HUMAN EYE AND THE COLOURFUL WORLD

Human body and Inventions of Science are closely related

clenched fist

Leg

Brain

Human Eye

Hammer

wheel

Computer

Camera

HUMAN EYE

Diameter of eye is about 2.4 cm.

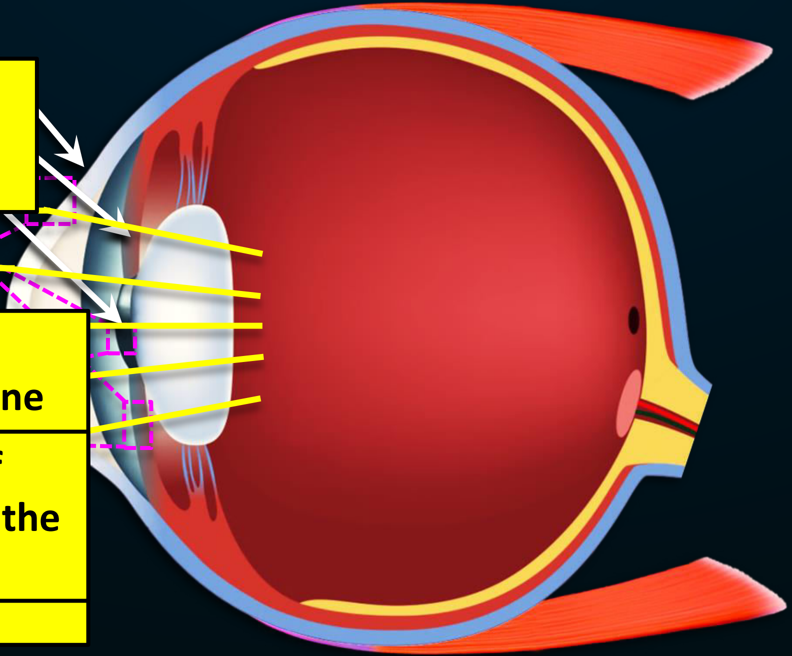
Cornea

Maximum refraction of light takes place from cornea

Cornea is a thin transparent membrane

Pupil is opening of changing diameter at the centre of the iris

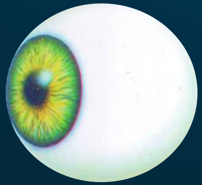
called the iris



FUNCTION OF IRIS

Regulates the amount of light entering the eye

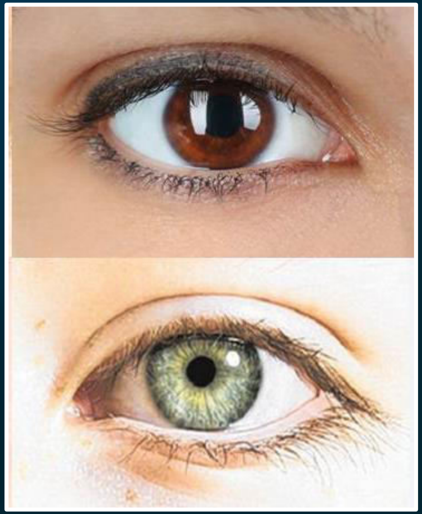
Imparts colour to the eye



In bright light, pupil contracts

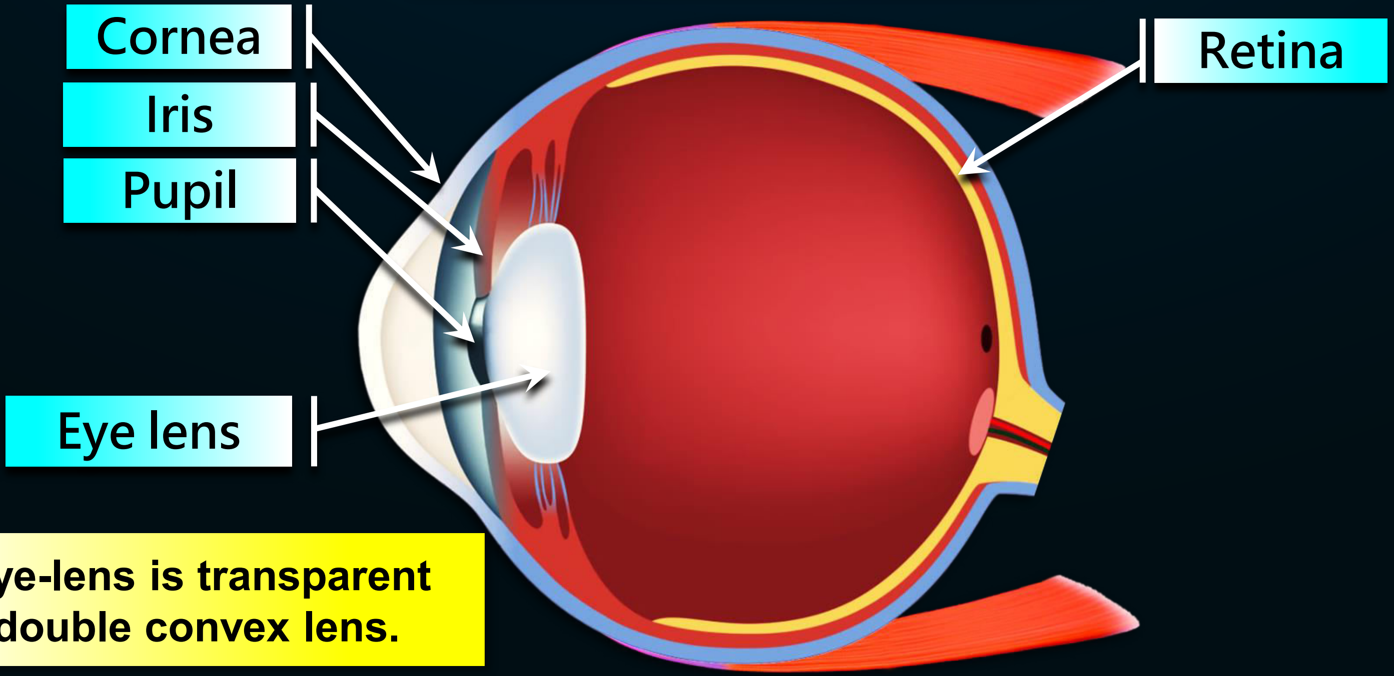
In dim ligh
widens

The tendency of the pupil to adjust the opening for light is called adaptation.



HUMAN EYE

It is light sensitive screen made up of light sensitive cells. These cells get activated upon illumination.



Eye-lens is transparent double convex lens.

RETINA

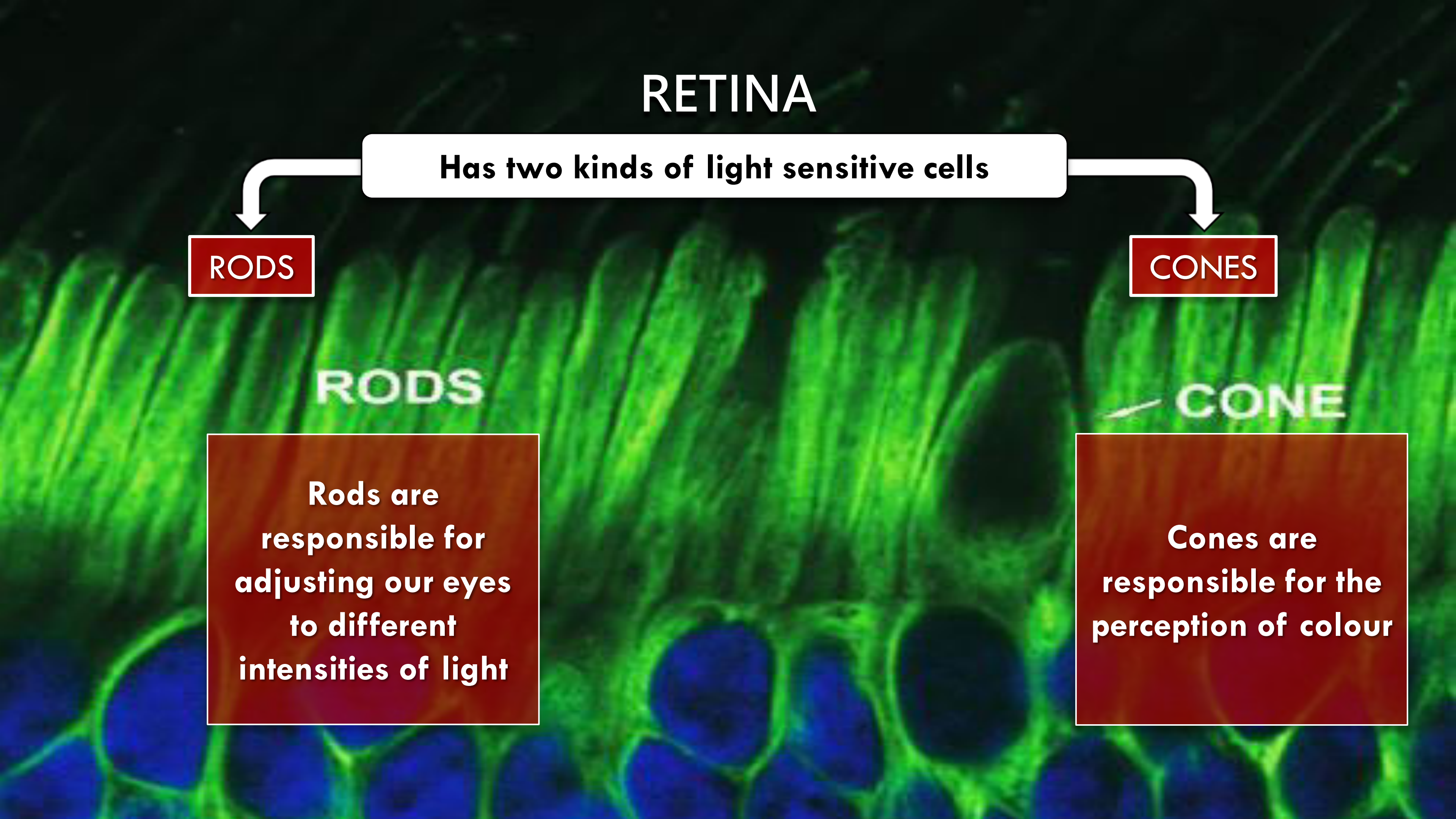
Has two kinds of light sensitive cells

RODS

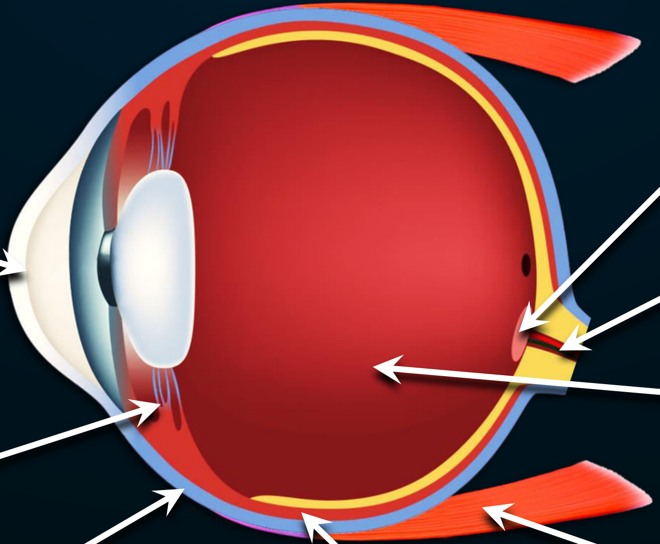
CONES

Rods are responsible for adjusting our eyes to different intensities of light

Cones are responsible for the perception of colour

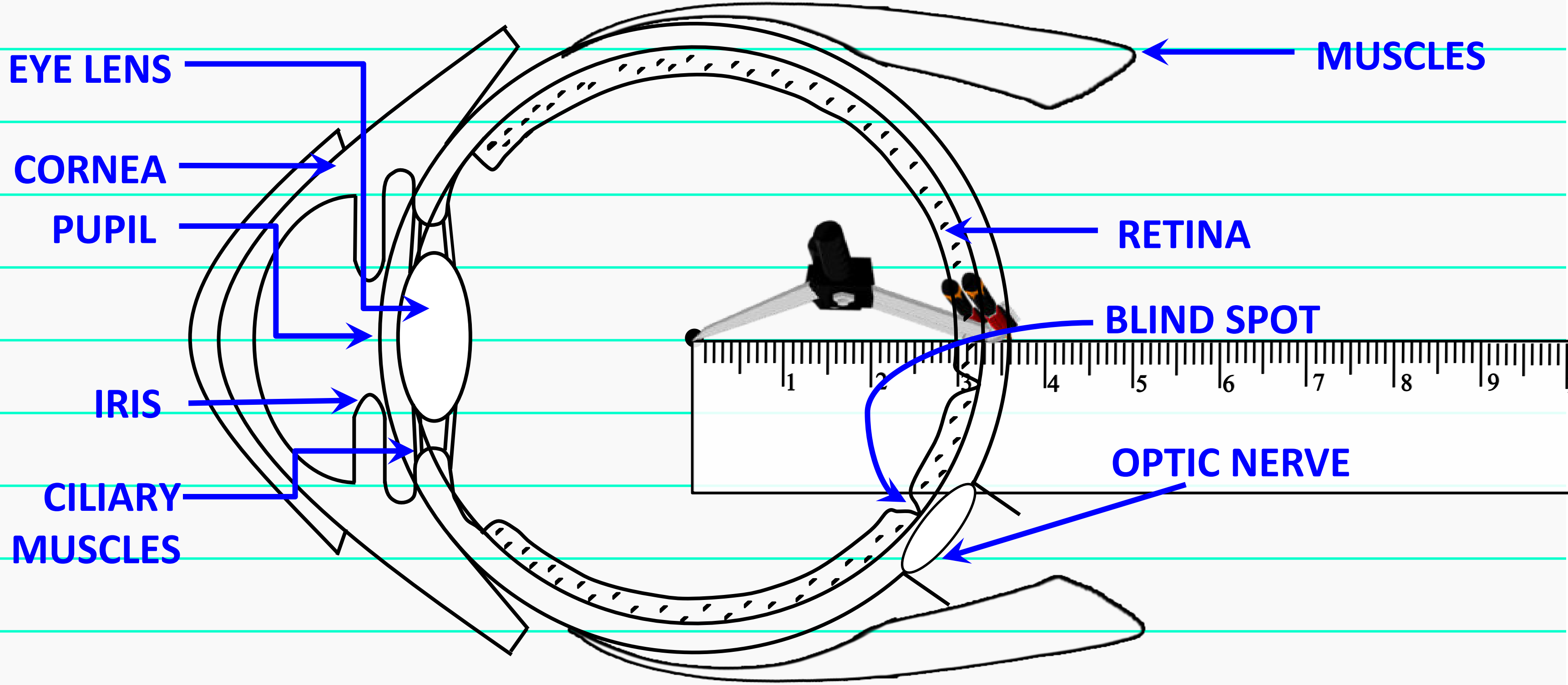


HUMAN EYE



Blind spot
At blind spot there are no light sensitive cells (no rods or cones) due to which no vision is possible at that spot.
Aqueous Humour
Humour
Ciliary muscles
Muscles
Choroid
Sclerotic coat
Ciliary muscles change thic lens w g.

