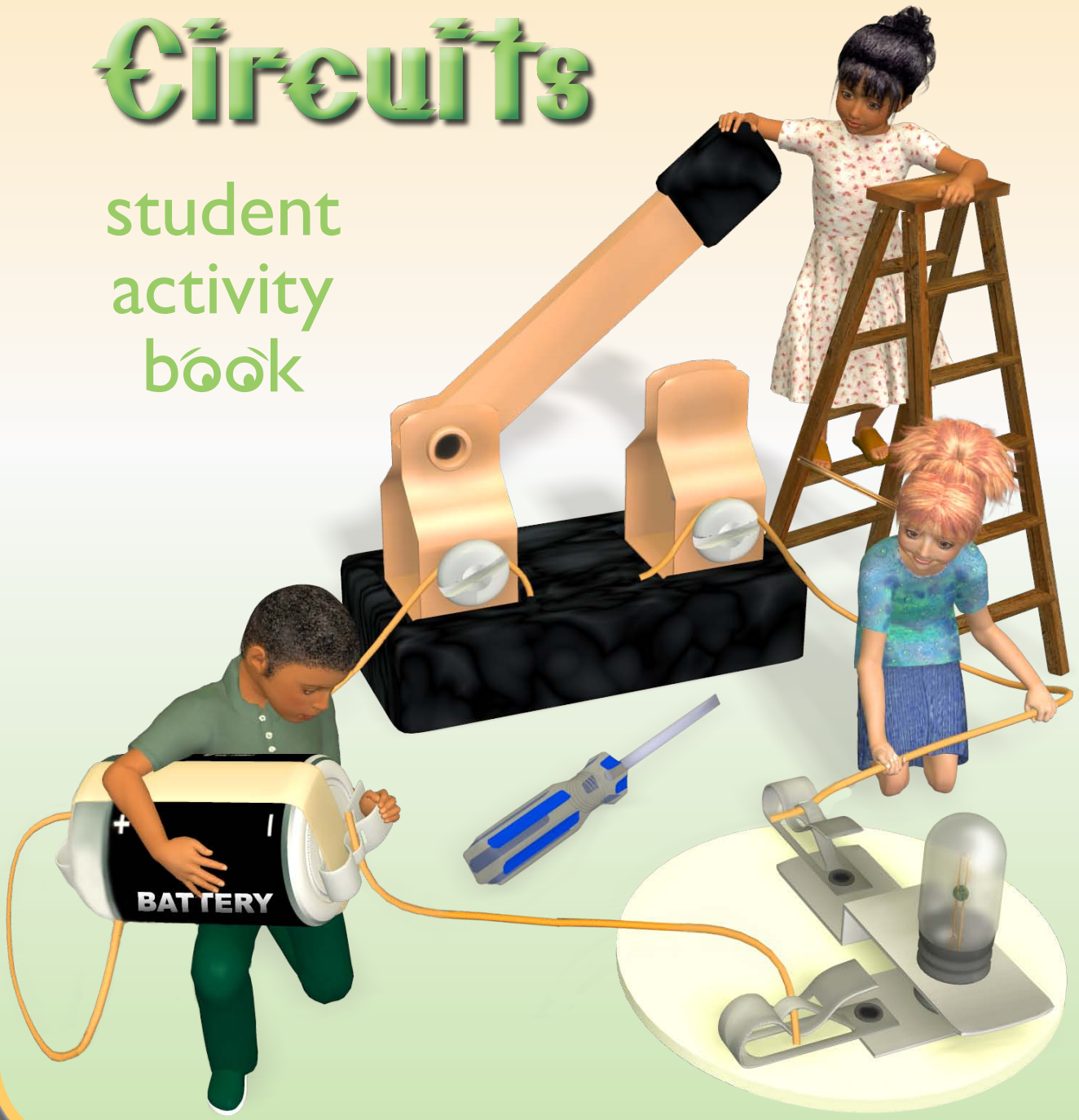
# Electrical Circuits

student activity book




Name _____

# Contents



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# Getting Started

**1.** Use complete sentences to write everything you think you know about **electricity** on the lines below.

## Getting Started (cont.)

**2.** What questions do you have on the topic of electricity?

# Light the Bulb

**Materials:**
2 #40 bulbs
2 15 cm copper wires
1 battery

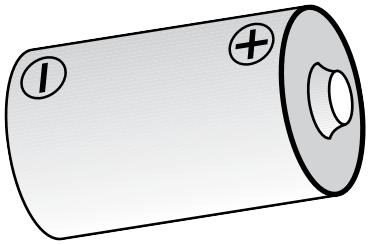
1. With your partner, use one **battery**, one **bulb**, and one piece of **copper wire** and try to light the bulb as many different ways as you can. In the space below, draw all the circuits you made that lit the bulb on the top part of the box below. Then draw the circuits you made that did not light the bulb at the bottom of the box. Each time the bulb lights, you have constructed a **closed** or **complete circuit**.

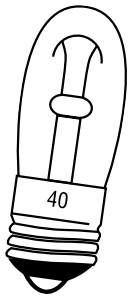
**Ways the bulb lit**

**Ways the bulb did not light**

# Light the Bulb (cont.)

**2.** The parts of the battery and bulb that must be connected in order to light the bulb are called **terminals**. Draw arrows pointing to the four terminals in the pictures below.

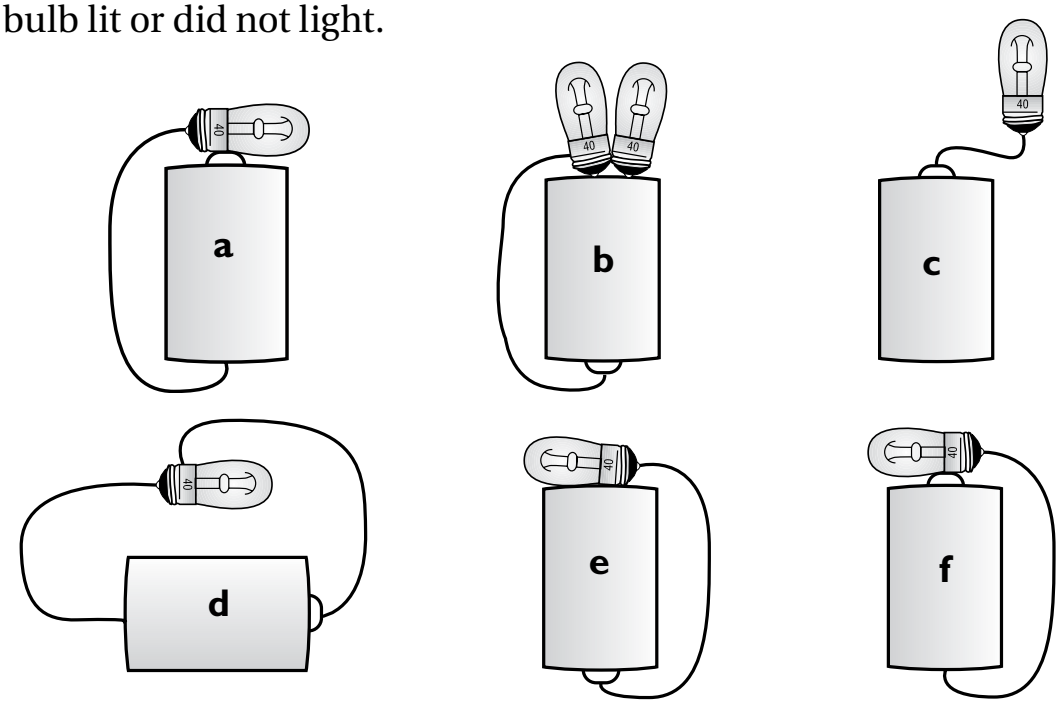





**3.** **Energy** and **matter** interact in a **system**. The battery, bulb, and wire (matter) interact with energy in the circuits constructed in number one. What is the evidence of an **interaction** in this system.

# Light the Bulb (cont.)

**4.** Look carefully at the pictures below. Circle YES if you think the bulb(s) will light and NO if you think the bulb(s) will not light. After you have made your **predictions**, try each one to see if you were correct. Explain why the bulb lit or did not light.




