Focal Length of A Convex Lens By A Graphical Method

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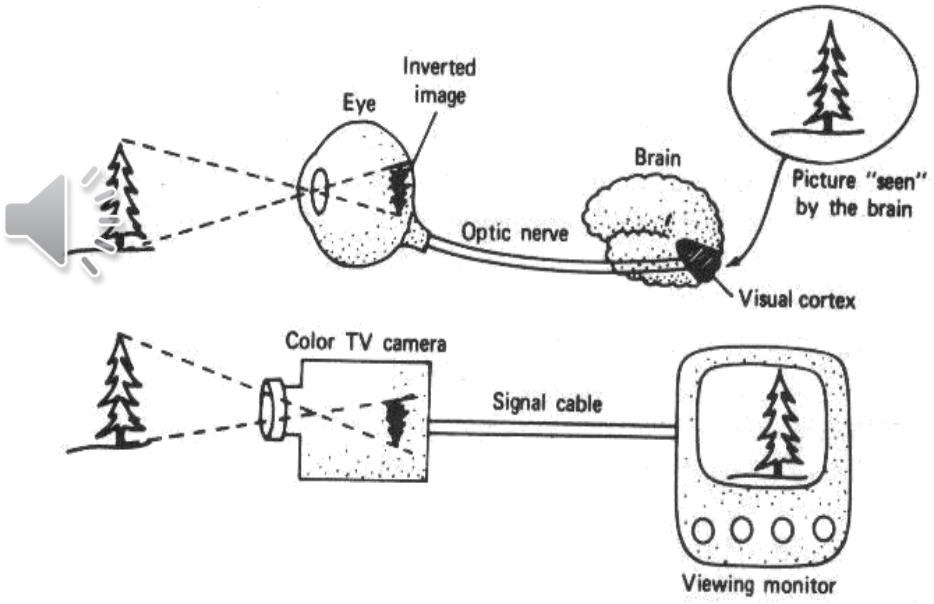
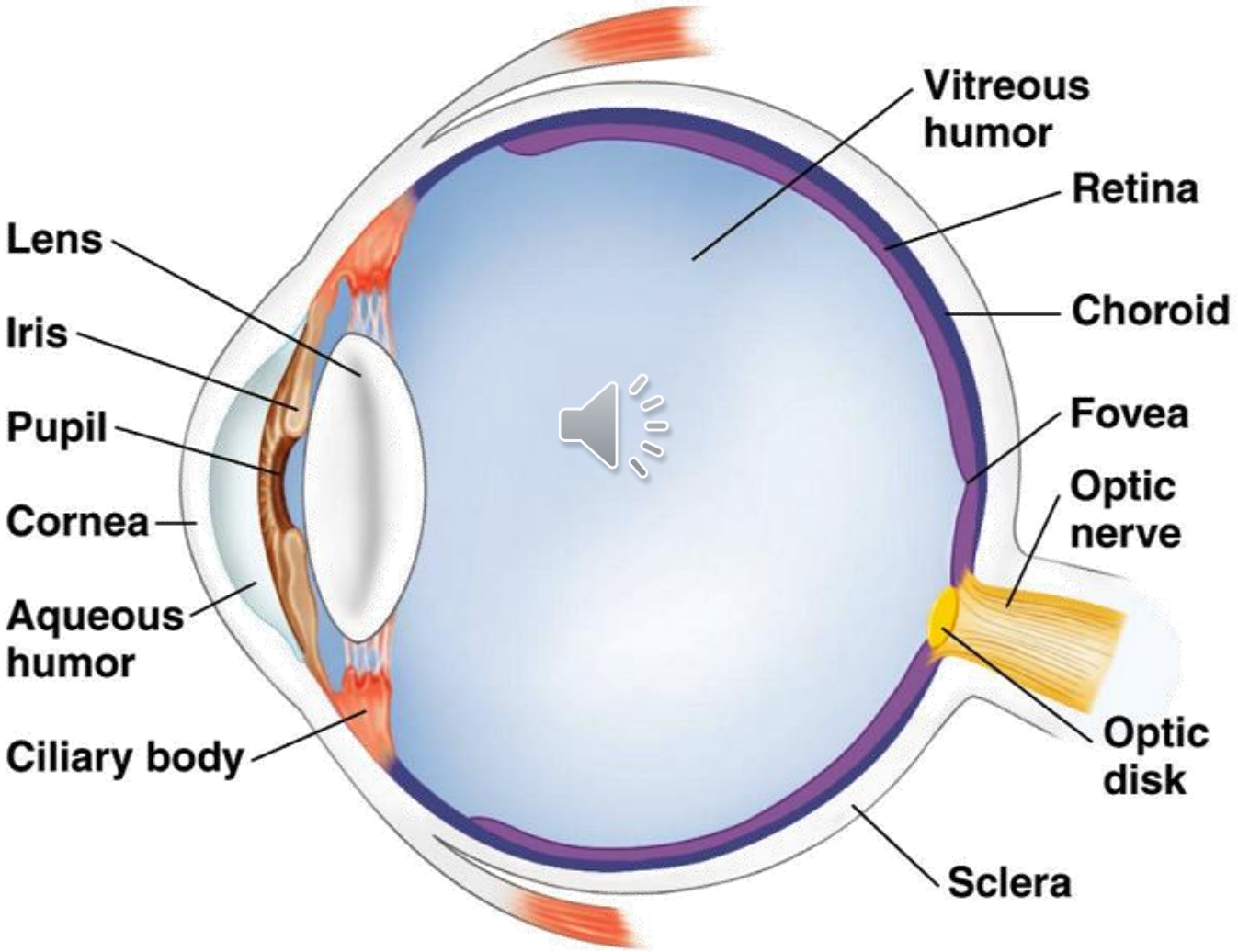
While the **eye** has some striking similarities to a **camera**, a better analogy exists between the **eye** and a closed circuit **color TV system**.