LETS LEARN TO DRAW HUMAN EYE

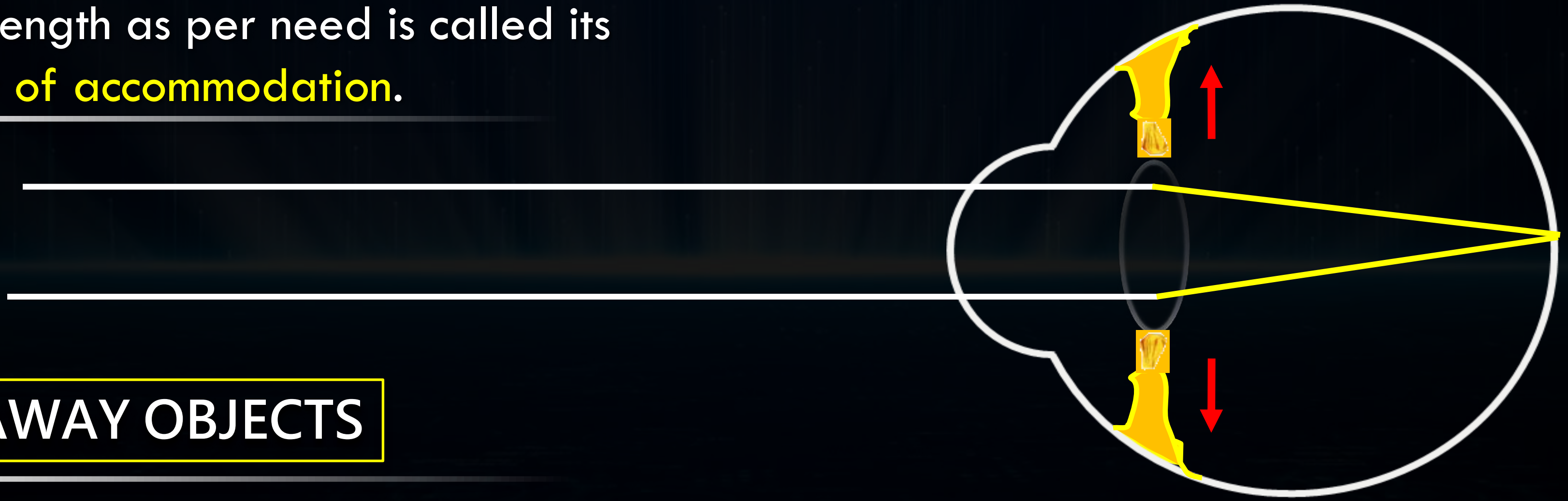


Match the function to its respective part of the human eye

PART	FUNCTION
1. Pupil	a) Bulges outwards and hence causes maximum refraction of light
2. Optic nerve	b) Imparts colour to the human eye. Controls the amount of light that enters the Eye.
3. Cornea	c) Regulates amount of light entering the eye
4. Cone cells	d) Converge the rays of light so that the image is formed on the retina within the eye. It forms a real and inverted image.
5. Iris	e) Conveys the degree of brightness to the brain.
6. Eye lens	f) Conveys the colours of image to the brain.
7. Rod cells	g) Carries information of retinal image to the brain.

Power Of Accommodation

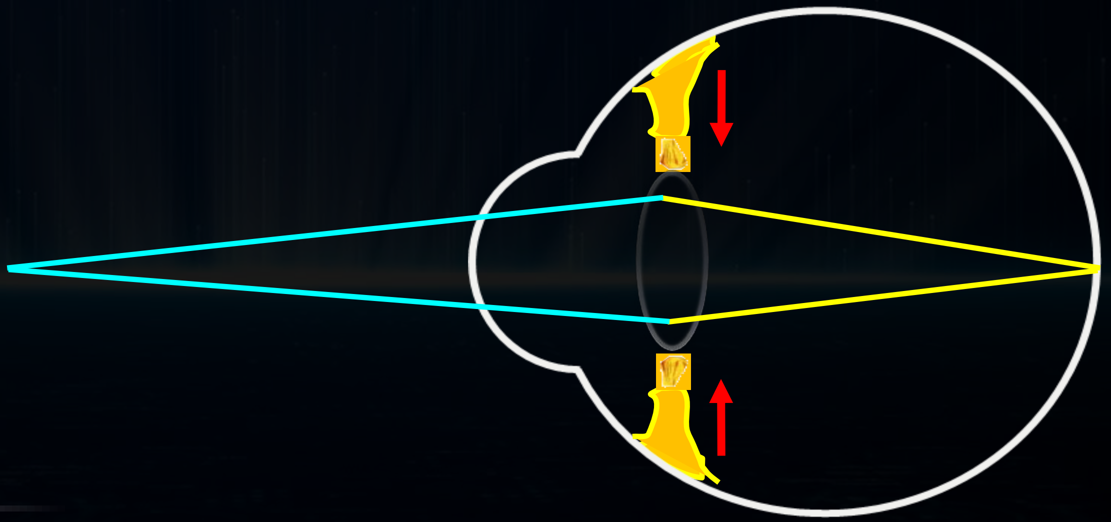
The capacity of the lens to change its focal length as per need is called its power of accommodation.



FAR AWAY OBJECTS

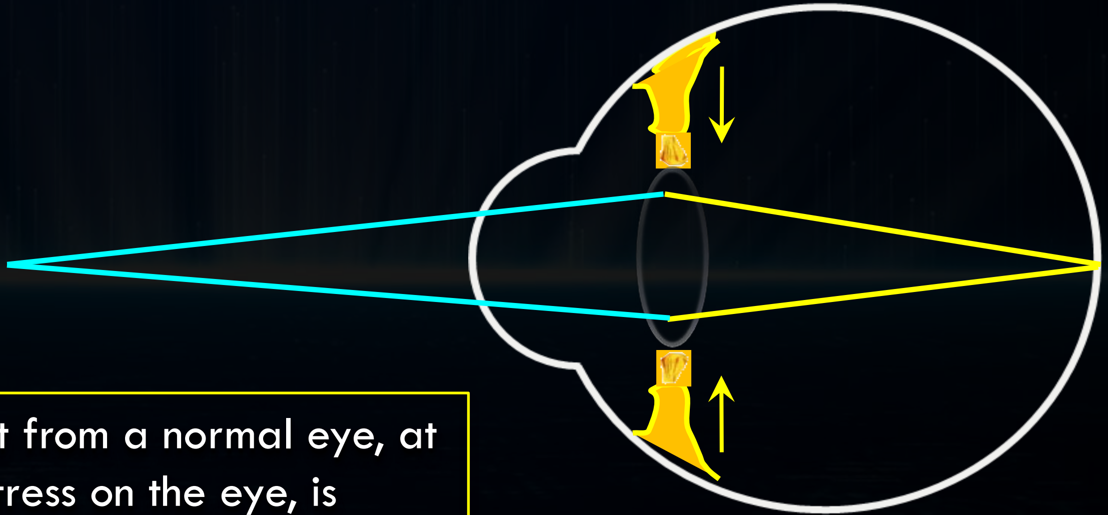
While seeing objects at large, infinite distances, the lens of the eye becomes flat and its focal length increases.

Power Of Accommodation



NEARBY OBJECTS

While seeing nearby objects the lens becomes more rounded and its focal length decreases.

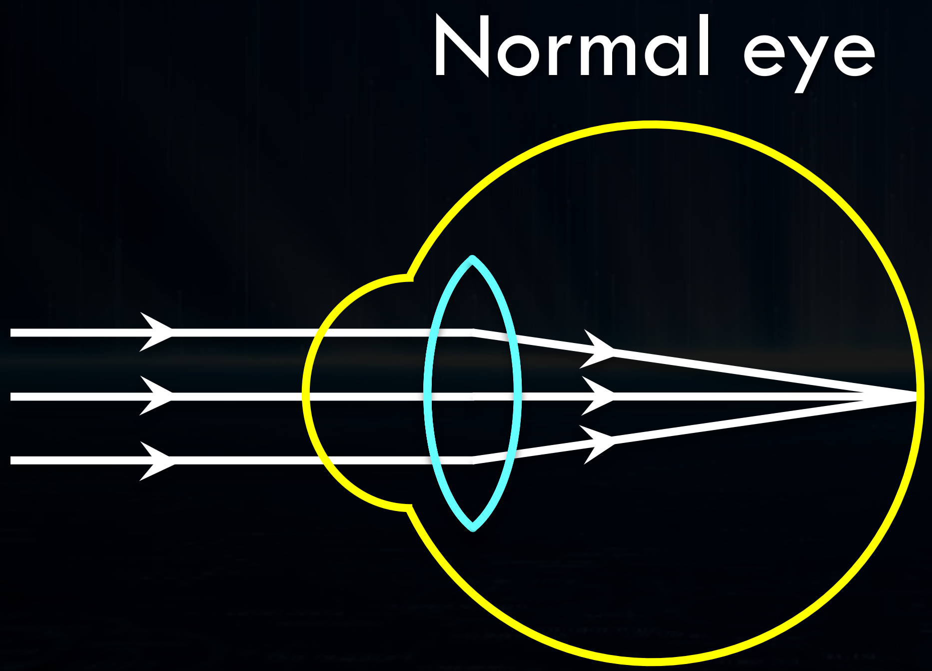


The minimum distance of an object from a normal eye, at which it is clearly visible without stress on the eye, is called as minimum distance of distinct vision.

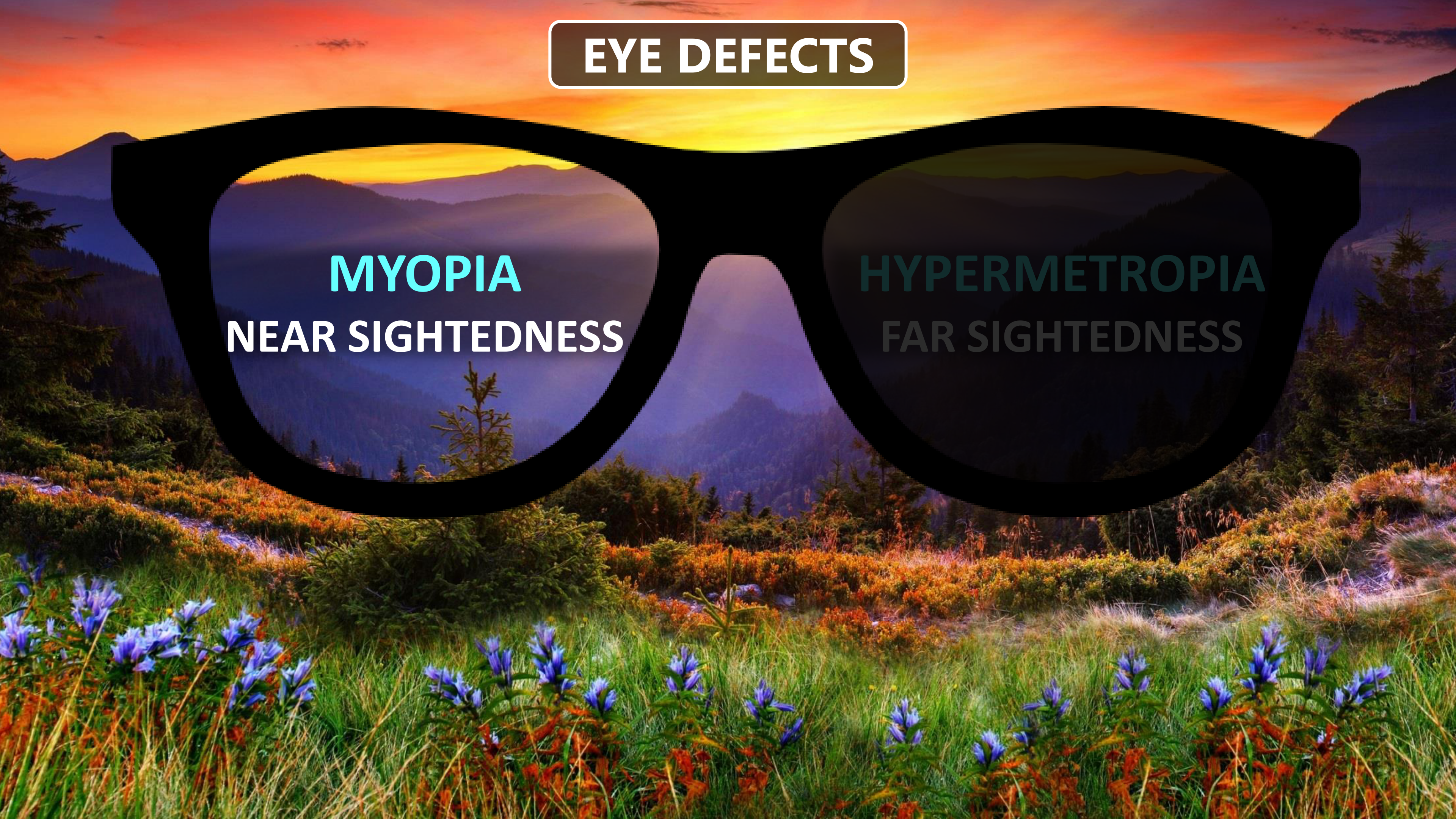
For a normal human eye, at the near point is at 25 cm.

