Name: _____ Date: _____

CONDUCTORS AND INSULATORS

Background

One thing that makes electricity useful is that not all materials conduct electricity. Materials that do not conduct electricity are called insulators.

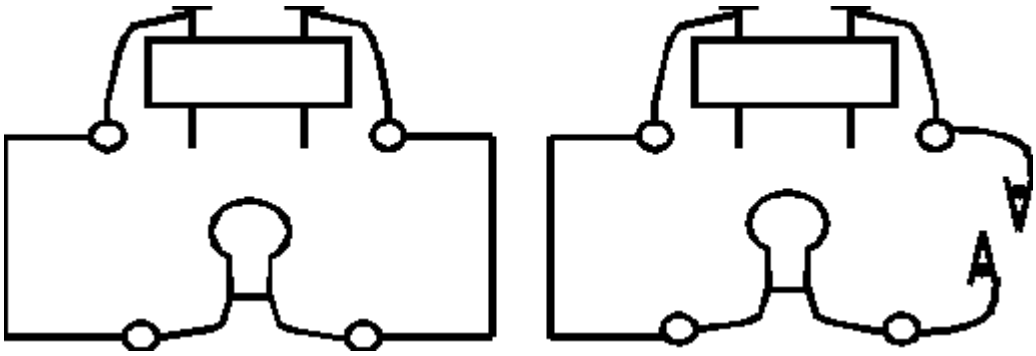
Materials Needed

1 battery in holder	bag-o-stuff
1 breadboard	wires with clips
1 light bulb	push pins
2 wires with washers	

Procedure

1. Build the simple circuit shown in the schematic below. If you do it correctly, the bulb will light.

2. Replace one of the wires with the 2 wires with clips as shown below.



3. Complete the circuit by clipping each of the materials in the bag-o-stuff between the clips.

4. Figure out which materials are conductors and which are insulators. List the materials in the following chart and check the appropriate column. How will you be able to tell which are conductors and which are insulators?

Material	Conductor?	Insulator?

Question

How would you summarize what sort of materials are insulators and which are conductors?

Name: _____ Date: _____

IS ELECTRICITY SAFE?

Background

Electricity is measured in units of volts, amps or watts. The higher the voltage, the more dangerous the electricity is.

Materials Needed

1 breadboard
2 batteries in holders
2 light bulbs
2 wires with washers
push pins

Procedure

1. Build the simple circuit with a single battery. Light the lamp.

2. Now replace the single battery by 2 batteries with both + signs in the same direction. What happens?

_____

_____

_____

3. Now reverse one of the batteries so that the two + signs are together. What happens? Why?

_____

_____

_____

4. What do you think would happen if you used 4 batteries to light one lamp?

_____

_____

_____

Try it with your neighbour.

Questions

Each D-Cell is 1.5 volts. How many volts do two D-Cells have?_____
What voltage is used in your house and school? _____

THE VOLTAGE IN YOUR HOUSE AND SCHOOL IS A LOT HIGHER THAN WE USE IN THESE EXPERIMENTS. NEVER TRY THESE THINGS USING ELECTRICITY FROM A WALL OUTLET!!

Name: _____ Date: _____

LIGHTNING ROD

Background

It too much electrical energy flows through objects they can overheat and cause fires. Since electrical current prefers the path of least resistance, we can easily protect our homes from the energy in lightning.

