

HUMAN EYE AND THE COLOURFUL WORLD

1. The Human Eye It is a natural optical instrument which is used to see the objects by human beings. It is like a camera which has lens and screen system.

(i) Retina : It is a light sensitive screen inside the eye on which image is formed. It contains rods and cones.

(ii) Cornea : It is a thin membrane which covers the eye ball. It acts like a lens which refracts the light entering the eye.

(iii) Aqueous humour : It is fluid which fills the space between cornea and eye lens.

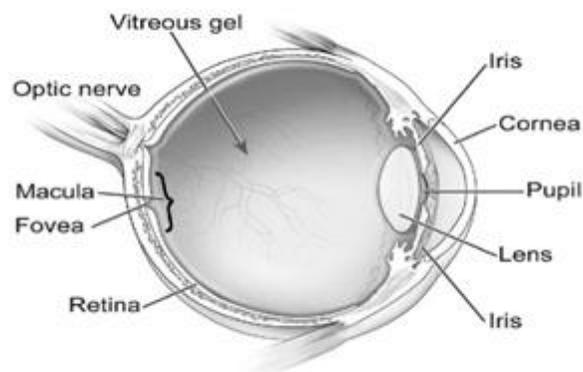
(iv) Eye lens : It is a Convex lens made of transparent and flexible jelly like material. Its curvature can be adjusted with the help of ciliary muscles.

(v) Pupil : It is a hole in the middle of iris through which light enters the eye. It appears black because light falling on it goes into the eye and does not come back.

(vi) Ciliary muscles : These are the muscles which are attached to eye lens and can modify the shape of eye lens which leads to the variation in focal lengths.

(vii) Iris : It controls the amount of light entering the eye by changing the size of pupil.

(viii) Optical nerve : These are the nerves which take the image to the brain in the form of electrical signals.



2. Accomodation power : The ability of eye to change the focal length of eye lens with the help of ciliary muscles to get the clear view of nearby objects (about 25 cm) and far distant objects (at infinity).

4. Myopia (Short sightedness) : It is a kind of defect in human eye due to which a person can see near objects clearly but he can not see the distant objects clearly. Myopia is due to

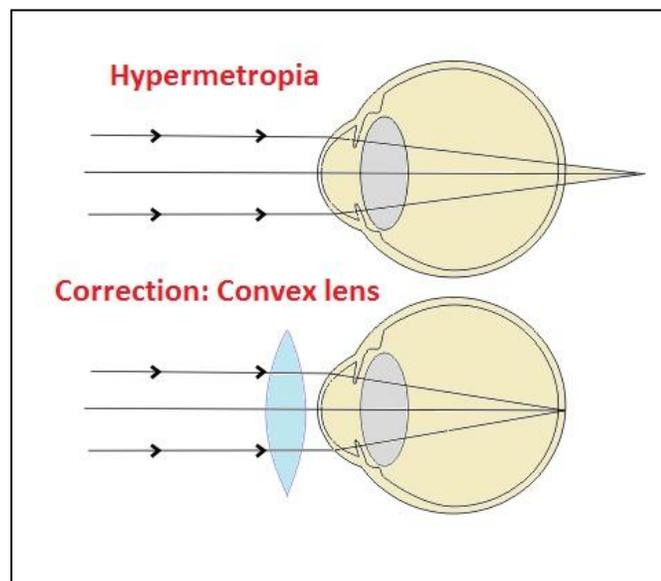
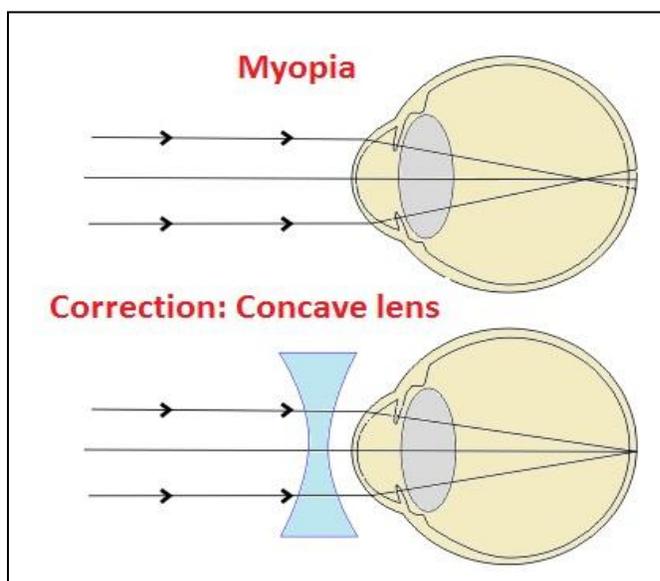
- (i) excessive curvature of cornea.
- (ii) elongation of eye ball.

