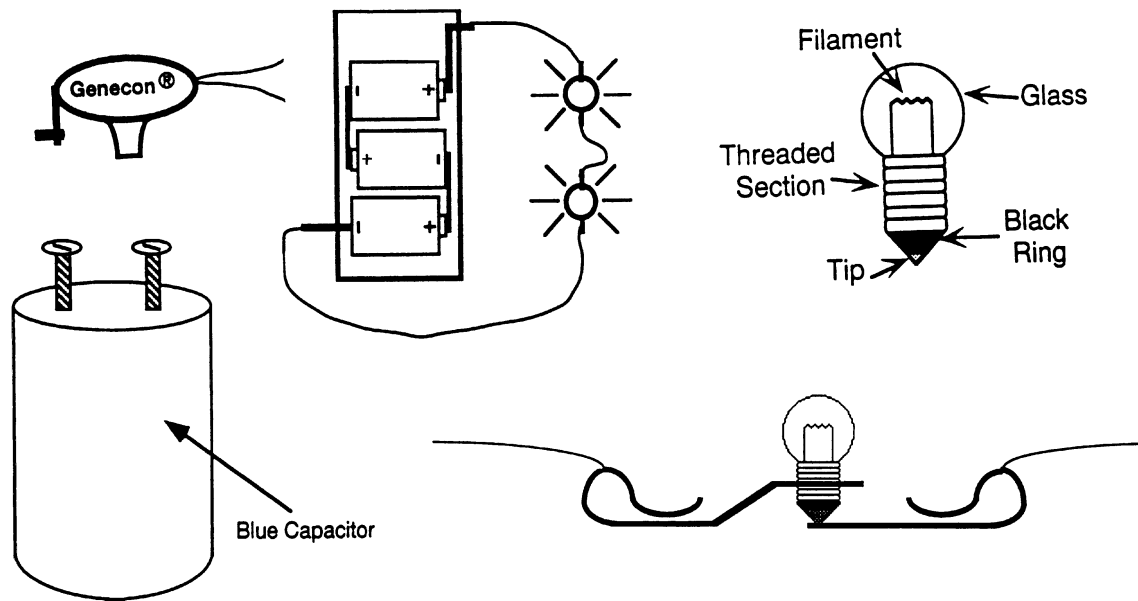


Object: To develop a mental model of electricity by doing inquiry-based experiments.

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 the lab copies)
- 1 battery holder (black)
- 3 D-cell batteries (lime green)
- 1 compass (green box)
- 1 bundle of ten wires (various colors)
- 4 light bulb holders (red)
- 2 long light bulbs
- 2 round light bulbs
- 2 10Ω resistors
- 1 $25000\mu\text{F}$ capacitor (blue)
- 1 $100000\mu\text{F}$ capacitor (silver)
- 1 1 F capacitor (green)
- 1 Genecon (translucent blue)
- 1 stopwatch

Procedure and Results: The procedures to follow are described in the CASTLE Curriculum Student Manual. You may either print the pages of the Manual you need and bring them to class with you, or borrow one of the copies kept in the lab as a classroom set.

If you print out your own copy of the pages before lab you will save yourself the trouble of hand-writing the questions and narrating your procedures, and you can simply write the answers in the space provided. It is available at <<http://www.pasco.com/castle>> (click on the Experiments tab) as a 2.8 MB zipped .pdf file. You will only need Part 1, and even then you could print only the pages that pertain to the sections listed below.

If you borrow a copy from the lab, it is for your use during the lab period; please do not take it with you and please do not write in it, instead record your procedures and results on your own paper (to be attached to this one). Strive to make your write-up communicate in the neatest and clearest way possible. Diagrams are good.

Whether you print your own copy or use a lab copy and write your answers on notebook paper, have a nice conclusion section.

Pair up with a (*i.e.*, one) fellow classmate who has about the same amount of prior electrical experience as you do. This makes a lab group of *two* (you and one partner). As a partnership, do the following sections from the Student Manual (and read as many of the other sections as you have time for): 1.1–1.11, 2.1–2.6, 2.8, 2.9, 2.12, 2.13, 3.1–3.8, 3.11–3.13, 4.1, 4.4, 4.6, 4.8–4.10.

Hints and Tips:

1. Forget everything you know—or think you know—about electricity. (Research indicates that students gain most from this experiential model-building approach if they start fresh.)
2. Do not use technical terms until you've defined them through observation and analysis.
3. Answer all questions, discuss ideas, verbalize predictions, and collaborate in investigations with your lab partner.
4. Disconnect circuits when not actually making observations so that the bulbs and batteries will last longer.
5. 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.
6. 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). Being too vigorous with the Genecon can also strip the gears in it.