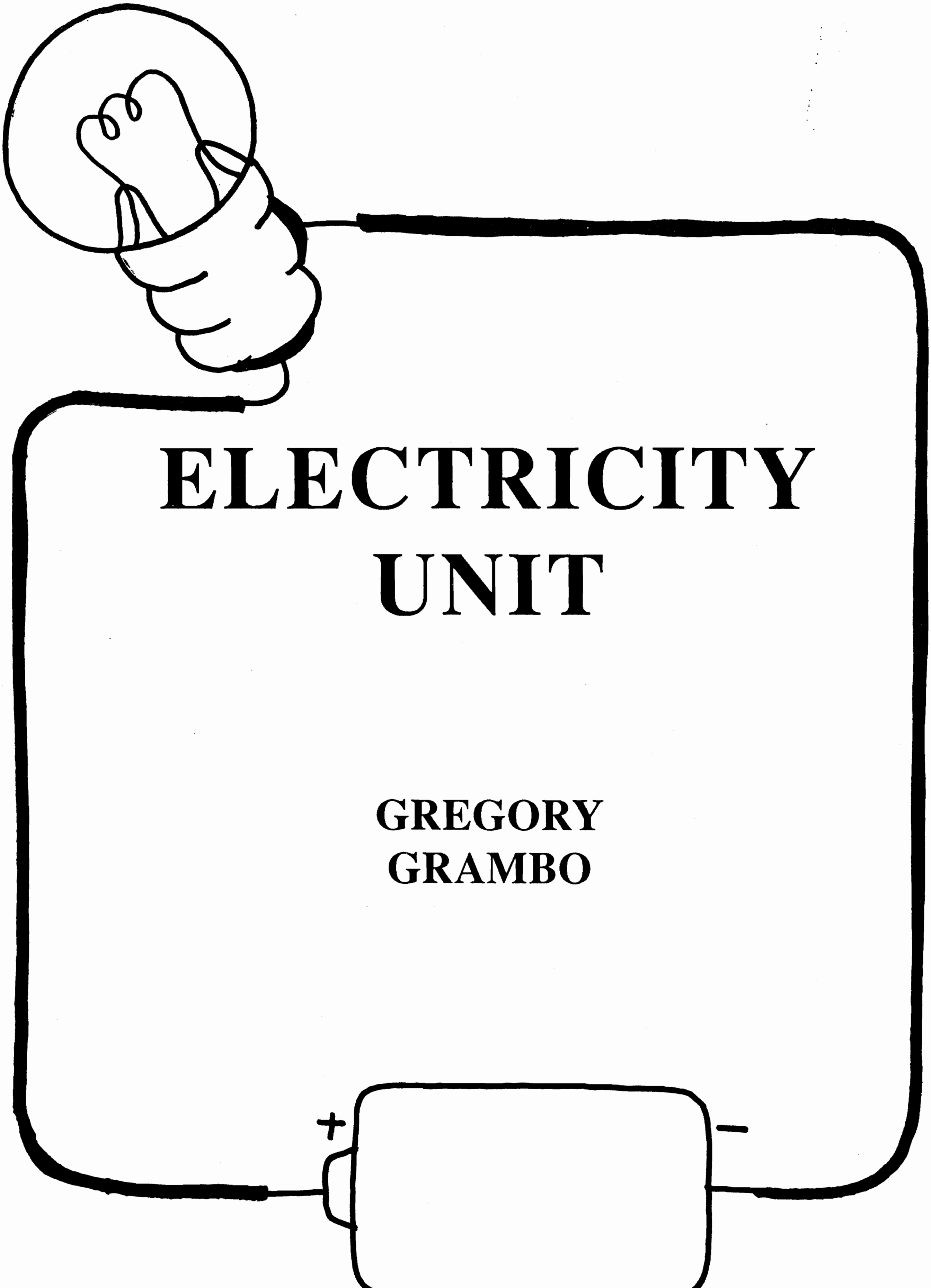

ELECTRICITY UNIT

GREGORY
GRAMBO

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A- Hands-On Guide To The Use And Understanding Of electricity

B- This is a hands-on electricity unit is intended for use in the middle school. It can, however, be modified for use in lower or upper grades.

C- Students will work cooperatively to conduct scientific investigations that will help them solve a scientific problem using a variety of inquiry skills including observing, predicting and testing solutions. Students will communicate their experiences through their student worksheets and in class presentations

D- Materials- Each cooperative work group will need one Voltmeter and ammeter. Other items are listed in box number one on each experiment sheet.

E- Each experiment in this unit will require one to two class periods (approx 45 min) to complete. The entire unit requires at least two weeks.

F - This unit includes ten hands-on experiments that introduce students to the world of electricity. Scientific vocabulary is introduced throughout the unit.

G- Teachers should send a note home to parents explaining the upcoming unit. It is important to explain that the children will be sharing equipment and that the children are working in cooperative learning groups whereby they learn from each other. Each student is responsible to do their share of the required work.

H- Questions for students are on the worksheets.

I- Assessment- After collection and review, the student worksheets should be graded from one to ten, ten being the highest grade. During lab time, question the students to see if they understand the material being presented to them. Se of the students are engaged in the activity and if they are working cooperatively. Finally, after students finish with the unit test, have the students write in their lab notebooks their ideas and comments about this electricity unit.

Electricity Unit

Materials List

Your group is responsible for all the materials in your box. Please keep them neat and clean. Report all missing materials to your teacher.

bulbs	**get from teacher**
wire	Voltmeter
bulb sockets (2)	Ammeter
knife switch	Ringstands
sample envelope	Wire Tester A
screw driver	Wire Tester B
resistors	
glass rod	
symbol chart - circuit drawing	

spelling words for alactricity unit

1- volt
2- Amp
3- dry cell
4- filament
5- conductor
6- nonconductor
7- in sulator
8- meter
9- ohm
10- resistance

11- series
12- parallel
13- circuit
14- schematic diagram

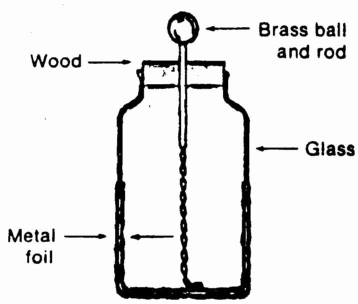
Franklin's Good Fortune

How did Benjamin Franklin fly his kite in a lightning storm without getting killed?

Trevor Pert—Shediac, New Brunswick

I had wondered about that, too. So I spent a lot of time in the library reading about Benjamin Franklin and his experiments on electricity.

In 1746 electricity was a curiosity. Letters and magazines began coming to the American colonies about experiments being done in Europe. Something called electricity could be made by rubbing a glass rod with silk. In Leyden, a city in Holland, a special jar had been invented to collect and store some electricity.



The Leyden jar
Today we would call it a capacitor.

