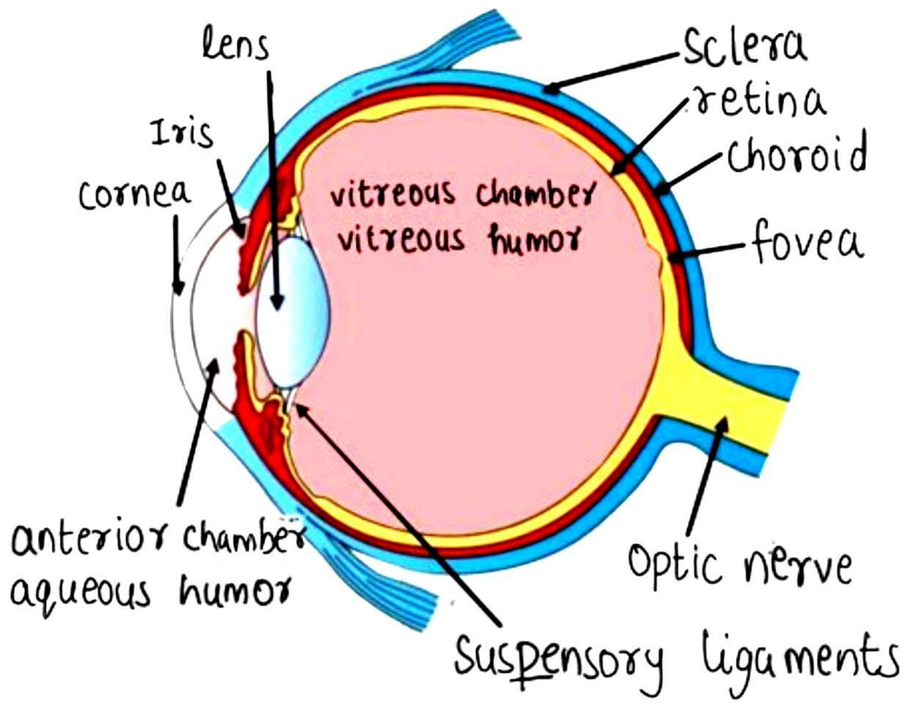
Unit 3 Natural Phenomena

Chapter 10:

The Human Eye & The Colourful World

The Human Eye

The human eye, an intricate and specialized sensory tool, holds the vital responsibility of facilitating vission. As a fundamental element of the human visual system, it play a critical role in our perception of the surrounding environment.



Human Eye

PARTS OF HUMAN EYE

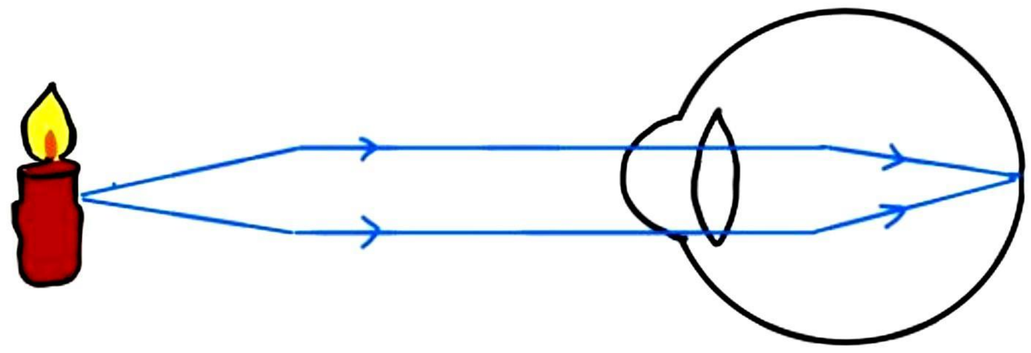
- The lens system forms an image on a light-sensitive screen called retina.
- Light enters the eye through a membrane called cornea
- It forms the transparent bulge on the front surface of the eyeball
- The eyeballs are approximately spherical in shape with a diameter of about 2.3 cm
- The crystalline lens merely provides the finer adjustment of focal length required to focus objects at different distance on the retina
- Most of refraction for the light rays entering the eye occurs at the other surface of the corned.
- Iris is a dark muscular diaphragm that controls the size of the pupil.
- The Pupil regulates and controls the amount of light entering

- The eye lens forms an inverted real image of the object on the retina.
- The retina is a delicate membrane having an enormous number of light-sensitive cells.
- The light-sensitive cells get activated upon illumination and generate electrical signals
- The signals are sent to the brain via the optic nerve.

