**Projectile Motion Simulation**

In order to get an understanding of projectile motion and the variables that describe the flight path of the soda bottle rockets, students can access an online simulation of a cannon shooting a pumpkin, a human, or other objects into the air with the goal of hitting a target.

Open <https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html>

Complete the following POGIL activity to gain an understanding about what variables can affect projectile motion.

* 1. Launch the **Lab** activity. Notice that there are multiple variables that can be changed, such as the Initial Speed, mass, and diameter of the object that is fired from the cannon. Fire the Cannonball and notice its flight path and where it lands. *Notice that the cannonball misses the target when using the default setting.*
  2. Try **changing the mass** of the cannonball. Explain if this will help to hit the target. *Click the eraser.*
  3. Try **changing the diameter** of the cannonball. Explain if this will help to hit the target. *Erase.*
  4. The Earth’s gravity is normally 9.81 m/s2, so do not change it. **Check the box to create air resistance** against the cannonball. Explain how the mass and diameter of an object determines the effect of air resistance on the height and distance the projectile travels.

1. Click the reset button . Move the target location so that it is centered at a distance of 25.0 m from the cannon. Now adjust only the **angle** of the cannon to try to hit the middle of the target. Explain how the angle of the cannon effects the height and distance the projectile travels.
2. Click the reset button . Move the target location so that it is centered at a distance of 20.0 m from the cannon. Now adjust only the **Initial Speed** of the cannonball to try to hit the middle of the target. Explain how the Initial Speed of the projectile effects the height and distance that it travels.
3. Click the reset button . Raise the platform that the cannon rests on to a height of 10 m and set the angle of the cannon to 0º. Fire 1 shot and note where the cannonball lands. Now, without changing the position of the cannon, adjust **any of the other variables** to try to hit the target in 2 attempts or less. Summarize what combination of variable settings resulted in a bulls-eye.