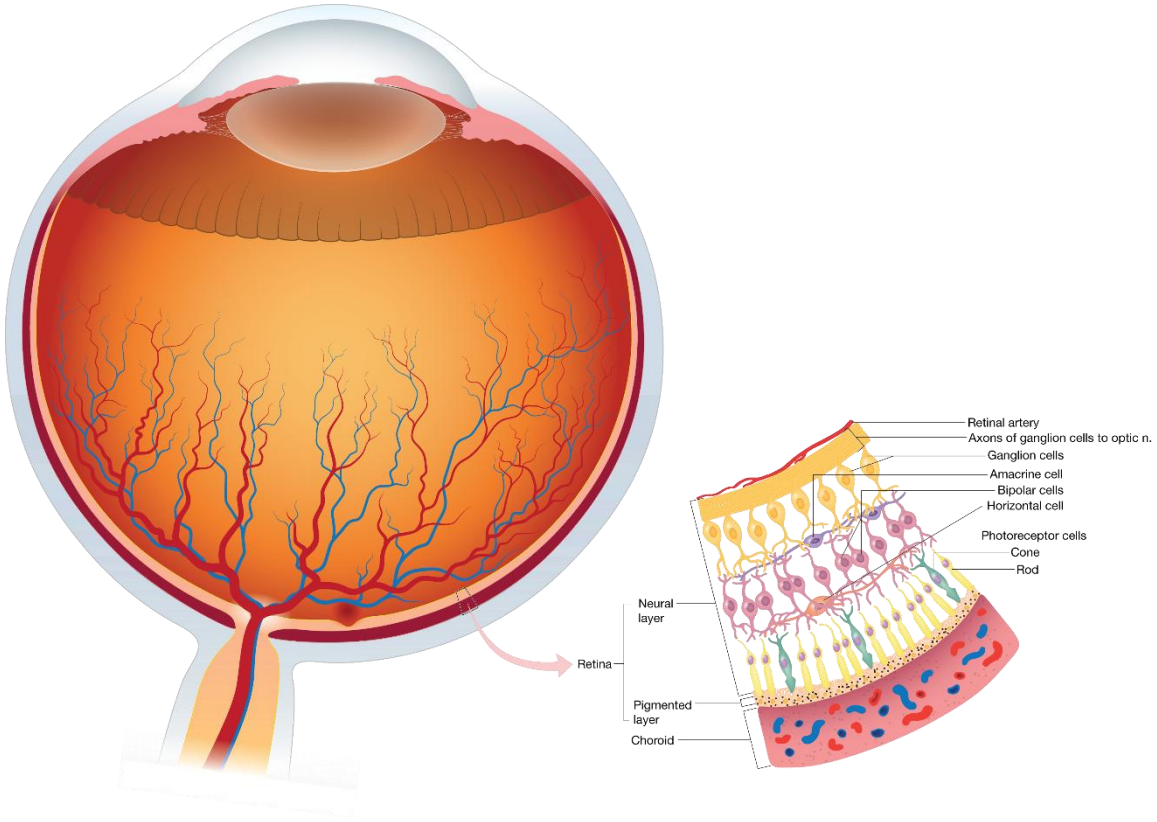
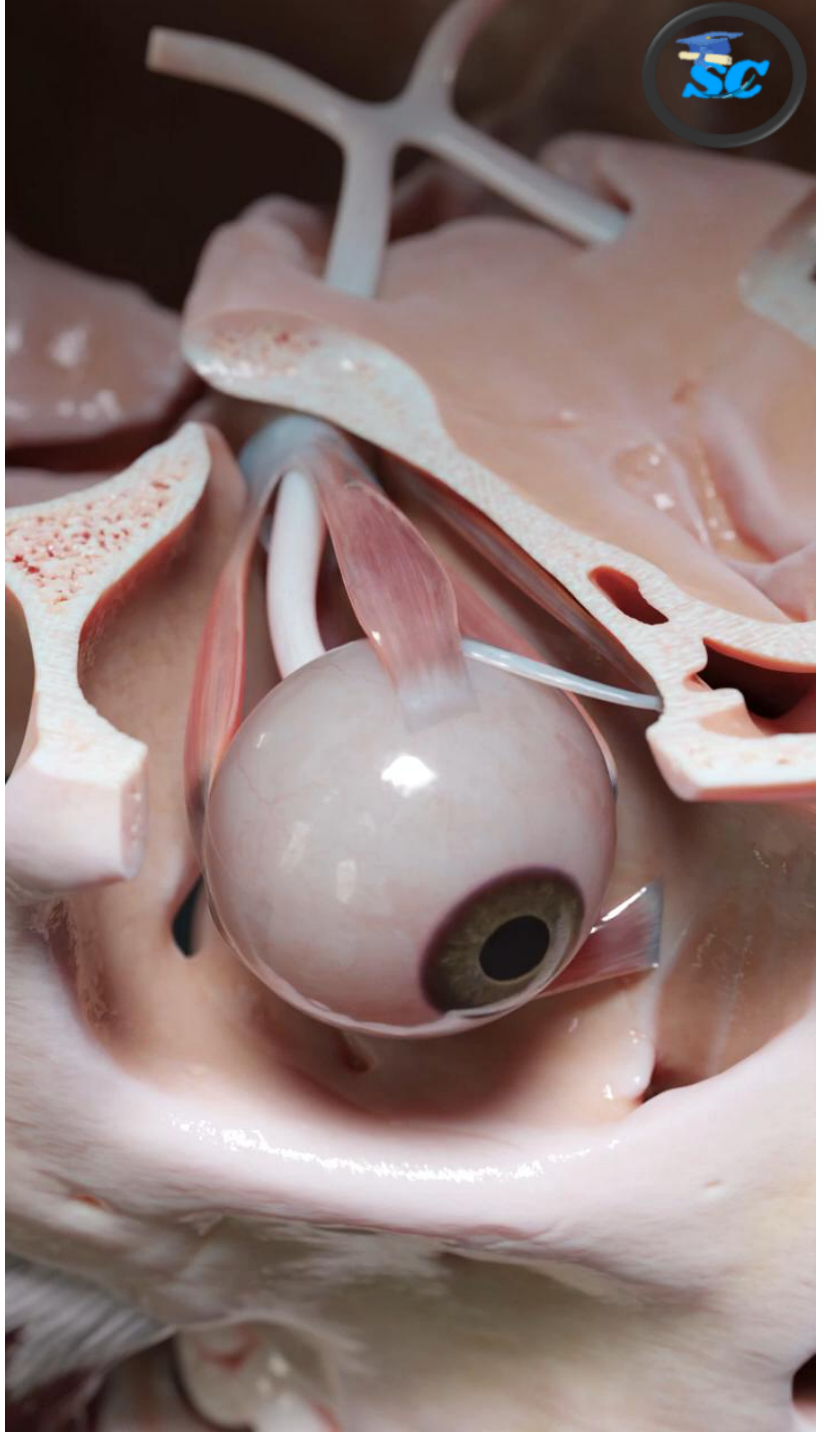
SCOPE CLASSES

