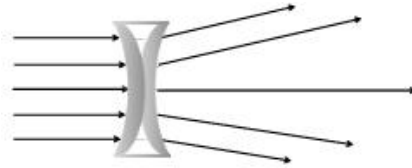


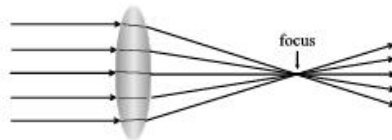
Topic 4 – Lenses and Vision (pgs. 208-220)

A lens is a curved piece of transparent material (glass/plastic).
When light rays pass through it, the light is refracted, causing the rays to bend.

A **double concave lens** is thinner and flatter in the middle than the edges.
Light passing through the thicker more curved areas of the lens will bend more than light passing through the thinner areas, causing the light to spread out or diverge.



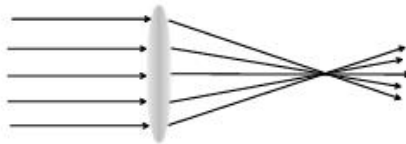
A **double convex lens** is thicker in the middle than around the edges.
This causes the light to come together at a focal point, or converge.



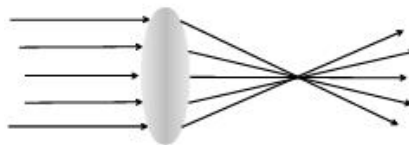
Lenses and Mirrors

Lenses are useful optical devices. Eyeglasses have been made from lenses since the thirteenth century.

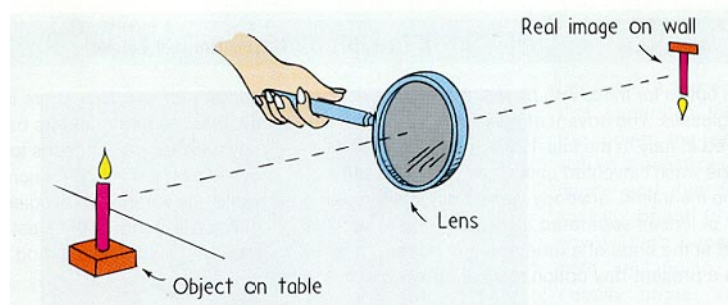
A convex lens refracts the light rays from an object so they can be focused.



Different size lenses can converge the light rays at different distances, enabling corrections to be made to focal points.



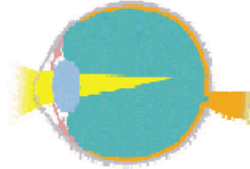
However, light from the left portion of the object is directed to the right and the light from the top is directed to the bottom. This inverts the image. Overhead projectors and film projectors do this



Eye Spy

The lens in the human eye is a convex lens, which focuses the light rays entering your eye to a point on your retina (a light sensitive area at the back of the eye). The image you see is formed on the retina. Some people however have eyes that are too long or too short.

If their eye is too long, the image forms in front of the retina - this is a condition called Myopic, or **near-sightedness**.



(They have trouble seeing distant objects)

If their eye is too short, the image forms behind the retina, making object that are close to them difficult to see. This condition is called **far-sightedness**.

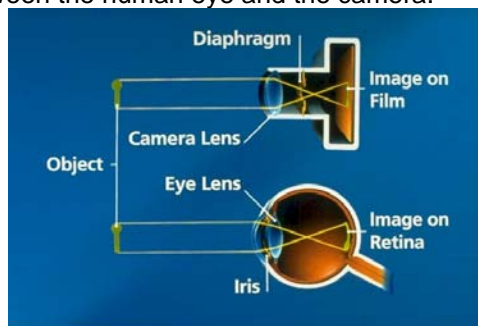


Knowledge of how light behaves when it travels through lenses helps eye specialists correct vision problems.

(see Figures 3.32A, 3.32B, 3.32C page 210)

Comparing the Eye and the Camera

There are many similarities between the human eye and the camera.



There is a more detailed image in Science Focus (Figure 3.33A, p. 211)

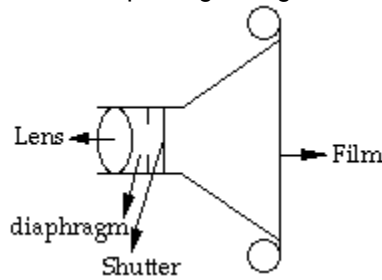
Putting It in Focus

In a camera, if an object moves closer to the film, the lens must move away to keep the image in focus. In the human eye, the lens cannot move, so the **ciliary muscles** change the shape of the lens (by making the lens bulge in the middle if the image comes closer to you and stretch if the object is further away). This is done so that the eyeball isn't stretched. The process of changing the shape of the lens is called **accommodation**. As people become older, the lens stiffens and loses its' ability to change shape (doesn't bulge) and many people need to wear (convex lens) reading glasses, so that the images can be focused.

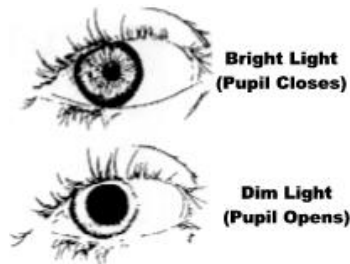
The shortest distance at which an object is in focus is called the **near point of the eye**. The longest distance is called the **far point of the eye**. On average, an adult has a near point of about 25 cm, whereas babies have a near point of only 7 cm. The far point is infinite (because you can see the stars).

Bringing In The Light

In order to adjust the amount of light that enters the eye and the camera, a special device opens and closes to let just the right amount of light in. In the camera, the **diaphragm** controls the **aperture** (opening) of the lens and the shutter limits the passage of light.



In the eye, the device (or part of the eye) that controls the amount of light entering is called the iris (the colored part of the eye), which changes the size of the **pupil** - in much the same way as the **diaphragm** controls the **aperture** (opening) of the camera lens.



The natural adjustment in the size of the pupils is called the **iris reflex**, which is extremely rapid. This iris reflex action automatically adjusts the pupil when you go from a darkened area to a well lit area, or, from a well lit area to a darkened one.

Seeing the Image

The Film at the back of the camera contains light sensitive chemicals which change when light hits it. These chemicals form the image on the film. In the eye, when the cells in the **retina** detect light, they produce small electrical impulses from the retina to the brain by way of the **optic nerve**. The point where the retina is attached to the optic nerve does not have any light sensitive cells. This point is known as the **blind spot**.

Can you find your blind spot?

View this image at arm's length. Cover your right eye with your hand. Stare at **x**, slowly leaning closer to the image, until the dot disappears (when you reach your blind spot) and then reappears when you have passed your **blind spot**.



The parts of a camera are housed in a rigid light-proof box, whereas layers of tissue hold the different parts of the eye together. The eyeball contains fluids, called humours, which prevent the eyeball from collapsing and refract the light that enters the eye.