To a curious man like Franklin, electricity was excitement. A friend in England helped him order Leyden jars and other apparatus needed to work with electricity. And Franklin invented some new gadgets. Rubbing a glass rod with silk seemed too slow. One of his friends helped him make a better generator of electricity. A glass ball with a rod running through it could be turned round and round. When the turning ball was rubbed with silk, it built up an electric charge that could be transferred to a Leyden jar. Then when Franklin put the knuckle of his hand close to the top of the jar, he could see a spark and feel the shock.

Franklin learned the hard way that there were dangers in his experiments. A big six-gallon Leyden jar would hold so much electric charge that its shock would kill a chicken. And he once got careless and let his hands get close to the top of a large jar. Here is his own account of what happened:

"I then felt . . . an universal Blow thro'out my whole Body from head to foot which seem'd within as well as without; after which the first thing I took notice of was a violent quick Shaking of my body which gradually remitting, my sense as gradually return'd . . ." Today we would probably say that Franklin was knocked out by that shock.

From his many experiments Franklin discovered some important characteristics of electricity. He found that he could make opposite kinds of electric charges. He called them positive and negative, or + and −, as we still do today. And he found that either kind of charge on a Leyden jar could be carried away to "ground." That's what happened

when he touched the jar and the electric charge went through his body and gave him a shock. An even better way was to use a wire that had one end buried in the ground.

Sometimes an electric charge could be carried away without any sparks. The way to do this was to hold a needle about six inches from a charged-up Leyden jar. That was a strange but important discovery. A pointed object would help take away an electric charge through the air.

Other scientists of the time had noticed that their electrical sparks were, in a small way, like the lightning of thunderstorms. Franklin wanted to go further. He wanted to find out by experiment whether the big spark of a lightning flash really was electricity made by the clouds. He wrote careful directions on how to test for electricity in a cloud. The idea was to have a tall pointed iron rod that came down into a little house. The house was just to keep the man working on the experiment dry during a rainstorm. The man was supposed to see if he could get sparks from the iron rod when a cloud passed overhead.

Franklin included the idea in letters that he sent to friends in London. The letters were passed on to some French scientists who liked Franklin's idea. They tried out his experiment in a village near Paris. They put up a pointed iron rod forty feet high and stationed a soldier in a little house underneath. There was excitement in the village when a cloud passed overhead. There were sparks and cracks in the little house, and later a Leyden jar was charged up from the rod so that it could make its own spark. The soldier was pretty excited but not harmed.

The French scientists were excited, too. A week later they repeated the experiment in Paris. Even without lightning, a tall pointed rod brought electricity from a dark cloud, enough to charge up many Leyden jars. So lightning was no longer a mystery—it was just electricity. Franklin had become the most famous American in France.

Why didn't Franklin do that experiment himself? He thought he needed a higher place and was waiting for a high church steeple to be built in Philadelphia. But before he could even have heard of his experiment being done in France, he thought of a new way to do it. Why not use a kite?

The kite experiment seems to have been done sometime in June of 1752, but its details were not written down as scientific notes. Here is what we think happened. Franklin did the experiment privately with only his son as a helper. Maybe he didn't want other people involved because he was afraid the experiment wouldn't work.

He built a kite out of a silk handkerchief and two strips of light wood. A pointed wire was attached to the top and also to the string which held the kite. A key was slipped onto the lower end of the string near the ground. And the string was tied to a silk ribbon. After they got the kite up, Franklin and his son went

underneath an open shed to stay dry. The idea was that any electricity picked up from a rain cloud would be carried down the string to the key. If the silk ribbon stayed dry, it would not carry the electricity any farther.

At first nothing much seemed to happen. One cloud passed over with no effect. But a second cloud did the job. The fibers of the string seemed to pull apart. When Franklin put his knuckle close to the key, he got a big spark. After the rain wet the string, he was able to charge up a Leyden jar again and again. Electricity collected from a cloud was just like electricity made by man.

A practical result of Franklin's experiments was his invention of the lightning rod.

Of course, you asked how Franklin could do the experiment without getting killed. If a lightning bolt had really hit the kite, he likely would have been killed. Actually, there was no lightning close by. The cloud that passed over had a big electric charge but not big enough to make lightning. Even so, I think that Franklin was just plain lucky. I don't think I would do that experiment.

There are several paintings of Franklin's experiment that are not accurate. This Currier and Ives print shows lightning in the cloud—which fortunately did not occur—and does not show the shed that Franklin and his son stood under. Other artists have depicted the scene with a lot of people, who actually were not there, and with Franklin as an old man (he was actually 46 at the time) and his son as a baby (he was 21).

Illustrated by Kit Wray

Electricity

Name
Class Group No

What is electricity?

Experiment 1

parent's signature

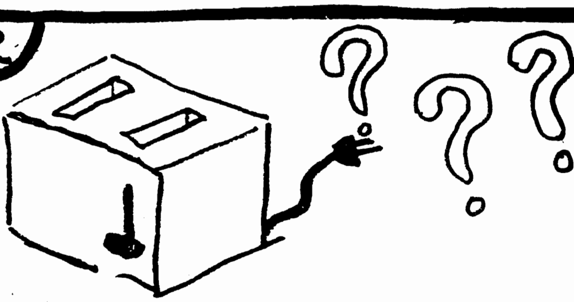
1

Begin With

Batteries

Encyclopedio

2



Q- How can I make this Work?

3

Q- Why is there a wire on the toaster?

4

Q- How do you think electricity gets into your toaster?

5

Q- How did Benjamin Franklin Discover electricity? (look in an encyclopedia)

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6

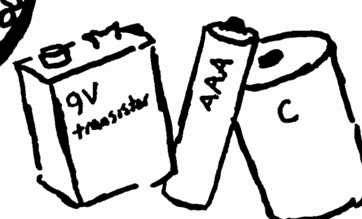
This light is nice but

Q- How can I make it easier to carry around?

7

Q- How has this light been made so it's easier to carry around?

8



(list more than one reason)

Look at the batteries the teacher will give out

Q- How are they different?

9

Q- Why are some large and some small?

Q- Why is there a + on one side and a – on the other?

10

Fill in Chart

Battery	Size	Shape	Voltage
AAA			
AA			
C			
D			

Homework –

Q- What is a battery?

Q- How is it like a storage chest?

Q- Why do we need batteries?

Electricity

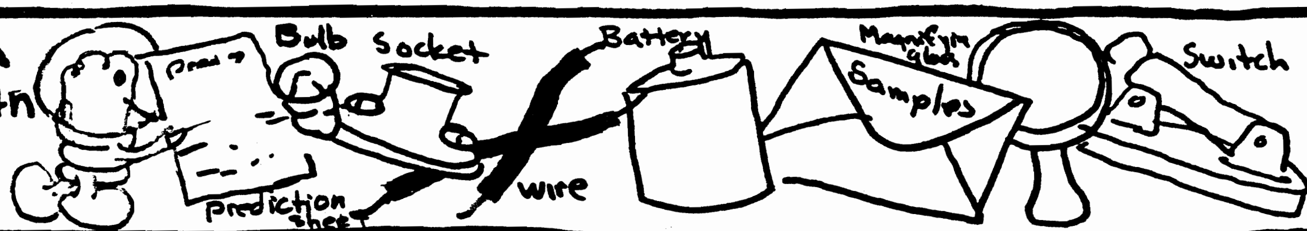
Name ______
Class ______ Group No ______

What are conductors, non conductors, and insulators?

