

## CBSE Class 10 Science

### Revision Notes

### CHAPTER-11

## THE HUMAN EYE AND THE COLOURFUL WORLD

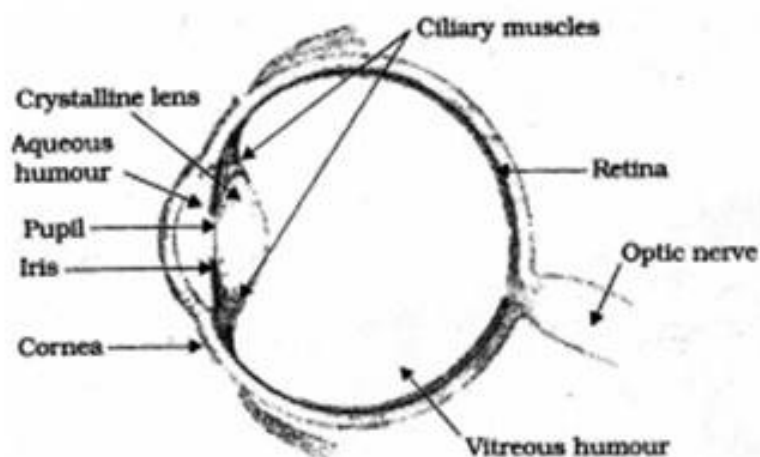
- Human eye is the optical instrument used which enables us to see.

We will study various natural optical phenomenon like Rainbow formation, twinkling of star, blue and red colour of sky etc.

### HUMAN EYE :

It acts like a camera, enable us to capture the colourful picture of the surroundings.

An inverted, real image on light sensitive is formed on the Retina



### The Various Parts of Eye and their Functions

- 1. Cornea :** It is a thin membrane through which light enters. It forms the transparent bulge on the front of eyeball. Most of the refraction occurs at the outer surface of the cornea.
- 2. Eyeball :** it is a convex lens, approximately spherical in shape, with a diameter of about 2.3 cm. It can alter its curvature with help of ciliary muscles.
- 3. Iris :** It is a dark muscular diaphragm that controls the size of pupil. It is behind the cornea. It helps in accommodation of light by changing the size of the pupil.
- 4. Pupil :** It regulates and control the amount of light entering the eye. It is the black opening between aqueous humour & lens. Black in colour. Light entering cannot exit.

**5. Crystalline eye lens** :Provides the focused real & inverted image of the object on the retina. It is composed of a fibrous, jelly like material.

This is convex lens that converges light at retina.

**6. Ciliary muscles** :It helps to change the curvature of eye lens and hence changes its focal length so that we can see the object clearly placed at different positions.

**7. Retina** : Thin membrane with large no. of light sensitive cells.

There are two types of photoreceptors in the human retina, rods and cones.

Rods are responsible for vision at low light levels . They do not mediate color vision.

Cones are active at higher light levels , are capable of color vision.

When image is formed at retina, light sensitive cells gets activated and generate electrical signal. These signals are sent to brain via optic nerve. Brain analyse these signals after which we perceive object as they are.

**8.** The *vitreous body* is the clear gel that fills the space between the lens and the retina of the eyeball of humans and other vertebrate

**9.** The *aqueous humour* is a transparent, watery fluid similar to plasma, but containing low protein concentrations.

### How Pupil Works ?

**Example:** You would have observed that when you come out of the cinema hall after watching movie, in the bright sun light, your eyes get closed . And when you enter the hall from the bright light, you won't be able to see but after some time you would be able to see. Here the pupil of an eye provides a variable aperture, whose size is controlled by iris

(a) **When the light is bright** : Iris contracts the pupil, so that less light enters the eye.

(b) **When the light is dim** : Iris expand the pupil, so that more light enters the eye.

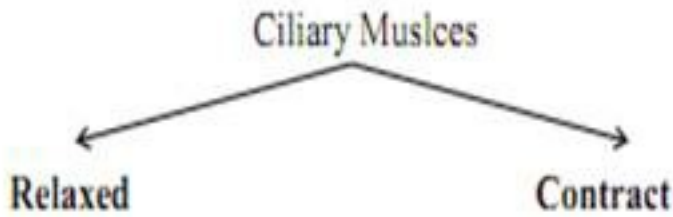
Pupil opens completely, when iris is relaxed.