**a.** YES NO Why? _____

_____

**b.** YES NO Why? _____

_____

**c.** YES NO Why? _____

_____

**d.** YES NO Why? _____

_____

**e.** YES NO Why? _____

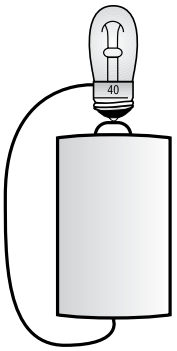
_____

**f.** YES NO Why? _____

_____

# The Bulb

**1.** Construct the circuit shown at the right to make the bulb light.



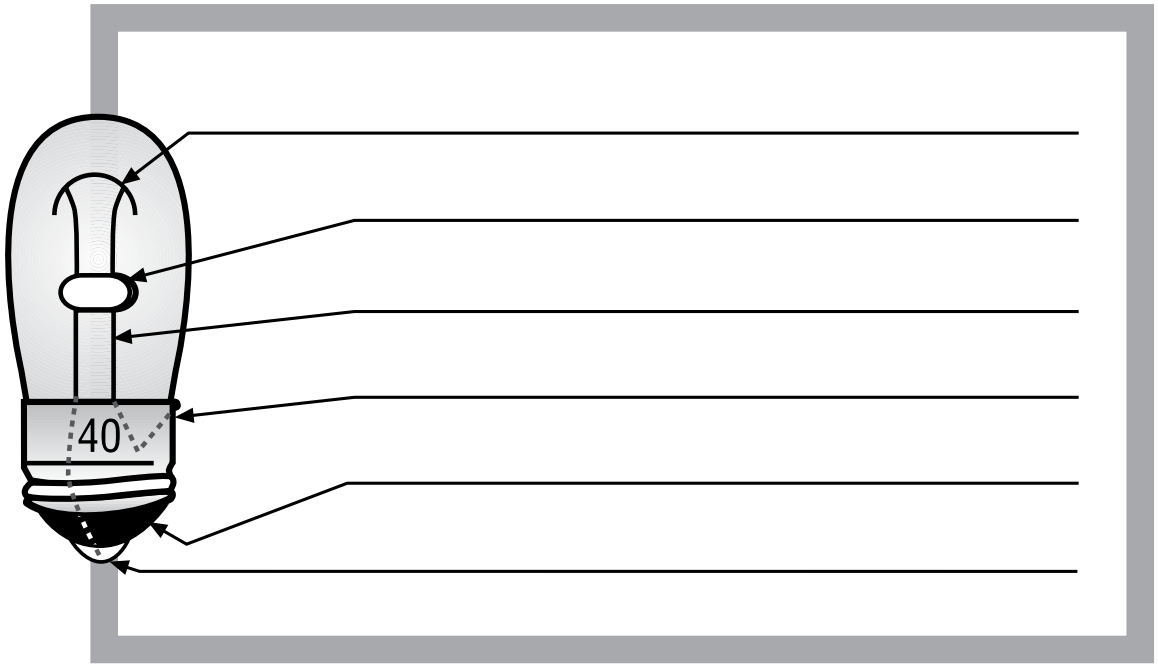

**Materials:**

1 #40 bulb
1 15 cm copper wire
1 battery
1 hand lens
1 red pencil or crayon

**2.** Use the glossary to help you label the following parts of a bulb:

**base terminal** **filament** **support wires**

**insulator** ***(there are two)*** **side terminal**




**3.** Draw a **red** line on the bulb picture above to show the path electricity takes when the bulb is lit. Start at the side terminal.

**4.** Observe the #40 bulb using a hand lens. Observe a lighted #40 bulb using a hand lens. What part of the bulb glows?

_____

_____

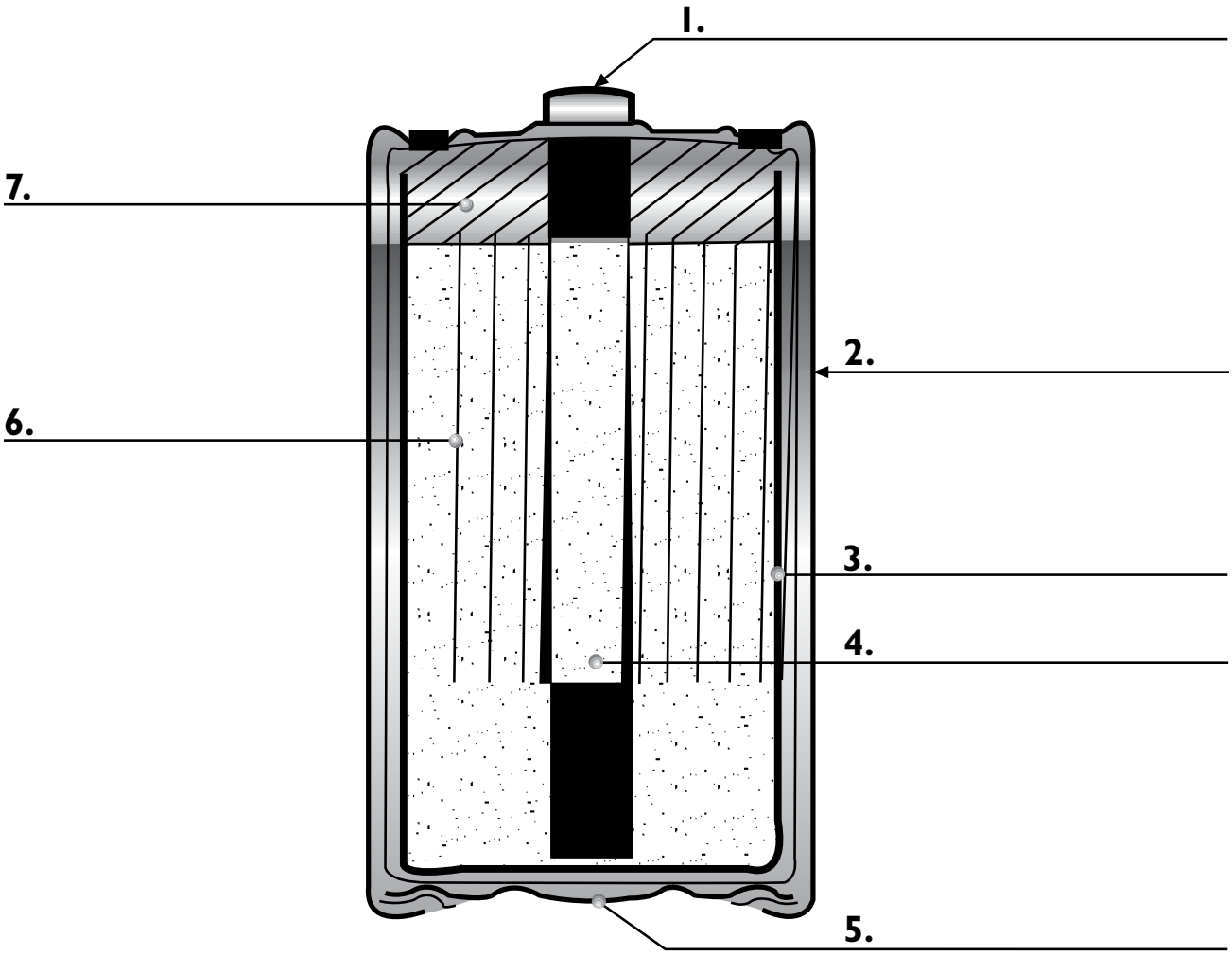
# The Bulb (cont.)

**5.** Reread the list of vocabulary words used to label the parts of the bulb on page 8. Write a paragraph describing how electricity flows through the light bulb using these vocabulary words. Read your paragraph to your partner. Your partner will help you check your work.

# The Battery

Batteries use chemicals to produce **electricity**. The illustration below shows what is inside the zinc-carbon batteries used in this unit.

Work with your class to identify the names of each part of the battery.




- steel cover
- moist paste (ammonium and zinc chloride)
- carbon rod
- zinc can
- positive terminal
- negative terminal
- chemical paste (manganese dioxide and carbon powder) and electrolyte (ammonium and zinc chloride)

# Battery Holders, Bulb Holders and Switches

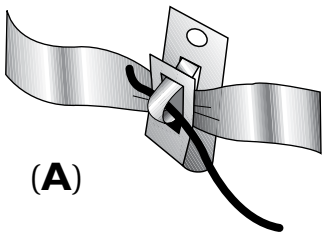
Follow the directions below to learn how to use a battery holder, bulb holder, and switch to create a circuit.

