

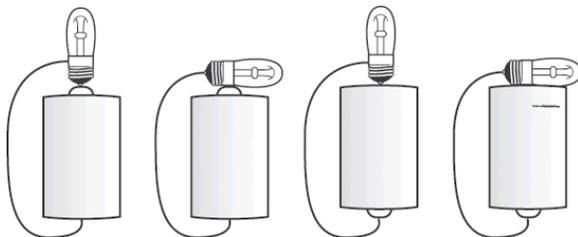
Electrical Circuits Student Activity Book Answer Key

Page 3 – 4 Getting Started

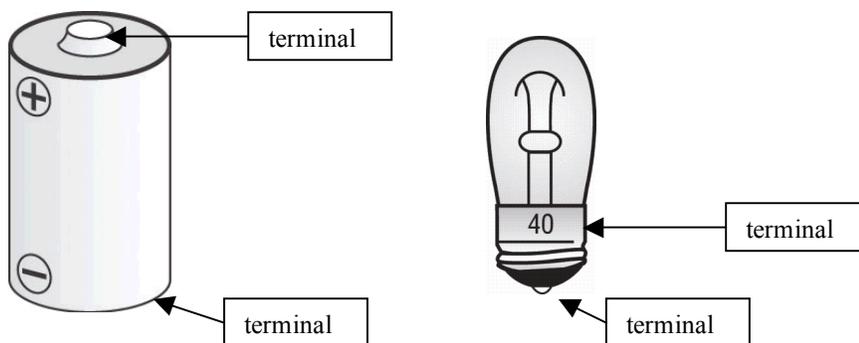
1. Answers vary.
2. Answers vary.

Page 5 – 7 Light the Bulb

1. Ways the bulb lights:



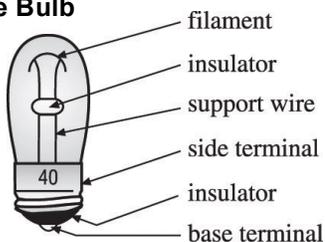
- 2.



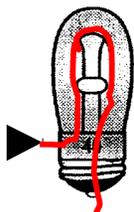
3. The bulb lights. The parts of the circuit may get warm.
4.
 - a. Yes, all four terminals are connected.
 - b. Yes, all four terminals are connected.
 - c. No, only one terminal of battery and of bulb is connected.
 - d. Yes, all four terminals are connected.
 - e. Yes, all four terminals are connected.
 - f. Yes, all four terminals are connected.

Page 8 – 9 The Bulb

- 2.



- 3.



4. The filament in the bulb glows.
5. Sample paragraph:
Electricity flows through the parts of a light bulb and causes it to light. A bulb has two terminals. There is a side terminal and a base terminal. The current flows through one of the bulb's terminals. After entering the bulb through one of the terminals, it flows through a support wire to the bulb's filament. The electrical current causes the filament to heat up and glow. The current then flows through the second support wire to the second terminal of the bulb. The bulb has two insulators to keep the current flowing properly. One insulator is the glass bulb that holds the support wires apart. The second insulator is at the base to separate the bulb's terminals. The current will continue to flow through the bulb until the circuit is broken.

Page 10 The Battery

1. positive terminal
2. steel cover
3. zinc can
4. carbon rod
5. negative terminal
6. chemical paste and electrolyte
7. moist paste

Page 11 – 12 Battery Holders, Bulb Holders and Switches

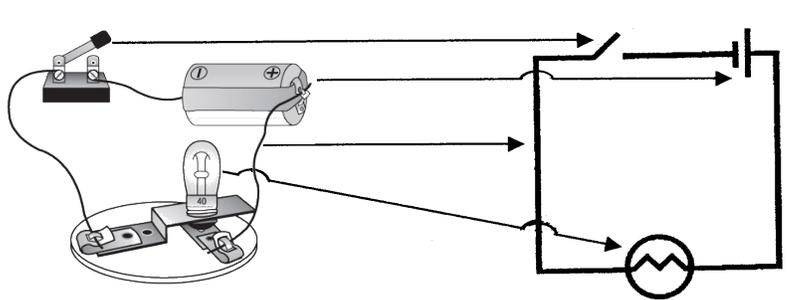
10. To add another bulb to the circuit, one must screw a bulb into a second bulb holder. Then disconnect the wire attached to the switch and the first bulb holder. Add a 15 cm piece of copper wire to the empty clip on the bulb holder and attach the second bulb holder to that wire. Then the wire attached to the switch can be connected to the other side of the second bulb holder.
11. The bulb holder and battery holder extend the terminals of the battery and bulb.

