Reflection, Diffraction, and Refraction

Diffraction

- Waves spread as they travel.
- When waves encounter an obstacle they bend around it and pass into the region beyond.
- The requirement for diffraction is that the size of the opening in the barrier is approximately the wavelength of the wave being diffracted.

Law of Reflection

- The angle of reflection equals the angle of incidence.

- The angle of incidence is the angle the incident ray makes with the perpendicular to the reflecting surface.

- The angle of reflection is the angle the reflected ray makes with the perpendicular to the reflecting surface.

Refraction

- When a wave strikes a boundary, some of the energy is reflected and some is transmitted or absorbed.

- When a wave crosses a boundary into a medium where its velocity is different, the transmitted wave moves in a different direction than the incident wave. This bending due to differences in velocity is refraction.

Law of Refraction

- When light travels between two media, it changes direction as it passes into the second medium. The slower the speed in the second medium, the smaller the angle of refraction.

Index of Refraction

- Index of Refraction = (3 x 10^8 m/s)/(speed of light in the second medium)

- n = (3 x 10^8)/ (speed of light in the second medium)
- See p. 2 of the Reference Table

Example

- The speed of light in a medium is 2.4 x 10^8 m/s. What is the index of refraction for this medium?

- n = (3 x 10^8 m/s)/(2.4 x 10^8) = 1.25

Examples of index of refraction

- Medium   index of refraction

- Air   1.0
- Water   1.33
- Flint glass   1.61
- Crown glass   1.52
- Diamond   2.42

Law of Refraction (Snell's Law)

- n1 sin(angle1) = n2 sin(angle2)
- Where n1 = refractive index for medium 1 and n2 = refractive index for medium 2.
- If n1 is for air, the value is 1.

Example of Snell's Law

- A light ray is incident upon a surface boundary between air and corn oil at an angle of 60 to the normal. Calculate the refracted angle of the ray in the corn oil.

- n1sin(angle1) = n2sin(angle2)

- Sin(angle2) = n1sin(angle1)n2

- $\quad$ 1 x sin60/1.47 = 0.59

- Angle2 = arcsin(0.59) = 36 degrees

Group Activity

- Calculate the speed of light in these media with these given index of refraction:

- Water, n = 1.33

- Corn oil, n = 1.47

- Ethyl alcohol, n = 1.36

- Flint glass, n = 1.66

- Diamond, n = 2.42