Bungee Lab 1

Your name and your lab partner(s): Andrew Blair, Teddy Bowie **Section:** 06 **Date: 10/26/16**

TITLE: Does a bungee cord behave similar to a spring according to Hooke's Law?

ABSTRACT: To explore Hooke's law, we compare the functional relationship between force and displacement of the weight and the cord. We are comparing the characteristics of the bungee cord to a similar functioning spring. We set up the cord to measure its displacement to obtain values to find k and how it works with Hooke's law. Measuring each different distance at different weights for each given equilibrium, we find our k value. Even though there is small room for error, the sources of uncertainty could skew the data.

INTRODUCTION*: Gives the purpose and conceptual or theoretical context.*

Using a cord made from rubber, we are able to find its stretch length by adding weight to one end of the cord. Finding the displacement in the Bungee cord at different lengths and with different weights will lead to the k value in the equation of Hooke's law for a spring. Because the cord stretches differently at different lengths, we know that the k value differs for each length of the cord.

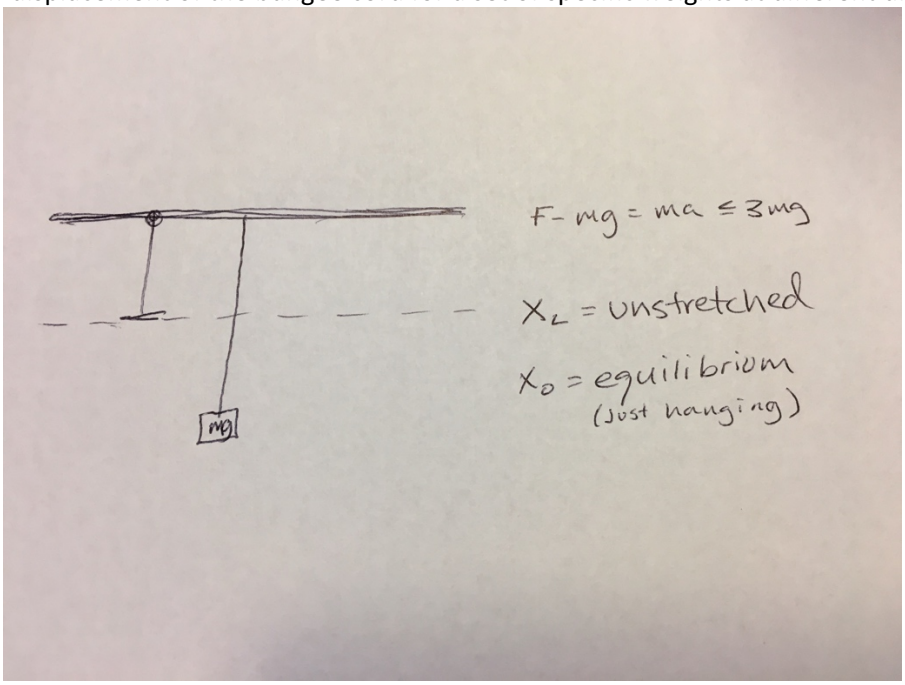
$$F - mg = ma \leq 3mg$$
$$F_{Spring} = -kx\ (\hat{\imath})$$
$$(PE + KE)_{top} = (PE + KE)_{bottom}$$
$$mgh = \frac{1}{2}kx^2$$

The speed of the egg can't exceed 3 times its weight or it will implode.
The second equation is one of Hooke's law for a spring
The CWE theorem is stated for the position of the hanging weight. And is stated directly below in a different form.

At different lengths the bungee cord will act similar to a spring in Hooke's Law.

METHODS:

Measuring the displacement of the bungee cord for a set of specific weights at different distances.



The model acts on one plane and is 1 dimension. The bungee cord hangs from a stationary arm and is pulled down by different amounts of weight.

