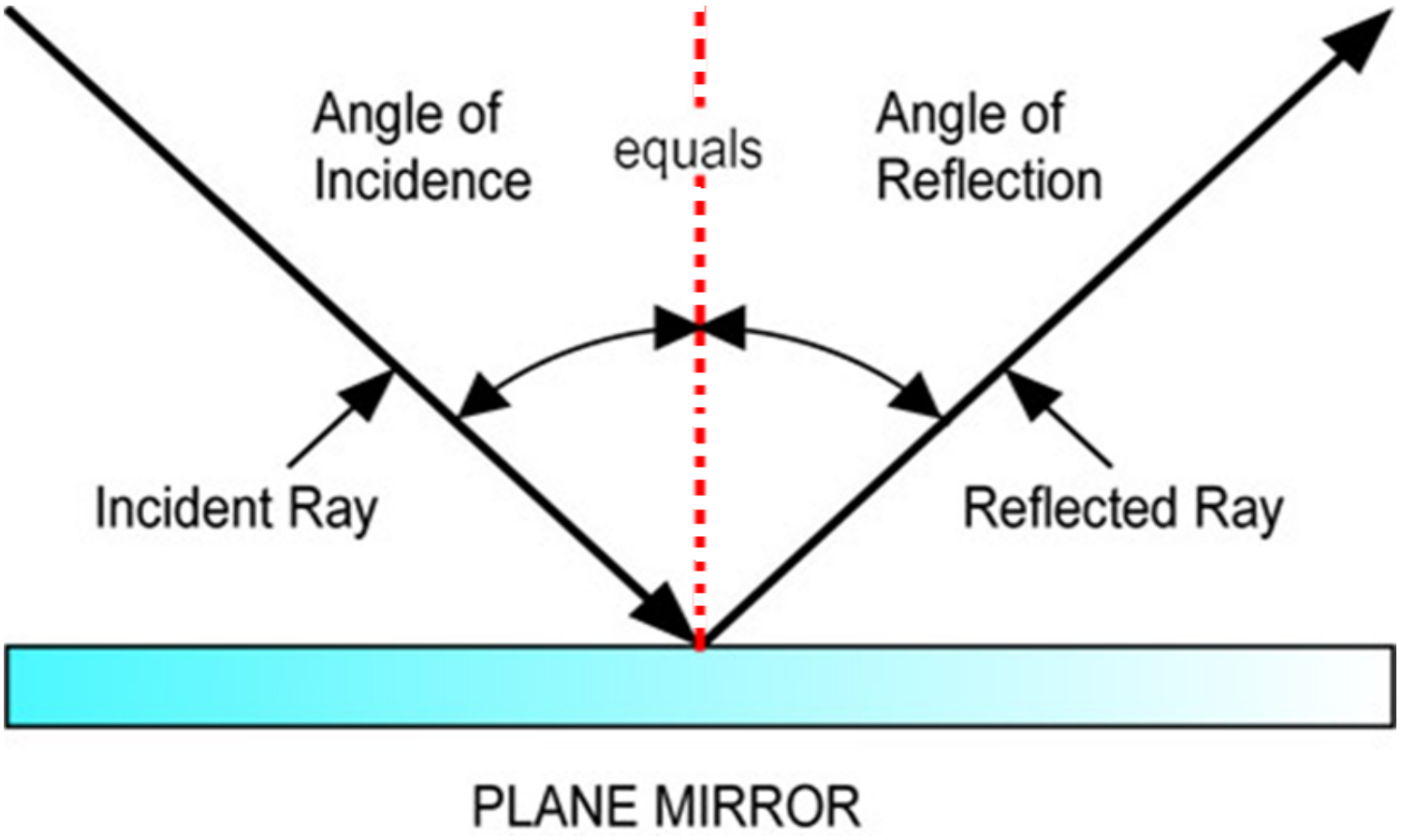
Law of reflection states that the angle of incidence equals the angle of reflection

Drawing Ray Diagrams

Normal – dotted line perpendicular to the surface (90◦ angle)



