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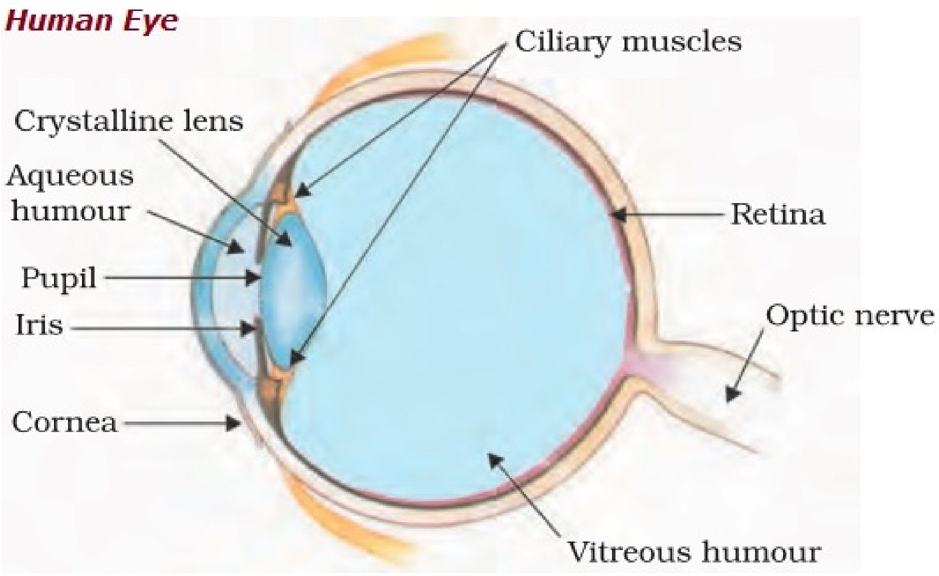
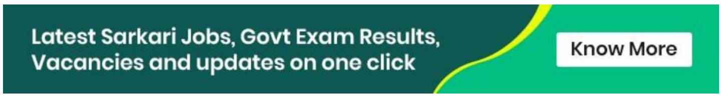
HUMAN EYE

- Human eye is one of the most valuable and sensitive sense organs.
- Light enters the eye through a thin membrane called the **cornea.**
- **Retina** is lens system forms an image on a **light-sensitive screen.**
- The human eye forms the image of an object at its **retina.**
- **Iris** is colored part of the eye. It may be blue, brown or green in colour. Every person has a unique colour, pattern and texture. It holds the pupil and also adjust the size of pupil according to the intensity of light.
- **Pupil** is black in color and absorbs all the light rays falling on it. It gets constricted when the intensity of light is high. It gets expanded when the intensity of light is low.
- **Pupil** is the centre part of the Iris. It is the **pathway for the light** to retina.
- **Ciliary muscles** hold the lens. They adjust the **focal length** of the lens.
- **Eye Lens** is the important part of human eye. It is **convex in nature**.
- The ability of the eye to focus on both near and distant objects by adjusting its focal length is called the accommodation of the eye.
- The eye lens forms an **inverted real image** of the object on the retina. The retina is a delicate membrane having enormous number of light-sensitive cells. The light-sensitive cells get activated upon illumination and generate electrical signals. These signals are sent to the brain via the optic nerves.
- 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 farthest point up to which the eye can see objects clearly is called the **far point** of the eye. It is **infinity** for a normal eye.



Source: Science NCERT; X

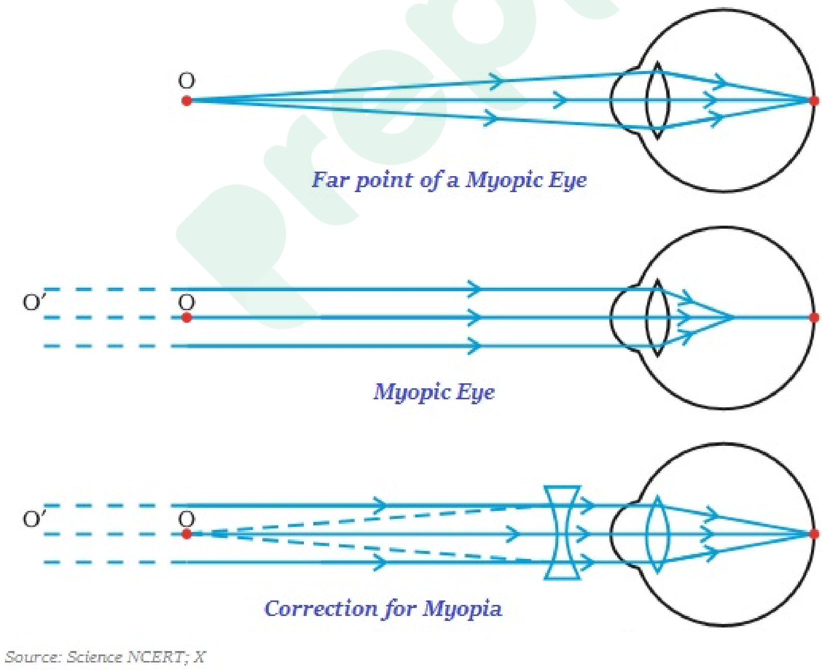


Defects Of Vision and Their Correction

- A normal human eye can clearly see all the objects placed between 25 cm and infinity. But, for some people, the eye loses its power of accommodation. This could happen due to many reasons including ageing. Hence, their vision becomes defective.
- There are mainly three common refractive defects of vision:
    - Myopia or near-sightedness
    - Hypermetropia or farsightedness,
    - Presbyopia

Myopia

- Myopia is also known as **near-sightedness.**
- A person with myopia can see nearby objects clearly but **cannot see distant objects distinctly.**
- The focal length of eye lens is reduced or the distance between eye lens and retina increases.
- In a **myopic eye the image** of a distant object is **formed in front of the retina.**
- A **concave lens** of suitable power will bring the image back on to the retina and thus the defect is corrected.

