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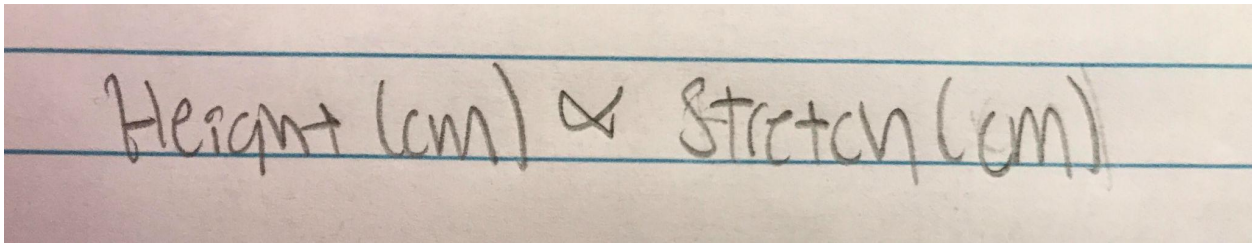
Section AT

Lab D1 - Spring Launch

I. The Question



II. Experimental Design

2.1: A.) We will pull the last rung of the spring down to different notches on the rod, each of which are 0.5 cm away from each other, and then we will release the spring, measuring the height that the top of the spring achieves at its peak. The initial measure will also be measured from the top.

B.)

Quantity to Measure	Symbol	Equipment for Measurement	Independent or Dependent?
Spring Stretch	cm	Rod	Independent
Spring Height	cm	Ruler	Dependent

2.2: I am assuming that the angle of the ruler and the camera accurately capture the height of the spring. I am also assuming that we can accurately pull the spring down to the correct notches, and that the spring does not exert its energy in a direction that is not vertical.

III. Perform the Experiment and Graph the Results

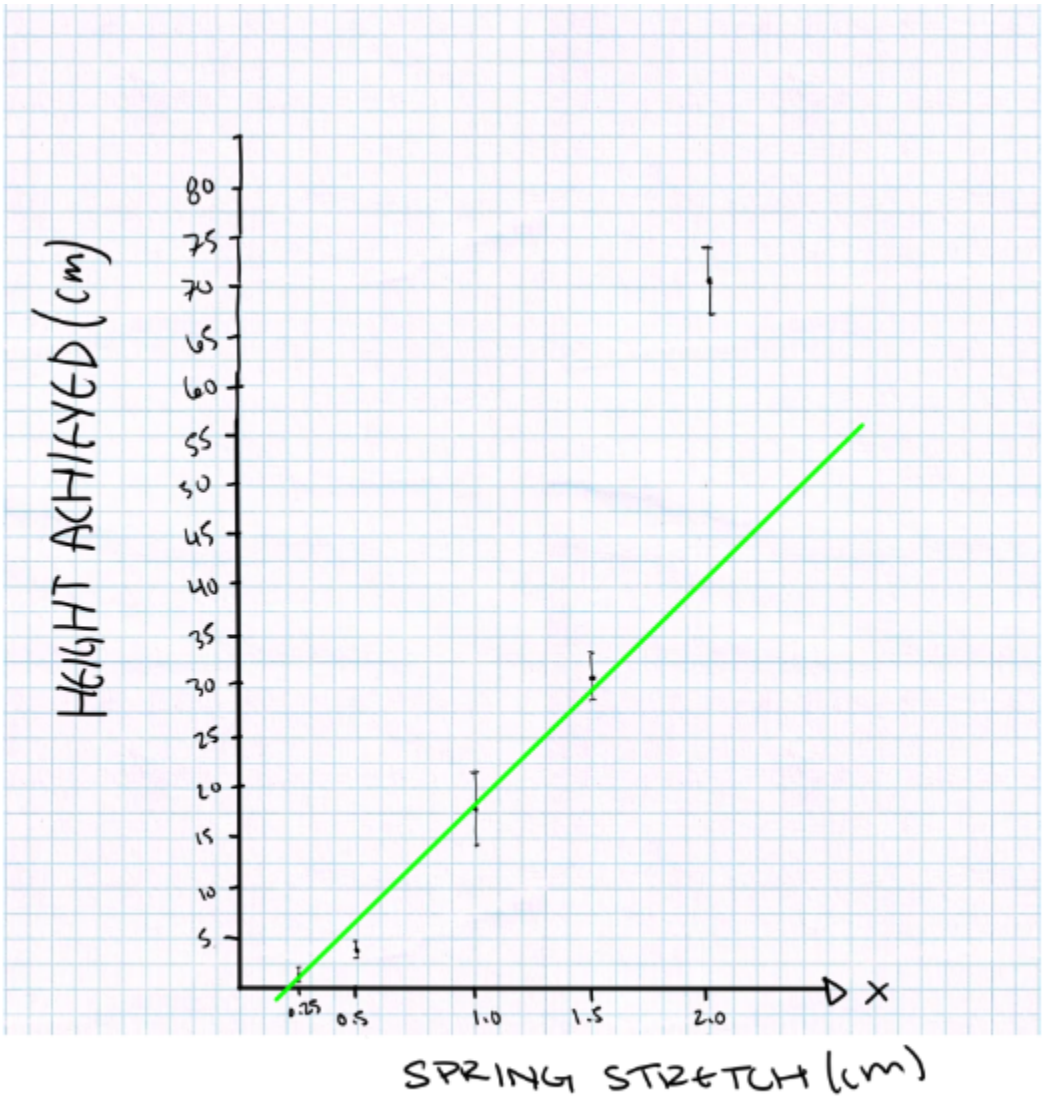
Data Collected:

