

# CPO Electricity Lab

## Safety Tips:

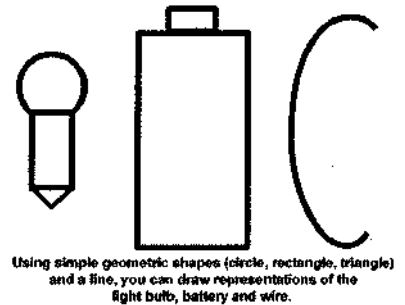
Be careful working with batteries. If they are damaged or broken, return them immediately to your teacher. If a battery or wire gets hot, disconnect the circuit and ask your teacher for help.

Always have a bulb somewhere in your circuit. Do not connect a wire directly from one terminal of a battery to the other terminal or you will make a short circuit.

## 1. What is a Circuit?

Using only one battery, one bulb, and one wire, find four different ways you can arrange these three parts that will make the bulb light up.

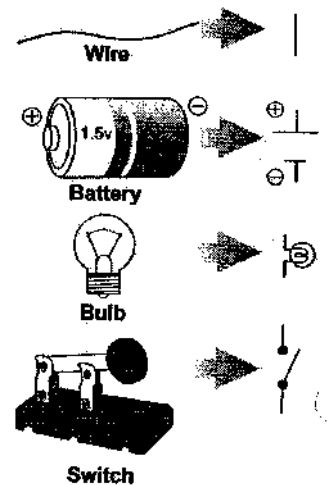
- Record all your circuit attempts on your student sheet by drawing each circuit (even the ones that do not work.). Use these simple drawings to design your circuits. Make sure you show the difference between the two ends of the battery.
- Explain why you think some configurations work and others don't. (record your first thoughts and impressions – don't worry if your answers are right or wrong.)



## 2. Using the electricity grid

Build one of the circuits you made in part 1, except you will now use the electricity grid. The grid contains battery holders and light bulb holders, which makes building circuits a lot easier. Your completed circuit should include: one base board, one battery and battery holder, one bulb and bulb holder, two wire connectors. The bulb should light up in the completed circuit.

- Practice drawing the *electric symbols* for each item by drawing each at least 3 times each.
- Using these electric symbols, draw a picture of the circuit you built on the electricity grid. (this is called a *circuit diagram* or *schematic*)



## 3. Observing how a switch works

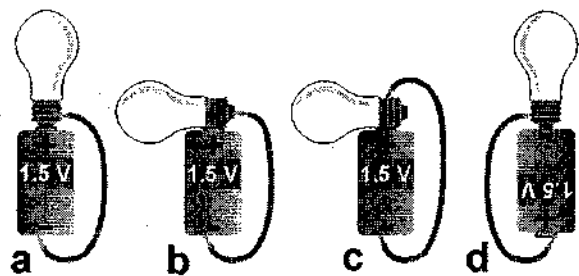
Add a switch to your circuit. You may need one more wire connector. Check that the switch turns the light bulb on and off. Examine the switch as it turns the light bulb on and off.

- Describe how a switch turns a circuit on and off (use both words and drawings)
- Draw a circuit diagram of the circuit with the switch added.
- Move the switch to a different place in the circuit design. Explain why it does or does not matter where in the circuit the switch is placed. (do not worry if the explanation is "right" or "wrong")

## 4. Questions so far

Answer the following questions:

- The word "circuit" comes from the same root as the word "circle." Describe the similarities between a circle and the circuits that you built.
- A circuit that is on and working is sometimes called a "closed circuit." Based on your observations of the switch, explain what "closed" means in a circuit.
- A circuit that is off or a circuit that is not working is sometimes called an "open circuit." Based on your observations of the switch, explain what "open" means in a circuit.
- Why do people use electrical symbols and circuit diagrams to describe a circuit?
- Draw each of the following circuits as circuit diagrams (using symbols) tell whether the circuit will light the bulb or will not light the bulb. If the circuit will not light the bulb, explain what you would do to close the circuit so the bulb will light.

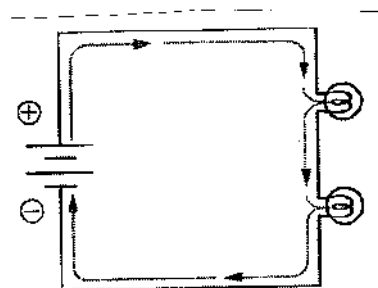


f. Use electrical symbols to draw a circuit that has two batteries, a bulb and a switch.

### 5. Building a series circuit

Gather the following materials: Two batteries with holders, two bulbs with holders, and six connectors. Build the circuit pictured.

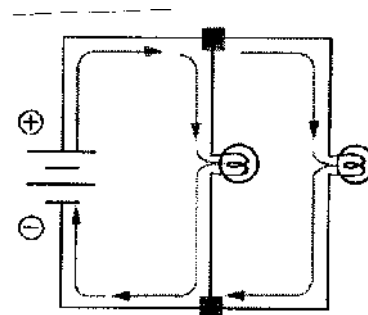
- Draw the schematic (circuit diagram) on your student sheet.
- With a pencil, trace the circuit path from positive terminal to the negative terminal. Does the current have any choice about where to go? Explain.
- Describe the brightness of the two bulbs.