Ray Diagrams



Ray Diagrams

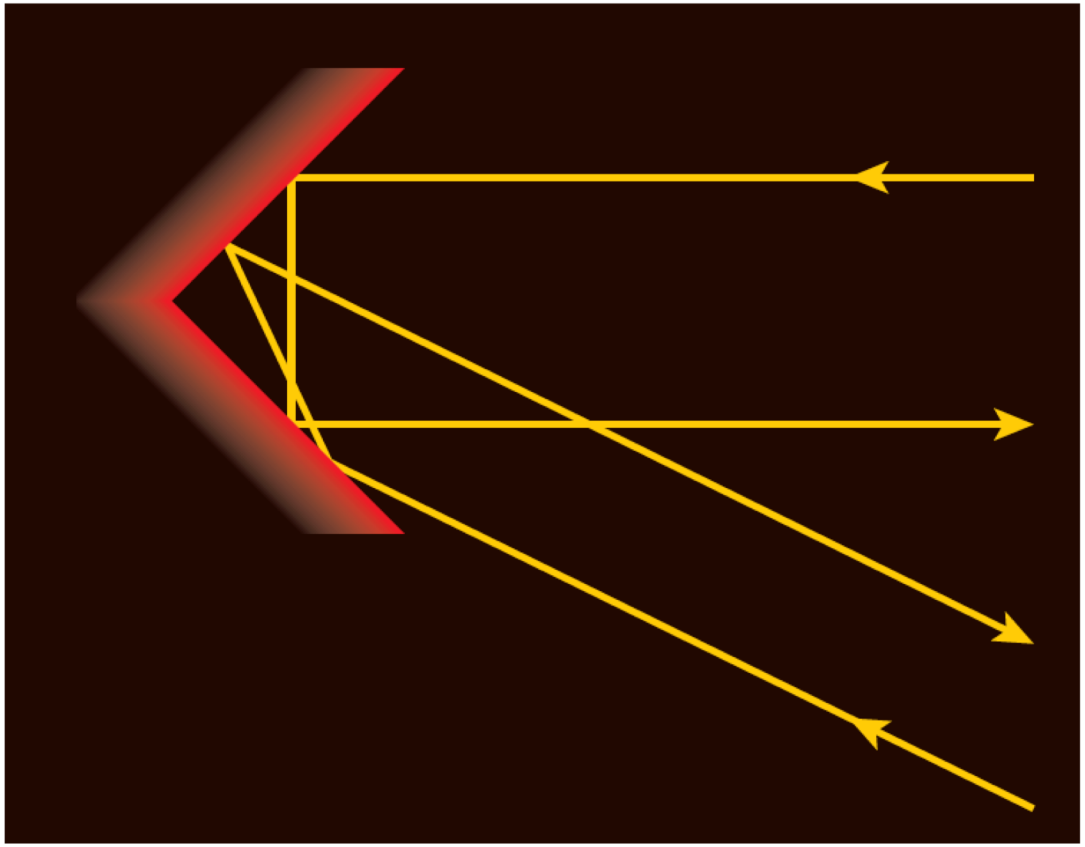
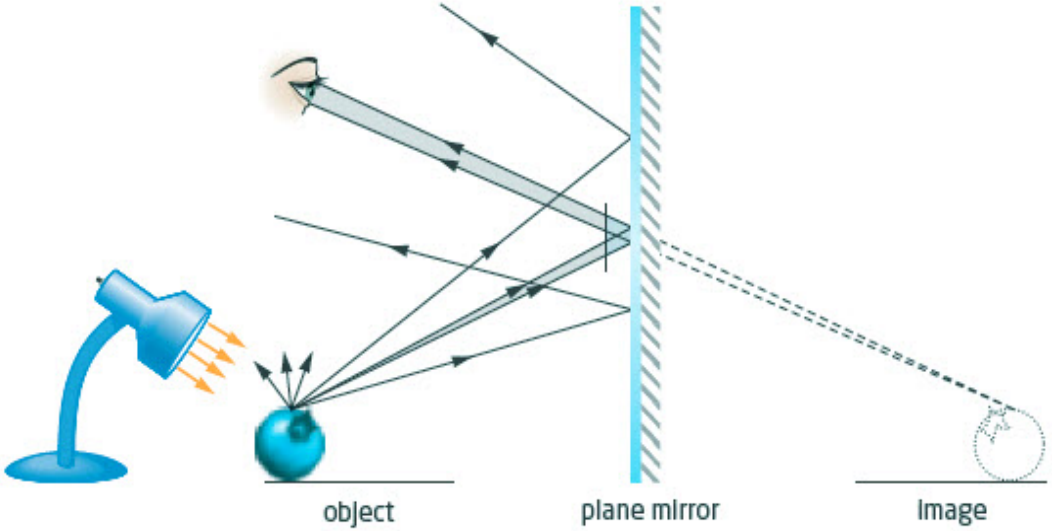