Describe procedure,

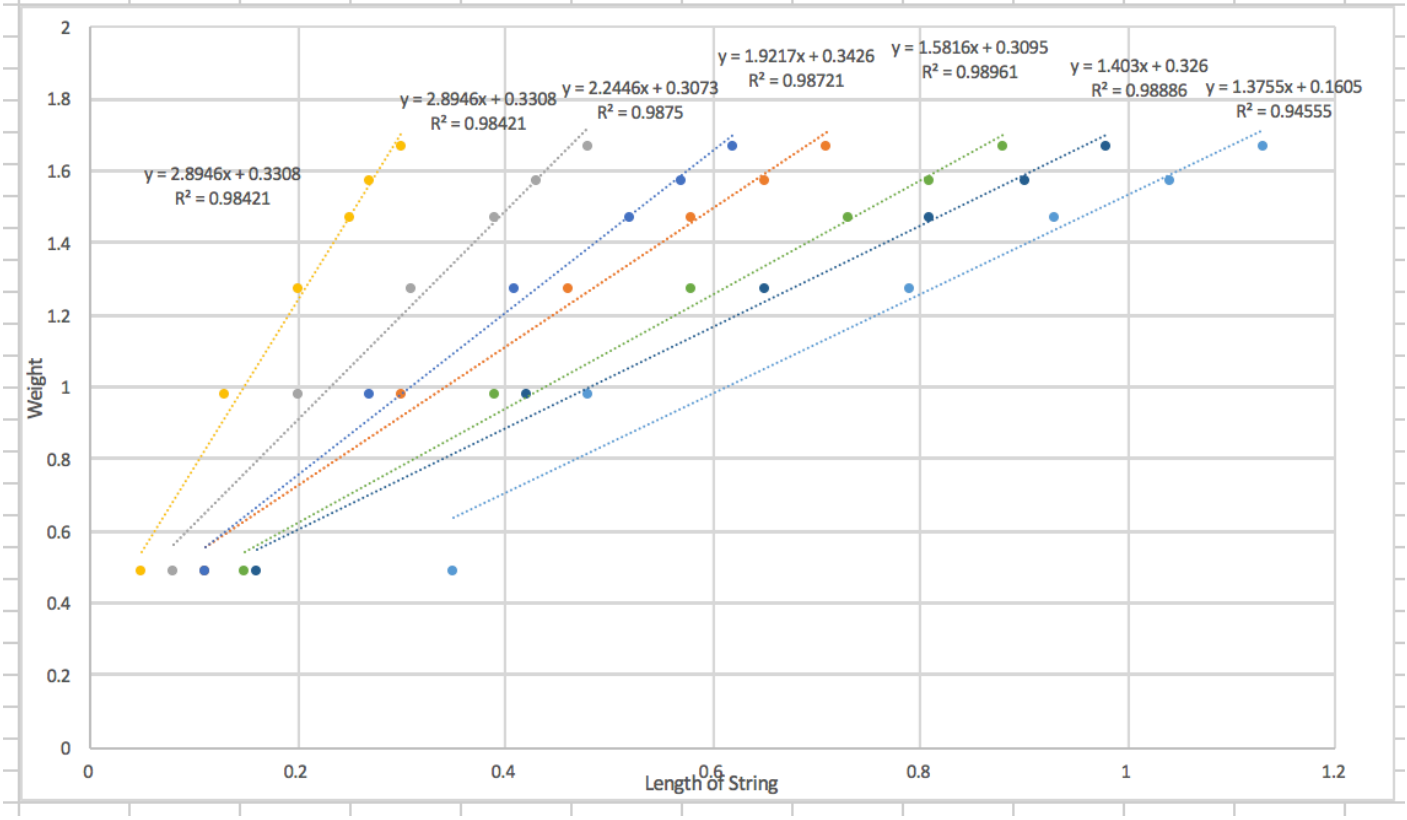
- Tie a loop in one end of the cord. Make sure to not tie too tight because knots weaken the cord.
- Attach the cord to the stationary arm and secure it with the screws at the top.
- Measure the un-stretched length of the cord.
- Add 50g of mass to the loop of the cord and measure the stretched length.
- Continue to add mass and measure the lengths.
- Repeat procedure for different un-stretched lengths, but adding the same weights.

