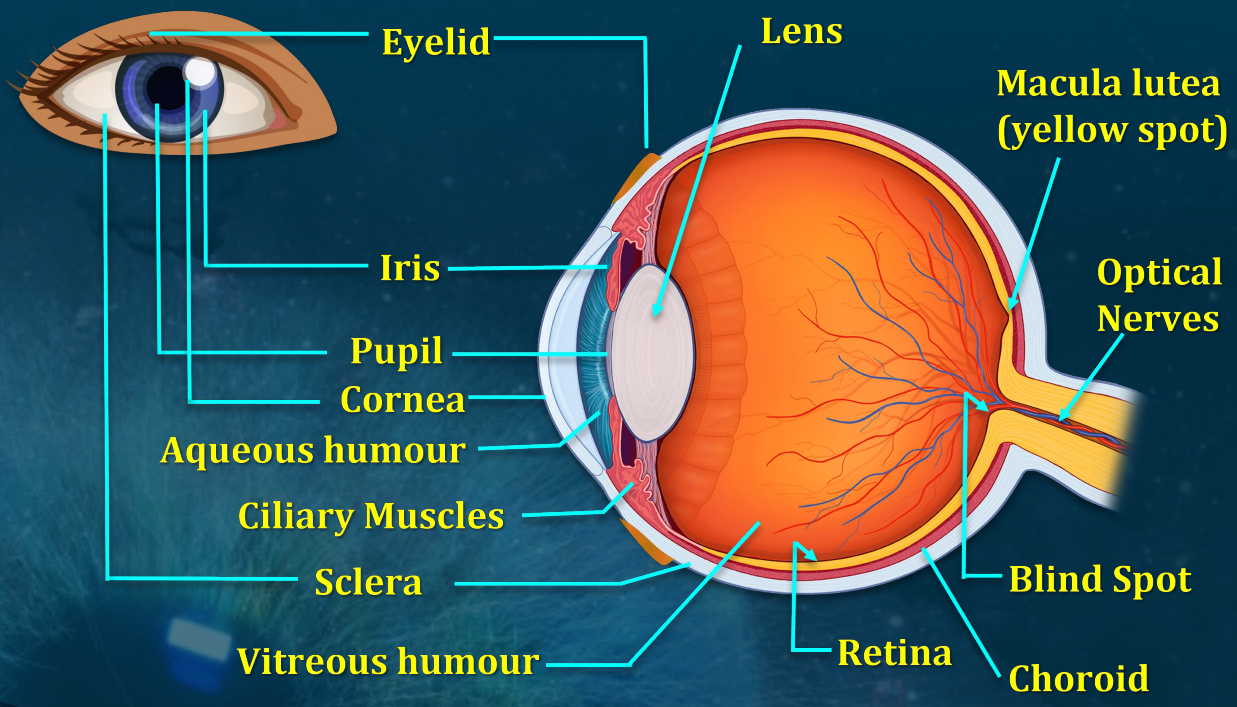
ALLEN®

The Human Eye & The Colourful World

Components and structure



Sclera or sclerotic

The outermost covering of eye and it is made of white fibrous tissue.

- It is tough so that it can protect the interior of the eye from accidents.

Aqueous humour

- Liquid between Cornea and Crystalline lens.

Vitreous humour

- Space between lens and the 'Retina' is filled with this liquid.

Cornea

- Thin transparent protective membrane visible from the outside.

Iris

- It is a muscular diaphragm, which gives distinctive colour to the eye.

Role of iris

- Iris controls the size of the pupil.
- When the light is very bright, iris contracts the pupil and the pupil becomes very small, thus, only a small amount of light enter into the eye.
- In low intensity of light, iris expands the pupil to allow more light to enter into the eye.

Eye lens

- A fibrous, jelly like material which is hard in the middle and soft at the edges.

Choroid

- A grey membrane attached to sclera.

Ciliary muscles

- The curvature of the lens is altered by the 'Ciliary muscles' to which it is attached.

