**E3: Batteries in Series**

**Materials:**
three batteries, three battery holders, 1 bulb, 1 bulb holder, a telegraph switch, wires with banana plugs at the ends

**Initial definitions and givens:**
**Series:** wired so that all the current must flow through one path only. Wired so there are no “forks in the road”.

**Initial Instructions and questions:**
1. Examine the battery holder, bulb holder, and switch. What did you learn in E2 that is relevant here?
2. Wire a circuit with 1 battery, a bulb, and a switch in series. Test it.
3. Add another battery in series. Test it.
4. Add yet another battery in series. Test it.
5. How does the number of batteries affect the current in the circuit? How do you tell if the current is increasing or decreasing?
6. Are there any other things we notice about batteries in series in a circuit?

**Guide to notes in your lab manual:**

1. **What do you predict the outcome will be? Why?**
2. **Make copious notes on exactly what you did and the outcome.**
3. **Can you construct a set of rules that describe this outcome and that could be used to predict the outcome if you tried a different configuration of batteries?**
4. **Did you or your fellow students have any misconceptions about this activity? Specifically, what evidence refuted this misconception?**
5. **Can you adapt one of the models we have discussed, or propose a new model that could be used to describe this circuit.**
6. **What “physics” did you learn from this activity?**
7. **Does this experiment give you any new insights into the results of E1?**
8. **Make a list of points you need to clarify. Discuss how you could address them experimentally.**