

- 1a. With a friend, go outside (or inside the gym) and throw rocks or tennis balls or baseballs as high as you can. Have your friend time your throw from hand release to maximum altitude. Then run it through this kinematic equation to find the initial velocity:

$$v_f = v_i + gt$$

v_i is the initial vertical velocity (the unknown),
 v_f is the final vertical velocity at peak altitude, 0 ft/sec,
 g is gravity measured to be -32ft/s^2
 t is the time to peak altitude (apogee)

- 1b. Now, using your newly derived initial velocity, v_i , figure how high you threw your rock/ball using this kinematic equation:

$$y_f = v_i t + \frac{1}{2}(gt^2)$$

where y_f is the final altitude at apogee.

How high did you throw your rock/ball?

- 1c. Now come up with the quadratic equation that describes your throw in terms of y and t . Meaning, come up with a function, $y(t)$, that is in the form $y = ax^2 + bx + c$. [where $x = t$].
- 1d. Now make a graph of *altitude* as a function of *time*. $y(t)$, using the equation from 1c. The y -axis will be y (*duh*), and the x -axis will be time, t . In order to find the vertex you will need to convert your equation from 1c into the form, $y(t) = -16\text{ft/s}^2(t - ?) + ??$. The vertex will be at (?, ??).

2. Go out and measure things. Find the height of the following structures on the Bard campus using trigonometry and the angle measurement feature of most smart phones. Here is the one that is built into the compass feature on the iPhone... no doubt there is something similar on Android.

<https://scientificmodelingsystem.com/how-to-use-the-angle-finder-on-your-iphone/>

If your phone doesn't have this feature or you just like low-tech methods, make an inclinometer (or other surveying instrument) using cardboard and a straw or figure out how to do it with an outstretched pencil or ruler. There are a variety of ways to measure angles to determine the heights of things. If you can, use the North Star!

You'll also have to figure out a way to measurement distance... probably by pacing off the distance and measuring your pace.

**All estimates need to be in both feet and meters.
Also draw crude diagrams to illustrate your methodology.**



Fisher Center



That sculpture

- a) The height of the chimney behind Henderson from its base to its top. [no photo]
- b) The height of the of the Fisher Center. [You don't have to do it from the front.]
- c) The height of that rotating sculpture behind Robbins/Ward/Manner.