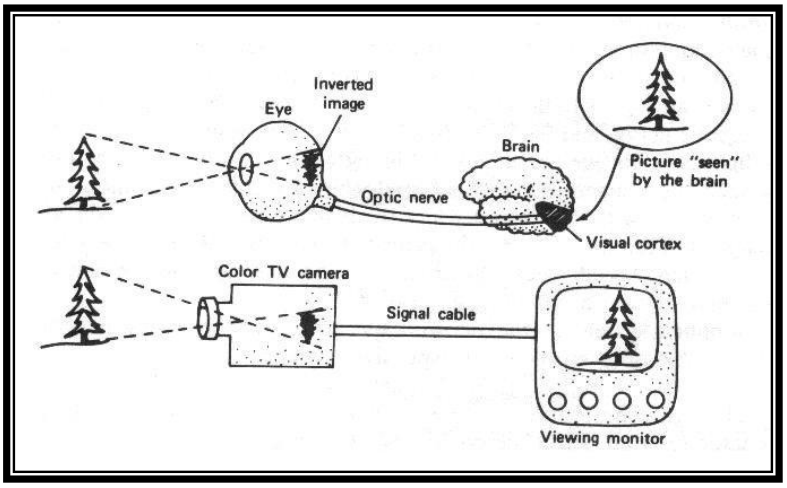
كلية طب الأسنان		الجامعة المستنصرية
	The focal length of a convex lens by a graphical method	
Medical Physics		**Lab -11-**

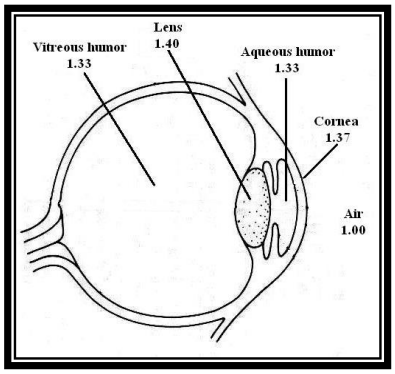
While the **eye** has some striking similarities to a **camera**, a better analogy exists between the **eye** and a closed circuit **color TV system**.

- The **lens** of the TV camera is the **cornea** and **lens** of the eye.
- The **signal cable** is the **optic nerve**.
- The **viewing monitor** is the **visual cortex**.



The Refractive Interfaces in the Lens System of the Eye

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**.



Focal Length of a Lens

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

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

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

Measurement of the Refractive Power of a Lens

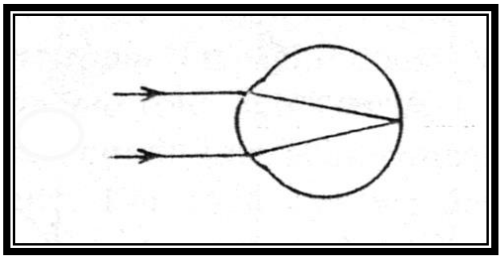
The more a lens bends light rays, the greater is its "**refractive power**". This refractive power is measured in terms of "**Diopters**". The refractive power in diopters of a convex lens is **equal** to 1 meter divided by its focal length.

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

Eye Conditions

I. For Normal Vision "Emmetropia"

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



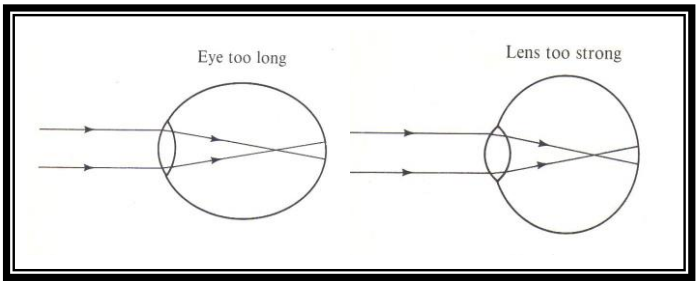
II. For Defect Vision "Ametropia"

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

There are four types of Ametropia: -

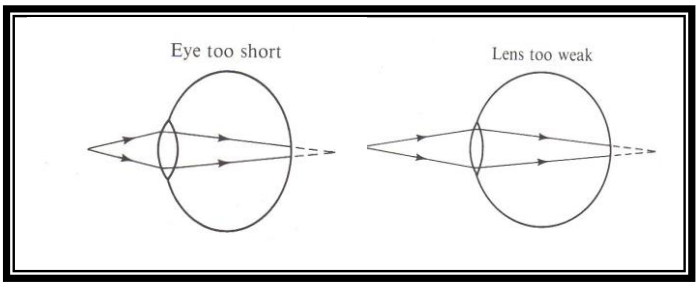
1. Myopia.

Which is also known as "**near-sightedness**", is usually due either to an eyeball that is **too long**, or occasionally, to a 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, partially **because** of progressive denaturation of the

lens proteins. Therefore, the ability of the lens to change shape progressively decreases with age.

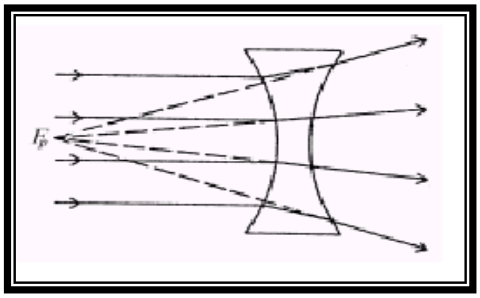
The Lenses

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

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

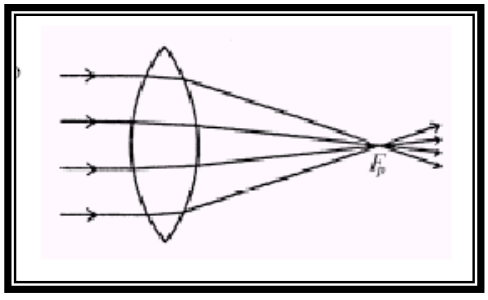
- **Concave Lenses**

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 principle 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 principle axis from an infinitely far object passes through the lens, it will **converge** at a focal point **F** on the principle axis. The distance between the focal point and the lens is the focal length, which is always a **positive value** for **converging lenses**.



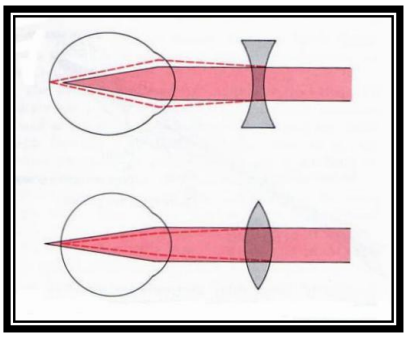
Correction of Eye Defects

- **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.

The Medical Applications of Lens

1. To determine the focal length of the eye and distance between the object and the lens.
2. For the treatment of the eye defects like far sight vision, near sight vision, old age vision, and astigmatism.
3. It is used in many medical and biological devices like microscope, otoscope, endoscope, ophthalmoscope, and etc.
4. In dentistry it is used in many devices and instruments, like dental chairs, mouth mirror, and etc..