March 13-15, 1997

It's Positively Shocking!

Grade Level: First Grade

Presented by: Linda Haskell and Janelle Catlett, Paul H. Cale Elementary School, Charlottesville, Virginia

Length of Unit: three weeks

I. ABSTRACT

Beginning with demonstrations and hands-on experiments, students will learn about positive and negative charges present in static electricity. Through discovery by trial-and-error, student pairs will make a flashlight bulb light up. Using predictions and experimentation they will discover: how to make the bulb burn brighter, how to make a closed circuit, and which common materials serve as conductors and insulators.

Areas of focus will be static electricity, current electricity through simple circuits, insulators and conductors. All materials used will be commonly found or easily obtained, and safe for handling by first graders. Safety with electricity will be stressed.

II. OVERVIEW

A. Specific content from Core Knowledge

1. The atom and its parts
2. Static electricity
3. Current electricity
4. Simple circuits
5. Insulators and conductors
6. Electrical Safety
7. Thomas Edison

B. Skills

1. Observing
2. Communicating
3. Comparing

4. Classifying

5. Applying

C. Learning objectives

1. Name the parts of an atom

2. Show an example of static electricity

3. Identify and demonstrate open and closed circuits

4. Classify objects as insulators or conductors

5. Demonstrate electrical safety

III. BACKGROUND KNOWLEDGE

A. Electrical Connections. AIMS Education Foundation, P.O. Box 8120, Fresno, California 93747-8120 Telephone: (209) 255-4094 Fax: (209) 255-6396

B. VanCleave, Janice. Electricity. New York:John Wiley & Sons,Inc. 1994

C. Marson, Ron. Global Tops. TOPS Learning Systems, 10970 S. Mulino Rd., Canby, OR 97013 USA

IV. RESOURCES

A. Books

1. Bedik, Shelley. Thomas Edison: Great American Inventor. New York: Scholastic, Inc., 1995, ISBN 0-590-48357-9.

2. Berger, Melvin. All About Electricity. New York:Scholastic, Inc., 1995, ISBN 0-590-48077-4.

3. Davies, Kay, and Oldfield, Wendy. Electricity and Magnetism. Austin: Raintree Steck-Vaughn, 1992, ISBN 0-8114-1532-5.

4. Macaulay, David. The Way Things Work. Boston:Houghton Mifflin Company, 1988. ISBN 0-395-42857-2

5. Magnetism and Electricity (Primary). Huntington Beach, CA.:Teacher Created Materials, Inc., 1994, ISBN 1-55734-643-7.

6. Molleson, Diane, and Savage, Sarah. Easy Science Experiments. New York:Scholastic, Inc., 1993, ISBN 0-590-45304-1.

7. Parker, Steve. Everyday Things and How They Work. New York:Random House, 1991, ISBN 0-679-80866-3.

8. Shipton, Paul. Science With Batteries. London:Usborne Publishing Ltd., 1992, ISBN 0-7460-1423-6.

9. Tannenbaum, Harold E., and Stillman, Nathan. We Read About Electricity and How It Is Made. St. Louis:Webster Publishing Co., 1960, (Webster Junior Science Series).

10. VanCleave, Janice. Electricity. New York:John Wiley & Sons, Inc., 1994, ISBN 0-471-31010-7.

B. Software

1. Gizmos & Gadgets. Fremont, CA: The Learning Company, 1995.

2. The Way Things Work. London: Dorling Kindersley, 1995.

C. Supplies

The following supplies will be necessary to perform the experiments: (See the specific experiments for daily needs)

batteries, size "D" (enough to have one per student)

4.5 volt battery (optional)

flashlight bulbs (one per student)

bulb holder (optional)

alligator clips (optional)

plastic coated electrical wire

round balloons of various sizes

toothpicks

red hots and Nerds candies

thread or string

tape

permanent marker

various types of cloth: wool, cotton, synthetic

spray bottle

aluminum foil

plastic food wrap

plastic (as from a report cover or overhead transparency sheet)

salt and pepper

plastic ruler

puffed rice cereal

paper clips and paper fasteners

small ball of clay

bar magnet

compass

cardboard

wooden clothespins with springs

heavy brown paper bag

pennies and nickels

scouring powder

V. LESSONS

A. Lesson One: A Model of an Atom

1. Objective/Goal:

a. The student will be able to label the parts of an atom

b. The student will learn about the movement of electrons around the nucleus.

