  Investigation 20

Conservation of Charge

Imagine you are canoeing down a river. Downstream you notice a large island. As you approach, it is not entirely clear which side of the island the river current will carry you. What do you experience/observe about the river as you approach and pass by the island?

Preliminary Observations

Observe the following electricity demonstrations:

* A single light bulb connected to a battery, then additional lights added in series
* A single light bulb connected to a battery, then additional light bulbs added in parallel

Your task is to design an experiment that focuses collecting data to develop a model that explains the nature of current in circuits. Your model should be valid for series circuits, parallel circuits and combinations of the two.

Your initial investigation will be made using the circuit in Figure 1:

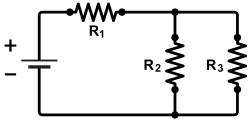


Figure 1

Procedure

1. Discuss and decide what variables you will consider in the process of constructing a model for describing the current flow in a circuit.
   * Consider any knowledge you have gained from previous coursework.
   * Conduct research as needed.
2. Develop a purpose and a procedure for your investigation.
   * Your purpose should ask a question or propose a model related to the nature and properties of current in simple circuits.
   * Include an explanation of the equipment you will use.
   * Decide how much data and what observations to take in order to have enough information to satisfy your purpose and stand up to questioning by your peers.
3. Carry out the investigation and record your data and observations. Make sure all group members have access to the data.

Analysis

Evaluate your data and develop a model based on this data to explain the phenomena you have observed. The model should allow you to predict the amount of current through any portion of a circuit consisting of resistors in series and parallel.

Use your model to explain the demonstrations conducted during the Preliminary Observations.

Construct a new circuit that contains both series and parallel elements. Predict the values of the current through each component. Measure the current through each component to verify your model. If your prediction does not match your measured values, revisit your model and adjust it as necessary.

Extensions

1. Compare the time required to deplete a battery when applied to a circuit in series and in parallel. Explain this in the context of conservation of charge and other observations in this investigation.
2. Starting with two bulbs in series with a battery, place an additional wire so that each end is in contact with the terminals of one of the bulbs. Describe your observations terms of current flow and explain in terms of your model. Is this a “short circuit” or an “open circuit”? Explain.
3. Research fuses and circuit breakers to provide a comparison of these two safety mechanisms and explain how that relates to the phenomena noted in the circuit in Extensions 1 and 2.