

Electricity and Circuits

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| Strand | Electricity and Magnetism |
| Topic | Investigating electrical circuits |
| Primary SOL | PS.11 The student will investigate and understand basic principles of electricity and magnetism. Key concepts include a) static electricity, current electricity, and circuits. |
| Related SOL | PS.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which a) chemicals and equipment are used safely; j) valid conclusions are made after analyzing data; m) models and simulations are constructed and used to illustrate and explain phenomena. PS.11 The student will investigate and understand basic principles of electricity and magnetism. Key concepts include d) conductors, semiconductors, and insulators. |

Background Information

Electric current is the uniform flow of electrons through a conductor. *Conductors*, such as metals, have outer-level electrons that are able to move more freely. *Insulators*, such as glass, plastic, and wood, have electrons that are more tightly bound with less freedom to move. A *semiconductor*, such as silicon, has more conductivity than an insulator, yet less than a conductor. Semiconductors are often found in solar cells, telephones, and electronics.

There are two basic circuit configurations—series and parallel. *Series circuits* connect all components end-to-end, allowing electron charges to flow along a single path. *Parallel circuits* connect components across each other's leads, creating several paths for electron flow. A string of holiday lights that cut off entirely when only one bulb burns out is an example of a series circuit. However, the main household lighting uses a parallel circuit—as one bulb burns out, the rest remain lit because the electricity can alternate to a new path.

Resistance is a property of matter that affects the flow of electricity. Resistance is the opposition to the flow of electrons. Some substances have more resistance than others.

Static electricity is electricity that does not flow in a current. Static electricity is generated by rubbing two nonmagnetic objects together. The friction between the two objects generates attraction because the substance with an excess of electrons transfers them to the positively-charged substance. The electric field formed from the excess of charges then causes the electric effects of attraction, repulsion, or a spark (i.e., lightning).

Previous lessons would have covered the basic principles and building simple circuits, including step-by-step procedures on how to build examples of each type of circuit.

Materials

- Circuit kits containing the following:

- Wires
- Battery
- Light bulb with socket base
- Switch
- Resistor
- “Circuits” handout (attached)

Vocabulary

conductor, current electricity, insulator, parallel circuit, semiconductor, series circuit, static electricity

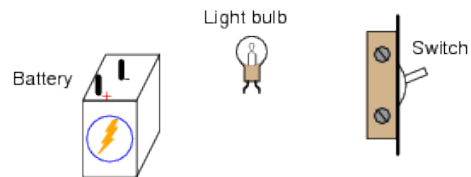
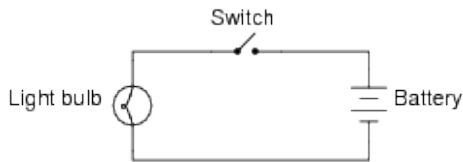
Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

1. Discuss current electricity with students. Identify the items in the circuit kits and discuss conductors and insulators.
2. Have students identify examples of conductors and insulators from the circuit kit.
3. Review series and parallel circuits. Lead students to identify similarities and differences between series and parallel circuits.
4. Review the schematic drawing symbols for battery, resistor, switch, and light bulb.
5. Distribute copies of the attached “Circuits” handout, and have students complete it.

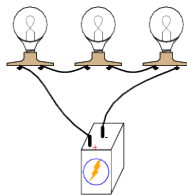
Assessment

• Questions

- Examine the diagram below on the left, then replicate the circuit by adding wires to the components shown below on the right.

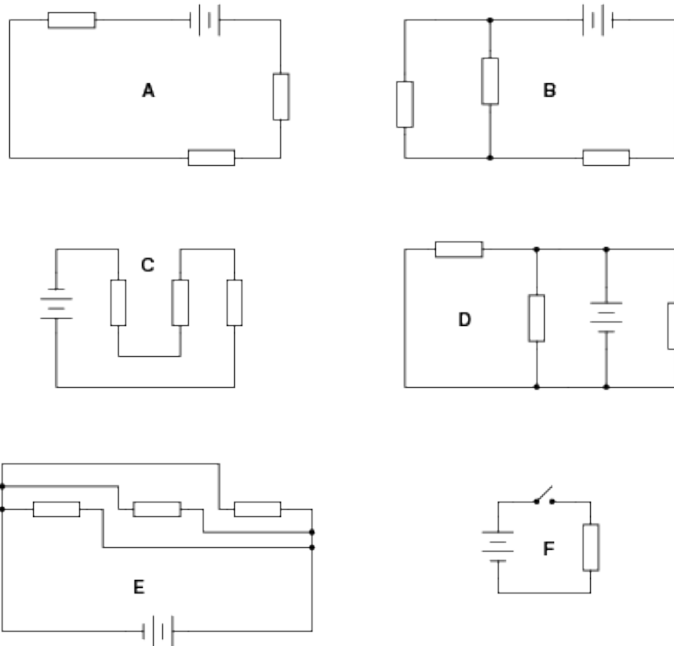


- Is the above circuit opened or closed? What does that mean?
- How would the circuit below be affected if you took out one light bulb?



- How would you compare and contrast series and parallel circuits?

- Identify the type of each circuit below:



- What are five examples of both conductors and insulators?

Extensions and Connections (for all students)

- Static electricity is a discharge of electrons rather than a flow of electrons in an electric current. Give students various materials (e.g., balloons, wool fabric, cardboard tubes, carpet samples, plastic rods) and tell them to try to create a static discharge. Draw a diagram representing their experience. Help students relate this activity to a lightning strike, and then ask them to draw a diagram to represent the static discharge produced by lightning.