- Camera TV **lens** is **cornea** and eye **lens**.
- **Signal cable** is **optic nerve**.
- **Viewing monitor** is **visual cortex**.

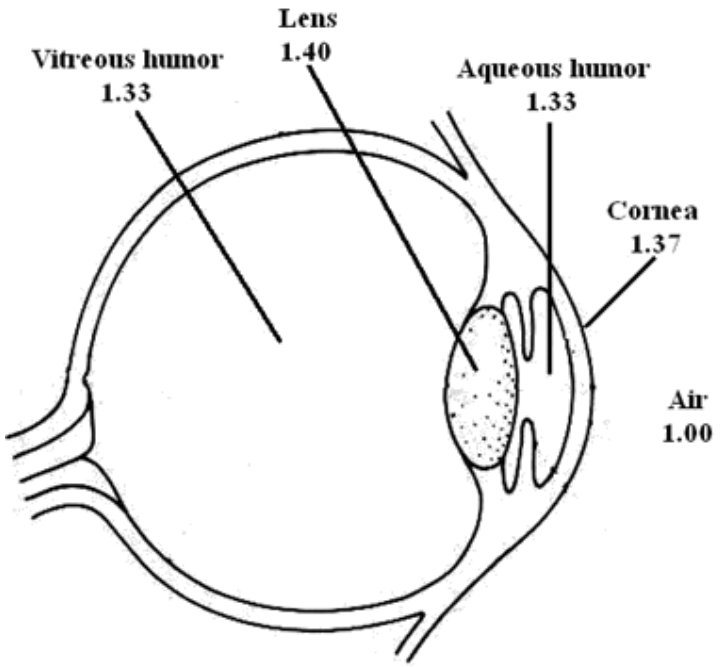


Simple Eye Anatomy



Refractive Interfaces in Eye Lens System

1. The interface between **air** and the **anterior surface** of the **cornea**.
2. The interface between the **posterior surface** of the **cornea** and the **aqueous humor**.
3. The interface between the **aqueous humor** and the **anterior surface** of the **crystalline lens** of the **eye**.
4. The interface between the **posterior surface** of the **lens** and the **vitreous humor**.

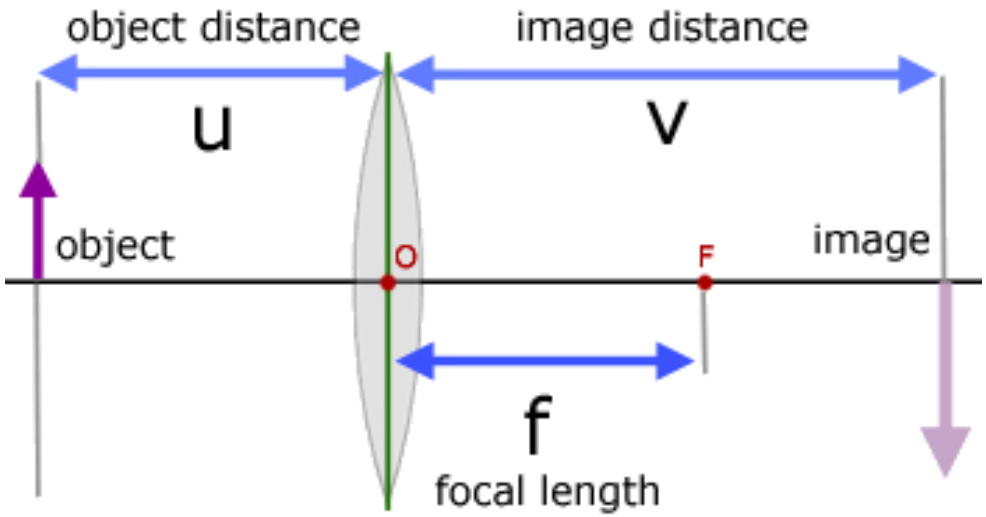


Lens Focal Length

The distance beyond a convex lens at which parallel rays converge to a common focal point is called "**focal length**" of lens.

