**Projectile Motion Video Capture Lab**

**Materials**: soccer ball, plastic golf ball, logger pro, cell phone camera, meter stick

**Purpose:** Examine whether the motion of a tossed ball differs when mass, speed, or launch angle is changed.

**Procedures:** Student groups will use cell phones to capture video of tossed projectiles (i.e. soccer and golf balls) and then analyze the videos using Logger Pro. Groups will need to capture at least six short videos of a tossed projectile: two that vary projectile mass (projectile should reach the same vertical and horizontal distances), two with the same projectile tossed at different speeds, and two with the same projectile but with different arc shapes (projectiles should have equal horizontal distances). Students should have completed video analysis earlier in the year for angry bird lab and will use those skills to answer the following questions.

Answer the following questions with complete sentences. You may use equations and calculations to support your answers. Please write your answers on a separate piece of paper.

1. While in the air, does a ball’s horizontal speed vary or remain constant when the ball is tossed faster?
2. While in the air, does a ball’s vertical acceleration vary or remain constant when the ball is tossed faster?
3. While in the air, does a ball’s horizontal speed vary or remain constant when it follows a tall/skinny arc rather than a low/wide arc?
4. While in the air, does a ball’s vertical acceleration vary or remain constant when it follows a tall/skinny arc rather than a low/wide arc?
5. Does a ball’s horizontal speed vary or remain constant if mass is changed?
6. Does a ball’s vertical acceleration vary or remain constant if mass is changed?
7. What are two new things you learned from completing this video capture activity?
8. How would you improve this capture activity if you were repeat it?

Answers:

**In the horizontal direction…**

* All position vs. time graphs are straight lines. The slope of the line represents the horizontal speed, which remains constant during flight.  This is like our previous model of constant velocity motion.
* All velocity vs. time graphs are flat lines. This means the horizontal acceleration is zero which matches up the horizontal position vs. time graph. Again, this is like our previous model of constant velocity motion.

**In the vertical direction…**

* All position vs. time graphs are in the shape of upside-down parabolas, with the time-squared coefficient being about 5 m/s/s. This is like our previous model of accelerated motion in free-fall.
* All velocity vs. time graphs have a slope of about -9.8 m/s/s. Again, this is like our previous model of accelerated motion in free-fall.

**Also…**

* The mass of the ball doesn’t matter. Again, this is like our previous model of accelerated motion in free-fall.
* Projectile motion is simply the combination of the constant velocity model (horizontal) and the acceleration motion model (vertical).