Lab Report Outline—the Bones of the Story

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TITLE:

How do the variables of mass and height of fall affect maximum displacement of the string?

ABSTRACT:

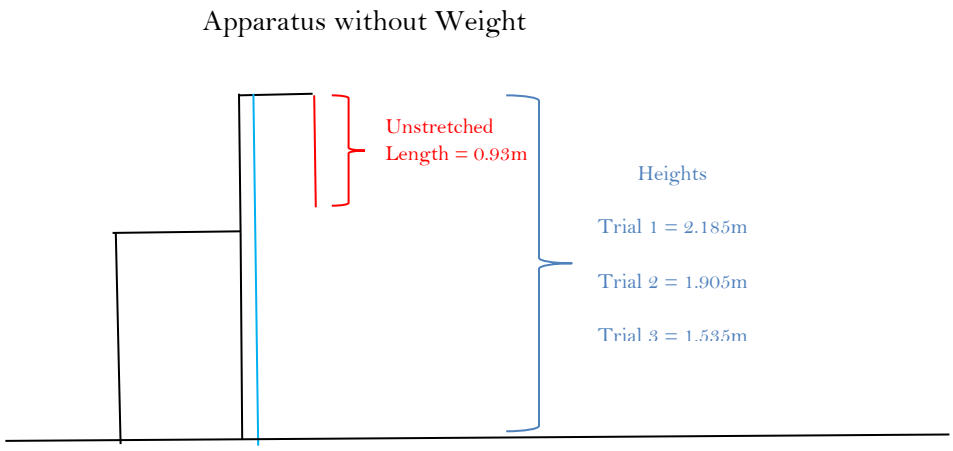
This experiment examined the physical properties, specifically the maximum displacement, of the material that we are going to use for our final bungee challenge. We attempted to examine how mass affects maximum displacement of the string (while keeping unstretched length consistent). We measured the maximum displacement from a different height during three separate trials using a slow-motion camera and a harness system. The system is diagrammed below. Our results provided several equations that relate mass and maximum displacement of the string. We plan to utilize this information in formulating a strategy for the final bungee jump. We strived to keep sources of error to a minimum. In conclusion, we are by and large pleased with our results and the progress made in understanding the string's physical properties, specifically maximum displacement when placed under certain stressors.

INTRODUCTION*:*

The purpose of this lab was to explore the relationship between mass and maximum displacement when a set weight is attached to the string. There are no equations that relate to the setup or purpose of this experiment, however we hope to use the specific data we collect to further our knowledge of the material that comprises the string.
This experiment is rooted in helping to quantify data of the unknowns that will not be given until the day of the bungee drop. We isolated the mass along with the height of the drop as key components that we needed to better understand before dropping. Our expectation is that we will be able to find linear equations that can be scaled up to meet the greater height and weight parameters that we will face on the day of the bungee drop.

METHODS:

Our method involved measuring maximum displacement of the string when a mass is attached to the string and dropped from a certain height. Unstretched length of the string and height from which the weight is dropped are consistent within each trial. Each of the three trials has its own consistent height. We are doing this in order to gain a better understanding of an unknown mass attached to a string comprised of the same material would function.