Distant Object

01 Parallel light rays reach eye

02 Cornea refracts light rays

03 Ciliary muscle relaxes, Lens flattens

04 Suspensory ligament under maximum tension

Near Object

01 Diverging light rays strike eye

02 Cornea refracts light rays

03 Ciliary muscle contracted

04 Suspensory ligament loose, Lens thickened

Retina

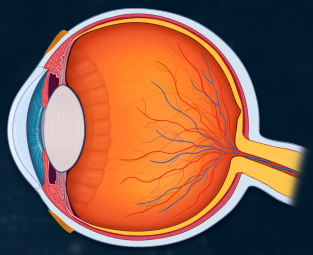
- A delicate membrane having enormous number of light sensitive cells.
- Image is formed on retina.
- Image is real and inverted.

There are two kind of cells -

Cones	Rods
Cones are responsible for color vision.	Rods are responsible for vision at low light levels.

Blind spot

- Image formed at this spot is not visible.

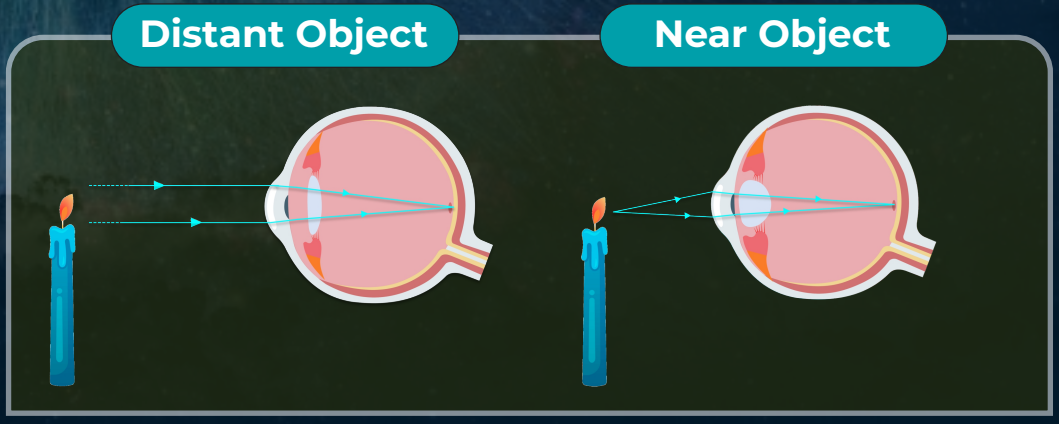


Optic nerves

- It transmit the information to the brain.

Power of Accommodation

- The ability or property of the eye to change the shape of lens so as to see the object clearly is called 'accommodation'.



Near point

- The nearest point for which the image can be formed clearly on the retina.

Least distance of distinct vision

- The minimum distance at which objects can be seen clearly without strain.

  For young adult – 25 cm

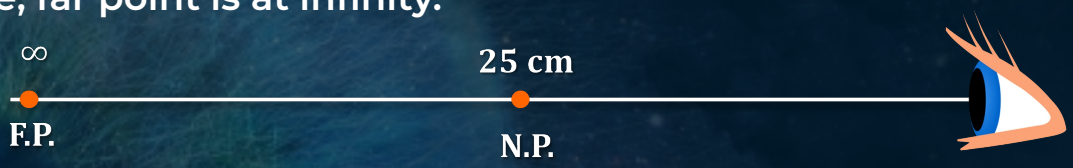
  For a child of 7 to 8 year – 7 to 8 cm