The image of a distance object is formed in **front of the retina** and not on the retina. Defected is corrected by using **Concave lenses** such that the lens will bring the image back on to the retina.

5. Hypermetropia (Long sightedness) : It is a kind of defect in human eye due to which a person can see distant objects properly but cannot see the nearby objects clearly. It happens due to

- (i) decrease in power of eye lens i.e., increase in focal length of eye lens.
- (ii) shortening of eye ball.

The image of a distance object is formed in **behind the retina and not on the retina**. Defected is corrected by using **Convex lenses** such that the lens will bring the image back on to the retina.



6. Presbyopia : It is a kind of defect in human eye which occurs due to ageing. It happens due to

- (i) decrease in flexibility of eye lens.
- (ii) gradual weakening of ciliary muscles.

7. Myopia and Hypermetropia : Sometimes a person may suffer from both near sightedness and far-sightedness. Such people are advised to use **bifocal lenses**. Bifocal lenses consists of concave on the upper portion and convex on the lower portion. Concave supports distinct vision and convex supports near vision.

7. Astigmatism : It is a kind of defect in human eye due to which a person cannot see (focus) simultaneously horizontal and vertical lines both.

8. Cataract : Due to the membrane growth over eye lens, the eye lens becomes hazy or even opaque. This leads to decrease or loss of vision.

The problem is called cataract. It can be corrected only by surgery.

9. Dispersion of white light by a glass prism : The phenomenon of splitting of white light into its seven constituent colours when it passes through a glass prism is called dispersion of white light. The various colours seen are Violet, Indigo, Blue, Green, Yellow, Orange and Red. The sequence of colours remember as **VIBGYOR**. The band of seven colours is called spectrum.

Violet

bends the most and Red bends the least. Newton first discovered this and then he passed this spectrum of light through an another prism and he observed that again white light emerged. **This proves that white light is made of VIBGYOR colors.**

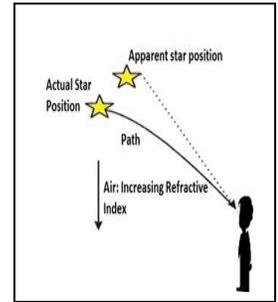
11. Monochromatic light: Light consisting of single colour or wavelength is called monochromatic light, e.g., sodium light

12. Polychromatic light : Light consisting of more than two colours or wavelengths is called polychromatic light, e.g. white light.

14. Formation of rainbow : The water droplets act like small prisms. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop. Due to the dispersion of light and internal reflection, different colours reach the observer's eye.

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

The twinkling of stars is also due to **atmospheric refraction**. The air in the earth's atmosphere is such that it has **increasing refractive index**. When starlight enters earth's atmosphere it undergoes multiple refraction continuously before it reaches the earth. Because of the increasing refractive index, the starlight bends downwards (ie towards the normal) and thereby the **apparent position of the star is slightly higher than its actual position**. Also, this apparent position of the star is not fixed. It keeps on changing slightly since the atmospheric conditions of the earth keep varying. But however the stars are so distant that they appear fixed to the naked eye.



Atmospheric Refraction is the same reason that the sun is seen about 2 minutes before actual sunrise and is seen for about 2 minutes after sunset. The **actual position of the sun is slightly shifted from the actual position of the sun**.

Tyndall effect : The earth's atmosphere is a mixture of many minute particles such as smoke, water droplets, dust etc. When a beam of light strikes these fine particles, the path taken by that beam becomes visible. Light gets reflected continuously by these particles and then reaches us. This phenomenon of scattering of light by particles is the **Tyndall effect**. Tyndall effects explain why we see the sky as blue, forests as green and so on.

Why does the Sky appear clear blue? The air molecules and other fine particles have sizes smaller than the wavelength of visible light. Such particles scatter light of shorter wavelengths ie blue more effectively than longer wavelengths(red). When sunlight passes through the atmosphere, the blue end of the spectrum is scattered more. This enters our eyes and hence we see the sky as blue.