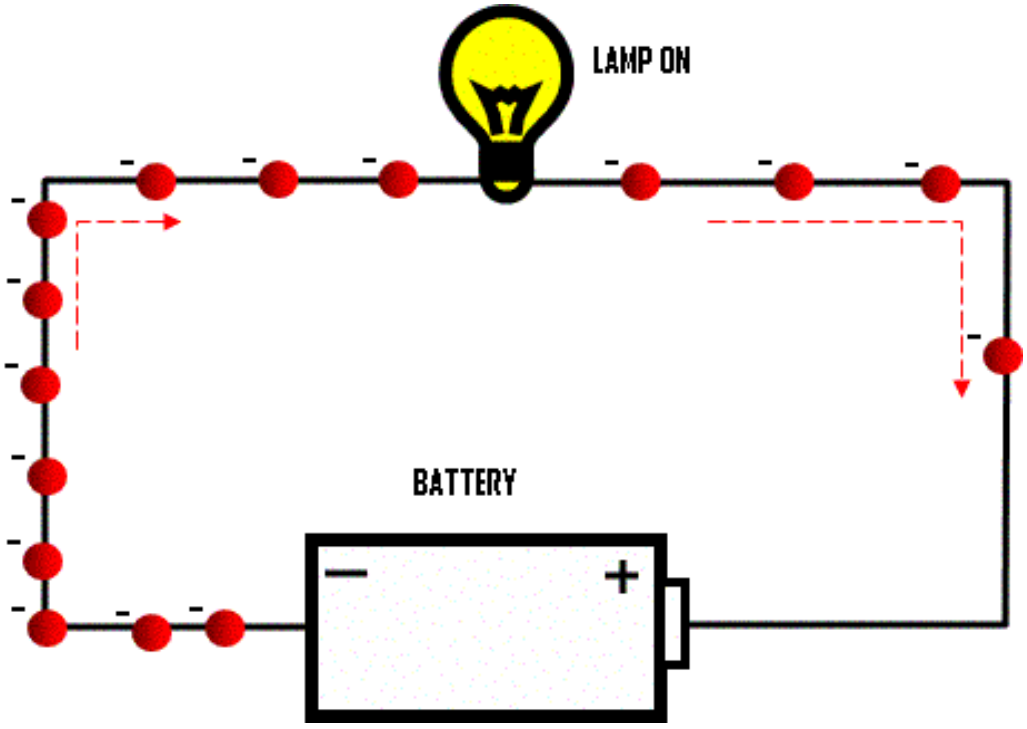
ELEMENTARY SCIENCE PROGRAM
MATH, SCIENCE & TECHNOLOGY EDUCATION

A Collection of Learning Experiences on

ELECTRICAL CIRCUITS

Revised August 2008

Electrical Circuits Student Activity Book



Name_____

This learning experience activity book is yours to keep. Please put your name on it now. This activity book should contain your observations of and results from your experiments.

When performing experiments, ask your teacher for any additional materials you may need.

TABLE OF CONTENTS

Activity Sheet for Learning Experience #2 Name_____

SIMPLE CIRCUITS WITH A BULB, A BATTERY AND WIRES

Materials:
Electrical Circuits Student Activity Book
2 15 cm. pieces of #20 bare copper wire
#48 bulb
"D" battery

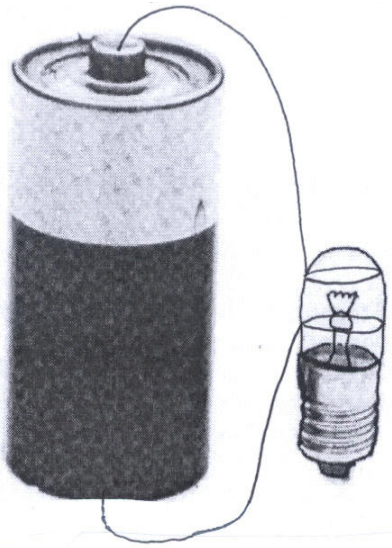
1. Examine diagrams A–J on the next two pages. Predict whether the circuit will be complete, and record your prediction on the chart below.

2. Your teacher, with a helper, will demonstrate the arrangements to test your predictions. Record their results on the chart below.

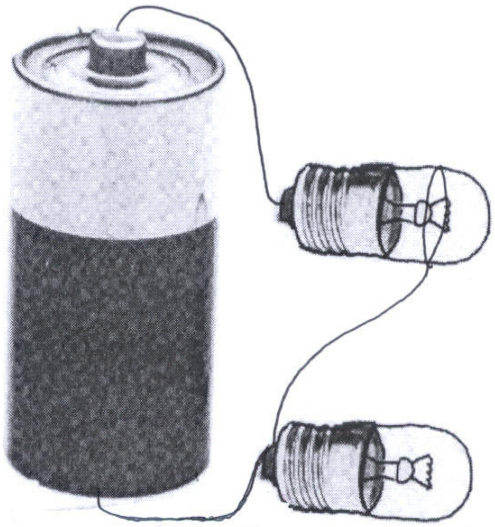
PREDICTION CHART

	Prediction		Test	
Circuit	Bulb will light		Results	
	Yes	No	Yes	No
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				