  For old man of 60 year – 200 cm

Far point

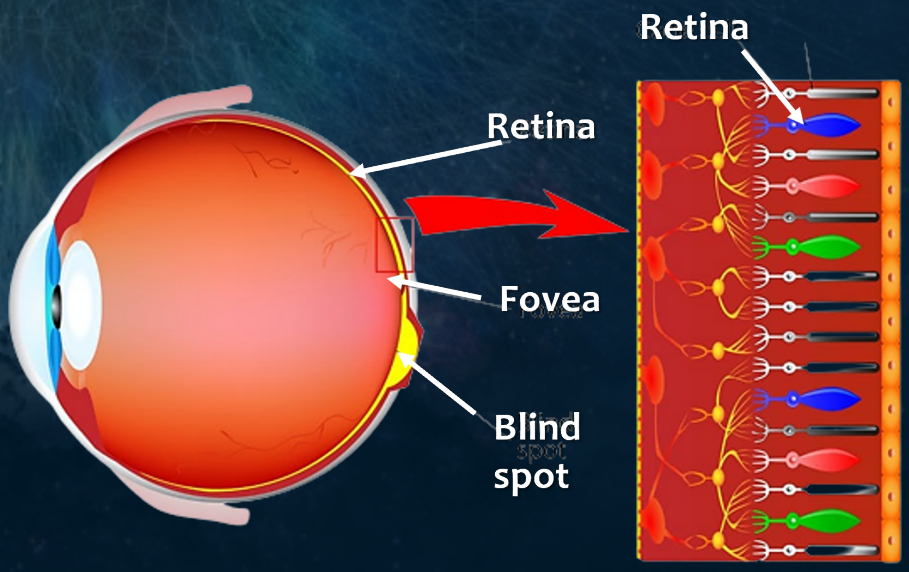
- The farthest point up to which the eye can see objects clearly.
- For normal eye, far point is at infinity.