The relation of lens focal length **F**, distance of light point source from the lens **u**, and distance of focus on the other side of the lens **v** is expressed by following formula:-

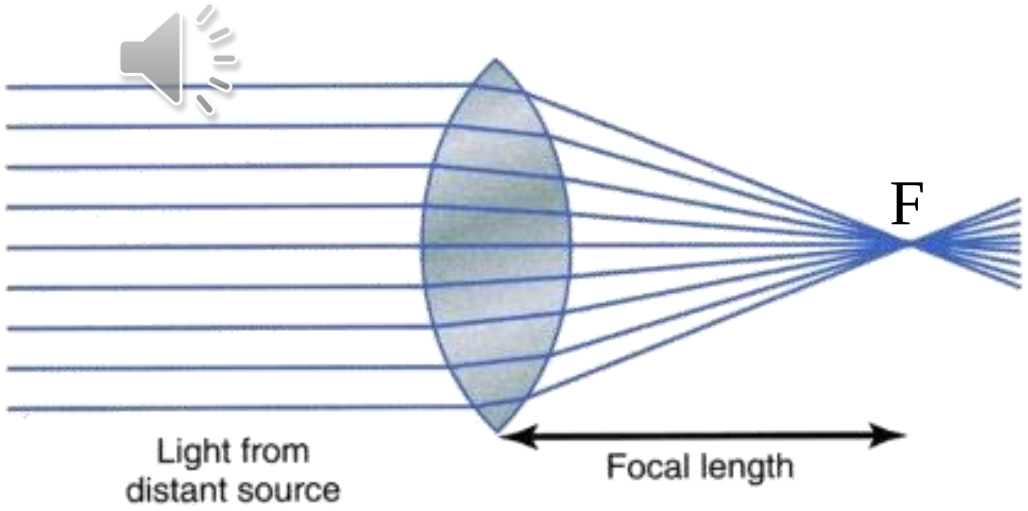
$$\frac{1}{F} = \frac{1}{u} + \frac{1}{v}$$



Measurement of the Refractive Power of a Lens

The more a lens bends light rays, the greater is its "**refractive power**". This refractive power is measured in terms of "**Diopters**". The refractive power in diopters of a convex lens is **equal** to 1 meter divided by its focal length.

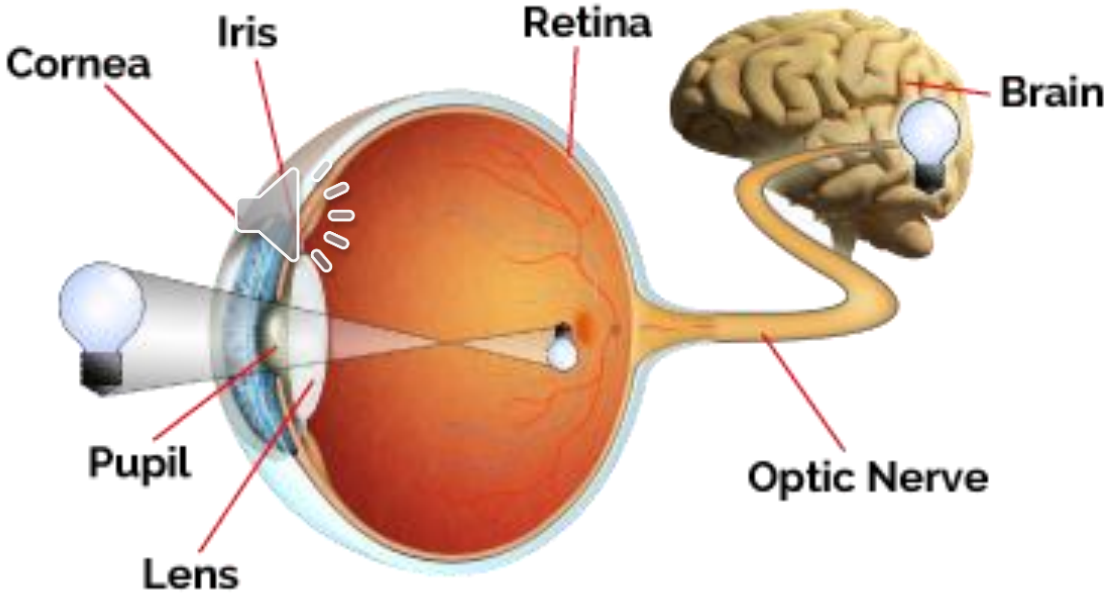
$$P = \frac{1}{F}$$



Eye Conditions

I. Normal Vision "Emmetropia"

The eye is considered normal, or "**emmetropic**", if parallel light rays from distance objects are in sharp focus on the **retina**.



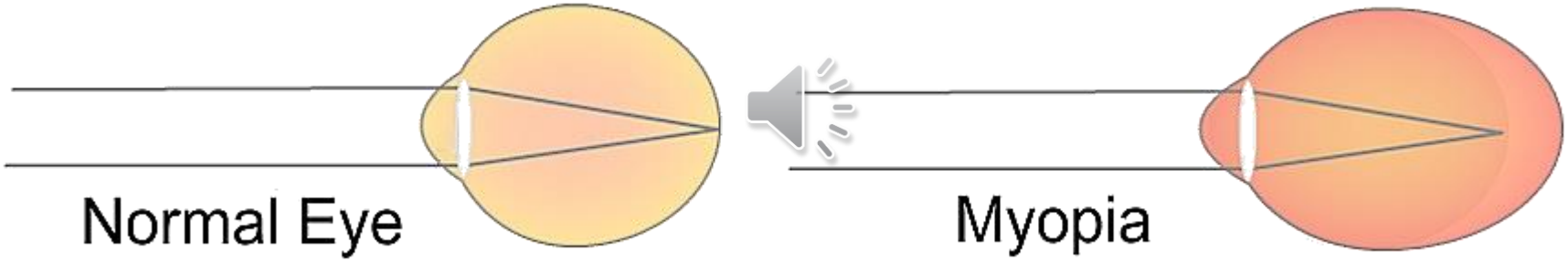
II- Defect Vision "Ametropia"