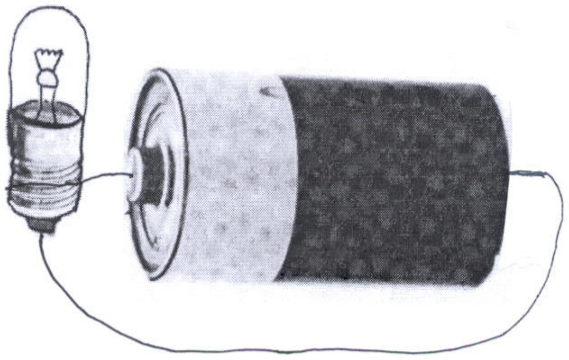
A



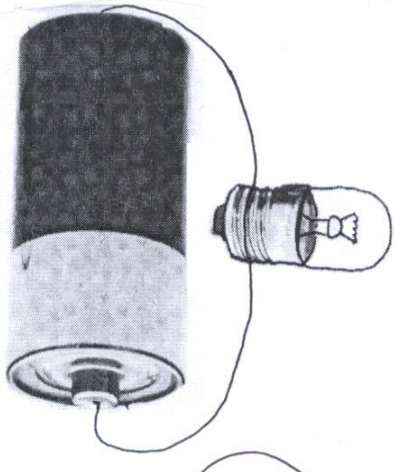
B



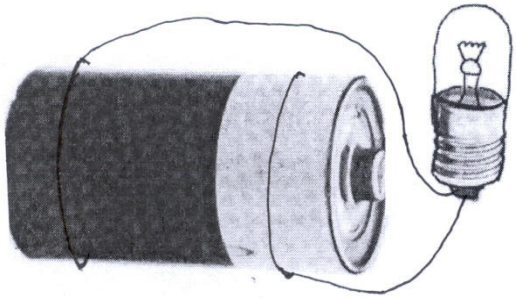
C



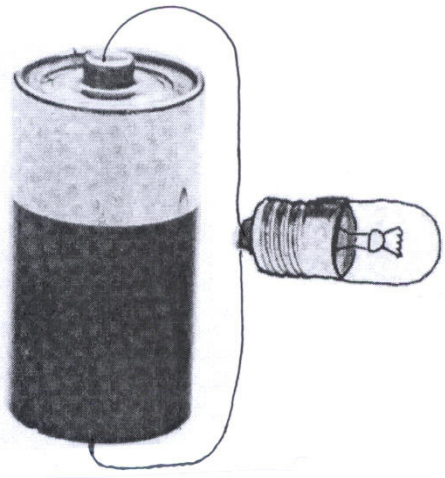
D

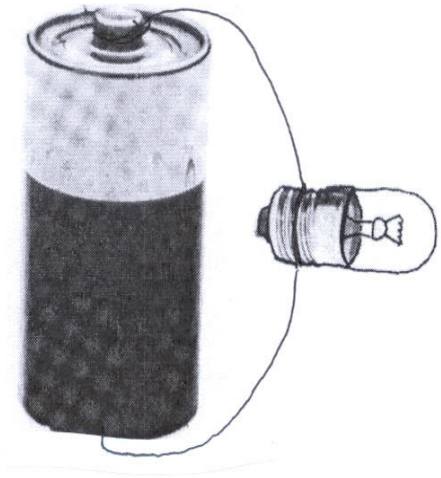


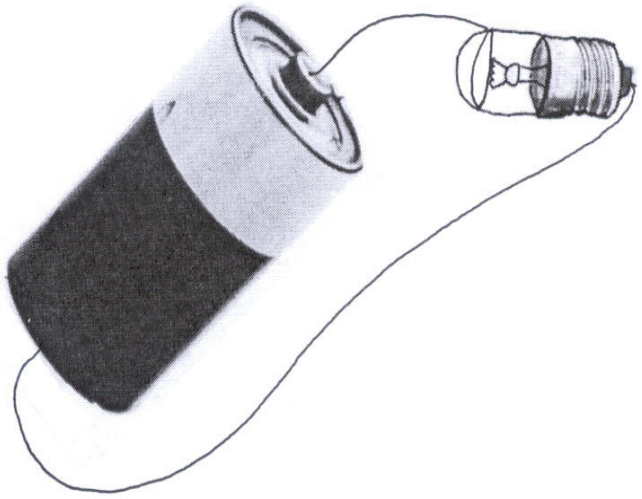
E



F



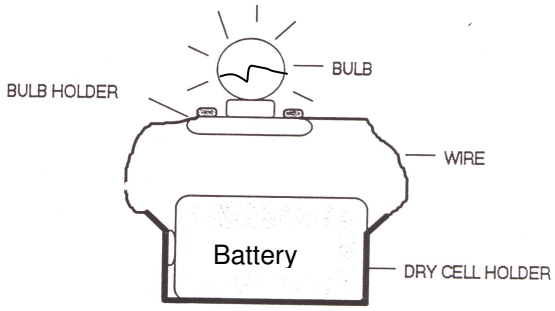




J

3. What makes the bulb light?

You may already understand an electrical circuit, or this may seem like magic to you. Give what your teacher demonstrated some thought. Why do you think the bulb in the diagram lights?



Activity Sheet for Learning Experience #3 Name_____

THE BULB AS PART OF A CIRCUIT

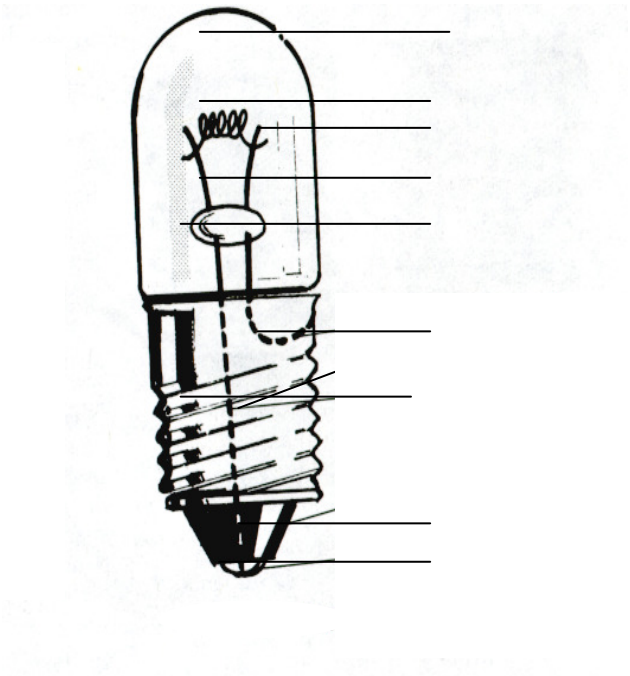
Session 1:

Materials:

Electrical Circuits Student Activity Book
#48 bulb
#41 bulb
2 bulb holders
Triple-lens magnifier
4 15 cm. pieces of #20 bare copper wire
2 "D" batteries
2 assembled battery holders
Red pencil/pen*

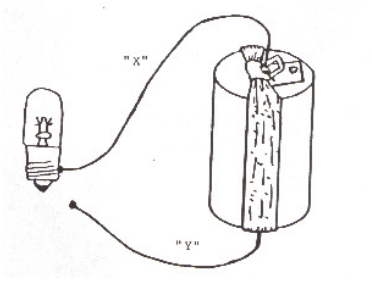
*provided by teacher

1. Label the following parts of the bulb on the picture below: gas, bulb, filament, support wire, glass bead, side terminal, base terminal, insulator, solder (between side terminal and base terminal).



2. Use a red pencil or pen to trace the flow of electricity through the bulb, by using arrows on your drawings.

3. Look at the picture below. Think about where the wires should be placed on the bulb to make the bulb light. Look at your diagram in question #1. Use your materials, and construct the circuit and actually make the bulb light.
   Explain where you placed the wires and why you placed them there.



_____

_____

_____

4. What happens if you reverse the position of wires "X" and "Y"? Explain why this occurs.

_____

_____

_____

Session 2:
MAKING A LEMON BATTERY CELL

Your teacher, with the help of one or two students, will construct a battery made from a large, juicy lemon, a galvanized nail and a copper penny.

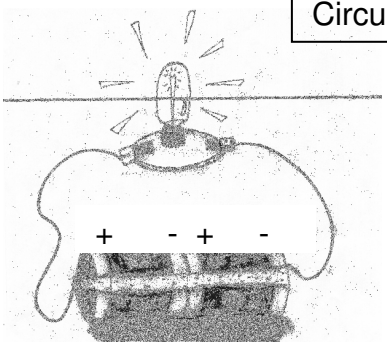
1. Draw a picture of the lemon battery cell that your teacher has constructed. Label the (–) negative electrode (nail) and the (+) positive electrode (penny).

Session 3:

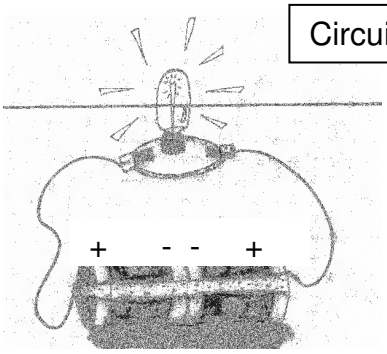
WHAT'S POLARITY?

Materials:
Electrical Circuits Student Activity Book
2 "D" batteries
2 assembled battery holders
Bulb holder
#48 bulb
3 15 cm. pieces of #20 bare copper wire

Circuit A



Circuit B



1. Study circuits A and B above. How are they different?

_____

_____

2. In which circuit, A or B, do you think the bulb will light? Write your prediction, and explain why you made this prediction.

_____

_____

3. Construct both circuits. In which circuit did the bulb light? _____

4. State the rule that should always be followed when connecting batteries in series.

_____

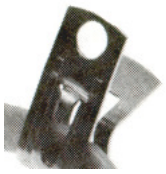
_____

Activity Sheet for Learning Experience #4 Name_____

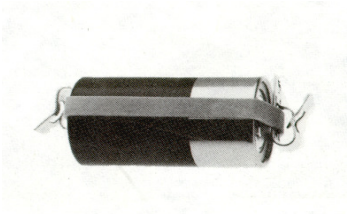
BATTERY AND BULB HOLDERS

Materials:
Electrical Circuits Student Activity Book
2 15 cm. pieces of #20 bare copper wire
4 Fahnestock clips
2 #82 rubber bands
Small storage box (shoe box)*
*provided by teacher or students
Bulb holder
#48 bulb
2 "D" batteries

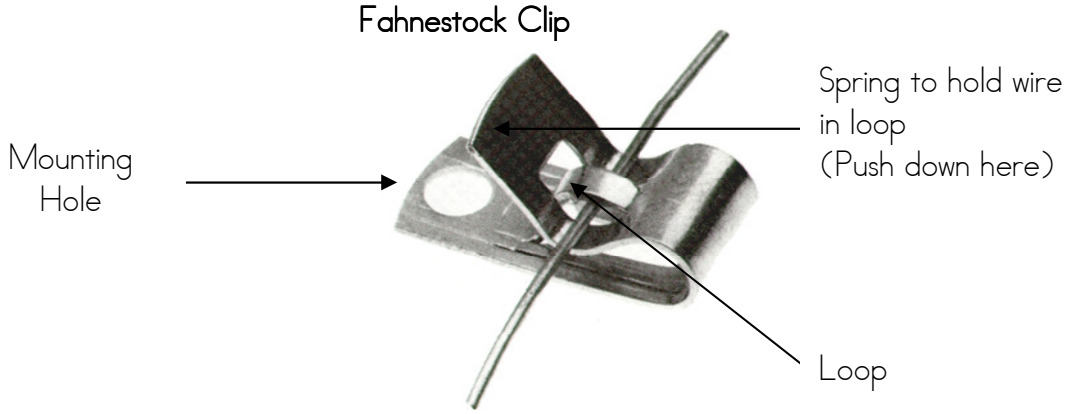
Make a battery holder as shown in the diagrams below. You will need one rubberband and two Fahnestock clips for each battery holder.