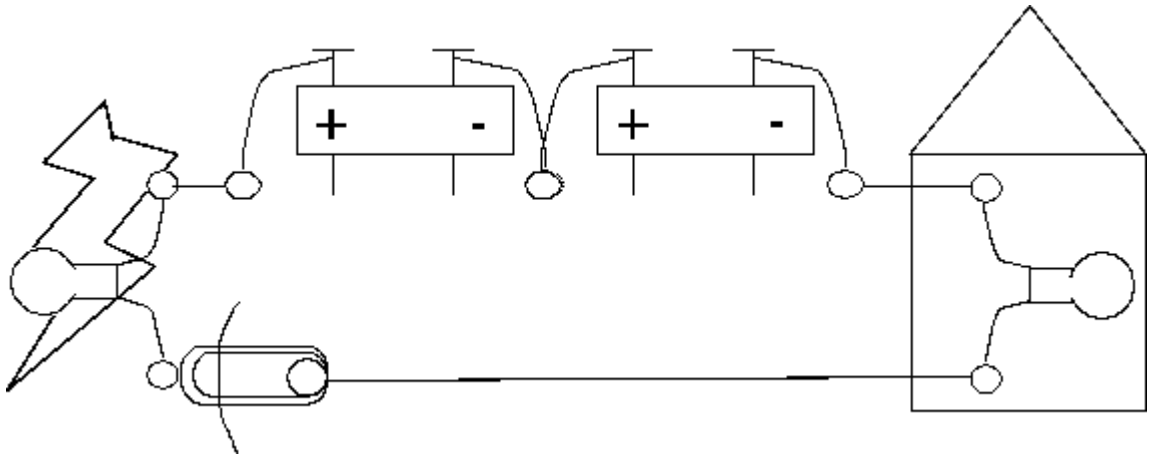
Materials Needed

2 batteries in holders	3 wires with washers	paper
1 breadboard	1 paper clip	pencil
2 light bulbs	push pins	tape

Procedure

1. Cut a lightning bolt out of paper.

2. Build the simple circuit with 2 light bulbs in series. Tape one bulb on the paper lightning bolt. When this light is lit it will indicate that lightning is striking.



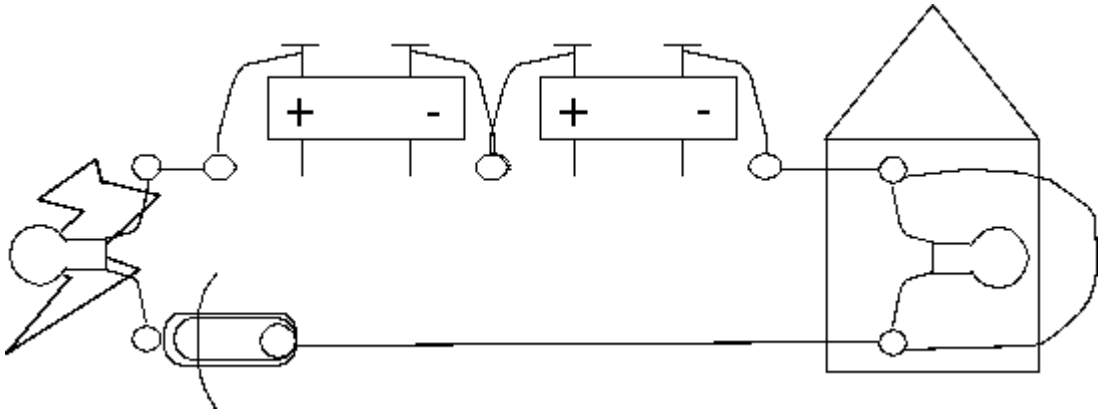
3. Make a house out of paper. Houses tend to be made of wood, bricks, etc. Are these things good conductors?

_____

4. Put the other light bulb on the house. When this light is lit it will indicate that the house has been damaged by lightning.

5. Simulate lightning striking the house by briefly closing the switch.

6. Now protect the house by building a circuit parallel to the light. This circuit must have resistance that is lower than the house so use just a plain wire.



7. Make lightning strike again by closing the switch. What happens? Why?

Name: _____ Date: _____

PARALLEL CIRCUIT

Background

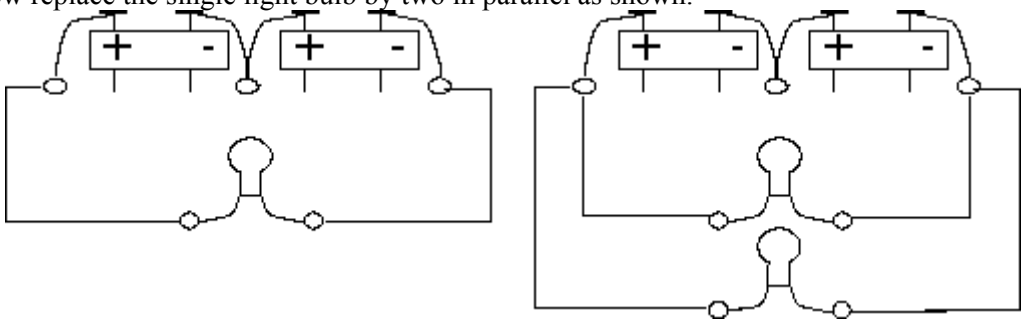
Light bulbs are in parallel if they are side-by-side. They still share the electrical energy but they affect each other differently than if they were in series.