Thank You

EYE-DEFECTS



The image is formed on the retina


EYE DEFECTS
MYOPIA
NEAR SIGHTEDNESS
HYPERMETROPIA
FAR SIGHTEDNESS

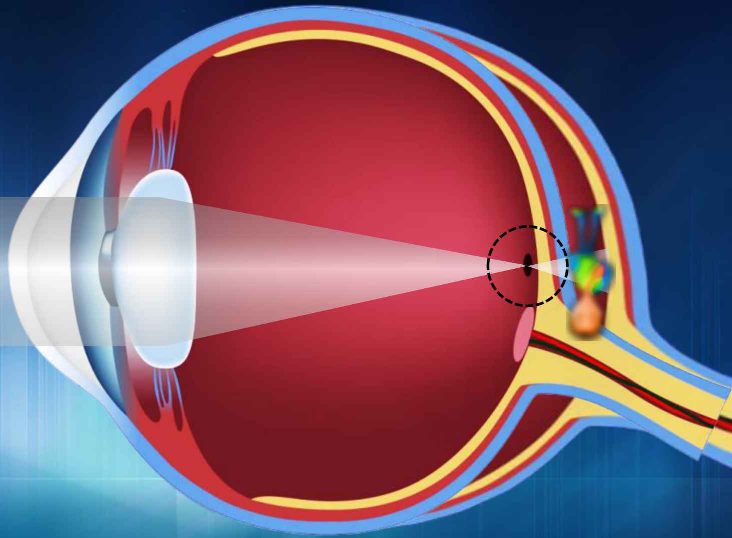
Myopia (*Near sightedness*)

Myopia (*Near sightedness*)

Myopia (Near sightedness)

Defected Eye

This defect may arise due to elongation of the eyeball.



The light rays from a distant object arriving at the eye lens, get converged at a point in front of the retina

Myopia (Near sightedness)

Correction

This defect can be corrected by using a concave (diverging) lens of appropriate focal length.

Myopia *(Near sightedness)*

Nearby objects ⟶ Clear

Faraway objects ⟶ Unclear

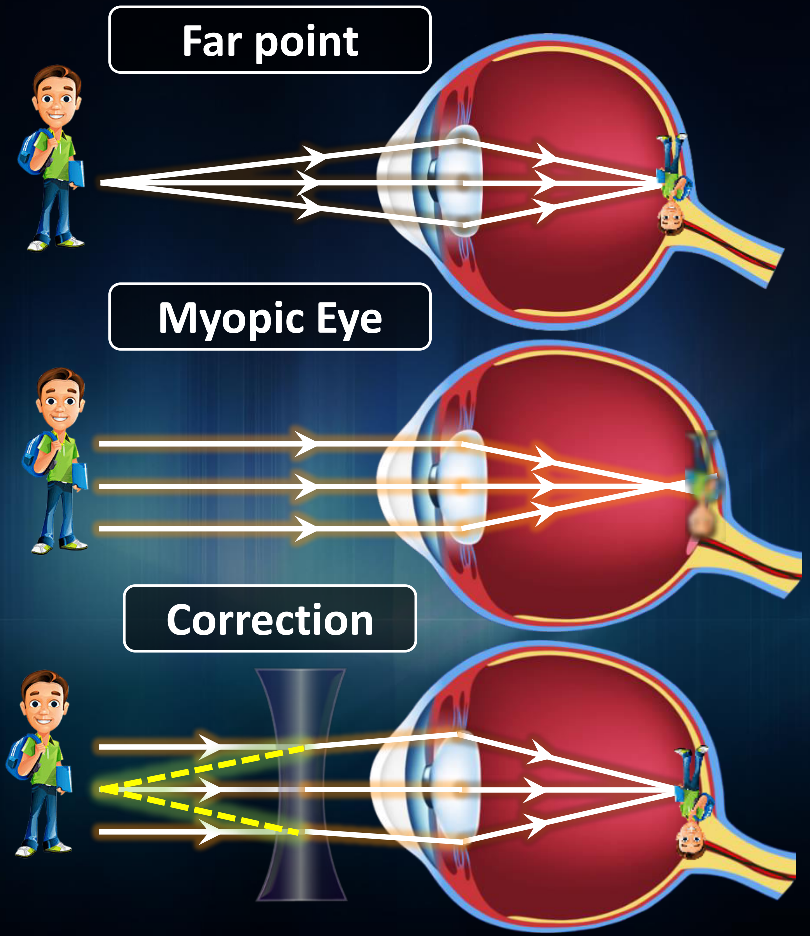
The light rays from a distant object, get converged at a point in front of the retina

This defect may arise due to

1. **Elongation of the eyeball.**
2. **Excessive curvature of the cornea and eye lens.**

Corrected using a ***CONCAVE*** (diverging) lens of appropriate focal length.

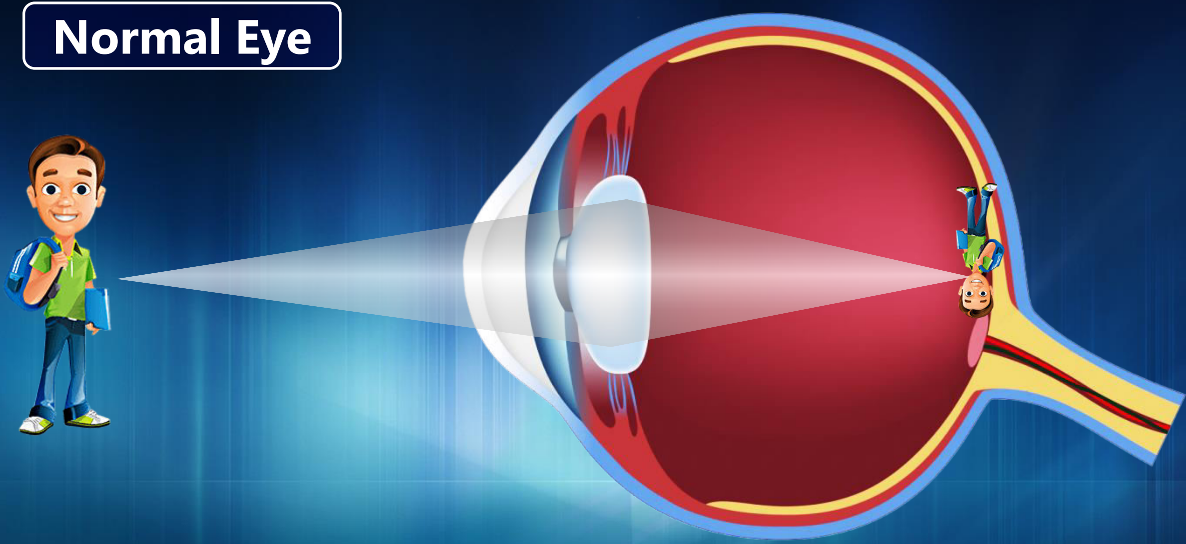
Power of the lens is – ve




MYOPIA
NEAR SIGHTEDNESS
HYPERMETROPIA
FAR SIGHTEDNESS

Hypermetropia (Far sightedness)

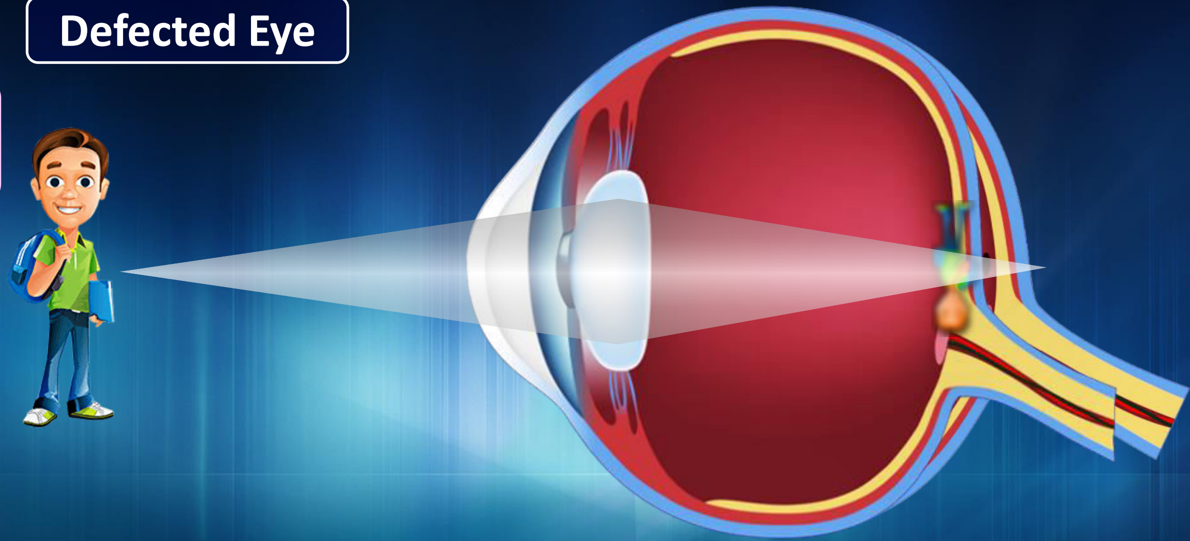
Hypermetropia *(Far sightedness)*



Hypermetropia *(Far sightedness)*

Defected Eye

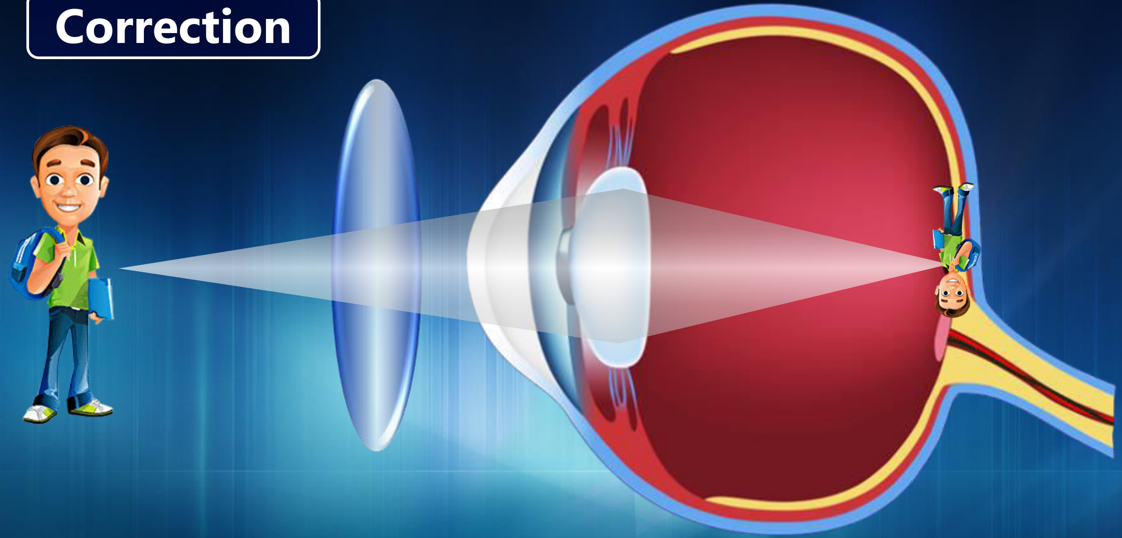
This defect may arise due to shortening of the eyeball.



The light rays from a nearby object arriving at the eye lens, get converged at a point behind the retina

Hypermetropia *(Far sightedness)*

Correction

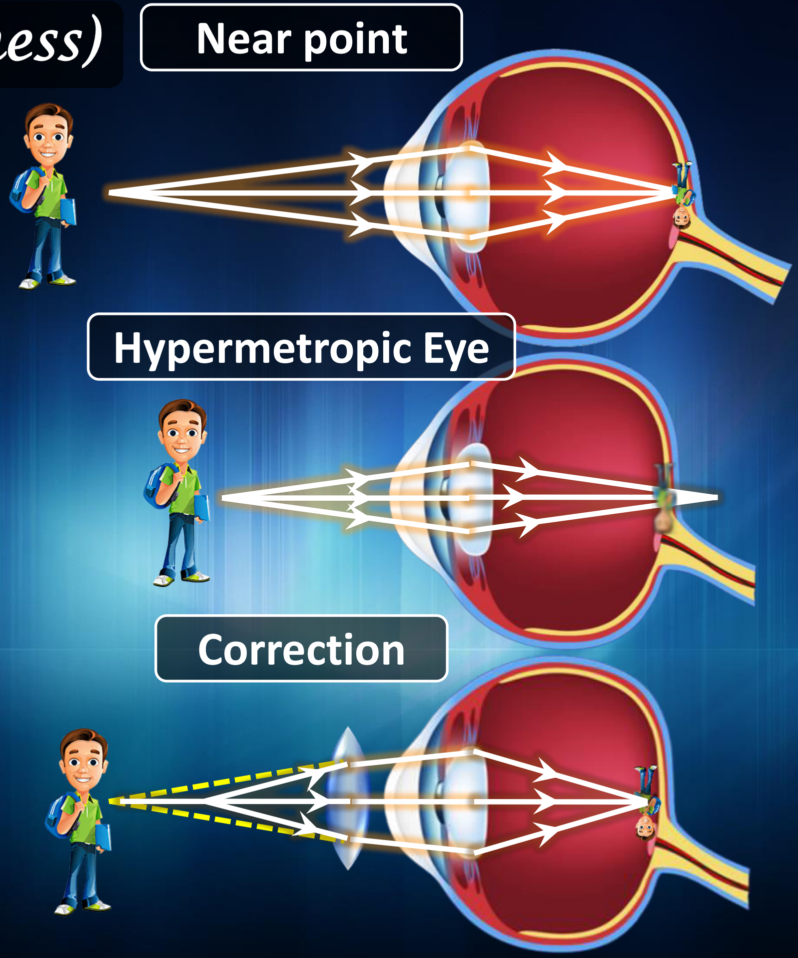


This defect can be corrected by using a convex (converging) lens of appropriate focal length.

