SNC2D PHYSICS

LIGHT & GEOMETRIC OPTICS

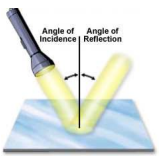
- Light Rays & Reflection (P.402-409)

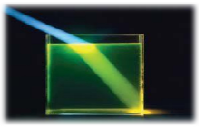
Light Rays & Reflection

A driver adjusts her rearview mirror. The mirror allows her to see the cars behind her. Mirrors help prevent accidents. How? What happens when light strikes a mirror?

The Ray Model of Light

The ray model of light describes how light travels. The ray model states that light travels in a straight line when it is travelling through a uniform medium (sharp shadows around objects such as trees or buildings are evidence of this). Light can also reflect when it strikes a reflective surface or bend (refract) when it travels from one medium to another.

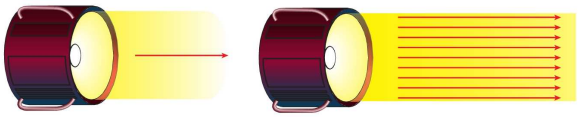




The Ray Model of Light

*In the ray model, a **ray** represents a single unit of light and is drawn as a single straight arrow. The arrowhead may be placed at the end or partway along the ray. A **beam** of light contains many rays of light moving in the same direction.*

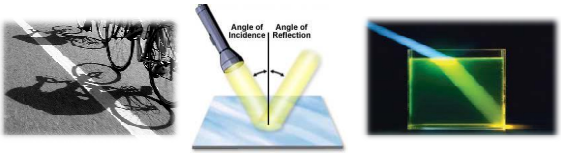
RAY **BEAM**



The Ray Model of Light

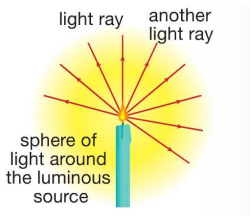
RAY MODEL OF LIGHT

- travels in a straight line (i.e. shadows) ☜ "linear propagation"
- can reflect when it strikes a surface
- can bend when it travels from one medium to another



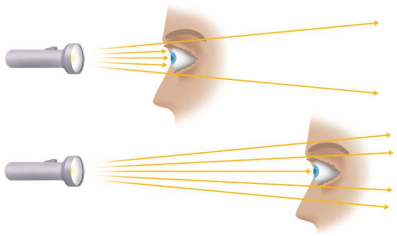
The Ray Model of Light

A candle flame or light bulb radiates light in all directions. We show this by drawing light rays radiating out from the light source in all directions.



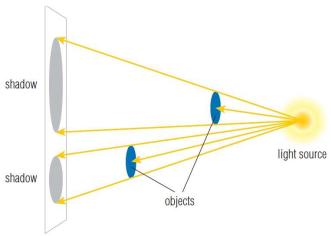
Ray Diagrams – Brightness

Ray diagrams can help explain why the brightness of a light changes with distance. The more rays that reach your eyes, the brighter the object appears.



Ray Diagrams – Shadows

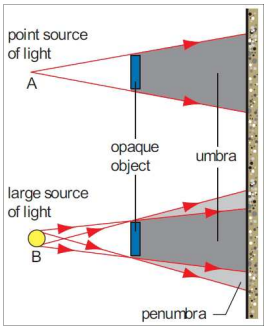
Ray diagrams can also be used to help explain the size and location of shadows and why some shadows are sharp and well defined while other shadows have less distinct edges. A ***shadow*** *occurs when an opaque object blocks the direct light from a light source. The closer the object is to the light source the larger the shadow.*



Ray Diagrams – Shadows

NOTE!

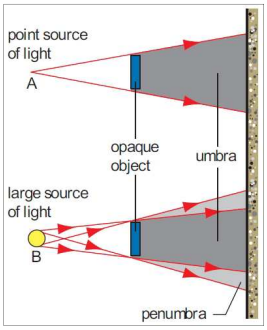
A small light source casts shadows that are sharp and well defined. If the light source is large compared to the object blocking the light, then the shadows will not have a sharp edge, because the object only partly blocks the light. The wider the light source is, the more blurred the shadows will be.



Ray Diagrams – Shadows

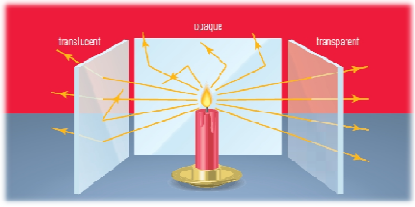
SHADOW

- occurs when an opaque object blocks the light from a source
- the closer the object is to the light source the larger the shadow



Transmission, Reflection & Absorption

Light travels in a straight line until it strikes something. Some materials let the light pass through – they transmit light. Some materials absorb light, and other materials reflect light. The properties of the matter in an object determine what happens to the light. Materials may be classified according to how they transmit, absorb, and reflect light.