Place the holder around a battery so that a Fahnestock clip touches each end terminal of the battery.



If you squeeze the open ends of the Fahnestock clip, you can slide the end of a wire under the small loop that is exposed. Two pieces of wire can be "joined" together using a Fahnestock clip by placing both wires in the loop.



Put one end of a piece of wire in each Fahnestock clip on the battery holder. Then place the other ends of those wires in the Fahnestock clips that are mounted on the bulb holder. Does the bulb light?

Activity Sheet for Learning Experience #5 Name_____

SCHEMATIC DIAGRAMS

In the box below are the symbols that are widely known and used in drawing schematic diagrams of electrical circuits:

Schematic Diagram Symbols

Battery:
Positive Terminal:
Negative Terminal:

Bulb:

Switch:

Resistance:

Fuse:

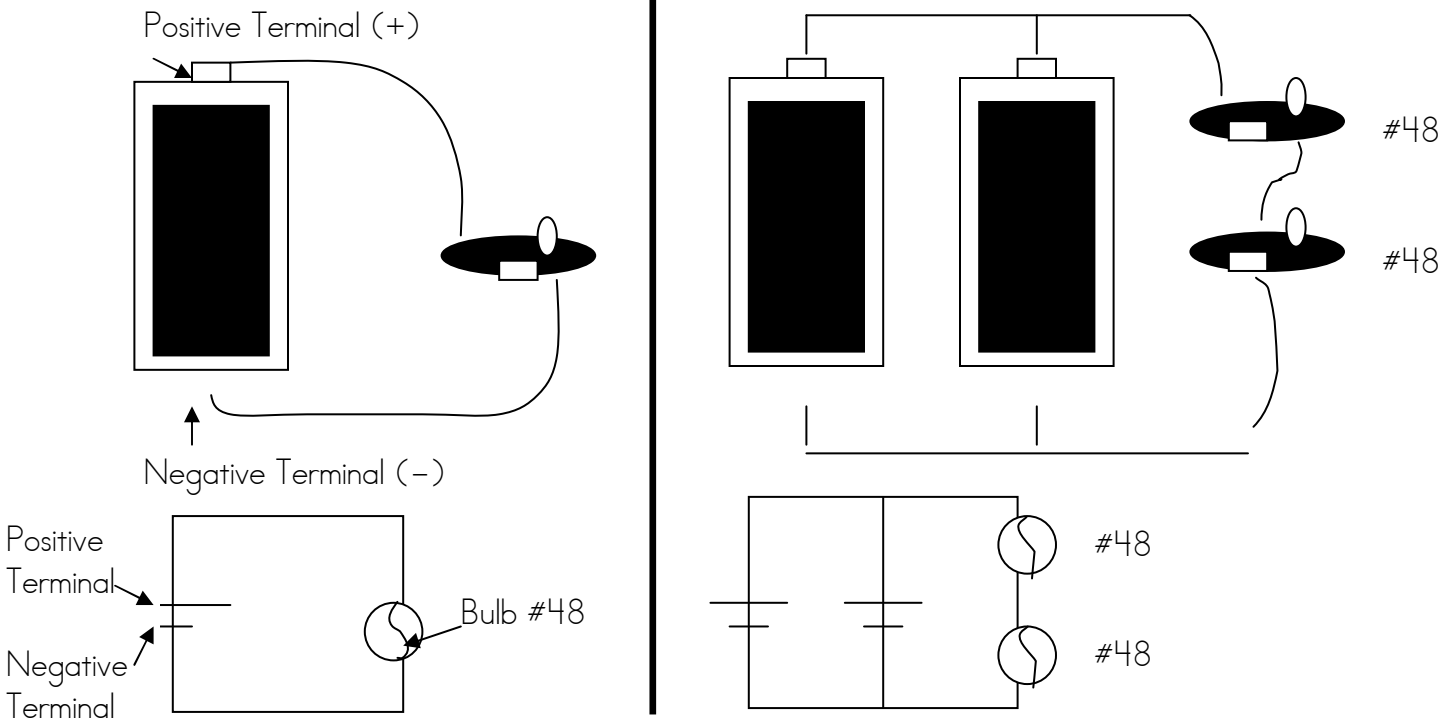
Wire:

Test Point:

Wires Joined:

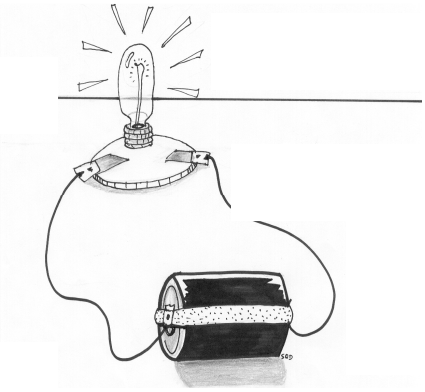
Wires crossed
but not joined:

The circuits pictured on the top are represented by the corresponding schematic diagrams on the bottom:

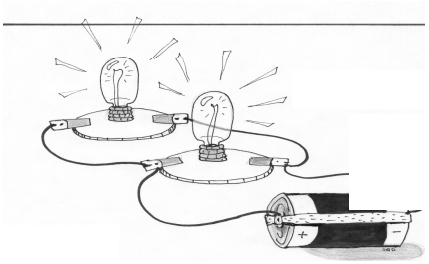


Pictured below are six complete electrical circuits. On another sheet of paper, draw the schematic diagram for each circuit.

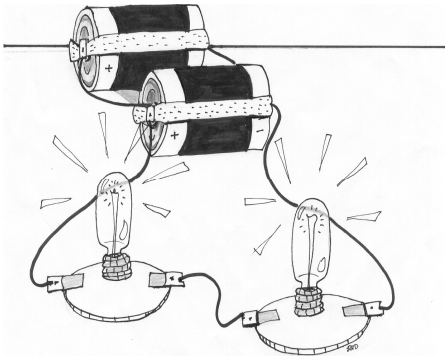
1.



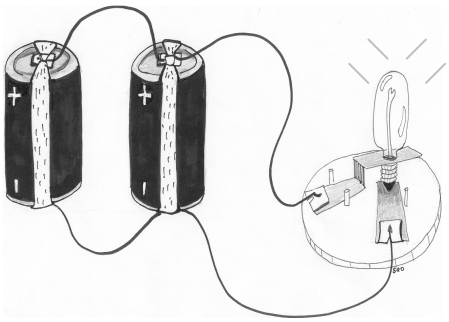
2.



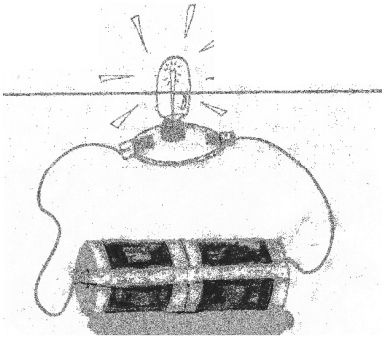
3.



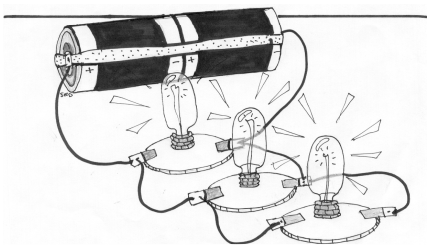
4.



5.

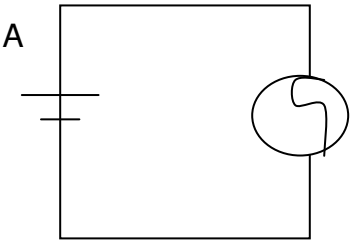


6.

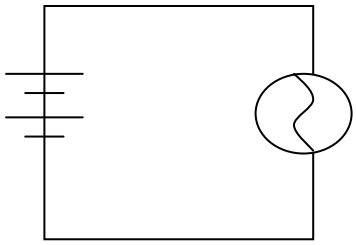


7. Read the schematic diagrams below. Construct the circuits shown below using batteries, bulbs, battery holders and bulb holders.