**Persistence of Vision** : It is the time for which the sensation of an object continue in the eye. It is about 1/16th of a second.

### Power of Accommodation

The ability of eye lens to adjust its focal length with the help of ciliary muscles is called

accommodation.



- |  |   |
|--|---|
| 1. Eye lens becomes thin                   | 1. Eye lens becomes thick                 |
| 2. Increases the focal length              | 2. Decreases the focal length             |
| 3. Enable us to see distant object clearly | 3. Enable us to see nearby object clearly |

#### Near point of the Eye

It is 25cm for normal eye. The minimum distance at which object can be seen most distinctly without strain.

#### Far point of the Eye

It is infinity for normal eye. It is the farthest point upto which the eye can see objects clearly

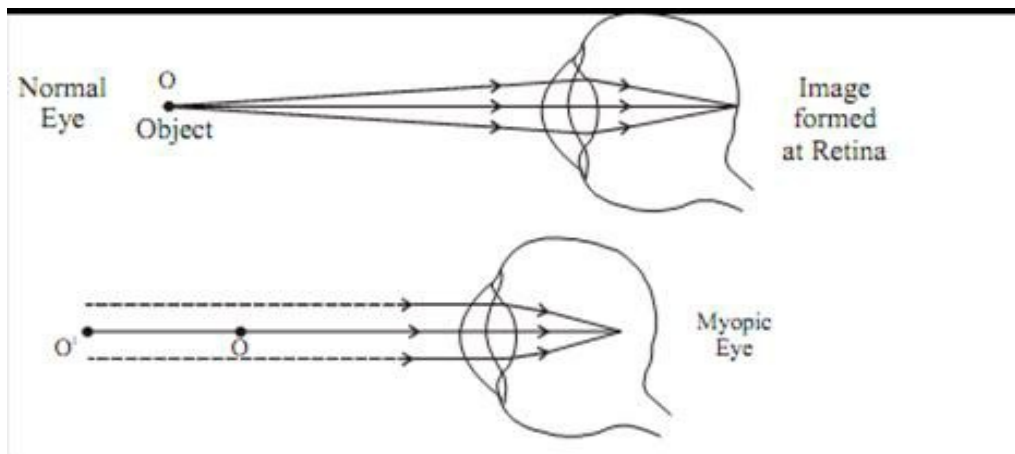
### Defects of Vision and their Correction

**1. Cataract :** The image can not be seen distinctly because eye lens become milky and cloudy. This condition is known as cataract, it can cause complete or partial loss of vision. This can be corrected by surgical removal of extra growth (cataract surgery).

#### 2. Myopia : (Near Sightedness)

A person can see nearby object clearly, but cannot see distant object distinctly.

#### Image formed in front of the retina.

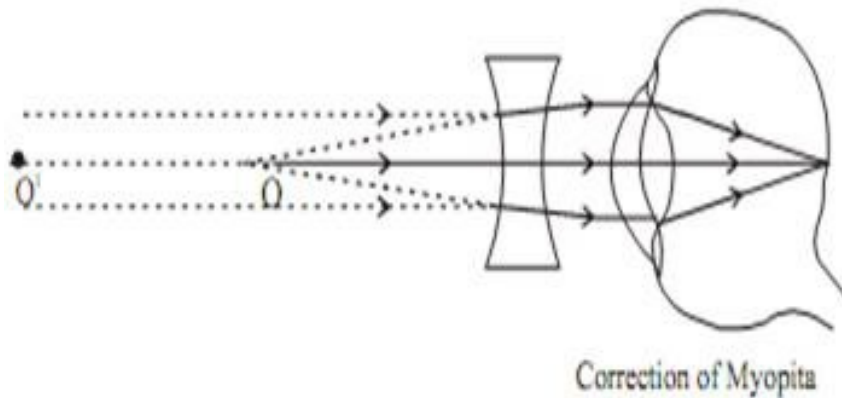


#### The Reason of defect

1. Excessive curvature of eye lens means Eye lens becomes thick and its focal length decreases.
2. Elongation of the eye ball.