2. Materials

a large round balloon

a small round balloon

8 red hots candies

8 pieces of Nerds candies

8 broken pieces of toothpicks

3. Prior Knowledge for Students

Matter should be taught prior to this lesson. Students need to know that matter includes solids, liquids, and gases. This lesson will demonstrate an atom, of which all matter is made. You may wish to introduce the concept of an atom by having students tear a piece of paper in half, then repeatedly tearing the smaller pieces in half until the piece remaining is too small to be torn any further. Tell students that an atom is much smaller than that remaining speck of paper. Then proceed with this demonstration of what makes up an atom.

4. Key Vocabulary

a. atoms

b. electrons

5. Procedures/Activities

a. This model will represent an atom of oxygen, with an atomic number of 8. The nucleus will be represented by the small balloon. Place 8 red hots in the small balloon to represent protons. Place 8 Nerds candies in the small balloon to represent neutrons.

b. Place 8 pieces of broken toothpicks in the large balloon. The large balloon will represent the electron cloud.

c. Insert the small balloon inside the larger one with the openings together. Inflate the small balloon and tie

it off.

d. Inflate the large balloon, pushing the small balloon further inside. Inflate the large balloon until it is much large than the smaller one, then tie it off.

e. This model will help children visualize the electron cloud that surrounds a nucleus (rather than a flat model that shows an unrealistic orbit pattern). When an atom is not excited, the electrons are at their lowest energy level (in the model the toothpick pieces rest at the bottom of the balloon). When the balloon is shaken, as in an excited atom, the toothpick pieces move around.

6. Evaluation/Assessment

Although not as accurate as the visual model demonstrated, you may ask the students to label a drawn model of an atom with the nucleus (protons and neutrons) and the electrons.

B. Lesson Two: Static Electricity

1. Objective/Goal:

The student will demonstrate static electricity occurring.

2. Materials

nine-inch round balloons

thread

tape

permanent marker

different pieces of materials such as wool, cotton, polyester, paper, plastic, etc.

chart paper

Appendix A

3. Prior Knowledge for Students

Students need to know that electrons move around in atoms, and can get knocked off of an atom.

4. Key Vocabulary

static electricity

5. Procedures/Activities

a. Balloons and Hand: Inflate some balloons and knot the ends. Attach a twelve inch piece of thread to the knot, and tape the other end of the thread to the edge of a table, allowing the balloon to hang freely. After washing and drying your hands, hold the balloon with one hand, and rub your other hand on the side of the balloon 8 to 10 times. Release the balloon and let it hang freely. Put the hand that rubbed the balloon near to, but not touching the balloon. Observe what happens. Results: The balloon will move toward your hand. It will even move upward if hand is held slightly above. Why: Static electricity is the build-up of electric charges on an object. When two objects are rubbed together, electrons move from the weaker pull (the hand) to the stronger pull (balloon). Both become charged (the hand is positively charged and the balloon is negatively charged), and unlike charges attract. Try this: Mark an X on one side of the balloon with the

permanent marker. Rub that spot. Turn the X side of the balloon away, let go, and place the rubbed hand near the balloon. Results: The balloon will turn so that the rubbed X spot will move toward the hand. Note: Although these experiments are written for a teacher's demonstration, most of them can be carried out by the students as well.

b. Sticky Balloons:In a second experiment, have one balloon inflated for each type of material that you will be testing (e.g. wool, cotton, paper, polyester, plastic). Take one piece of a material and rub it 5 times against a balloon. Try to stick the balloon to a wall. You may wish to use a stopwatch to time how long the balloons rubbed by varying materials will stick to the wall. Will rubbing a balloon on your head work? Record findings on chart paper following the format below. Extension: Try using one material, such as the wool, and rub one balloon 10 times, another one 15 times, or various increasing and decreasing numbers of times. Determine whether or not this affects how long the balloon remains on the wall. If you wish for students to make predictions and test their hypotheses, use Appendix A as a recording sheet. This sheet may be used any other time that you wish to have your students make predictions of outcomes.