Hypermetropia (Far sightedness)

Faraway objects ⟶ Clear

Nearby objects ⟶ Unclear



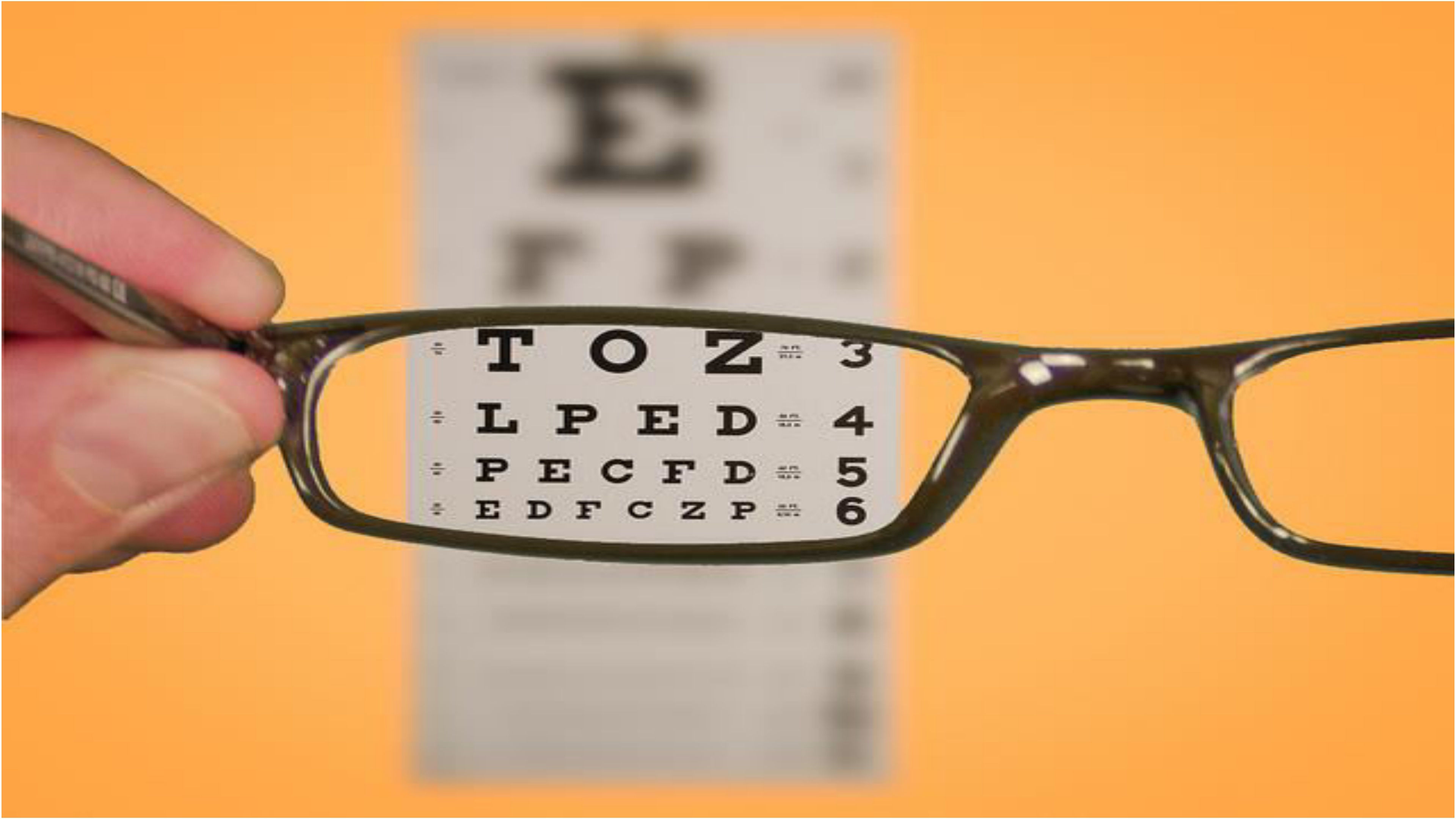
The light rays from a nearby object arriving at the eye lens, get converged at a point behind the retina

This defect may arise due to

1. **Eyeball gets flattened.**
2. **Curvature of the cornea and the eye lens decreases.**

Corrected using a ***CONVEX*** (converging) lens of appropriate focal length.

Power of the lens is + ve


T O Z 3
L P E D 4
P E C F D 5
E D F C Z P 6

EYE-DEFECTS

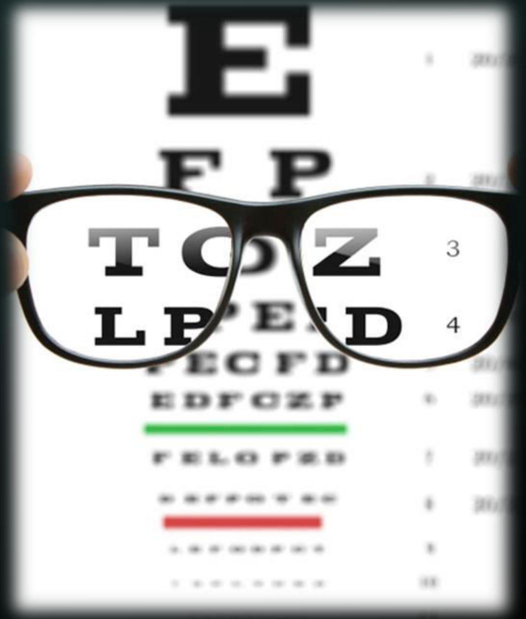
Presbyopia (Old age hypermetropia)

Faraway objects ➡ Clear

Nearby Objects ➡ Unclear

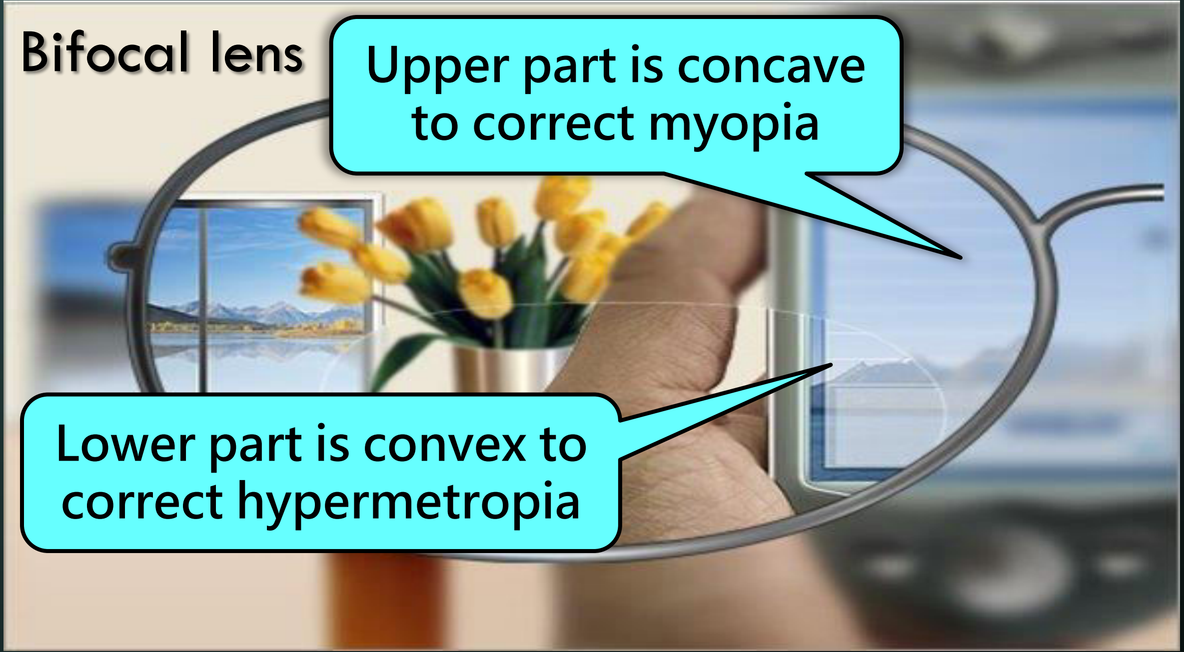
Old age (Above 40 years)

- Muscles near the lens lose their ability to change the focal length.
- Near point (25 cm) shifts farther from eye.
- **Correction:** Convex lens of suitable focal length.



EYE-DEFECTS

Some people develop a combination of myopia and presbyopia in which they are not able to see near as well as far away objects clearly.



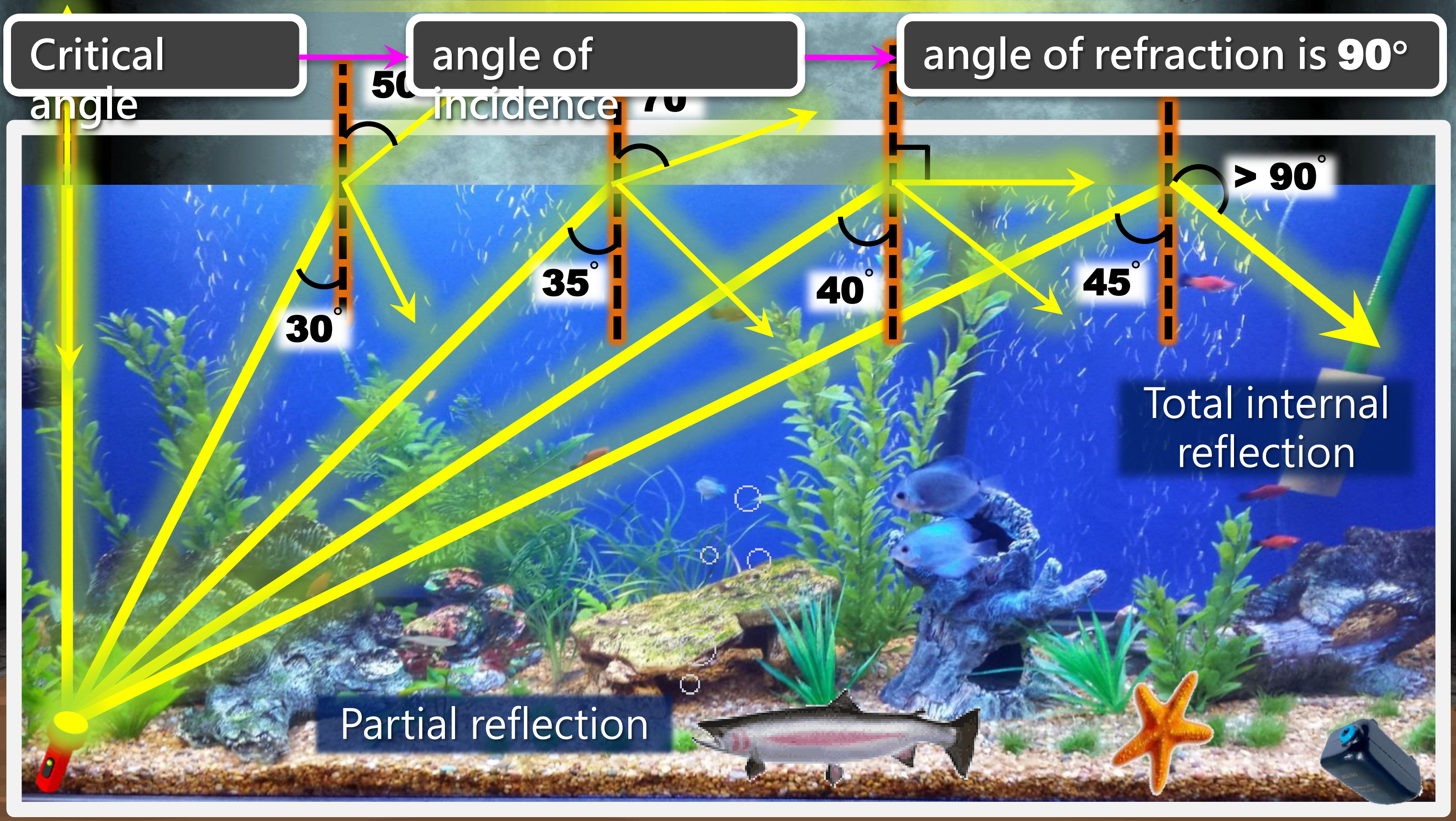
Distinguish between Myopia and Hypermetropia

Myopia	Hypermetropia
A person can see nearby objects clearly.	A person can see faraway objects clearly.
This defect arises due to the elongation of eye ball.	This defect arises due to the flattening of eye ball.
The image of a distant object is formed in front of the retina.	The image of a nearby object is formed behind the retina.
This defect is corrected by the use of concave lens of suitable focal length.	This defect is corrected by the use of convex lens of suitable focal length.