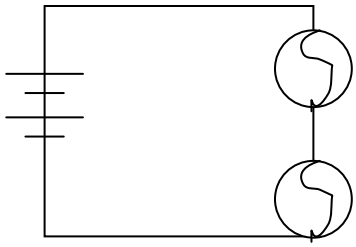
A



B

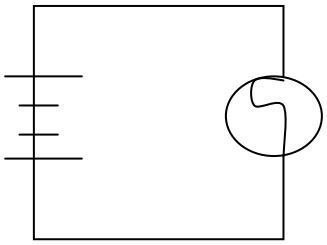


C



Remember to now use schematic diagrams whenever you draw a circuit in this activity book.

8. Will the bulb light if you construct the circuit below? Why or why not?



_____

_____

_____

Activity Sheet for Learning Experience #6 Name_____

BRIGHTNESS METER

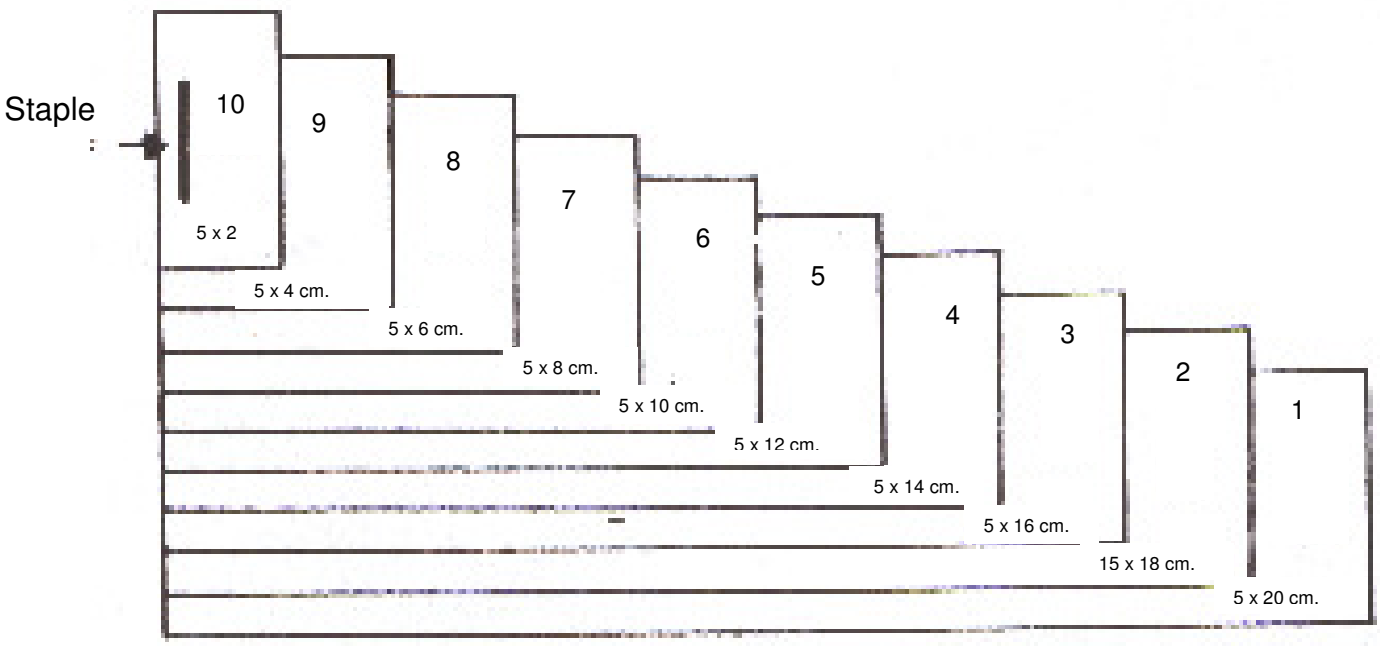
Materials:

Electrical Circuits Student Activity Book

3 "D" batteries
Bulb holder
#48 bulb
2 15 cm. pieces of #20 bare copper wire
Metric rulers*
White duplicating paper (15 x 28 cm. or 8.5 x 11 in.)*
3 #82 rubberbands
6 Fahnestock clips
Stapler*
Scotch tape*
Scissors*

*provided by teacher

1. Cut 10 strips of white duplicating paper 5 cm. wide and ranging in length from 2 to 20 centimeters. Each piece of duplicating paper should be 2 cm. longer than the one preceding it. Piece #1 should be 20 cm. long, piece #2 should be 18 cm. long, etc. (See diagram below.)
2. Write the metric size on each section near the bottom edge of each strip.
3. Put the strips in a pile according to length with the shortest one on top. Staple or tape the strips together at the left edge.



4. **How to use the brightness meter**:
   - Place the number "1" on the brightness meter over the lighted bulb.
   - Keep moving the numbers over the bulb until you can no longer see the light from the bulb through the paper.
   - When you reach that number, the number before it should be recorded as the brightness of the bulb because it was the last place on the brightness meter that the bulb could shine through.

(Example: 7 – can see the bulb, 8 – can see the bulb, 9 – cannot see the bulb. Brightness of the bulb = 8)

5. Construct a complete circuit with one battery and one bulb. Place the brightness meter over the bulb, and measure the brightness of the bulb. What is the rating of this bulb on the brightness meter? _____

6. Construct a complete circuit using two batteries and one bulb. Now that you have added another battery, what do you predict the bulb's brightness will be?

_____

Why did you make this prediction? _____

_____

Use the brightness meter to measure the brightness of the bulb. What is the actual brightness of this bulb on the brightness meter? _____

7. Construct a complete circuit using three batteries and one bulb. What do you predict the bulb's brightness will be? _____

Why did you make this prediction? _____

_____

Use the brightness meter to measure the brightness of the bulb. What is the actual brightness rating of this bulb on the brightness meter? _____

8. What is the relationship between the number of batteries and the brightness of the bulb? _____

_____

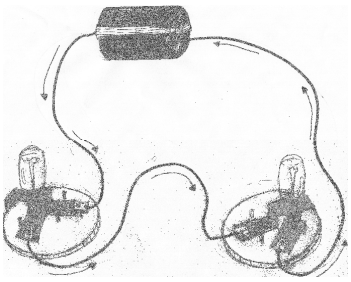
Keep this brightness meter in your storage container for use in future learning experiences.

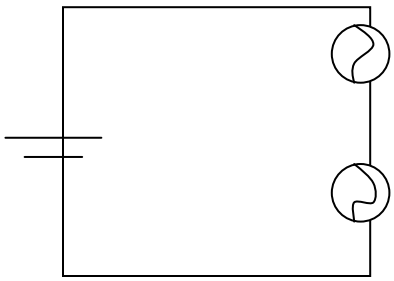
Activity Sheet for Learning Experience #7 Name_____

SERIES CIRCUIT

Materials:
Electrical Circuits Student Activity Book
"D" battery 3 #48 bulbs
3 bulb holders Assembled battery holder
4 15 cm. pieces of #20 bare copper wire (as needed)

1. Construct a complete circuit with a battery and a bulb.
2. Using another wire, add a second bulb as shown on the picture below.





3. What did you notice happened to the first bulb when the second bulb was added?

_____

_____

4. Look carefully at how the series circuit is set up. Write a prediction of what you think will happen if you unscrew one of the bulbs.

_____

_____

Why did you make this prediction? _____

_____

5. Unscrew bulb "X". Describe what happens to bulb "Y".

_____

_____

6. Tighten bulb "X", and unscrew bulb "Y". Describe what happens to bulb "X".

_____

_____

7. Add a third bulb to your series circuit. What happens to the brightness of the bulbs each time another bulb is added to the series? Use your brightness meter to help you.

