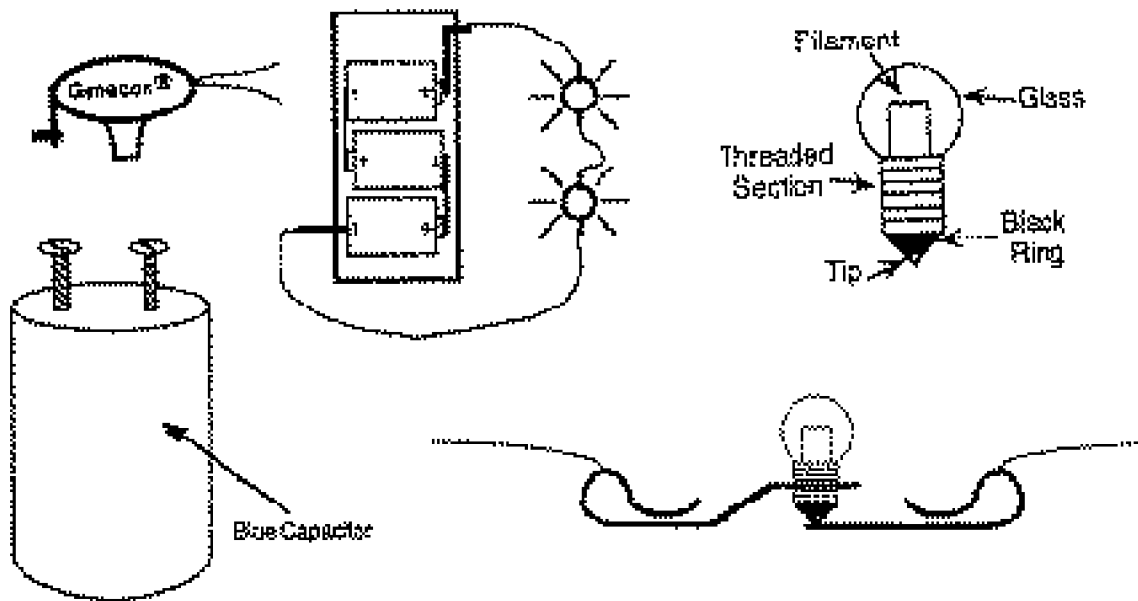


Object: To develop a mental model of how electricity flows by doing inquiry-based experiments.

Introduction: Electricity is usually invisible. The Capacitor-Aided System for Teaching and Learning Electricity (CASTLE) is a system to help students visualize the concepts. It utilizes batteries, wires, bulbs, compasses, and (of course) capacitors, some of which are pictured below.



Equipment: Each group of two students will need:

- 1 CASTLE Curriculum Guide in 3-ring binder (do not write in them)
- 1 battery holder (black)
- 3 D-cell batteries (yellow)
- 1 compass (green box)
- 1 bundle of ten wires
- 4 light bulb holders (red)
- 2 long light bulbs
- 2 round light bulbs
- 1 25000  $\mu\text{F}$  capacitor (blue)
- 1 100000  $\mu\text{F}$  capacitor (silver)
- 1 1 F capacitor (green)
- 1 Genecon (light blue)
- 1 stopwatch

Procedure and Results: Copies of the CASTLE Curriculum – Student Guide are provided for your use during this lab. Please do not write on them; instead record your answers on your own paper, as usual (to be attached to this one). Strive to make your write-up communicate in the neatest and clearest way possible. Diagrams are good. Include conclusions.

Pair up with a (*i.e.* one) partner with about as much previous electrical experience as you have. If you are both novices try to do sections 1.1, 1.2, 1.7, 1.8, 2.1, 2.2, 2.4, 2.5, 2.7, 3.1, 3.2, 3.3, 3.6, 3.8, 3.9, 3.14, 4.1. If you both have some prior electrical experience then hunt around in the Student Guide and find sections that are more appropriate to your level (otherwise you'll feel you are wasting your time). Regardless of your level of electrical expertise, please tailor this lab to create a suitable educational experience for yourself.

Hints and Tips:

1. Disconnect circuits when not actually making observations so that the bulbs and batteries will last longer.
2. Unless instructed otherwise, you should not connect a single bulb across a 3-battery system (4.5 V) since the bulbs are rated for 2.0 V.
3. Don't crank the Genecon too quickly or you will burn out the bulbs (it can generate 6.0 V and the bulbs are rated for 2.0 V).