**Materials:**

4 15 cm copper wires
2 #40 bulbs
2 battery holders
2 bulb holders
1 battery
1 screwdriver
1 switch

### Battery Holder

1. Place the holder on the battery so the flat side of each **Fahnestock** clip touches each terminal of the battery.
2. Squeeze a Fahnestock clip and insert a wire under the hook. See picture (**A**).
3. Repeat for the other Fahnestock clip.

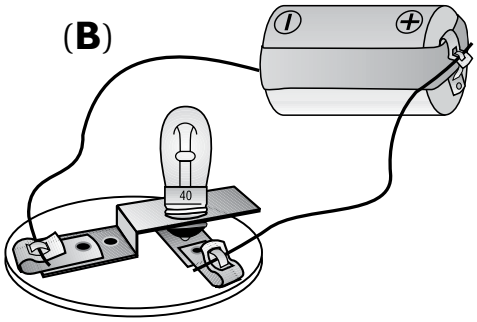


(**A**)

### Bulb Holder

4. Screw the bulb into the center circle of the bulb holder so the base terminal touches the metal at the bottom of the bulb holder.
5. Connect the wires from the battery to the bulb holder. The bulb should light. See picture (**B**).

(**B**)

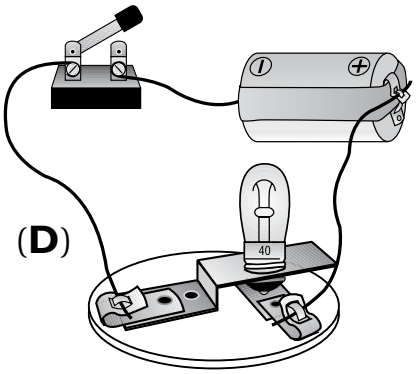



### Switch

6. Connect two wires to a switch as shown in picture (**C**). Use the screwdriver to tighten the screws that attach the wire to the switch.
7. Add the switch and wires to the circuit. See picture (**D**).
8. To conserve energy, leave the **switch** open when not in use.
9. Close the switch when testing each new circuit.

(**C**)

(**D**)



# Battery Holders, Bulb Holders and Switches (cont.)

**10.** Add another bulb and bulb holder to the circuit. Describe how you added the bulb and bulb holder to the circuit.

_____

_____

_____

_____

**11.** Describe the relationship between the terminals of the bulb and battery and the bulb and battery holders.

_____

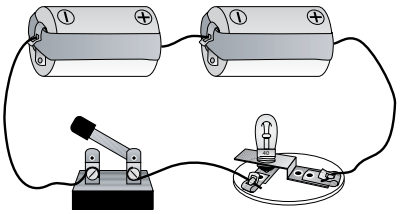
_____

_____

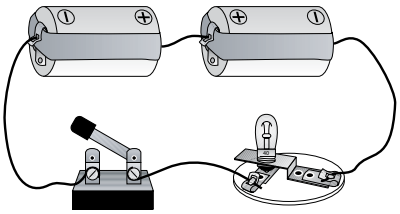
_____

# Polarity

**A**



**B**



**Materials:**

5 15 cm copper wires
3 batteries
3 battery holders
1 #40 bulb
1 bulb holder
1 screwdriver
1 switch

**1.** Construct **Circuit A**. Close the switch. What did you observe?_____

_____

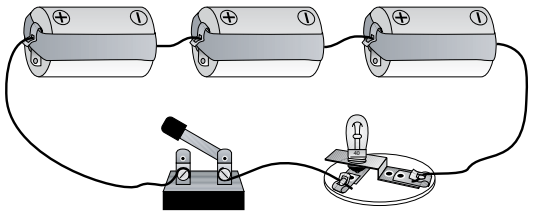
**2.** Construct **Circuit B**. Close the switch. What did you observe?_____

_____

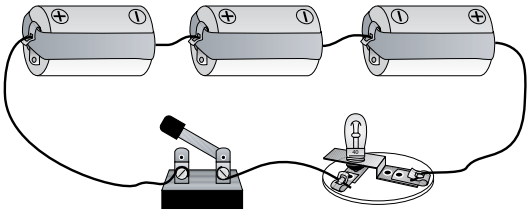
**3.** How is **Circuit A** different from **Circuit B**? _____

_____

**C**



**D**



**4.** Construct **Circuit C**. Close the switch. What did you observe?_____

_____

**5.** Look at **Circuit D**. Predict what will happen when the switch is closed in **Circuit D**. _____

_____

**6.** Construct **Circuit D**. Close the switch. What did you observe?_____

_____

# Polarity (cont.)

**7.** How is **Circuit C** different from **Circuit D**? _____

_____

**8.** Write a paragraph describing what you learned about connecting batteries in a circuit. Use **evidence** from your exploration with circuits that have more than one battery to explain your learning.

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# Wiring Diagrams

These are some **symbols** used in **wiring diagrams** (**schematics**):

Battery — *Positive* *Negative*

Bulb

Fuse

Resistance

Switch

Test Point

Wire

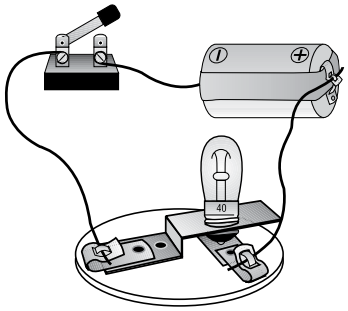
Wires crossed but not joined

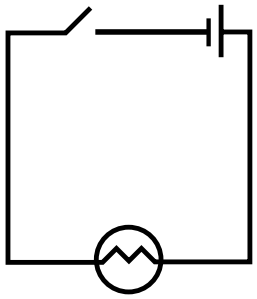
Wires joined

**Materials:**

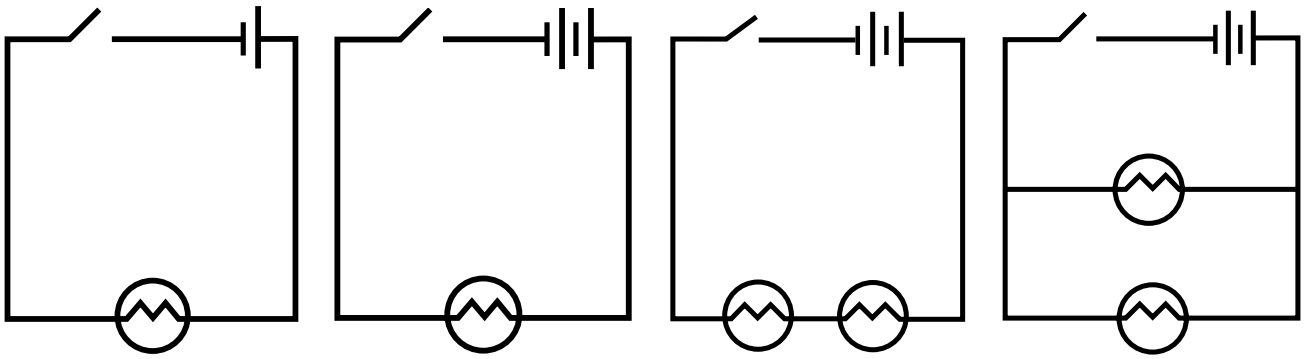
4 15 cm copper wires
2 #40 bulbs
2 batteries
2 battery holders
2 bulb holders
1 screwdriver
1 switch

**1.** This circuit can be represented by this diagram. Draw a line from each part of the circuit picture to its symbol in the wiring diagram(schematic).





**2.** Read the wiring diagrams below. After discussing the diagrams as a class, construct the circuits with a partner.

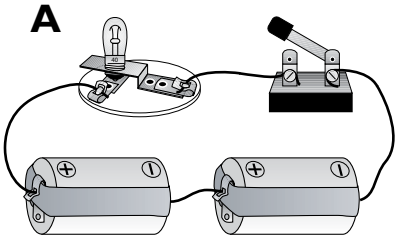


**Circuit A** **Circuit B** **Circuit C** **Circuit D**

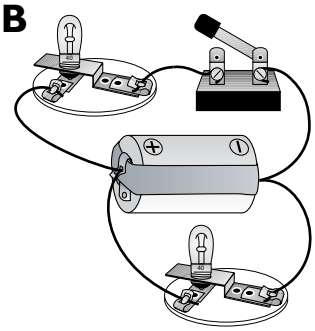
# Wiring Diagrams (cont.)