_____

_____

8. Draw a schematic diagram of the circuit you constructed with three bulbs.

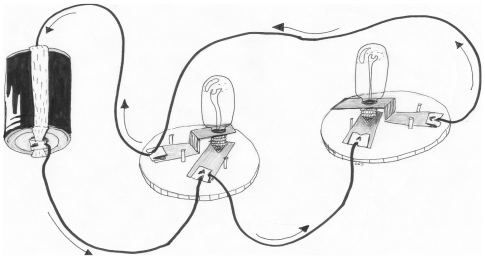
Activity Sheet for Learning Experience #8 Name_____

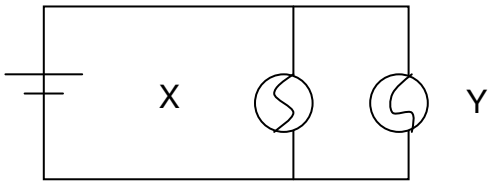
PARALLEL CIRCUIT

Materials:
Electrical Circuits Student Activity Book
"D" battery
Assembled battery holder
6 15 cm. pieces of #20 bare copper wire
3 #48 bulbs
3 bulb holders

1. Construct a complete circuit with one battery and one bulb.

2. Using another two wires, add a second bulb as shown on the picture below





3. What do you notice happened to the first bulb when the second bulb was added?

_____

_____

4. Look carefully at how a parallel circuit is set up. Write a prediction of what you think will happen if you unscrew one of the bulbs in the parallel circuit.

_____

_____

Why did you make this prediction? _____

_____

5. Unscrew bulb "X". Describe what happens to bulb "Y".

_____

_____

6. Tighten bulb "X" and unscrew bulb "Y". Describe what happens to bulb "X".

_____

_____

7. Pair up with another team of two students. Create a parallel circuit using one battery and both groups' sets of bulbs. How many bulbs did you light? Was the brightness of the bulbs affected when you added more bulbs? Why or why not?

_____

_____

_____

_____

Activity Sheet for Learning Experience #9 Name_____

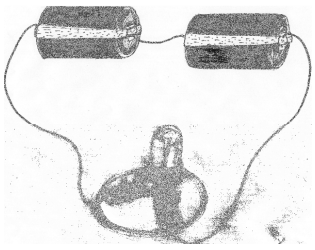
BATTERIES WIRED IN PARALLEL AND IN SERIES

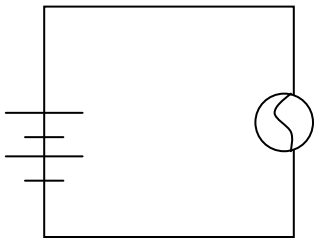
Materials:
Electrical Circuits Student Activity Book
3 "D" batteries
3 assembled battery holders
6 15 cm. pieces of #20 bare copper wire
2 #48 bulbs
2 bulb holders

1. Construct a complete circuit with one battery and one bulb.
2. Measure the brightness of the bulb with your brightness meter. What is the bulb's brightness? _____
3. Construct the circuit below. Are these batteries in series or parallel?_____

   How can you tell? _____

   _____





4. Use the brightness meter to test the brightness of this bulb. Is the bulb brighter than it was with one battery? _____

_____

5. If you added a third battery to this circuit in series, what do you think would happen to the brightness of the bulb? _____

_____

Why do you think this? _____

_____

6. Add a third battery to this circuit. Describe what happens to the bulb as this battery is added to this circuit in series and why you think the bulb is acting in this way.

_____

_____

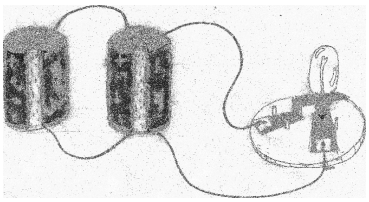
7. Construct another complete circuit with one battery and one bulb. Record again what the brightness of the bulb is using your brightness meter.

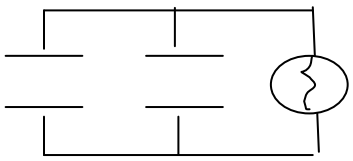
---

8. Look at the pictures below, are the batteries in the picture in series or parallel?_____

   How can you tell? _____

   _____





Construct the circuit in #8. Is the bulb brighter with two batteries than it was with one battery?_____

9. Add **one** more battery to this circuit in parallel. Describe what happens to the bulb as one more battery is added to this circuit in parallel and why you think the bulb is acting this way.

   _____

   _____

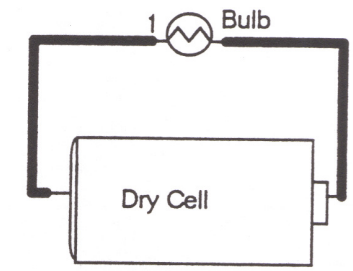
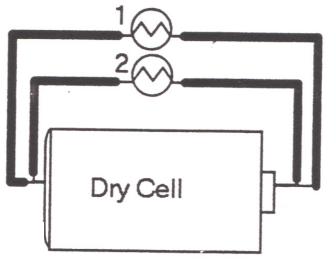
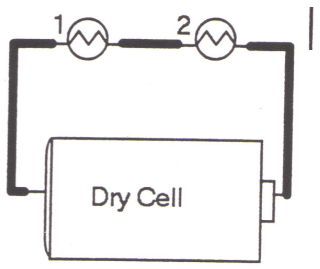
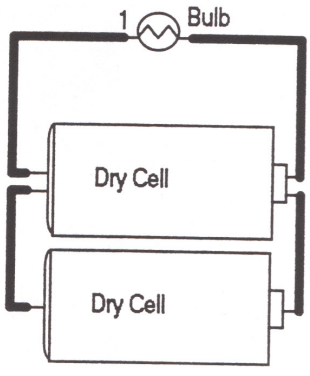
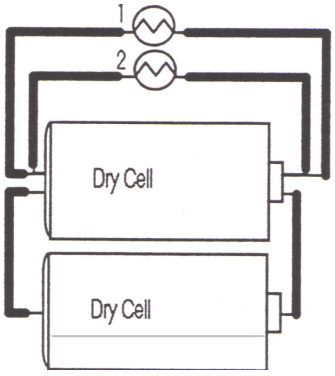
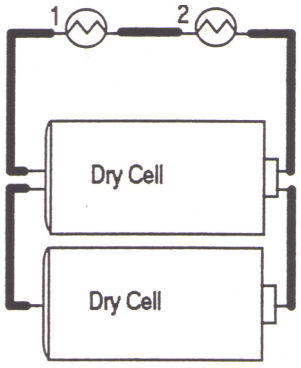
   _____

Extension:

10. Look back at the activity sheet for Learning Experience 5 – Schematic Diagrams and discuss which circuits are in parallel? _____
    Which are in series? _____
    Which are combined?_____
11. Look at the pictures on page 3 of this activity (the next page). Indicate your predicted brightness for each bulb labeled "1" in the pictures.

    Brightness scale: O = Does not light
    L = Low (1–3 on brightness meter)
    M = Medium (4–7 on brightness meter)
    H = High (8–10 on brightness meter)

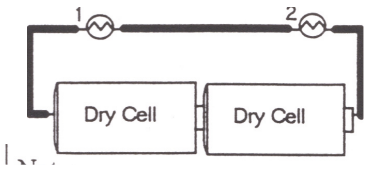
    The bulb brightness for Challenge A = Medium.

A Brightness Prediction Actual _____ _____  Notes:	B Brightness Prediction Actual _____ _____  Notes:	C Brightness Prediction Actual _____ _____  Notes:
D Brightness Prediction Actual _____ _____  Notes:	E Brightness Prediction Actual _____ _____  Notes:	F Brightness Prediction Actual _____ _____  Notes:

G Brightness

Prediction Actual

_____ _____



Notes:

Activity Sheet for Learning Experience #10 Name_____

SWITCHES

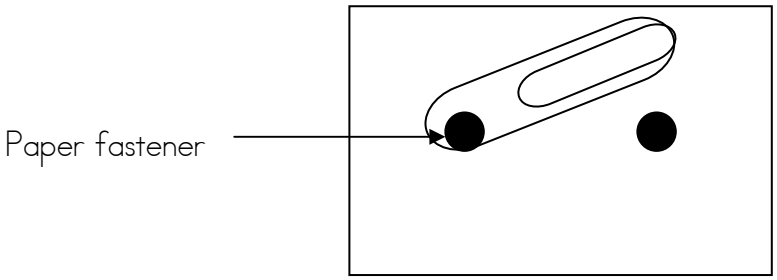
Materials:
Electrical Circuits Student Activity Book
3 15 cm. pieces of #20 bare copper wire
#48 bulb
"D" battery
Assembled battery holder
2 paper fasteners
Paper clip
3 x 5" index card*
Colored pen/pencil*

