

## Chapter – 11: Light, Shadows and Reflections

- Light – form of energy – needed to see things
- Any object – visible under source of light
- Day time – source – sunlight – night time – source – light bulb, torch, etc
- Objects – either source of light or reflects light – visible to us

### Sources of light

- Any object – gives out light – source of light
- Sun, stars, electric bulb, candle, torch, etc
- Most imp. source – sun – 150 million km away from earth – daytime – bright
- Firefly – source of light – too dim – not useful – BUT – looks good in dark night
- 2 main groups –
  - Natural –
    - Occur in nature
    - Sun – best natural source
    - Stars, meteors, firefly, etc
  - Man-made –
    - Manufactured by men
    - Also called – artificial sources
    - Electric bulb, kerosene lamp, candle, torch, etc

### Luminous and non-luminous objects

- Objects – give out light – luminous objects
- These objects – sources of light
- Light given out by them – enters our eye – makes the objects visible
- Sun, flame of gas burner, red hot iron, etc
- Objects – do not give out light – non-luminous objects
- These objects – reflect light
- Luminous object – gives out light – falls on non-luminous objects – reflected by them – visible to us
- Table, chair, book, moon, planets, etc
- Sun – gives out light – moon – reflects the light – visible to us
- Most objects – around us – visible – reflected light

### Transparent, Translucent and Opaque Materials

- Light falls on any object –
  - All light passes through
  - Some light passes through – some light is reflected
  - All light reflected
- Transparent materials –
  - Allows – all the light to pass through
  - See through them clearly
  - Glass, polythene, air, water, groundnut oil, etc
  - Glass windows at home – transparent – easily seen through it

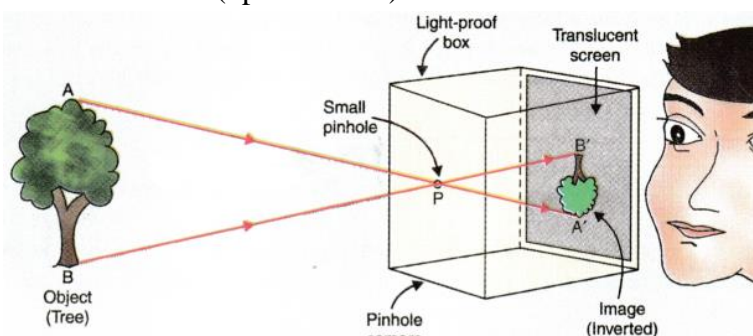
- Translucent materials –
  - Allow – some light to pass through
  - Cannot see through them clearly
  - Frosted (shaded) glass, butter paper, oily paper, etc
  - Clouds – translucent – cannot see the sun through clouds – but sunlight still there
- Opaque materials –
  - Do not allow – any light to pass through
  - Cannot see through them
  - Cardboard, book, wooden door, wall, etc
  - Cardboard – opaque – cannot see through it at all

## Light Travels in Straight Line

- Take any light source – observe its beam – straight line
- Search lights at airport – lights at light houses
- Place something in the path of light – shadow forms – confirms – light travels in straight path
- This property of light – rectilinear propagation of light
- Activity –
  - Light a candle – see it through a straight pipe – candle flame visible
  - Now – bend the pipe a little – try to see through it
  - Cannot see the candle flame
- Activity –
  - Take 3 cardboards – same size – make a hole – same position in all 3
  - Light the candle – place the cardboards – parallel to each other – all the holes in same line – candle flame visible
  - Push the middle cardboard – slightly sideways – candle flame not visible

## Pinhole Camera

- Small box – pinhole (small hole) in the front – translucent screen in the back
- Translucent screen – made of butter paper – receive image of objects
- Uses the concept – light travels in straight line
- Working of a pinhole camera –
  - Ray of light – coming from point A – forms an image at point A' on the screen
  - Ray of light – coming from point B – forms an image at point B' on the screen
  - Each point between A and B – forms an image between A' and B'
  - Lines AA' and BB' – straight lines – cross over (intersect) at pinhole P
  - Image formed – inverted (upside down)



- Pinhole camera – forms a real and inverted image
- Depending on distance between object and camera – size of image changes
- Making of a pinhole camera –
  - Take a cardboard box – make a pinhole in front – make a larger hole in the back – cover it with tracing paper
  - Take another cardboard box – slightly bigger – cut open the front and back
  - Slide the bigger box over smaller box
  - Pinhole camera is ready