Materials Needed

2 batteries in holders
1 breadboard
2 light bulbs
4 wires with washers
push pins

Procedure

1. Connect up the simple circuit with 2 batteries.
2. Now replace the single light bulb by two in parallel as shown.



3. Remove one bulb from its socket. What happens? Why?

_____
_____
_____

4. How does the operation of this parallel circuit compare to the series circuit you worked with earlier?

_____
_____
_____

Name: _____ Date: _____

RESISTANCE

Background

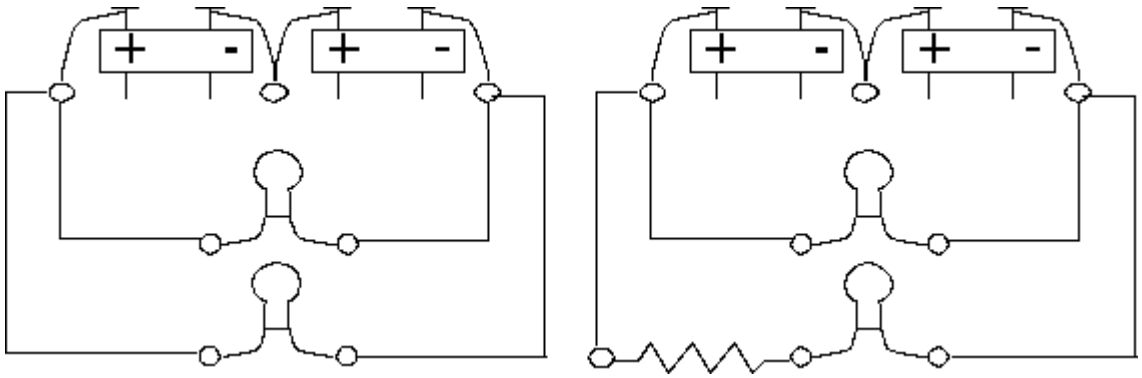
Resistors pass some electrical energy but convert some of it to heat. They are neither conductors nor insulators but somewhere in between.

Materials Needed

2 batteries in holders	2 light bulbs	2 10-Ohm resistors
1 breadboard	push pins	1 100-Ohm resistor
4 wires with washers		

Procedure

1. Build a simple parallel circuit. Both light bulbs should be lit equally.
2. Break the circuit to one of the lights and reconnect it with a resistor in the path. The resistance of an object is measured in Ohms. The higher the resistance, the more Ohms the object has. Resistors typically have the number of Ohms marked on them. Start by using the 10 Ohm resistor.



3. With the resistor in the circuit, observe and record what changes have occurred in the two lights.

_____

_____

_____

4. Replace the resistor by the 100 Ohm resistor. What happens?

_____
_____
_____

5. What do you think would happen if you put a 10 Ohm resistor in BOTH paths?

_____
_____
_____

Try it. What happens?

_____
_____
_____

Question

You have now learned about 3 types of electrical materials. What are they?

1. _____
2. _____
3. _____

Name: _____ Date: _____

SERIES CIRCUIT

Background

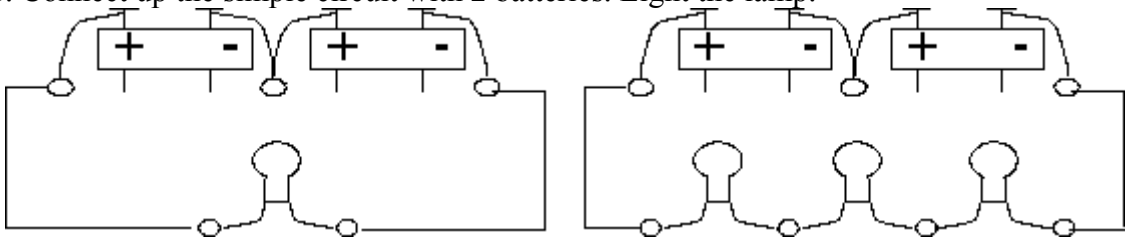
Light bulbs are said to be in series when they are in the same loop or circuit. All of the light bulbs share the available electrical energy equally.

Materials Needed

1 breadboard
2 batteries in holders
2 wires with washers
3 light bulbs
push pins

Procedure

1. Connect up the simple circuit with 2 batteries. Light the lamp.



2. Now replace the single light bulb by three in a row. Another way to say this is that the 3 lights are in series. What happens? Why?