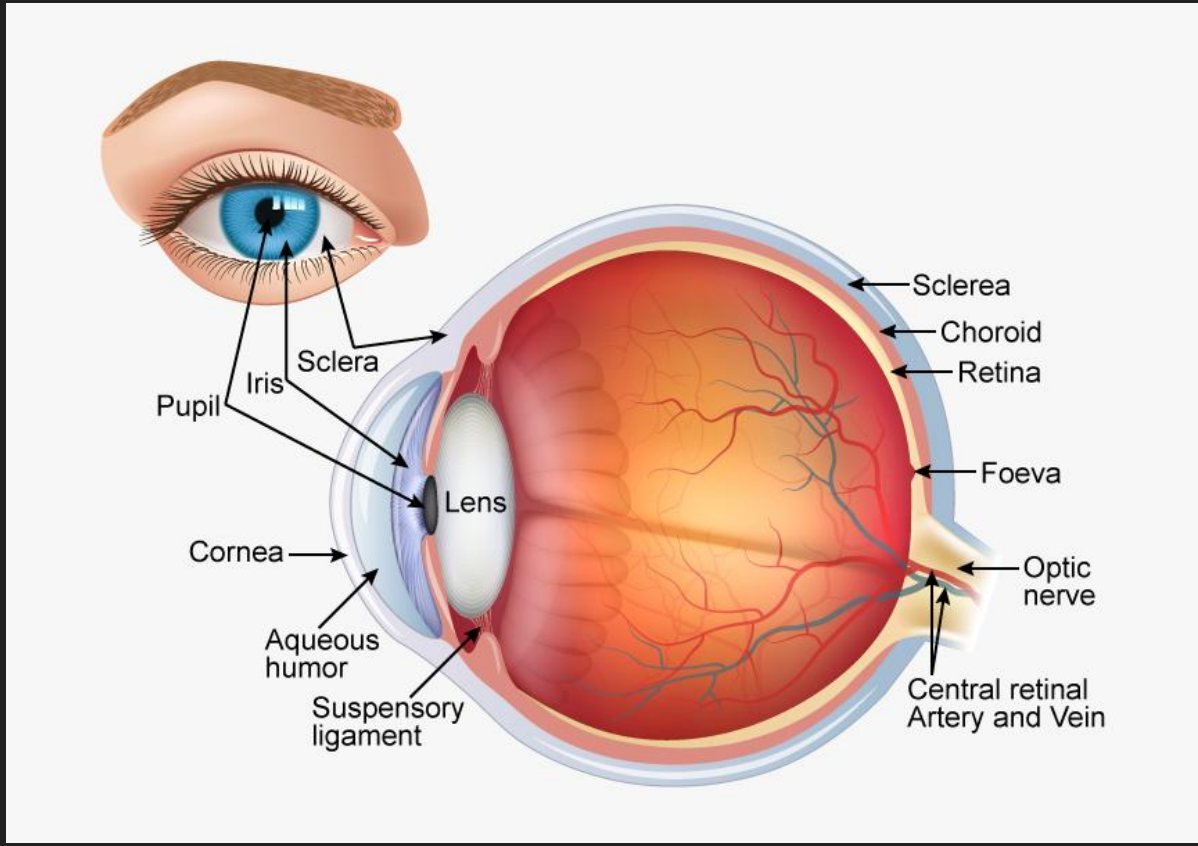
THE HUMAN EYE AND COLOURFUL WORLD

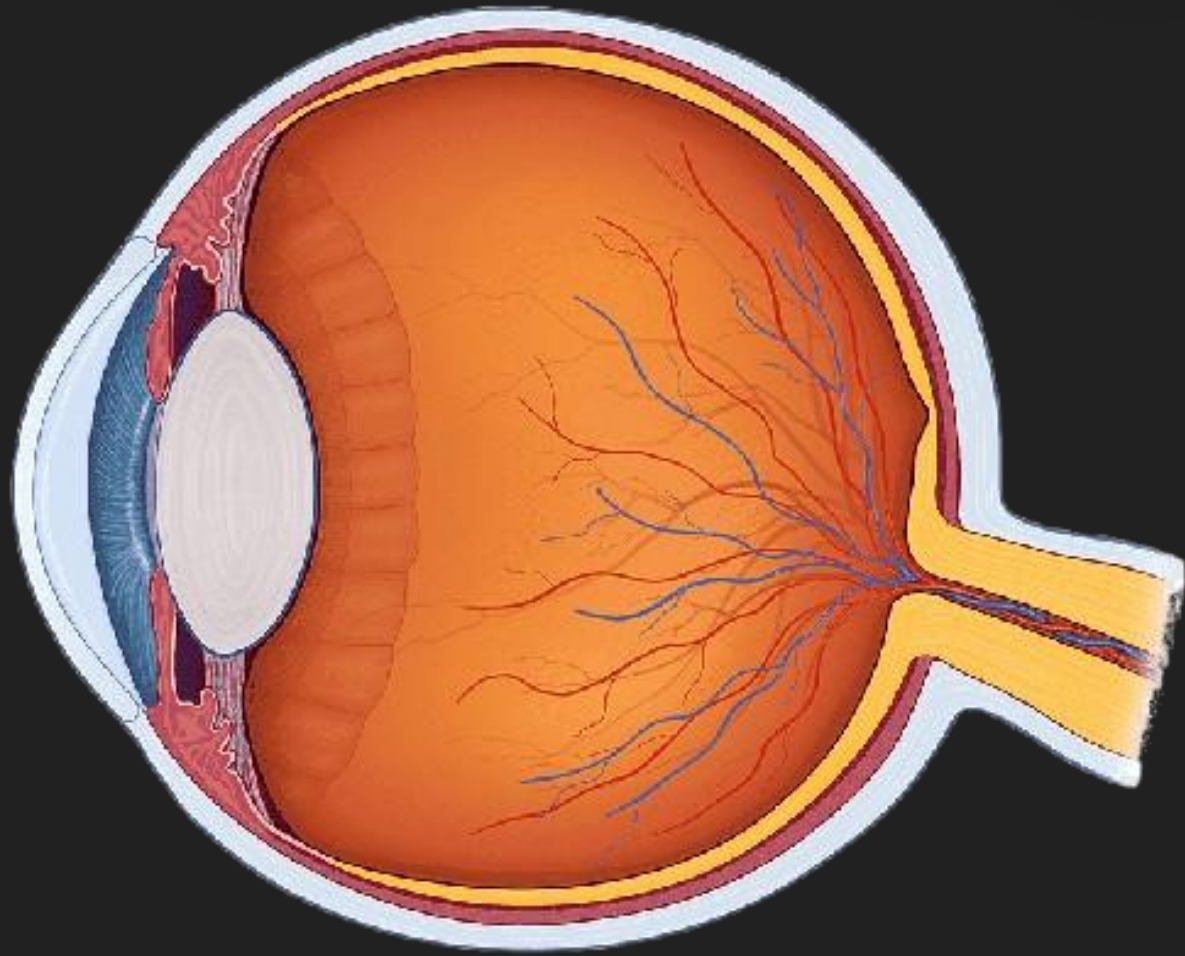
Exploring Vision and the Magic of Colors





Structure of human eye





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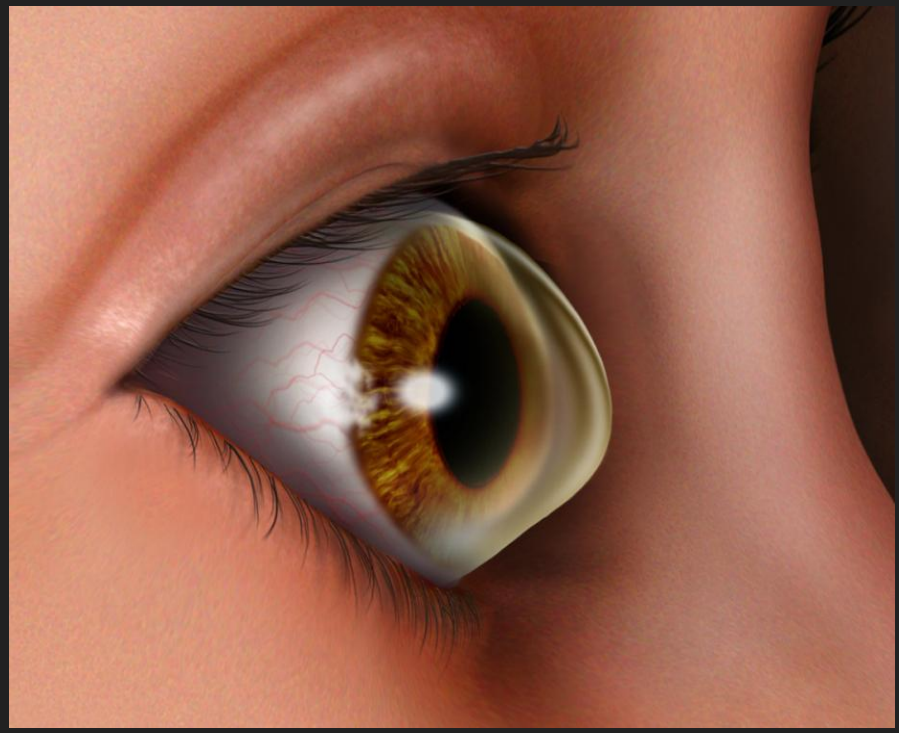
Cornea

1.The front part of the eye is called cornea.
2) It is made of a transparent substance and it is bulging outwards.
3) The outer surface of cornea is convex in shape.
4) The light coming from objects enters into eye through cornea.



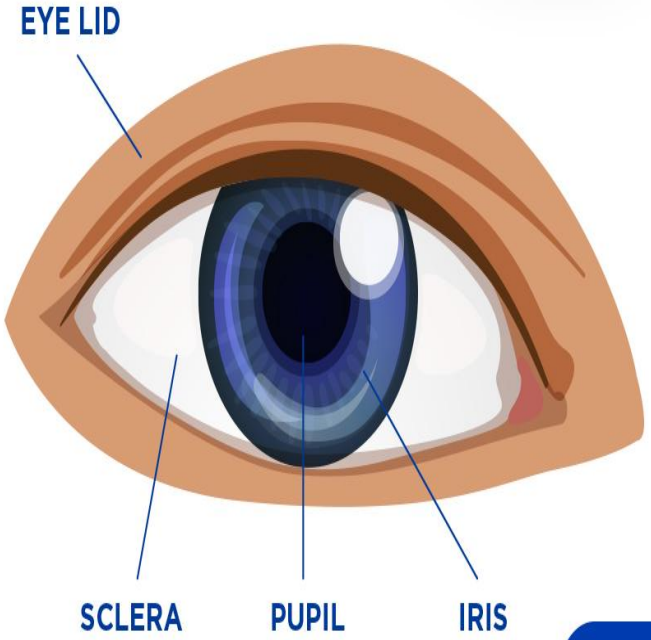
IRIS AND PUPIL

1) The colour diaphragm between the cornea and the lens is called Iris.

2)The iris is just situated behind the cornea.

3)There is a hole in the middle of the iris which is called pupil of the eye.

