

Chapter 10: The Human Eye and the Colourful World

10.1 The Human Eye

The human eye is a complex sense organ that allows us to see the world and its colours. It functions like a camera.

Important Parts of the Eye:

- **Cornea:** Transparent front part; refracts most light entering the eye
- **Iris:** Coloured muscle controlling the size of the pupil
- **Pupil:** Black opening that controls how much light enters the eye
- **Eye Lens:** A flexible, transparent lens that focuses light on the retina
- **Retina:** Inner back layer where image is formed; contains light-sensitive cells
- **Optic Nerve:** Sends electrical signals from retina to brain

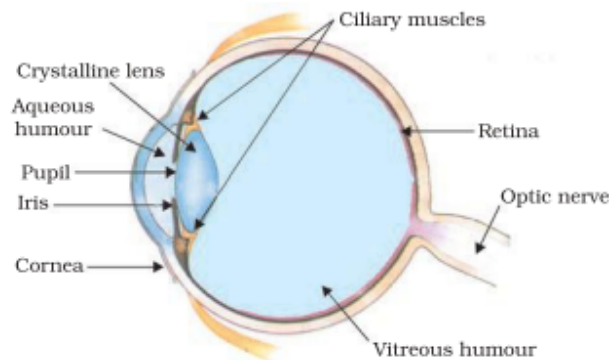


Fig. 10.1 – Structure of the human eye

Function: Light enters through cornea → passes through pupil → lens focuses it on retina → retina sends signals to brain → image is perceived.

10.1.1 Power of Accommodation

Accommodation:

The ability of the eye to change the focal length of the lens to see near and far objects clearly.

- Done by ciliary muscles
- For distant objects → muscles relax → lens becomes thin → increases focal length
- For near objects → muscles contract → lens becomes thick → decreases focal length

Least Distance of Distinct Vision:

Minimum distance at which a person can see clearly without strain. For a healthy adult, it is 25 cm.

■ **Near Point:** 25 cm (for normal vision)

■ **Far Point:** Infinity (for normal vision)

■ **Cataract:**

Clouding of the eye lens in old age; can be corrected with surgery.

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◆ 10.2 Defects of Vision and Their Correction

There are 3 main types of vision defects:

1. Myopia (Near-sightedness)

- Can see near objects, not far
- Image of distant object forms before retina
- Cause: Long eyeball or high curvature of lens
- Correction: Concave lens of suitable power

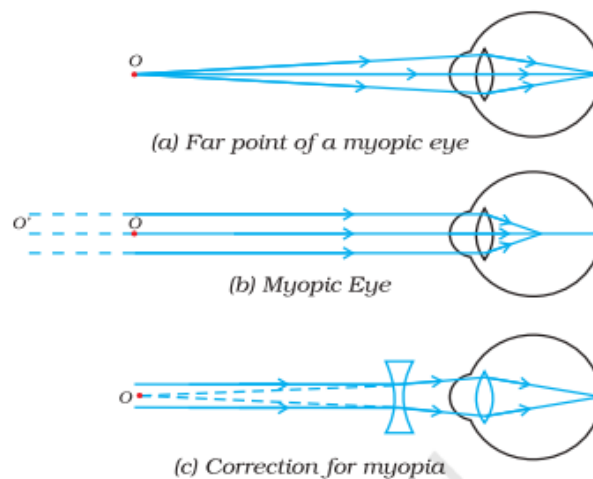
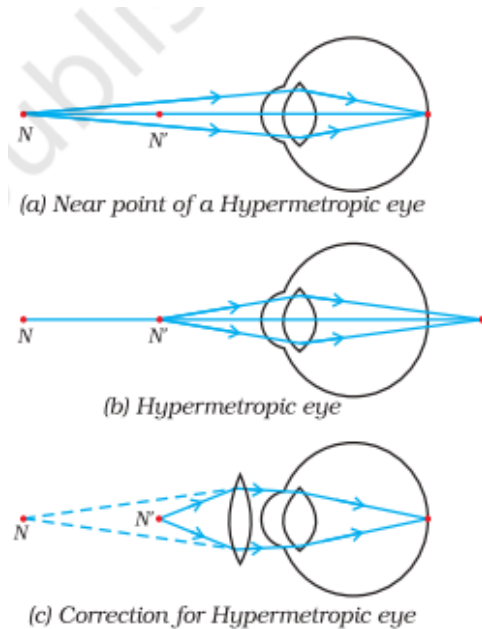