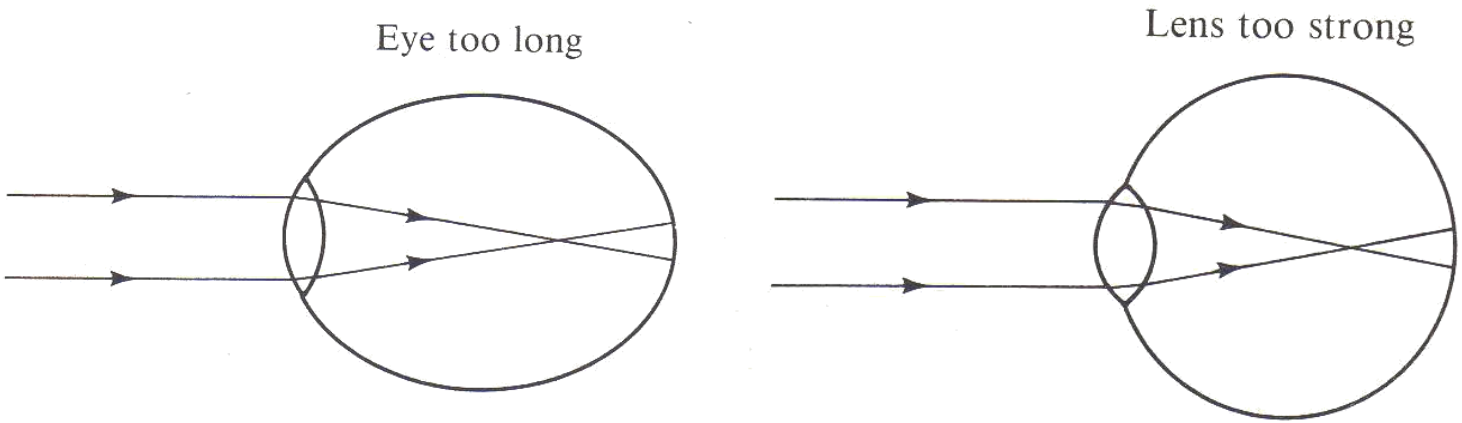
Is the defective eyesight due to focusing "**Refractive**" problem.

Ametropia Types

1- Myopia

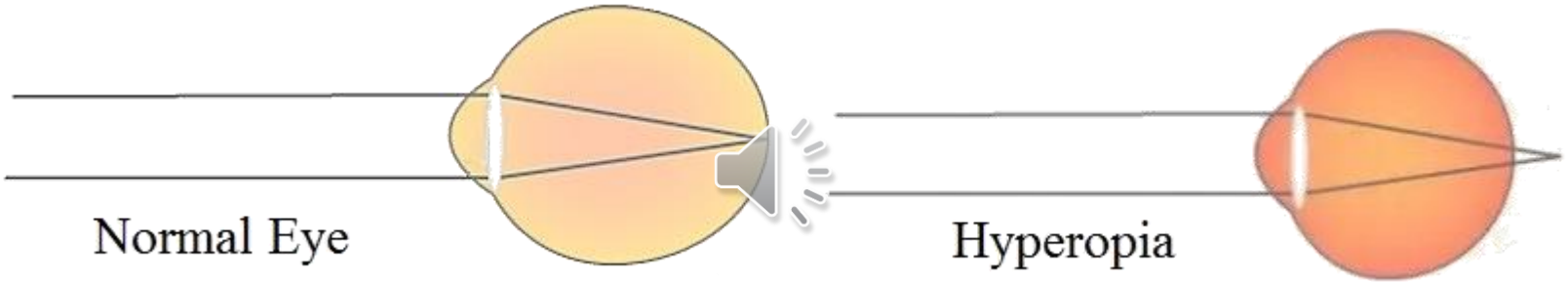
Which is also known as "**near-sightedness**", is usually due either to an eyeball that is **too long**, or lens system that is **too strong**.