**3.** Draw the circuits using symbols in a wiring diagram.

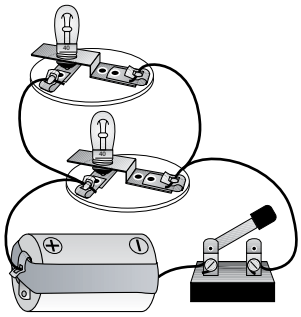
**A**



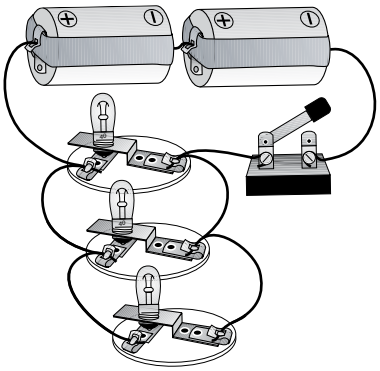
**B**



**C**



**D**



# Wiring Diagrams (cont.)

**4.** Now that you have used the symbols to create wiring diagrams, write one or two paragraphs to answer the questions below.

**a.** Why do you think electricians use symbols to illustrate circuits rather than actual drawings of the circuit parts?
**b.** How do you feel about using symbols to draw your circuits rather than actual pictures?
**c.** Do you think it is easier?
**d.** Why or why not?

# Hidden Circuits

**1.** With your partner, discuss and write the definition of a closed or complete circuit.

_____

_____

_____

**2.** Examine your **circuit tester**. Is it a closed or complete circuit? Why or why not?

_____

_____

_____

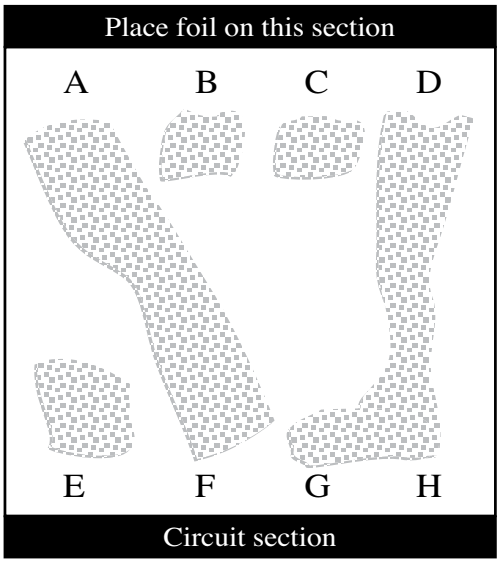
**Directions:**

**a.** Open your hidden circuits folder.

**b.** Tape pieces of aluminum foil connecting some of the black circles inside the folder.

**c.** Tape loops can be used to attach the aluminum foil to the folder. All the black circles are to be covered with aluminum foil (see example). Use the same side of the aluminum foil to connect the black circles.

**Example**




**d.** When finished, close the cover on the circuit folder.

**e.** Place 2 small paper clips at the ends of the folder to keep it closed.

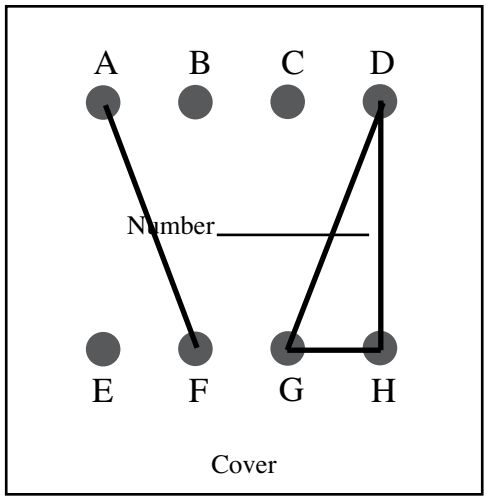
**f.** Place the end wires of your circuit tester on the circles to check if the foil connections complete the circuit.

**g.** Write the number your teacher assigns you on the front of your circuit folder.

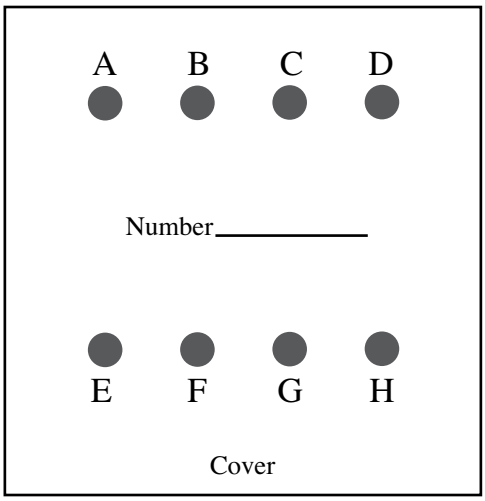
# Hidden Circuits (cont.)

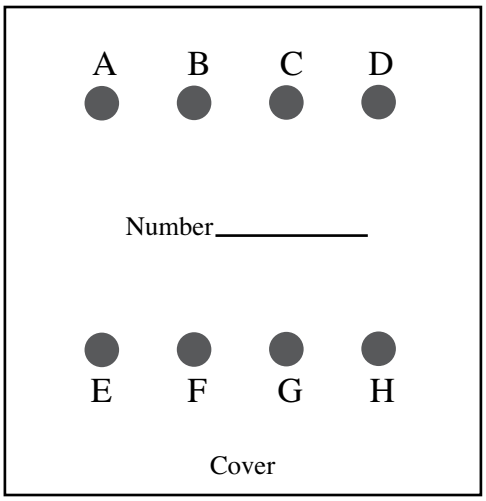
**3.** Exchange hidden circuit folders with another pair of students. Write the number of their circuit folder in the center of one of the boxes below. Test their hidden circuits with your circuit tester. Record the results as shown. Don't peek! After you are done testing each circuit folder, remove the paper clips and open the circuit folder to check your work.

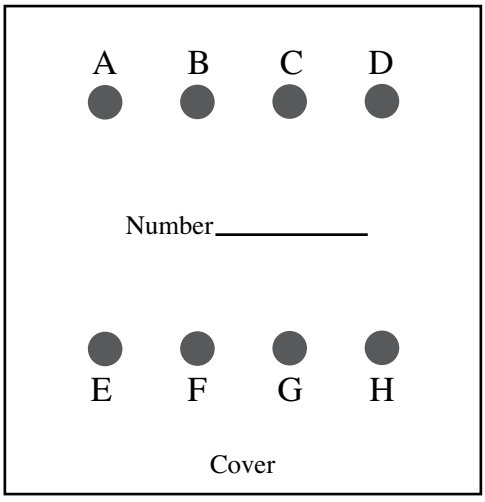
**Example Results**

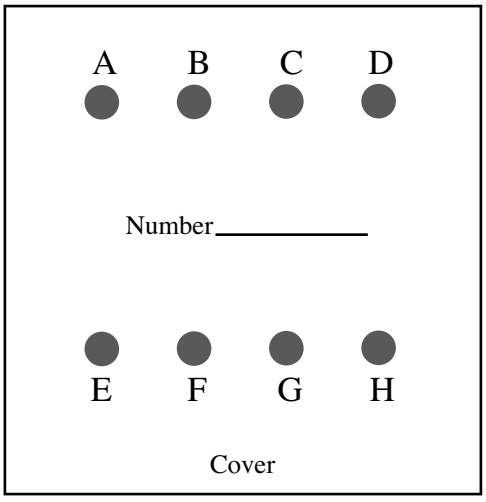



**Student Folder Results**



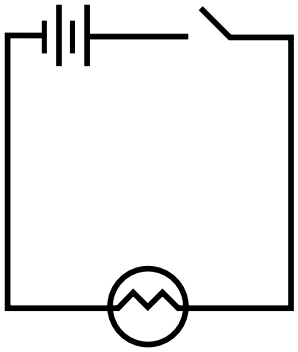



# Hidden Circuits (cont.)

**4.** In your own words, explain how the circuit tester was made into a complete circuit using the hidden circuit folder.