Experiment 2

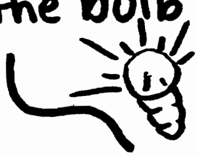
______
parent's signature

1) Begin With



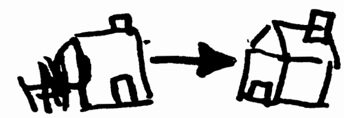
2) A road allows a car to go from one place to another.

Q- How does the wire help the bulb light?



3) Q-Why are wires put in Circuits?

4) Q-How does electricity get from the power plant to your house?



5) Q- How does electricity move around your house?

6) Examine a wire. Q-What is it made out of?

7) What part of the wire do you think electricity can move through?

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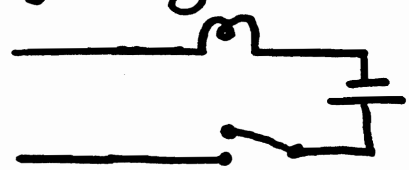
8) Set up this circuit

Q- How does electricity get from the battery to the bulb?

9) Q-What will happen if I cut the wire?

Q- Why?

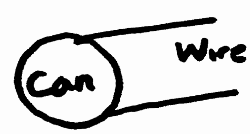
10) Q- How can I make this bulb light again?



11) Q- We will try to complete the circuit with some of our samples.

Note- Set up circuit in Box 10

12) Connect wires with objects in sample envelope.



Object	lights	Does not light

13) Why do some objects make the bulb light and others do Not?

Use the Prediction Sheet.

Homework

We call objects which allows electricity to travel through them Conductors.

Non conductors will not carry electricity.

Insolators are like non conductors. The will not carry electricity. They also will not carry heat.

Electricity

Name

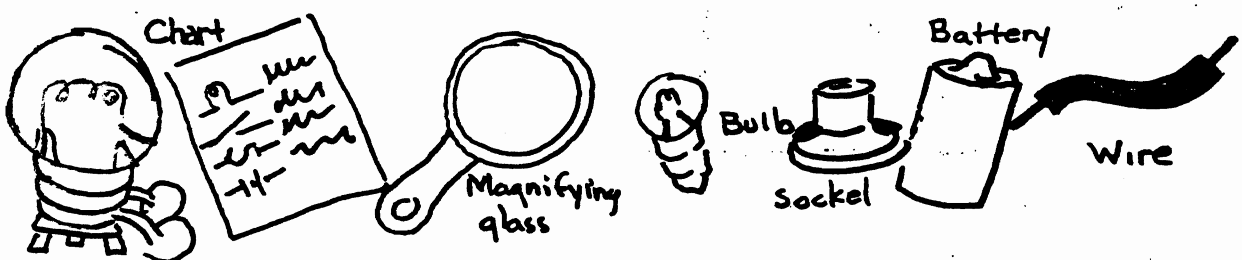
Class Group No

How can we make a circuit drawing?

parent's signature

Experiment 3

1 Begin With

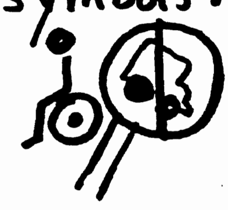


2 Make a drawing of a circuit with a bulb, wire and a battery.

3 How would a house circuit drawing look if we drew every bulb switch and wire?

4 How can we make it simpler so it isn't so crowded?

5 On road signs, Why do we use symbols?



6 How can we use symbols to make our circuit drawing simpler?

7 look at the symbol chart on the back of the materials list. How can we use these symbols to redraw our circuit with the bulb, wire and a battery?

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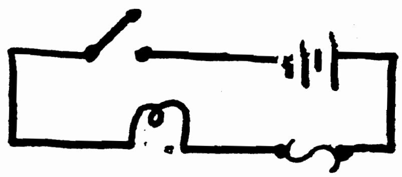
8) We call these new drawings <u>Schematic diagrams</u>

label the things in this circuit



9) Q- Why will the bulb go off if I open the switch?

10) Q- Why will the bulb go off if I break the wire?

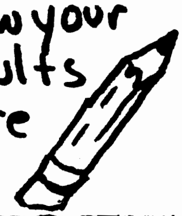
11) Examine the bulb

Why is a wire going across the inside of the bulb?

12) Q- How can I make another light bulb light in our circuit?

<u>Try it</u>

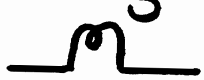
Draw your Results Here



Homework

1) What do the following symbols mean?

a. ______



b. ______

c. ______

d. ______

e. ______

2) Why do we use symbols in schematic diagrams?

Electricity and Magnetism

Name [ ]

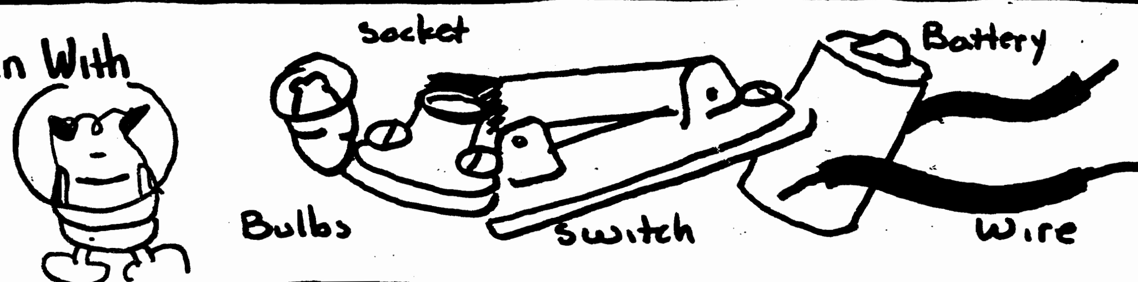
Class [ ] Group No [ ]

Why are some circuits different?