Spring Stretch	Trial	Y Initial (cm)	Y Max (cm)	Average (cm)	Adjusted to 0 (cm)	Uncertainty (cm)
	1	90	90			
	2	90	90			
0	3	90	90	90	0	0
	1	90	88.5			
	2	90	89			
0.25	2	90	88	88.5	1.5	0.5
	1	90	87			
0.5				86.167	3.833	1.167

	2	90	86.5			
	3	90	85			
	1	90	72.5			
	2	90	76			
1	3	90	68	72.167	17.833	4.167
	1	90	59.5			
	2	90	58			
1.5	3	90	55	57.5	32.5	2.5
	1	90	23			
	2	90	17.5			
2	3	90	17	19.167	70.833	3.83

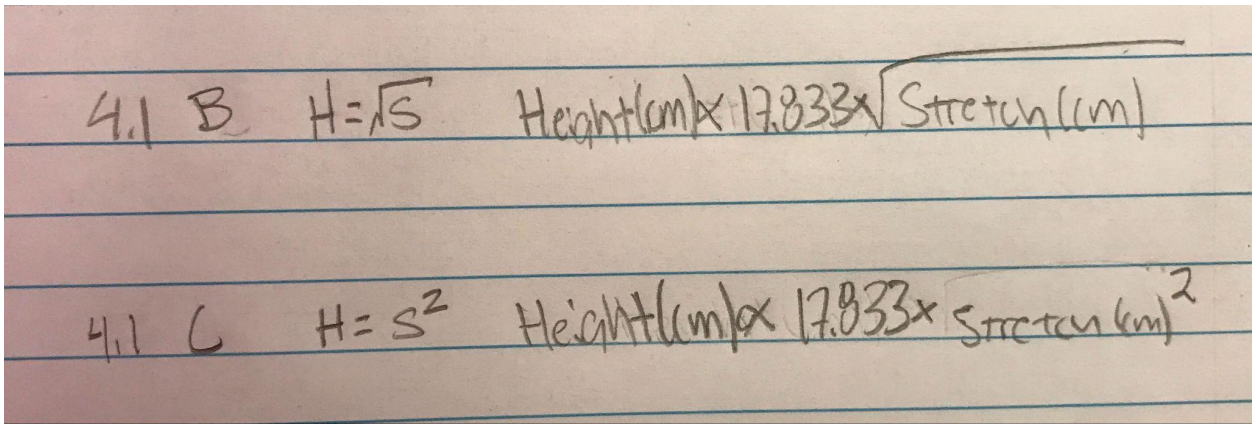
The uncertainty was determined by taking three trials of each spring stretch, calculating their average, then subtracting the largest outlier out of the three data points from the average. For example, for the trials collected for the spring stretch of 1, we calculated: ((72.5cm+76cm+68cm)/3)-68cm = 4.167cm

Graph from the data:



A line of best fit was attempted. However, this line does not pass through at least 2/3rd of the points, therefore it cannot be the line of best fit. Because of this, max and min lines were not attempted, for it would be redundant.

IV. Graph Linearization



Student B's Hypothesis:

Height = 17.833s^-2			
Spring Stretch	Y Initial (cm)	Y Max (cm)	Uncertainty (cm)
0	0	undefined	4.167
0.5	0	71.332	4.167
1	0	17.833	4.167
1.5	0	7.926	4.167
2	0	4.458	4.167

The stretch^-2 was multiplied by 17.833 to be consistent with the equation for student C's hypothesis, explained below.