Figure 10.2

(a), (b) The myopic eye, and (c) correction for myopia with a concave lens

1. Hypermetropia (Far-sightedness)

- Can see far objects, not near
- Image of close object forms behind retina
- Cause: Short eyeball or long focal length
- Correction: Convex lens



1. Presbyopia (Age-related)

- Reduced accommodation power with age
- Can't see near or far clearly
- Correction: Bifocal lenses or surgical methods

🧠 Note: Bifocal lenses have both concave (upper part for distance) and convex (lower part for near) segments.

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◆ 10.3 Refraction of Light through a Prism

📖 Prism:

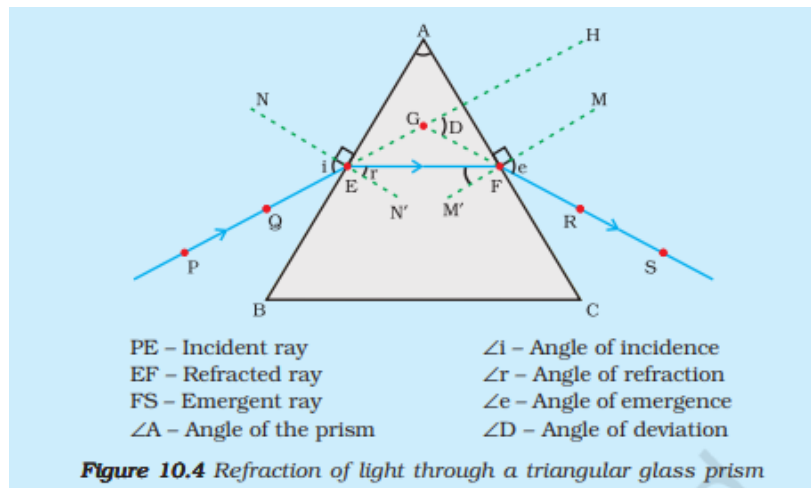
A transparent optical element with inclined surfaces (triangular cross-section) that bends light.

🔧 Activity 10.1:

- Shine light through prism → observe path
- Light bends twice (at both surfaces)
- The emergent ray is deviated from the incident ray

📖 Angle of Deviation:

Angle between the incident ray and emergent ray.



◆ 10.4 Dispersion of White Light by Glass Prism

📖 Dispersion:

Splitting of white light into its 7 colours due to refraction through prism.

Colours (in order): VIBGYOR (Violet, Indigo, Blue, Green, Yellow, Orange, Red)

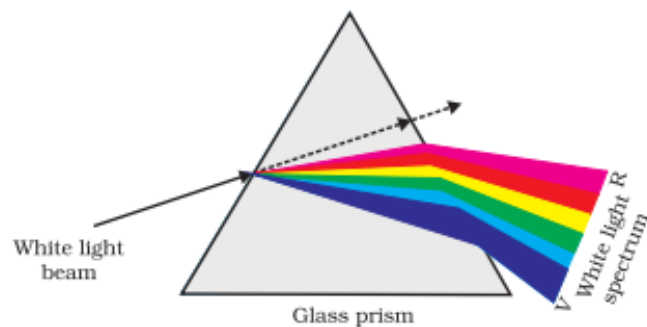


Figure 10.5 Dispersion of white light by the glass prism

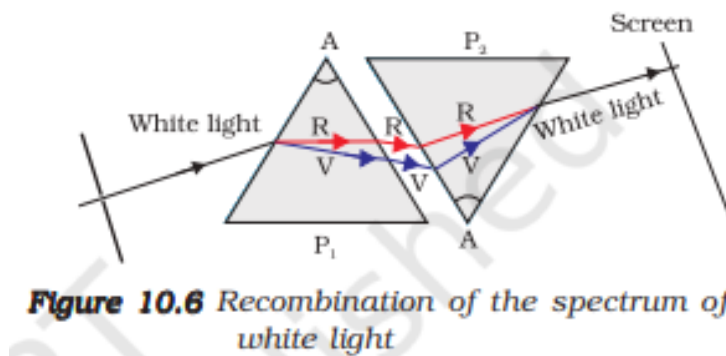


Figure 10.6 Recombination of the spectrum of white light

🧠 Why dispersion occurs:

Different colours bend at different angles; violet bends most, red bends least.