Experiment 4

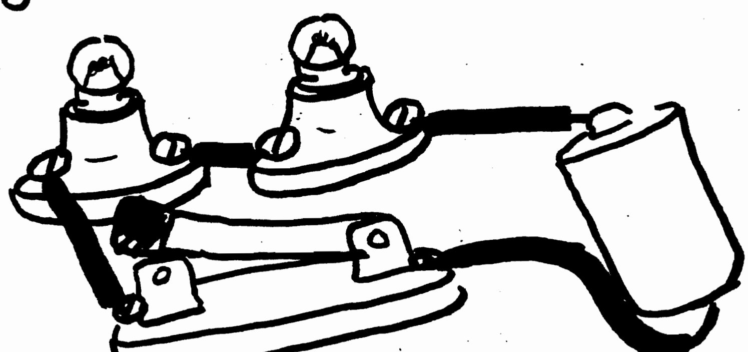
____
parent's signature

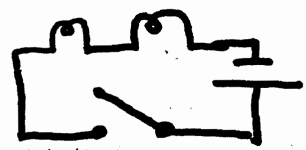
1) Begin With



2) Examine these Drawings

A

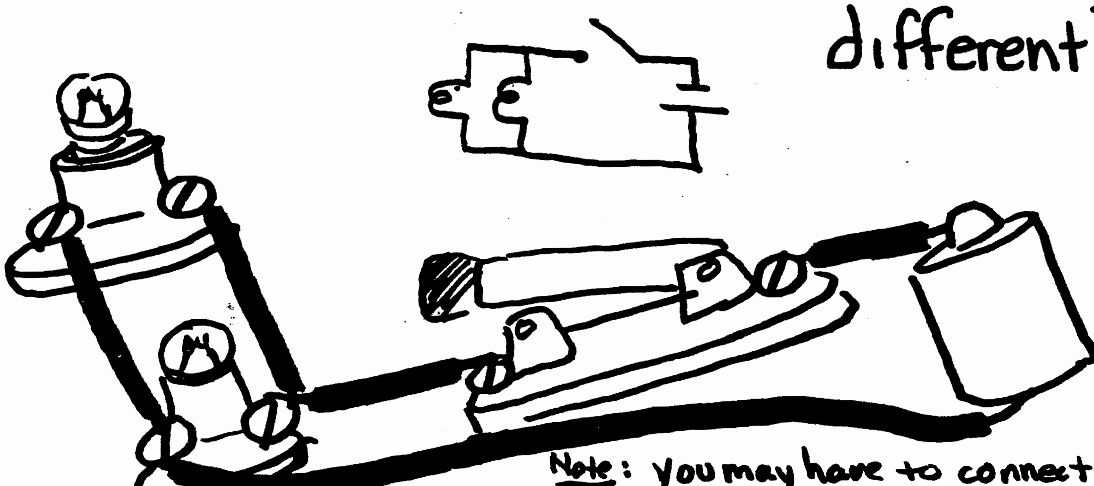




Q- How are they similar?

Q- How are they different?

B



Note: you may have to connect battery with tape or rubberband

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3) Q-What will happen to each circuit when I close the swith?

Q-Why?

4) Q-What will happen If I unscrew one bulb? Try it

5) Q-How is each circuit affected?

Q-Why do you think this happened?

6) Remember: electricity is like a car. It has to have a road to drive on and a place to go

7) Trace the path or road of electricity from one end of the battery to the other.

8) In circuit A, Why do both bulbs go out when I remove one bulb?

9) What is needed in order to make the other bulb stay on?

10) In Circuit B. Why don't both bulbs go out when I remove one of the bulbs?

A is a Series Circuit. B is a parallel circuit.

Homework.

Q-How is a series and a parallel circuit different?

Electricity

What are series and parallel circuits?

Name

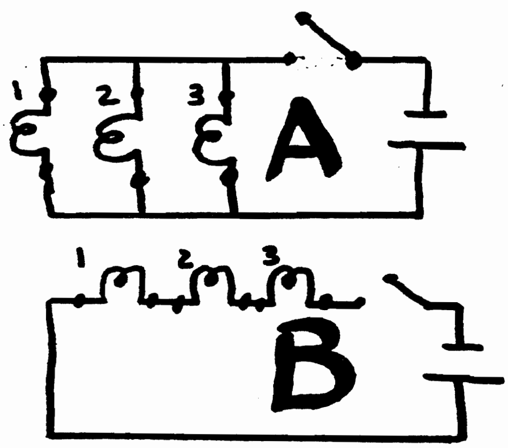
Class Group No

Experiment 5

____
parent's signature

1) Begin With

2) Set up the following Circuits



3) Q- What will happen if I close the switches?

Q- Why?

4) Q - What will happen in each one If I remove bulb #1?

5) Q- Why will this happen?

Q- Which stays lit A or B?

Screw all light bulbs back in sockets.

6) Close switch.

Q- Examine the Bulbs. Which are brighter?

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7) Q-Why are these bulbs brighter?

8) Q-In the circuit, which is not bright, How will the bulbs be affected if I hook up all 6 bulbs the same way. Try it

9) Q-Did they get brighter or dimmer (not bright)?

Q-Why?

A is a parallel circuit
B is a series circuit

10) Q-Would you want your house connected in series or Parallel?

Q-Why?

11) Q-What are the advantages and disadvantages of series and parallel circuits?

	Advantage	Disadvantages
Series		
Parallel		

Homework-

1) -You have a battery and three bulbs. Draw a series and parallel circuit.

2) How are they different?

Name

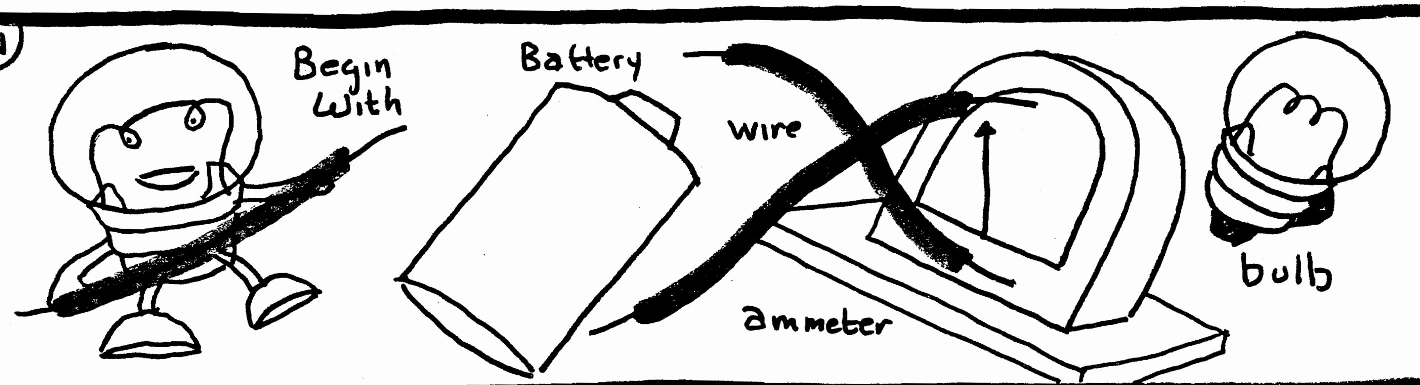
Class Group No

How is electric current measured?

Experiment 6

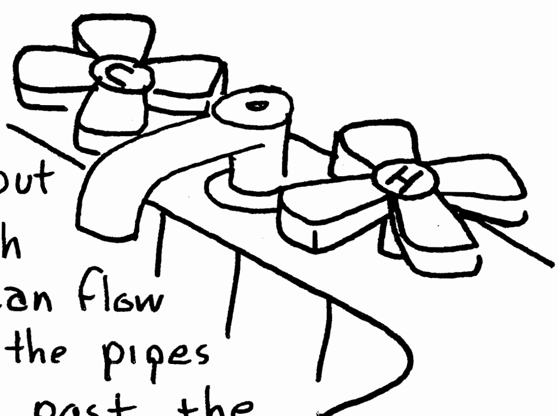
parent's signature

1)



2)

You have a sink and want to find out how much water can flow through the pipes and go past the faucet in an hour.