### Correction

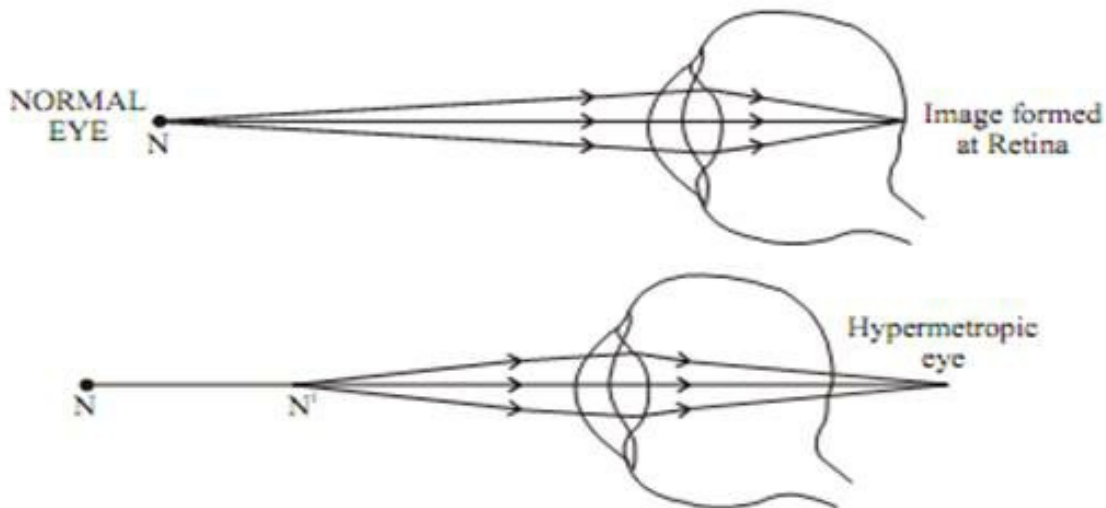
Corrected by using a Concave Lens of appropriate power.



### Hypermetropia (Far - Sightedness)

A person cannot see nearby object clearly, but can see distant object distinctly.

### Image formed at a point behind the retina

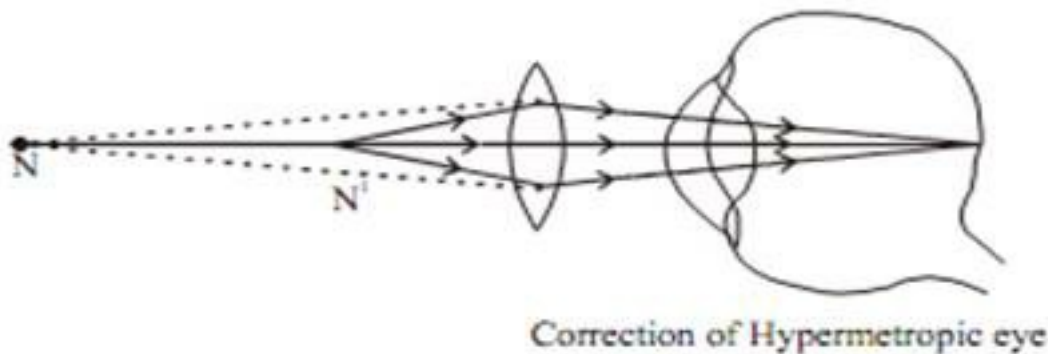


### The Reason of defect

1. Increase in focal length of the eye lens (Thin eye lens)
2. Eye ball has become too small.

### Correction

Corrected by using a Convex Lens of appropriate power.