Power OF Accomodation

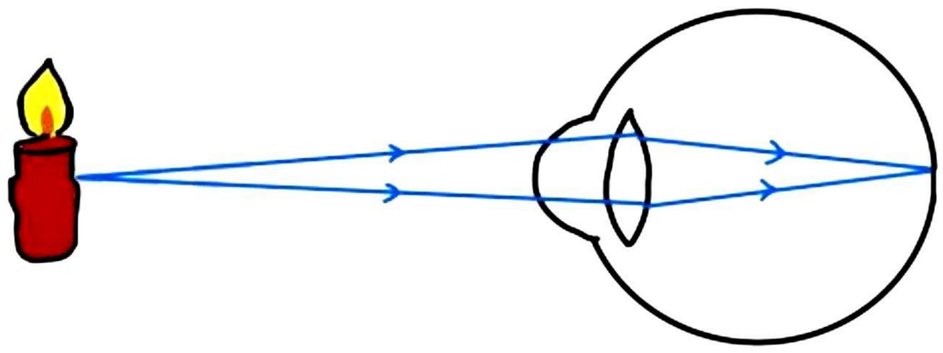
The power of accomodation is the eye's ability to adjust and focus on objects at different distance by changing the shape of the lens, allowing us to see clearly at various ranges.

a) The farthest point up to which the eye can see properly is called the far point of the eye.



when we are looking at a distant object (usually farther than 6m) the ciliary muscles are in their most relaxed state. Then the focal length of the eye-lens is such that rays coming from the distant objects are focused on the retina and we see the object clearly.

b) The closest point at which an object can be placed and seen clearly is called the near point of the eye.



when we are looking at a nearly object and ciliary muscle contract to increase the curvature of the crystalline lens. The thickness of this lens increases, which decrease its focal length. The ciliary muscle adjust the focal length in such a manner that a sharp image is formed on the retina.

⚠ NOTE - The Normal Eye can see objects clearly that are between 25 cm and infinity.

➡ Defects of Vision and Correction

Defects of vision refer to abnormalities in the eye that affect how one sees. Common defects include myopia (near sightedness), hyperopia (far sightedness), astigmatism (blurred vision) and presbyopia (difficulty focusing up close with age). These conditions can be corrected with glasses, contact lenses or surgery.

📌 Myopia (Near sightedness)

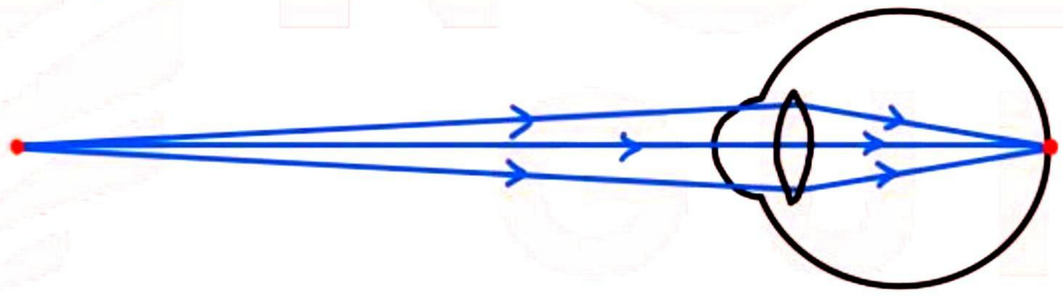
Myopia, or nearsightedness, is a vision where distant objects appear blurry due to the eye's inability to focus properly on them.