Figure 11.5 The mirrors in a bicycle tail light reflect headlight beams back to the driver of the car that sent them.

Images in Plane Mirrors

Images in Plane Mirrors

- Plane Mirror – A mirror with a flat, reflective surface
- Scientists call an object in front of a mirror the **object**, and they call what is seen in the mirror the **image** of the object.
- Using the laws of reflection to rays going from the object, you can predict where the image will be and where the image would look like.



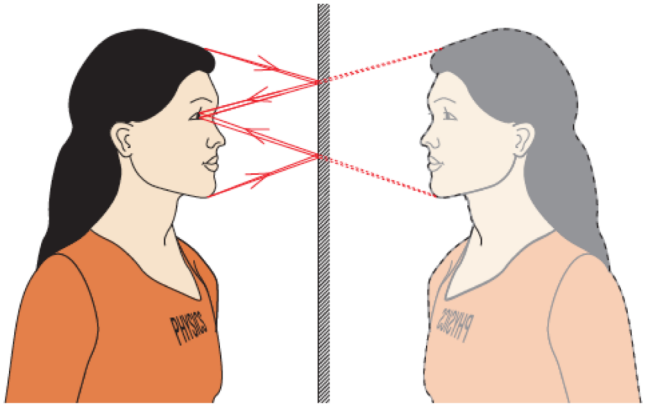


Figure 11.7 A ray diagram shows how a virtual image forms in a plane mirror.

TYPE OF IMAGE

- Real vs Virtual
  - Real Images can be seen on a piece of paper or screen placed because the focal point is *in front of* the mirror or *behind* the lens.
  - Virtual Images can not be seen on a piece of paper or screen, because the focal point is *behind* the mirror or *in front of* the lens. Virtual images are images which are formed in locations where light does not actually reach; it only appears to an observer as though the light were coming from this position.

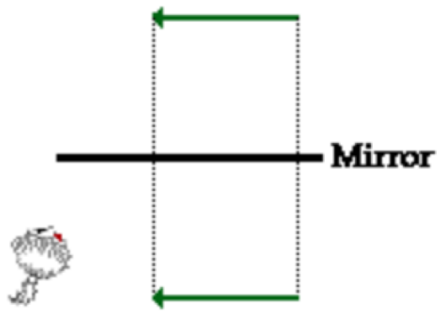
Drawing Plane (Flat) Mirror Ray Diagrams

- https://www.youtube.com/watch?v=XnkIEtD9eMY&t=310s
- https://www.physicsclassroom.com/class/refln/Lesson-2/Ray-Diagrams-for-Plane-Mirrors

Drawing Ray Diagrams - a Step-by-Step Approach

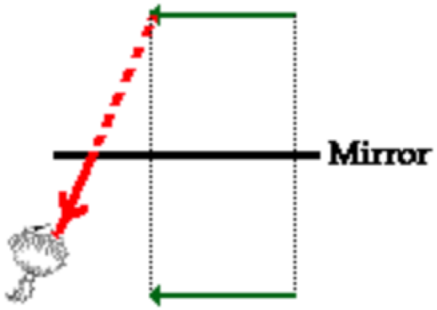
This section of Lesson 2 details and illustrates the procedure for drawing ray diagrams. Let's begin with the task of drawing a ray diagram to show how Suzie will be able to see the image of the green *object arrow* in the diagram below. For simplicity sake, we will suppose that Suzie is viewing the image with her left eye closed. Thus, we will focus on how light travels from the two extremities of the object arrow (the left and right side) to the mirror and finally to Suzie's right eye as she sights at the image. The four steps of the process for drawing a ray diagram are listed, described and illustrated below.