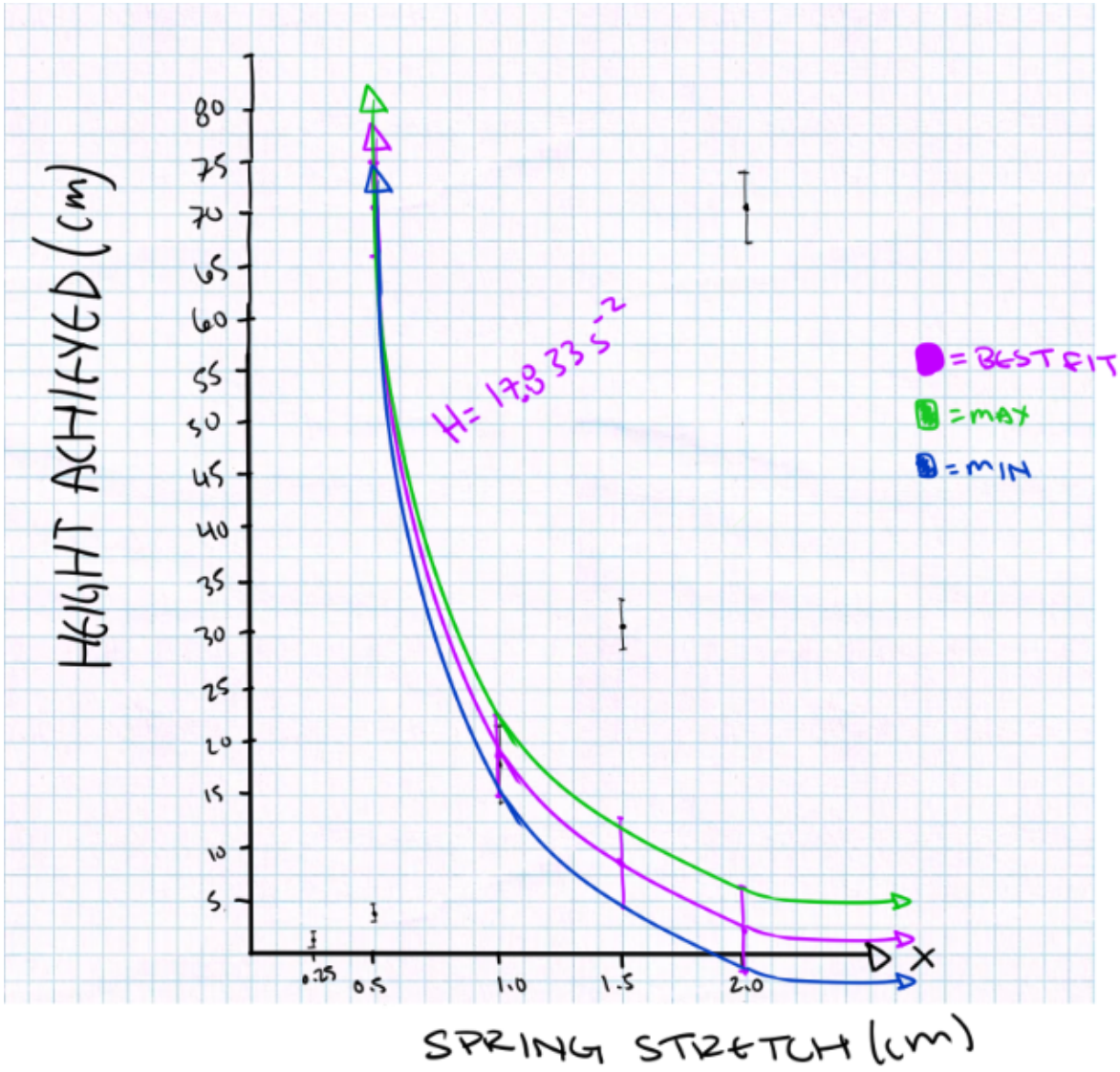
Student C's Hypothesis:

Height = 17.833s^2			
Spring Stretch	Y Initial (cm)	Y Max (cm)	Uncertainty (cm)
0	0	0	4.167
0.5	0	4.458	4.167
1	0	17.833	4.167
1.5	0	40.124	4.167