# Series Circuits

**1.** Look at the wiring diagram of the circuit. Construct the circuit and close the switch. Write what you observe.



**Materials:**

3 batteries
3 battery holders
1 screwdrivers
1 switch
#40 bulbs
15 cm copper wires
bulb holders
red pencil or crayon

_____

_____

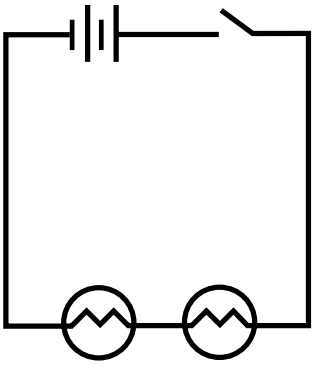
_____

_____

_____

_____

**2.** Keep the circuit made in number 1 together. Look at the wiring diagram of the **series circuit**. Construct this circuit and close the switch. Write what you observe and explain how this circuit lights differently than the first circuit.



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# Series Circuits (cont.)

Let's add more bulbs to the series circuit.

**3.** Predict how many bulbs can be lit in a series circuit using 2 batteries._____

**4.** Test your prediction by adding one light bulb at a time to the circuit. How many bulbs did you get to light? _____

**5.** As bulbs were added to the series circuit, explain what happened to the brightness of the bulbs?

_____

_____

_____

**6.** Predict what will happen when you add another battery to the series circuit.

_____

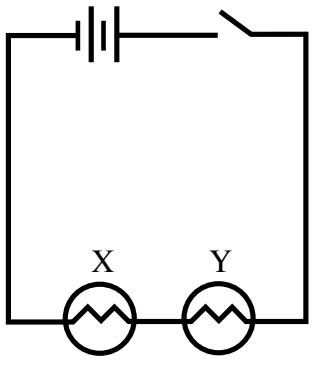
_____

**7.** Describe the result of adding another battery to the series circuit.

_____

_____

**8.** Look carefully at the diagram of a series circuit. Draw a red line showing the path of electricity in this circuit. Predict what will happen when you unscrew bulb X in the circuit. Write your prediction on the lines below.

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## Series Circuits (cont.)

**9.** Unscrew bulb X in the circuit. Write your observation on the lines below.

_____

_____

**10.** Predict what will happen when you tighten bulb X then unscrew bulb Y in the circuit. Write your prediction on the lines below.

_____

_____

**11.** Tighten bulb X and unscrew bulb Y. Write what you observe.

_____

_____

**12.** Summarize what you know about a series circuit.

_____

_____

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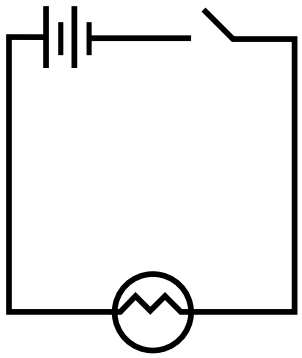
# Parallel Circuits

**1.** Look at the wiring diagram of the circuit. Construct the circuit and close the switch. Write what you observe.



**Materials:**

3 batteries
3 battery holders
1 screwdriver
1 switch
#40 bulbs
15 cm copper wires
bulb holders
red pencil or crayon

_____

_____

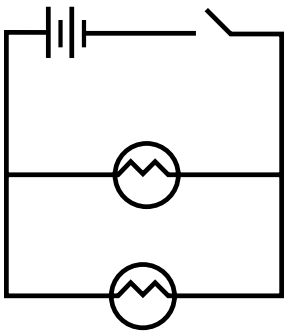
_____

_____

_____

_____

**2.** Keep the circuit made in number 1 together. Look at the wiring diagram of the **parallel circuit**. Construct this circuit and close the switch. Compare this circuit to the first circuit. Write what you observe.



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# Parallel Circuits (cont.)

Let's add more bulbs to the parallel circuit.

**3.** Predict how many bulbs can be lit in a parallel circuit using 2 batteries. ____

**4.** Test your prediction by adding one light bulb at a time to the circuit. How many bulbs did you get to light? _____

**5.** As bulbs were added to the parallel circuit, explain what happened to the brightness of the bulbs? _____

_____

_____

**6.** Predict what will happen when you add another battery to the parallel circuit.

_____

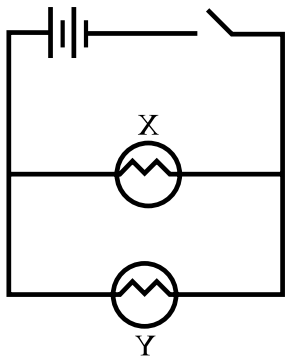
_____

**7.** Describe the result of adding another battery to the parallel circuit.

_____

_____

**8.** Look carefully at the diagram of a parallel circuit. Draw a red line showing the path of electricity in this circuit. Predict what will happen when you unscrew bulb X in the circuit. Write your prediction on the lines below.




_____

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# Parallel Circuits (cont.)

**9.** Unscrew bulb X in the circuit. Write your observation on the lines below.

_____

_____

**10.** Predict what will happen when you tighten bulb X then unscrew bulb Y in the circuit. Write your prediction on the lines below.

_____

_____

**11.** Tighten bulb X and unscrew bulb Y. Write what you observe.

_____

_____

**12.** Summarize what you know about a parallel circuit.

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# Testing Solids

In the circuits you have been making, copper wire has been used to **conduct** electricity.

**Materials:**
1#40 bulb
1 battery
1 battery holder
1 bulb holder
copper wire as needed
variety of solid objects

1. Use the circuit materials listed in the box to construct a circuit that can be used to test whether or not different solids conduct electricity. Then try your solid **conductor** tester to be sure it works.

2. Draw a wiring diagram of your tester in the space provided.

3. Decide with your partner the objects that you are going to test for conductivity. List those items in the **Object** column of the chart below. Then complete the **Material** column describing what material the item is made of (i.e. wood, metal, plastic, glass, etc.).

4. First, predict if you think the item will conduct electricity. Write YES or NO on the chart for each item in the **Prediction** column.

5. Use your solid conductor tester to find out if each object conducts electricity and lights the bulb. Write YES or NO in the **Conductor** column on the chart.

| Object | Material | Prediction | Conductor |
|---|---|---|---|
| i.e. aluminum foil | metal | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

6. Objects made of what material conduct electricity?

_____

***Be sure to save your tester for the next activity!***

# Resistance

Read the paragraph below:

When a material limits the amount of electricity that can pass through it, it has **resistance**. All materials that conduct electricity have some resistance. The length and thickness of a material affect its resistance.

1. Copper is commonly used as wire because it has a low resistance to the flow of electricity. **Nichrome wire** is more resistant to the flow of electricity than copper wire. If enough electricity goes through a Nichrome wire, it will get hot and turn red. Name some appliances found in your home that use Nichrome wire.

   _____

   _____

2. What are some materials that have such high resistance that they are used as insulators. For example, plastic is used to cover and insulate electrical wire used in houses. What else?

   _____

   _____

3. Watch the demonstration using the thick end of the resistance board. Observe the Fahnestock clip move along the wire and the bulb. Describe how length affects the flow of electricity in a wire.

   _____

   _____

4. Watch the demonstration using the thin end of the resistance board. Observe the Fahnestock clip move along the wire and the bulb. Describe how thickness affects the flow of electricity in a wire.

   _____

   _____

# Resistance (cont.)

**5**. Water hoses can be used as models for how wire is resistant to the flow of electricity. Which of the hoses below will conduct more water? Explain why.

**garden hose**

**fire hose**

_____

_____

**6.** Which of the wires below will conduct more electricity? Explain why.

**thin wire**

**thick wire**

_____

_____

Read more about wire thickness below:

Wire thickness is measured by a **gauge**. The bare copper wire used in the activities in this unit is #20 gauge wire. The larger the gauge number of the wire, the more resistance it has to electricity and the thinner the wire. The smaller the gauge number of the wire, the less resistance it has to electricity and the thicker the wire. In houses and schools, #14 wire is used for most circuits and #12 wire is used for circuits that supply electricity to **appliances** such as refrigerators and microwave ovens. For an appliance that uses a lot of electricity, such as an electric stove, #8 wire is used.

