كلية المستقبل الجامعة

قسم الفيزياء الطبية

المرحلة الثالثة

Medical Physics

Lecture 2

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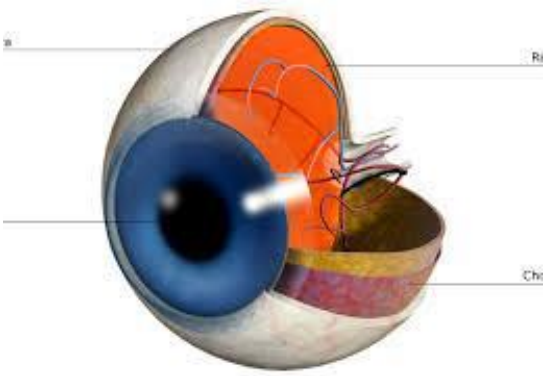
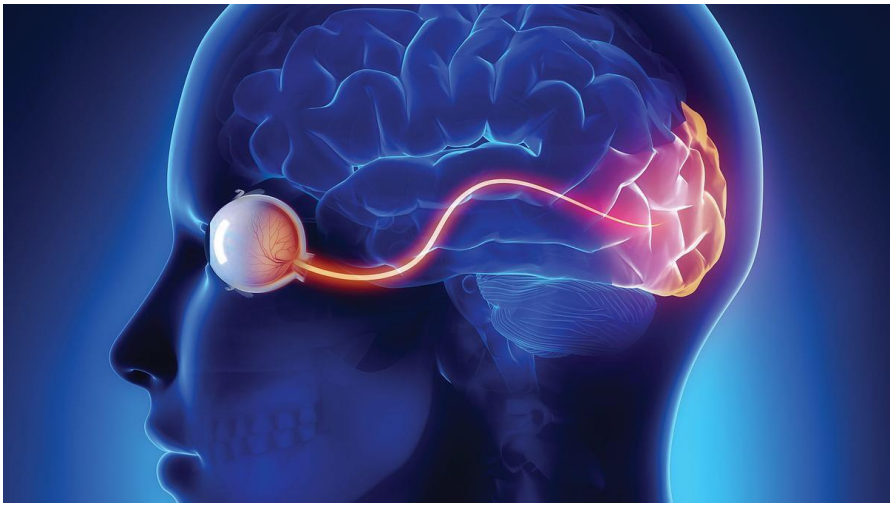
Physics of Eyes Vision :

The Eye :

The human eye is optical instrument that reacts to light and allows vision; rod and cone cells in the retina allow conscious light perception and vision, including color differentiation and the perception of depth. The human eye can distinguish about 10 million colors .

The human eye is an optical instrument that enables us to view all the objects around us is a very complex organ .