Page 13 – 14 Polarity

1. The bulb lit, and it was brighter than with one battery.
2. The bulb did not light.
3. Circuit A has batteries connected positive terminal to negative terminal. Circuit B has batteries connected positive terminal to positive terminal.
4. The bulb lit, and it is even brighter than two batteries.
5. Predictions vary.
6. The bulb lit, but it is about as bright as it is when lit with one battery.
7. All batteries are lined up the same way in Circuit C (positive to negative terminal). One battery is turned around in Circuit D.
8. Sample paragraph:
When a circuit has more than one battery, the batteries must be connected in a certain way to get the brightest light. The positive terminal of one battery must be connected to the negative terminal of a second battery. In Circuit A of this activity, the batteries were connected positive to negative. So the bulb was able to light. In Circuit B, the positive terminals were connected. The current could not flow and the bulb did not light. In Circuit C, the light was very bright because it was getting power from three batteries. All the batteries were connected positive to negative. In Circuit D, the bulb lit but not as brightly. This is because two batteries in the circuit were connected negative terminal to negative terminal. Those two batteries could not add to the current in the circuit. The third battery in the circuit was lighting the bulb. So if you are building a circuit with more than one battery, and it is not working properly, check your battery terminals first!

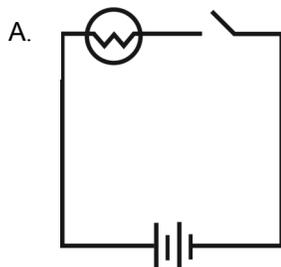
Page 15 - 17 Wiring Diagrams

1.

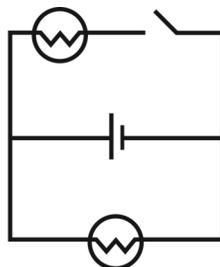


2. Observe students construct circuits from the schematic diagrams for accuracy.

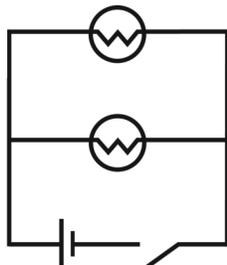
3.



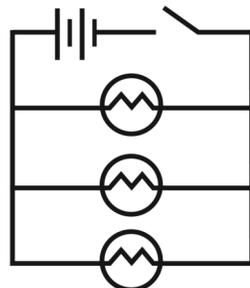
B.



C.



D.



4. Sample paragraph:

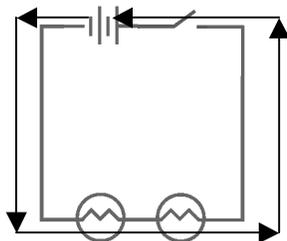
I think electricians use symbols in their diagrams for a couple of reasons. One reason is so all electricians can understand their drawings. The common symbols are understood by every electrician. Another reason is that a symbol can be drawn easily and quickly. Drawing pictures of the parts of a circuit can be more difficult to draw. I think using symbols to draw circuits is easier than drawing pictures of circuit parts. The line drawings are understood by my classmates, and I am able to easily draw more complicated circuits.

Page 18 – 20 Hidden Circuits

1. A closed or complete circuit is one where an electrical current flows through a complete path (from one battery terminal through the circuit to the other battery terminal).
2. The circuit tester is not a complete circuit. The wires from one end of the battery and one end of the bulb are not touching. The circuit is open or incomplete.
3. Answers vary according to individual puzzles.
4. The circuit tester is an incomplete or open circuit. The wires from one end of the battery and one end of the bulb are not touching. When we place one wire in one of the holes of the hidden circuit folder and the other wire in another hole of the folder, sometimes the bulb lit. The bulb lit when there was a piece of aluminum foil connecting the two holes. The electrical current could then flow from one terminal of the battery to one end of the wire, through the foil, to the end of the second wire, through the bulb, to the other terminal of the battery. The circuit is complete when all the connections are made.

Page 21 – 23 Series Circuits

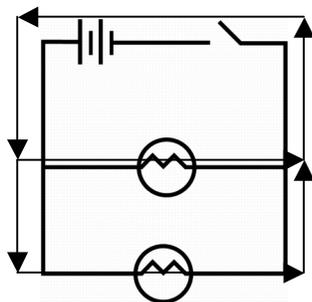
1. The bulb lights brightly.
2. The bulb lights, but it is not as bright.
3. Predictions vary.
4. Results vary, usually 3 or 4 bulbs.
5. The brightness of the bulbs decreased.
6. Predictions vary.
7. A third battery added to the circuit will make the bulbs brighter.
8. Predictions vary.



9. Bulb Y does not light.
10. Predictions vary.
11. Bulb X does not light.
12. A series circuit has one path for the electricity to follow. If one bulb is removed from the circuit, the path through the circuit is broken. All bulbs in the circuit go out. The bulbs in the circuit also share the power from the batteries because there is one path for the current to follow. As bulbs are added to a series circuit, the bulbs get dimmer.

