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TITLE: Measuring Stretch of Bungee Cord by a Dropped Mass

ABSTRACT:

In our experiment, we attempted to find a relationship between the length of cord and its stretch caused by a falling mass attached to it. To do this, we attached a 49.9 g mass to a bungee cord of various lengths and dropped the mass from a height of 2.10 m, recording the drop with a slow motion camera to see the extent of the stretch. We did this ten times for three different lengths of cord, averaging the ten drops for each length to get an average total stretch. For original cord lengths of .305 m, .580 m, and 1.070 m, we recorded average stretch length of .438 m, .848 m, and 1.577 m respectively. We then plotted the stretch length vs. original length and obtained the equation y = 1.469x. This means, by our equation, the total stretched length of the cord will be 1.469 times the original length.

INTRODUCTION:

The relationship between the total stretch of the cord and the original length of the cord was explored. Hooke's law, F = -kx, is related to this experiment, but it was not directly explored in our experiment. K is the spring constant, specific to each spring (or cord in our situation), and x is the displacement from the equilibrium. In our experiment, we use the original length of the cord as our x, and the slope of the graph as our k to find the stretch length.
We expected that as the cord got longer, the stretch length from the drop would increase.

METHODS:

We varied the length of the cord three times and dropped a 49.9 g mass from a height of 2.10 m to acquire an equation that relates the stretch length to the original length.

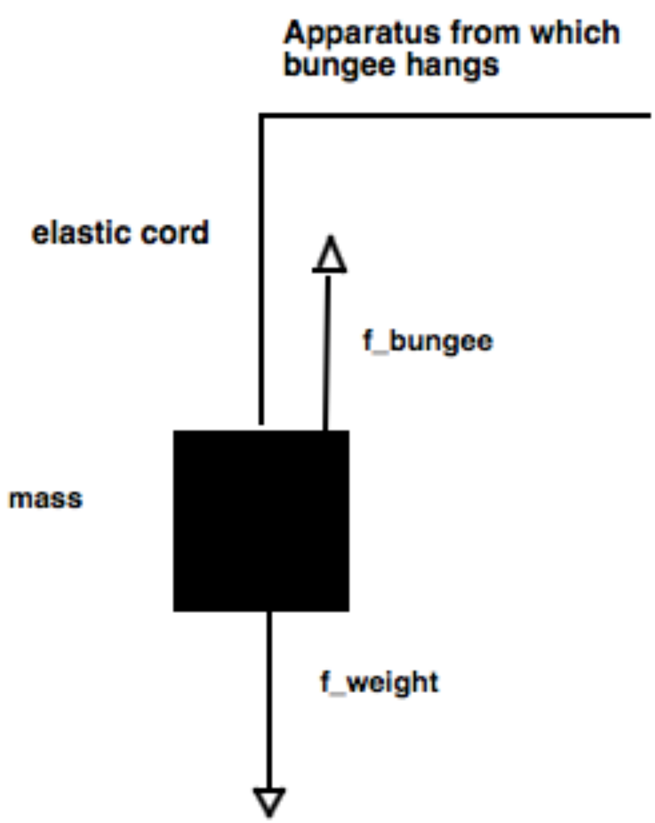

Figure 1: Setup Diagram

- Used three different cord lengths: .305 m, .580 m, and 1.070 m
- Dropped mass of 49.9 g from height of 2.10 m ten times
- Recorded each drop with slow motion camera
- From slow motion footage, recorded total stretch length of cord
- Averaged the ten drops to get average stretch length for each original length

RESULTS:

Introduce the Results section in a sentence or so, to give the reader context—data collected, and how it is analyzed to get the relevant result: We collected thirty total data points over the three lengths and averaged each trial. We then graphed the average stretch lengths vs. the original cord length.

Original length (m)	Stretch Length (m)
0.305	0.438
0.58	0.848
1.07	1.577

Figure 2: Length of bungee cord and average stretch for each length. For each length there were ten drops, and we took the average of the ten drops.