#### 4. Presbyopia

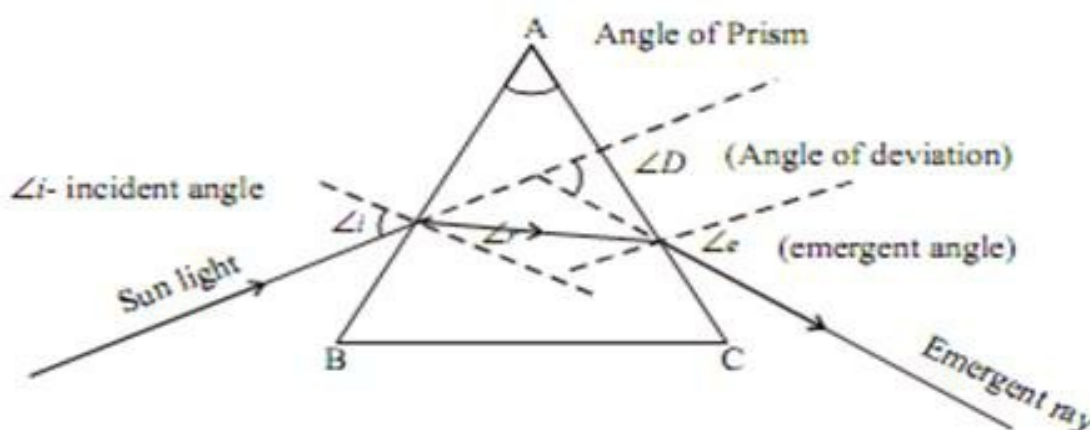
As we become old, the power of accommodation of the eye usually decreases, the near point gradually recedes away. This defect is called Presbyopia, a special kind of Hypermetropia. Person may suffer from both myopia and hypermetropia.

**Reason of defect :** Gradual weakening of ciliary muscles and decreasing the flexibility of the eye lens.

**Correction :** Using Bifocal lens with appropriate power. Bifocal lens consists of both concave and convex lenses; the upper portion consists of a concave lens and the lower portion consists of a convex lens.

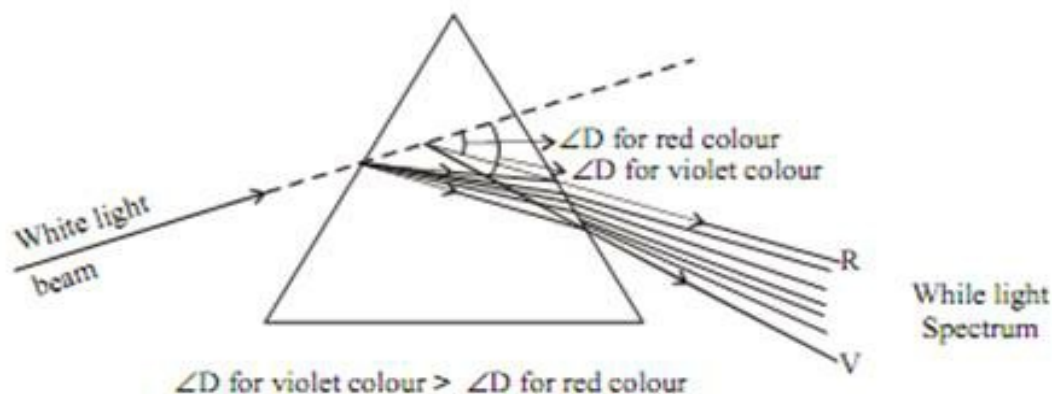
**Prism :** It has two triangular bases and three rectangular lateral surfaces.

These surfaces are inclined to each other. The angle between its two lateral faces is called **Angle of Prism**.



**Angle of Deviation (D)** → The angle between the incident ray and emergent ray.

Dispersion of white light by a Glass Prism



Inclined refracting surfaces of glass prism show exciting phenomenon.

### Splitting of White Light into Band of Colours

The band of the coloured components of light beam is called **Spectrum i.e. VIBGYOR**