4) Thus, pupil is a hole in the middle of the iris. The pupil appears black because no light is reflected from it



FUNCTION OF IRIS AND PUPIL

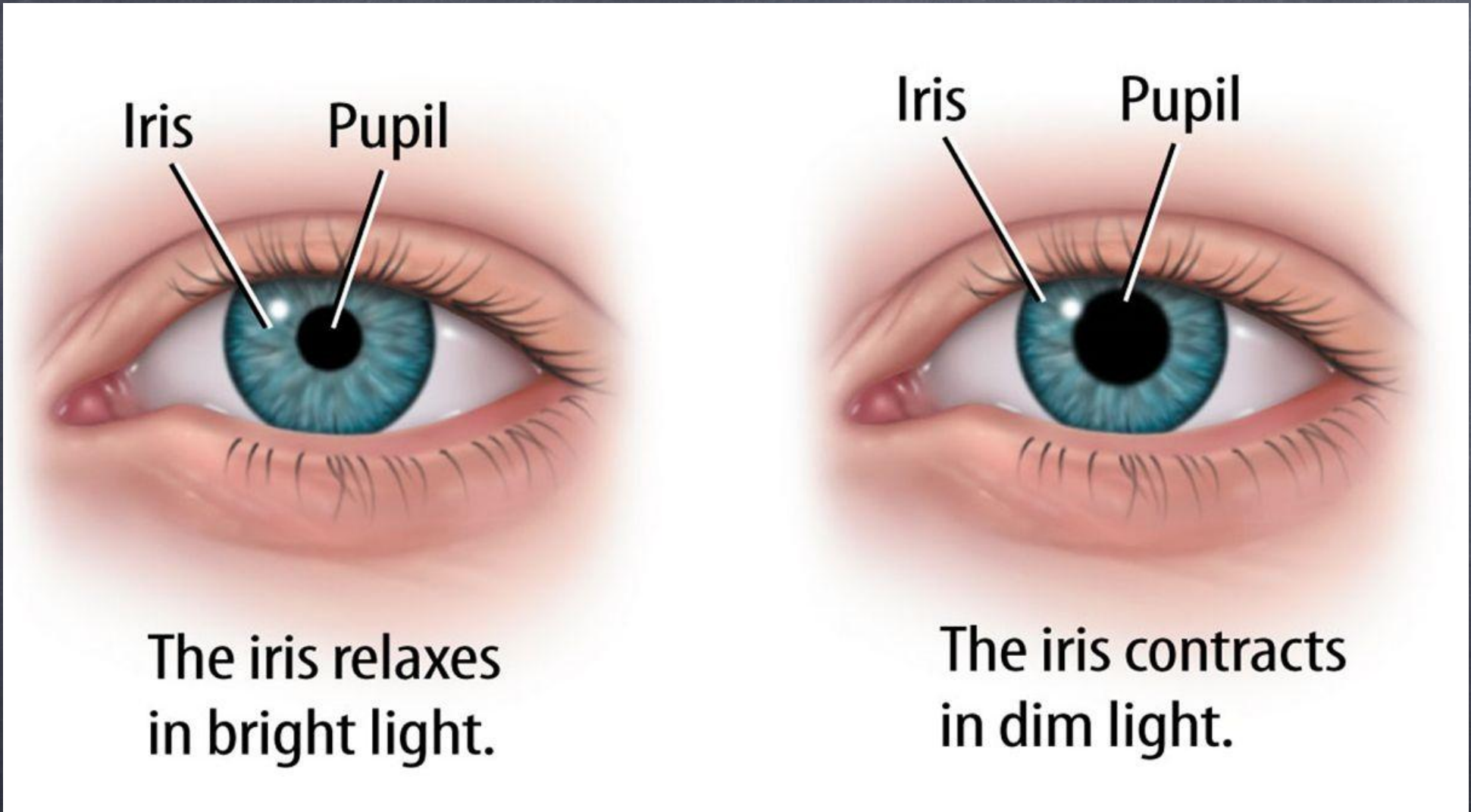
1.The iris controls the amount of light entering the eyes.

2. If the amount of light received by the eye is large (as during the day time), then the iris contracts the pupil (makes the pupil small) and reduces the amount of light entering the eye

3. if the amount of light received by the eye is small (as in a dark room or during night), the iris expands the pupil (makes the pupil large) so that more light may enter the eyes

Imp- The iris makes the pupil ‘expand’ or ‘contract’ according to the intensity of light around the eye.

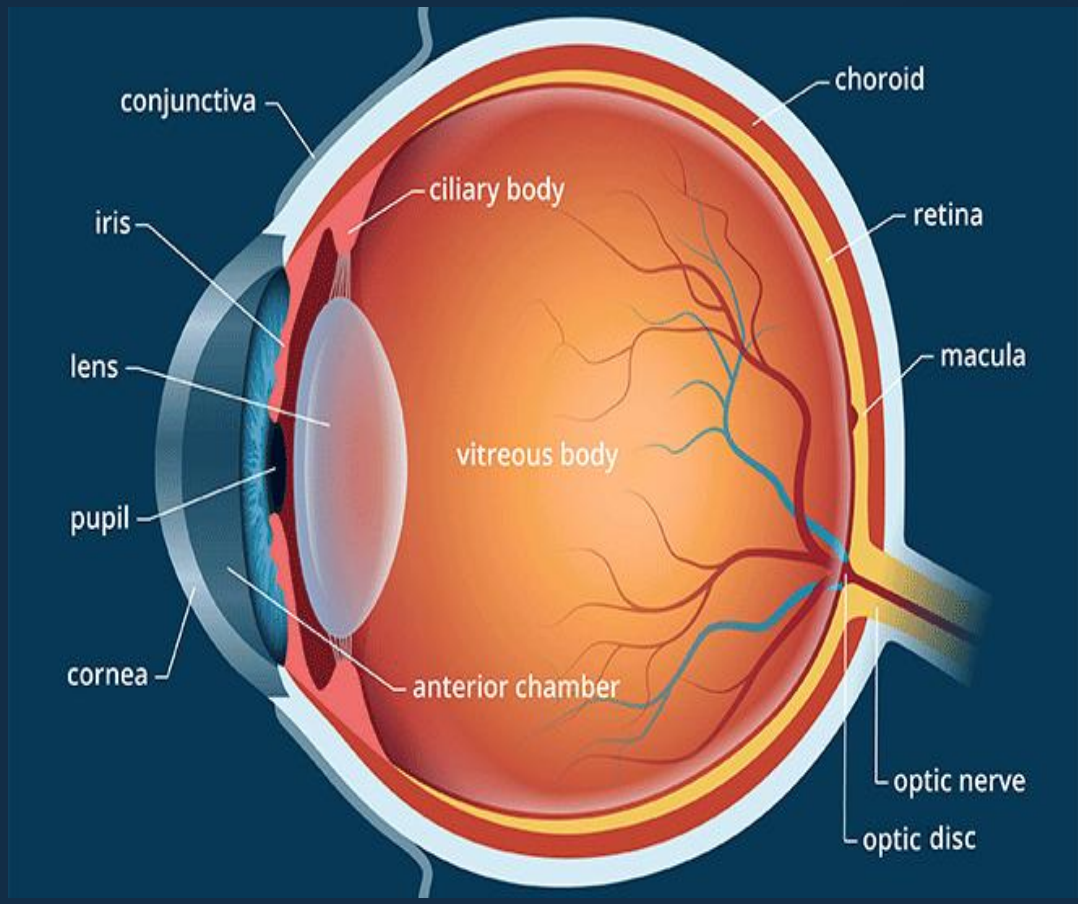
If the intensity of the outside light is low, then the pupil expands to allow more light to enter the eye. On the other hand, if outside intensity of light is high, then the pupil contracts so that less light enters the eye


Iris
Pupil
The iris relaxes in bright light.
Iris
Pupil
The iris contracts in dim light.

EYE LENS

1.The eye-lens is a convex lens made of a transparent, soft and flexible material like a jelly made of proteins.

2. The eye-lens is held in position by suspensory ligaments



CILIARY MUSCELES

Ciliary muscles change the thickness of eye-lens while focusing.

In other words, the focal length of eye-lens (and hence its converging power) can be changed by changing its shape by the action of ciliary muscles

RETINA

1) The screen on which the image is formed in the eye is called retina.
2) The retina is behind the eye-lens and at the back part of the eye.
3) The image is formed on retina is real and inverted.
4) The Retina have enormous number of light sensitive cells called Rods and Cones.

RODS AND CONES

Rods are the rod-shaped cells present in the retina of an eye.
which are sensitive to dim light.
It is also responsible for intensity of light.

Cones are the cone-shaped cells present in the retina of an eye.
which are sensitive to bright light (or normal light)
cone cells cause the sensation of colour of objects in our eyes.

OPTIC NERVES

There are some nerves that connect the retina with the brain and it is called the optic nerves.

BLIND SPOT

- Blind spot is the small region where the optic nerve and the retina meet.
- It has no sensory organs.

WORKING OF EYES

1.The light rays coming from the object kept in front of us enter through the cornea of the eye, pass through the pupil of the eye and fall on the eye-lens.

