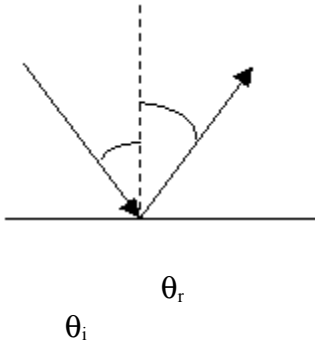
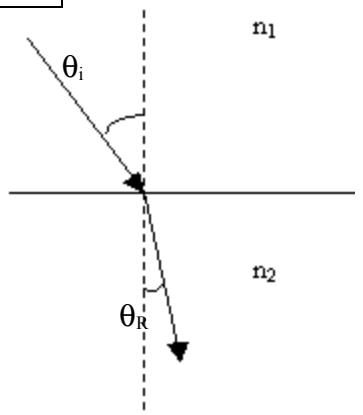
Mirrors and Lenses – Everyday reflection and refraction

A mirror is basically a "smooth" surface that neither absorbs nor transmits most (at least 90%) of the electromagnetic radiation that strikes it, but instead most of the radiation bounces off according to the **law of reflection**. For this course we will stick with the **reflection** of visible light. Reflection is simply the light bouncing off a reflective surface and is a commonly observed behavior. For example: making a bounce pass in basketball, bouncing a ball off of a wall, playing tennis, making a bank shot in billiards (pool), etc. The **law of reflection** states the relationship between the **angle of incidence** (θ_i) and the **angle of reflection** (θ_r). These angles indicate how the light strikes (θ_i) and leaves (θ_r) the reflective surface. The light striking the surface is called incident light and the light leaving the surface is called the reflected light. An important tool used in analyzing this behavior is that the light waves can be represented by a ray. (→) This then gives us two rays: **incident ray** and **reflected ray**. Another very important reference line is the **normal line**. The **normal line** is drawn at a right angle to the reflective surface at the point of incidence. From the diagram you can see the **law of reflection** says that $\theta_i = \theta_r$.



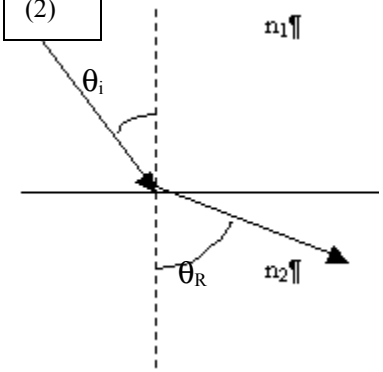
This also works exactly the same for a curved surface. The difference is drawing the normal to a curved surface. To do this either find the tangent line at the point of incidence and draw the normal perpendicular to it or find the center of curvature and connect it with the point of incidence. The second method, **easy rays**, is the easiest and the one we will use with concave and convex mirrors.
For details of curved mirrors, please see the tutorial at http://domb.thetetersz one.net
Your teacher has provided blank copies of the diagram for you.

(1)



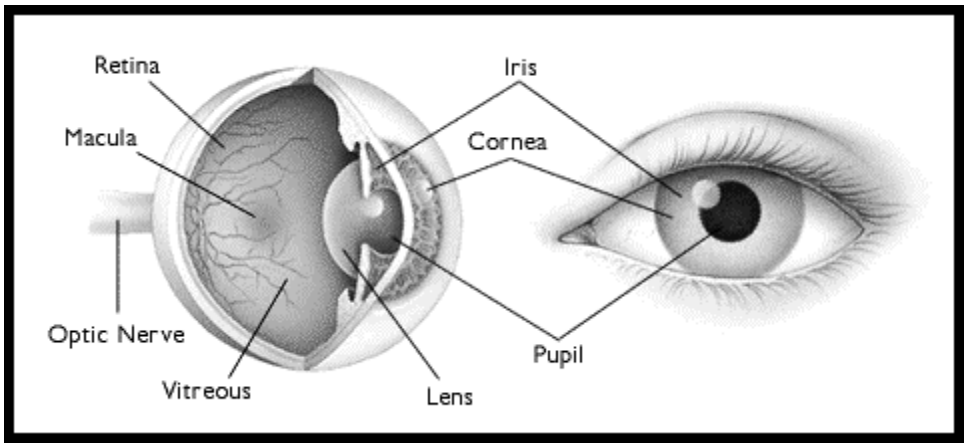
A lens is an object/material that allows most (90%) of the light to pass through two surfaces (at least one curved) without being absorbed or reflected. When this happens the light will usually change speed because of the difference in the two media. For example, light in a vacuum travel at a speed of 3.0×10^8 m/s (a little slower than this in air), if it enters a piece of glass it will slow down tremendously ~ 2.0×10^8 m/s. This change in speed causes **refraction** as you might recall from the previous unit. The ratio of the speed of light in a vacuum to the speed of light in another medium is known as the **index of refraction (n)** of that medium; or by what factor does light slow down and bend as a result of the change in medium. The higher the index of refraction, the slower the speed of light and the more the light will bend. The lowest index of refraction is 1, in a vacuum. The **law of refraction** can be summarized as follows: **(1)** If $n_1 < n_2$, the light will bend towards the normal, $\theta_i > \theta_R$ **(2)** if $n_1 > n_2$, the light will bend away from the normal, $\theta_i < \theta_R$ and **(3)** if $\theta_i = 0$, there is no observed bending but the light still changes speed. There are two basic types of simple lenses: **concave** (diverging) and **convex** (converging). Draw each type of lens below:

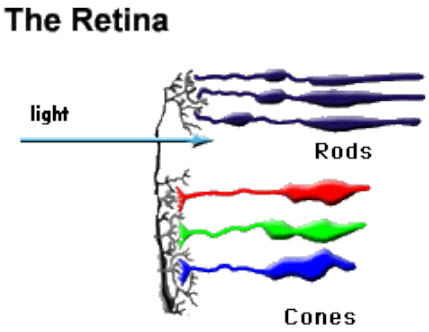
(2)



The Human Eye and Vision

The main parts of the eye are shown in the picture below. The tough, white, outer covering of the eye is called the **sclera**. Light enters the eye at the cornea and passes through until it reaches the retina. The eye is filled with a fluid called the vitreous humor. At the retina the energy of the light causes the stimulation of two main types of nerve cells, the **rods** (light intensity) and the **cones** (color). There are three main cones which detect the three primary colors of light: **red, blue, and green**. The signals from the rods and cones are sent to your brain, which interprets the brightness and color you "see". The area of the retina with the highest concentration of nerve cells is called the macula.





An eye with "normal" vision will refract and focus light as it passes through the cornea and the lens and form a focused image on the retina, along the back of the eye. A **nearsighted** eye will focus the light "in front" of the retina producing a blurry image on the retina. A nearsighted eye is able to focus near objects, while distant objects are blurry. A **farsighted** eye will focus the light "behind" the retina producing a blurry image on the retina. A farsighted eye is able to focus distant objects, while near objects are blurry. Many people "become" farsighted as they get older. These people have probably always been farsighted, it's just that as you age the muscles in your eye that control the fine tuning lens become weaker. As a result you can no longer compensate for the discrepancy in your eye.

Corrective lenses are often used for vision problems. A concave lens for nearsighted vision and a convex lens for farsighted vision. After exploring lenses you should draw the appropriate lens for each eye.

Nearsighted