✿ Cause of Myopia

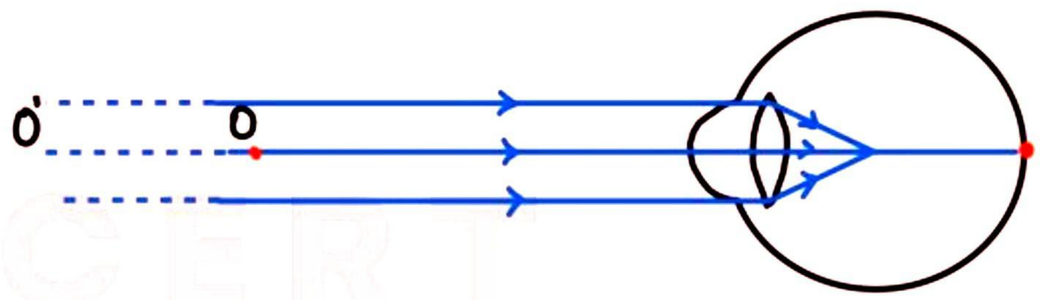
- Excessive curvature of the eye lens.
- Elongation of the eyeball.

✿ Correction of Myopia

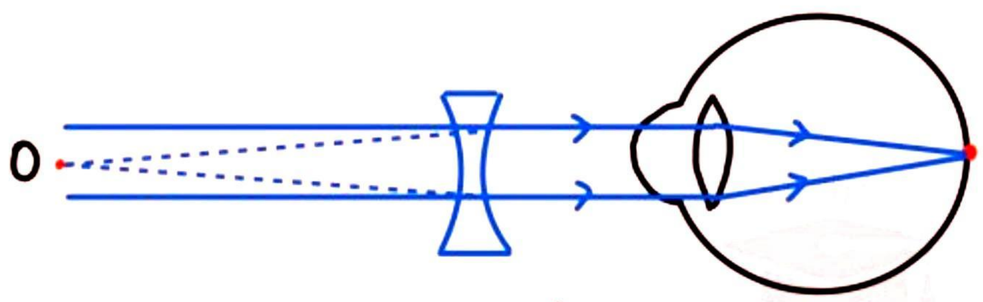
Myopia can be rectified by employing a concave (diverging) lens with the suitable focal length (or power)



Far Point of a myopic eye



Myopic Eye



Correction of Myopic Eye

Hypermetropia (Far Sightedness)

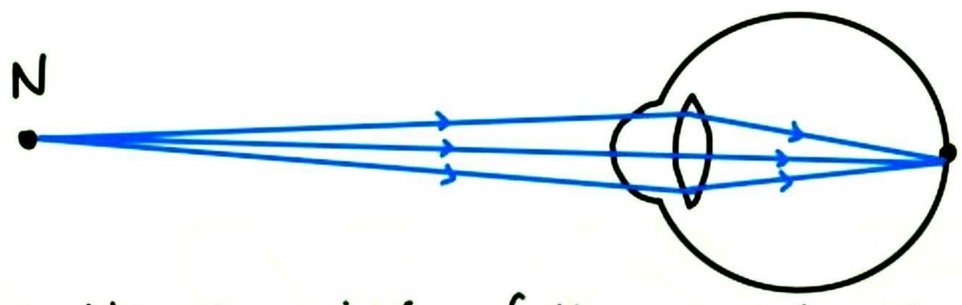
Hypermetropia, also known as Farsightedness, is a vission condition where distant objects are clearer than close-up objects due to the eye's inability to focus on nearby objects properly.

Cause of Hypermetropia

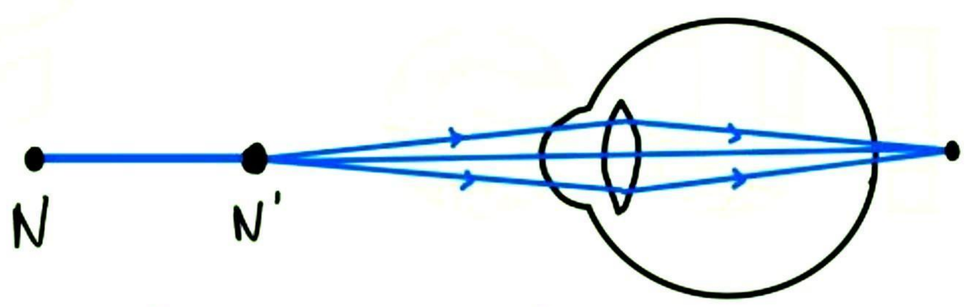
- Large focal length of the eye lens
- Shortening of the eyeball.