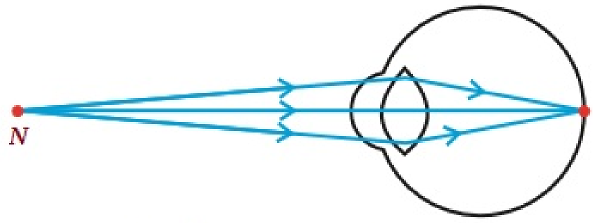


Hypermetropia

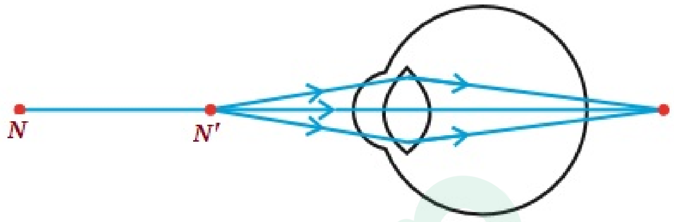
- Hypermetropia is also known as **far-sightedness.**
- A person with hypermetropia can see distant objects clearly but cannot see nearby objects distinctly.
- The focal length of eye lens is increased or the distance between eye lens and retina decreases. Hence, the near point will not be at 25 cm for such eyes and the near point has

moved farther. Due to this, the image of nearby objects is formed behind the retina.

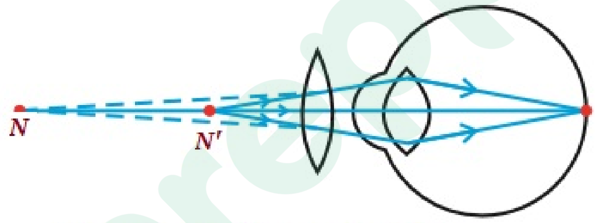
- In a hypermetropia eye the image of a close by object are focused at a **point behind the retina.**
- This defect can be corrected by using a **convex lens** of appropriate power.



Near Point of a Hypermetropic Eye



Hypermetropic Eye



Correction for Hypermetropic Eye

Source: Science NCERT; X

Presbyopia

- The power of accommodation of the eye usually decreases with ageing.
- It arises due to the gradual **weakening of the ciliary muscles and diminishing** flexibility of the eye lens.
- This defect can be corrected by using a **bi-focal 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.

Astigmatism

- In this defect, eye cannot see parallel and horizontal lines clearly. It may be inherited or acquired.
- It is due to the imperfect structure of eye lens because of the development of cataract on the lens, ulceration of cornea, injury to the refracting surfaces, etc.

- Astigmatism can be corrected by using cylindrical lenses.

Dispersion Of White Light by a Glass Prism

- The angle between its two lateral faces is called the angle of the prism.
- The prism has probably split the incident white light into a band of colours.
- The various colours seen are Violet, Indigo, Blue, Green, Yellow, Orange and Red.
- The **band of the coloured components** of a light beam is called its **spectrum.**
- The **splitting of light** into its component colours is called **dispersion.**
- Isaac Newton was the first to use a glass prism to obtain the spectrum of sunlight.
- Different colours of light bend through different angles with respect to the incident ray, as they pass through a prism. The **red light bends the least** while the **violet the most.**
- **Red light has the longest wavelength** because red **refract least**, while **violet has the shortest** because violet refract most.
- A **rainbow is scattering of light** a natural spectrum appearing in the **sky after a rain shower**. It is caused by **dispersion of sunlight by tiny water droplets**, present in the atmosphere. A **rainbow is always formed** in a direction **opposite to that of the Sun**. 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.

Atmospheric Refraction

- 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.
- 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**. The apparent flattening of the Sun's disc at sunrise and sunset is also due to the same phenomenon.

Scattering of light

- When a beam of light interacts with a particle of matter it is redirected in many different directions. This phenomenon is called scattering of light.
- Scattering of light causes the blue colour of sky and the reddening of the Sun at sunrise and sunset.

Why The Colour of Sky Is Blue

- Molecules of air and other fine particles in the atmosphere have size smaller than the wavelength of visible light.
- The red light has a wavelength greater than blue light. 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.

- The red is least scattered by fog or smoke that is the reason danger signal lights are red in colour.
- At noon the Sun appears white as only a little of the blue and violet colours are scattered. Near the horizon most of the blue light and shorter wavelengths are scattered away by the particles. Therefore, the light that reaches our eyes is of longer wavelengths. This gives rise to the reddish appearance of the Sun.