**Projectile Motion – Horizontal Launch**

In this activity we will study the motion of a projectile launched horizontally using kinematics and conservation of energy.

Time to Land

The first question we need to address is how the time for the projectile to land depends on the launch speed.

*Prediction 1*: Imagine that you roll a ball off the edge of a table and you measure the time to land. If you increase the initial speed, how does the time change? Justify your answer.

1. increase 2) decrease 3) no change

*Check 1:* Now check your prediction by measuring the time to land for two very different speeds. Note that this time will be very short and difficult to measure manually. Try measuring by taking a video using the iPad app *Video Physics*. Explain your results.

Horizontal Projectile Launcher

Now we will use a ‘Horizontal Projectile Launcher’ to systematically control the launch speed as shown below.

h

y

x

v0

The speed can be changed by changing the release height.

*Prediction 2*: How do you think the landing distance (x) will depend on the release height (h)? Specifically, if you double h, then x will

1. double 2) less than double 3) more than double

Justify your answer.

*Check 2*: Release the steel ball from a given height (h) above the table and measure the horizontal distance (x) the marble travels from the edge of the table before landing. (Repeat this 2 or 3 times for accuracy.) Now repeat this for 4 different values of h and sketch a graph of x versus h. How does the graph compare with your prediction?

Now make a graph of x2 versus h. Is this graph more linear than x versus h? (Class discussion)

*Prediction 3*: What effect does rolling have on x? Specifically, if the ball did not roll but were to slide down the ramp without friction, would it go 1) further, 2) not as far, or 3) the same distance . Explain your reasoning.

*Check 3*: Check your results for one of your measurements by using h to calculate x assuming no rolling.

If time allows –

1. Compare the rolling speeds of differently shaped round objects (solid ball, hollow ball, solid cylinder, hollow cylinder) released from the same height. The amount of rotational versus translational kinetic energy depends on the shape (mass distribution).
2. Use the projectile motion simulator (<http://walter-fendt.de/html5/phen>) to explore how the time to land for a horizontally launched projectile depends on initial speed.