Normal Eye



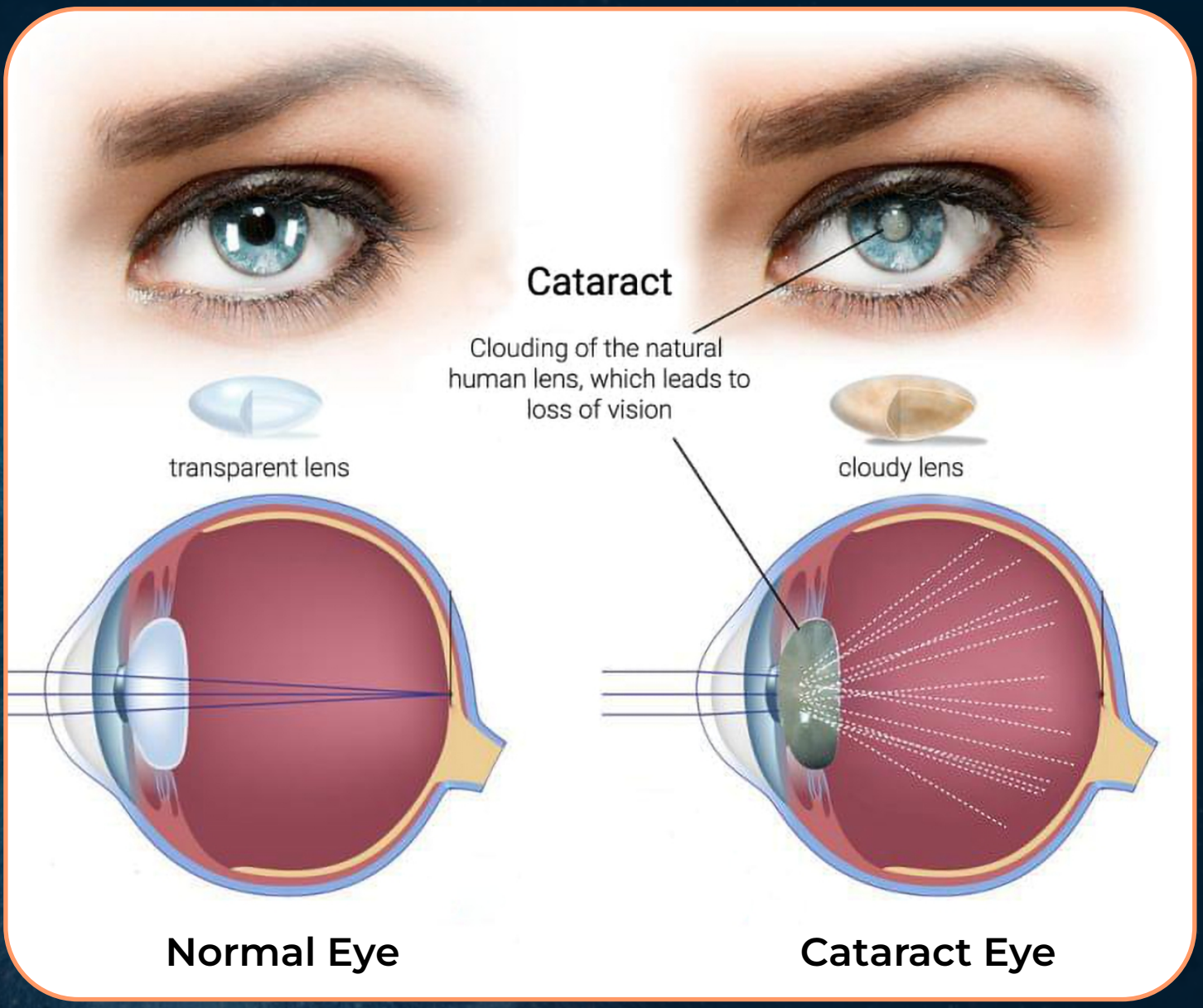
Colour blindness

- The defect of eye due to which a person cannot distinguish between colours is called 'colour blindness'.
- Colour blind persons cannot distinguish between red, blue and green colours.



Cataract

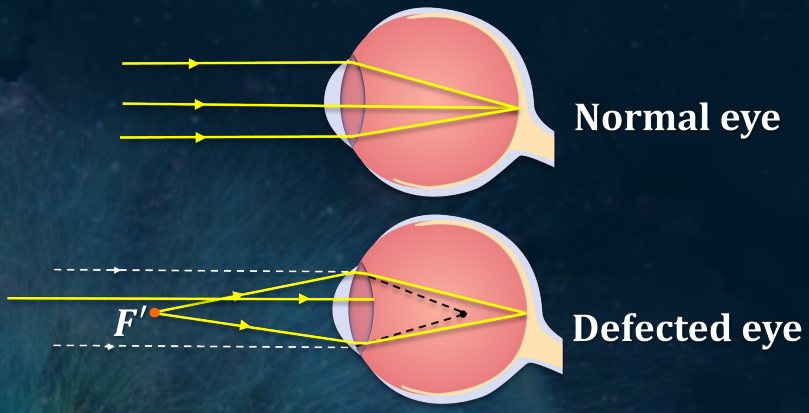
- The crystalline lens of some people in old age becomes hazy or even opaque due to development of membrane over it.
- Cataract can be removed by performing surgery to restore clear vision.



