The Ray Model of Light

Notes_3_SNC2DE_09-10

Light travels in a straight line as long as it is moving through the same medium.
A laser beam shows that light travels in a straight line. The fact that we can not see around corners is further evidence of this.

[Note: light can be made to change directions : reflection, refraction.]

Medium refers to the substance through which light is travelling.

The fact that light usually travels in straight lines has led to the **Ray Model of Light**.
In a ray model of light, light is represented as straight lines called rays, which show the direction that light travels.

The path followed by the light is represented by a directed straight line called a **ray,** the arrowhead of the ray shows the direction in which light waves are travelling.

A bundle of rays is called a **beam**.

A beam in which the rays are parallel to each other is referred to as a **parallel beam**.

A beam in which the rays move closer together and meet is called a **converging beam**, while one in which the rays spread out is called a **diverging beam**.

Ray diagrams are drawings that show the path that light takes after it leaves its source.
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.

The use of light rays to determine the path of light when it strikes an object is called **geometric optics.**

When the light emitted from a light source such as a ray box or the Sun strikes a surface it is referred to as **incident light**.

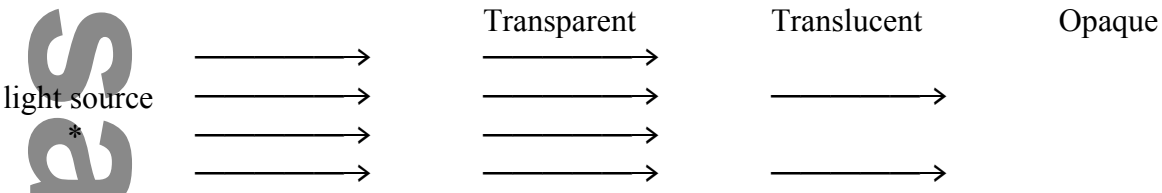
Types of Media

Light can travel through a vacuum and through some materials.
All substances may be classified according to how they transmit (i.e. pass on), reflect and absorb light.
Materials are classified according to their ability to transmit light.
1. **Transparent** media transmit all or almost all of the incident light so that objects can be seen clearly through them. Window glass, water, air, clean water and coloured plastic are transparent media.

2. **Translucent** media also transmit light, however some of the light is scattered, (absorbed or reflected), so the object can not be seen clearly. Frosted glass, clouds, human skin, waxed paper, and tissue paper are translucent media.

3. **Opaque** media does not transmit any incident light, all incident light is either absorbed, (causing the material to heat up), or reflected. Objects behind the material can not be seen. Metals, rocks, wood, and asphalt are examples of opaque media.

Ray diagrams to show how light is affected by transparent, translucent and opaque media.



Demo: To use behaviour of light to classify materials
Use a ray box to shine light through various materials such as wax paper, a wood block, triangular glass prism, frosted glass, plane mirror, paper.
Observe whether each material reflects light, and if the reflection is regular or diffuse.
Classify each material as transparent, translucent or opaque.

Assignment

1. What is the ray model **of** light?

2. What two models of light are used to describe how light behaves?

3. Draw a simple ray diagram of light rays travelling out from a light bulb.

4. What three things can happen when light strikes an object?

5. What determines how light rays behave when they strike an object?

6. Explain why a piece of metal would make a better reflector than a piece of wood.

7. One style of collector panel for domestic hot water consists fo a sheet of glass on top, a sheet of black painted metal on the bottom, and water flowing between. Describe the steps of what happens to sunlight striking such a panel.

Shadows

A shadow is a dark region that forms behind an object that is being illuminated more brightly on one side than on any other .

Shadows are formed when some or all of the light falling on an object is absorbed or reflected by it.

Ray diagrams help to 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 is the result when an opaque object blocks the direct light from a light source.

The size of a shadow depends on:

(1) the size of the object blocking the source of light
(2)and the distance of the blocking object from the light source.

A small light source casts a shadow that is sharp and well defined.
If the light source is large compared to the object blocking the light then the shadow will not have a sharp edge: this gives rise to the umbra and the penumbra regions.

The further the object from the light source smaller the shadow.
Example: the shadow created by your hand on a wall grows larger when you move your hand towards the light source.

Question:

1. State and explain the type of shadow that is likely to be cast when a spotlight shines on an actor on a stage.

2. a. Explain why the moon produces both an umbra and a penumbra during a solar eclipse.
   b. Draw a ray diagram to show how the shadows are formed during a total eclipse.