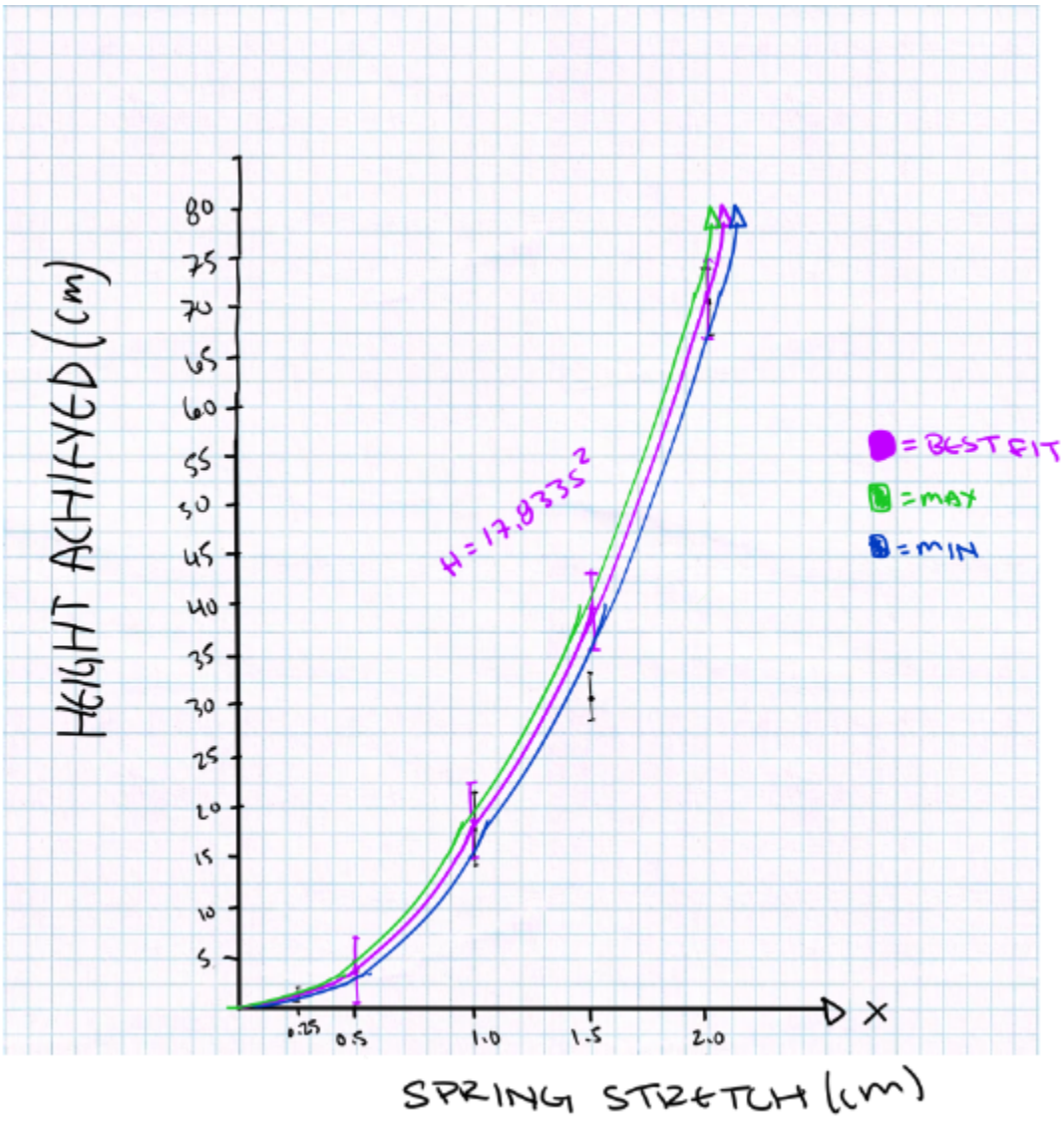
2	0	71.322	4.167

The stretch ^2 was multiplied by 17.833, the height (cm) from the 0.5 (cm) notch in the collected data, because it stretched the equation to align better with the height of the data.

Graph for student B's hypothesis:



Graph for Student C's hypothesis:



H=17.833s^2, student C's hypothesis, fits the collected data well, more so than student B's hypothesis, and more so than a linear line of best fit. This line passes through more than 2/3rds of the points, with the single outlier being fairly close to the line.

V. Homework

Student A's hypothesis was incorrect. The data is not directly proportional, because the data cannot fit within a linear line of best fit. It is, however, proportional to student C's hypothesis, which is exponential.