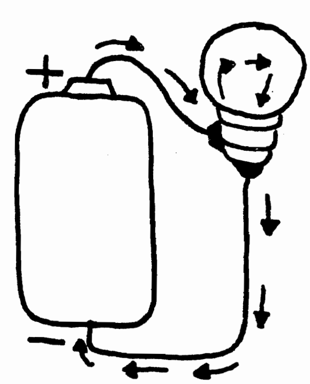


How can you do this?

3)

When you turn on an electric current things called electrons (which carry a negative charge) travel from the positive side of the battery to the negative side.

How can the electrons get from one side of the battery to the other?



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4) How could you find out how much electricity has traveled through your circuit?

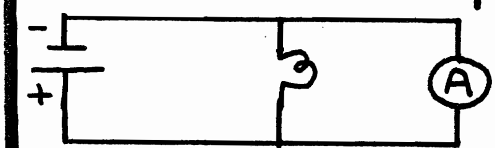
5) We use an instrument called an ammeter to measure the electron flow at a given point, just as you could use a water meter to measure water flow in a pipe

The symbol for an ammeter is

An ammeter measures the unit of electric current called an ampere

6) Set up circuit A

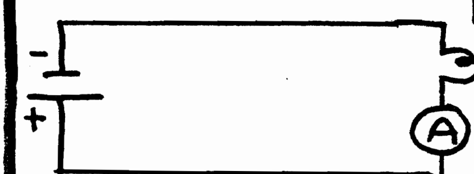
A



ammeter reading ______

7) set up circuit B

B



ammeter reading ______

8) How is circuit A different from B?

How do the ammeter readings differ?

9) How would you measure current in a series circuit?

How would you measure current in a parallel circuit?

Homework-

1- What is electric current?

2- How is electric current measured?

Electricity

What is electromotive force (EMF)?

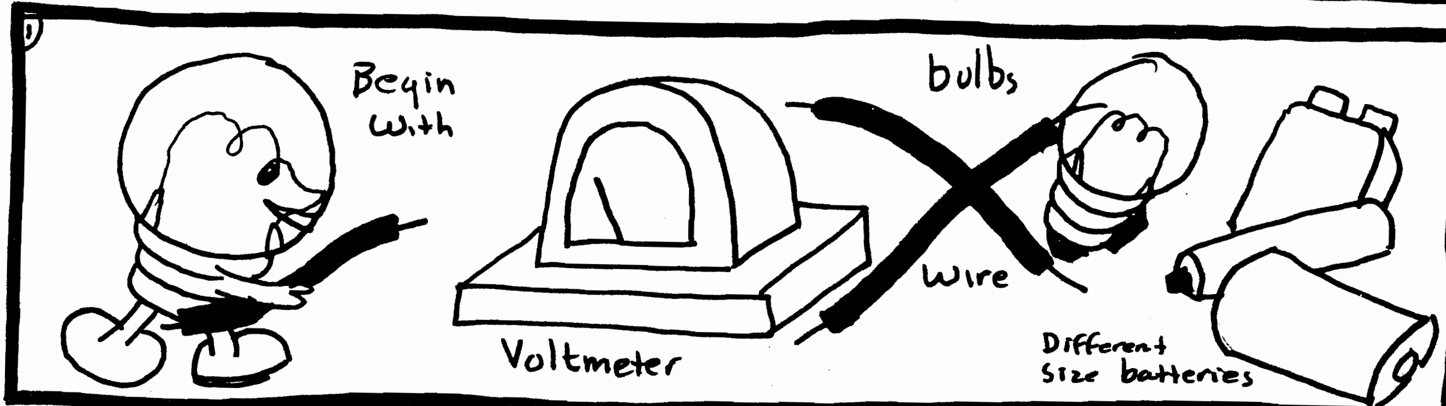
Name [ ]

Class [ ] Group No [ ]

Experiment 7

____
parent's signature

1)



2) What is an ampere?

3) Define - Amperage

4) How can you measure amperage in a parallel circuit?

Draw a picture.

5) Electrons move to make an electric current, just as a plane moves through the air or water moves through a pipe. The speed of the plane is determined by the push that the engines give the plane. Electrons also have to get a push in order to move. The force that makes electrons move is called electromotive (e-LEK-troh-MOH-tiv) force. A force is a push or a pull. "Electro" means electricity and "motive" means moving. Electromotive force (or EMF as it is called) is the push that makes electricity, or electrons, move.

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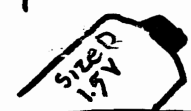
6 How is a radio affected by batteries?

7 Electric current or electrons are pushed through the radio by EMF

EMF is measure in Volts

The EMF or push is written on the battery.



8 What is the EMF on your batteries?

A ______________ Volts

C ______________ V

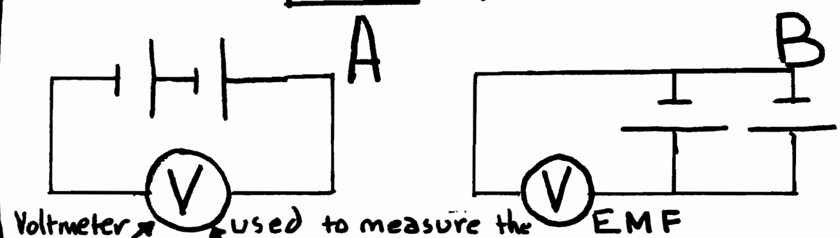
D ______________ V

transistor ______________ V

Lantern battery ______________ V

9 Which will make the EMF or Voltage increase

[ ] predict [ ]



10 **Try it.**

Why does this happen?

11 How many 1½ Volt dry cell batteries would you need to make a 9 Volt battery?

12 Now do the EMF reading sheet.

Homework-

1- What is EMF?

2- How is EMF Measured?

3- How can you increase the EMF of a circuit?

Electricity

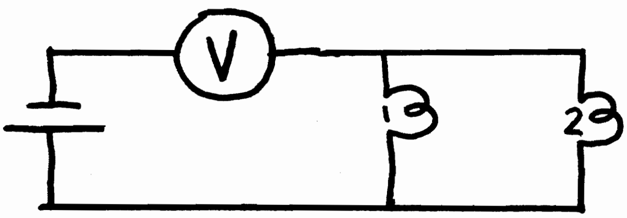
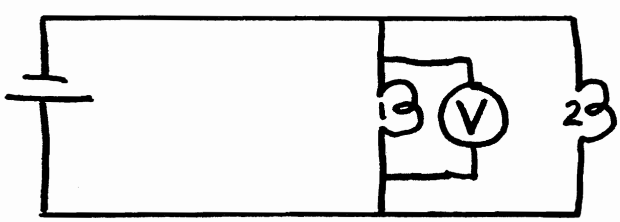
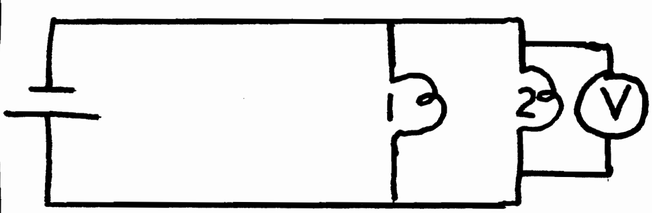
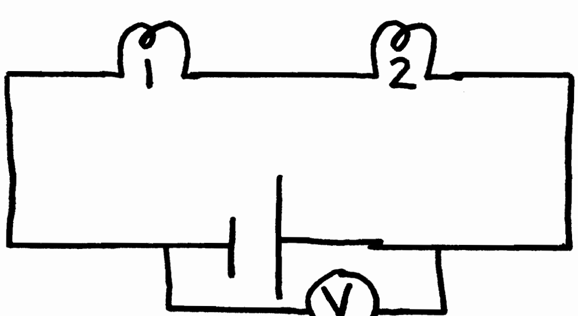
Name

Class Group No

EMF Reading Sheet

part of experiment 7

Set up the circuits as indicated. Tell what you are measuring the Voltage of!