Correction of Hypermetropia

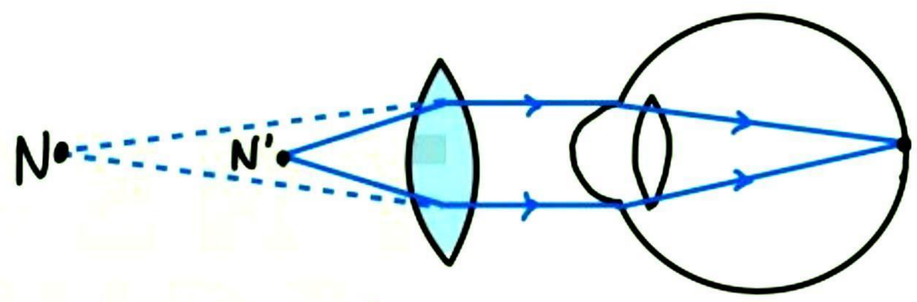
Hypermetropia can be corrected by using a convex (converging) lens of appropriate focal length (or power)



Near point of Hypermetropic eye



Hypermetropic eye



correction of Hypermetropic eye

Presbyopia

Presbyopia is an age-related vision condition where it becomes difficult to focus on close objects, usually requiring reading glasses for correction.

Cause of Presbyopia

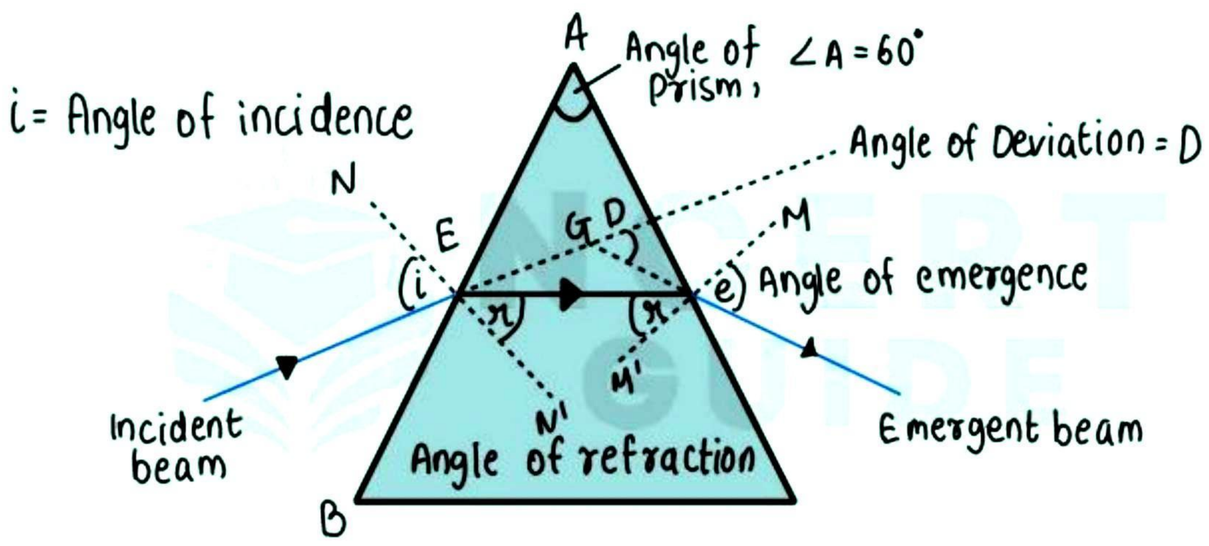
- Gradual weakening of the ciliary muscles with age.
- Decreasing flexibility of the crystalline lens.

Correction of Presbhopia

For a person suffering from both myopia and hypermetropia, bi-focal lenses are required in which the upper part is a concave lens and lower part is a convex lens.