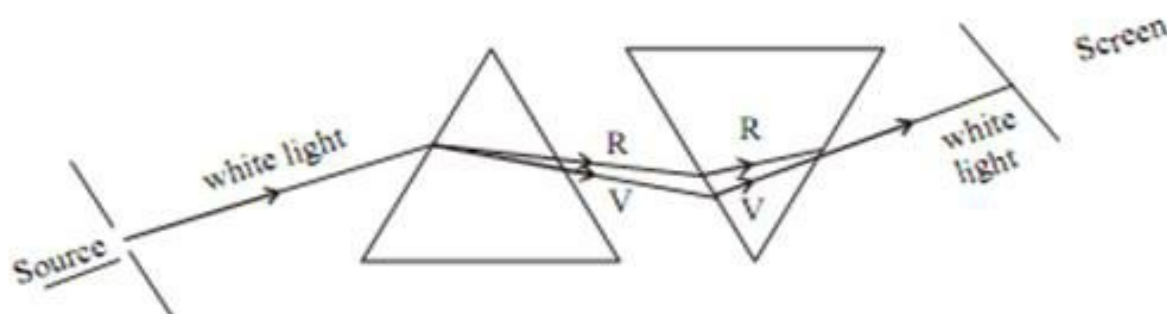
The splitting of light into its component colours is called **Dispersion**.

The different component colour of light bends at different angle with respect to incident angle, the red light bends the least while the violet bends most.

**ISSAC NEWTON** → He was the first, who obtained spectrum of sunlight by using glass prism. He tried to split the spectrum of white light more by using another similar prism, but he could not get any more colours.

He repeated the experiment using second prism in an inverted position with respect to the first prism.

Allowed all the colours of spectrum to pass through second prism. He found white light emerges on the other side of second prism.



He concluded that sun is made up of seven visible colour 'VIBGYOR'

**RAINBOW** → It is the spectrum of sunlight in nature It is formed due to the dispersion of sunlight by the tiny water droplet, present in atmosphere.

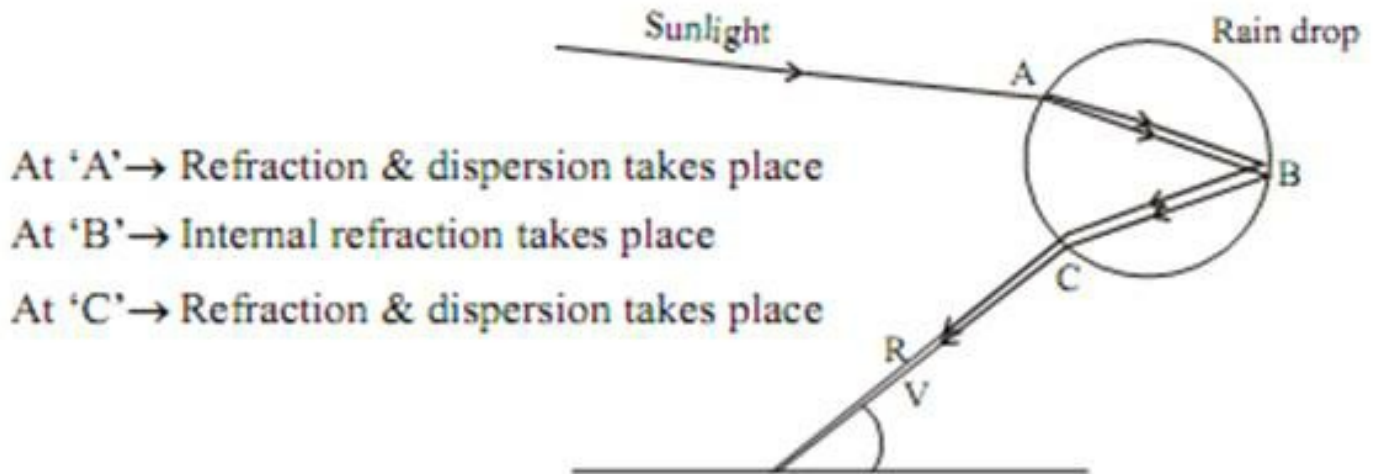
## Water Droplet Act like Prism

It refracts and disperses the incident sunlight, then reflects it internally (internal reflection) and finally refracts it again, when it emerges out of the water droplet.

A rainbow is always formed in a direction opposite to that of sun.

Due to dispersion and internal reflection of light, different colours reach the observer's eye.