*provided by teacher

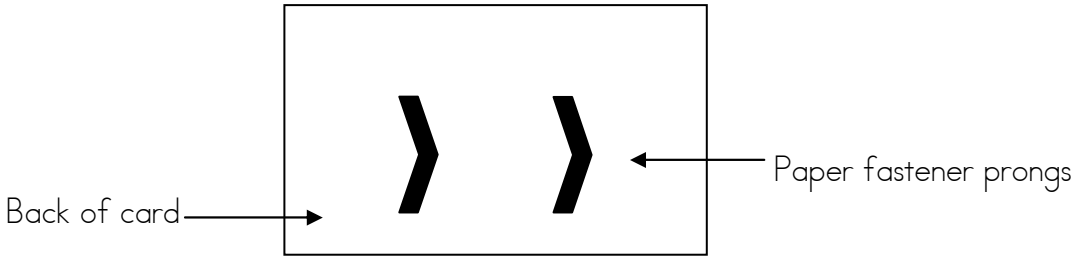
1. Place the paper clip in the center of the index card. With a pencil, make a mark at each end of the paper clip

2. Use the tip of a pencil to punch small holes where the two dots are.

3. Put a paper fastener in each hole. One paper fastener should go on the inside of the paper clip.

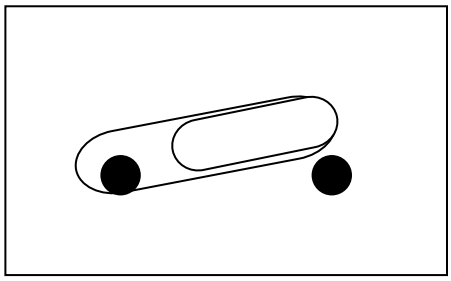


4. Flip the card over and flatten the prongs of the paper fasteners.



Tape the prongs down to the card. Be sure the prongs do not touch one another.

5. When your switch is complete, you should be able to move the paper clip so that it touches the head of the other paper fastener.



6. Hook up the switch to a simple circuit using the wires, battery and bulb.

Draw a picture of the circuit with the switch in the box below. Use schematic drawing. See the symbol for a switch for Learning Experience #5.

With a colored pen or pencil, trace the flow of electricity through the circuit.

When you use the switch to turn on the light bulb, are you closing the circuit? Explain why you think it would be called a "closed" circuit.

_____

_____

_____

When you "open" a switch, what happens to the circuit?

_____

_____

_____

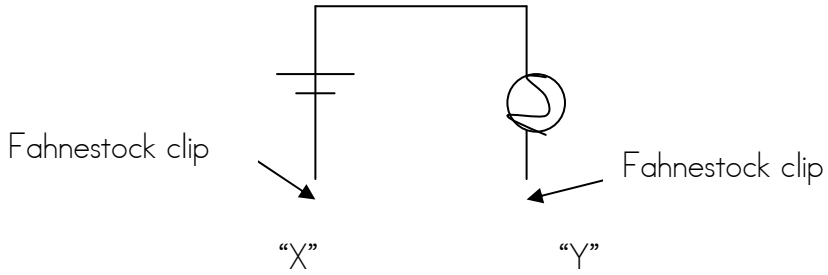
Activity Sheet for Learning Experience #11 Name_____

SOLID CONDUCTORS AND INSULATORS

Materials:
Electrical Circuits Student Activity Book
3 15 cm. pieces of #20 bare copper wire
#48 bulb
Bulb holder
"D" battery
Assembled battery holder
2 Fahnestock clips
Variety of solids such as pencils, erasers, paper clips, clay, scissors, crayons, etc.*

*provided by teacher

Create a circuit tester like the one pictured in the diagram below.



1. Touch wire "X" and wire "Y" together to make a complete circuit. Does the bulb light? _____ (If the bulb does not light, problem solve with your partner to figure out why the bulb is not lighting.)
2. Choose 10 different objects in your classroom to test to see if they conduct electricity. Predict whether or not you think the object will conduct electricity. (In other words, if you place the wires from the circuit tester on the object, the bulb will light.) Record your predictions on the chart on Page 2 of this activity sheet.
3. Use the circuit tester to test the materials in your classroom to see if they conduct electricity or do not conduct electricity. Touch wire "X" to one side of the object and wire "Y" to the other side of the object. Record if the bulb lights on the chart below. If the bulb lights, the object is a conductor of electricity. If the bulb does not light, it is a non-conductor or an insulator.

Record whether the object is a conductor or non-conductor on the chart on Page 2 of this activity sheet.

Objects	Prediction Will the bulb light? (yes or no)	Actual Result Did the bulb light? (yes or no)	Is the object a conductor or non-conductor?	What material is the object made of?
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

4. What materials are the objects that conduct electricity made of?

_____

_____

5. What materials are the objects that did not conduct electricity made of?

_____

_____

6. Name three other objects that you did not test that you predict would conduct electricity based on your results from this learning experience.

_____

_____

Extension Activity
Activity Sheet for Learning Experience #12 Name_____

BUZZERS

Materials:
Electrical Circuits Student Activity Book
2 15 cm. pieces of #20 bare copper wire
2 "D" batteries
2 assembled battery holders
Buzzer
Switch (students made in Learning Experience #13)

- Place the battery holder on the battery, and attach the red wire from the buzzer to the battery holder at the positive terminal. Attach one end of one piece of bare copper wire to the negative terminal of the battery and the other end to the switch.
- Attach the black wire on the buzzer to the switch.
- Move the paper clip to the "closed" position to sound the buzzer.

Describe what happens.

_____

_____

_____

Predict what will happen if you connected another battery to the buzzer.

_____

_____

Place another battery in a holder, and hold the two batteries together end to end. Now attach the wires of the buzzer to the ends of the batteries. Did the buzzer sound change? Explain.

_____

_____

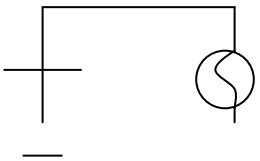
_____

Extension Activity
Activity Sheet for Learning Experience #13 Name_____

HIDDEN CIRCUITS CARD

Materials:
Electrical Circuits Student Activity Book
"D" battery
Assembled battery holder
Hidden circuits card
3 15 cm. pieces of #20 bare copper wire
Hole punch*
#48 bulb
Bulb holder
Scissors*
*provided by teacher

1. Construct the circuit tester shown below.



2. Construct the hidden circuit connections with aluminum foil. The aluminum foil conducts electricity. Connect the foil strips between the numbers on the inside of your card. Attach the aluminum foil to the card with tape. Be careful not to cover the entire piece of foil. See the example in figure 1 below. Make your hidden circuits different from the one shown in figure 1. You will be switching circuit folders with other students. They will be trying to find your hidden circuits!
3. Be sure you place a piece of aluminum foil over the hole for each number, even if the foil does not lead to another letter in the folder.
4. Close the cover on the circuit folder. Use the circuit tester to check the hidden circuits. Place the wires on the holes covered with aluminum foil. If your bulb lights, you found a path. If you cross strips of aluminum foil, place a piece of tape between the pieces of foil so the person that tests your card does not get an inaccurate reading.

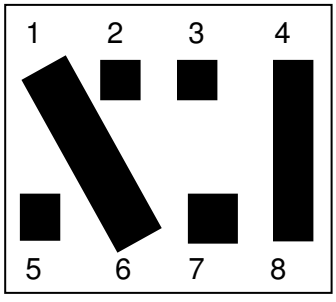


Figure 1

If your hidden circuit looked like the one above…….