Reflection Of A light through A Prism

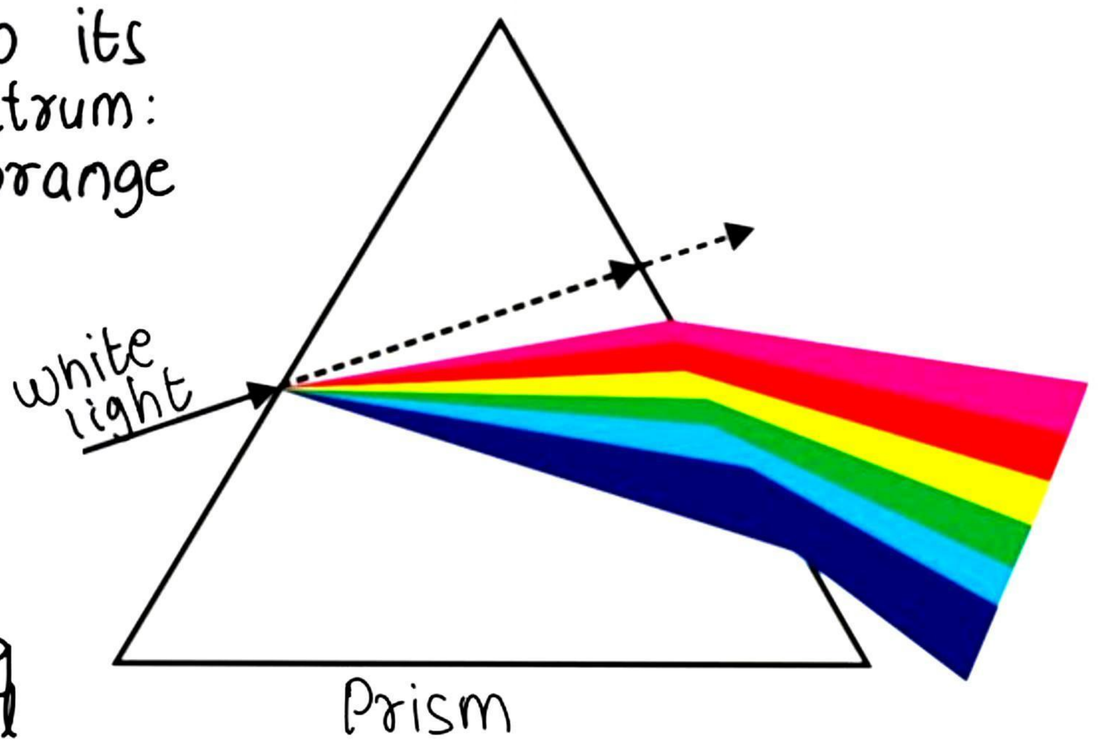
A prism is a transparent optical material characterized by at least two angled surfaces, which result in the refraction or bending of light as it traverses through due to the angled orientation of the surfaces.



Refraction of light through prism

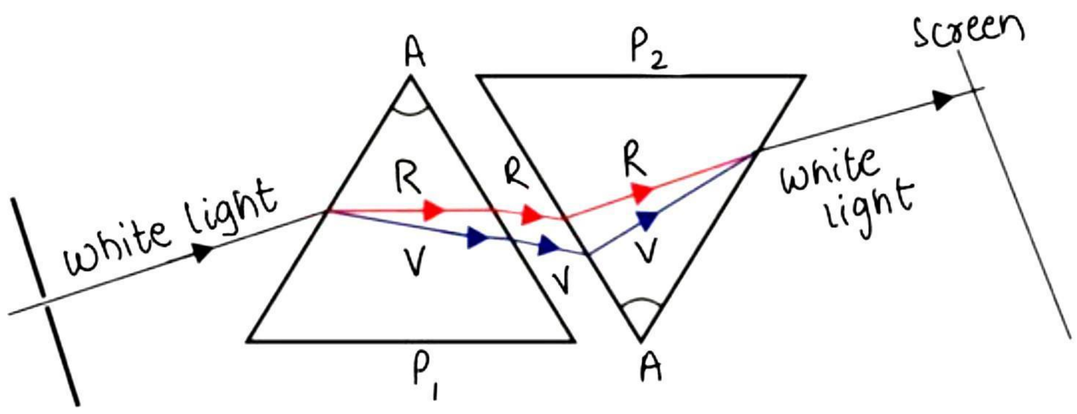
Dispersion of white Light By a Glass Prism

A prism separates white light into its constituent colours, forming a spectrum: voilet, Indigo, Blue, green, yellow, orange and Red (VIBGYOR). This process is called dispersion, occurs as lights passes through prism, with each colour bending at different angles. Red light bends the least, while violet light bends the most. Each colours exits the prism along unique paths, allowing for individual identification.