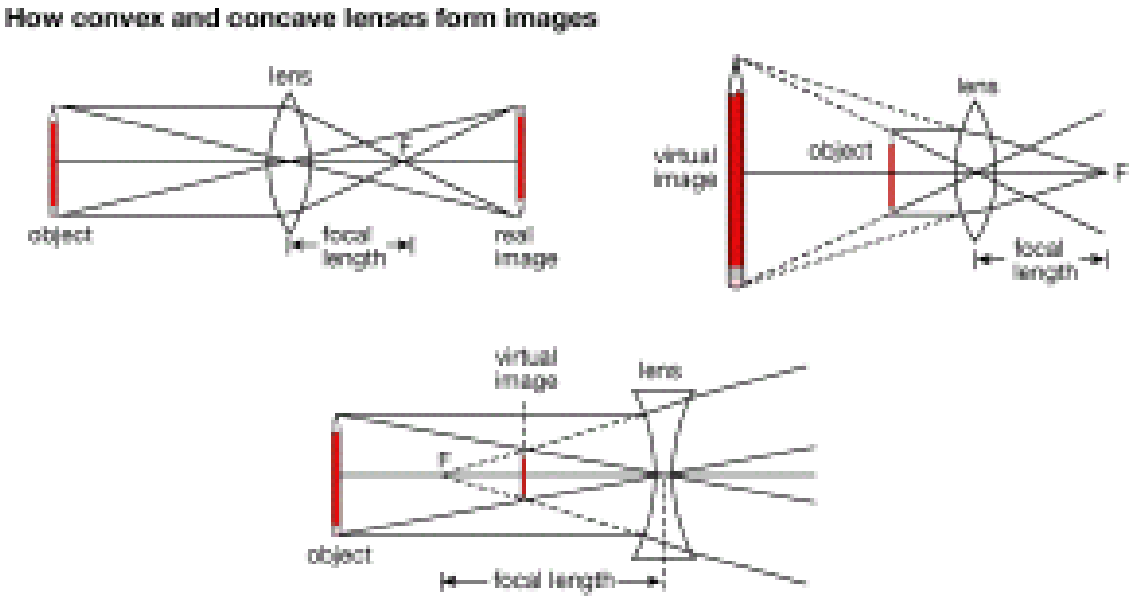
It helps us in visualizing objects and also helps us in light perception, color and depth perception. Besides, these sense organs are pretty much similar to cameras, and they help us see objects when light coming from outside enters into them .

That being said, it is quite interesting to understand the structure and working of a human eye. It also helps us in understanding how a camera actually functions .

How Lenses Form Images :

Light rays are bent, or refracted, when they cross an interface between two materials that have different indices of refraction.

The refractive index of a material is the ratio of the speed of light in a vacuum to the speed of light in the medium. Light passing through a lens crosses two such interfaces: one where it enters the lens at the front surface, and another where it leaves the lens at the back surface .



The eye has two major focusing :

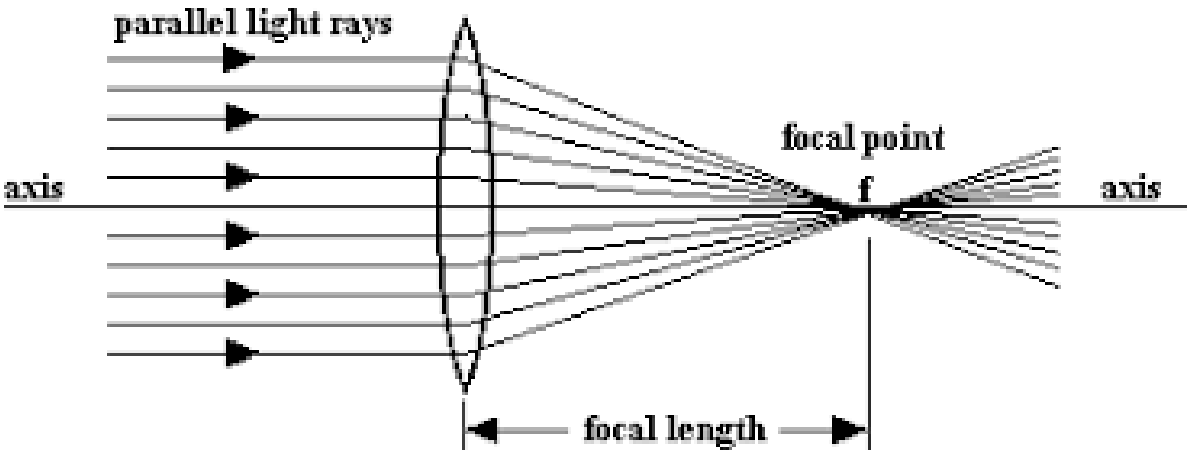
1- The cornea is a fixed focus element .

2- The lens is variable in shape and has the ability to focus objects at various distances .

Lenses and Focal Length :

The focal length of an optical system is a measure of how strongly the system converges or diverges light .