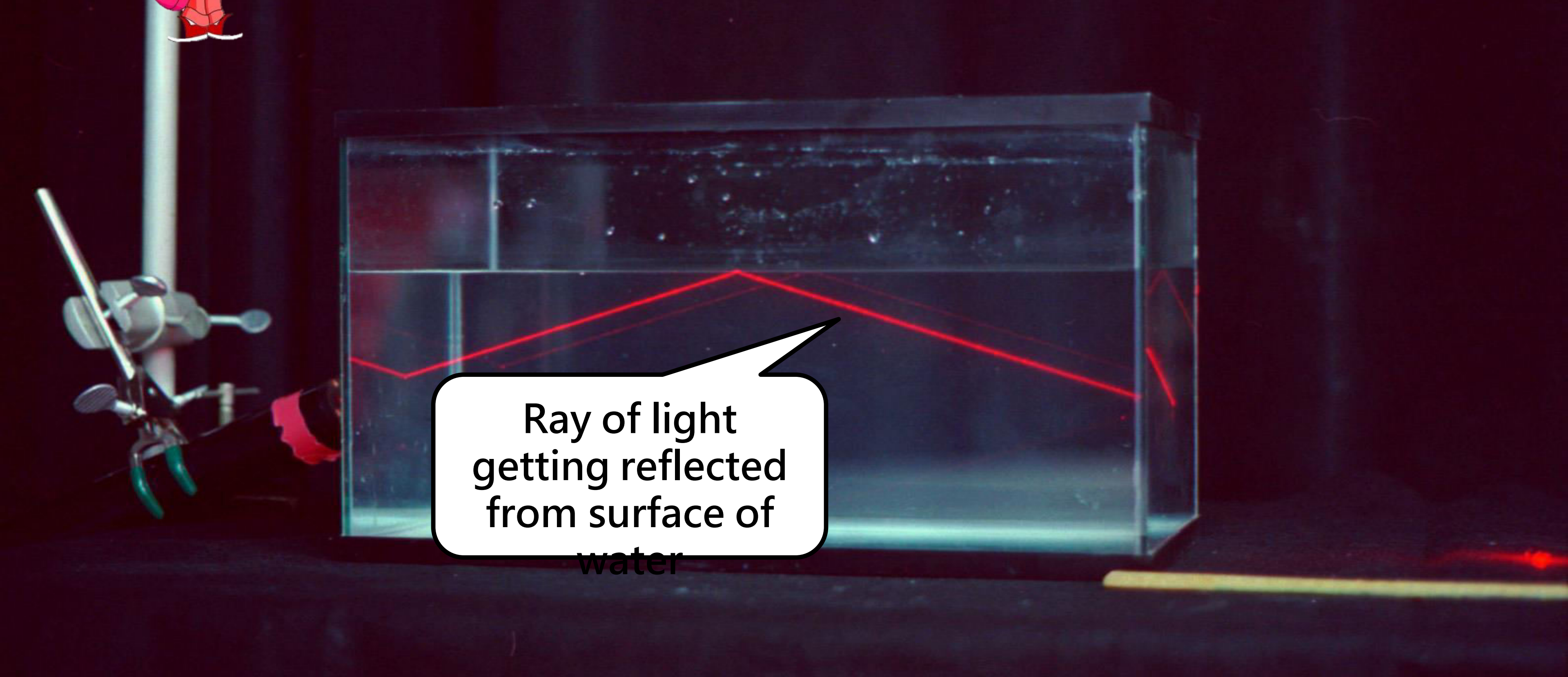
Thank You

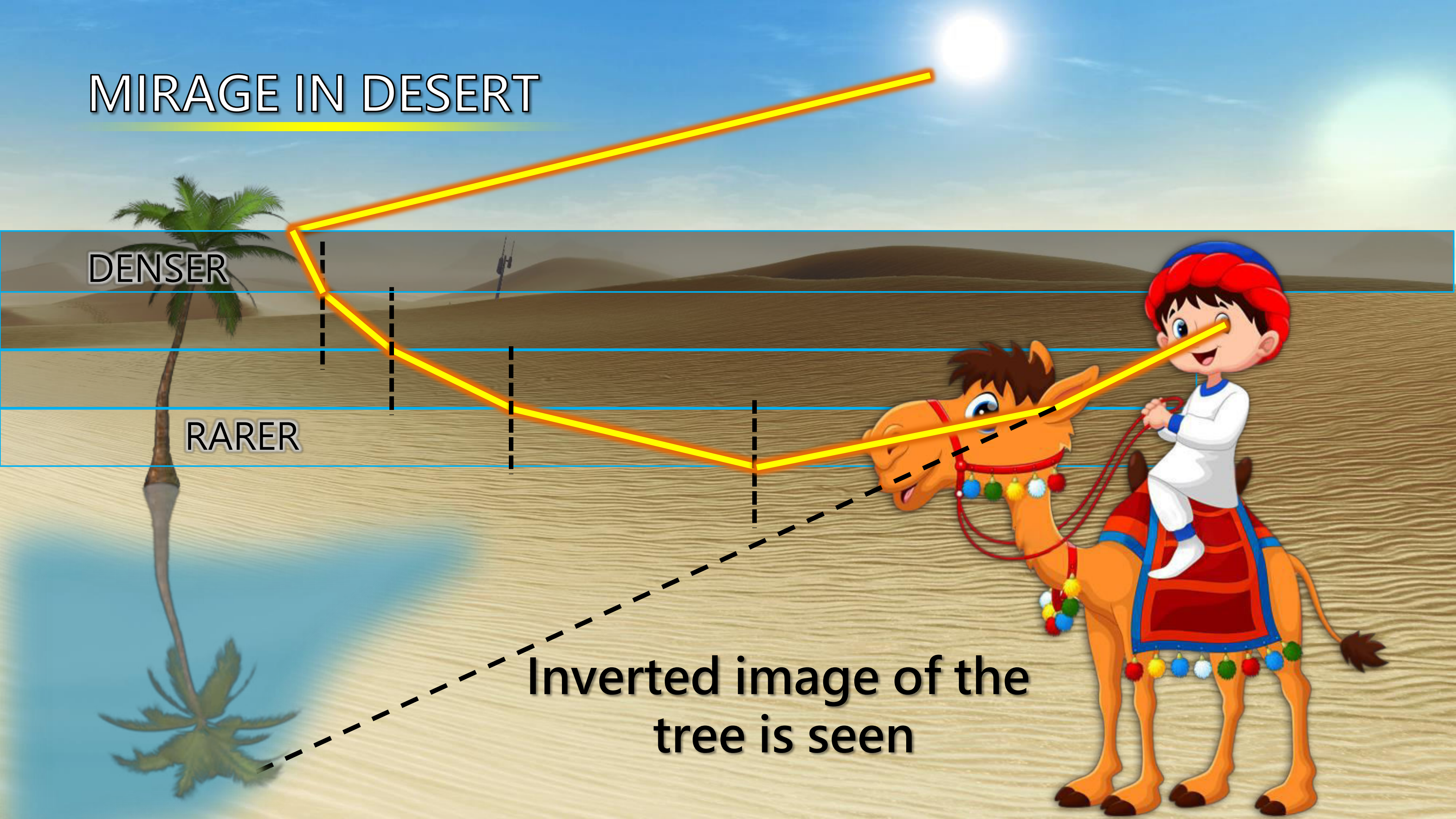
Total Internal Reflection

Partial and total internal reflection



Experiment showing Total Internal Reflection




MIRAGE IN DESERT
DENSER
RARER
Inverted image of the
tree is seen

The water that you can see is actually the reflection of blue sky on the ground due to mirage.

Have you seen water on highway on roads in summer season on a hot afternoon ?

For mirage to occur there has to be TOTAL INTERNAL REFLECTION

Two conditions :-

1. Light should travel from denser medium to rarer medium.
2. Light should hit at an angle greater than critical angle.

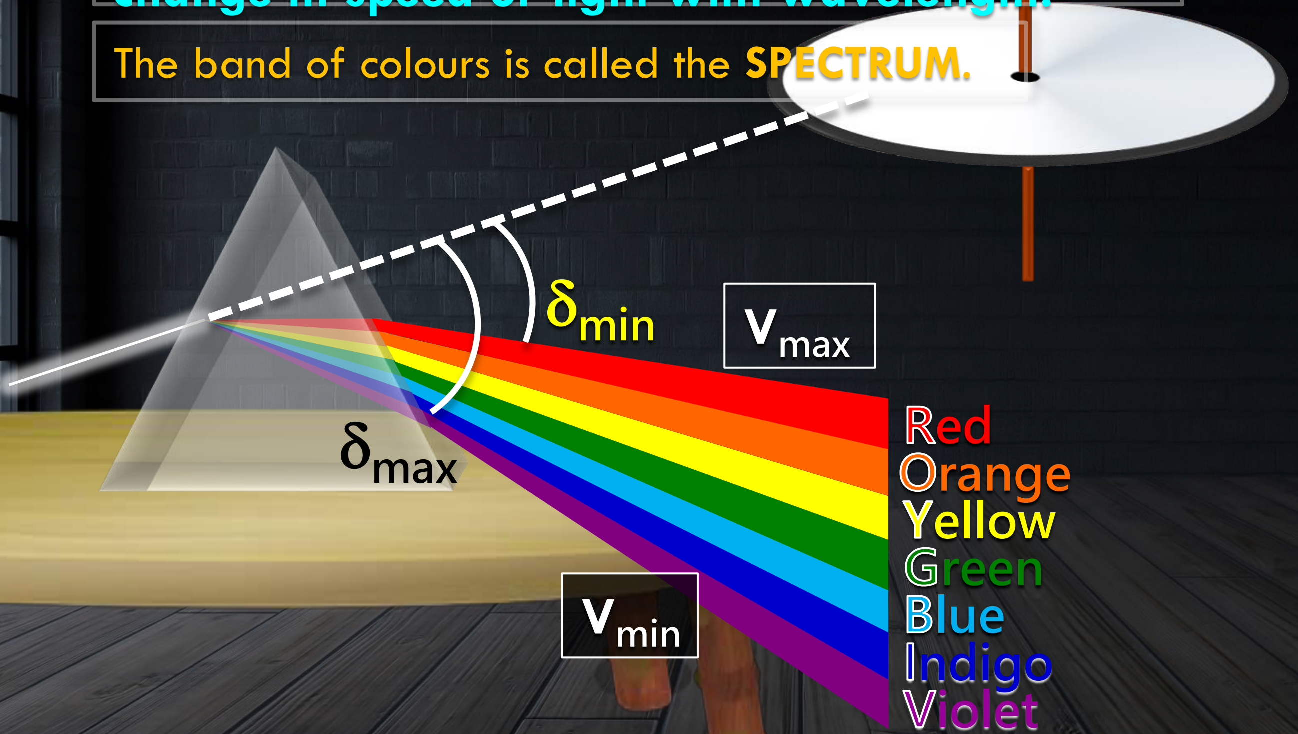
DISPERSION OF WHITE LIGHT

(NEWTON'S EXPERIMENT)

The phenomenon of splitting of white light by a prism into its constituent colours is known as **DISPERSION**.

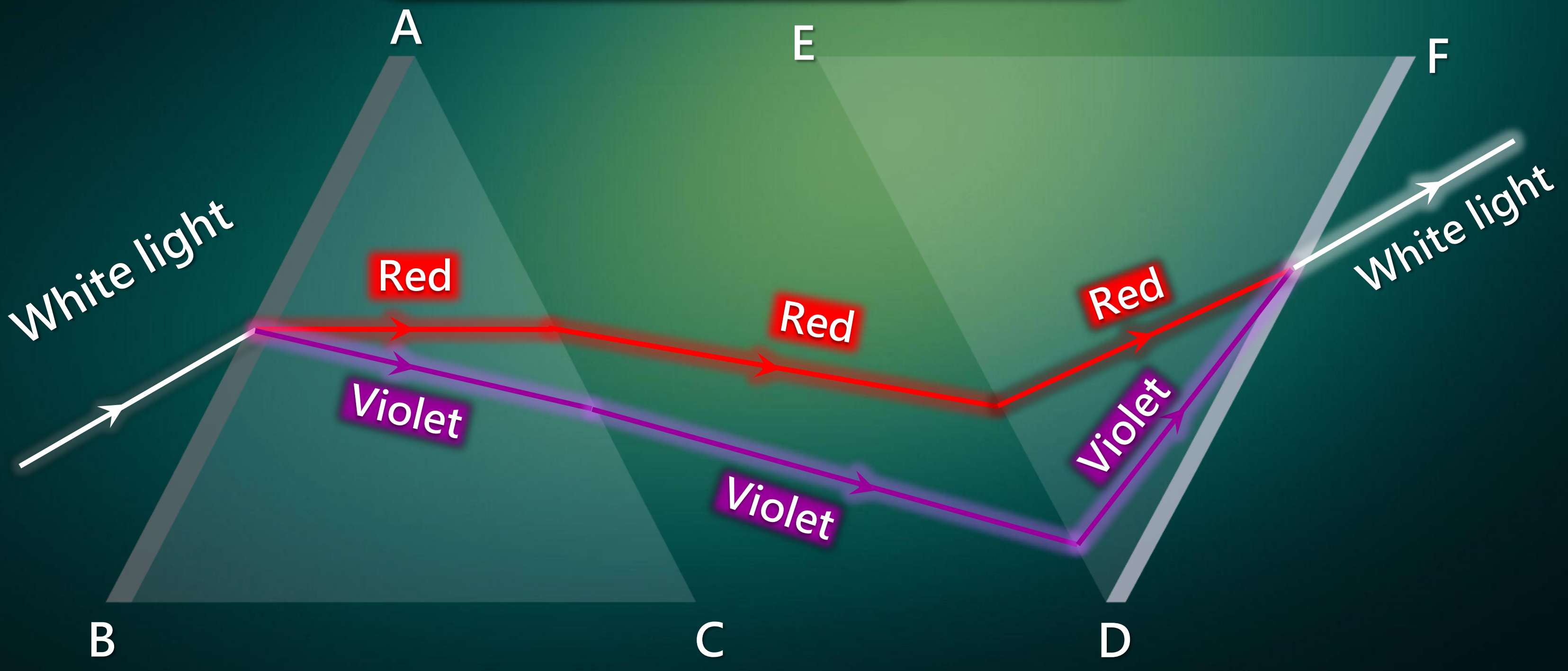
The cause of dispersion of white light is the change in speed of light with wavelength.

The band of colours is called the **SPECTRUM.**

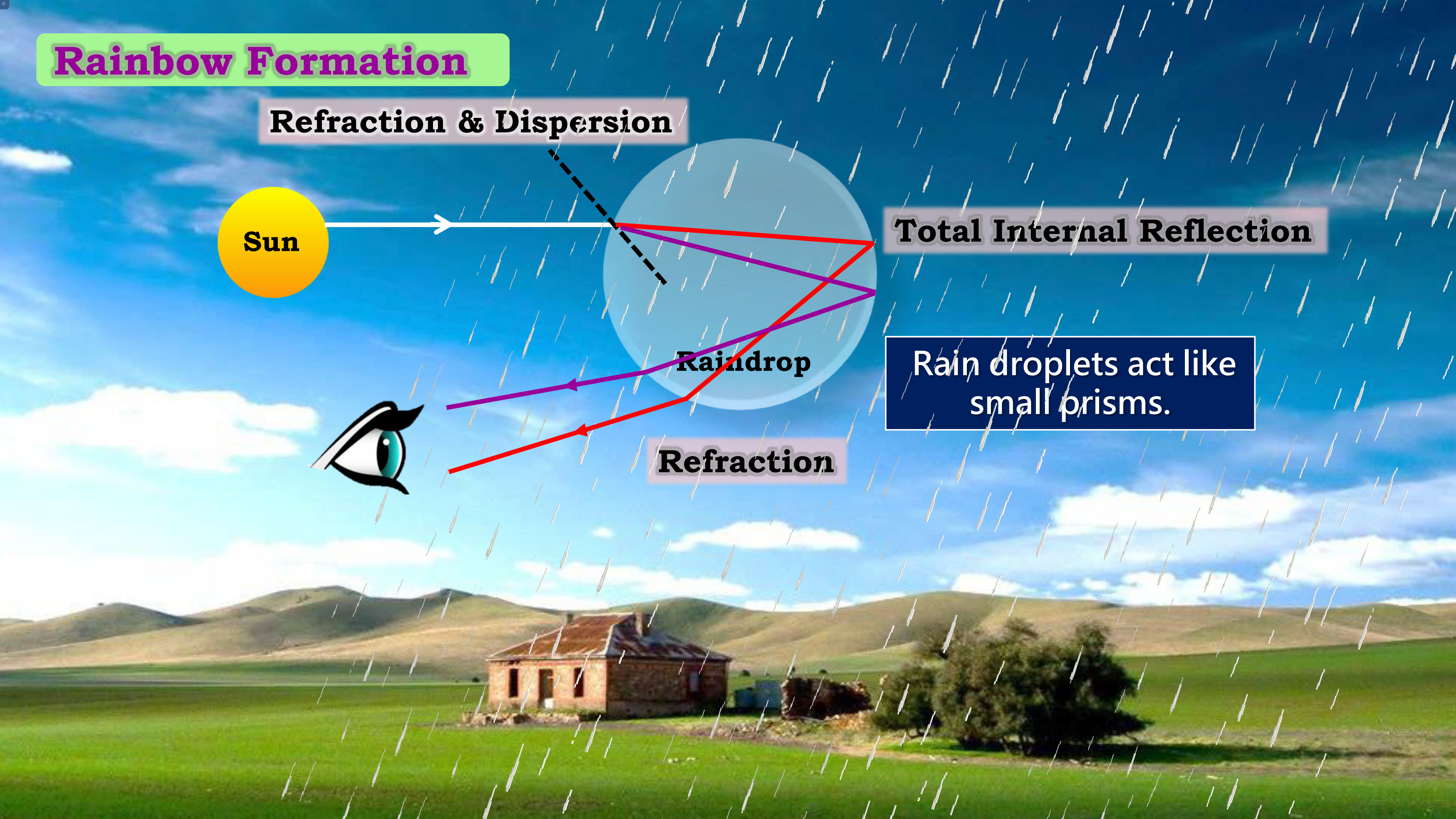


RECOMBINATION OF WHITE LIGHT

Hence there is no … as a
dispersion in a glass slab … ed prism.