Red colour appears on top & violet at the bottom of rainbow



## Atmospheric Refraction

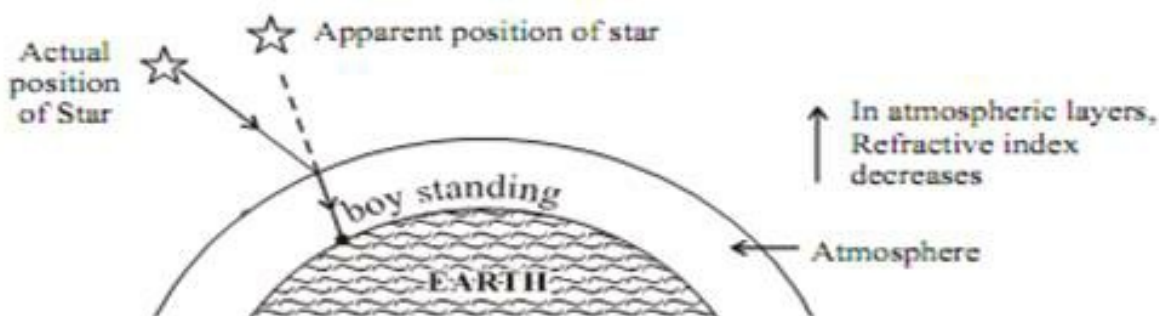
**1. Apparent Star Position :** It is due to atmospheric refraction of starlight.

The temperature and density of different layers of atmosphere keeps varying. Hence we have different medium.

Distant star act as point source of light. When the starlight enter the earth's atmosphere it undergoes refraction continuously, due to changing refractive index i.e. from Rarer to denser, it bends towards the normal.

Due to this the apparent position of the star is different from actual position.

The star appears higher than its actual position.





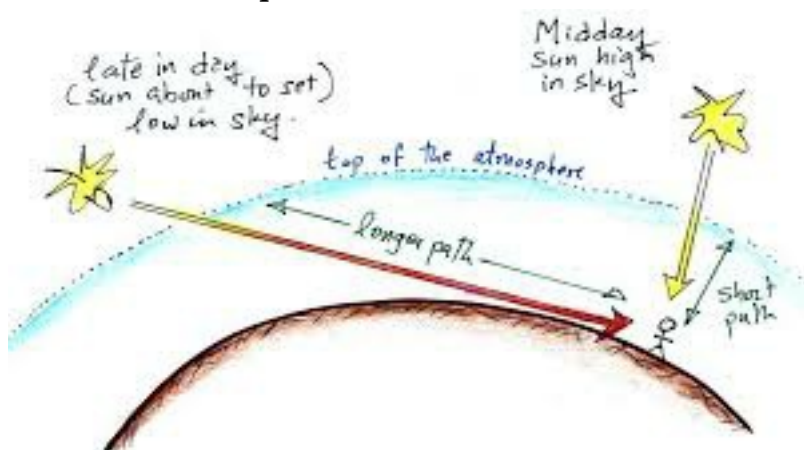
## 1. **Twinkling of Star** : It is also due to atmospheric refraction.

Distant star act like a point source of light. As the beam of starlight keeps deviating from its path, the apparent position of star keeps on changing because physical condition of earth's atmosphere is not stationary

Hence the amount of light enters our eyes fluctuate some time bright and sometime faint. This is the "**Twinkling effect of star**".

## **Blue Sky**

The blue color of the sky is caused by the scattering of sunlight off the molecules of the atmosphere. This scattering, called Rayleigh scattering, is more effective at short wavelengths (the blue end of the visible spectrum). Therefore the light scattered down to the earth at a large angle with respect to the direction of the sun's light is predominantly in the blue end of the spectrum.



## **What you have learnt**

- The ability of the eye to focus both near and distant objects, by adjusting its focal length, is called the accommodation of the eye.
- The smallest distance, at which the eye can see objects clearly without strain, is called the near point of the eye or the least distance of distinct vision. For a young adult with normal vision, it is about 25 cm.
- The common refractive defects of vision include myopia, hypermetropia and presbyopia. Myopia (short-sightedness – the image of distant objects is focused before the retina) is corrected by using a concave lens of suitable power.



Hypermetropia (far-sightedness – the image of nearby objects is focused beyond the retina) is corrected by using a convex lens of suitable power. The eye loses its power of accommodation at old age.

- The splitting of white light into its component colours is called dispersion.
- Scattering of light causes the blue colour of sky and the reddening of the Sun at sunrise and sunset.