Recombination of white light

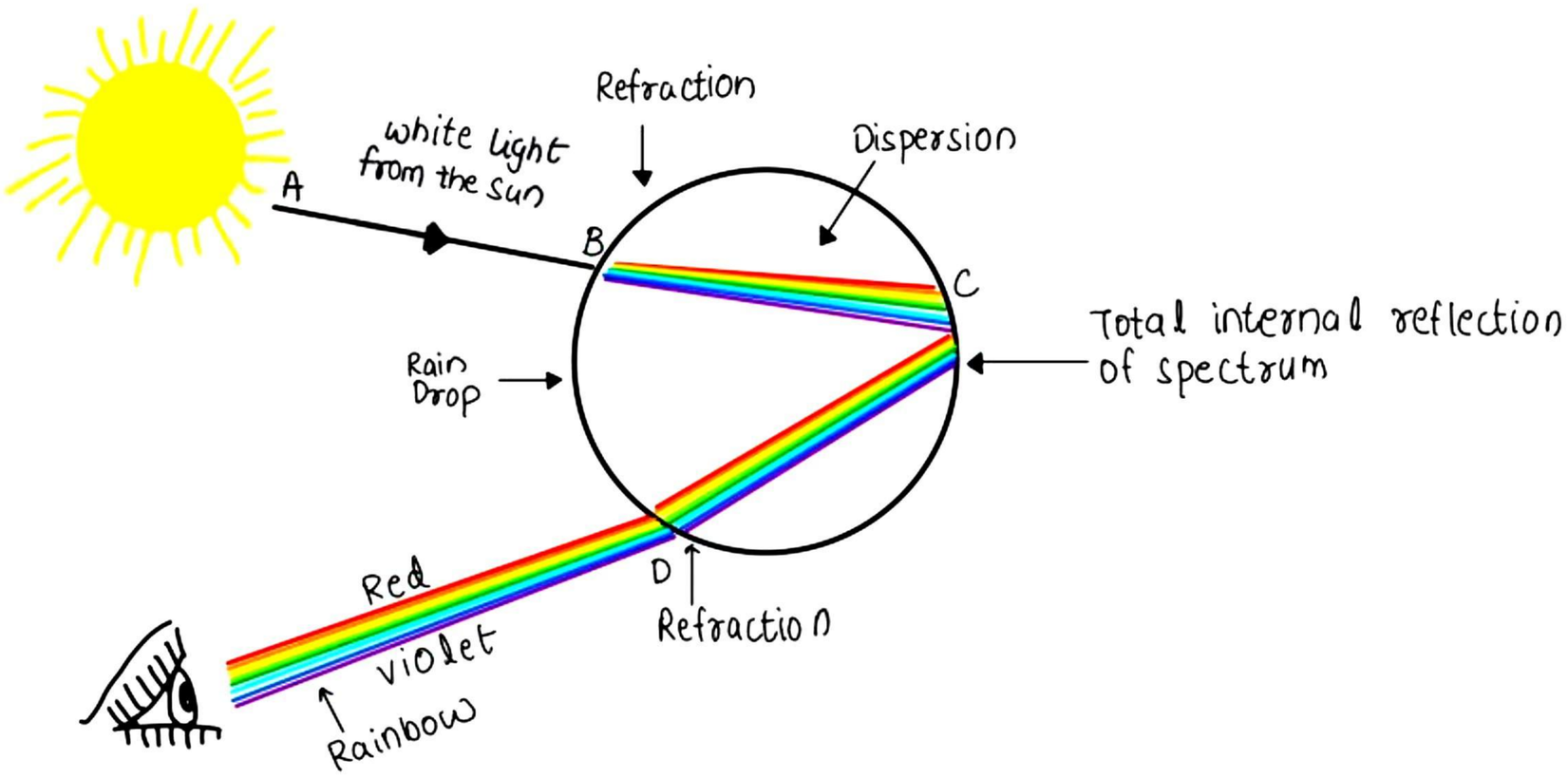
Recombination of white light involves merging the separated colours (spectrum) created by a prism or similar device, resulting in the restoration of white light.