Page 24 – 26 Parallel Circuits

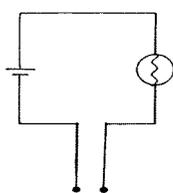
1. The bulb lights brightly.
2. Both bulbs light and have the same brightness.
3. Predictions vary.
4. As many as 20 bulbs can be added.
5. It stayed about the same.
6. Predictions vary.
7. The brightness of the bulbs stays about the same.
8. Predictions vary.



9. Bulb Y stays lit.
10. Predictions vary.
11. Bulb X stays lit.
12. A parallel circuit has more than one path for electricity to follow through the circuit. If one bulb is removed from a parallel circuit, there is another path for the current to follow to light a second bulb. A parallel circuit has multiple paths for electricity while a series circuit has only one path. The bulbs in a parallel circuit only use the amount of energy necessary from the batteries to light. When both bulbs are lit, they are about the same brightness.

Page 27 Testing Solids

2. Sample tester:



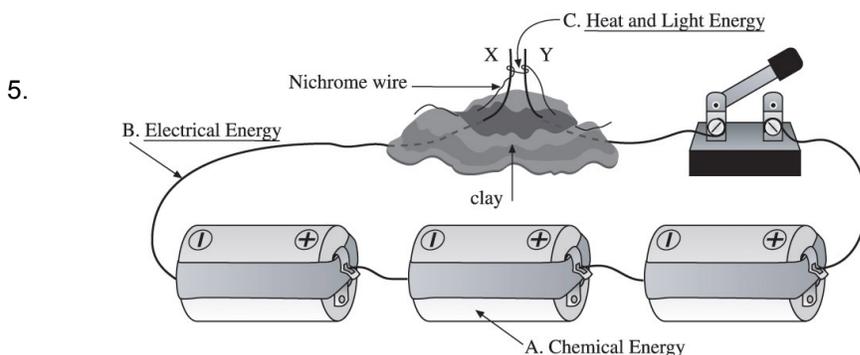
3. Objects chosen by students vary.
4. Predictions vary.
5. Answers vary.
6. Metal

Page 28 – 30 Resistance

1. Toaster, hair dryer, electric stove, etc.
2. Rubber, glass, etc.
3. As the length of the wire increases, the flow of electricity decreases. The bulb gets dimmer.
4. Thinner wire decreases the flow of electricity. The bulb gets dimmer.
5. The fire hose will conduct more water because it thicker and easier for the water to flow through it.
6. The thick wire will conduct more electricity because there is less resistance to the flow of the current.
7. Answers vary. Rheostats are found in light dimmer switches, volume control of TV, radio, etc.
8. In cars, a rheostat is found in the dashboard dimmer switch and the radio.
9. A rheostat is a device that changes the resistance in an electrical circuit. It is often used to change the brightness of a light. When one wants a light to be brighter, the rheostat is adjusted so the wire the electrical current is flowing in is made shorter. When one wants a light to be dimmer, the rheostat is adjusted so the wire the electrical current is flowing in is made longer. Longer wires provide more resistance for electrical current. This causes the lights to be dimmer.

Page 31 Model Heater

1. Yes. The Nichrome wire glows so electricity must be going from the batteries, through the copper wires to complete the circuit. Or, it is a series circuit; electricity goes through all parts of the single path.
2. The Nichrome wire has more resistance than the copper wire. Copper wire has very low resistance.
3. The Nichrome wire is so resistant to the flow of electricity that the wire begins to heat up and glow.
4. Toaster, hair dryer, electric stove, electric clothes dryer, etc.