6. Evaluation/Assessment

On chart paper record the results of your various experiments conducted in Activity b. The chart may resemble this:

Type of Material # of Times Rubbed Time on Wall

C. Lesson Three: Static Electricity Part 2

1. Objective/Goal

The student will demonstrate and illustrate unlike charges attracting, and like charges repelling.

2. Materials

round balloons

two pieces of string or thread, one yard long each

water in a spray bottle

wool cloth

salt and pepper

response sheet, Appendix B

3. Prior Knowledge for Students

same as Lesson Two

4. Key Vocabulary

attracting, repelling

5. Procedures/Activities

a. Attracting Balloons: Inflate two balloons, knot the ends, and tie a string onto each balloon. Hold together the ends of the strings, letting the balloons hang. Observe what happens. Rub both balloons with the wool cloth. Again, hold the strings together, observe, and record what happens. Lightly mist one balloon and put them back together hanging from the strings. Observe and record. Lightly mist the second

balloon, put them together, observe and record. Results: When both balloons are rubbed, their charges are alike and they will repel each other. When a balloon is misted, the charge changes, and the balloons are able to attract each other again.

b. A Magic Trick: Shake a pile of salt onto a table and spread it

into a layer. Shake some pepper on top of the salt. Rub a balloon with a piece of wool. Hold the balloon over the salt and pepper mixture. What happens? The pepper flies up to stick to the balloon. Why? Pepper is lighter than salt.

6. Evaluation/Assessment

Use Appendix B to record the results of Attracting Balloons.

D. Lesson Four: Static Electricity Part 3

1. Objective/Goal

a. The student will demonstrate that when unlike charges attract, the charges will eventually even out and the attraction will cease.

b. The student will discover that lightning is a form of static electricity.

2. Materials

puffed rice cereal

plastic food wrap (a 2-foot piece)

a piece of paper

comb

tissue paper torn into small pieces

piece of wool material

6-inch square of aluminum foil

plastic ruler

paper clip

marble size piece of clay

2-inch by 8-inch piece of plastic (from a report cover or

transparency)

3. Prior Knowledge for Students

same as for Lesson Three

4. Key Vocabulary

gravity

5. Procedures/Activities

a. Attraction Action: Put about 20 pieces of puffed rice cereal on a table. Wad the plastic food wrap into a ball about fist-size. Rub the wad of plastic wrap back and forth across the piece of paper 10-15 times. Hold the plastic wrap above the puffed rice. Place the torn pieces of tissue paper on a table. Rub the comb 10-15 times with the wool cloth, and hold the comb above the paper. What happens in both cases? You have changed the neutral charge of the plastic wrap and the comb, and they are now going to attract the unlike charges of the cereal and tissue paper.

b. Foil Airplane: Make a "paper" airplane out of a six-inch square of aluminum foil. Lay the airplane on a table. Rub the flat end of the ruler with the wool 10-15 times. Immediately hold the ruler closely above the foil airplane. What happens? Continue hold the ruler steady until the airplane falls away. Why did it fall away? The airplane became balanced with the ruler, causing like charges which repel. Gravity then caused the airplane to fall.

c. Making Lightning: Stand a paper clip upright in the ball of clay. Darken the room. Lay a 2-inch by 8-inch piece of plastic on a piece of wool material. Wrap the wool material around the plastic, and quickly pull the strip of plastic through the wool material several times. Hold the plastic strip near the paper clip. Results: A spark of light leaps between the plastic strip and the paper clip. Why? Electrons from the wool have collected on the plastic strip, making it negatively charged. Holding it near the neutral paper clip causes the electrons in the clip to move away (repulsion of like charges), creating a positive charge on the surface of the paper clip. The air between the plastic and the paper clip becomes charged, forming a path through which electrons can move. The spark is a static discharge, a loss of static electricity.