_____

_____

_____

3. Remove one bulb from its socket. What happens? Why?

_____

_____

Question

What do you think would happen if you connected 5 bulbs in series?

Name: _____ Date: _____

SIGNALLING

Background

Signalling is a way to communicate where speaking won't work. Smoke signals, football signals and telemetry signals to spaceships are some examples. Signalling is also used to move information around inside of circuits.

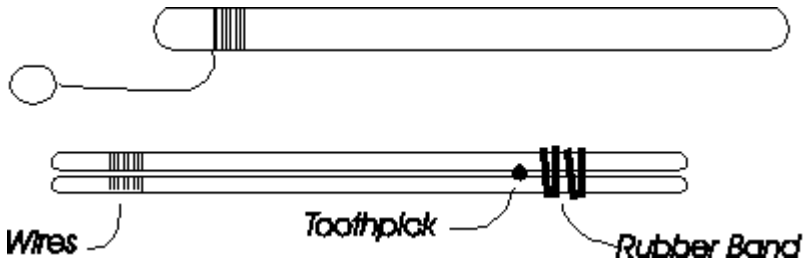
Materials Needed

1 battery in holder	1 toothpick
1 breadboard	1 rubber band
1 light bulb	2 1-foot wires with washer at one end
2 three foot wires	1 book
push pins	

Build A Switch

First you have to make a "momentary" switch. Here's how:

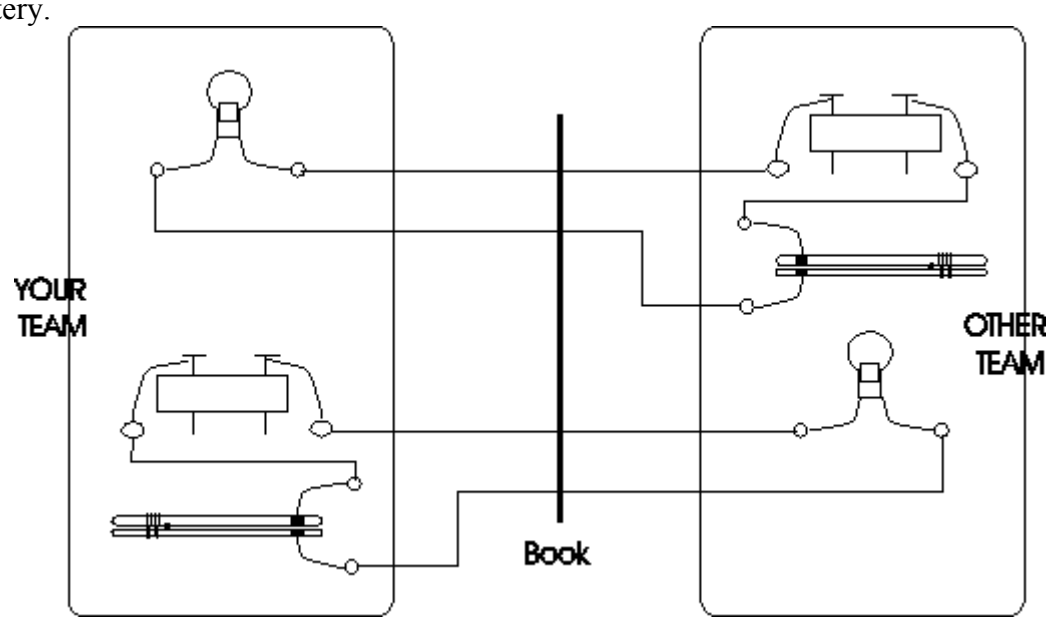
1. Take a wire that has no washer on one end and tightly wrap the bare wire around the end of one craft stick. The wires should be touching each other. Use the other wire for the other craft stick.



2. Put the 2 sticks on top of each other with the wires touching. Wrap a rubber band tightly around the other end.
3. Put the toothpick between the craft sticks near the rubber band. The wires should now touch when you push down on the switch and open up when you stop pushing.
4. Now that you have your switch, go on to the next page to finish this experiment. You will need to work with another team.

Procedure

1. Build the simple switched circuit using long wires so that your light can be placed a long way from the battery on the other team's breadboard. Keep your switch close to your battery.