Set this up	What are you measuring?	EMF Reading Voltage
		
	Voltage across bulb Number 1	
		
	Voltage across battery	

parent's signature.

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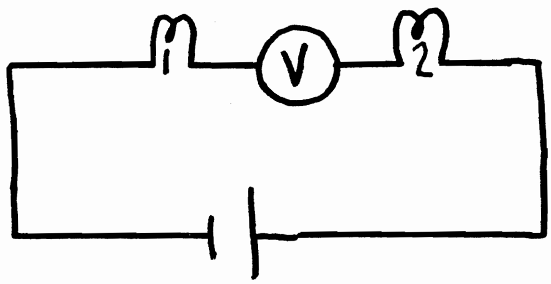
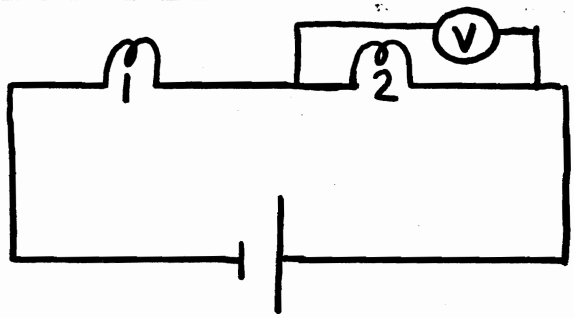
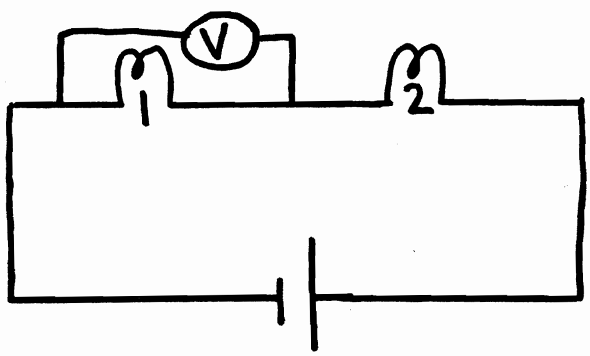
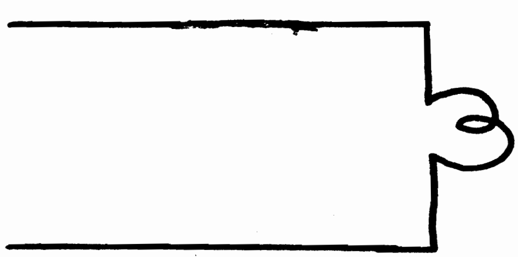
Set This Up	What are you measuring?	EMF Reading Voltage
		
		
		

Draw in two (2) batteries so that it would make the EMF of the circuit greater than 1.5 V.



_______ V
Reading

Then measure the <u>EMF</u>

Electricity

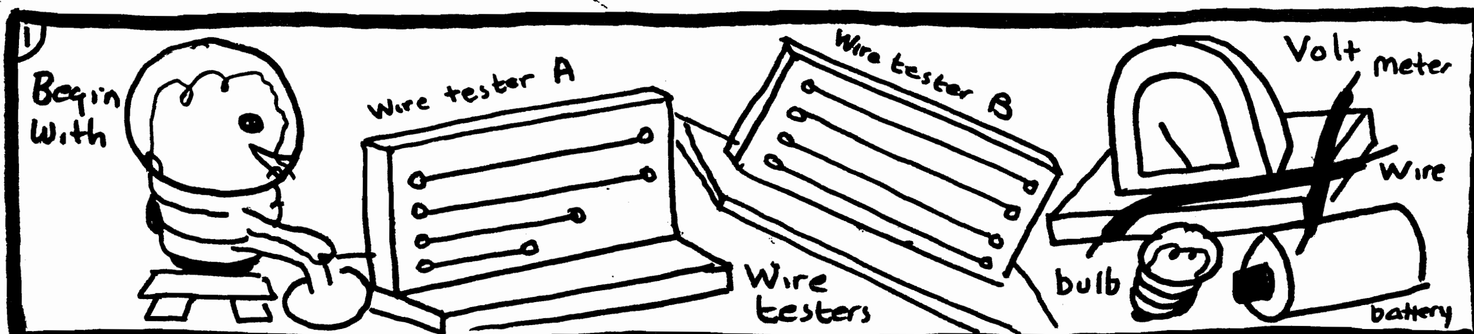
Name [ ]

Class [ ] Group No [ ]

What is Resistance?

Experiment 8

____
parent's signature



2) Imagine driving your car on a bumpy pot-hole filled road.

Why would you drive slowly?