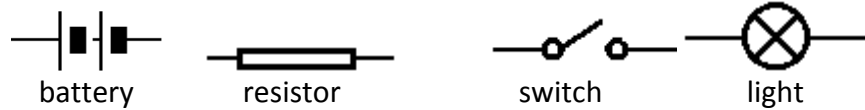
Strategies for Differentiation

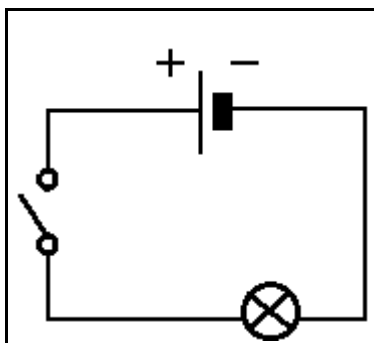
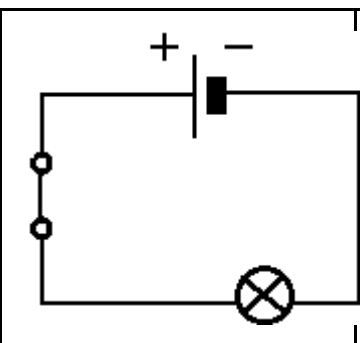
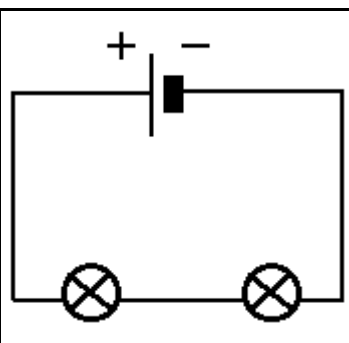
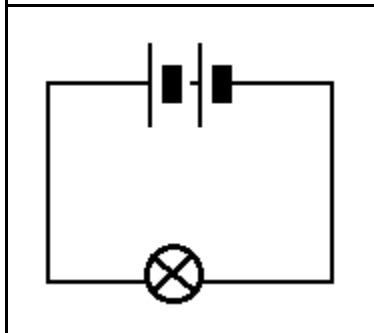
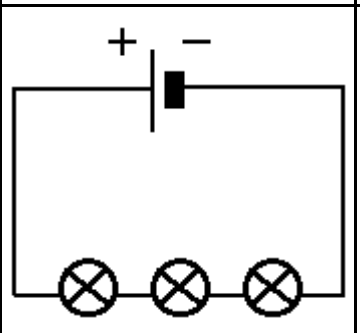
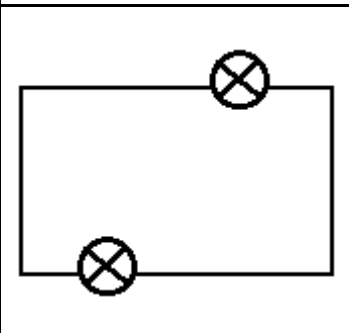
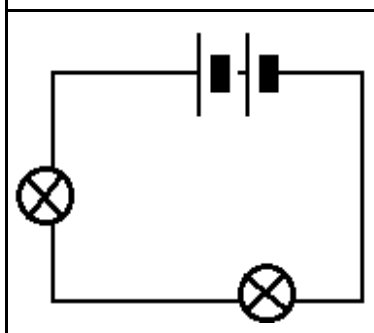
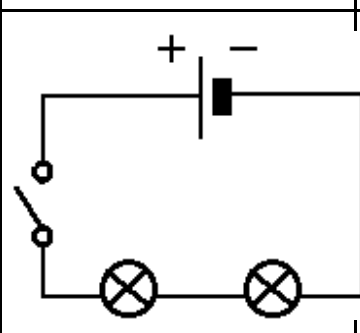
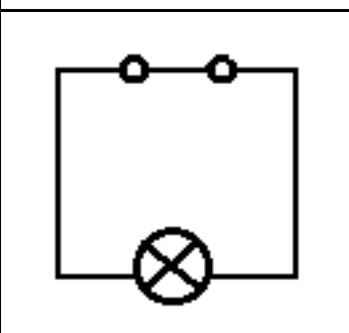
- Provide (or create with the class) a step-by-step troubleshooting guide to help students identify the potential problems in a given circuit.
- Require students to have their data reviewed by a teacher after every three diagrams. Reduce the amount of assigned circuits as necessary, based on the students' progress.
- Compare and contrast series and parallel circuits by creating a visual representation of each circuit for the assessment.
- Have students review the schematic drawings of the circuits that did not light up and predict possible solutions to correct the circuit. Allow them to retest their predictions and draw a corrected schematic for each.

Circuits

Refer to the diagrams shown below.

1. In Box A, predict whether or not each circuit will light up.
2. Use the circuit kits to build each circuit.
3. In Box B, record the actual result.
4. Compare your predictions to your results.



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|---|-------|---|-------|---|-------|
|  | Box B |  | Box B |  | Box B |
| Box A | Box B | Box A | Box B | Box A | Box B |
|  | Box B |  | Box B |  | Box B |
| Box A | Box B | Box A | Box B | Box A | Box B |
|  | Box B |  | Box B |  | Box B |
| Box A | Box B | Box A | Box B | Box A | Box B |