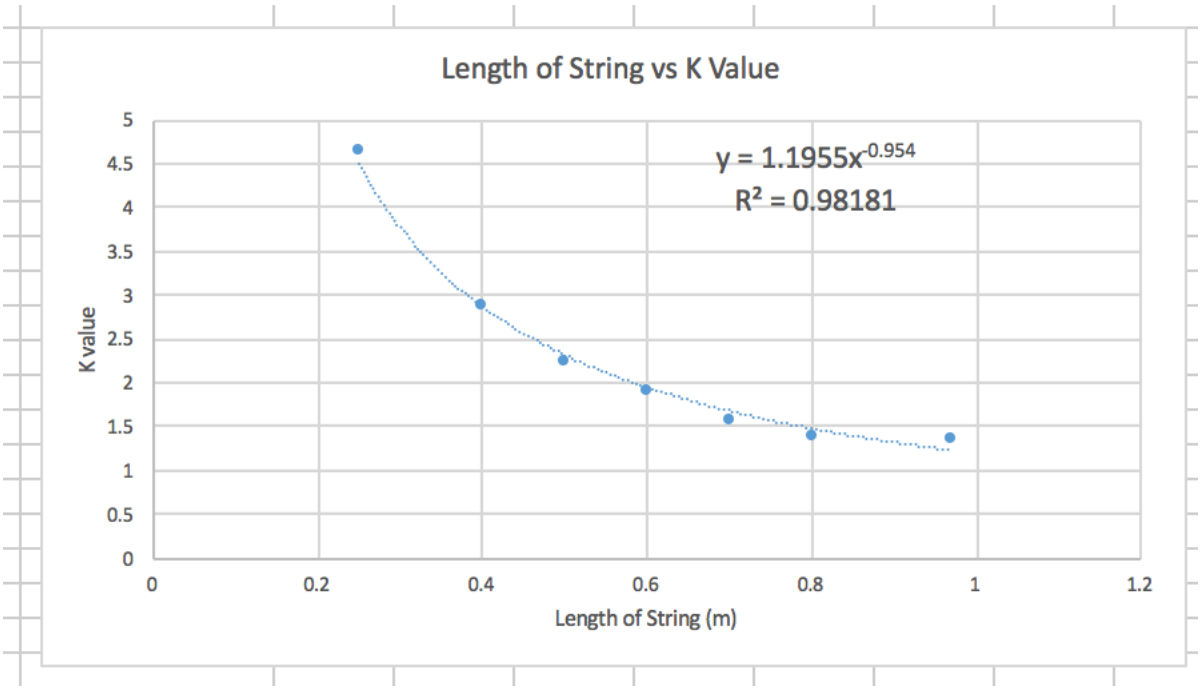
RESULTS:

At different lengths of bungee cord, we get a displacement for each trial of different weight. X_L(1-7) is for the cord's length, X_(1-6) is for the stretched length for the given weights and S_(1-6) is the displacement of the cord.

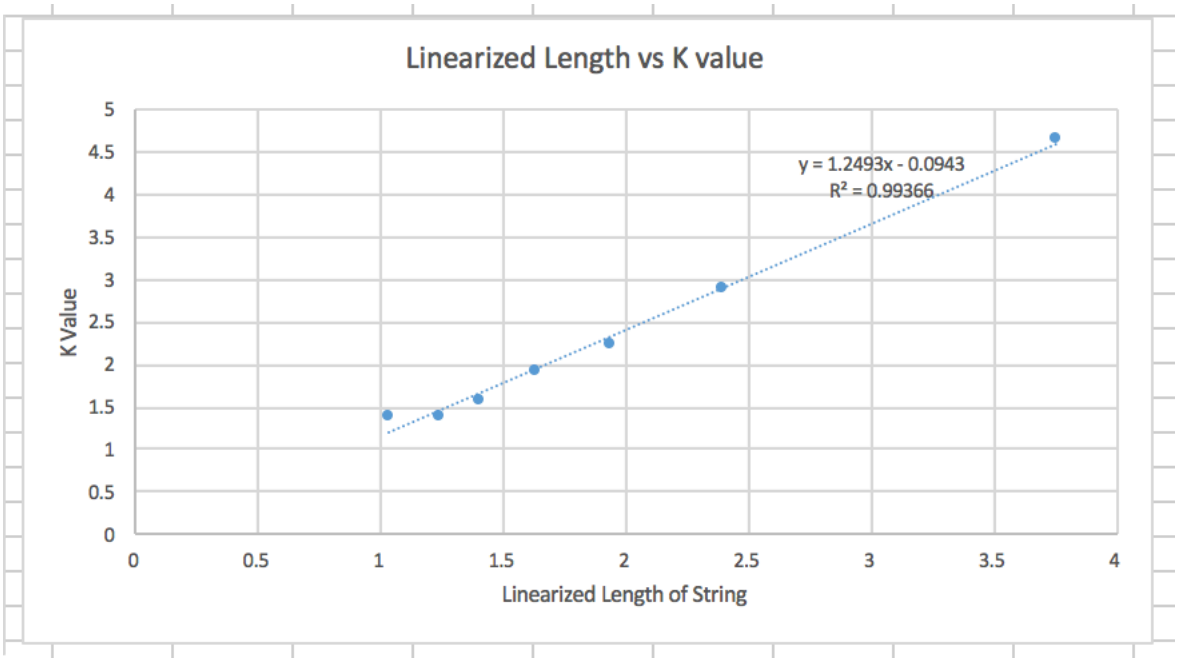
X_L1	X_L2	X_L3	X_L4	X_L5	X_L6	X_L7
0.97	0.6	0.4	0.25	0.5	0.7	0.8