**7.** Look up the word **rheostat** in the glossary. The resistance board demonstrated by your teacher is a good model of a rheostat. Do you have a rheostat in your home? _____ If yes, where is it? _____

_____

_____

_____

# Resistance (cont.)

**8.** Where is a rheostat located in a car?

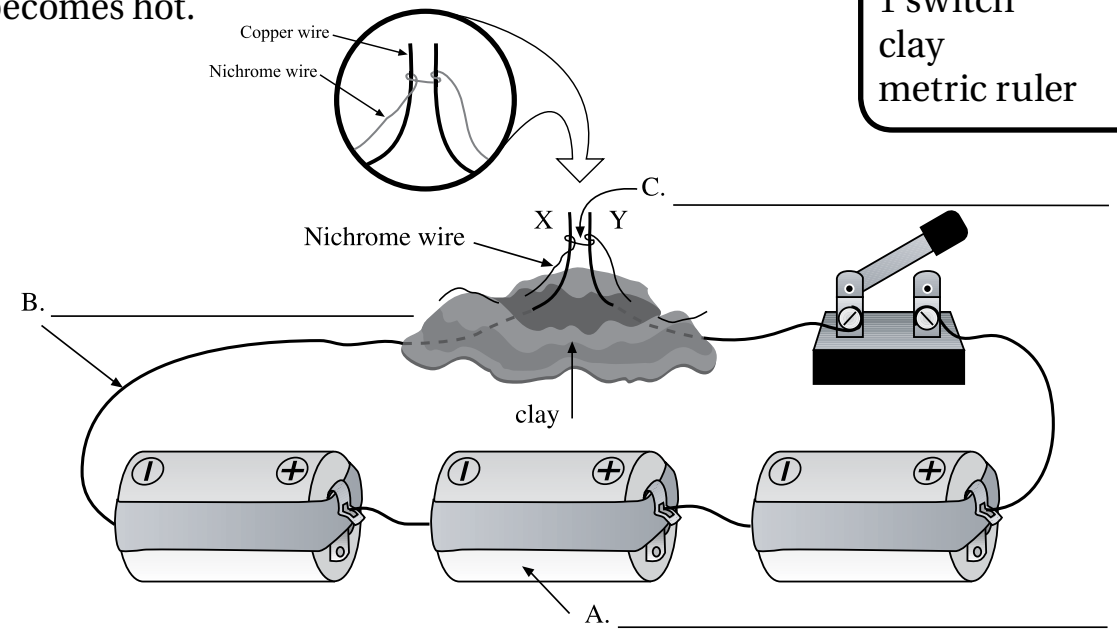
**9.** Explain in your own words how a rheostat works.

# Model Heater

Construct the model heater shown below. Copper wires X and Y should be less than 1 cm apart. Make sure the Nichrome wire is wrapped tightly around wires X and Y as shown. Stick the ends of the Nichrome wire into the clay. Close the switch. Observe the heater. Caution: the Nichrome wire becomes hot.

**Materials:**

5 15 cm copper wires
3 batteries
3 battery holders
1 8 cm Nichrome wire
1 screwdriver
1 switch
clay
metric ruler




**1.** Is electricity going through the copper wires? _____ How do you know?

_____

**2.** Why does the Nichrome wire heat up when the copper wire does not?

_____

**3.** Explain how the model heater works.

_____

_____

**4.** List some appliances that work like the model heater.

_____

**5.** Because of **energy transformations**, ***heat energy, light energy, chemical energy***, and ***electrical energy*** are all present when the switch on the model heater is closed. Label A, B, and C in the picture above with the kind(s) of energy present in that part of the circuit.

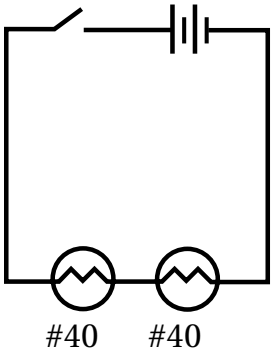
# Comparing Filaments

Follow the directions below to learn more about resistance and the difference between the #40 and the #41 bulb.

**Materials:**

10 15 cm copper wires
4 batteries
4 battery holders
4 bulb holders
3 #40 bulbs
2 #41 bulbs
2 switches
1 magnifier
1 screwdriver

**Tip:** ***Conserve your batteries by opening the switch before recording your answers.***

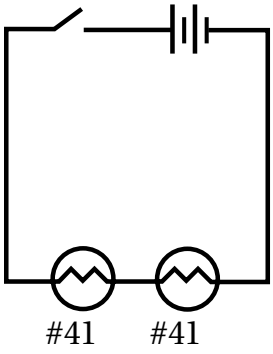



**1.** Construct the circuit in the diagram. Close the switch. What do you observe?

_____

_____

_____




**2.** Construct the same circuit using two #41 bulbs. Close the switch. What do you observe?

_____

_____

_____

**3.** How do the two different bulbs in each series circuit compare?

_____

_____

_____

_____

**4.** In the series circuit with the two #41 bulbs, remove one #41 bulb. Replace the #41 bulb with one #40 bulb. Close the switch. What do you observe?

_____

_____

# Comparing Filaments (cont.)

**5.** Reverse the bulbs. Close the switch. What do you observe?

_____

_____

**6.** Does electricity flow through the #41 bulb in this circuit? _____

How could you find out? _____

_____

_____

**7.** Use your magnifier to observe the filaments of the #40 and #41 bulb. How do the filaments compare?

_____

_____

**8.** Which bulb has more resistance, the #41 or the #40? _____
*(Hint: Think back to the activity using the resistance board.)* Why?

_____

_____

_____

_____

**9.** In a series circuit with a #40 and a #41 bulb, is the flow of electricity greater in the #40 bulb, greater in the #41 bulb, or the same in both? Explain.

_____

_____

_____

_____

# Comparing Filaments (cont.)

**10.** In a paragraph, explain why the #40 and the #41 bulbs in a series circuit act as they do. Be sure you use the words resistance and filament in your explanation.

# Short Circuits

Follow the directions below to learn more about short circuits.

**Materials:**

4 15 cm copper wires
2 #40 bulbs
2 batteries
2 battery holders
2 bulb holders
1 switch
red pencil or crayon

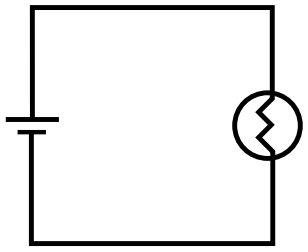
**Tip:** ***Conserve your batteries by not leaving the short circuits connected for a long time.***

**1.** Construct Circuit **A**. What do you observe?

_____

_____

_____



**Circuit A**

**2.** What kind of circuit is **A**? Why?

_____

_____

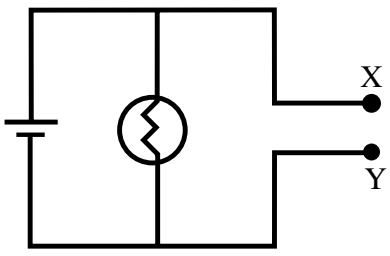
_____

**3.** Add wires to Circuit **A** to make Circuit **B**. What do you observe?

_____

_____

_____




**Circuit B**

**4.** What kind of circuit is **B**? Why?

_____

_____

_____

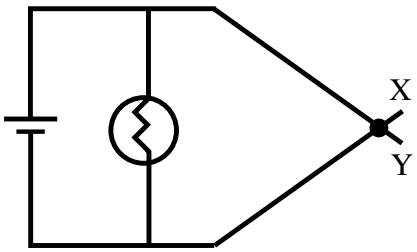
# Short Circuits

**5.** Make Circuit **C** by touching X and Y together. What do you observe?

_____

_____

_____




**Circuit C**

**6.** What kind of circuit is **C**?_____

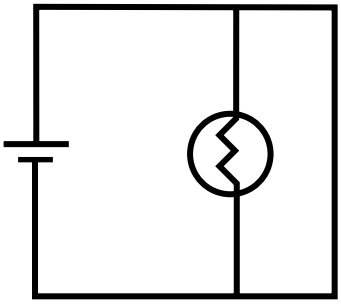
**7.** Use a red pencil or crayon to draw the paths of electricity on Circuits A, B, and C.