2. Put a book upright between the two breadboards so that you cannot see the light and switch the other team.
3. Write a one word question and translate it into Morse Code.
4. Use Morse Code to ask the other team your question. Turn your light on for a "long" time for a dash and a "short" time for a dot. Use an extra-long flash of light to indicate that you are done.
5. Now decode their answer. Write down the dots and dashes. Then translate them into letters.

International Morse Code

Letter	Code
A	●−
B	−●●●
C	−●−●
D	−●●
E	●
F	●●−●
G	−−●
H	●●●●
I	●●
J	●−−−
K	−●−
L	●−●●
M	−−
N	−●
O	−−−
P	●−−●
Q	−−●−
R	●−●

Letter	Code
S	●●●
T	−
U	●●−
V	●●●−
W	●−−
X	−●●−
Y	−●−−
Z	●●−−

Name: _____ Date: _____

SIMPLE CIRCUIT

Background

Unlike static electricity that can exist on a single object, electrical current flows between objects.

Materials Needed

1 bread board 2 wires with washers 1 piece of string 1 battery in holder 1 light bulb push pins

Procedure

1. Figure out how to make the light bulb light.
2. Once you figure it out, draw a "schematic" of your circuit on the next page. This sort of picture is used to describe how to build a particular circuit. It uses symbols to represent things like the battery and light bulb. It shows what each wire connects together. Here are some of the symbols you can use for your schematic:
3. Once you have drawn your schematic, see how many different ways you can get the bulb to light. Draw a schematic for each one. What things are necessary in your circuit for the bulb to light?
4. Build the circuit shown here and make sure the bulb lights. Take out one of the wires. What happens? Why?
5. Build the circuit shown here and make sure the bulb lights. Replace the wire by the string. What happens?

Question

The string is an insulator and the wire a conductor. How might you define these terms?
An insulator is

_____

_____

_____

A conductor is

_____

_____

_____

Name: _____ Date: _____

STATIC ELECTRICITY

Background

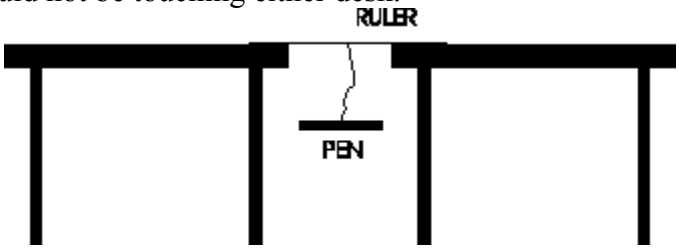
Invisible electrical charge can build up on objects that rub together. Sometimes this happens to clouds. The discharge can go unnoticed or be spectacular like lightning.

Materials Needed

2 plastic stick pens
1 ruler
1 piece of wool
30 cm of string tape

Procedure

1. Pull two desks apart and put the ruler between them. Tie the string around the middle of one pen and tape it in place. Use the string to hang this pen from the middle of the ruler. The pen should not be touching either desk.



2. For the rest of this experiment if you are asked to charge a pen, hold it by its cap and rub it briskly 50 times with the piece of wool. If you are asked to discharge a pen, roll it gently between your hands a few times.
3. Discharge both pens. Hold the loose pen by the cap and slowly bring it near the other pen. Observe what happens and record this in the chart on the next page.
4. Now charge the loose pen. Hold it by the cap and slowly bring it near the other pen. Observe what happens and record this in the chart below.

STEP	CHARGED/UNCHARGED		OBSERVATION ATTRACT,REPEL,NO EFFECT
	LOOSE PEN	HANGING PEN	
3			
4			
5			
6			
7			

5. Discharge the loose pen. Now record what happens when you bring it near the other pen?

6. Charge both pens. Record what happens when you bring them near each other.

7. Discharge the loose pen but leave the hanging pen charged. Record what happens when you bring them near each other.

Conclusion

If two objects are charged the same, they _____ each other. If they are charged differently, they _____ each other.

Name: _____ Date: _____

SWITCHED CIRCUIT

Background

Switches provide an easy way to open and close an electrical circuit.

Materials Needed

2 batteries in holders
1 breadboard
1 paper clip
2 light bulbs
2 wires with washers
push pins

Procedure

1. Assemble the simple circuit with 2 batteries. Open and close the wires to turn the bulb off and on.
2. Now wire in the paper clip as a switch as shown and use it to turn the light on and off.

Question

Why does the light go out when you move the switch?

_____

_____

_____