📖 Rainbow:

Natural dispersion by tiny water droplets – acts as prism and mirror. Formed by refraction,

internal reflection, and dispersion of sunlight.

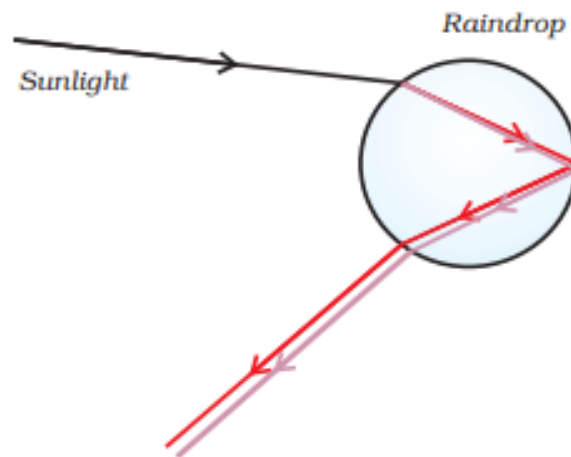


Figure 10.8 Rainbow formation

◆ 10.5 Atmospheric Refraction

📖 Atmospheric Refraction:

Bending of light due to varying air densities in Earth's atmosphere.

Examples:

- Twinkling of stars
- Advance sunrise and delayed sunset

📖 Why stars twinkle?

- Starlight bends irregularly due to atmospheric changes → flickering brightness.

📖 Why planets don't twinkle?

- They are closer and appear as extended sources → twinkling averages out.

📖 Advance Sunrise and Delayed Sunset:

- Due to bending of light, Sun appears about 2 mins before actual sunrise and remains visible 2 mins after sunset.

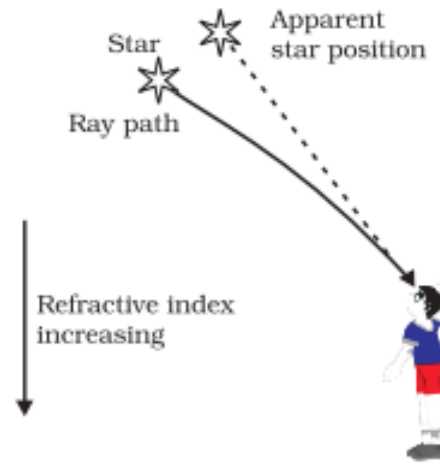


Figure 10.9
*Apparent star position
due to atmospheric
refraction*

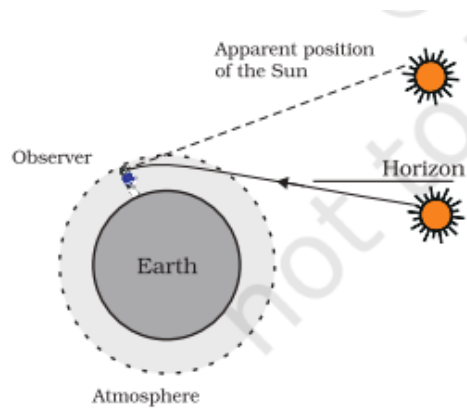


Figure 10.10
*Atmospheric refraction
effects at sunrise and
sunset*

◆ 10.6 Scattering of Light

■ Scattering:

When particles in the atmosphere deflect light in all directions.

■ Tyndall Effect:

Visible path of light in colloids or fog due to scattering by particles.

Examples:

- Sunlight passing through forest mist
- Light beam in a dusty room

◆ 10.6.2 Why is the Sky Blue?

- Shorter wavelengths (blue) scatter more than longer ones (red)
- Blue light is scattered in all directions and reaches our eyes → sky appears blue

Why is danger signal red?

Red has longer wavelength and is scattered the least → visible from far even in fog/smoke

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Summary:

- The human eye adjusts lens curvature to see near and far objects (accommodation).
- Eye defects like myopia, hypermetropia and presbyopia can be corrected with lenses.
- White light splits into 7 colours on passing through a prism (dispersion).
- Atmospheric refraction causes twinkling of stars and time gap in sunrise/sunset.
- Scattering of light explains sky's colour, red sunsets, and Tyndall effect.