Rainbow

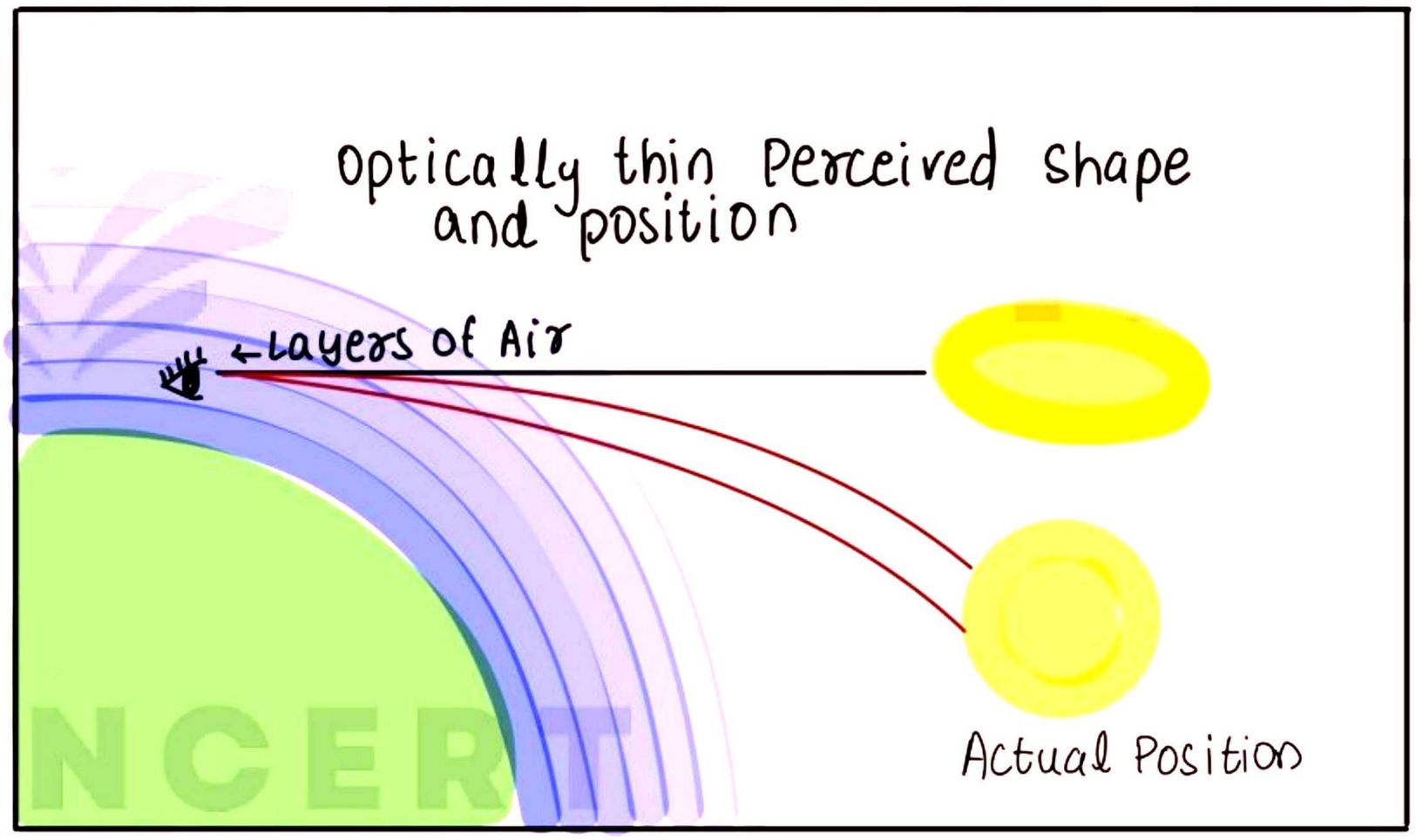
A rainbow manifests as a vibrant, circular arc of light observed in the sky following rainfall. It emerges from the bending of sunlight with in water droplets, presenting the colours red, orange, yellow, green, blue, indigo and violet sequentially. water droplets function akin to miniature prisms. They refract and disperse incoming sunlight, then internally

refract it, culminating in a final refraction upon exiting the raindrop.