2. The eye-lens is a convex lens, so it converges the light rays and produces a real and inverted image of the object on the retina.

3. The image formed on the retina is conveyed to the brain by the optic nerve and gives rise to the sensation of vision.

4.. The retina sends these electrical signals to the brain through the optic nerve and gives rise to the sensation of vision

POWER OF ACCOMODATION

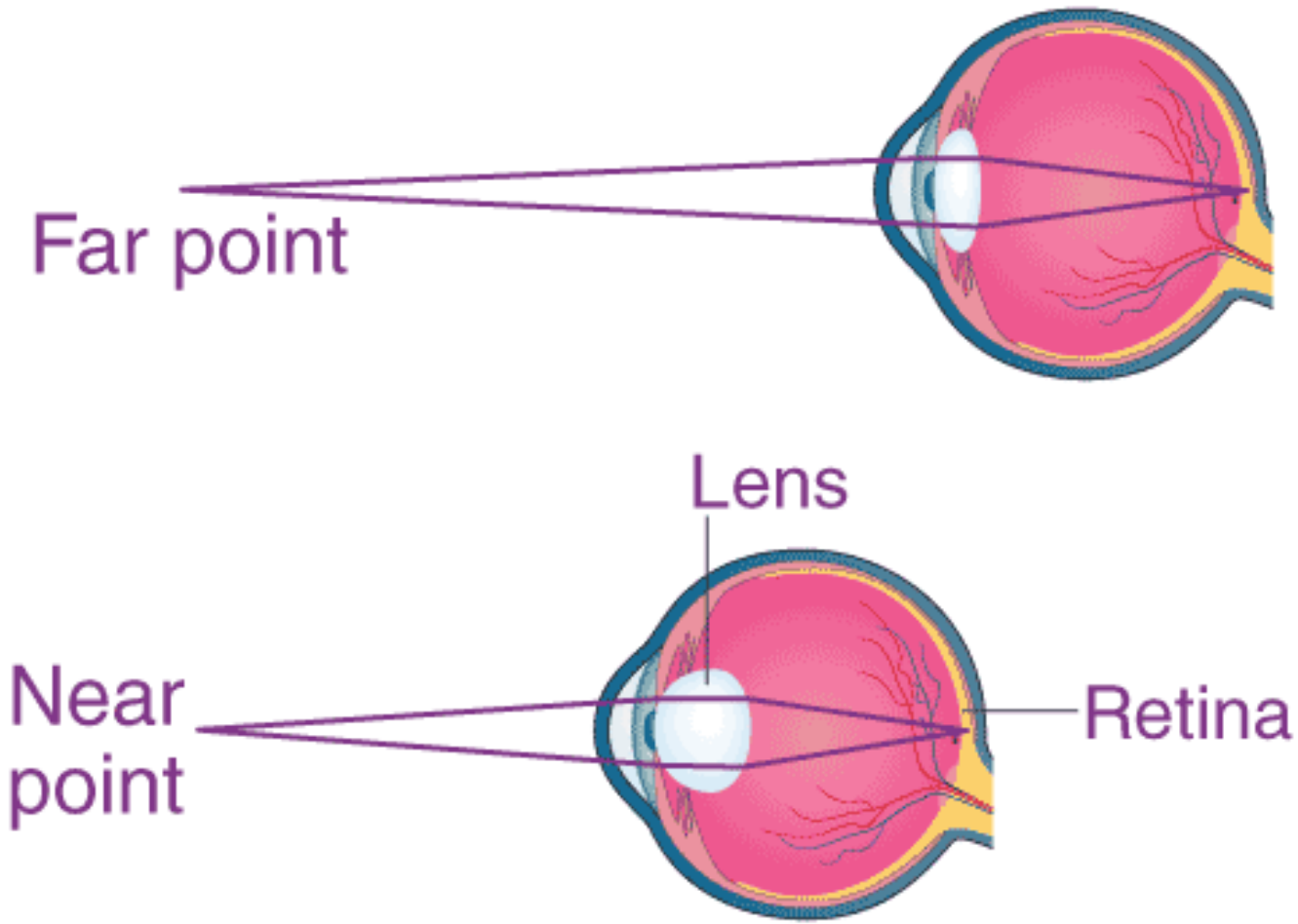
The ability of eye lens to adjust its focal length is called accommodation.

An eye can focus the images of the distant objects as well as the nearby objects on its retina by changing the focal length of its lens.

When the eye is looking at a distant object, the eye is said to be unaccommodated because it is the relaxed state of the eye.

The farthest point from the eye at which an object can be seen clearly is known as the "far point" of the eye. The far point of a normal human eye is at infinity

The nearest point up to which the eye can see an object clearly without any strain, is called the "near point" of the eye. The near point of a normal human eye is at a distance of 25 centimetres from the eye.



DEFECTS OF VISION AND THEIR CORRECTION

1. Myopia (Short-sightedness or Nearsightedness)
2. Hypermetropia (Long-sightedness or Far-sightedness)
3. Presbyopia.
4. Astigmatism
5. Cataract

MYOPIA

Myopia (or short-sightedness) is that defect of vision due to which a person cannot see the distant objects clearly (though he can see the nearby objects clearly).

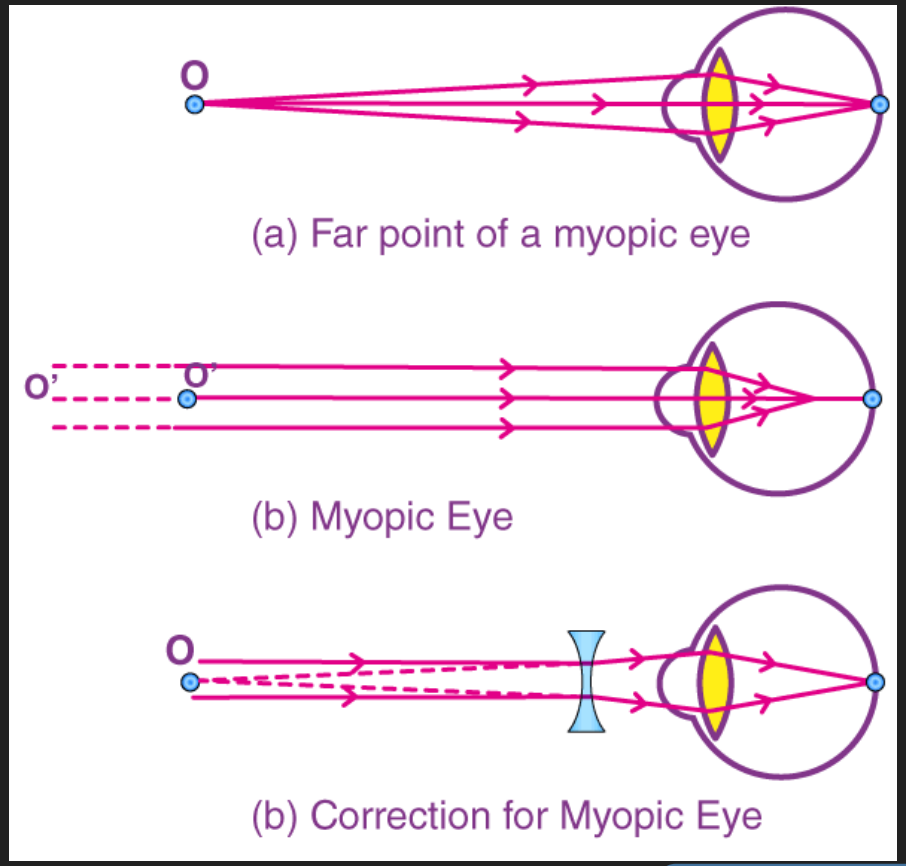
caused :

(i) due to high converging power of eye-lens (because of its short focal length)

(ii) due to eye-ball being too long

CORRECTION

Myopia (short-sightedness or near-sightedness) is corrected by using spectacles containing concave lenses.



HYPERMETROPIA

Hypermetropia (or long-sightedness) is that defect of vision due to which a person cannot see the nearby objects clearly (though he can see the distant objects clearly.