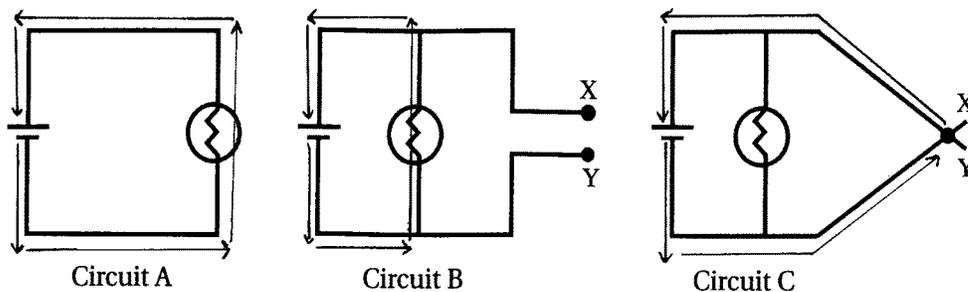


Page 32 – 34 Comparing Filaments

- Both bulbs in the circuit light.
- Both bulbs in the circuit light.
- The #41 bulbs are brighter.
- Only the #40 bulb lit.
- Only the #40 bulb lit.
- Yes. If the #41 bulb is removed, the #40 bulb will go out (series circuit).
- The filament of the #40 bulb is thinner.
- The #40 bulb has more resistance. It has more resistance because the filament is thinner than the #41 bulb. The thinner wire has more resistance.
- The flow of electricity is the same in both bulbs. The difference between the two bulbs is the filament in the #40 bulb is providing the resistance.
- The #40 bulb and #41 bulb in a series circuit act differently. The #40 bulb has more **resistance**. This is due to the thinner **filament** in this bulb. It acts like a regulator by keeping the flow of electricity in the circuit below what is needed to light the #41 bulb. The #41 bulb has a thicker **filament** so it needs additional current to light. The **resistance** of the #40 bulb does not allow that amount of current to flow in the circuit to light the #41 bulb.

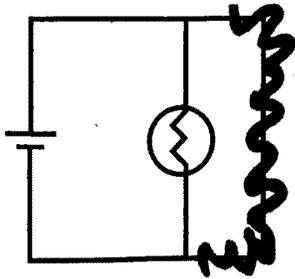
Page 35 – 37 Short Circuits

- The bulb lights.
- It is a closed circuit. It has a single path for electricity to follow.
- The bulb lights.
- It is a closed circuit. It has a single path for electricity to follow.
- The light goes out. There is a second, less resistant, parallel path for the electricity to follow.
- It is a short circuit.

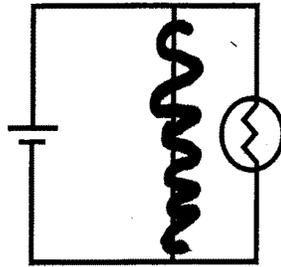


- Predictions vary. Result - no.
- Predictions vary. Result - yes.
- Predictions vary. Result - no.

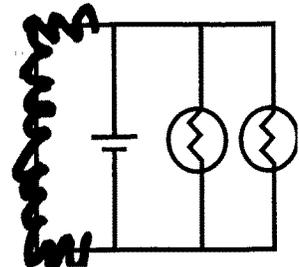
14. For 8 through 10, remove a wire (see drawings below).



Circuit 8



Circuit 9

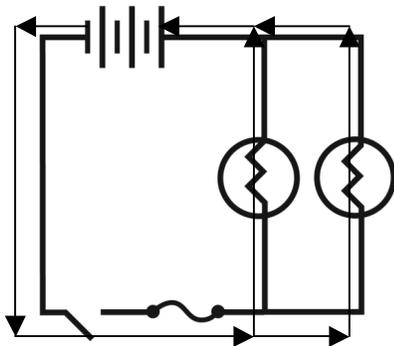


Circuit 10

For 11, remove a battery or reverse the direction of one battery. For 13, disconnect wires at test point.

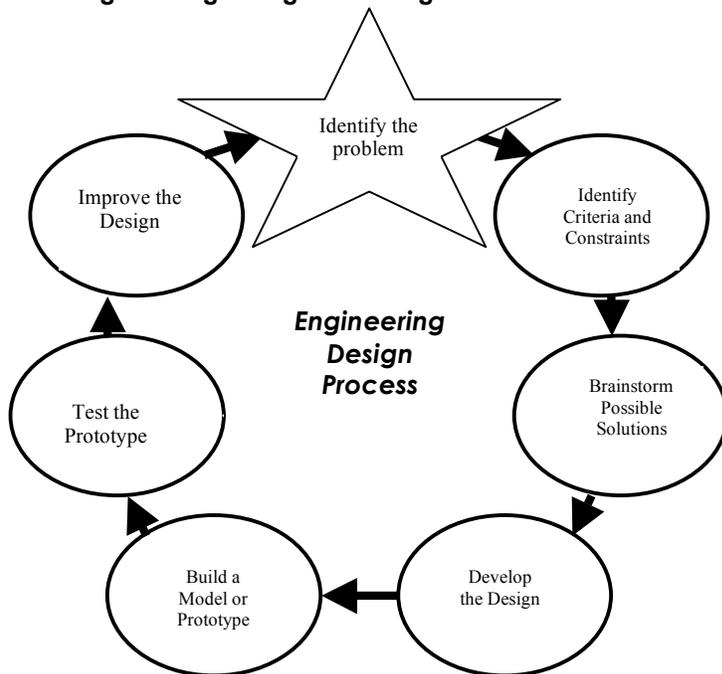
Page 38 Making a Fuse

2. Yes, both bulbs in the circuit light.
3. Yes, electricity flows through the fuse.



4. Yes. The bulbs are arranged in parallel.
5. The steel wool glowed red, broke, and burned.
6. So much electricity goes through the #41 bulb that the steel wool breaks (overload).

Page 39 – 41 Engineering Design Challenge



1– 5. Answers vary.