Defects of Vision and their Correction

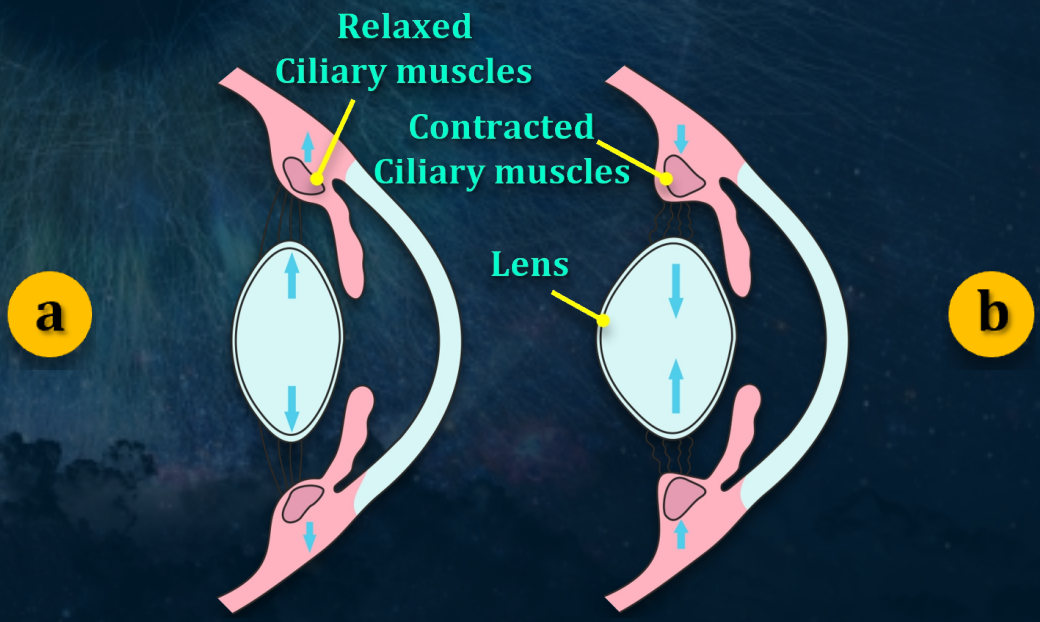
Myopia (Nearsightedness)

- Some persons can see near objects clearly but cannot see distant objects so clearly.
- In this defect nearby objects are clearly visible but distant object are not clearly visible.
- Far point of eyes is closer than infinity.



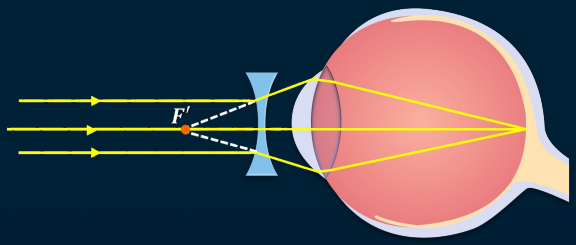
Reason

- High converging power of the lens (Ciliary muscles are not relaxed).
- Excessive curvature of the cornea.
- Elongation of eye-ball.



Correction of defect

- To remove this defect diverging lens (concave lens) is used.

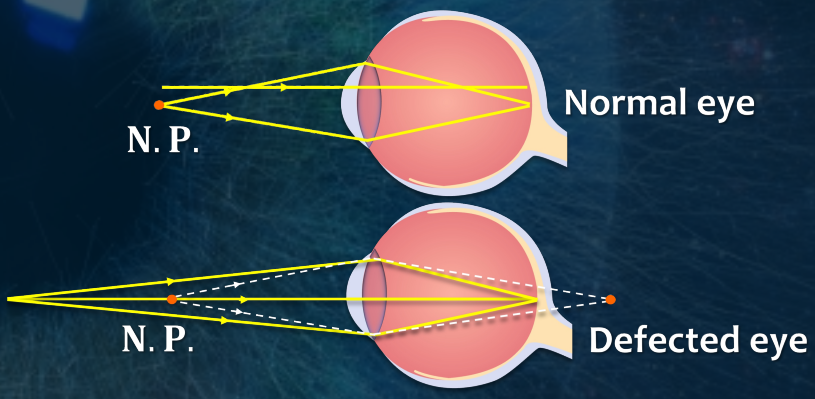


Hypermetropia (far sightedness)

- Some persons cannot see near objects clearly but they can see distant objects quite well.

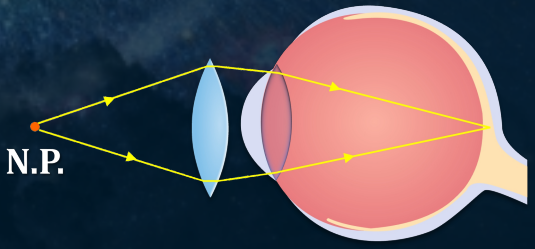
Reason

- The focal length of the eye lens is too great or eye ball becomes too short.
- In this defect distant objects are clearly visible but near by object are not clearly visible .
- Near point of eye is shifted away from the eye .