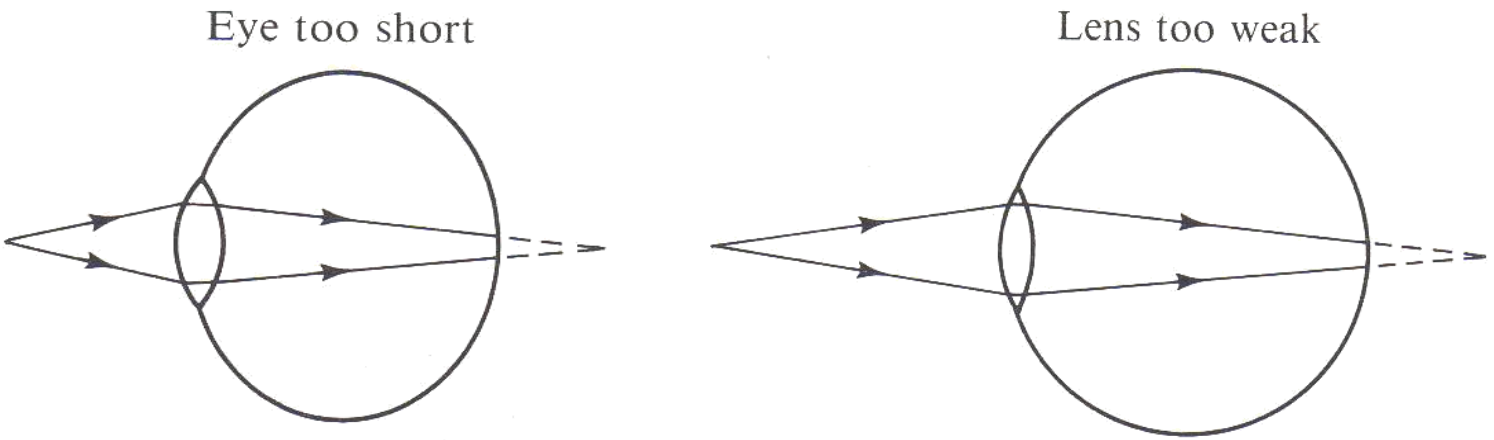




2- Hyperopia

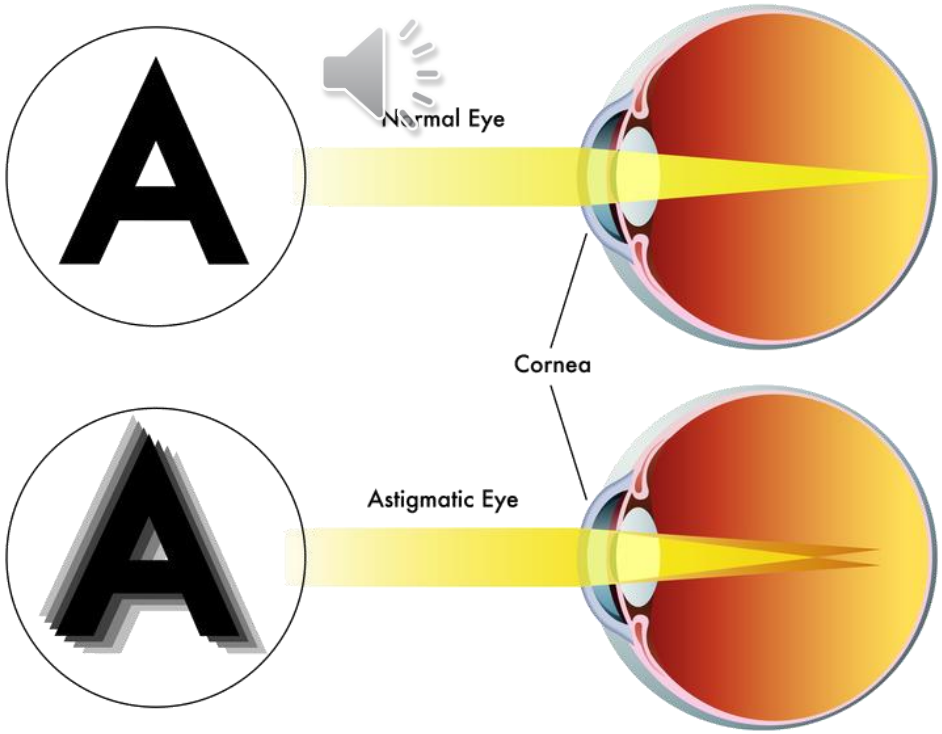
Which is also known as "**far-sightedness**", is usually due either to an eyeball that is **too short**, or occasionally, to a lens system that is **too week**.