Graph, if applicable, inserted from *Excel*, **formatted and labeled according to "Formalities"** document, and with ***curve-fit*** (also known as "trendline" in *Excel,* this could be a linear or non-linear fit):

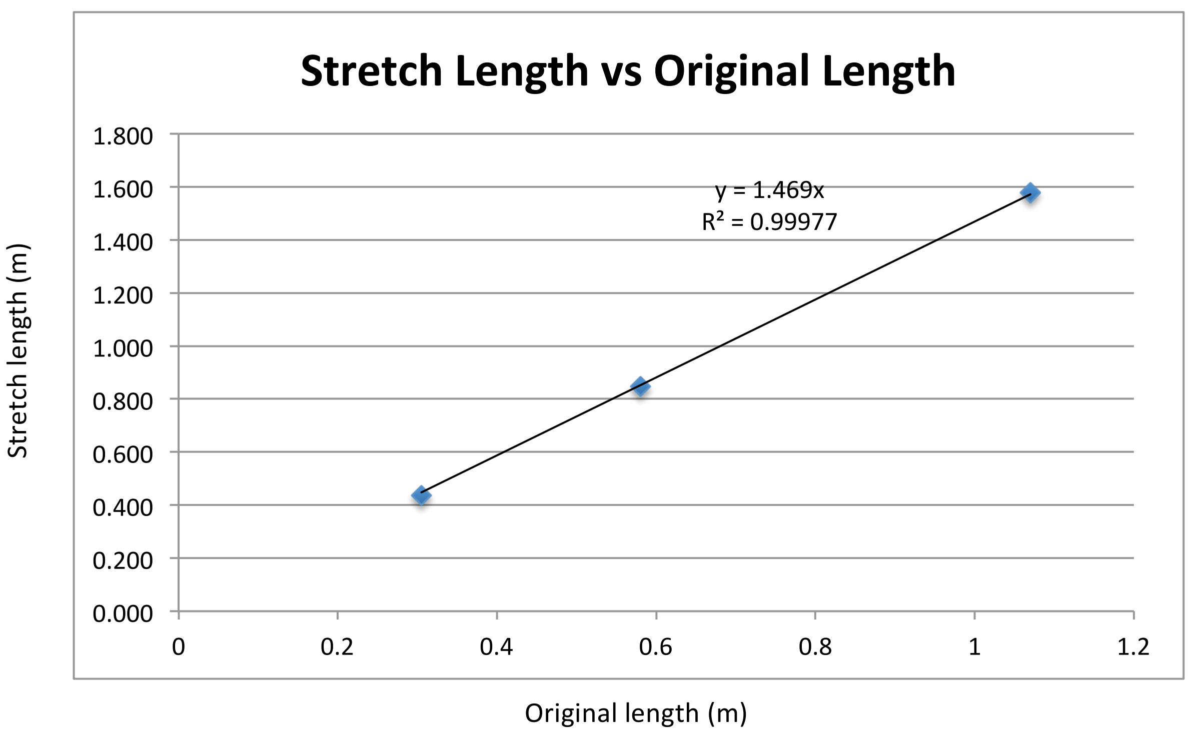

Figure 3: Stretch Length vs. Original Length Graph: Our stretch variable here is 1.469

As can be seen from the graph, we obtained a linear equation of y = 1.469x, which will allow us to determine the amount of total stretch the cord will have when stretched by a falling object. Our value of interest here is the coefficient of the x variable, or the "stretch variable", which is 1.469. By Excel's regression analysis, we obtained an uncertainty of .007 for this value, giving us a percent uncertainty of .48%. With this data in hand, we can confidently estimate the total stretch our cord will undergo when stretched by a falling mass.

DISCUSSION:

There is no accepted value for what we have done here, so we cannot compare it to anything. Our uncertainty and percent uncertainty for our "stretch variable", however, make us very confident in our obtained value since they are so low. We did not have time to test our experimental value, but it would have been quite easy to do so. An easy test would have been to pick a cord length we had not already done, calculate what the stretch would have been according to our model, and then run our experiment with that length of cord to see if it matches our model.

There were multiple sources of uncertainty in our experiment. Two major ones that come to mind are our slow motion camera and our knots holding the masses. Although our slow motion camera was quite reliable, its slow motion view was not perfectly frame-by-frame. Because of this, it is possible that what we saw as our total stretch distance on the camera might not be how far the cord actually stretched. The knot is also a problem because if it was not tied tight enough, it could affect how far the mass falls, and thus affect the total stretch of the bungee cord.

Our results supported our hypothesis. As can be seen from the results, the difference between the total stretch and original length got greater as the original length got longer.

CONCLUSION: *What does this experiment reveal? Step back and look at the experiment's purpose and value, remembering that the only failed experiment is an inconclusive one.*

Clearly and definitively state the experimental outcome(s) in terms of your question or purpose:
We now have a "stretch variable" that relates original length of our bungee cord to the total stretch it undergoes when stretched by a falling object. This stretch variable can help us determine how long a cord will stretch when different lengths of cord are used. Our next step should be to test this relationship for different masses and to drop the mass from different heights. If we can form a relationship between our stretch variable and mass and a relationship between the stretch variable and drop height, it will be much easier to estimate how far our egg will drop in our final bungee challenge.

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

Dominic VOlpe