Bungee Lab

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Introduction

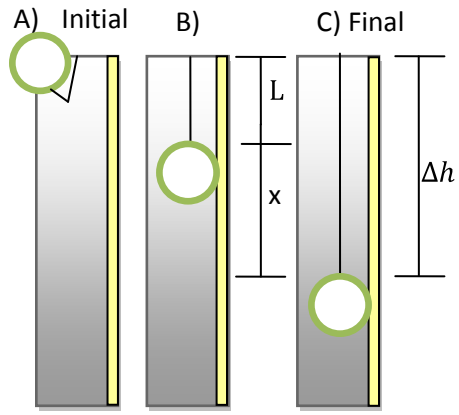
How does the spring constant of a bungee affect the distance that it stretches when dropped?

The group's purpose was to prove the law of Conservation of Energy. The group hypothesized that as the spring constant of the bungee increases, the distance that the bungee stretches decreases. As the length of a spring decreases, the spring constant increases.

Procedure and Materials

Three twelve-inch pieces of 'linguine' were tied together, and then attached to the keychain of a stuffed animal. Additionally, approximately 20g of mass was added using duct tape. A ramp was taped to the wall for use as a ruler. The stuffed animal was held at the top of the ramp, and then dropped (position A). At position B, the linguine began to stretch. At position C, the velocity of the stuffed animal was zero. A camera (30 fps) was used to record each trial for accurate and consistent measurement. The distance from the top of the ramp to the ending point of the stuffed animal was recorded for seven trials of six settings. The spring constant was altered by reducing the length of the linguine. A mark was placed on duct tape at the bottom of the linguine to keep constant recording position and to aid with camera readings.

Diagram



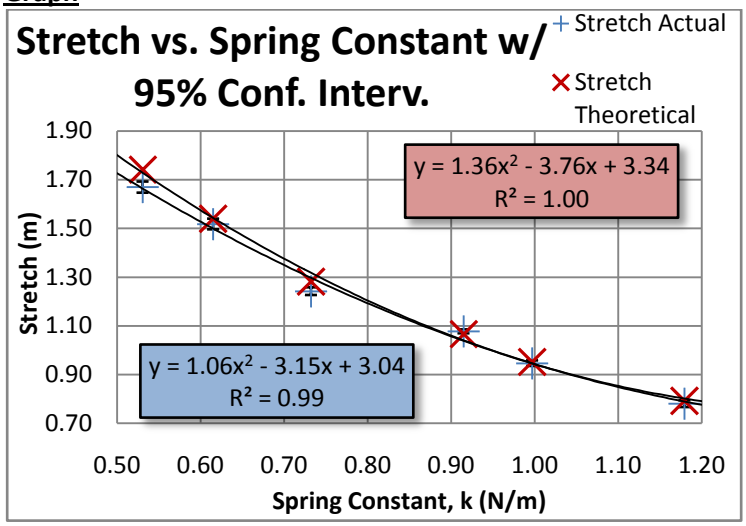
Constants and Equations

m=40.8g=.0408kg	F=-kx
g=9.80m/s^2 Δh=hi-hf	L=un-stretched linguine length
Vi=0m/s	x= stretched linguine length =Δh-L
Vf=0m/s	PEg=mgh, PEs=1⁄2 kx^2
	x=√(2mgΔh⁄k) Derivation in appendix.

Data

k (N/m)	s_{actual} (cm)	stdev of s	95% C.I. of s	PE_g (J)	PE_s (J)	%error of energy
0.53	166.9	3.1	2.3	0.81	0.74	8.2
0.62	151.8	3.0	2.2	0.73	0.71	2.8
0.73	124.2	2.1	1.6	0.60	0.56	6.2
0.91	107.7	1.1	0.8	0.52	0.53	-2.0
1.00	94.6	1.5	1.1	0.45	0.45	1.3
1.18	78.0	1.9	1.4	0.37	0.36	3.0

Graph



Analysis

The slope of the graph cannot produce any worthwhile information. The slope would be expressed as the stretch/spring constant, or x/k. From the appendix, mgΔh=1⁄2 kx^2. Because k and x are directly proportional, the equation cannot be used to describe the equation (Also, k and x are directly proportional in F=-kx. One use for this graph could be finding the force on the stuffed animal by finding the area under the graph. Each trial, approximately .9N of force acted downward on the stuffed animal.

Error for the collected data was calculated. The data is reasonable accurate because the measured stretch lengths came close to the theoretical stretch lengths (within 5%) .The data is very precise because there is a low standard deviation and low confidence interval range. A low standard deviation indicates little dispersion of data points within a setting. The low confidence interval range indicates a precise data set because the produced error range is very small relative to the range of the data set.

The graph cannot be used for extrapolation. If the graph was expanded to the right, the graph would suggest that the stretch length would become larger with increasing spring constant (beyond ~1.7N/m). In addition, the graph would suggest a negative spring constant (the negative sign in Hooke's law indicates a restoring force, k is always positive).

Conclusions

The law of Conservation of Energy was proven in this lab. As the spring constant of the bungee increased, the distance that the bungee stretched decreased. The tightness of the knots on the linguine may have affected the lab. As the knots become tighter, the linguine becomes slightly longer, thus increasing L and decreasing k. The group made test runs to attempt to align the camera, but the angle between the perpendicular and the camera produced Δh values higher or lower than expected depending on the location of the camera.