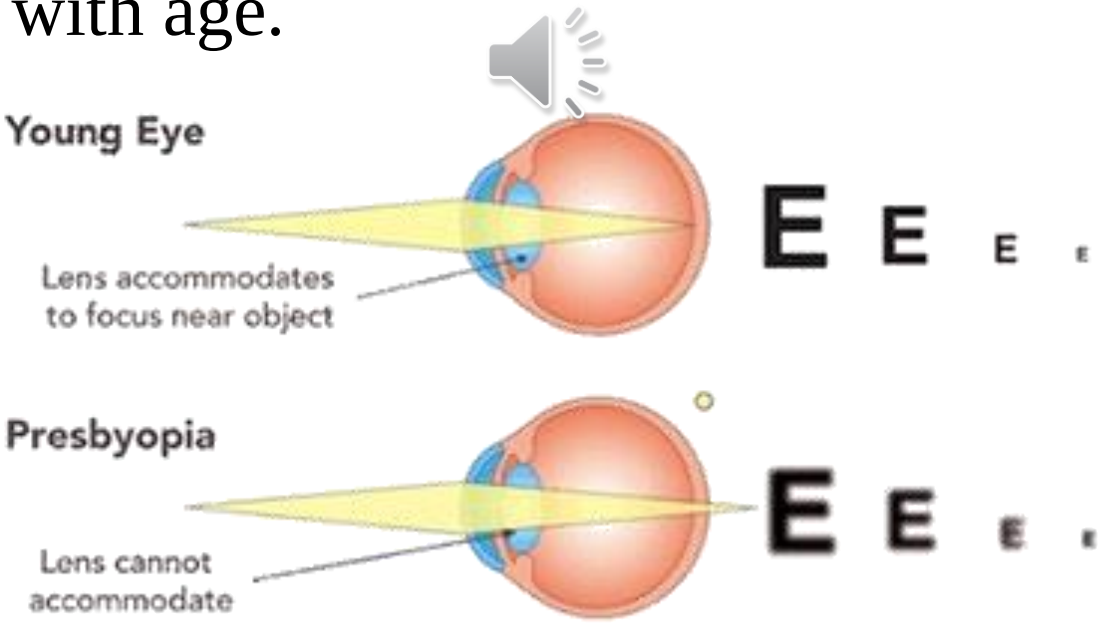
3- Astigmatism

Is a refractive error of the eye that causes the visual image in one plane to focus at a different distance from that of the plane at right angles. In astigmatism the cornea or lens of the eye is **not symmetric**.



4- Presbyopia

As a person grows older, the lens grows **larger** and **thicker** and becomes far less elastic, partly **because** of progressive denaturaion of the lens proteins. Therefore, the ability of the lens to change shape progressively decreases with age.



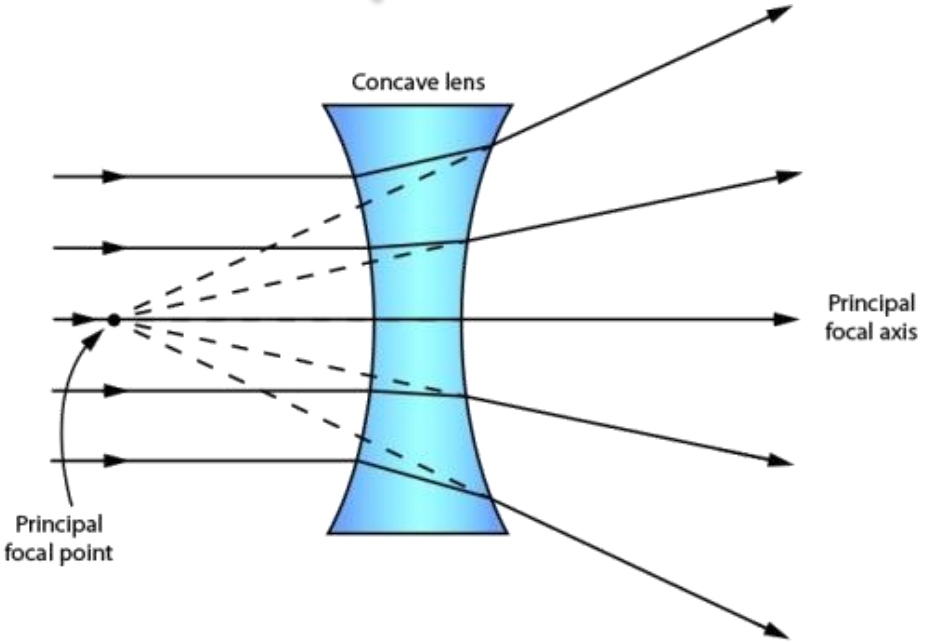
Lenses

Lenses are used to focus light and form an image in **cameras**, **telescopes**, **microscopes**, **eyeglasses** and even in our **eyes**.

Lenses work very much like **mirrors**. We will discuss **two** types of lenses.

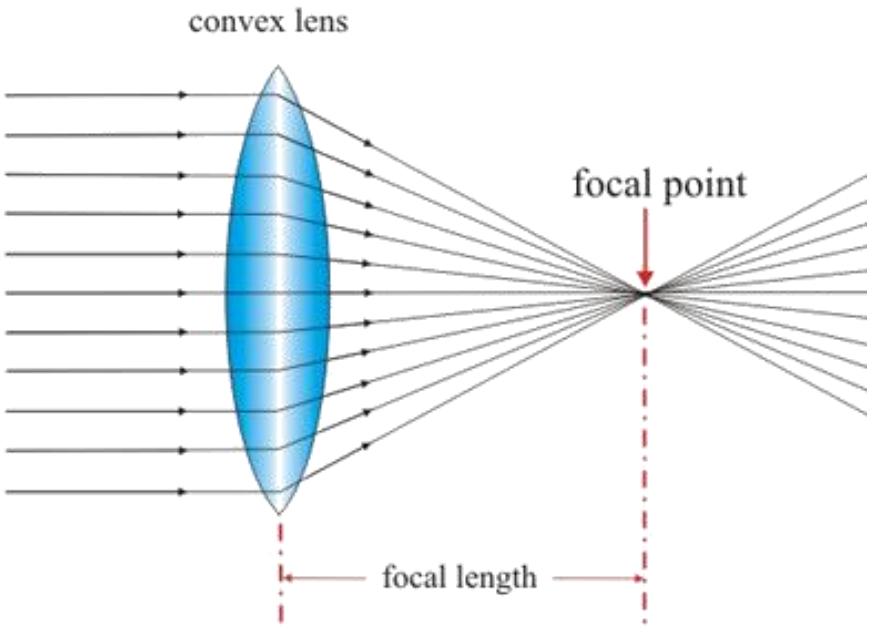
➢ Concave Lenses

The double concave lens is a **diverging lens**. When light waves from an infinitely far object passes through the lens, the light waves will **diverge** as if it originated from a focal point **F** on the principal axis. The focal length is always a **negative value** for **diverging lenses**.



