**Physics** _____ **Instructor: Barton Clark**
**Sir Francis Drake High School** **name here please** **Fall 2020**

# Exploring the Error of Our Ways

- Groups of up to three to four students. ***Due Thurs (Fri), Sept 11th.***

This activity has students collecting error data for their handcrafted "throwing machines". Students began throwing tennis balls first looking for the distance at which they started to miss their targets (throwing five shots at each distance). From this point forward, students increased the distance, with increasing error until the machine simply couldn't throw any further.

a. Draw a sketch illustrating the scenario in which students threw at increasing distances and measuring error. Keep it simple but use your creativity.
b. Create a data table using Microsoft Excel (or some other, comparable program) including the following data.
    i. Throw distance
    ii. Error for each throw
    iii. Average error at each distance
c. Use Excel to plot both individual errors and average error *as a function of distance*.
d. Use the "best fit line" function to plot the curve (choose linear or exponential) and then to "show the function" pull the function out and rewrite the variables to represent error (E) and distance (d) (instead of y and x).
e. Quantify the precision and accuracy for both your throwing error and show how the measurements themselves, also have possible error (uncertainty?).
f. Describe in words the value of your quantification strategy and leverage what ever math skills you have regarding statistical analysis.
    i. % error (note: what value could you use in your comparisons to "the right answer?").
    ii. % uncertainty
    iii. Standard deviation? Confidence factor?
    iv. Some other definition of accuracy which you have created?
g. Create a brochure "selling" your throwing machine highlighting the accuracy and precision in
h. a way to celebrate your machine's strengths (*This is a separate 10 pt lab assignment*! creativity here!).

Robotic surgery works best for operations that require small incisions and levels of precision that would be difficult for even the nimblest human. In this demo video from Intuitive Surgical, the multi-armed machine is dextrous enough to paint a tiny picture—while guided by a human, at least. Real-world applications include removing cancerous tissue, performing hysterectomies, and bypass surgery. The smaller incisions enabled by machines mean smaller scars and less bleeding for patients.

*Grading categories.*

1. Complete the assignment?
2. Clear progression of ideas?
3. Accuracy/depth of discussion?
4. Creativity in layout, mathematics, writing or illustrations?
5. Professional?

*Possible scores per category*
5 = impressive.
4 = good job.
3 = you understood the directions,
2 = weak. (1 = even weaker)
0= missing.

Note: Scoring all 4s = 88% of pts possible. (20/23). To earn an A, at least one category score must be impressive (= 5)