Correction of defect

- To remove this defect converging lens (convex lens) is used.



Presbyopia

- The defect that arises due to ageing in which a person cannot read comfortably and distinctly without corrective eye glasses is called 'presbyopia'.
- **Reason :** The power of accommodation of the eye decreases with ageing.
- **Correction of defect :** The defect can be corrected with converging lens.

Important Point

- Sometimes, a person may suffer from both myopia and hypermetropia. Such people often use bifocal lens.
- Commonly, the upper portion of bifocal lens is a concave lens (used for distant vision) and the lower portion is a convex lens (used for reading purpose).

Refraction of Light through a Prism

Triangular prism (Prism)

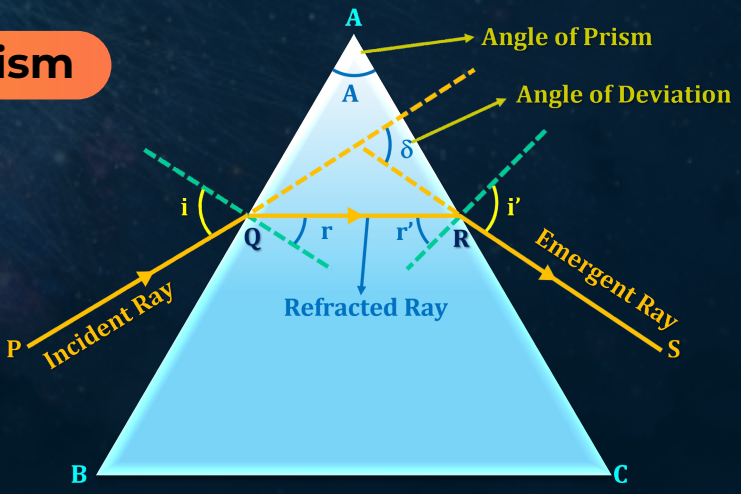
- A triangular cross-section piece of glass called a prism.



Refraction of light through a prism

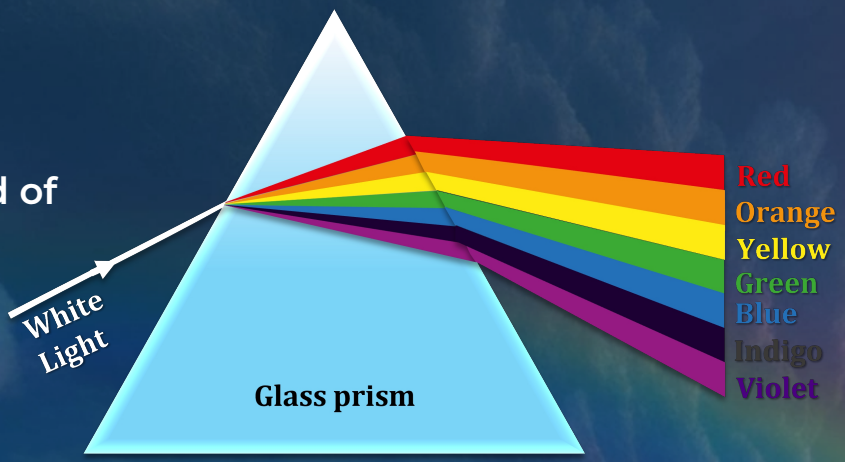
Angle of deviation

- The angle between the incident ray and the emergent ray is called ' angle of deviation'.



Dispersion of White Light

- White light is composed of seven different colors.



