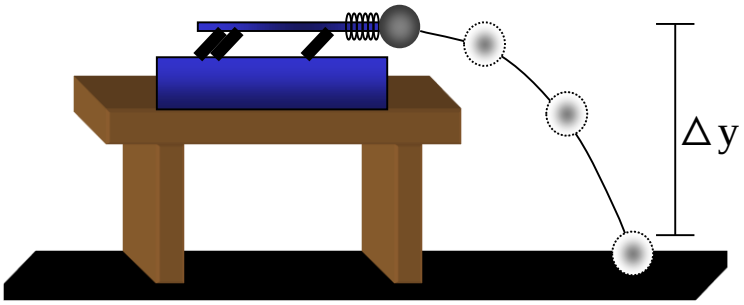
Projectile Motion Lab Protocol

Physics

In this lab, your job will be to use an initial set of measurements to predict the motion of a ball shot from a projectile launcher. You will need to work in groups to collect initial data and make some initial calculations when the ball is launched horizontally (the launcher will be resting on a table). You will then use that information to predict the motion of the ball when it is launched at an angle.



You will be using the Big 4 to analyze the motion of the ball. Since the ball is moving in two dimensions (horizontally and vertically), the measurements and calculations you make will need to correspond to x- and y-variables that describe positions, velocities, acceleration, and time.

1. Launch the ball at various angles and heights. Without making any actual measurements, observe how the path of the ball changes under different launch conditions. With your group members, discuss the variables you can easily measure and what other data you can calculate from those variables. (One example variable is shown in the drawing above.) Determine a frame of reference so you can precisely identify Big 4 variables. **In your notes, show how you can use the Big 4 equations to derive formulas that will allow you to complete a variable inventory for both the x- and y-components of the motion of the ball. Make sure to include a diagram showing your frame of reference for both the x- and y-axes.**

2. As part of this lab, you will need to be able to predict the location of the ball at various points in its trajectory. Since the ball will be launched at an angle, you will need to include trigonometric formulas where necessary in your equations. With your group, discuss how you could calculate the height of the ball at any distance along its path, and how you could calculate the distance the ball has traveled by knowing its height. Use the information from part 1, along with the trigonometric formulas, to derive formulas for these calculations. (It might help you to think of the final position variables – x and y – as functions of time; i.e., x_t and y_t.) **In your notes, detail the derivations of these formulas – there may be several – and show them in their final form. You will need to highlight**

all measured and calculated values, including numbers that will be unknown until you conduct your final tests (such as the angle of launch).

3. Launch the ball, from a fixed height, with the launcher locked in the horizontal position. Make as many measurements as you see fit (feel free to launch multiple times). In your group, discuss the most accurate way to consolidate your data (should you average it? Why or why not?). Then, use this data to calculate any other Big 4 variables you might need. **In your notes, record all your raw data, along with any adjustments such as averages. Separately, record all of the Big 4 variables that you have been able to measure or calculate so far. This information will serve as the basis for your predictions.**

4. Check your work with your instructor. When you're ready, ask for your launch angle. Then use your equations to predict the exact height and distance of the ball at various points along its path. You should be able to use any one of the following three variables to calculate the other two: x, y, t. Discuss with your group any fine-tuning of your formulas, and make sure you know individually how to carry out the calculations. **In your notes, document any information you might need in order to use your formulas quickly and accurately.**