Mass (kg)	Weight (mg)	x_1	x_2	x_3	x_4	x_5	x_6	x_7	S_1	S_2	S_3	S_4	S_5	S_6	S_7
0.05	0.4905	1.32	0.71	0.48	0.3	0.61	0.85	0.96	0.35	0.11	0.08	0.05	0.11	0.15	0.16
0.1	0.981	1.45	0.9	0.6	0.38	0.77	1.09	1.22	0.48	0.3	0.2	0.13	0.27	0.39	0.42
0.13	1.2753	1.76	1.06	0.71	0.45	0.91	1.28	1.45	0.79	0.46	0.31	0.2	0.41	0.58	0.65
0.15	1.4715	1.9	1.18	0.79	0.5	1.02	1.43	1.61	0.93	0.58	0.39	0.25	0.52	0.73	0.81
0.16	1.5696	2.01	1.25	0.83	0.52	1.07	1.51	1.7	1.04	0.65	0.43	0.27	0.57	0.81	0.9
0.17	1.6677	2.1	1.31	0.88	0.55	1.12	1.58	1.78	1.13	0.71	0.48	0.3	0.62	0.88	0.98





$$k = 1.1955m^{-0.954}$$



$$k = 1.2493m - 0.0943$$

uncertainty for slope= 0.044615644 % uncert= 3.57%

uncertainty for y-intercept= 0.09358282 % uncert= 99%

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.99682651
R Square	0.99366308
Adjusted R Sq	0.9923957
Standard Erro	0.10170097
Observations	7

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	8.10926016	8.10926016	784.027017	1.0878E-06
Residual	5	0.05171544	0.01034309		
Total	6	8.1609756			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.0943498	0.09358282	-1.008196	0.35963121	-0.3349121	0.14621247	-0.3349121	0.14621247
X Variable 1	1.24925956	0.04461564	28.0004824	1.0878E-06	1.1345714	1.36394773	1.1345714	1.36394773

Length of String (m)	K value	Linearized Length
0.97	1.375547	1.029484
0.6	1.921734	1.62796
0.4	2.894614	2.396816
0.25	4.642232	3.752885
0.5	2.244632	1.937236
0.7	1.581602	1.405324
0.8	1.402954	1.237235

The experimental value of interest is the slope of K value vs. the linearized length of the cord
value obtained = each k value from the chart above is relevant because at each length there is a different k value

uncertainty of experimental value(s) = 0.044615644 % uncert= 3.57%

By finding the k value for different lengths of the cord we modeled the length in k.

$$k = 1.2493m - 0.0943$$

DISCUSSION:

The weight varying on the cord gives us a k value for the length of a cord.

The only sources of uncertainty would come from the extra stretch from the knot if it stretched differently for the different weights. There could have been an uncertainty in the measurement for each weight.

The results agree with the hypothesis of the experiment. Each length of the cord has its own k value in Hooke's law for a spring.

CONCLUSION: The K value obtained shows that the cord acts similar to a spring. We are able to find out the k value for a designated length with a certain given weight. For the next step we are going to find the adequate amount of cord needed to bungee jump a mass around 170 grams.

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

Pledged: Andrew Blair