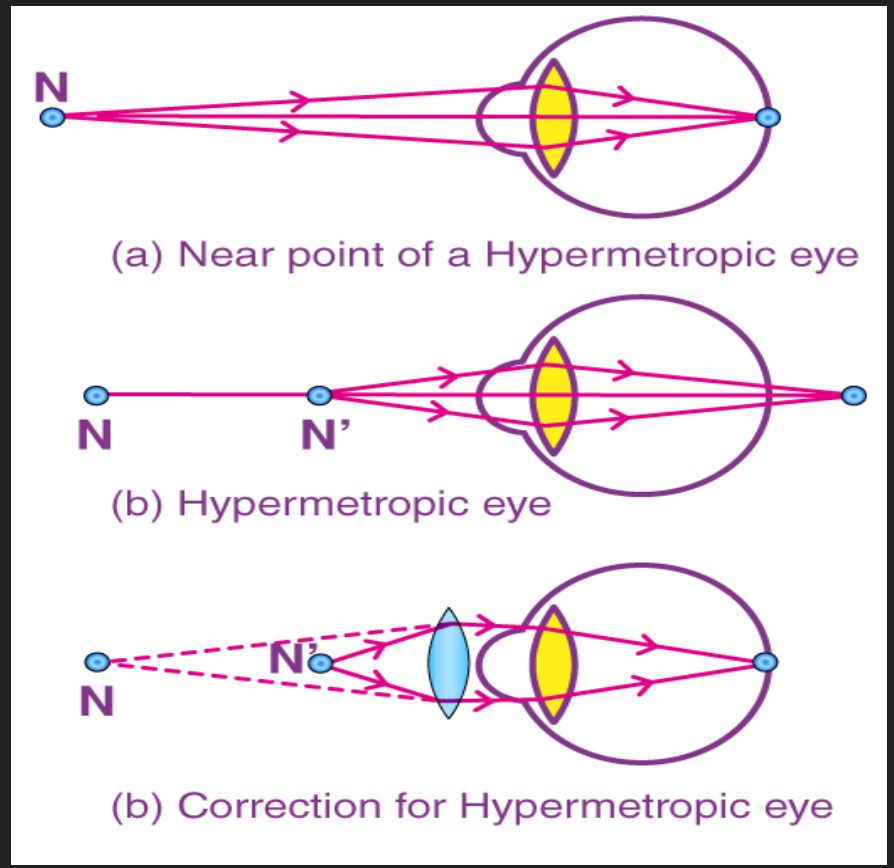
CAUSES -

(i) due to low converging power of eye-lens (because of its large focal length)

(ii) due to eye-ball being too short.

CORRECTION-

Hypermetropia (long-sightedness or far-sightedness) is corrected by using spectacles containing convex lenses



DEFECT	FARPOINT	NEAR POINT
Normal eye	Infinity	25cm
Myopia	infinity	Less than 25cm
Hypermetropia	Infinity	More than 25cm

PRESBYOPIA -. Presbyopia is that defect of vision due to which an old person cannot see the nearby objects clearly due to loss of power of accommodation of the eye.

OR

The eye which suffer from myopia as well as hypermetropia is said to be suffer from Presbyopia.

CAUSE - Presbyopia occurs in old age due to the gradual weakening of the ciliary muscles and diminishing flexibility of the eye-lens.

CORRECTION - It can be corrected by using bifocal lens having both types of lens concave as well as convex lens.(Bi-focal lens)

CATARACT - The medical condition in which the lens of the eye of a person becomes progressively cloudy resulting in blurred vision is called cataract.

CORRECTION - It can be corrected by surgery - opaque lens is removed and new artificial lens is put.

ASTIGMATISM

In this defect a person cannot focus on both horizontal as well as vertical lines at the same time so the person can see objects clearly only in one plane.

CAUSES: Astigmatism is caused by an irregularly shaped cornea or distorted lens.
CORRECTION: This defect can be corrected using cylindrical lens.

Persistence of vision

The sensation of the image remains on the retina for about $1/16^{th}$ of a second. It is called persistence of vision.

NUMERICALS

MYOPIA

HYPERMETROPIA

Q) A person needs a lens of power -5.5 dioptres for correcting his distant vision. For correcting his near vision he needs a lens of power +1.5 dioptre. What is the focal length of the lens required for correcting (i) distant vision, and (ii) near vision ?

Q) The far point of a myopic person is 80 cm in front of the eye. What is the nature and power of the lens required to correct the problem ?

Q) Make a diagram to show how hypermetropia is corrected. The near point of a hypermetropic eye is 1 m. What is the power of the lens required to correct the defect ? Assume that the near point of the normal eye is 25 cm.

Q) A person with a myopic eye cannot see objects beyond 1.2 m distinctly. What should be the type of the corrective lens used to restore proper vision?

Q) The far point of a myopic person is 80 cm in front of the eye. What is the nature and power of the lens required to correct the problem?

Refraction through a glass prism:

- When a ray of light passes through the prism, it bends toward the base of prism.

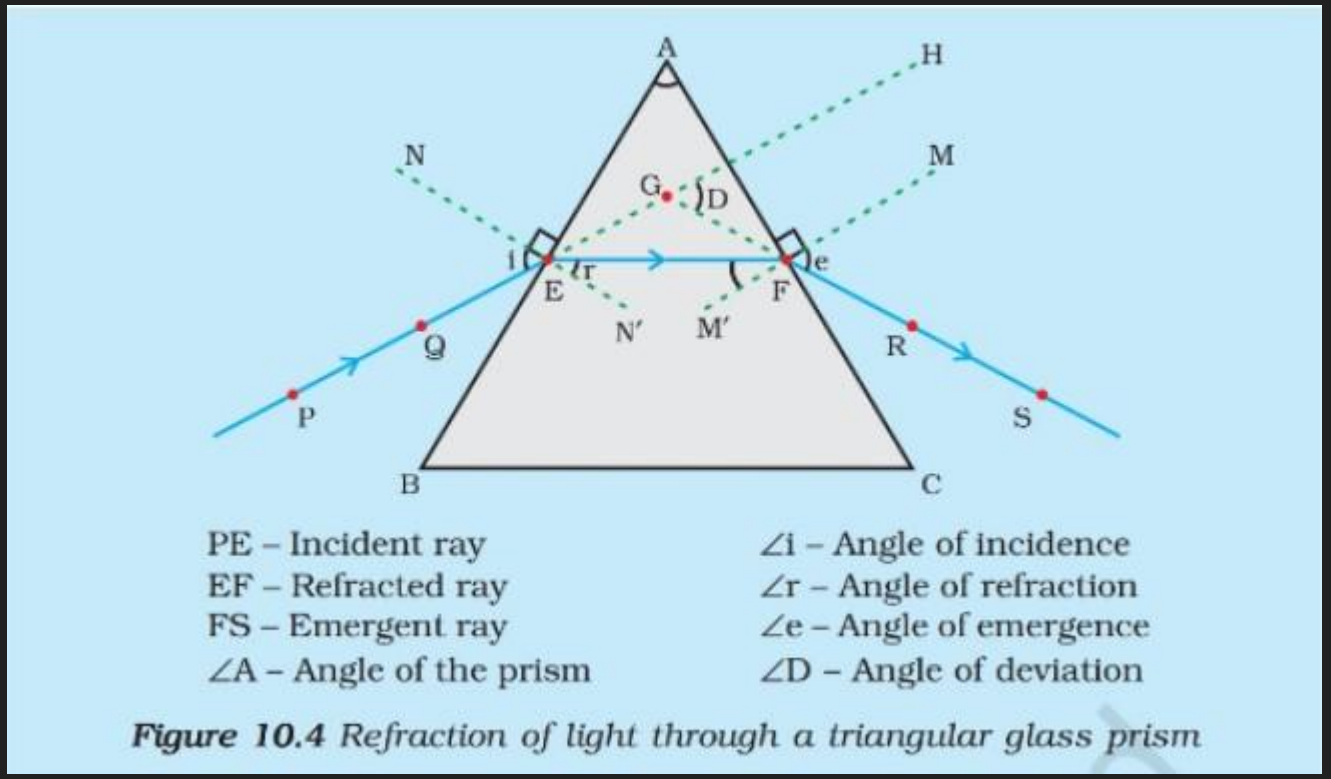


Figure 10.4 Refraction of light through a triangular glass prism

Angle of deviation

- The angle b/w incident ray and emergent ray is called angle of divination.

The basic different between refraction through a prism and glass slab is:

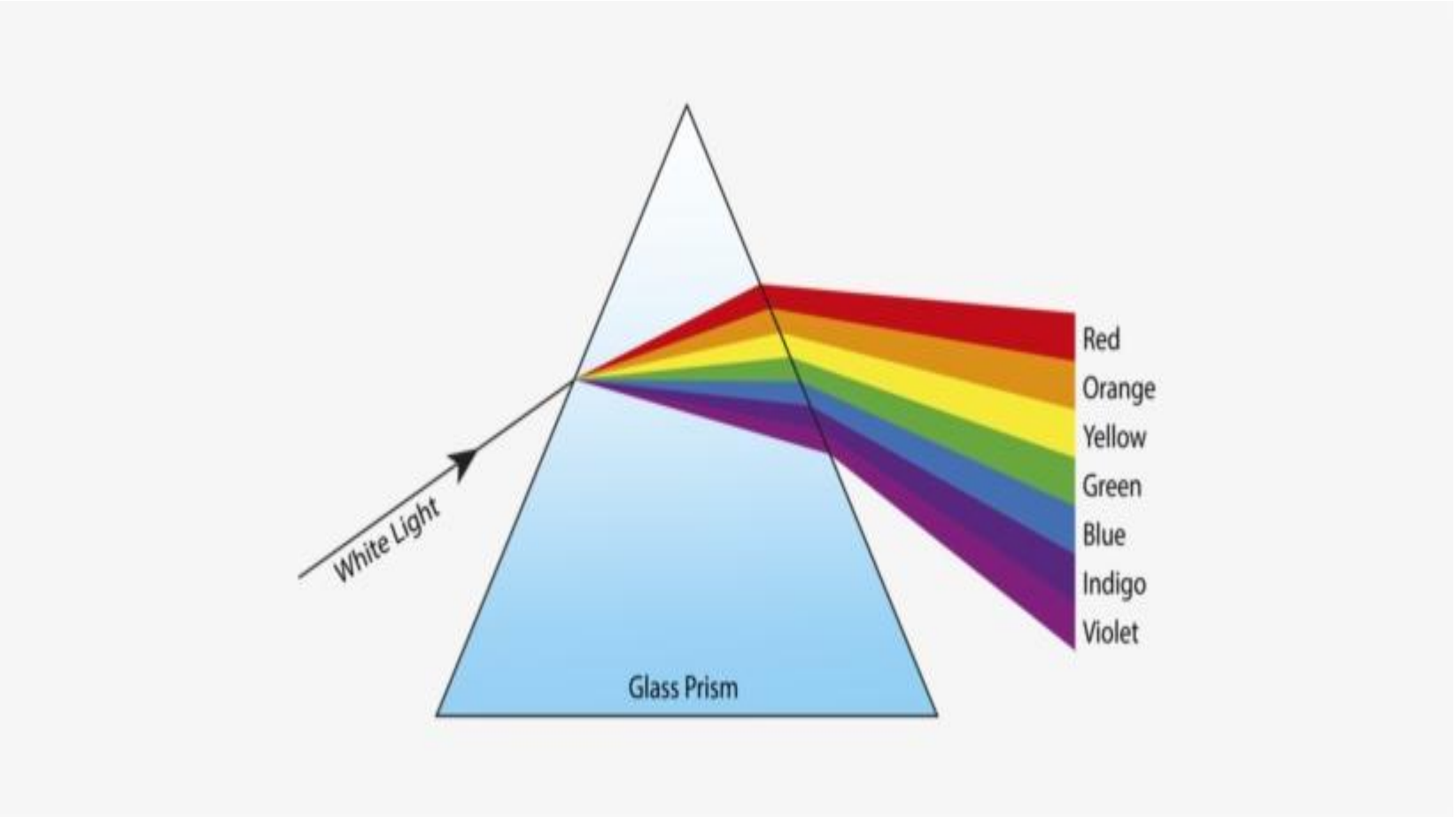
- Incident ray and emergent ray are **not parallel in glass prism.**

- Incident rays and emergent ray become **parallel in glass slab.**

Angle of prism

The angle between the two refracting surfaces of the prism, where light enters and exits.

Dispersion of white light



Dispersion of white light

In the year 1665, NEWTON prove that white light is a mixture of lights of seven colours.

The band of seven colours formed on a white screen, when a beam of white light is passed through a glass prism, is called spectrum of white light.

The splitting up of white light into seven colours on passing through a transparent medium like a glass prism is called dispersion of light.

. The dispersion of white light occurs because colours of white light travel at different speeds through the glass prism.

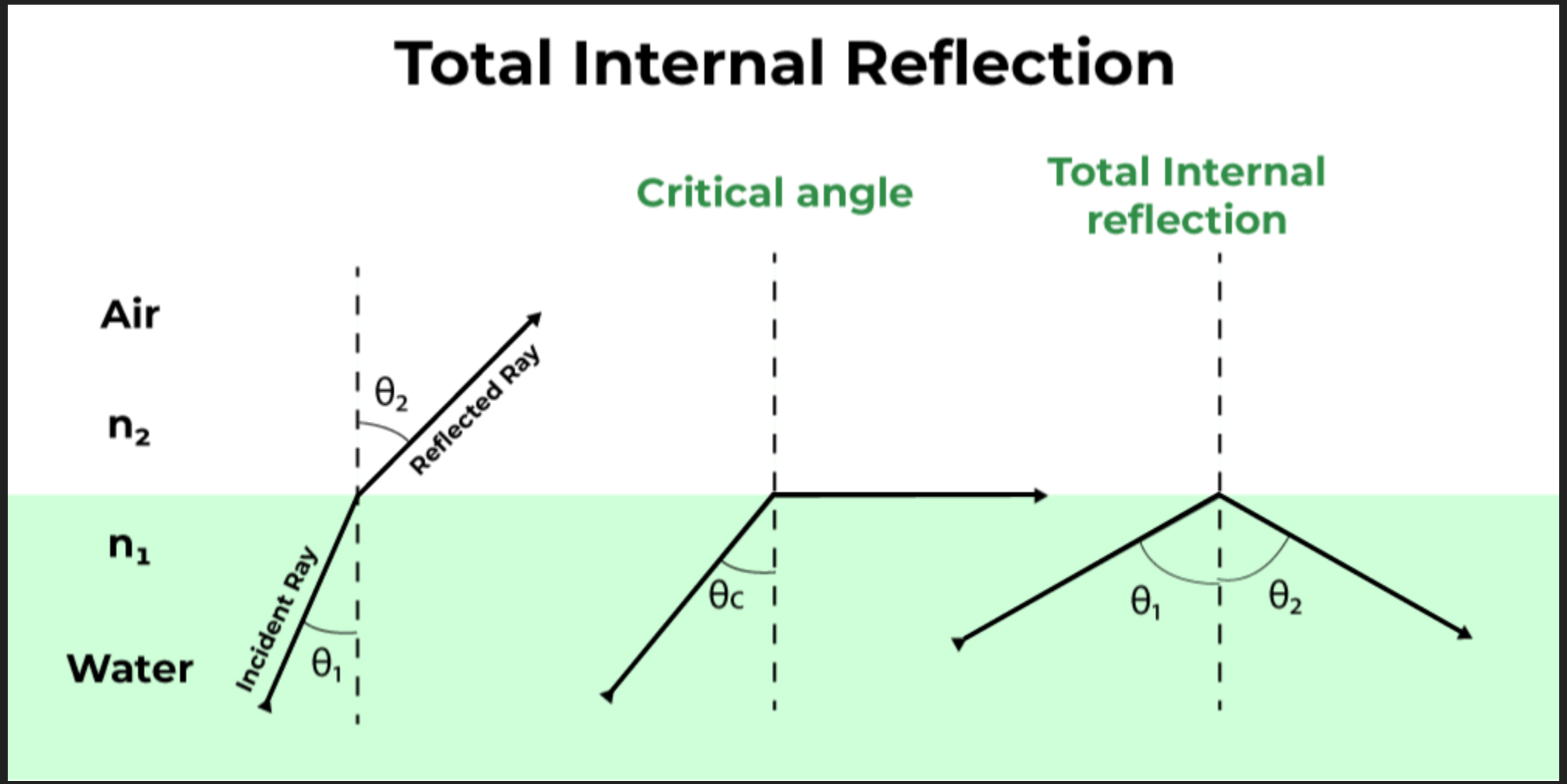
The red colour is deviated the least

The violet colour is deviated the maximum

Recombination of white light.

The first glass prism dispenses (Split) white light into seven colour. The Second glass prism (white has been placed upside down) recombined the sever Colour spectrum to give back white light.

Total Internal Reflection



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Total Internal Reflection

→ When light enters obliquely from a denser medium to a rarer medium and the angle of incidence exceeds critical angle, the light reflects in the denser medium. This is called total internal reflection.

Conditions necessary for Internal Reflection

→ Light should enter obliquely from a denser to a rarer medium.

→ The angle of incidence should exceed critical angle, the light reflects in the denser medium.

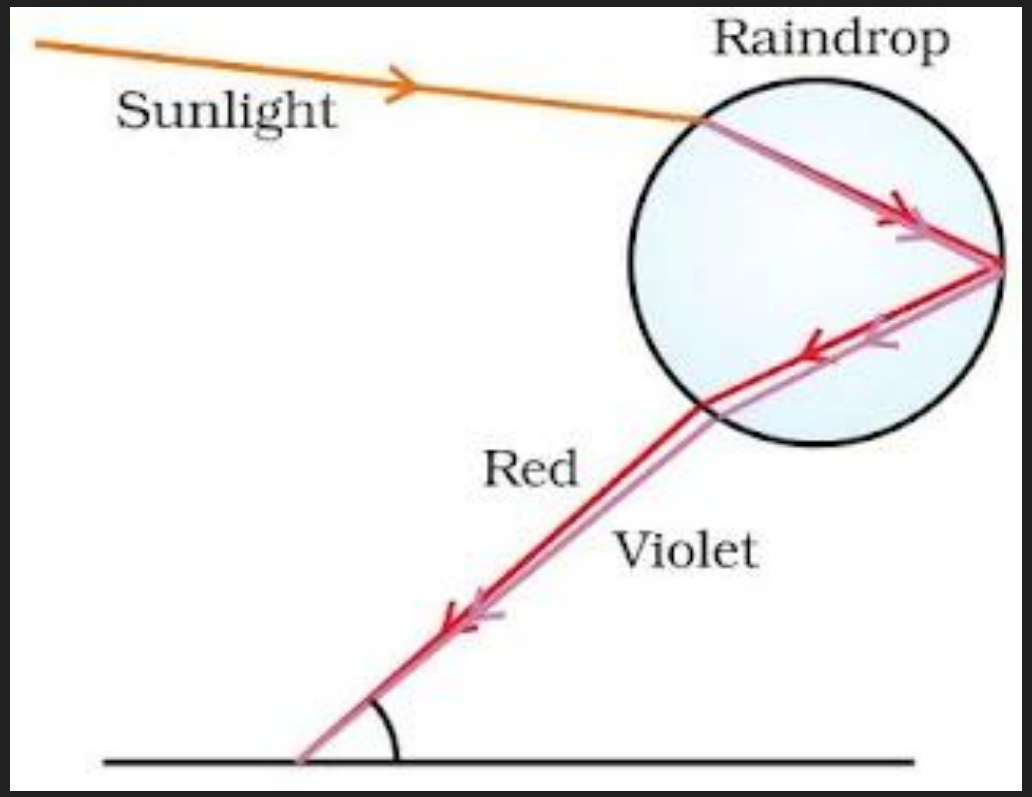
Critical angle: The angle of incidence for which the angle of refraction is 90º

Rainbow

The rainbow is an arch of seven colours visible in the sky which is produced by the dispersion of sun's light by raindrops in the atmosphere.