The amount by which light is bent is quantified by the lens's focal length. A strong lens, which can bend rays so that they intersect at a short distance, is said to have a short focal length. A weaker lens bends rays less, so that they intersect further away, and is said to have a long focal length. If the incoming rays are parallel, the distance at which the outgoing rays intersect is equal to the lens's focal length.



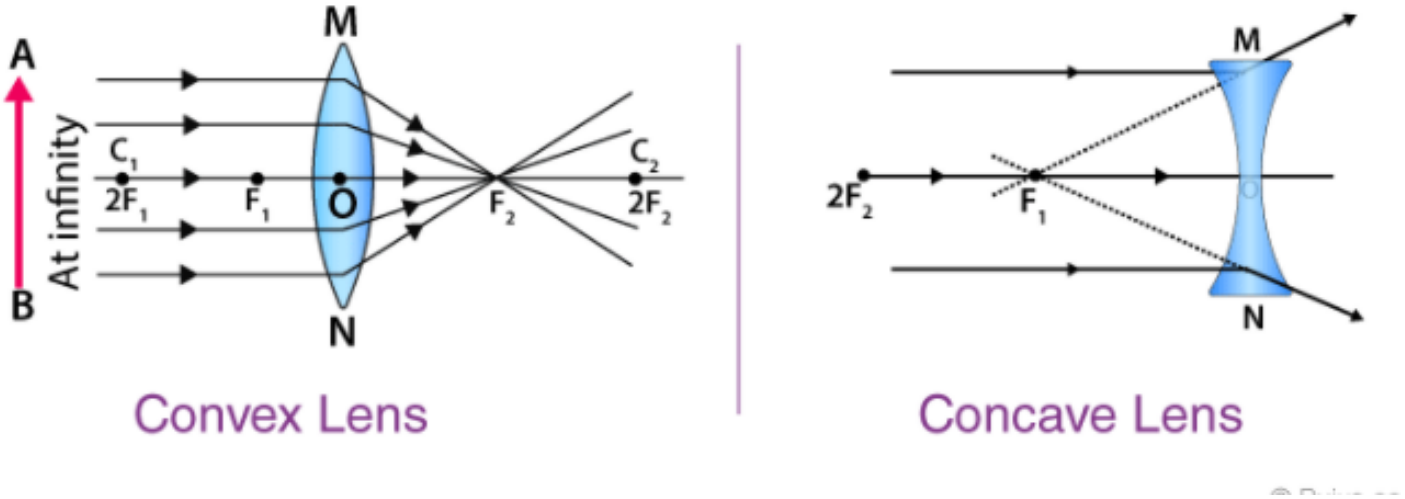
The focal length of a lens is determined by the curvatures of the its front its index of refraction, and the index of refraction of ، and back surfaces the material surrounding the lens. A lens with highly curved surfaces usually has a shorter focal length than one with flatter surfaces made from the same material .

A lens with a high refractive index has a shorter focal length than an identically shaped lens with a low refractive index .

Types of Lenses :

Spherical lenses are the lenses formed by bounding two spherical transparent surfaces together.

In general, there are two types of spherical lenses. So, lenses formed by binding two spherical surfaces bulging outward are known as convex lenses while the lenses formed by binding two spherical surfaces such that they are curved inward are known as concave lenses .



There are two types of lenses :

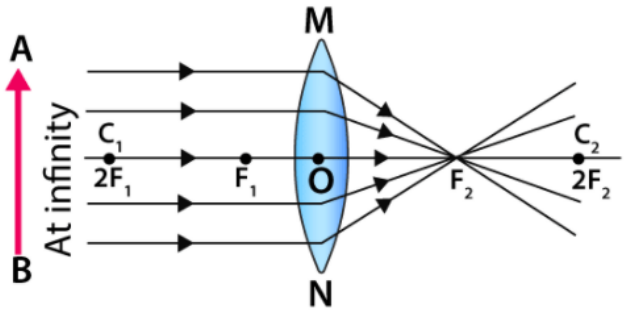
1- Convex lenses : are also known as converging lenses since the rays converge after falling on the convex lens .

