# Reflection and Refraction

## Equipment

Acrylic block set, plane-concave-convex universal mirror, cork board, cork board stand, pins, flashlight, protractor, ruler, mirror worksheet, rectangular block worksheet, equilateral prism worksheet, converging lens worksheet.

## Preparation

Review the laws of reflection and refraction and Snell's law. Understand the concept of total internal reflection. Review the geometry of a prism. Know the lensmaker's equation.

## Goals of the Experiment

To study and observe the laws of reflection and refraction. To understand and practice optical ray tracing. To observe the operation of mirrors and prisms. To examine light travel in rectangles and equilateral triangles using the laws of reflection and refraction. To verify the lensmaker's equation.

## Theory

Materials transparent to light are called **optical materials**. It has been found that the speed of light varies in different optical materials. The speed of light is highest in a vacuum. In air the speed is slightly slower. In a solid optical material like glass the speed of light can be less than half of the speed of light in free space. This speed of light difference is an important property of optical materials. The **index of refraction,** or **refractive index**, of an optical material is defined as the ratio of the speed of light in a vacuum to the speed of light in the material. The refractive index of empty space is 1.0, while the refractive index of all other optical materials is greater than 1.0. The refractive index of air is about 1.0003 while the index of refraction of the acrylic plastic used in this experiment is 1.49 .

When a ray of light passes between two optical materials, part of the ray is **reflected** and stays in the first medium while the remaining ray is **refracted** and passes into the second medium. Figure 1 shows a ray of light crossing an optical boundary. Let the index of refraction of the first medium be n and the second medium be n'. A line perpendicular to the boundary called the **surface normal**, N, is used to measure the angles of the light rays. The angle the incident ray makes with the normal is called the **angle of incidence**, φ. The angle the reflected ray makes with the normal is called the **angle of reflection** and the angle the refracted ray makes is called the **angle of refraction**, φ'. It has been found that the behaviour of reflected and refracted rays can each be described by a law.

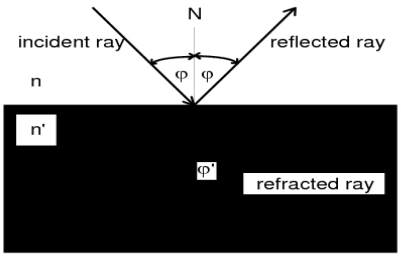

Figure 1

The **law of reflection** states that *"the angle of incidence equals the angle of reflection and the reflected ray is on the opposite side of the normal from the incident ray and the incident ray, surface normal, and reflected ray all lie in the same plane"*. The **law of refraction** states that *"the sine of the angle of incidence and the the sine of the angle of refraction are in constant ratio to each other and the refracted ray lies on the opposite side of the normal from the incident ray and the incident ray, surface normal, and refracted ray all lie in the same plane"*. The law of