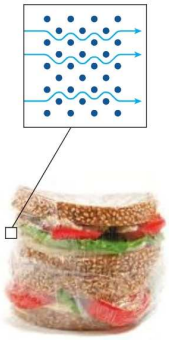


Transmission, Reflection & Absorption

*A **transparent** medium is a material that allows light to pass through it. You can easily see objects behind a transparent medium. Window glass, air, pure water, and plastic wrap are examples of transparent media.*

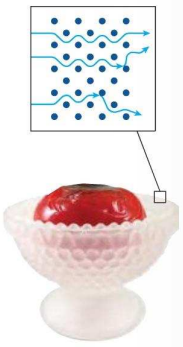
TRANSPARENT

- material that allows light to pass through easily (i.e. glass, air, …)



Transmission, Reflection & Absorption

*Some materials are **translucent**, which means that they transmit some of the light that strikes them, and reflect or absorb the rest. Translucent objects are only partially see-through. Frosted glass and waxed paper are examples of translucent media.*

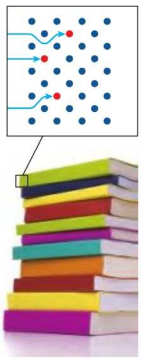


TRANSLUCENT

- material that is partially see-through (i.e. frosted glass, wax paper, …)

Transmission, Reflection & Absorption

*Objects such as textbooks are **opaque**. They are made of materials that do not allow any light to pass through them. Building materials, such as wood, stone, and brick, are also opaque.*



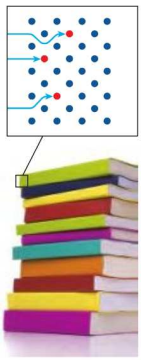
OPAQUE

- material that does not allow any to pass through (i.e. textbook, you, …)

Transmission, Reflection & Absorption

NOTE!

*Opaque materials gather the light that strikes them in a process called **absorption**. The light energy is then converted into other forms of energy, such as thermal energy.*



Transmission, Reflection & Absorption

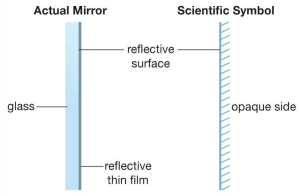
*When light strikes a very smooth, opaque object, such as a mirror, most of the light bounces off the shiny surface in a process called **reflection**. Most opaque objects absorb some light and reflect some light. The reflected light determines the colour that we see.*

REFLECTION

- the bouncing of light back from an object

The Plane Mirror

*A driver can see the cars behind her because of the reflective surface of the flat mirror in the car. A flat mirror is called a **plane mirror**.*

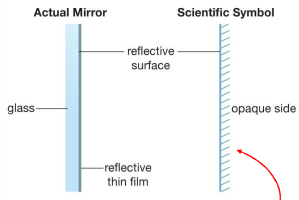


PLANE MIRROR

- a flat, reflective surface

The Plane Mirror

Plane mirrors have two layers. The front layer is transparent, usually glass or plastic. The back layer is a thin film of an opaque, reflective material such as silver or aluminum. Light reflects off the boundary between these two layers.

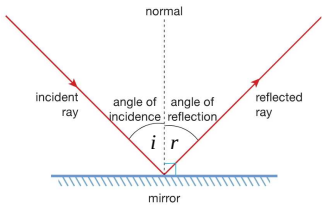


NOTE!

The scientific symbol used to represent a mirror shows only this reflective surface.

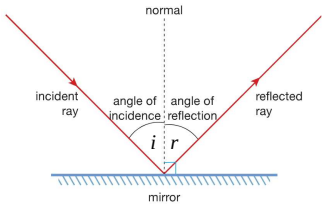
Reflection in a Plane Mirror

*You can use a **ray diagram** to show what happens when a light ray strikes a mirror. The ray of light that strikes the mirror is called the **incident ray**. The ray that reflects off the mirror is called the **reflected ray**. The ray diagram also includes a dotted line called the **normal**.*



Reflection in a Plane Mirror

The normal is an imaginary perpendicular line extending from the surface of the mirror (i.e. it makes an angle of 90° with the reflective surface). The normal is always drawn at the point where the incident ray strikes the mirror.



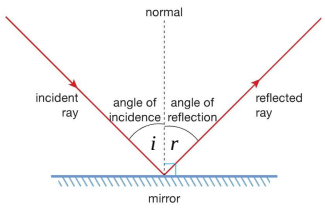
NOTE!

The normal allows us to measure the angles formed by the rays.

Reflection in a Plane Mirror

RAY DIAGRAM

- diagram showing the path of a light ray when it hits an object
- the normal allows us to measure the angles



NOTE!

*The angle between the incident ray and the normal is called the **angle of incidence (i)**. The angle between the reflected ray and the normal is the **angle of reflection (r)**. Notice that the arrowheads on the light rays show which way they are travelling.*

✔ Check Your Learning

1. Sometimes you can see a beam of sunlight streaming into a room through a window. Why is the beam visible?

   the room is darkened and the beam is traveling in a straight line

✔ Check Your Learning

2. (a) Draw a diagram showing light rays leaving a light bulb.
   (b) Explain how your diagram shows the direction and path of light.

✔ Check Your Learning

3. (a) Draw a ray diagram of a light ray being reflected by a plane mirror.
   (b) Describe the position of the normal in your diagram. What does the normal allow you to measure?

   (b) normal – is perpendicular (90°) to the surface
   – allows us to measure angles

✔ Check Your Learning

4. Explain, with the help of a ray diagram, why the shadow created by your hand on a wall grows larger when you move your hand closer to the light source.

✔ Check Your Learning

5. Explain why, when it is dark outside, you cup your hands around your eyes as you attempt to peer outside through a window in a well-lit room?

your hands are blocking the light in the room from reflecting off the window into your eyes so the only light entering your eyes is the light reflecting off the objects outside

✔ Check Your Learning

TEXTBOOK
P.409 Q.18

WIKI (PHYSICS)
- 2DPHYS - WS1 (Reflection)
- 2DPHYS - WS2 (What Is Light)