Rainbow is always formed in a direction opposite to that of the sun

A rainbow is produced by the dispersion of white sunlight by raindrops (or water drops) in the atmosphere. Each raindrop acts as a tiny glass prism splitting the sunlight into a spectrum. The raindrops in the atmosphere act like many small prisms.



Three phenomenon which are involved in rainbow formation are
:(i) Dispersion
(ii) Refraction
(iii) Internal reflection

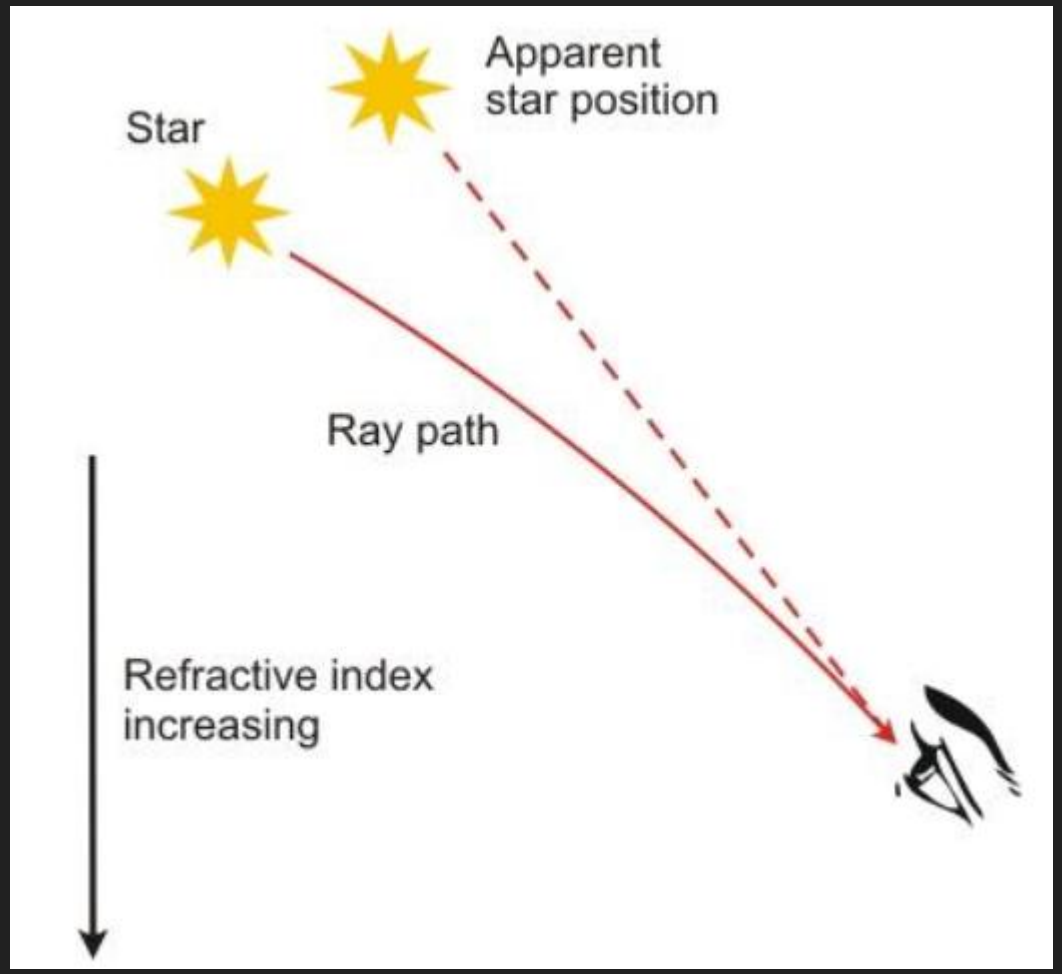
Atmosphere refraction

The refraction of light caused by the earth's atmosphere (having air layers of varying optical densities) is called atmospheric refraction.

Apparent position of star

- Light from star under goes continuous refraction as it enters the earth atmosphere since the refracted ray bend toward the normal, the star appears at different position and appear slightly higher than their actual position.

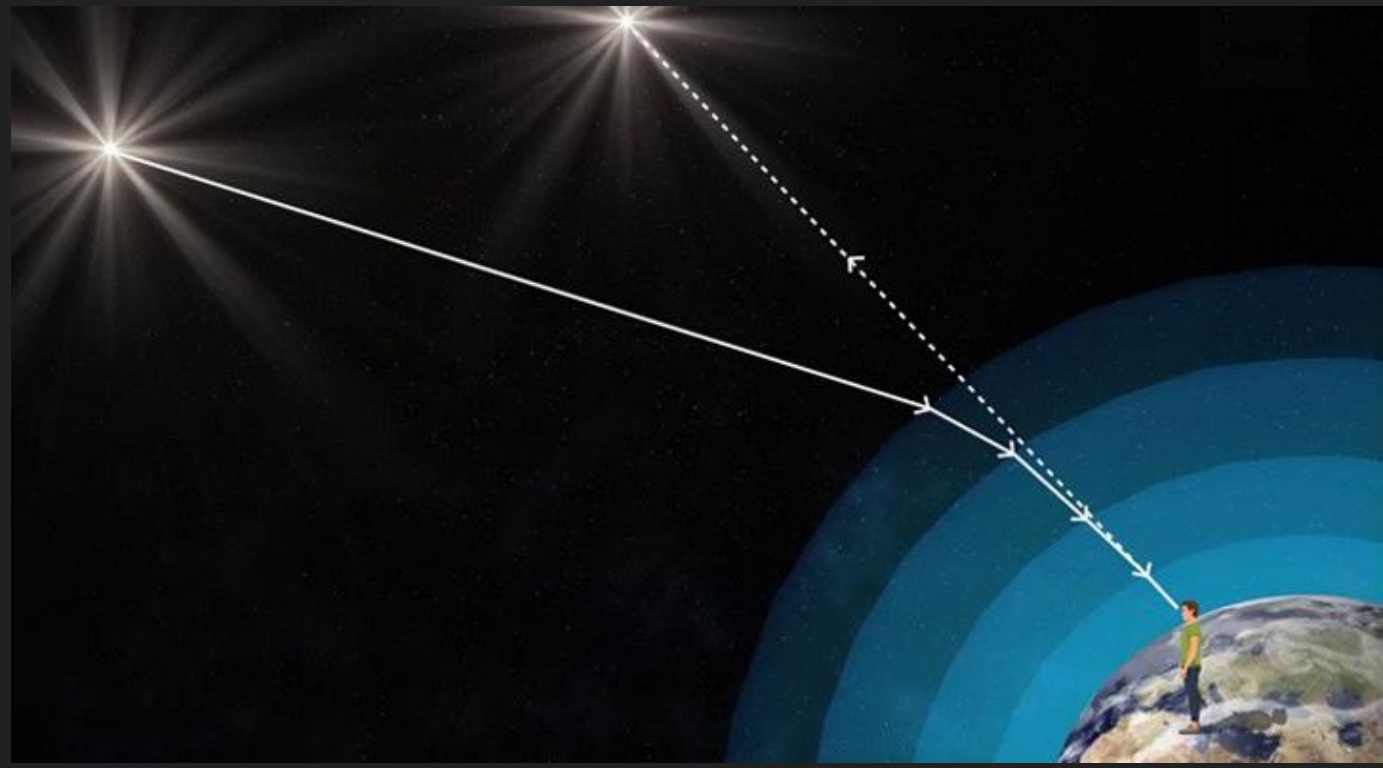
- The apparent position of the star also changes gradually due to change in atmosphere. There before the apparent position of the star fluctuates. As a result, path of light from the star varies.



Twinkling of star

- Twinkling of Star is due to the atmospheric refraction of Stars light.

- The Star light reaching our eye increase and decreases Continuously due to atmospheric refraction. And the star appears to twinkling at night.