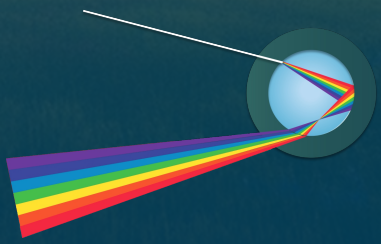
Dispersion of white light

- The phenomenon of splitting up of white light into its constituent colours is called 'dispersion of light'.
- When white light travels through a prism, a rainbow-like pattern appears on the other side. This effect is called dispersion.
- Dispersion is a method of demonstrating that white light is composed of many different colours (wavelengths) of light.
- Ice crystals, diamonds, raindrops, etc. also shows dispersion.

Rainbow

Natural Phenomenon

- The rainbow is the nature's most spectacular display of the spectrum of white light.



Formation of the rainbow

- After rain, there are many tiny droplets of water still in the air.
- Sunlight falls on these water droplets.
- These droplets act as tiny prisms.

- When sunlight falls on these droplets , the rays get refracted , then internally reflected and then refracted again.
- Due to this different colours of sunlight are bent at different angles and we are able to see a spectrum in the form of a rainbow.
- Violet ray emerges at an angle of 40° relative to incoming sunlight .
- Red light emerges at an angle of 42°.

  For other colours , angles lies in between these two values.
- We can see all the seven colours of rainbow in a hollow circular arc which is making an angle of 40° and 42° at our eye.

Atmospheric Refraction

- The refraction of light caused by the earth's atmosphere due to variable refractive index of air at different zones is called 'atmospheric refraction'.

Twinkling of stars

- Atmospheric refraction takes place due to gradually changing refractive index of the air.
- Luminous energy reaching our eyes per second from the star increases and decreases with time.

Star appears slightly higher than its actual position

- Apparent position of star is slightly higher than its actual position when it is viewed from the earth's surface.
- This apparent position is not stationary but it changes with time because of variable physical condition of the refracting medium.

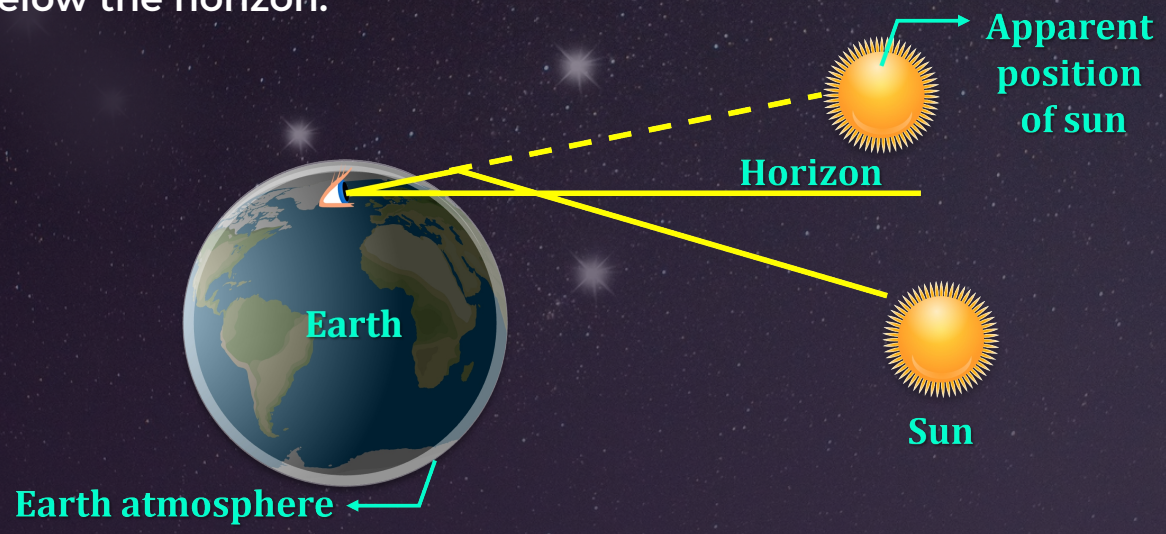


Why do planets not twinkle?

