**All About Springs**

In today’s activity, you will be stretching a spring various distances, measuring the force required to do so, and graphing the force versus the distance of stretch. Then, you will complete two graphical analyses to determine the two important spring-specific equations.

**Procedure:**

1. Stretch the spring five different distances using a spring scale, and collect the data.
2. Graph the force required, in Newton’s, versus the distance stretched, in meters.

**Graphical Analysis, Part 1: Slope**

1. Find the slope of the line.
2. What are the units for this slope?
3. What quantity has these units?
4. Determine the equation, based on the quantities in your slope equation.
5. Solve the equation for force. This is called Hooke’s Law, and is the spring force equation.

**Graphical Analysis, Part 2: Area**

1. Find the area under the curve.
2. What geometric shape does this area most resemble?
3. Find the area under the curve in terms of variables only.
4. Substitute in the equation found in part 1 for force. What is the resulting equation? What else does this equation equal?

**Analysis:**

1. Describe in words what the spring constant tells you about a spring. Include specific reference to other groups’ springs (and their spring constants) in the classroom.
2. In an automobile’s (or train’s) suspension, the wheel assembly is connected to the passanger compartment using several springs. You may even have seen these springs before. Comment on how the spring constant of an auto spring compares to the spring constant you measured today.
3. How did the force required to stretch the spring change as the distance of stretch changed? What does this indicate about the force that springs apply? Does the equation found in part 1 support this?
4. When finding the area under the curve, you multiply the two graphed quantities together. In this case, what were those two quantities?
5. When you found the area under the curve in this scenario, you found an equation you already knew. So, what is happening when a force is applied to a system over some distance?

**In your conclusion:**

* State Hooke’s Law.
* Explain how your data demonstrates Hooke’s Law.
* State the spring constant of your spring with appropriate units and explain how you found it.
* Citing your data, explain why a rubber band cannot be modeled by a simple equation or function.

**Graphical Analysis, Part 3: Rubber band**

1. Determine whether the rubber band you are given obeys Hooke’s law.

**Data/Observations**

1. Record whatever data and graphs you consider necessary in order to determine whether the rubber band obeys Hooke’s law.
2. At a minimum: justify existence or nonexistence of a spring constant, with reference to the spring lab or justify the rubber band’s obedience to Hooke’s law based on a graph. (note that the answer will likely be more complicated than a simple “yes” or “no.”)

**Analysis**

1. Write a very brief account of the experiment for Part 3. The account will consist of two paragraphs.
   1. Paragraph 1: Experiment
      1. Describe what you measured and how you measured it. This should take no more than three or four sentences. It will be useful to include a diagram, but a diagram is not a substitute for a verbal description.
   2. Paragraph 2: Analysis :
      1. State whether the rubber band obeys Hooke’s law and justify your answer with reference to your data. Remember, the answer will likely be more complicated than a simple “yes” or “no.”