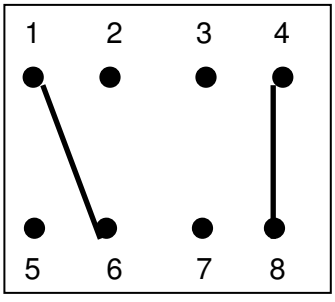
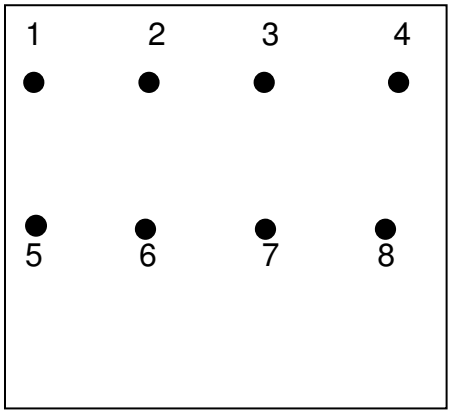
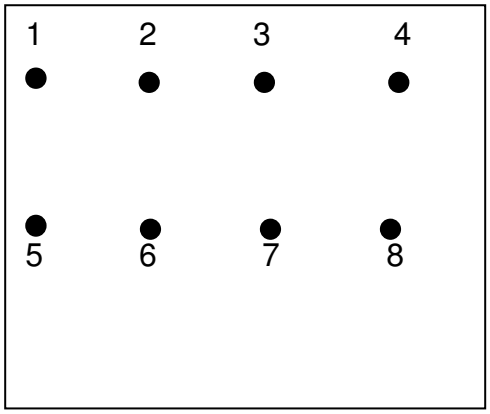


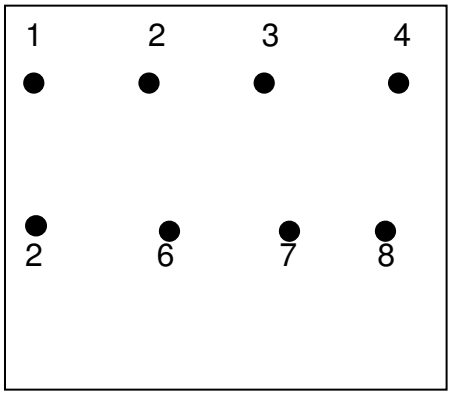
Figure 2

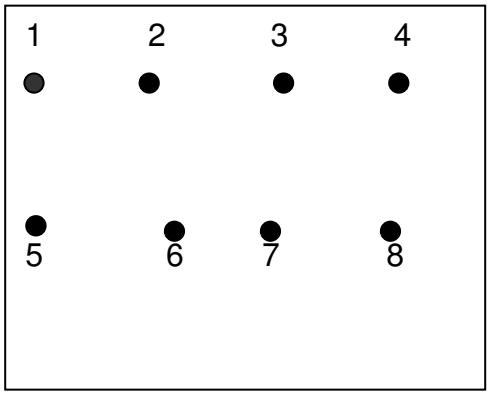
you would draw the hidden circuit like this.

5. Exchange your circuit folder with another student, and test their hidden circuits. Draw lines showing paths you identify for each circuit folder you tested in the first box below. Don't peak! Repeat this exchange three more times.









Extension Activity
Activity Sheet for Learning Experience #14 Name_____

COMPARING BULB FILAMENTS

Materials:
Electrical Circuits Student Activity Book
#48 bulb
Triple-lens magnifier
2 "D" batteries
4 15 cm. pieces of #20 bare copper wire
2 bulb holders
#41 bulb
2 assembled battery holders

The size of the wire in a filament is numbered in the same way as all wire. Therefore, a #41 bulb has #41 gauge wire as its filament and a #48 bulb has #48 gauge wire as its filament.

1. Observe the filament of a #48 bulb very carefully through a magnifier. Also observe the filament of a #41bulb very carefully through a magnifier. Describe in writing or with a picture how the filament in a #48 bulb is different than the filament in a #41 bulb.

_____

_____

2. If you were to light each of these bulbs, which do you think would be brightest and why?

_____

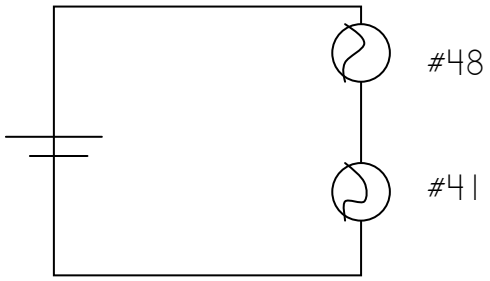
_____

3. Create two complete circuits. In one circuit, light a #41 bulb, and in the other light a #48 bulb. How do they compare in brightness?_____

_____

4. From what you observed with the magnifiers, what conclusion can you make between the filament and the brightness of the bulb?_____

_____



5. Construct the series circuit above. Explain what you observe.

_____

_____

6. How does this differ from the series circuit you made with two #48 bulbs in Learning Experience 7? _____

_____

_____

7. Reverse the #41 and #48 bulbs, and record what happens. _____

_____

_____

8. Why do you think these results are occurring? _____

_____

_____

9. If you were to set up a parallel circuit with a #48 and a #41 bulb, what do you think would happen? _____

_____

10. Set up a parallel circuit with a #41 bulb and a #48 bulb. Describe what happens.

_____

_____

_____

11. Are your results different than the series circuit with a #41 and #48 bulb? Explain.

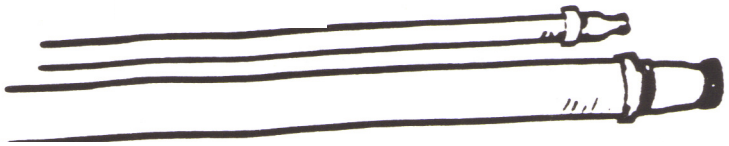
_____

_____

_____

Extension Activity
Activity Sheet for Learning Experience #15 Name_____

INTRODUCTION TO RESISTANCE



1. Which hose will conduct more water? Explain why?

_____

_____

2. Which wire will conduct more electricity? Explain Why?

_____

_____

When a material limits the amount of electricity that can pass through it, it has **resistance**. All materials that conduct electricity have some resistance.

Wires used in circuits	Gauge wire
Copper wire used in the electrical circuits kit.	#20
Wires used in circuits in houses/schools.	#14
Wires used in circuits in refrigerators.	#12
Wires used in circuits in electric stoves.	#8

The higher the gauge wire number, the thinner the wire. Copper wire is the most commonly used wire because it has a low resistance to the flow of electricity. Nichrome wire has more resistance to electricity than copper wire.

3. Which nichrome wire, #26 (thick) or #32 (thin), will conduct electricity the best? Explain your answer.

4. Which conducts electricity better, a long piece of Nichrome wire or a short piece of Nichrome wire? Explain.

5. Nichrome wire is more resistant to the flow of electricity than copper wire. If enough electricity goes through the nichrome wire, the nichrome wire will get hot and turn red. Name some appliances found in the home that use nichrome wire.

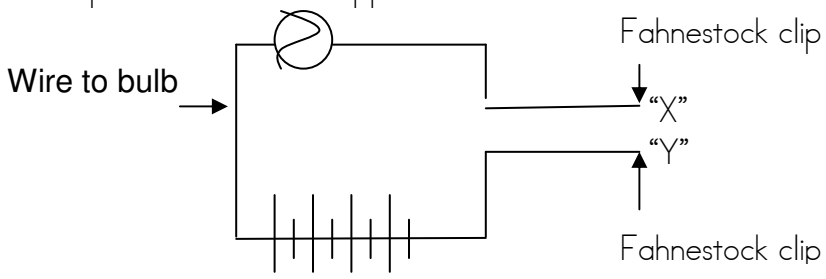
6. Look up the word **rheostat** in a dictionary. Where do you have a rheostat in your home or car?

Extension Activity
Activity Sheet for Learning Experience #16 Name_____

LIQUID CONDUCTORS & NON CONDUCTORS

Materials:
Electrical Circuit Student Activity Book

4 "D" batteries	Bulb holder
4 assembled battery holders	#41 bulb
Teaspoon salt, sugar, baking soda, vinegar	5 medicine cups
2 Fahnestock clips	Toothpick
3 15 cm. pieces #20 bare copper wire	Warm water*
3 5 cm. pieces #20 bare copper wire (to hook	



1. Construct a circuit tester like the one pictured above. Attach one Fahnestock clip to test point "X" and one Fahnestock clip to test point "Y".

2. Touch Fahnestock clip "X" and Fahnestock "Y" together to make it a complete circuit. Does the bulb light? (If it does not light, problem solve with your partner to figure out why the bulb is not lighting.)

3. Look at the liquids listed on the chart on the next page. If the Fahnestock clips are placed in the liquids, which liquid would light the bulb? Predict which liquids will or will not conduct electricity. Record your predictions on the chart below.

4. Fill one medicine cup with water and another with vinegar. Solutions are made by first filling the three remaining medicine cups with warm water. Add one level teaspoon of salt to the warm water gradually, then one level teaspoon of sugar to another cup, and then one level teaspoon of baking soda to the last.

5. Test to see if the five liquids or solutions conduct electricity by placing the Fahnestock clip "X" and Fahnestock clip "Y" into the liquid. Be careful to keep the clips close to each other (about 5 mm.) but not touching. (For best results, the flat sides of the Fahnestock clips should face each other.)