E. Lesson Five: Current Electricity Demonstration

1. Objective/Goal:

a. The student will participate in a demonstration of the movement of electrons in relation to the transfer of energy.

b. The student will categorize the uses of electricity for

heat, light, sound and movement.

2. Materials

teacher-made worksheet or chart (see activity b.)

3. Prior Knowledge for Students

Electricity is created by the movement of electrons.

4. Key Vocabulary

electric current

energy

5. Procedures/Activities

a. Human Current: Have large group of children stand in a line an arm's length away from the person in front, and move into a circle formation. Each person should hold his arm up, palm forward, keeping his palm about one inch from the back of the person in front of him. One person begins by taking a small step forward, bringing his palm in contact with the back of the person in front of him. As each person is

touched, he in turn steps forward to gently touch the next person. The demonstration continues until the person who began is touched from behind. Reasoning: This demonstrates the quick transfer of the impulse (hand touching the back) in contrast to the short distance travelled (people in circle taking only a small step forward). Free electrons move forward and bump into other free electrons, sending them forward, resulting in a slow drift of electrons through the wire. There is, however, a speedy transfer of energy from one electron to the next.

b. Uses of Electricity: Electricity can make heat, light, sound, and movement. Discuss common electrical items with the students and make a chart to show if each item produces light, heat, sound, or movement (may make more than one). Place an X next to the appliance and under the correct heading.

Examples_____Light_____Heat_____Sound_____Movement hair dryer

CD player

stove

lamp

TV

6. Evaluation/Assessment

Teacher will prepare a worksheet similar to the chart completed in class. The students will be asked to take the worksheet home, and fill it out by taking an inventory of the electrical appliances in their homes.

G. Lesson Six: Generators and Batteries

1. Objective/Goal

a. The student will generate electricity similar to that produced by a generator.

b. Through trial-and-error the student will make a closed circuit, which will result in a bulb lighting.

2. Materials

two yards of electrical wire

bar magnet

compass

aluminum foil strips, 18 inches by 2 inches

masking tape

"D" batteries

flashlight bulb

Appendix C

3. Prior Knowledge for Students

Students should have some experience with compasses to see that the needle always points to the north.

4. Key Vocabulary

generators, magnet, compass, circuit

5. Procedures/Activities

a. Making a generator: Peel 1-inch covering off both ends of the wire. Leaving several inches free, wrap one end of the wire around your hand about ten times, making a coil. Remove your hand from the coil. Wrap the other end of the wire around the compass 5 times, leaving six inches of the end of the wire free. Twist the two uncovered ends of the wire together. Place the bar magnet inside the coil of wire you created. Slide the bar magnet quickly back and forth inside the coil of wire. This makes electricity flow in the wire and should show the compass needle moving. Extension: This makes a generator. Generators make electricity by having a magnet moving inside a coil of wire, or having a coil of wire moving around a magnet. Power stations have very large generators. You can show how falling water and steam can move a pinwheel as examples of how hydroelectric plants and steam turbine stations create electricity. Nuclear power results in steam, too, which helps create the generator.

b. It Works!: In this trial-and-error experiment, the student will learn of the necessity of circuits in making an electric current light a bulb. Prepare aluminum foil strips for the students by using strips 18"x2" and placing a similar strip of masking tape on the dull side of the foil. Fold the strips in half, making them one inch in width (shiny side out). Give each student a size "D" battery, a flashlight size bulb, and an aluminum foil strip. Have them figure out how to get the bulb to light. It will not be until someone has made a closed circuit that the bulb will light. They will have to have a portion of the foil strip wrapped around the stem end of the bulb, with one end of the foil strip touching the positive terminal of the battery, and the other end of the strip touching the negative terminal. Extension: Have students pair up to see if they can make one bulb burn brighter. They should discover that by putting their batteries together, positive terminal of one to negative terminal of the other, the bulb will burn brighter. This can tie back to earlier learning about opposite charges attracting. Students can experiment with different combinations of batteries: positive to positive, negative to positive, negative to negative.