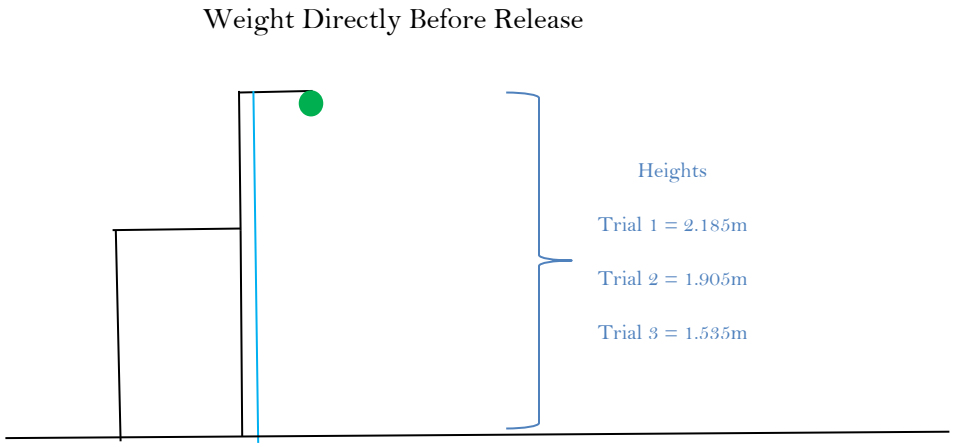


Black- Table, Floor, and hanging apparatus

Red- String

Light Blue- Height Control Apparatus

Figure 1: Experiment Set-Up without weight, including unstretched string



Black- Table, Floor, and hanging apparatus

Red- String

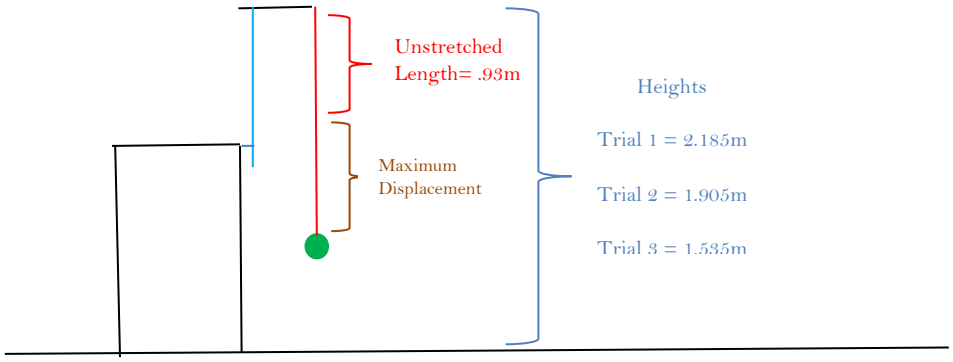
Light Blue- Height Control Apparatus

Green- Weight

*It is important to note that the string is present and attached to the weight.

Figure 2: Experiment set-up with the weight directly before it is dropped

String at Maximum Displacement



Black- Table, Floor, and hanging apparatus

Red- String

Light Blue- Height Control Apparatus

Green- Weight

Figure 3: Experiment set-up after release of the weight with the string is at its maximum displacement

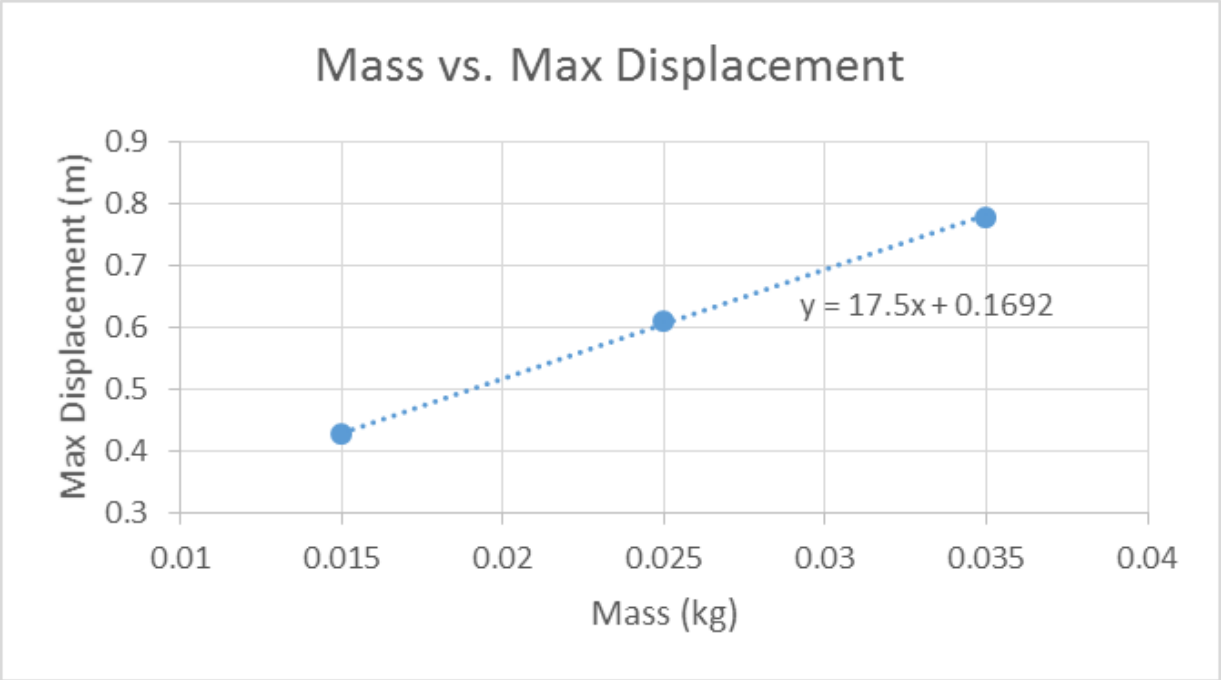
We set up the apparatus as indicated in Figure 1, using different heights for each trial. Between each trials we adjusted the height using the "Height Control Apparatus", which is simply a winch that was attached to the table along with a rod that allowed for the raising and lower of the hanging apparatus. We then attached the weight to the string and raised up the weight to the top of the apparatus, but no further (Figure 2). We lined up the top of the weight with the top of the apparatus. Then we released the weight from its maximum height, allowing it to fall to its maximum displacement (Figure 3). We then captured the motion of the string/weight with a slow-motion camera , using a tape measure in order to determine how far the weight fell. We again used the top of the weight as our reference point for measurement.

