Extension Activity – Water

Title of Activity – Refracting Rays

Concepts/Principles Covered –

Snell's Law describes the relationship between the refractive indices and the angles of incidence and refraction at the boundary between two media: $n_1 sin\theta_1 = n_2 sin\theta_2$. You see the pencil as light rays reflect off it and travel to your eyes. This means that the light originates in the water and then passes through an interface before entering the air on its way to your eyes. The light waves pass from a medium of higher refractive index ($n_{water} = 1.33$) to a medium of lower refractive index ($n_{air} = 1$). Therefore, the light waves bend away from the normal at the interface, which is why the part of the pencil in the water appears wider. Since the angle of refraction is related to the ratio of the sines of the angles of incidence and refraction relative to normal, this effect is more pronounced when the angle of incidence is closer to the normal. The brain assumes that light travels in a straight line, so the part of the pencil that is submerged appears to be offset from the part of the pencil that is above the water line. The overall effect is an enlarged offset image resting at the same angle as the original.

Short Description –

Learn about Snell's Law using a simple experiment to indicate how the angle of refraction changes between two different media.

Standards Covered -

4-PS4-2: Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

CCSS.MATH.CONTENT.4.MD.C.6: Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

MS-PS4-2: Develop and use a model to describe how waves are reflected, absorbed, or transmitted through various materials.

CCSS.MATH.CONTENT.7.G.B.5: Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.

Length - 30 minutes

Age Group – Grades 4-8

Materials and Supplies -

- Clear, tall glass half filled with water
- Wooden pencil
- Additional glass with cooking oil

Step-by-step Instructions -

- Fill a clear glass halfway with water.
- Fill another clear glass halfway with oil.

- Place a pencil in each glass.
- Observe the pencil in each container. Does the pencil in water look the same as the one in the oil?