The rainbow is an arch of seven colours visible in the sky which is produced by the dispersion of sun’s light by raindrops in the atmosphere.


Rainbow Formation
Refraction & Dispersion
Sun
Total Internal Reflection
Raindrop
Rain droplets act like small prisms.
Refraction

Thank You

TWINKLING OF STARS

Why do stars twinkle?

Stars are point source of light

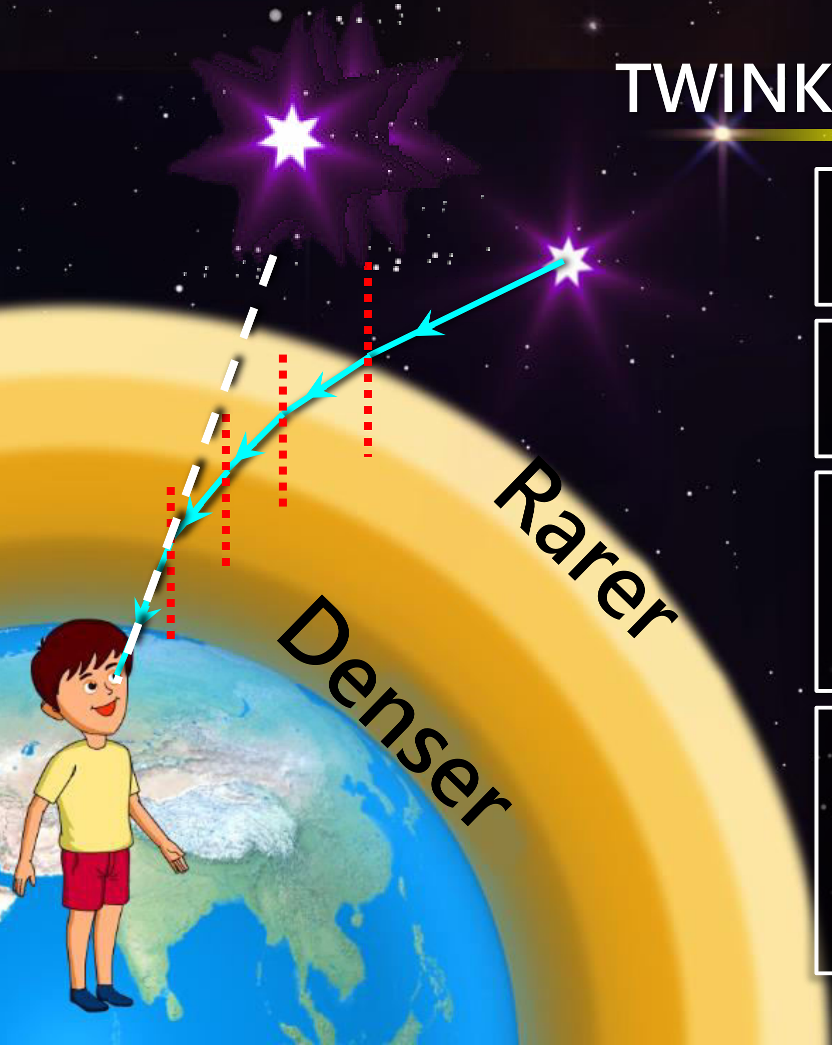
TWINKLING OF STARS

Light Year

Distance travelled by light in one year

6 trillion miles

TWINKLING OF STARS



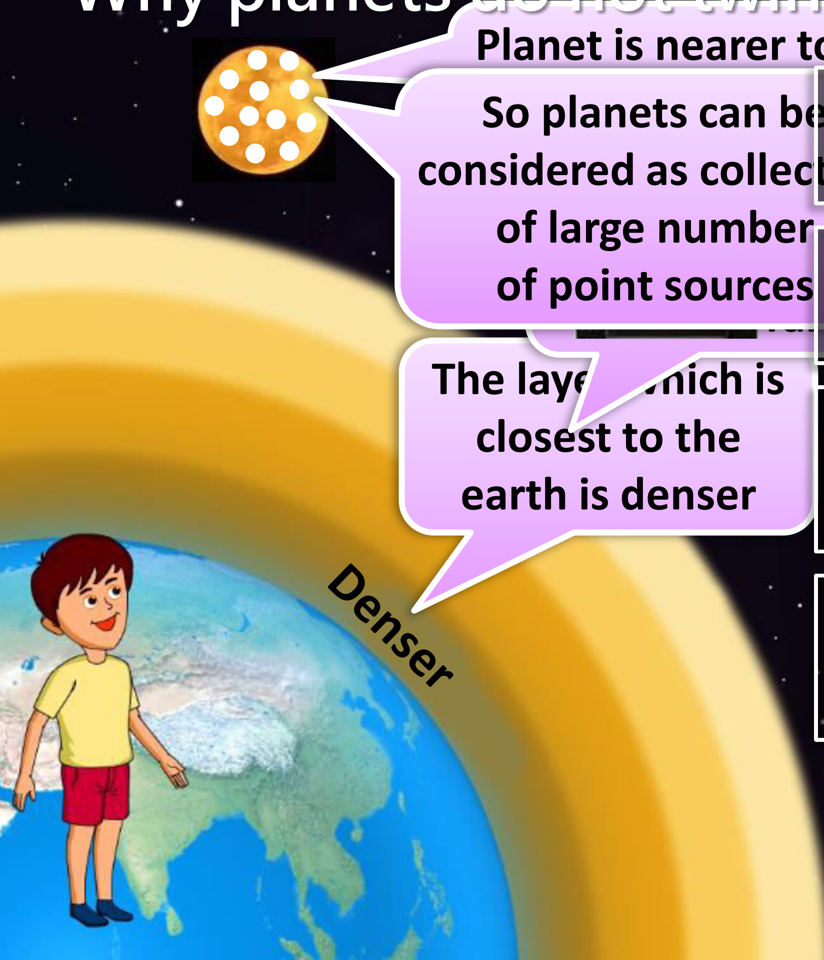
Stars are self luminous and can be seen at night in the absence of sunlight.

They appear to be point sources because of their being at a very large distance from us.

The apparent position of the star keeps changing a bit. This is because of the motion of atmospheric air and changing air density and temperature.

Because of this, the refractive index of air keeps changing continuously because of this change, the position and brightness of the star keep changing continuously and the star appears to be twinkling.

Why planets do not twinkle ?



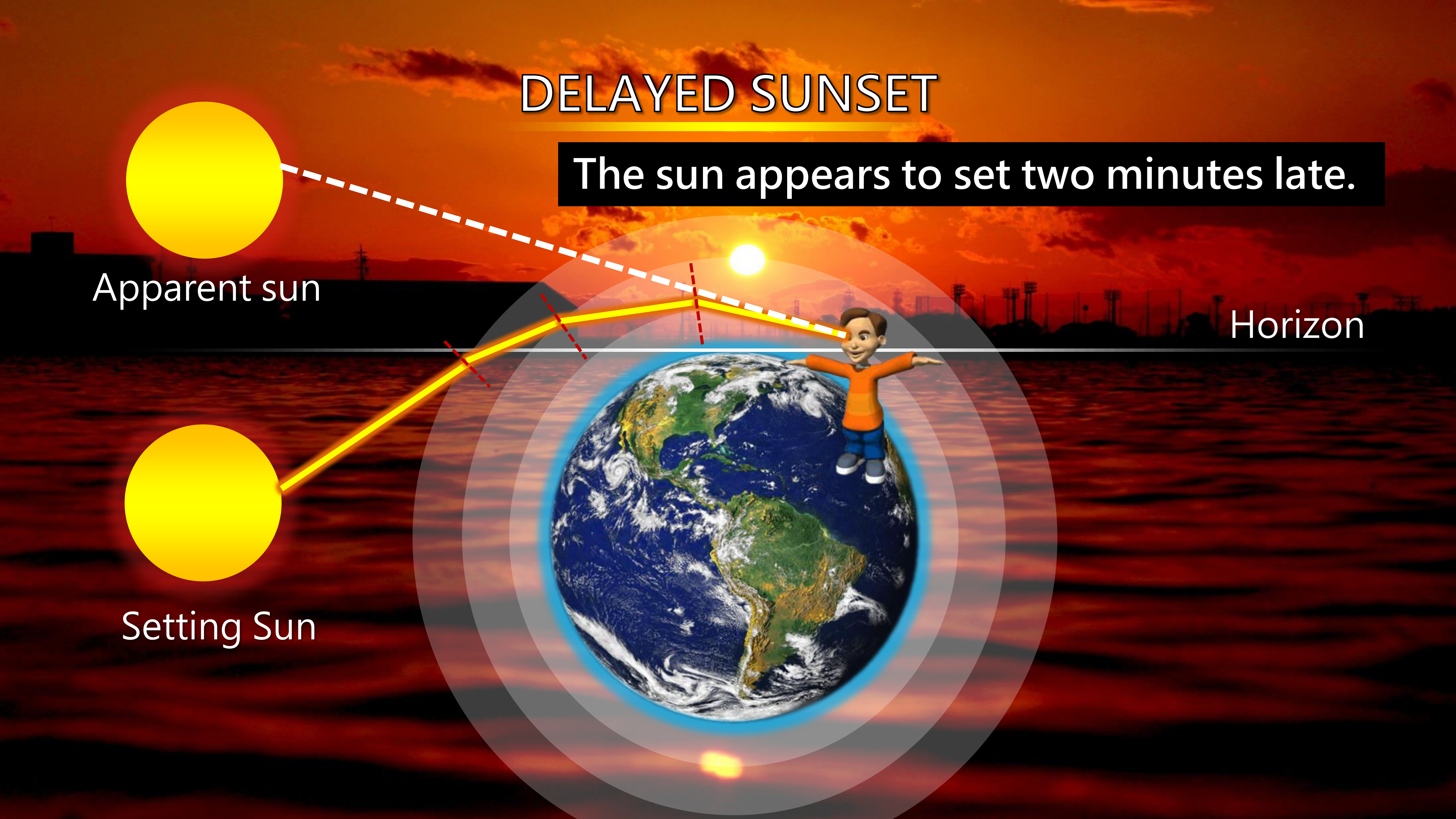
Planets are much closer to us as compared to stars.

They, therefore, do not appear as point sources but appear as collection of point.

Because of changes in atmospheric refractive index the position as well as the brightness of individual point source changes.

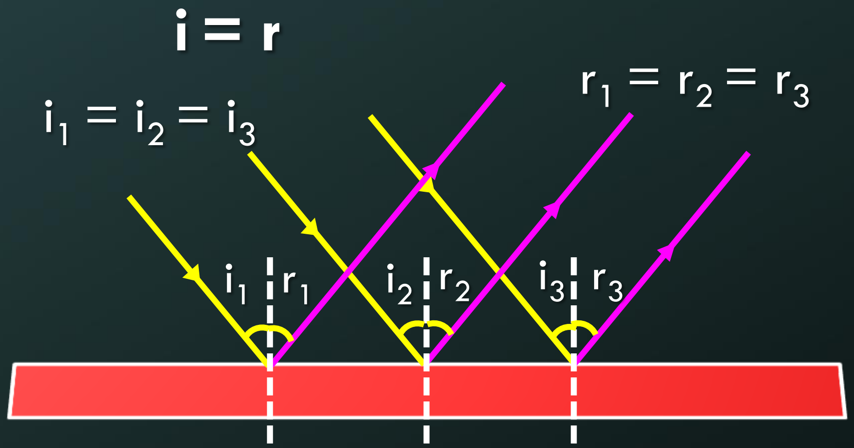
The average position and total average brightness remains unchanged and planets do not twinkle.