1. Draw the image of the object.



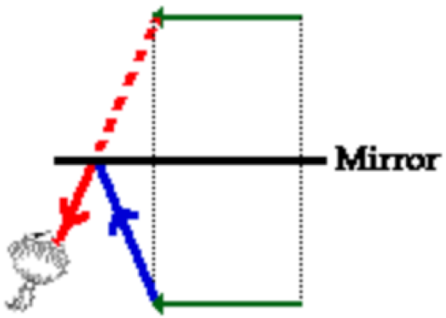
Use the principle that the object distance is equal to the image distance to determine the exact location of the object. Pick one *extreme* on the object and carefully measure the distance from this *extreme point* to the mirror. Mark off the same distance on the opposite side of the mirror and mark the image of this *extreme point*. Repeat this process for all extremes on the object until you have determined the complete location and shape of the image. Note that all distance measurements should be made by measuring along a segment that is perpendicular to the mirror.

2. Pick one extreme on the image of the object and draw the reflected ray that will travel to the eye as it sights at this point.



Use the line of sight principle: the eye must sight along a line at the image of the object in order to see the image of the object. It is customary to draw a bold line for the reflected ray (from the mirror to the eye) and a dashed line as an extension of this reflected ray; the dashed line extends behind the mirror to the location of the image point. The reflected ray should have an arrowhead upon it to indicate the direction that the light is traveling. The arrowhead should be pointing towards the eye since the light is traveling from the mirror to the eye, thus enabling the eye to see the image.

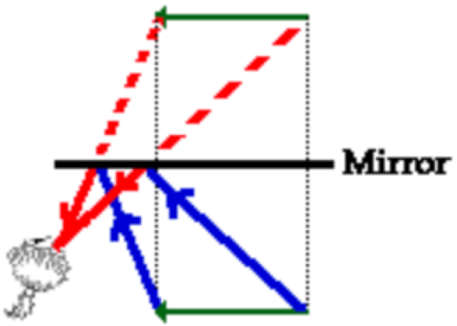
3. Draw the incident ray for light traveling from the corresponding extreme on the object to the mirror.