Liquids	Prediction	Actual Result
	Will the liquid conduct electricity? (yes or no)	Did the liquid conduct electricity? (yes or no)
Plain water		
Vinegar		
Salt solution (salt & water)		
Sugar solution (sugar & water)		
Baking soda solution (water & baking soda)		

6. Look carefully at your results. What conclusions can you make about the solutions that conduct electricity and solutions that do not conduct electricity?

_____

_____

_____

7. Name three other liquids you did not test that you predict would conduct electricity based on your results from this learning experience.

_____

_____

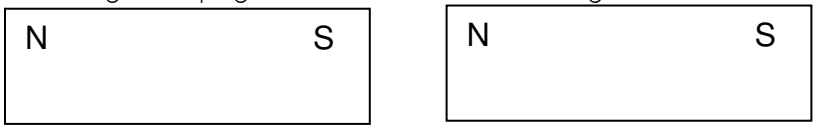
_____

Extension Activity
Activity Sheet for Learning Experience #17 Name_____

MAGNETISM AND ELECTRICITY

Materials:
Electrical Circuits Student Activity Book
Test objects (iron nail, aluminum nail, gram centimeter cube, glass marble)
2 bar magnets
Compass
"D" battery
Assembled battery holder
30 cm. piece of #20 enameled copper wire

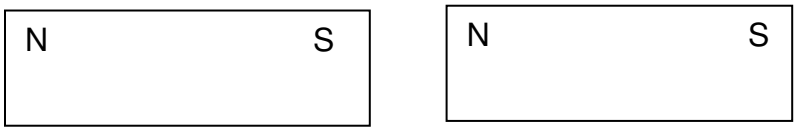
Place your two magnets upright on your desk and facing one another, as shown below.



1. What happens to the first magnet when you move the second magnet closer to it?

_____

_____



2. Turn the first magnet so the two north poles are next to each other. Then move it closer to the second magnet. Describe what happens.

_____

_____

3. The ends of a magnet are called **poles**. What happens to the magnets when two "opposite" poles come close to each other?

_____

_____

4. How is that different or similar to when two "like" poles come close to each other?

_____

_____

5. Test to see which of the four objects are attracted to the magnet. Place an "X" in the correct box below. Choose four items from your desk to see if they are attracted to a magnet. Write their names on the chart below, and record your results.

Object	Attracted to magnet?	
	Yes	No
1. iron nail		
2. aluminum nail		
3. gram centimeter cube		
4. glass marble		
5.		
6.		
7.		
8.		

6. What conclusions can you make about what material magnets are attracted to based on your data above. _____

_____

Extension – Session 2

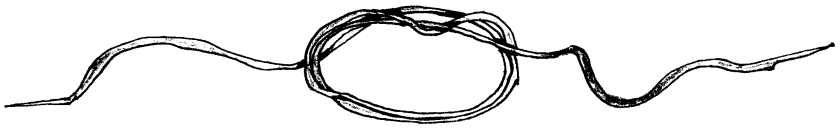
Place the compass on your desk, and observe how the needle comes to the rest in a specific direction. Pick up your magnet, and move it back and forth over the compass.

7. Describe what happens to the compass needle when the magnet is moved back and forth over the compass.

_____

_____

Coil up the 30 cm. of #20 enameled copper wire as shown below. Sand the ends of the enameled wire 1 cm. from the end.



8. Hold the ends of the wire in your hand and describe what happens to the compass needle when the wire is moved back and forth over the compass.

_____

_____

Connect the ends of the wire to the battery. Move the coiled wire back and forth over the compass at rest.

9. Describe what happens to the compass needle when the magnet is moved back and forth over the compass.

_____

_____

10. What conclusions can you make about the wire with the electrical current or electrons running through it based on your results?

_____

_____

ELECTRICAL CIRCUITS STUDENT SELF–ASSESSMENT

Name:_____

1. What do you now know about electrical circuits that you didn't know before?

_____

_____

What do you now know about magnets that you did not know before?

_____

_____

2. How do you think you and your partner(s) worked together? Give some examples.

_____

_____

3. What learning experiences did you enjoy? Explain why did you liked them.

_____

_____

4. Were there any learning experiences in the unit you didn't understand or that confused you? Explain your answer.

_____

_____

5. Take another look at your activity sheets and science notebook. Describe how well you think you recorded your observations and ideas.

_____

_____

6. How did your work in this unit affect your attitude toward science?

_____

_____

GLOSSARY

Battery:	a combination of cells that create opposing poles resulting in the ability to create an electrical current.
Brightness:	radiation of light.
Bulb:	an incandescent electric lamp.
Buzzer:	a signaling apparatus that produces a buzzing sound due to an electrical current and electromagnet.
Closed circuit:	a complete circuit, electricity is flowing.
Circuit :	a circuit is a complete or partial path through which an electrical current may flow.
Compass:	an instrument used for determining direction by a freely rotating magnetized needle that shows magnetic north.
Composition:	the material that an object is made of.
Conductor:	materials through which energy, such as electricity moves rapidly.
Connect:	to band or link together.
Contact:	a junction of electric conductors.
Copper:	metallic element that is used as a conductor of electricity.
Current:	the movement or flow of an electric charge.
Diameter:	the width or thickness of a circular figure or object.
Electron:	a negatively charged particle in an atom.
Energy:	the capacity for doing work and overcoming resistance.
Filament:	the fine metal wire (usually made of tungsten) in a light bulb that glows when heated by an electric current.

Function:	the purpose for which something is designed or exists.
Fuse:	a strip of easily melted metal, usually set in a plug, placed in a circuit as a safeguard; if the current becomes too strong, the metal melts, breaking the circuit.
Glass bead:	support wires of a bulb are placed in this bead for stability.
Insulated:	to cover with non conducting material to prevent or reduce the transfer of electricity, heat, or sound.
Insulator:	any kind of matter that does not carry electricity well or at all (glass, plastic, rubber) used to hold electricity in metal wires.
Interaction:	act on upon another.
Length:	the linear extent of anything as measured form end to end.
Liquid:	the state of matter that takes the shape of its container, feels wet, and takes up definite space (not solid or gaseous).
Magnetic Field:	the space around a magnet that has the ability to attract another magnet.
Material:	the substance of which a thing is made.
Meter:	an instrument used to measure quantity, distance, etc.
Negative:	charges with electricity caused by an excess of electrons.
Non-conductor:	materials through which electricity cannot pass.
Nichrome:	a material used to make wire that is composed of nickel and chrome.
Observe:	to become aware of an object or when by using any of the senses to identify properties.
Open circuit:	an incomplete or broken circuit, the electricity stops flowing.

Parallel circuit:	the arrangement of electrical devices where all positive terminals are joined to one conductor and all negative ones to another conductor so that there is more than one path for the electricity to follow. If one bulb fails to function, the other bulbs will stay lit.
Path:	a route along which something moves.
Polarity:	the quality or condition in a body which exhibits opposite powers in opposite direction.
Poles:	the ends of a magnet, usually labeled north and south.
Positive:	charged with electricity caused by a lack of electrons.
Prediction:	an educated guess.
Property:	an essential or distinctive trait or characteristic of a living or non living thing.
Resistance:	the opposition offered by a material to the steady flow of electric current.
Rheostat:	an adjustable resistor used for controlling the current in a circuit, as in dimming lights.
Schematic:	a symbolic representation of all parts of a system.
Series circuit:	a series circuit is a circuit which all parts are connected end to end so there is only one path through which electricity can flow.
Short circuit:	a closed circuit of electricity that is formed with a wire and a power source such as a battery; a circuit that bypasses the main circuit and takes a "shortcut" back to the power source.
Solution:	a homogenous mixture of two substances.
Strategy:	a detailed plan for reaching a goal.
Support wire:	wires in a bulb that holds the filament in place.
Switch :	a device for making or breaking a connection in an

	electrical circuit or for altering the connection in a circuit.
Symbols:	letters, numbers, or drawings that represent meaningful concepts or ideas.
System:	a group of interacting objects.
Terminal:	terminals are the points on the battery and bulb which must be touched in order to make a complete circuit.
Variable:	a part of an experiment that can change values.
Voltage:	the measurement of electrical pressure that flows through a wire.
Watts:	a unit of electric power, equal to the power in a circuit in which one ampere flows across a potential difference of one volt.