In Circuit C, the copper wires touching at X and Y provide a path of lower resistance than the filament of the bulb. The electricity by-passes the bulb and goes through the copper wire. The bulb does not light. When the electricity follows a path of lower resistance, as in Circuit C, it is known as a **short circuit**.

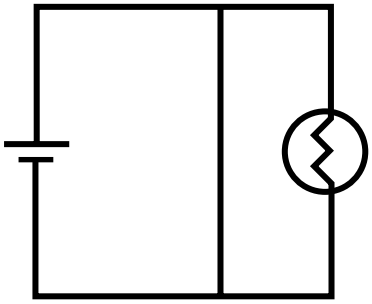
# Short Circuits (cont.)

Look carefully at each wiring diagram below. Predict if the bulb or bulbs will light by writing **yes** or **no** in the space provided. Construct the circuits to see if your predictions were correct. Record your results.

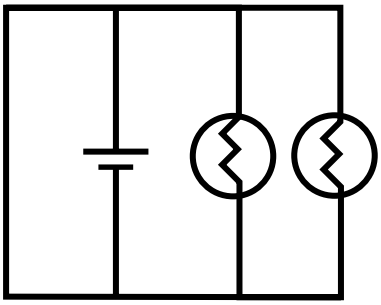
**8. Prediction**_____ **Result** _____



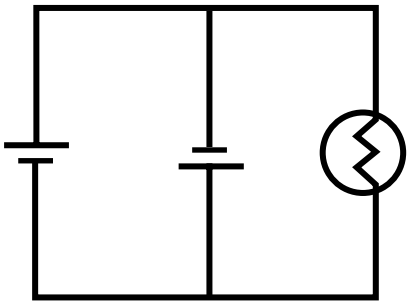
**9. Prediction** _____ **Result** _____



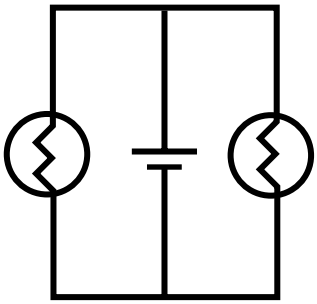
**10. Prediction**_____ **Result** _____



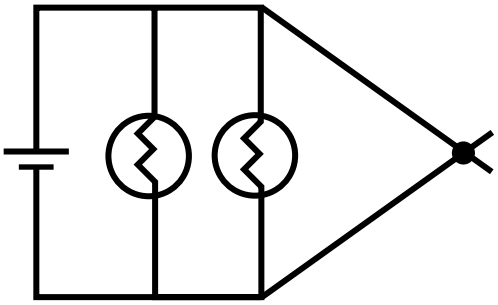
**11. Prediction** _____ **Result** _____



**12. Prediction**_____ **Result** _____



**13. Prediction** _____ **Result** _____



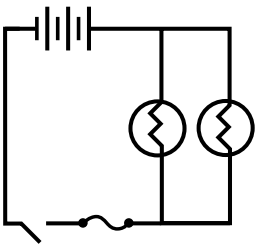
**14.** Use a red pencil or crayon to make changes to any of the diagrams above which have short circuits so the bulbs will light.

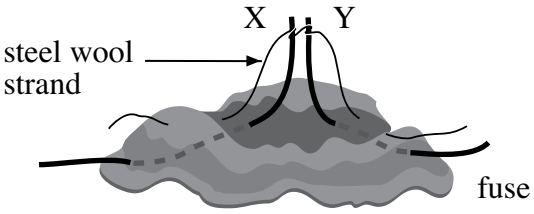
# Making a Fuse

**1.** Construct the circuit below using two #40 bulbs. Leave the switch open. The fuse is constructed from clay, copper wires, and a strand of steel wool (see below). Push the X wire and the Y wire through the clay so that about 2 cm of each wire is exposed. Wires X and Y should be about 1 cm apart. Wrap one strand of steel wool around the X wire and then around the Y wire. Press the ends of the steel wool into the clay.

**Materials:**

8 15 cm copper wires
3 batteries
3 battery holders
2 #40 bulbs
2 bulb holders
1 #41 bulb
1 screwdriver
1 switch
clay
metric ruler
red pencil or crayon
steel wool strand






**2.** Avoid getting close to the fuse when testing the circuit. Close the switch. Do the bulbs light?_____

**3.** Use a red pencil or crayon to trace the flow of electricity in the circuit diagram above. Does the electricity flow through the fuse?_____

**4.** Take out one of the #40 bulbs. Is the other bulb still lit? _____
What does this tell you about the arrangement of the bulbs in this circuit?

_____

_____

**5.** Open the switch. Put a #41 bulb into the empty bulb holder. Remember: avoid getting close to the fuse when testing the circuit. Close the switch. What did you observe? _____

_____

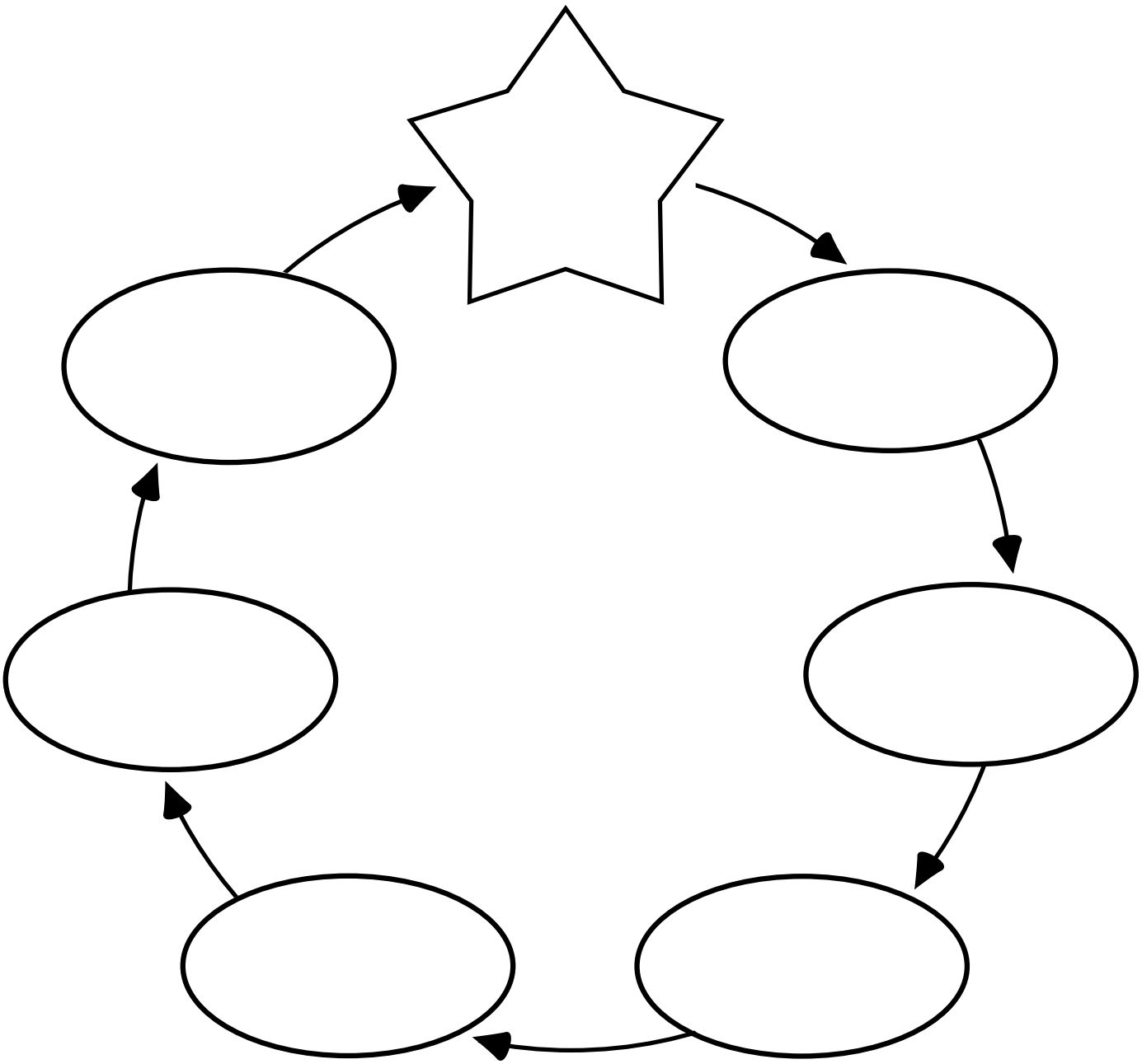
**6.** Open the switch. Put another strand of steel wool around wire X and wire Y. Watch the steel wool very carefully when you close the switch. Explain why this happened? _____