➡ Atmospheric Reaction

When refraction transpires between two mediums, with one of them being the Earth's atmosphere, this occurence is termed as atmopheric refraction.



Twinkling stars

Effects of Atmospheric Refraction - The twinkling of stars occur due to the bending of starlight as it traverses through the Earth's atmosphere. This bending is caused by fluctuations in the refractive index of the atmosphere resulting in rapid changes in a star's apparent position and brightness when viewed from Earth

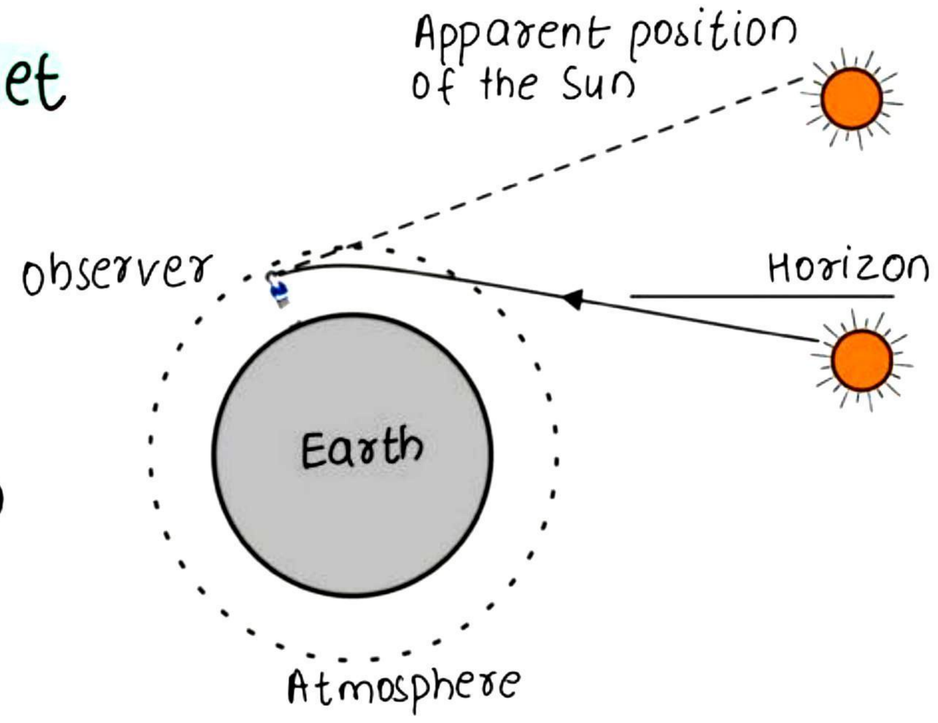
Planets do not twinkle

Planets exhibit no twinkling because they present as small

disks and reflect sunlight, providing a steady and consistent source of illumination when observed from Earth. This is unlike distant stars, which are singular points of light and prone to twinkle due to atmospheric effects.

Advance sunrise and delayed sunset

We can see the Sun approximately two minutes before it officially rises and about two minutes after it technically sets. This phenomenon is a result of atmospheric refraction



➡ Scattering of light

Light scattering the phenomenon wherein light disperses in various directions upon interaction with an object, is influenced by the nature of the particles involved. Finer particles tend to scatter lights mostly in the blue spectrum, while larger particles scatter lights with longer wavelength. The intensity of scattering increases with shorter wavelengths.

➡ Consequences of light Scattering

Tyndall Effect - The Tyndall Effect occurs when Earth's atmosphere, comprised of minute particles such as smoke, tiny water droplets and airborne dust, becomes perceptible due to the scattering of light.

Colour of Sky is Blue - The sky appears blue due to Rayleigh scattering, a phenomenon where small molecules of air and fine particles in Earth's atmosphere scatter shorter wavelength light, particularly in the blue spectrum, more than longer wavelength light, such as red. As sunlight traverses through the atmosphere, these minuscule particles scatter blue light more efficiently than red. Consequently the scattered blue light is what enters our eyes, defining the sky's distinct blue hue.

Colour of Sun at Sunrise and Sunset

During Sunrise and Sunset, the sun takes on a red or orange hue because sunlight travels through a longer path in Earth's atmosphere, causing shorter wavelengths to scatter and allowing red and orange hues to predominate.