6. Evaluation/Assessment

a. The student should be able to demonstrate how to move the bar magnet so as to create an electric current, moving the compass needle.

b. The student will demonstrate how to make a bulb light.

c. The student will be able to recognize and/or draw the correct alignment of two batteries and wire to show a closed circuit. You may use Appendix C for responses.

G. Lesson Seven: Making Circuits and Switches

1. Objective/Goal

The student will make an operational switch that will represent the concept of off/on switches.

2. Materials

4.5 volt battery

flashlight bulb

lightbulb holder

plastic coated wiring, cut into 3 pieces

paper clip

two paper fasteners, or brads

small piece of cardboard (about 4"x2")

adhesive tape

Appendix D

3. Prior Knowledge for Students

Students need to have successfully demonstrated a closed circuit, as in Lesson Six-b.

4. Key Vocabulary

switch, open, closed

5. Procedures/Activities

The Switch: Join the battery, bulb in the bulb holder, and the three wires together as in the illustration in Appendix D. Hook the paper clip to a paper fastener, and push the fastener through the cardboard near one end. Push the other paper fastener into the cardboard so that it can be touched by the paper clip. Wrap one free wire around each paper fastener on the underside of the cardboard. Bend the legs of the fasteners out and tape them down. Make sure the legs of the paper fasteners do not touch each other. When the paper clip is moved to touch the second fastener, the switch is "on", completing the circuit and lighting the bulb. When the paper clip is not touching the second fastener, the circuit is not complete and the switch is "off."

6. Evaluation/Assessment

The student will be able to demonstrate an "open" and "closed" circuit, and relate this to an "On/Off" switch. The student should be able to name several common places where "On/Off" switches can be found.

H. Lesson Eight: Conductors and Insulators

1. Objective/Goal

a. The student will be able to provide examples of a conductor and an insulator.

b. The student will conduct an experiment on common objects to determine whether they are conductors or insulators.

2. Materials

a circuit (from Lesson Seven) a variety of different materials such as: a large nail, a coin, a wood ruler, a drinking glass, a plastic lid, feather, soda can (empty and dry), a rubber glove, a piece of paper, a toothbrush, a pencil

Appendix D

Appendix E

3. Prior Knowledge for Students

Electrons moving from one atom to another atom produce a current of electricity.

4. Key Vocabulary

insulator, conductor

5. Procedure/Activities

Conductors and Insulators: Set up a circuit as illustrated in Appendix D. Place an assortment of objects to be tested near the circuit. Place the exposed ends of the two free wires on opposite sides of the object to be tested, or at least an inch apart. Does the lightbulb light? If so, the item is a conductor of electricity, allowing the electrons to flow through. If not, the item is an insulator.

6. Evaluation/Assessment

a. Students can record the results of the experiment on the response sheet found in Appendix E.

b. Students should be asked to draw conclusions about what types of objects are conductors and insulators (of what are they made?). Students should be able to provide other examples of items that would serve as conductors and insulators.

I. Lesson Nine: Make a Battery

1. Objective/Goal

The student will make a weak battery out of common items.

2. Materials

small bowl half filled with water

4 tablespoons salt

heavy brown paper bag

scouring powder

5 shiny pennies

5 shiny nickels

3. Prior Knowledge for Students

The student should have had experiences with dry cell batteries, closed circuits, and conductors.

