Human Eye: The Colourful World

THE HUMAN EYE: Structure:

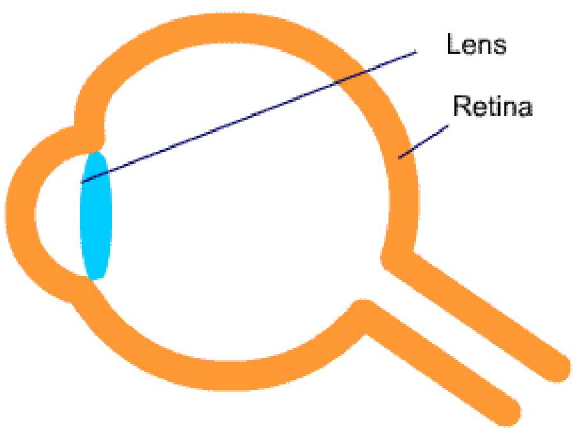
1. Pupil: Pupil is the round black spot in front of eye. It regulates the amount of light entering the eyes. Pupil works like aperture of a camera. In case of dim light pupil dilate to allow more light to enter the eyes. In case of strong light pupil constrict allowing less light to enter.

2. Irish: Irish is made of muscles. They control the size of opening if pupil.

3. Lens: Lens lies just behind the pupil. Lens becomes thin to increase its focal length. This enables us to see distant objects clearly. To focus on nearer objects lens becomes thick to decrease its focal length. But there is a limit. The minimum distance of clear vision is 25 cm. Below this distance we cannot see things clearly.

4. Retina: Retina works like a screen or camera film. Retina is full of light and colour sensitive cells. These cells, upon receiving image send electrical signals to the brain, which processes these information to make a mental image of what we see.

Benefits of two eyes: One eye is having a field of vision of about 150 degrees. Both the eyes enable us to see upto a field of 180 degrees. Moreover, as two different images get juxtaposed in the brain, so we are able to see a three dimensional view of the world.



Malfunctions of Eyes:

1. Cataract: In old age the cornea becomes cloudy. This reduces the vision in old age. In early stages of the disease cataract can be cured by eye surgery. Sometimes artificial lens is also transplanted during cataract surgery. This is called Intra Ocular Lens Transplantation.

2. Myopia: Myopia is also known as near-sightedness. A person with myopia can see nearby objects clearly but cannot see distant objects distinctly. In a myopiceye, the image of a distant object is formed in front of the retina and not at the retina itself. This defect may arise due to (i) excessive curvature of the eye lens, or (ii) elongation of the eyeball. This defect can be corrected by using a concave lens of suitable power. A concave lens of suitable power will bring the image back on to the retina and thus the defect is corrected.

3. Hypermetropia: Hypermetropia is also known as far-sightedness. A person with hypermetropia can see distant objects clearly but cannot see nearby objects distinctly. The near point, for the person, is farther away from the normal near point (25 cm). Such a person has to keep a reading material much beyond 25 cm from the eye for comfortable reading. This is because the light rays from a closeby object are focussed at a point behind the retina. This defect arises either because

(i) the focal length of the eye lens is too long, or

(ii) the eyeball has become too small.

This defect can be corrected by using a convex lens of appropriate power. Eye-glasses with converging lenses provide the additional focussing power required for forming the image on the retina.

4. Presbyopia: The power of accommodation of the eye usually decreases with ageing. For most people, the near point gradually recedes away. They find it difficult to see nearby objects comfortably and distinctly without corrective eye-glasses. This defect is called Presbyopia. It arises due to the gradual weakening of the ciliary muscles and diminishing flexibility of the eye lens. Sometimes, a person may suffer from both myopia and hypermetropia. Such people often require bifocal lenses. A common type of bi-focal lenses consists of both concave and convex lenses. The upper portion consists of a concave lens. It facilitates distant vision. The lower part is a convex lens. It facilitates near vision.

ATMOSPHERIC REFRACTION

Twinkling of stars

The twinkling of a star is due to atmospheric refraction of starlight. The starlight, on entering the earth’s atmosphere, undergoes refraction continuously before it reaches the earth. The atmospheric refraction occurs in a medium of gradually changing refractive index. Since the atmosphere bends starlight towards the normal, the apparent position of the star is slightly different from its actual position. The star appears slightly higher (above) than its actual position when viewed near the horizon . Further, this apparent position of the star is not stationary, but keeps on changing slightly, since the physical conditions of the earth’s atmosphere are not stationary, as was the case in the previous paragraph. Since the stars are very distant, they approximate point-sized sources of light. As the path of rays of light coming from the star goes on varying slightly, the apparent position of the star fluctuates and the amount of starlight entering the eye flickers – the star sometimes appears brighter, and at some other time, fainter, which is the twinkling effect.

Advance sunrise and delayed sunset

The Sun is visible to us about 2 minutes before the actual sunrise, and about 2 minutes after the actual sunset because of atmospheric refraction. By actual sunrise, we mean the actual crossing of the horizon by the Sun. The time difference between actual sunset and the apparent sunset is about 2 minutes. The apparent flattening of the Sun’s disc at sunrise and sunset is also due to the same phenomenon.

SCATTERING OF LIGHT

Tyndall Effect

The earth's atmosphere is a heterogeneous mixture of minute particles. These particles include smoke, tiny water droplets, suspended particles of dust and molecules of air. When a beam of light strikes such fine particles, the path of the beam becomes visible. The light reaches us, after being reflected diffusely by these particles. The phenomenon of scattering of light by the colloidal particles gives rise to Tyndall effect. This phenomenon is seen when a fine beam of sunlight enters a smoke-filled room through a small hole. Thus, scattering of light makes the particles visible. Tyndall effect can also be observed when sunlight passes through a canopy of a dense forest. Here, tiny water droplets in the mist scatter light. The colour of the scattered light depends on the size of the scattering particles. Very fine particles scatter mainly blue light while particles of larger size scatter light of longer wavelengths. If the size of the scattering particles is large enough, then, the scattered light may even appear white.

Why is the colour of the clear Sky Blue?

The molecules of air and other fine particles in the atmosphere have size smaller than the wavelength of visible light. These are more effective in scattering light of shorter wavelengths at the blue end than light of longer wavelengths at the red end. The red light has a wavelength about 1.8 times greater than blue light. Thus, when sunlight passes through the atmosphere, the fine particles in air scatter the blue colour (shorter wavelengths) more strongly than red. The scattered blue light enters our eyes. If the earth had no atmosphere, there would not have been any scattering. Then, the sky would have looked dark. The sky appears dark to passengers flying at very high altitudes, as scattering is not prominent at such heights. You might have observed that 'danger' signal lights are red in colour. The red is least scattered by fog or smoke. Therefore, it can be seen in the same colour at a distance.