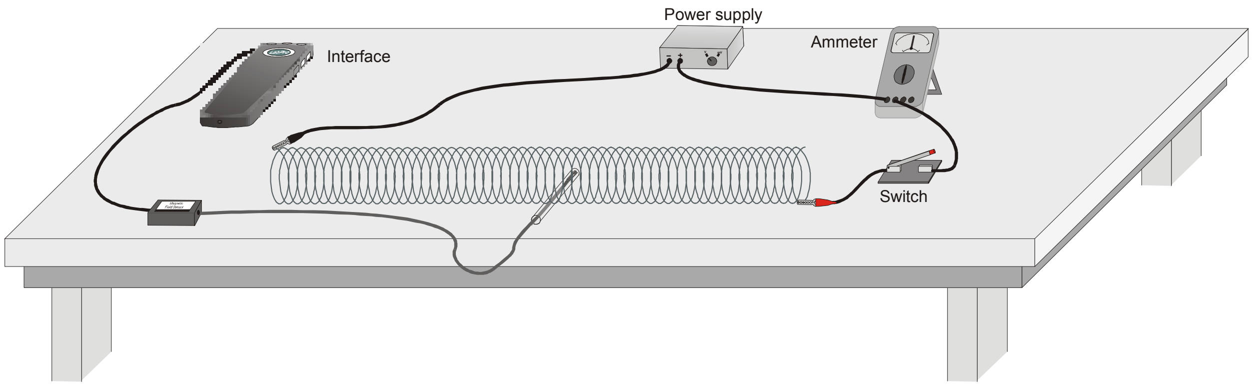
Name:_________________________

Slinky Lab Handout (for Vernier Sensors)

Initial Setup:



1. Connect the Vernier Magnetic Field Sensor to Channel 1 of the interface. Set the switch on the sensor to *High (*0.3 mT).
2. Stretch the Slinky until it is about 1 m long. The distance between the coils should be about 1 cm. Use a non-conducting material (tape, cardboard, etc.) to hold the Slinky at this length.
3. Set up the circuit and equipment as shown in Figure 1. Wires with clips on the end should be used to connect to the Slinky. If your power supply has an accurate internal ammeter you do not need an additional external ammeter.
4. Turn on the power supply and adjust it so that the ammeter reads 2.0 A when the switch is held closed. **Note:** This lab requires fairly large currents to flow through the wires and Slinky. Only close the switch so the current flows when you are taking a measurement. The Slinky, wires, and possibly the power supply may get hot if left on continuously.
5. Open the file "Magnetic Field in Slinky" in the *Physics with Vernier* folder. A graph will appear on the screen. The meter displays magnetic field in millitesla, mT. The meter is a live display of the magnetic field intensity.

Initial Thoughts:

1. Hold the switch closed. The current should be 2.0 A. Place the Magnetic Field Sensor between the turns of the Slinky near its center. Rotate the sensor and determine which direction gives the largest magnetic field reading. What direction is the white dot on the sensor pointing?
2. What happens if you rotate the white dot to point the opposite way? What happens if you rotate the white dot so it points perpendicular to the axis of the solenoid?
3. Stick the Magnetic Field Sensor through different locations along the Slinky to explore how the field varies along the length. Always orient the sensor to read the maximum magnetic field at that point along the Slinky. How does the magnetic field inside the solenoid seem to vary along its length?
4. Check the magnetic field intensity just outside the solenoid.

Hall Probe and Solenoid Usage:

1. Adjust the power supply so that the current will be 1.5 A when the switch is closed.
2. With the Magnetic Field Sensor in position, but no current flowing, click Zero to zero the sensor and remove readings due to the Earth's magnetic field and any magnetism in the metal of the Slinky. Since the Slinky is made of an iron alloy, it can be magnetized itself. Moving the Slinky around can cause a change in the field, even if no current is flowing. This means you will need to zero the reading each time you move or adjust the Slinky.
3. Click Collect to begin data collection. Close and hold the switch for about 10 seconds during the data collection. As before, leave the switch closed only during actual data collection.
4. View the field *vs.* time graph and determine where the current was flowing in the wire. Select this region on the graph by dragging over it. Find the average field while the current was on by clicking on the Statistics button. Count the number of turns of the Slinky and measure its length. If you have any unstretched part of the Slinky at the ends, do not count it for either the turns or the length. Record the length of the Slinky and the average field in the data table.
5. Repeat Steps 1 – 4 after changing the length of the Slinky various different lengths. Each time, zero the Magnetic Field Sensor with the current off. Make sure that the current remains at 1.5 A each time you turn it on.

Your Job:
Your lab group must design and execute an experiment to answer the following questions. Your experiment should record the field produced by the current for various lengths of the slinky. You should be careful to remember to use your knowledge of error analysis and reporting.

1. What is the shape of the graph relating turns per unit length of the solenoid (slinky) to the magnetic field produced by the current? Find an equation that fits the data for this graph. Should the equation produce a curve that passes through the origin? Explain.
2. What is the physical meaning of the coefficient(s) in your model? Do they make sense? Why?
3. What is the value of μ_0 (the permeability of free space) according to your experiment?
4. Does the current through the slinky have anything to do with the slope of your graph? For example, if you increased the current to 3 Amps, how would your expect the new data to compare to your original graph?
5. How is this related to an MRI machine?
6. What have you learned during this experiment about creating a safe environment around an MRI machine?

The Report:
Your report should begin with a clearly stated procedure. A reader should be able to recreate your experiment by following the steps listed. You do not need to spell out how to use the computer or hall probe. Turn in all your graphs and data by pasting directly from Excel into Word. Be sure to answer all of the questions in paragraph form.