2- Concave lenses : are known as diverging lenses as the rays diverge after falling on the concave lens.

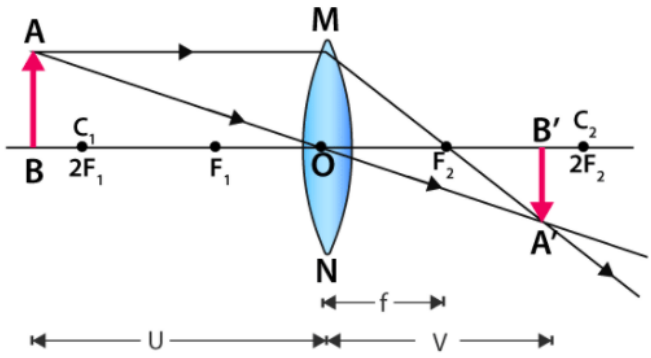
Image Formation by Concave and Convex Lenses:

Convex lens :

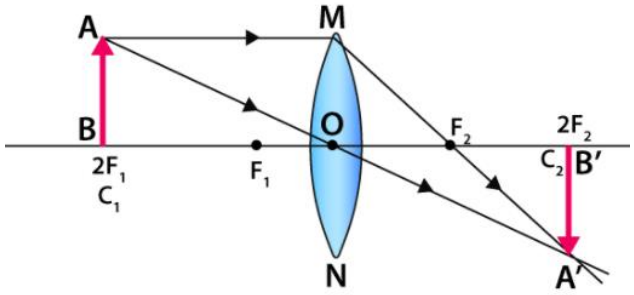
1- When an object is placed at infinity, the real image is formed at the focus. The size of the image is much smaller than that of the object.



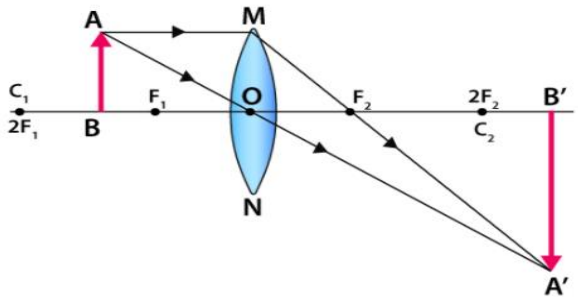
2- When an object is placed behind the center of curvature, the real image is formed between the center of curvature and focus. The size of the image is the same as compared to that of the object .



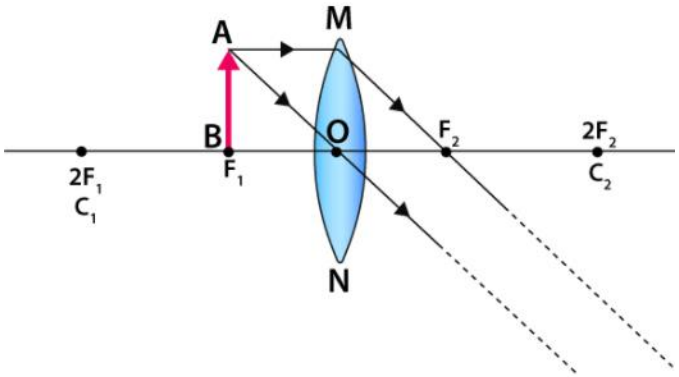
3- When an object is at the center of curvature, the real image is formed at the other center of curvature. The size of the image is the same as compared to that of the object .



4- When an object is placed in between the center of curvature and focus, the real image is formed behind the center of curvature. The size of the image is larger than that of the object .



5- When an object is placed at the focus, a real image is formed at infinity. The size of the image is much larger than that of the object .



6-When an object is placed in between focus and pole, a virtual image is formed. The size of the image is larger than that of the object.