ADVANCE SUNRISE
The sun appears to rise two minutes earlier.
Horizon
Apparent sun
Rising Sun

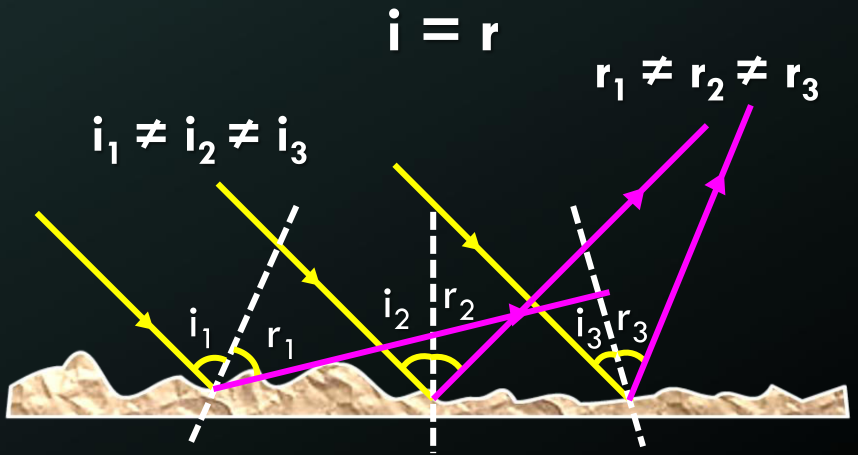

DELAYED SUNSET
The sun appears to set two minutes late.
Apparent sun
Horizon
Setting Sun

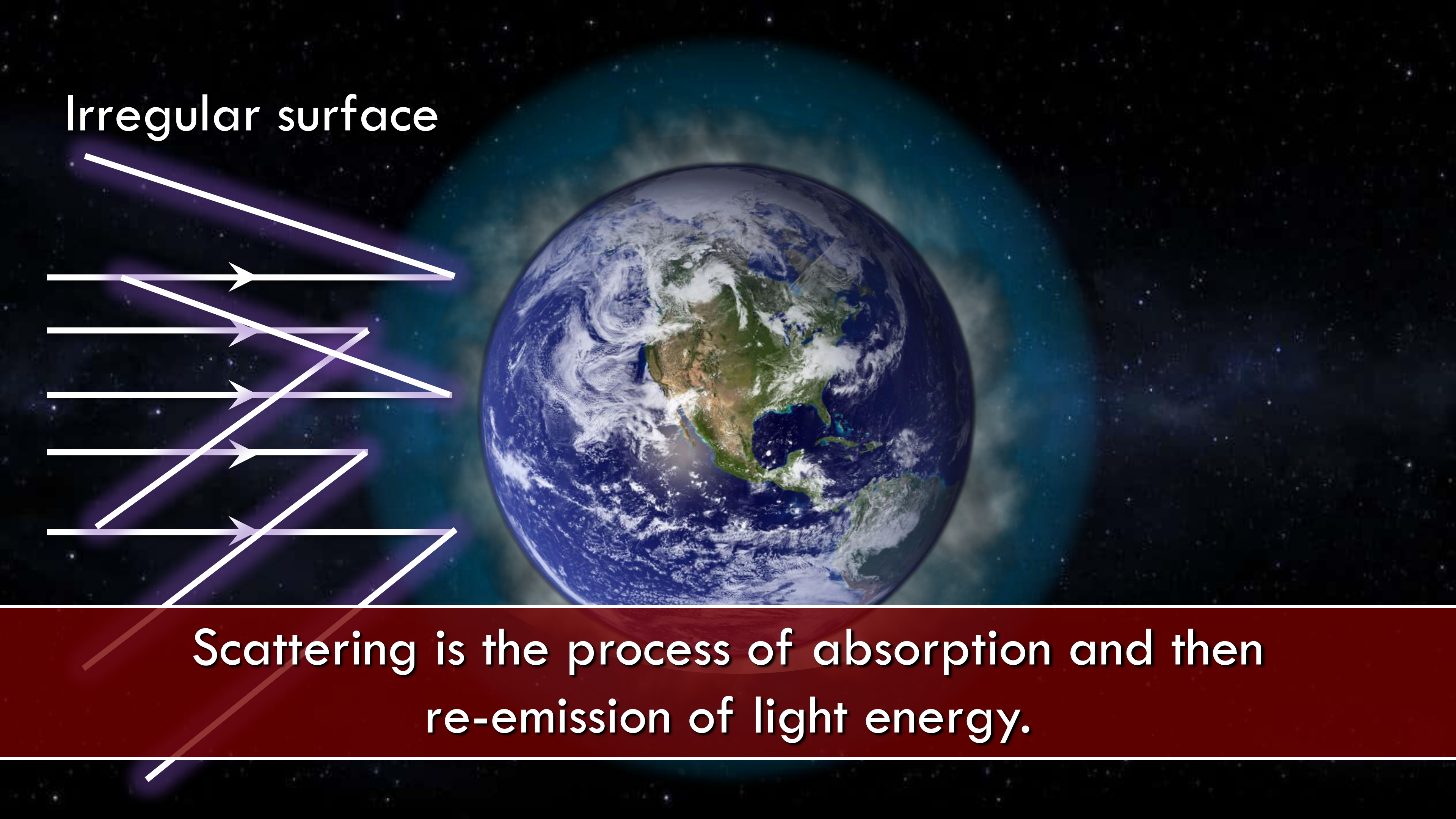
SCATTERING OF LIGHT

Regular reflection



Irregular reflection




Irregular surface
Scattering is the process of absorption and then re-emission of light energy.

Factors affecting scattering of light

Wavelength

Red $\lambda_r = 8000Å$

Orange

Yellow

Green

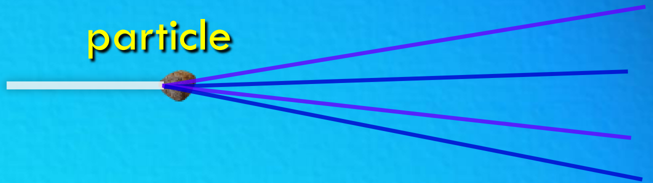
Blue

Indigo

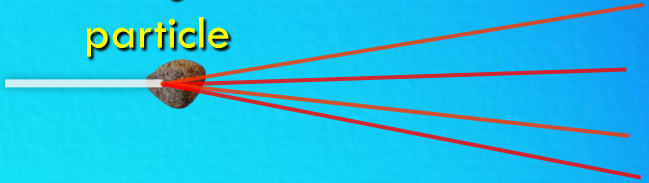
Violet $\lambda_v = 4000Å$

Size of particle

Smaller particle



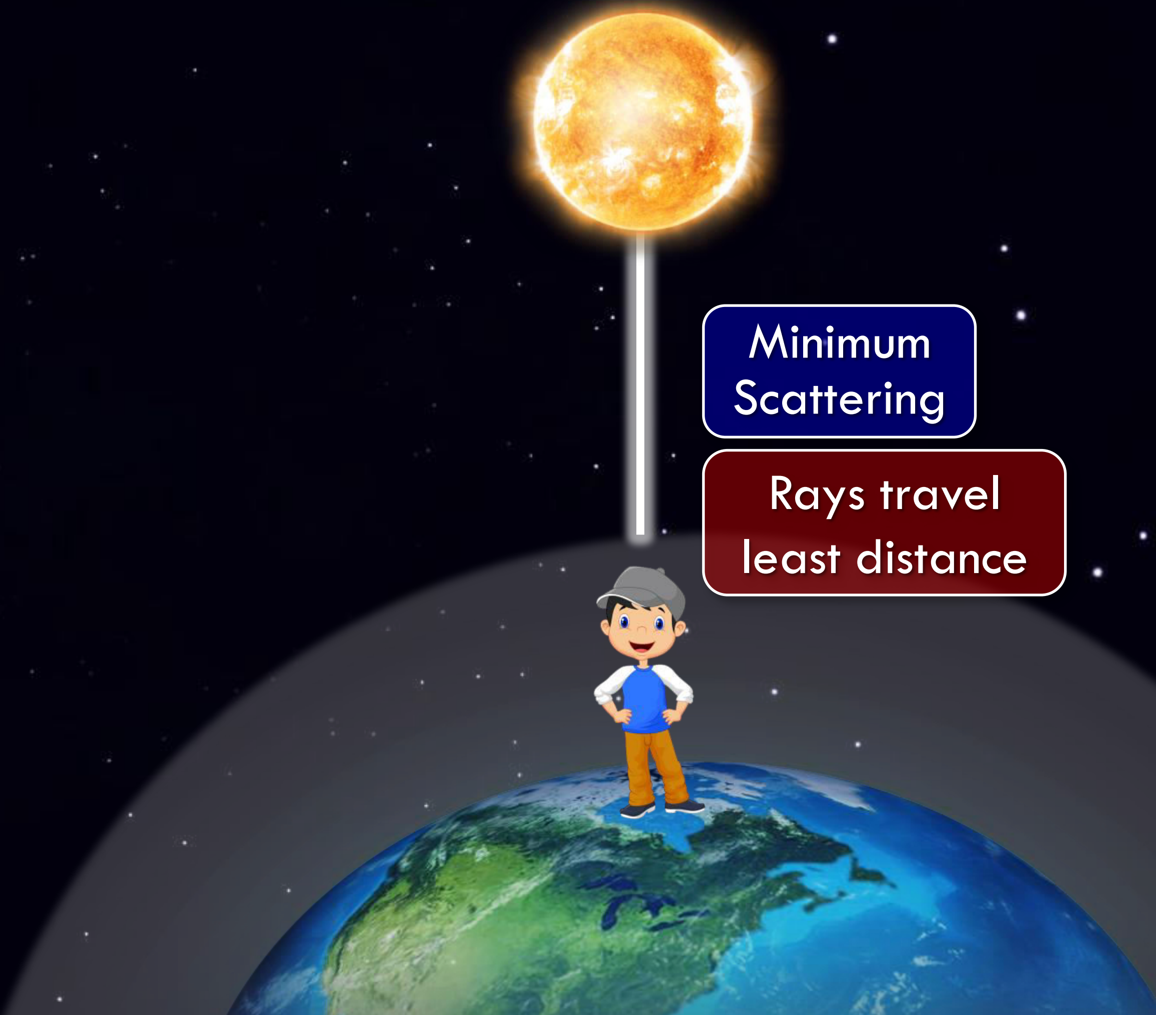
Big particle

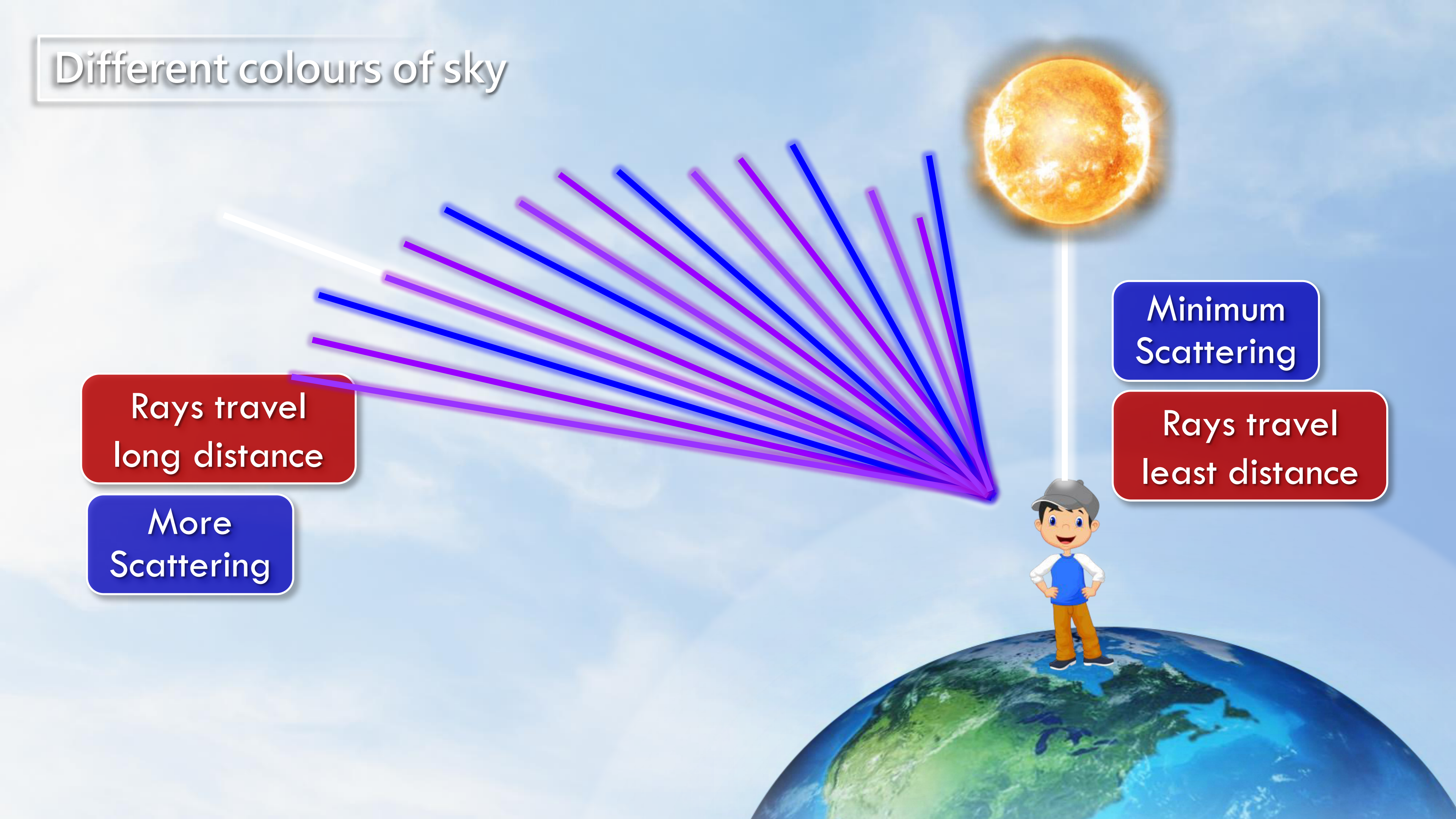


Very big particle

Violet light is scattered nearly 16 times more than the red light.

Different colours of sky



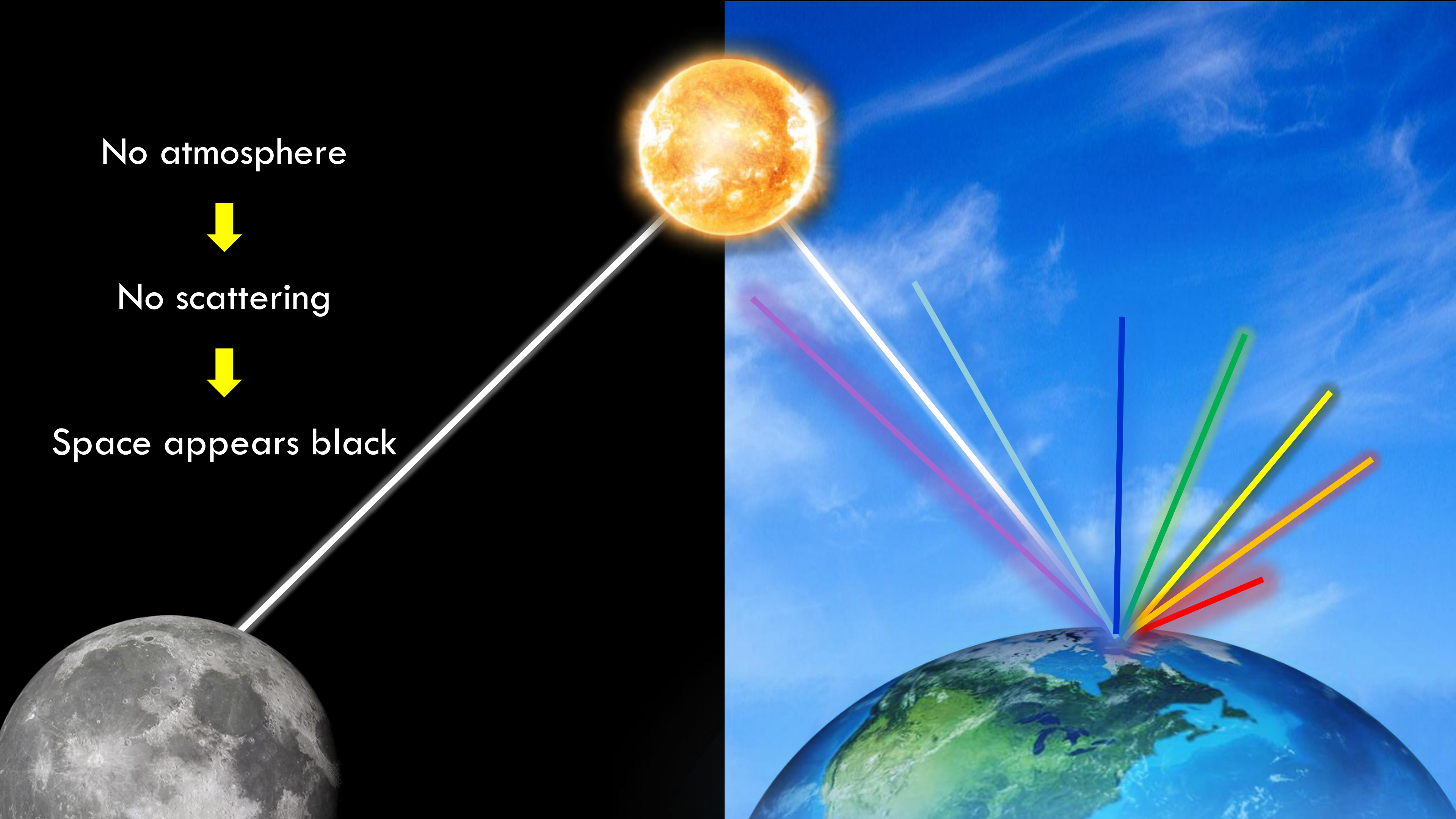

Different colours of sky
Minimum Scattering
Rays travel least distance
Rays travel long distance
More Scattering