RESULTS:

The data collected consists of measurements of the maximum displacement of the weight, along with drop height, mass and unstretched length. We analyzed and graphed the relationship between mass and maximum displacement from all three trials.

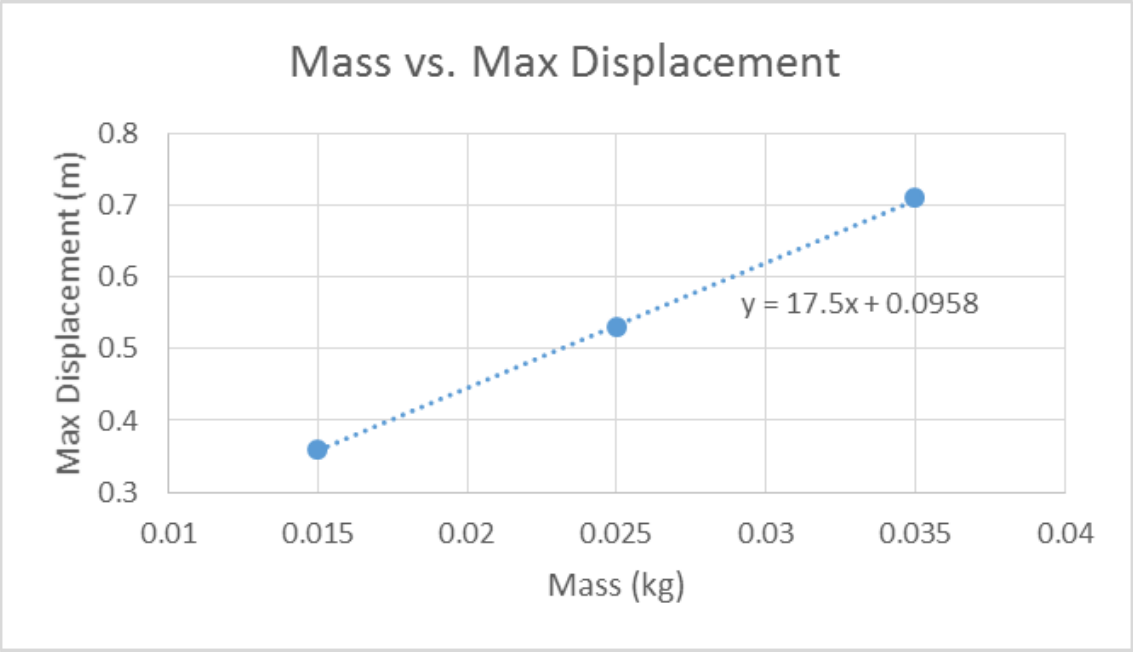
Trial #1

Height (m)	Unstretched Length (m)	Mass(kg)	Max Displacement (m)
2.185	0.93	0.015	0.43
2.185	0.93	0.025	0.61
2.185	0.93	0.035	0.78