_____

_____

# Engineering Design Challenge

Read the steps of the **engineering design** process in the box below. Discuss each step with your class. Decide what order the steps should be followed. Write the steps in order on the Engineering Design Process diagram below. Write the first step in the star.



| | | | |
|---|---|---|---|
| **Identify the problem** | **Brainstorm possible solutions** | **Improve the design** | **Develop the design** |
| **Test the prototype** | **Build a model or prototype** | **Identify criteria and constraints** | |

# Engineering Design Challenge (cont.)

Read each problem below. Discuss each problem with the members of your team. Choose one of the problems to solve. You and your teammates will design a product to solve one of the problems, and the product must be battery powered. To design the product, use your knowledge about electricity and the engineering design process. The materials from the ***Electrical Circuits*** kit can be used to build the product. Other materials from home can be brought to class (to be approved by the teacher).

**a.** A family has one member who has difficulty hearing. The family wants your team to design a system that will allow visitors to announce themselves when they arrive at the door. The system must fit near the main entryway of the house. It is the only system in the house so it must be useful for all members of the family. It must be battery powered.

**b.** Joey has a treasure box, and his little brother is always taking things out of it. He wants your team to design a product that will alert him when his brother is in his box. The product must be hidden on or near the treasure box. It also must be safe to use. It must be battery powered.

**c.** Your team has been asked to design an electrical device that would be used to teach 3rd graders about an important topic in math or science. The device must be able to fit on ½ of a student's desk. It must be battery powered. Instructions on how to use the device must be included.

**1.** What I was really happy with in my team's solution:

_____

_____

_____

**2.** What was OK in my team's solution:

_____

_____

_____

# Engineering Design Challenge (cont.)

**3.** What I was not happy with in my team's solution:

_____

_____

_____

**4.** Some things I learned while doing this project:

_____

_____

_____

_____

_____

_____

_____

_____

_____

**5.** New vocabulary I learned while doing this project:

_____

_____

_____

_____

_____

_____

_____

_____

_____

# Glossary

***Acid*** - a substance that is below 7 on the pH scale and conducts electricity.

***Appliance*** - a piece of equipment that is usually operated electrically. Examples include refrigerators, washing machines, toaster, etc.

***Base*** - a substance that has an excess of OH- ions. Another word for base is alkali.

***Base terminal*** - the soldered knob at the bottom of a bulb that must be touched in order to complete a circuit.

***Battery*** - an object that produces an electrical charge or current.

***Battery holder*** - used to secure a battery in place in a circuit. The ends of the holder are extensions of the battery terminals where wires are attached.

***Bulb*** - an object that produces light when electricity passes through it.

***Bulb holder*** - used to secure a bulb in place in a circuit. The ends of the holder are extensions of the bulb terminals where wires are attached.

***Chemical energy*** - energy in a substance that can be released by a chemical reaction.

***Circuit*** - a complete or partial path through which an electrical current may flow.

***Circuit breaker*** - a safety device that automatically stops the flow of electricity when the current becomes excessive.

***Circuit tester*** - an electrical device made from a battery, a bulb and wires used to test for electrical current.

***Closed circuit*** - when an electrical current flows through a complete path (from one battery terminal through the circuit and back to the other battery terminal), also called a complete circuit.

***Conduct*** - to serve as a channel or medium for electricity.

***Conductor*** - material through which energy, such as electricity, moves easily.

***Conductivity*** - the property or power of conducting heat, electricity, or sound.

***Conserve*** - to prevent waste or loss (of energy).

***Constant*** - the part(s) of an experiment that remain unchanged under specified conditions.

***Constraints*** - restrictions that affect planning and outcome of a project.

***Control*** - the part of an experiment which is not changed, used to compare to other parts of the experiment.

***Criteria*** - a rule or principle for evaluating or testing something.

***Current*** - a flow of electricity through a conductor measured in amperes.

***Dry cell*** - a type of electric cell (battery) whose contents are made of a paste which can not spill.

***Electrician*** - a tradesman specializing in electrical wiring of buildings, machines, and equipment.

# Glossary (cont.)

***Electricity*** - a form of energy, a movement of particles through wire used for lighting, heating, etc.

***Energy*** - the capacity for doing work.

***Energy transformation*** - energy changing from one form to another.

***Engineer*** - a person who uses scientific knowledge to solve practical problems.

***Engineering design*** - a process used by engineers to help develop products.

***Evidence*** - something that proves or disproves something.

***Fahnestock clip*** - a device used to hold wire in some circuits.

***Filament*** - the resistant wire in a light bulb that becomes heated and produces light when electricity passes through it.

***Fuse*** - a strip of easily melted metal, placed in a circuit as a safeguard.

***Gauge*** - the measurement of the thickness of wire, the larger the number of gauge the thinner the wire.

***House current*** - the alternating electrical current flowing through the circuits in houses; this type of current is dangerous and should not be experimented with.

***Insulator*** - a material that does not conduct electricity, used to cover and support electrical wires.

***Interaction*** - when one object influences or changes another object.

***Matter*** - anything that has mass and takes up space.

***Negative terminal*** - the terminal of a battery marked by a minus (-) symbol.

***Nichrome wire*** - a type of wire that has a high resistance to electrical flow.

***Open circuit*** - a circuit in which no electrical current can flow because the path for the current is broken, also called an incomplete circuit.

***Parallel circuit*** - an electrical circuit in which there are multiple paths for the electricity to follow.

***Polarity*** - the positive (+) and negative (-) electrodes of a battery which affect the flow of electricity in a circuit.

***Positive terminal*** - the terminal of a battery marked by a plus (+) symbol.

***Power surge*** - a sudden sharp increase of electrical current in a circuit.

***Prediction*** - to state what you think a future observation might be.

***Problem*** - a question proposed for solution or discussion.

***Prototype*** - the model on which something is based or formed.

***Regulator*** - a mechanism that controls the flow of electricity in a circuit.

***Resistance*** - the opposition offered by a material to the steady flow of electric current.

***Rheostat*** - a device for varying the resistance in an electric circuit,

usually for varying the brightness of lights.

***Safety*** - the state of being safe; freedom from risk of injury or danger.

***Salt*** - a chemical formed when an acid and a base are combined, for example table salt, and conducts electricity if dissolved in water.

***Schematic*** - a plan or diagram of electric wiring in a circuit.

***Series circuit*** - an electrical circuit in which there is only one path for the electricity to follow.

***Short circuit*** - when electricity accidentally follows an alternate lower resistant path, often causing damage.

***Side terminal*** - the terminal found on the side of the base of a bulb.

***Socket*** - a device into which something fits, i.e.: light bulb, electrical cord, etc.

***Solution*** - 1. the act of solving a problem or question. 2. a mixture of two or more substances, often (but not always) a liquid solution.

***Support wires*** - wires used to support the filament in a light bulb.

***Switch*** - a device for making or breaking a connection in an electric circuit or for altering the connection in a circuit.

***Symbol*** - something that stands for or represents another thing.

***System*** - a group of interacting objects.

***Terminal*** - points which must be touched in order to make a complete circuit.

***Variable*** - the part of the experiment being tested that is different from the controls.

***Volt*** - a unit of electric force.

***Voltage*** - a measure of electrical energy.

***Wet cell*** - a type of electric cell (battery) which contains a liquid.

***Wire*** - a metal conductor that carries electricity over a distance.

***Wiring diagram*** - a drawing using symbols to show the arrangement of wires and other devices in a circuit.

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