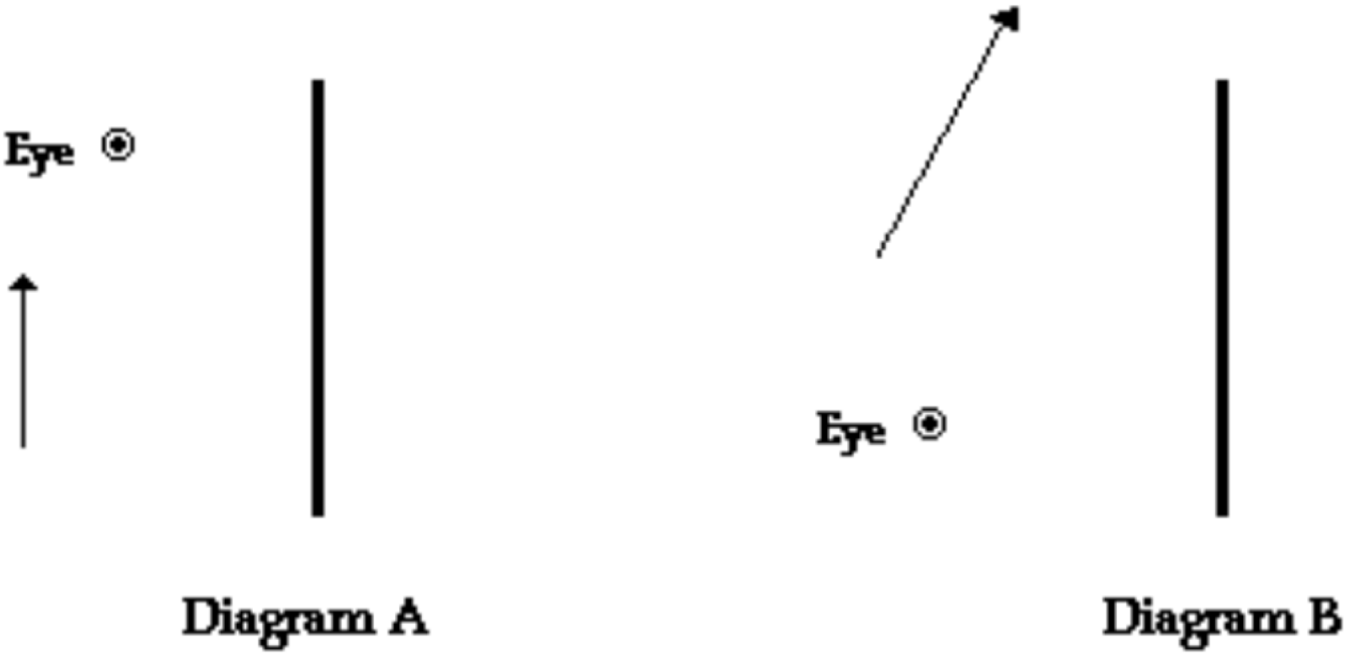
The incident ray reflects at the mirror's surface according to the law of reflection. But rather than measuring angles, you can merely draw the incident ray from the *extreme* of the object to the point of incidence on the mirror's surface. Since you drew the reflected ray in step 2, the point of incidence has already been determined; the point of incidence is merely the point where the line of sight intersects the mirror's surface. Thus draw the incident ray from the *extreme point* to the point of incidence. Once more, be sure to draw an arrowhead upon the ray to indicate its direction of travel. The arrowhead should be pointing towards the mirror since light travels from the object to the mirror.

4. Repeat steps 2 and 3 for all other extremities on the object.

After completing steps 2 and 3, you have only shown how light travels from a single *extreme* on the object to the mirror and finally to the eye. You will also have to show how light travels from the other *extremes* on the object to the eye. This is merely a matter of repeating steps 2 and 3 for each individual extreme. Once repeated for each extreme, your ray diagram is complete.



Practice: Draw the Virtual Image



Answer is on next slide

Answer

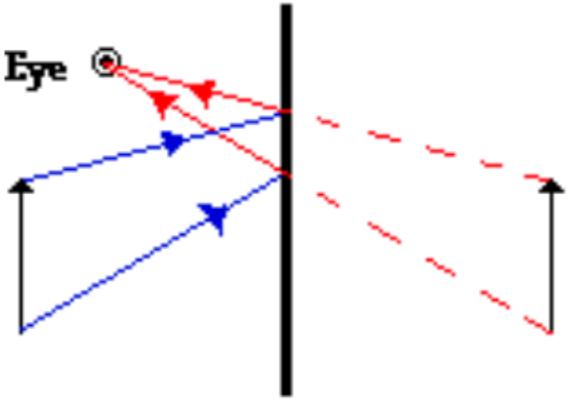


Diagram A

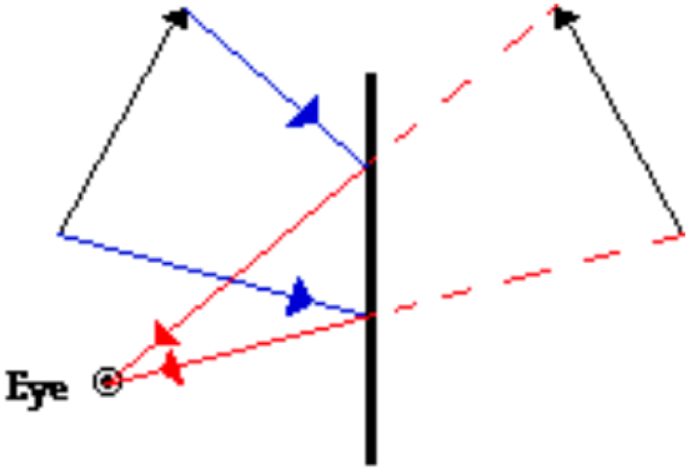


Diagram B