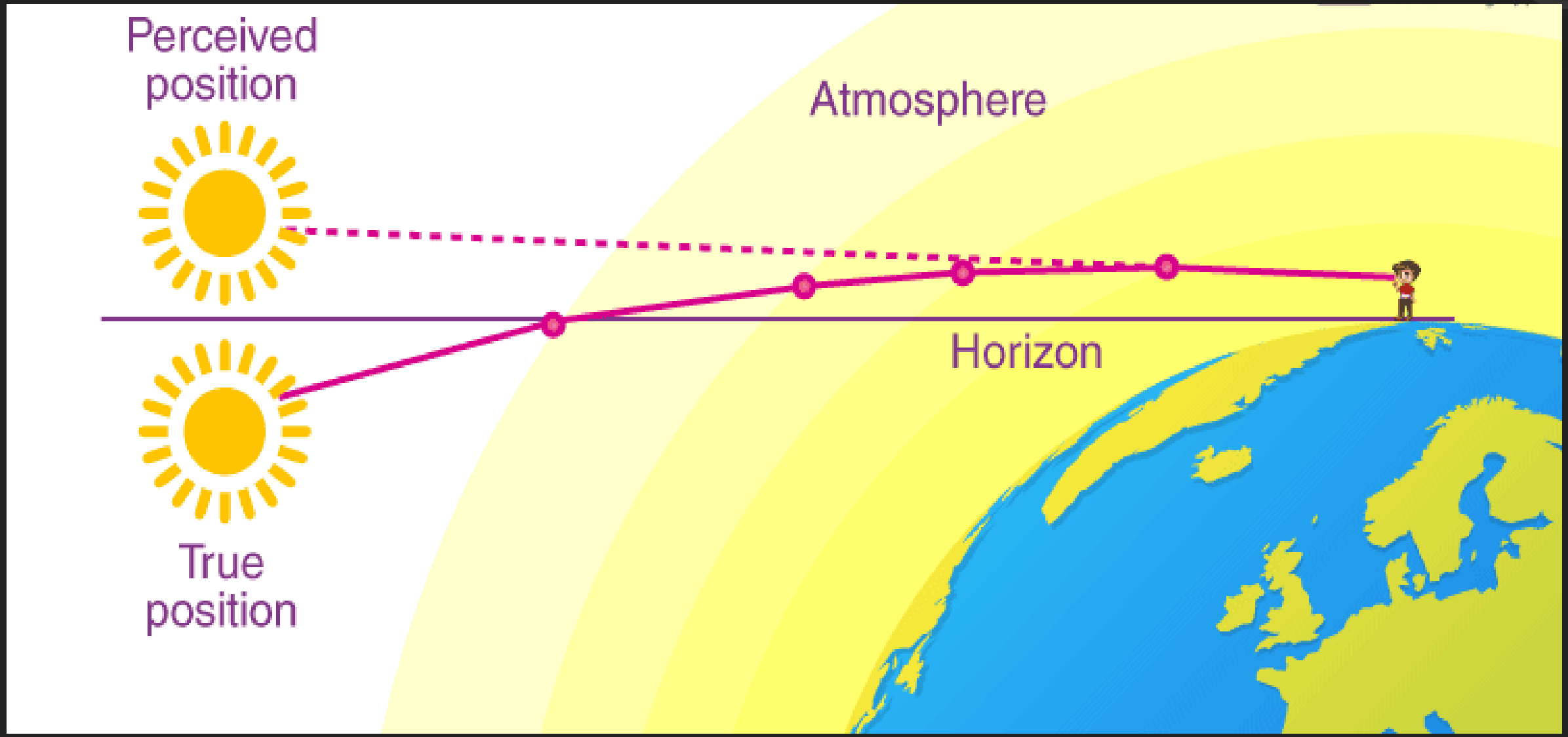
Why planets do not twinkle?

- **It is close to earth and appears bigger than star.**

The continuously changing atmosphere is unable to cause variations in the light coming from a big-sized planet (due to refraction) because of which the planet does not twinkle at all.

Advance sunrise and Delay sunset.

- We Can See the sun about 2 min before the actual Sum rise and 2 min after the actual sun set because of atmosphere refraction.
- It is also due atmosphere refraction we see the sun about 2 min even after the sunset below horizon. This is called Delay sunset.
- The length of day increases by 4 min.



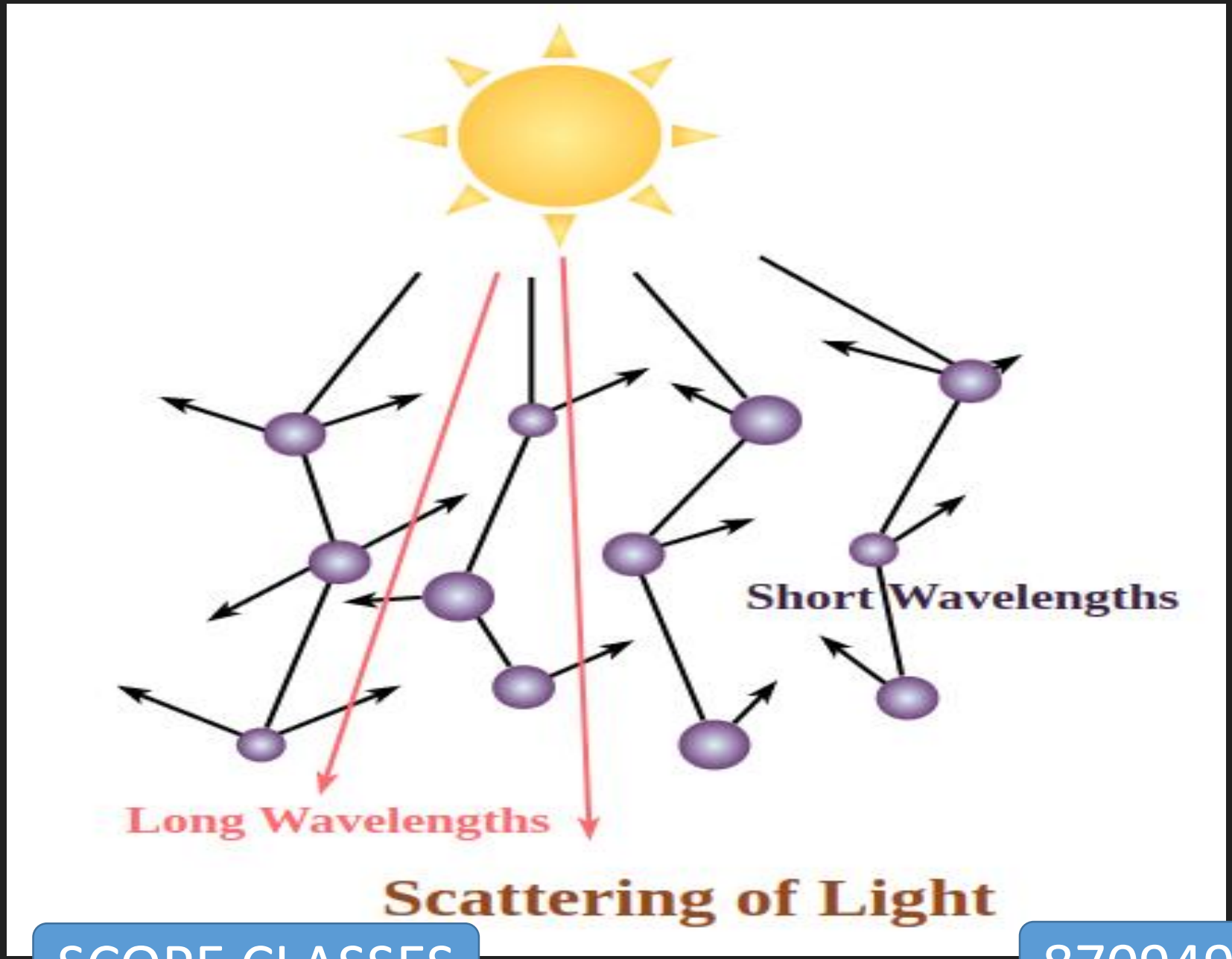
Scattering of light

The light spreads in all directions by the dust particles, free water molecules and the molecules of the gases present in the atmosphere. This phenomenon is called scattering of light.

The colour of scattered light Depending on the size of particles in the atmosphere.

Blue colour scatter most and red colour scatter least.

The blue colour of white light having shorter wavelength is scattered much more than the red colour having longer wavelength.



Scattering of Light

Tyndall Effect

When light passes through a colloid its path become visible. This path is called Tyndall effect

i)Path of light becomes visible when light enters a dark and dusty room through a slit or ventilator.

(ii) Path of light becomes visible when light passes through dense canopy of trees in a forest.

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Colour of sky appears blue on a clear day

→ The upper layer of atmosphere contains very fine particles of water vapours and gases. These particles are more effective in scattering of light of shorter wavelength mainly blue than larger wavelength. So, the sky appears blue.

Colour of sun appear red during sunrise and sunset

→ While sunset and sunrise, the colour of the sun and its surrounding appear red. During sunset and sunrise, the sun is near horizon and therefore the sunlight has to travel larger distance in atmosphere.

→ Due to this most of the blue light (shorter wavelength) are scattered away by the particles. The light of longer wavelength (red colour) will reach our eye. This is why sun appear red in colour.

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