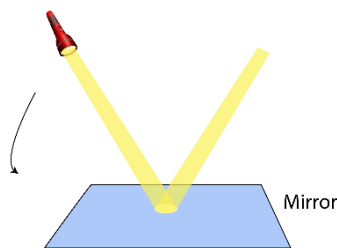
### Natural pinhole camera

- This effect – observed in everyday life
- Sunny day – pass under a tree – lots of leaves – bright circular patches – under the tree
- Small holes – between the leaves – act as pinhole

### Shadows

- Light – stopped by an object – produces a shade behind it – shadow
  - Transparent – light passes through it – no shadow
  - Translucent – some light passes – some light stopped – weak shadow
  - Opaque – stops all the light – stronger (darker) shadow
- Shadow – formed on the opposite side of light source
- Similar in outline to the objects – identify objects easily
- Sunlight – always forms a shadow – opposite side of source of light
- Shadow – observable on screen – walls of room, buildings, ground – act as screen
- Bird on ground – shadow observed easily – same bird – flying in air really high – shadow not observed
- Some sources of light – form strong (darker) shadows – sunlight, electric bulb
- Some sources of light – form weaker (lighter) shadows – long fluorescent tubes (tube light)
- Characteristics –
  - Always erect (same side up as the object)
  - Always real (formed on a screen)
  - Always black
  - Size may vary – depending on the distance of source of light

### Reflection of Light



- Light falls on an object – light bounces back – due to reflection
- Take a mirror – throw a beam of light – light reflects back – image formed on a screen (wall, piece of cardboard)
- Almost all objects – reflect light – rest other – sources of light

- Some objects – polished, shining surface – reflect more light
- Other objects – unpolished, rough surface – reflect less light
- Narrow beam of light – ray – travels in straight line – represented by straight line – arrow at the head (top)
- This ray – before reflection – incident ray – after reflection – reflected ray

## **Mirrors**

- Any object – reflects sufficient light – mirror
- Example – highly polished, shiny metal objects – acts as mirror
- Thin, flat, smooth sheet of glass – polished with silver or aluminium – one side – plane mirror
- Silver coating – protected by red paint
- Glass sheet – offers smooth surface – regular reflection – clear image
- Silver coating – offers shiny surface – maximum reflection – bright image
- Reflects most of the light
- Represented by straight line with some slant lines
- Straight line – represents front of the mirror
- Slant lines – represent silver coating at the back
- Plane mirrors – regular reflection – no scattering – image formed
- Rough surfaces – irregular reflection – lots of scattering – no image formed

## **Image of an Object**

- Look into a mirror – whatever seen in the mirror – reflection of ourselves – image
- Our face – object – reflection in mirror – image
- 2 types of images –
  - Real images –
    - Images obtained on the screen
    - Light rays – reflected from a surface – actually meet at a point after reflection
    - Example – image formed on cinema screen
  - Virtual images –
    - Images cannot be obtained on a screen
    - Just an illusion – also called unreal images
    - Example – image formed in a mirror, still water of lakes, pond, etc
- Virtual images – always erect, same size, at same distances as the object – BUT – reversed sideways
- Stand in front of the mirror – lift your right hand – image in the mirror – lifts its left hand
- This phenomenon – lateral inversion

## **To study the characteristics of image formed by a plane mirror**

- Rays coming from a bulb – fall on the mirror – reflects back from mirror
- Reflected rays – produced back inside the mirror – image formed there
- Characteristics –
  - Virtual –
    - Image – can only be seen inside mirror – cannot be obtained on screen – virtual
  - Same distance –
    - Distance of image – same as distance of object

- Same size –
  - Length and breadth of image – same as that of object
- Erect –
  - Top and bottom of object – same as top and bottom of image
  - Such image – upright
- Lateral inversion –
  - Right side of object – left side of image

## Periscope

- Device – provides higher view
- Using a periscope – see objects on the other side of a wall – without climbing the wall
- Soldiers use it – sitting in a trench – observe enemy activities on the ground
- Submarines – use periscope – watch enemies outside water
- Making of a periscope –
  - Take a long tube – 2 mirrors fitted at the 2 ends
  - Both the mirrors – parallel to each other – BUT – form  $45^\circ$  with the sides of the tube
  - 2 holes – one in front of each mirror
  - Top hole – light from an object enters the periscope – bottom hole – light exits form the periscope