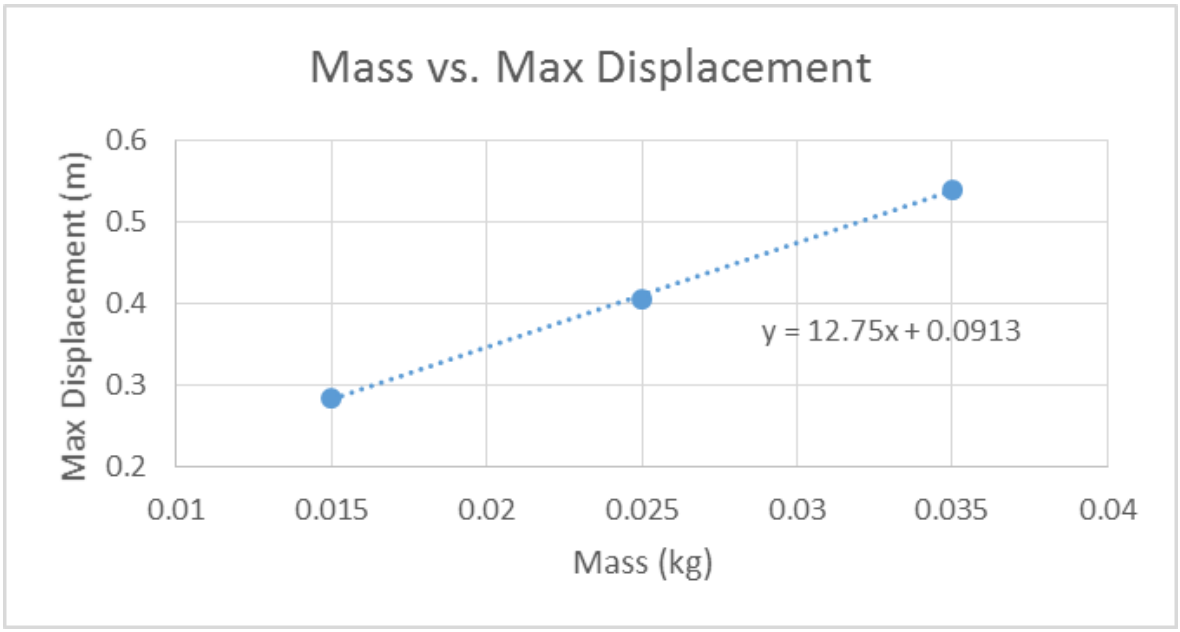
Trial #2

Height (m)	Unstretched Length (m)	Mass (kg)	Max Displacement (m)
1.905	0.93	0.015	0.36
1.905	0.93	0.025	0.53
1.905	0.93	0.035	0.71



Trial #3

Height (m)	Unstretched Length (m)	Mass (kg)	Max Displacement (m)
1.535	0.93	0.015	0.285
1.535	0.93	0.025	0.405
1.535	0.93	0.035	0.54



Equations:

Trial #1 y=17.5x + 0.1692
Trial #2 y=17.5x + 0.0958
Trial #3 y=12.75x + 0.0913

Trial #1

uncertainty for slope= .289 % uncert= 1.65 %

uncertainty for y-intercept= .008 % uncert= 4.73%

Trial #2

uncertainty for slope= .289 % uncert= 1.65%

uncertainty for y-intercept= .008 % uncert= 8.35%

Trial #3

uncertainty for slope= .433 % uncert= 3.40%

uncertainty for y-intercept= .011 % uncert= 12.05%

Other Uncertainty:

- Measurement of Max Displacement: ± 0.005 m

Our experimental value of interest is the slope measurements from all three equations.

Trial #1: 17.5
Trial #2: 17.5
Trial #3: 12.8

Uncertainty of experimental value(s) = .289 % uncert= 1.65%

Uncertainty of experimental value(s) = .289 % uncert= 1.65%

Uncertainty of experimental value(s) = .433 % uncert= 1.65%

We used regression analysis in order to determine uncertainty. The important results here is the slope of the equations from all three trials. Using these equations we hope to be able to scale our equations to the potential mass of the egg along with the potential height of the egg.

DISCUSSION:

We are not able to quantitatively compare our experimental data with any accepted values. However, we find our results to be acceptable considering the consistency with which we were able to measure maximum displacement. Our percent uncertainties for the slope values were 3.40% or less, which we deemed acceptable. A test for our "error" would include retesting these trials at greater heights and with greater weights in order to positively determine if our equations hold when scaled up.

Sources of Uncertainty

- The string's K-value may have been permanently altered when stretched to great degree during initial, pre-trial testing of the string

Our results support our expectations that through analysis of the relationship between mass and maximum displacement, we will gain insight into how the material that comprises the string functions when stretched to a certain height. A cause for concern exists in that Trial #3 produced a significantly different slope value. However, we deem our results acceptable due to the low percent uncertainty values derived from the trials.

CONCLUSION:

Using data regarding the relationship between fall height, weight, and maximum displacement, we were able to formulate valuable equations that will assist us in constructing our final bungee jump model. Our next step is to take the data from all three trials, and scale these equations to larger masses and larger drop heights, assisting in the final calculations that we will use for predicting the fall of the egg/harness system during the bungee drop.

On my honor, I have neither given nor received any unacknowledged aid on this assignment.

Pledged: Tyler Murphy