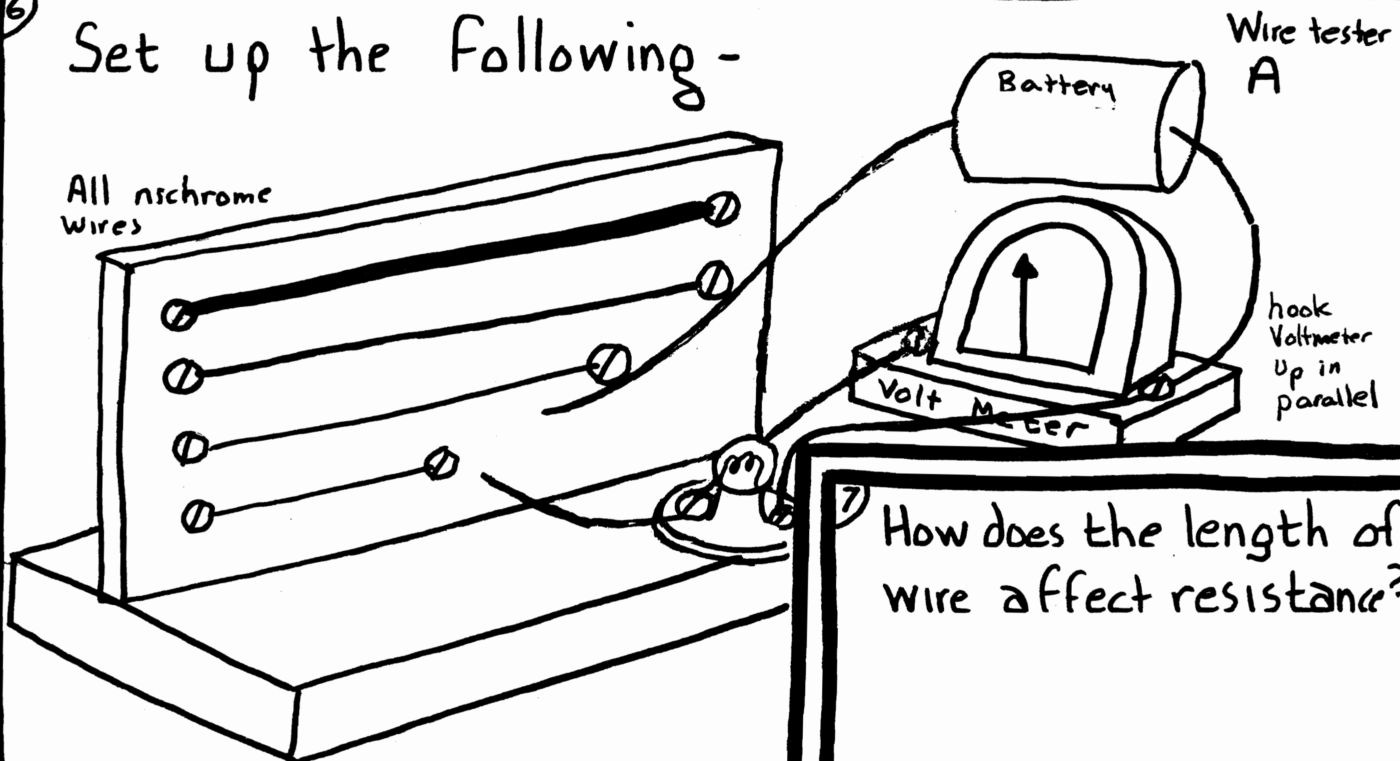
3) The holes and bumps give restance to the car, or try to slow it down. <u>Conductors</u> are like super highways, allowing electricity to move through them easily. <u>Insulators</u> and <u>non-conductors</u> try to slow down or stop electricity from moving, just as the holes tried to stop the car.

4) Conductors have little or no resistance. Non-conductors and insulators have high resistance.

Grambo

5 Resistance can depend on many things: The type of wire, length of the wire and the thickness of the wire.

6 Set up the Following -



7 How does the length of wire affect resistance?

8 How does the thickness of the wire affect resistance?

9 Using wire tester B. How does the type of wire affect resistance?

Homework -

1- How does the length and thickness of a wirer affect the resistance?

2- Why would the 3rd rail (electrified) of a train need generators in various places to boost or add electricity to the rail?

Electricity

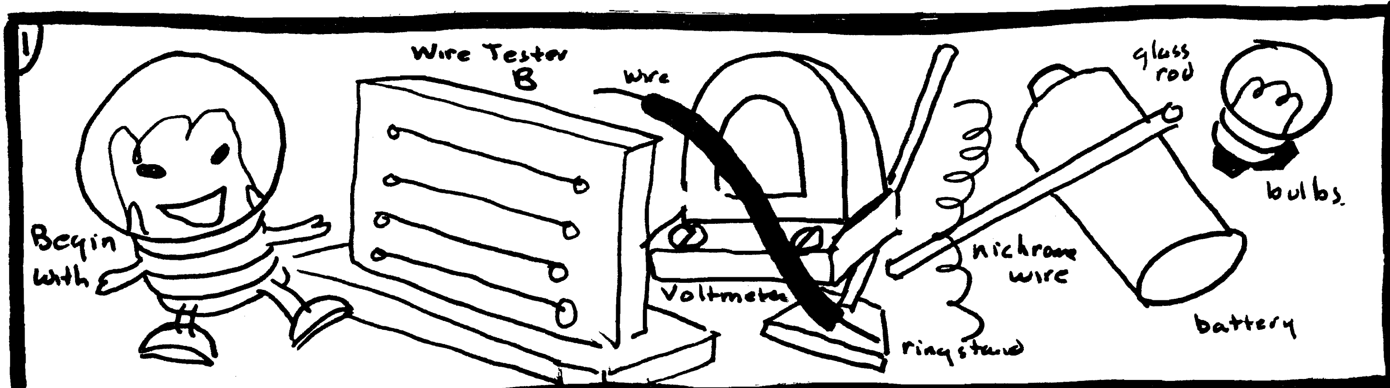
Name ____ Class ____ Group No ____

How can you change the resistance of a wire?

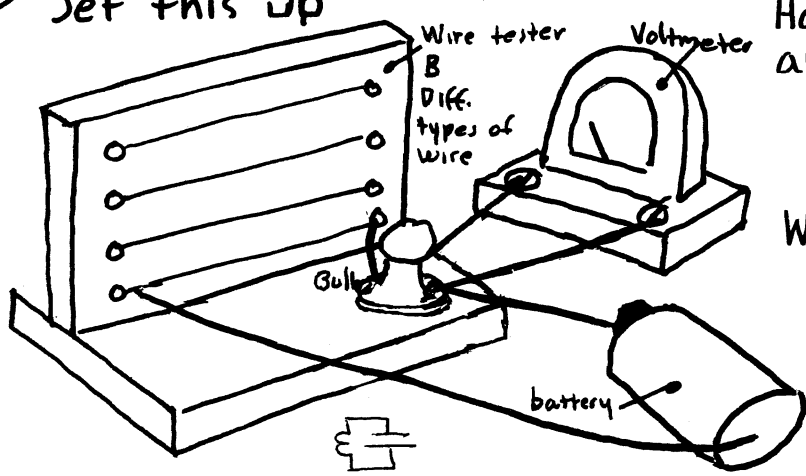
Experiment 9

____
parent's signature

1)



2) Set this up



How does the type of wire affect resistance?

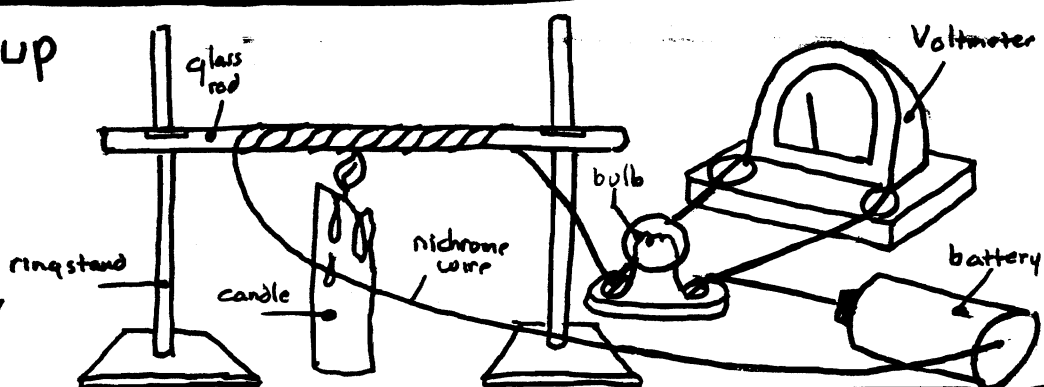
Which has the <u>most</u> resistance?

