University of Portland Lunabotics STEM Workshop
Projectile Motion

Introduction:

- Navigate to the PhET Projectile Motion Simulation and start the *Intro* lab (https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html).

- Remember that g = 9.8 m/s^2.

- Compare your calculated results by recreating the scenario in the simulation. On a piece of paper, record your calculated and simulated results, along with the percent error ($\%\ error = \frac{|simulated\ result - calculated\ result|}{calulated\ result} * 100$).

Free Fall:

1. With the cannon set to -90 degrees (straight down), 15m high, and an initial velocity of 0m/s, calculate the time it takes the projectile to hit the ground. (Hint: y_f should be zero because the ground is the final height.)

2. Find the initial height of the object if it took 1.11 seconds to hit the ground. Keep the cannon at the same angle. For checking your answer, use the blue measurement tool and line up the crosshair with the bottom point of the trajectory.

$$t = \sqrt{\frac{2(y_i - y_f)}{g}}$$
$$y_i = y_f + \frac{1}{2}gt^2$$

Horizontal Launch:

3. With the cannon set to 0 degrees (parallel with the ground) and 10m high, and with the target distance set to 15.0m:

    a. Find the time it takes for the projectile to hit the ground (notice how equation is the same as free fall for time).

    b. Calculate the initial velocity of the project in order to land on the target.

$$t = \sqrt{\frac{2(y_i - y_f)}{g}}$$
$$v_{x_i} = \frac{x_f - x_i}{t}$$

Exploration:

4. Set the cannon's height to 0m with an initial velocity of 15m/s. Without using any equations, try finding which angle makes the projectile travel the furthest on the x-axis (maximize x_f). Record your results.

Conclusion:

Take a picture of your work and email it to robotics@up.edu.