### 6. Building a parallel circuit

Build the circuit pictured at right. The circuit “branches” at the square dots. If you are not sure how to build this circuit, ask your teacher for help.

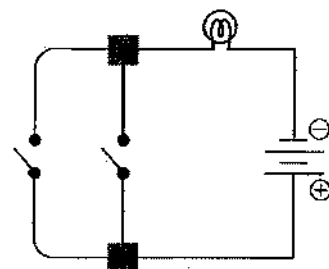
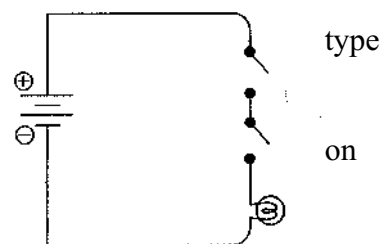
- Draw the schematic (circuit diagram) on your student sheet.
- With a pencil, trace the circuit path from positive terminal to the negative terminal. Does the current have any choice about where to go? Explain.
- Describe the brightness of the two bulbs.
- Compare the brightness of the bulbs in each kind of circuit. Why do you think they are different?



### 7. Building an AND / OR circuit

Many circuits include multiple switches that are arranged in both series and parallel combinations. If two switches are arranged in series, then both switches must be on for the circuit to work. This type of arrangement is called an AND circuit. If two switches are arranged in parallel, then only one switch needs to be on for the circuit to work. This of arrangement is called an OR circuit.

- Gather the following additional materials: two switches and one connector and build the circuit pictured at right. Draw the circuit your student sheet.
- Place a label next to each switch (both on the board and on your drawing). Label one #1 and the other #2
- Try all combination of switches: both on, both off, #1 on and #2 off, and #2 on and #1 off. Record what happens to the bulb in each case. (use a data table)
- Is this a series or a parallel circuit? Explain.
- Is this an AND or an OR circuit? Explain.
- Build the circuit pictured at right. Draw the circuit on your student sheet.
- Place a label next to each switch (both on the board

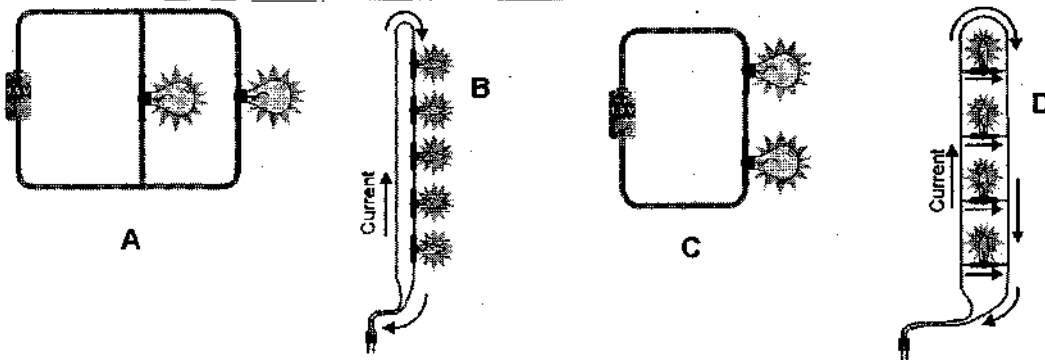


- and on your drawing). Label one #1 and the other #2
- Try all combination of switches: both on, both off, #1 on and #2 off, and #2 on and #1 off. Record what happens to the bulb in each case. (use a data table)
  - Is this a series or a parallel circuit? Explain.
  - Is this an AND or an OR circuit? Explain
- A car will sound a warning bell if you open the door while the lights are on. Is this circuit and AND circuit or an OR circuit? Explain your reasoning.
  - Your household wiring is a parallel circuit, with each appliance or device on a separate branch of the circuit. With your group, discuss the possible advantages of using parallel circuits for a home. You can experiment with your parallel circuit to help you answer this question. Write a paragraph summarizing the points you discussed with your group.

## 8. Questions

Answer the following questions on your student sheet:

- Identify each of the following circuits as series or parallel.



- Many people use strings of lights to decorate their homes at holiday times. Inexpensive versions of the lights are wired in series, while the better ones are wired in parallel. If one of the bulbs in the string of lights burns out, what happens to the other bulbs? Tell what would happen in each string, the inexpensive and the better one.
- Using what you learned in the Investigation, predict which of the following will be true about the circuit at right. (think carefully! There may be more than one correct answer)

- Bulb a is brighter than bulbs b or c.
- Bulb a is dimmer than bulbs b or c.
- Bulbs b and c are equally bright.
- Bulbs a, b, and c, are equally bright.

- A burglar alarm system has switches at each door and window. If a door or window is opened, the switch opens a circuit. Draw a circuit that uses one battery and one light bulb to check five doors and windows. The bulb should go out if any of the five doors or windows is opened.
- In the Investigation, you learned that a car has a warning bell that turns on if the door is opened when the lights are on or the key is in the ignition. A single circuit with three switches and a bell can be built to ring in both cases. One switch is attached to the door, one to the ignition, and one to the headlights. Figure out how to construct a circuit that would make the bell ring at the right times. Draw your circuit on your student sheet using the correct symbols for each element.

