Springs and Things

Apparatus

- steel spring (with strings attached)
- Plexiglas tube
- 50 g, 100 g, 200 g, 500 g masses
- rubber hose
- meter stick
- clamps and clamp-stands

Pre-lab Exercise

You must have completed this pre-lab exercise and have the results written in your lab book before arriving at your scheduled lab session. If you have not done so, you will not be allowed to proceed with the lab.

Read over the section of your text which discusses Hooke’s Law. Take this discussion and develop a testable hypothesis about springs. Try to state the hypothesis as simply as possible. It can be a sentence or two, or a single equation, or a combination of words and math. What you are doing here is a central aspect of science: you are taking a theoretical statement about how things ought to work, and distilling it into a hypothesis that you can test in the laboratory. It is very important, therefore, to concentrate on the meaning of what you write down, and to try to simplify the hypothesis down to something you can actually test. (For example, a hypothesis that begins “The atoms in the metal of the spring act to....” is meaningless because we don’t have any lab equipment that will let you actually observe these atoms.) You may find it useful to refer to the apparatus list above which shows what you will have available to you in lab.

It is difficult to design your hypothesis without at the same time designing the experiment to test it. So...if you are working with an equation, think about what each variable means in a physical sense. Think about what kind of data you can obtain on a spring, and how best to display it. A simple table of numbers? A graph?

Write your hypothesis in your lab book. Also write down any thoughts you had while developing it. Next write down the procedure you plan to follow to test this hypothesis in lab.
Finally, read the rest of the manual for this experiment before coming to lab.

**Procedure**

**A. Introduction**  Well, you have already designed a procedure for this lab, but now that you are actually in lab, you may want to revise it. First, familiarize yourself with the collection of apparatus. Pick up the spring and stretch it and compress it. Does your hypothesis make different predictions for stretching versus compressing? How can you test if there is a difference? What problems might you run into? and can you see a way around them?

**B. Measurement**  Take the data that will allow you to test your hypothesis. Write everything in your lab book. Here is what is meant by “everything:” write down the procedure that you use and all the data that you obtain. **DO NOT** wait until you are done and write up a prettified procedure. Write down what you do as you do it!! If you ask any practicing scientist to show you their lab book, what you will find is a detailed diary of what they did written as they were doing it! Treat your own book the same way—as a “real time” journal of what you are doing.

If the procedure you actually follow is different from the procedure you outlined in your pre-lab, that is fine! But you must explain why you found that it was better to do it that way. Write this explanation in your lab book as part of your procedure/diary.

**C. Analysis**  From your data, determine whether the results of the experiment support or contradict you hypothesis. Use tables, or graphs—whatever method you feel will most effectively reveal what is important about the data. Use what you have learned about estimating uncertainty to decide whether the support or contradiction of your hypothesis is strong or weak. Resist the temptation to be mushy or mealy-mouthed. You’re being asked to make a judgment, so look hard at the data, make a judgment about the results, and present the evidence to back up your judgment.

**D. Application**  You were asked to develop and test a hypothesis about a metal spring. But there are lots of other stretchy things. Does the same hypothesis apply to them as well? You can’t test everything in the universe, but you do have a piece of rubber hose as part of your apparatus kit. Play with it for a bit and decide how it is like and unlike the spring. Record your observations and conclusions in your lab book.

Now do an experiment to determine if the rubber hose also supports the hypothesis. Be careful—650 g is probably the most weight you can safely hang from the hose. Carefully report anything unusual or surprising that you observe while taking data.
Analyze your results as you did in part C to determine how well the behavior of the rubber hose supports your original hypothesis. If your results are very different from the predictions of your hypothesis, explain why.

**E. Some Questions** Write answers to the following questions in your lab book.

1. Is a rubber hose the same as a steel spring? What are the important differences between them? What are the important similarities?

2. In your experiments on the spring, what happened in lab that you did not anticipate when first devising your procedure?

3. If you were to describe your data on the rubber hose in terms of a spring “constant,” would it be actually constant? If not, what would it depend on, and in what way?

4. Describe anything unusual or surprising you noticed while taking data on the rubber hose. Did it complicate your measurements? How did you cope with this complication? Can you explain this behavior?