Which has the <u>least</u> resistance?

3) Set this up

Voltage before heating ______V

After heating for 5 min. ______V

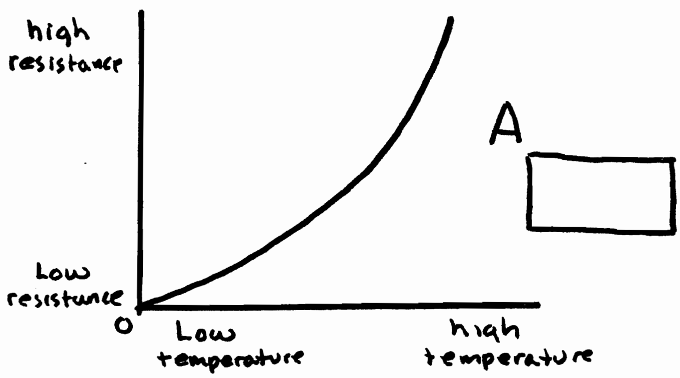


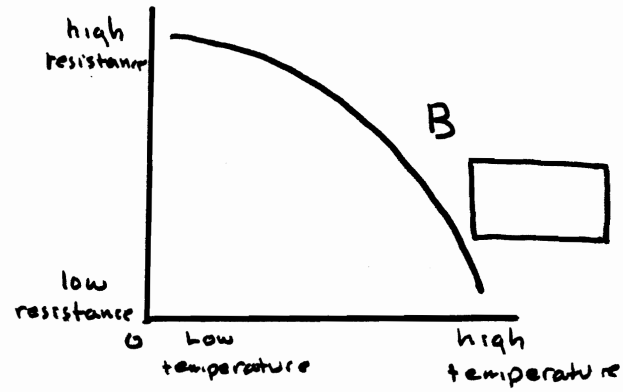
Grambo

4) How does heating the nichrome wire affect the resistance of the wire?

5) What might happen to the resistance of the wire if you lower the temperature?

6) Which graph would show the relationship between the temperature and the resistance of a wire?





7) Why do you say this?

Homework -

1- The science dealing with the effects of low temperatures on electricity is called cryogenics. Look up Cryogenics and explain it.

2- What is the relationship between the resistance of a wire and its temperature?

Electricity

Name ______

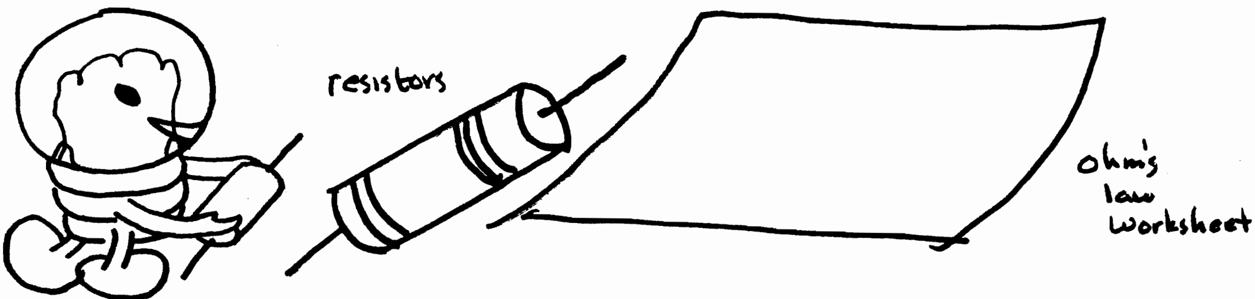
Class ______ Group No ______

What is ohm's law?

______
parent's signature

Experiment 10

1)



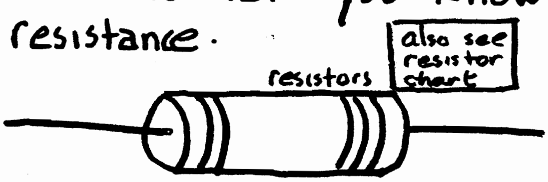
2) What are the units of EMF or Voltage?

3) What are the units of electric current?

4) Resistance is measured in <u>ohms</u>. The symbol for an ohm is Ω

5) Flashlight bulbs usually have a resistance of 1Ω. 60 watt light bulbs have a resistance of about 200Ω

6) Scientists and electronics people have made small objects with known resistances. They are called <u>resistors</u>. Resistors have stripes or color codes on them to let you know the resistance.



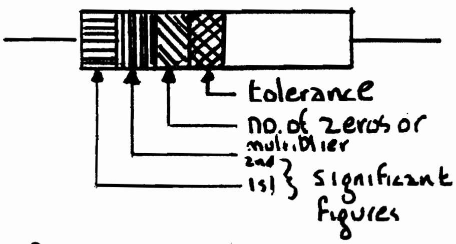
color code

color	Black	Blue	Red	Orange	Yellow	Green	Blue	Violet	gray	white	Gold	Silver
digit	0	1	2	3	4	5	6	7	8	9		
multiplier	1	10	100	1,000	10,000	100,000	1000000	10000000	100000000	1000000000		

Grambo

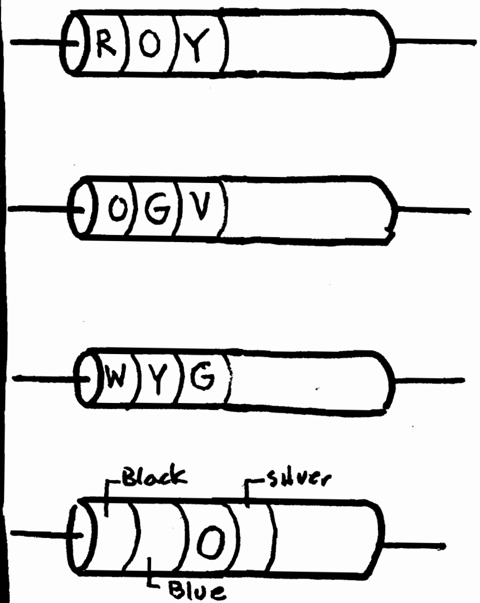
(7) Using the resistor code you can find out the resistance of a resistor.

(8) explanation code



for more information see resistor chart.

(9) What is the resistance



________ Ω

________ Ω

________ Ω

________ Ω

A man named George Ohm discovered that the electric current in a circuit is affected by EMF and resistance. He described this effect by a scientific rule. Ohm's law says that the electric current in a circuit is equal to the EMF devided by the resistance.

(10) Ohm's Law

$$I = \frac{V}{R}$$

I = current (A) Amps
V = EMF (V) Volts
R = Resistance (Ω) ohms

$$\text{Electric Current (Amps)} = \frac{\text{EMF (volts)}}{\text{Resistance (ohms)}}$$

(11) Do the Ohm's Law worksheet

Homework-

1- What is a resistor?

2- What does ohm's law say?