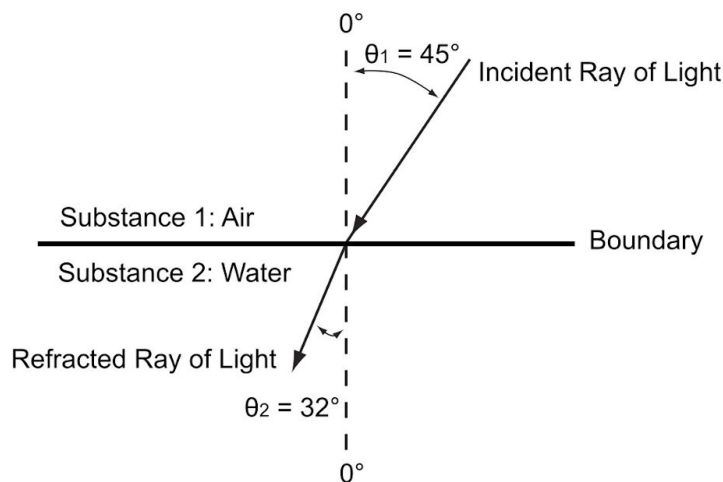


## ANALYZING DATA

**Refraction—Snell's Law**

As light travels from one medium into another, refraction often occurs. Refraction is the bending of a wave that occurs when it enters a new substance as shown in Figure 1. This bending occurs because the speed of light changes when it passes from one substance to another, due to a difference in the densities of the two substances. In 1621, Dutch astronomer and mathematician Willebrord Snellius (1580–1626) came up with a quantitative law of refraction, which is known today as Snell's law. In this activity you will analyze data on the transmission of light from air into water to derive Snell's law.

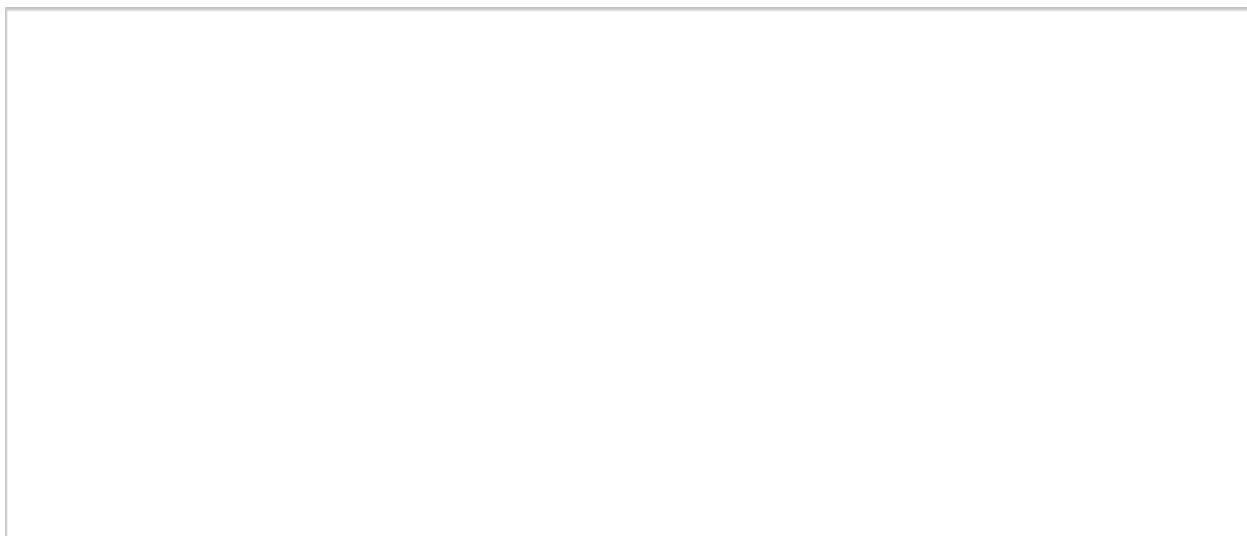
**Figure 1**

<b>Angles of Incidence and Refraction for Light Moving from Air into Water</b>	
<b>Angle of Incidence, <math>\theta_1</math> (degrees)</b>	<b>Angle of Refraction, <math>\theta_2</math> (degrees)</b>
10	7.5
15	11.2
20	14.9
25	18.5
30	22.1
35	25.5
40	28.9
45	32.1
50	35.2
55	38.0
60	40.6
65	43.0
70	44.9
75	46.6
80	47.8
85	48.5
90	48.8
95	48.5
100	47.8
105	46.6
110	45.0
115	42.9
120	40.6

1. **CCC Patterns** Given a two-variable data set like that in the table, how can you begin to uncover the mathematical relationship between the two variables, i.e. whether there is a linear relationship between the variables, a linear relationship between the inverse of one variable and the absolute value of the other, or some other relationship?

2. **SEP Analyze Data** Is there a linear relationship between the angle of incidence and the angle of refraction? Explain.

3. **SEP Use Math** Use graphing software or the space to construct graphs to determine which one of the following x-y plots of the data yields a straight line:  $\theta_1$  vs.  $\theta_2$ ,  $\ln(\theta_1)$  vs.  $\theta_2$ ,  $\theta_1$  vs.  $\theta_2^2$ , or  $\sin(\theta_1)$  vs.  $\sin(\theta_2)$ .



- 4. CCC Patterns** Describe how detection of a pattern between two variables in nature, such as between the angle of incidence and the angle of refraction for light transmitted across an intermedia boundary, can be useful in understanding the natural world.