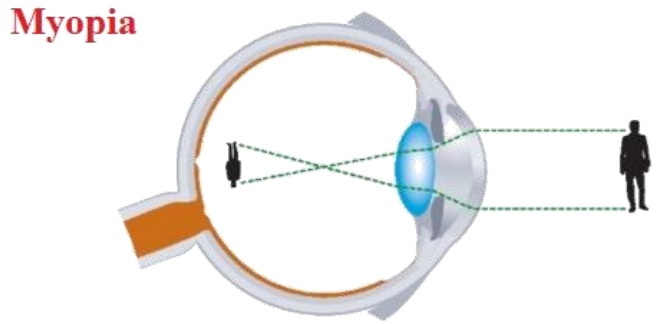
➢ Convex Lenses

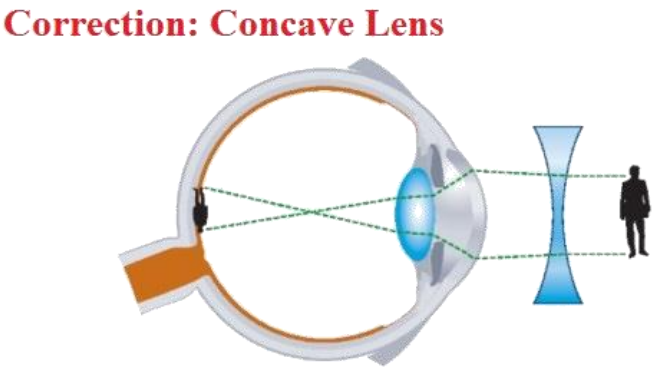
The double convex lens is a **converging lens**. When light waves parallel to the principal axis from an infinitely far object passes through the lens, it will **converge** at a focal point **F** on the principal axis. The distance between the focal point and the lens is the focal length, which is always a **positive value** for **converging lenses**.



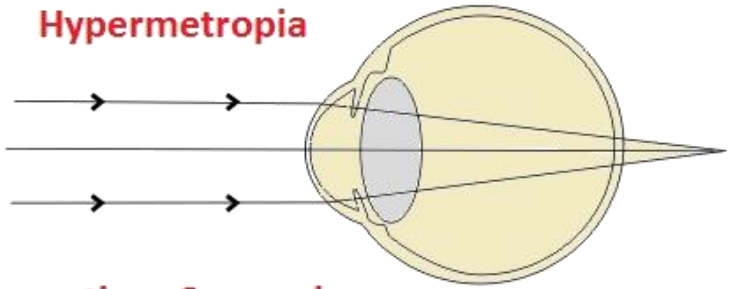
Correction of Eye Defects

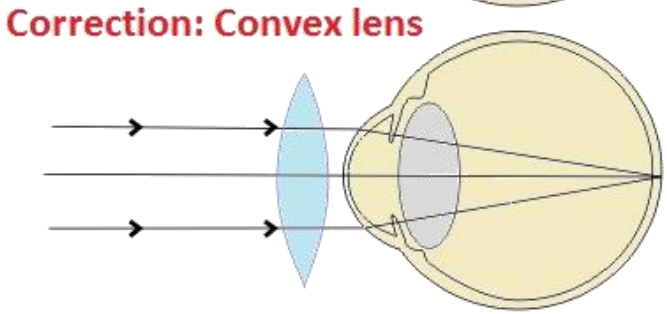
❑ **Myopia near-sightedness"**
Concave Lens is used to correct the **Myopic** persons.





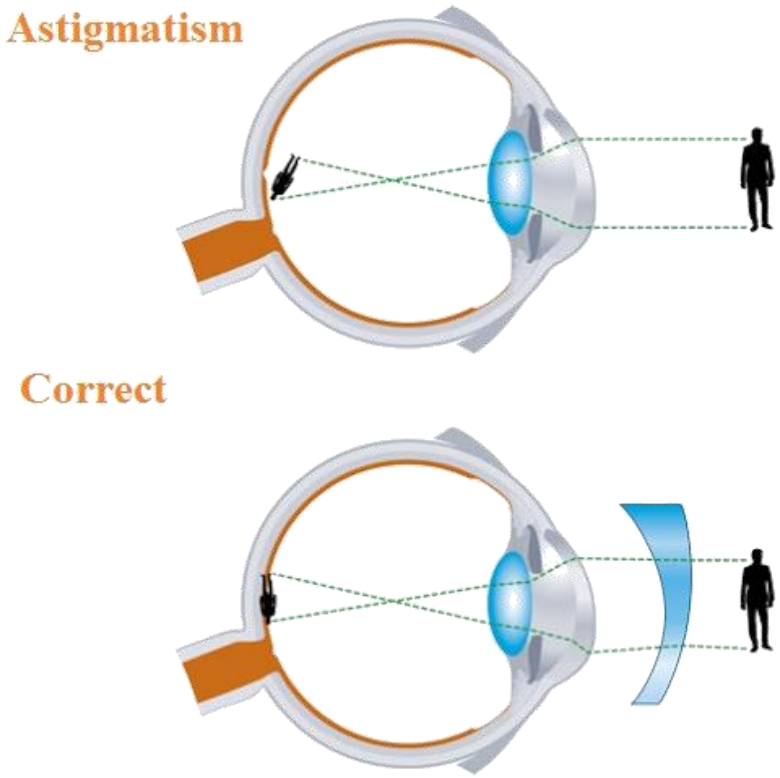
❑ **Hyperopia "far- sightedness“**
Convex Lens is used to correct the **Hyperopic** persons.