- The apparent size of stars is very small as compared to apparent size of planets. The star may be considered as a 'point sized' source of light and the planet as an 'extended source' of light.

Delayed sunset and advanced sunrise

- The sun is visible before actual sunrise and after actual sunset because of atmospheric refraction.
- The sun appears to be raised above the horizon when it is slightly below the horizon.



- The apparent shift in the direction of sun is about ½° and corresponding time difference between actual and apparent sunrise is about 2 minutes.

Scattering of light

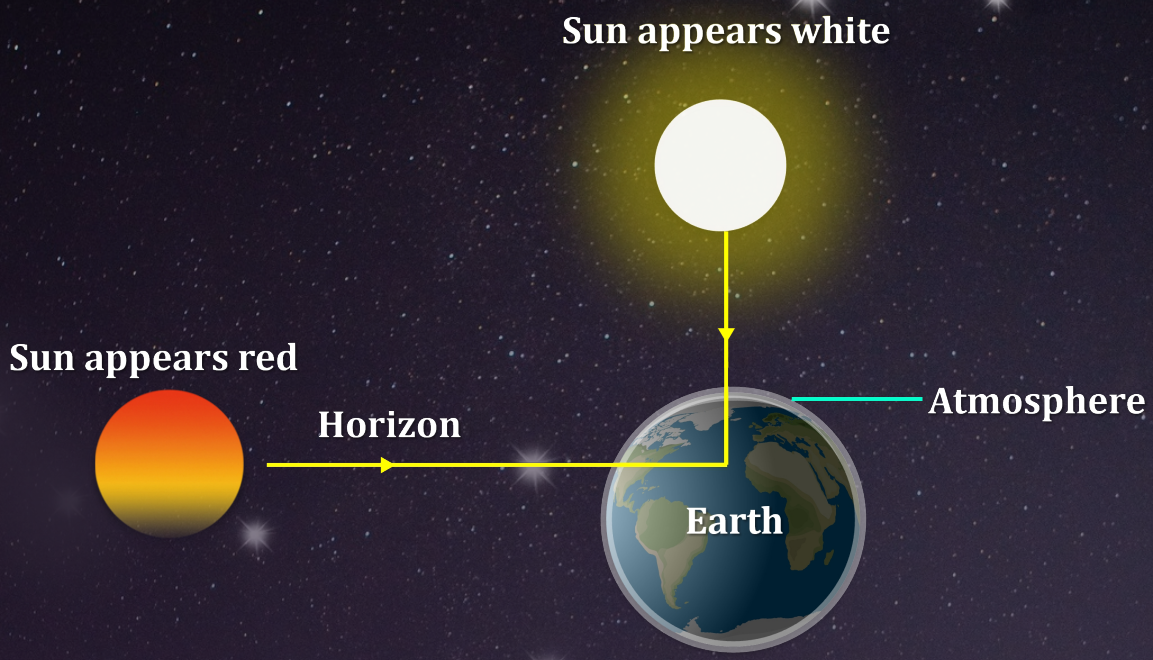
- The process in which the light rays are deflected by the particles of the medium through which they pass is called scattering of light.

Tyndall effect

- The scattering of light as it passes through a medium containing small particles is called 'Tyndall effect'.

- When sunlight passes through a canopy of a dense forest, tiny water droplets present in the air scatter the light.

Color of the sun at sunrise and sunset



- At the sunrise or sunset, the sun is near the horizon.
- Light reaching the eye of an observer travels a larger distance through the atmosphere.
- Most of the blue light and shorter wavelength rays are scattered away by the air particles.
- The light that reaches the eye of an observer is of longer wavelength (of red end).

Sun looks white at noon

- At the noon, the light has to travel a comparatively shorter distance.
- Only a very little amount of blue or violet light is scattered away.

Clouds are generally white

- The larger particles like dust and water drops scatter light of all colour, almost equally and all the colours reach our eyes equally and combine to form white light.