Different colours of sky

Different colours of sky

Colour of Sky in Space

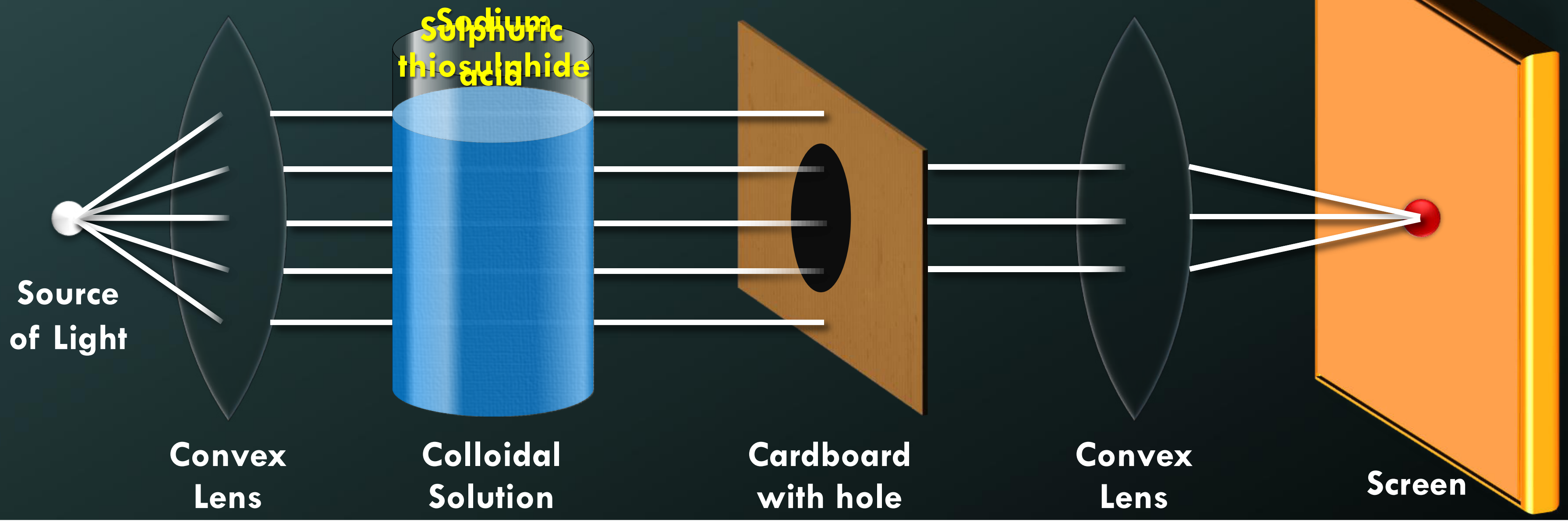
No atmosphere ➡ No scattering ➡ No colour


No atmosphere
No scattering
Space appears black

Thank You

TYNDALL

The phenomenon of scattering of light by colloidal particles.



Conclusion :

- Violet, indigo blue get scattered most hence solution turns bluish.
- Orange and red are scattered least hence reddish orange spot is observed on the screen.

NUMERICALS

The far point of a myopic person is 80 cm in front of the eye. What is the nature and power of the lens required to correct the defect ?

Given : $u = \infty$

$v = -80$ cm

To find : Nature and Power ?

Formulae : $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$$P = \frac{1}{f\,(m)}$$

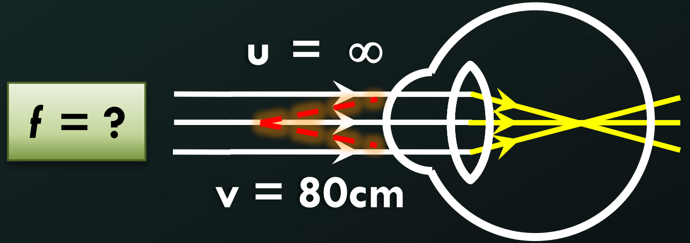
Solution : $\frac{1}{-80} - \frac{1}{\infty} = \frac{1}{f}$

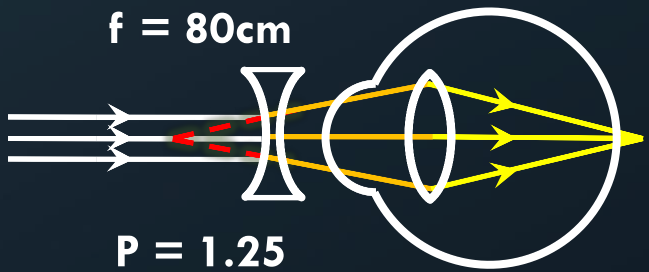
$\therefore -\frac{1}{80} - 0 = \frac{1}{f}$

$\therefore -\frac{1}{80} = \frac{1}{f}$

$\therefore f = -80$ cm

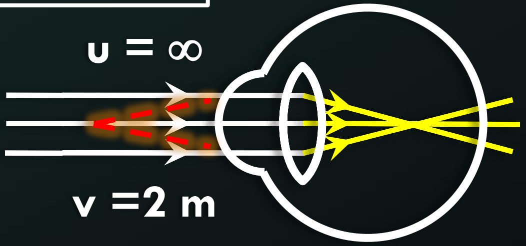
$$P = \frac{1}{-0.8} = \frac{-10}{8} = -1.25\text{ D}$$





A concave lens of focal length 80 cm is required and the power of the lens is 1.25 Diopters

A Myopic eye has a far point 2m. What type of lens in spectacles would be needed to increase the far point to infinity ? Also calculate the power of lens required.



Given : $u = \infty$

$v = -2$ m

To find : Focal Length and Power ?

Formulae : $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$$P = \frac{1}{f\ (m)}$$

Solution : $\frac{1}{-2} - \frac{1}{\infty} = \frac{1}{f}$

$\therefore \frac{1}{-2} = \frac{1}{f}$

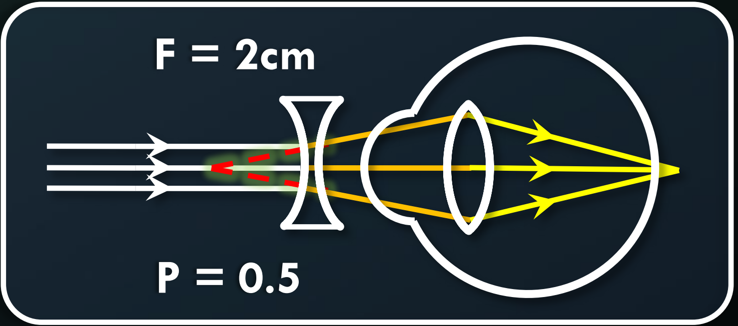
$\therefore f = -2$ m

$\therefore$ Concave lens is required

$$P = \frac{1}{f}$$

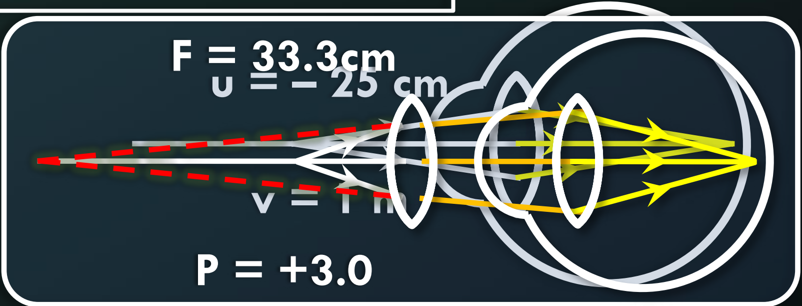
$\therefore = \frac{1}{-2}$

$\therefore = -0.5$ diopters



A concave lens of focal length 2 cm is required and the power of the lens is 0.5 Diopters

The near point of a hypermetropic eye is 1m. What is the nature and power of the lens required to correct this detect (Assume that the near point of the normal eye is 25 cm).



Given : $u = -25$ cm

$v = -1$ m

$= -100$ cm

To find : Nature and power of lens ?

Formulae : $$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$P = \frac{1}{f\,(m)}$$

Solution : $$\frac{1}{-100} - \frac{1}{-25} = \frac{1}{f}$$

$$\therefore -\frac{1}{100} + \frac{1}{25} = \frac{1}{f}$$

$$\therefore \frac{-1+4}{100} = \frac{1}{f}$$

$$\therefore \frac{3}{100} = \frac{1}{f}$$

$$\therefore f = \frac{100}{3}$$

$$\therefore = 33.3 \text{ cm}$$

$$P = \frac{1}{f}$$

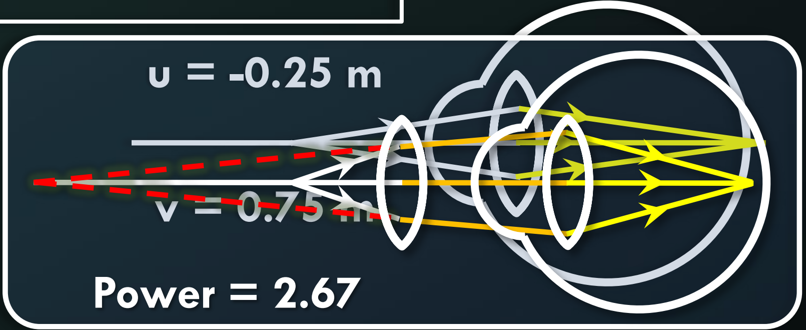
$$= \frac{1}{0.33}$$

$$= \frac{100}{33}$$

$$= +3.0 \text{ D}$$

A convex lens of focal length 33.3 cm is required and the power of the lens is +3.0 Diopters

An eye has a near point distance of 0.75 m. What sort of lens in spectacles would be needed to reduce the near point distance to 0.25 m ? Also calculate the power of lens required is this eye long-sighted or Short-sighted.



Given : $v = -75$ cm

$u = -25$ cm

To find : Nature and power of lens ?

Formulae :

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$P = \frac{1}{f\,(m)}$$

Solution :

$$\frac{1}{-75} - \frac{1}{-25} = \frac{1}{f}$$

$$\therefore \frac{1}{-75} + \frac{1}{25} = \frac{1}{f}$$

$$\therefore \frac{-1+3}{75} = \frac{1}{f}$$

$$\therefore \frac{2}{75} = \frac{1}{f}$$

$$\therefore f = \frac{75}{2}$$

$$\therefore f = 37.5 \text{ cm}$$

∴ Convex lens is required

$$P = \frac{1}{f} = \frac{1}{0.375} = \frac{1000}{375} = 2.67 \text{ D}$$

Power of the lens is 2.67 diopters.

A person needs a lens of power − 5.5 diopters for correcting his distant vision. For correcting his near vision he needs a lens of power +1.5 diopter. What is the focal length of the lens required for correcting (i) Distant vision. (ii) Near vision?

Given : $P_1 = -5.5\ D$

$P_2 = 1.5\ D$

To find : $f_1 = ?$

$f_2 = ?$

Formula : $P = \frac{1}{f}$

Solution :

For distant vision

$$P_1 = \frac{1}{f_1}$$

$$\therefore f_1 = \frac{1}{P_1}$$

$$f_1 = \frac{1}{-5.5}$$

$$f_1 = \frac{1 \times 10}{-5.5 \times 10}$$

$$= \frac{-10}{55}$$

$$= -0.1818\ m$$

For near vision

$$P_2 = \frac{1}{f_2}$$

$$\therefore f_2 = \frac{1}{P_2}$$

$$f_2 = \frac{1}{1.5}$$

$$f_2 = \frac{1 \times 10}{1.5 \times 10}$$

$$f_2 = \frac{10}{15}$$

$$= 0.667\ m$$

$$\boxed{\begin{aligned} f_1 &= -0.1818m \\ f_2 &= 0.667m \end{aligned}}$$

A person with myopic eye cannot see an object beyond 1.2 m distinctly. What should be the type of corrective lens used to restore the proper vision?

Given : $u = \infty$

$v = -1.2 \text{ m}$

To find : $P = ?$

Formula : $$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

Solution : $$\frac{1}{f} = \frac{1}{-1.2} - \frac{1}{\infty}$$

$$= -\frac{1}{-1.2}$$

$$P = -0.83 \text{ D}$$

∴ To restore the proper vision, a concave lens of power – 0.83 D should be used.

The far point of a myopic person is 150 cm in front of the eye. Calculate the focal length and the power of the lens required to enable him to see distant objects clearly.

Given : $v = 150 \text{ cm} = 1.5 \text{ m}$

$u = \infty$

To find : $P = ?$

Formula :

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

Solution :

$$\therefore \frac{1}{f} = \frac{1}{-1.5} + \frac{1}{\infty}$$

$$\therefore f = -1.5 \text{ m}$$

$$P = \frac{1}{f}$$

$$= \frac{1}{-1.5}$$

$$= -0.67 \text{ D}$$

A focal length is -1.5 m and
The Power of the lens is -0.67 diopters.

Thank You