❑ Astigmatism

To correct for **astigmatism**, the usual procedure is to find a **spherical lens** that corrects the focus in one of the two plans of the **astigmatic lens**. Then an additional **cylindrical lens** is used to correct the error in the remaining plane. To do this, both the **axis** and the **strength** of the required **cylindrical lens** must be determined.



Lens Medical Applications

1. Treatment eye defects like far sight vision, near sight vision, old age vision and astigmatism.
2. It is used in many medical and biological devices like microscope, ophthalmoscope, otoscope, and endoscope…etc.
3. In dentistry it is used in many devices and instruments, like dental chairs, mouth mirror and etc..

Aim

To determine the focal length of Convex lens by graphical method

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Apparatus

1-convex lens .2- three holders.3-optical bench. 4-object body or candle. 5- paper screen . 6-illumination source.

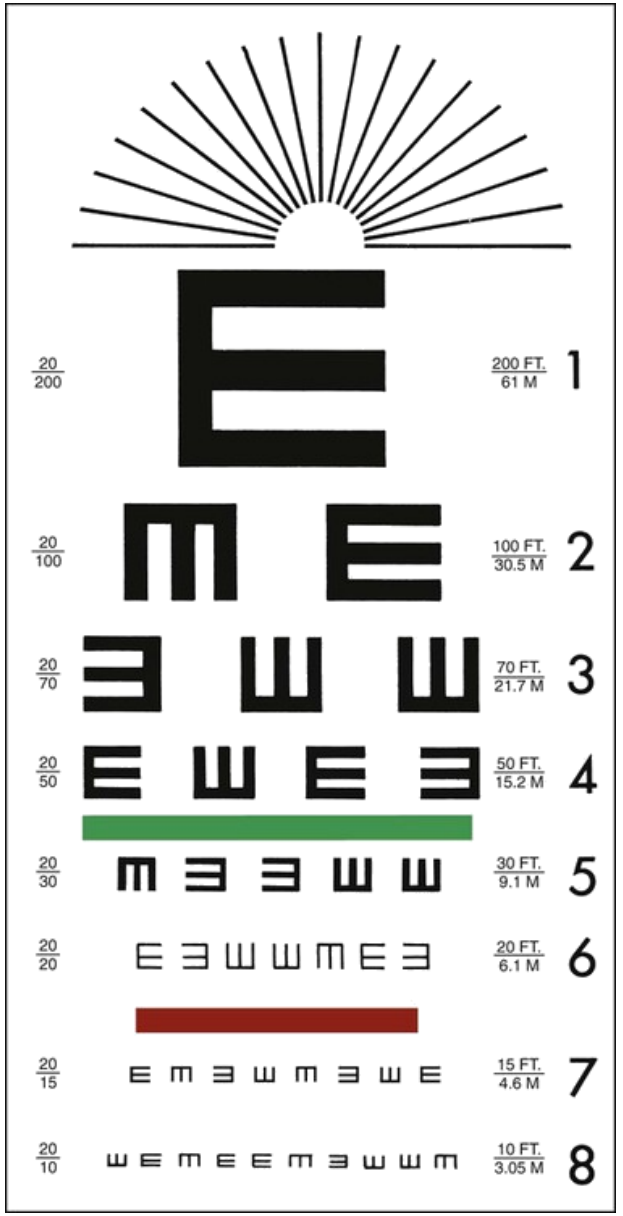
Method

1-obtain rough value of lens for focal length (f) of lens by focusing window image on sheet of paper.2-Set the object at distance from convex lens equal to approximately to twice the focal length of lens it is a useful starting point in any convex lens experiment,as it is the position in which the object and image distance are equal and the magnification unity 3-place the illumination source ,object, lens and screen paper on optical bench as shown diagram below. 3- put object at 5 cm from illumination source then put lens at 5 to 10 cm behind it and screen paper behind lens at 5 cm .4- remove the lens position until get sharp image of object on screen paper.5- measure the distance between object and lens and record it as U1. 6- measure the distance between lens and screen paper and record it as V1.7- remove the lens position more 5 cm and change screen paper position until get best image on it,then record U,V value.8-repeat step 7 to gate 5 to 10 values to U,V.9 - record you values on table(1) then draw graph between 1/U,1/ V.

Theory and calculation

In the usual notation Hence ,if values of 1/U cm-1 plotted against values of 1/V cm-1 , a straight line inclined at 45' to each axis is obtained.the intercept on each axis is a value of .Take the mean of the two intercepts.The reciprocal of this is magnitude of the focal length of lens.

Snellen Eye Chart

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