4. Key Vocabulary

electric shock

5. Procedures/Activities

Making a Battery: Put salt in the bowl of water and stir. Cut 9 one-inch squares of brown paper and soak them in the salt water. Hold the pennies and nickels under warm tap water. Scrub both sides of each coin with scouring powder and rinse in tap water. Make a stack of coins and paper, alternating like this: nickel, wet paper, penney, wet paper, nickel, wet paper, etc. Dip your fingers in the salt water. Hold the stack of coins and paper with your thumb and pointer fingers. You should feel a mild tingling. This is a mild electric shock as from a battery.

6. Evaluation/Assessment

J. Lesson Ten: Safety

1. Objective/Goal

a. The student will be able to understand and explain safety issues regarding the use of electricity.

b. The student will identify unsafe conditions and be able to tell you how to make them safe.

2. Materials

pictures or drawings of safe and unsafe conditions with regard to the use of electricity (All About Electricity and Electricity and Magnetism contain illustrations that may help).

3. Prior Knowledge for Students

Students need to have an understanding of the serious consequences that could result due to unsafe electrical conditions.

4. Key Vocabulary

electrical outlet, socket

5. Procedures/Activities

a. Through drawings or illustrations, discuss with students the importance of safety around electricity. They should learn such rules as:

*never put your finger or anything metallic in an electrical outlet

*never touch an electrical appliance or switch when your hands are wet

*never have electrical appliances plugged in nearby when you

are taking a bath

*never put your finger in a light socket

*never use appliances that have frayed or exposed wires

*never run the wires of appliances under rugs or across large

open spaces

*do not leave heat-generating appliances (i.e. irons) on or

plugged in when not in use

*do not overload outlets with too many plugs

*use safety covers on outlets if young children are around

b. Students should also discuss and learn about safety during storms with lightning. For example:

*if outdoors, do not stand near a tree or pole

*crouch down if you are in an open field

*do not touch anything made of metal

*if indoors, stay away from windows and doors

*do not use electrical appliances

*stay away from tubs and sinks

*use the telephone only for emergencies

6. Evaluation/Assessment

The student should be able to recognize illustrations of proper electrical safety. The student should recognize examples of improper electrical safety, and give ways in which the situation could be made safe.

K. Lesson Eleven: Thomas Edison

1. Objective/Goal

The student will be able to name some of the contributions of Thomas Edison.

2. Materials

Thomas Edison, Great American Inventor by Shelley Bedick.

Appendix F

3. Prior Knowledge for Students

4. Key Vocabulary

inventor, inventions, phonograph, motion picture projector

5. Procedures/Activities

Read Thomas Edison, Great American Inventor to the students. Discuss Edison's contributions to the dawn of electric use. Discuss the importance of his inventions: lightbulb, phonograph and the motion picture projector. Have the students decide on an invention that they would like to create. What will it do? Is it for work or for fun? What will you call it? What will it be made of? Use Appendix E for student responses.

6. Evaluation/Assessment

The student will create an invention, illustrating and writing about it on the response form on Appendix F.

VI. CULMINATING ACTIVITY (Optional)

When this unit has been completed, the time would be perfect to pair your class with an upper elementary class in your school that has also studied electricity (usually third or fourth grades). Student pairs could work on such projects as circuit mazes, electric puzzles, or an electricity fair. Students can prepare circuit mazes similar to the one shown in Appendix G. On cardboard the students would glue strips of aluminum foil in maze patterns, starting from points in each corner. Only two points, however, should be connected by strips (in the example given it is points A and D). The other two points should dead end without touching any other strips. Once the maze is completed, it can be used to assess a student's understanding of open and closed circuits. Electric puzzles can be developed as quizzes in other content areas such as math, language arts, etc. Examples of electric puzzles can be found in the Global Tops curriculum, as well as in Electricity and Magnetism.

VII. HANDOUTS/STUDENT WORKSHEETS

Appendices A-G

Home | About Core Knowledge | Schools | Bookstore | Lesson Plans | Conference

Send questions and comments to the Core Knowledge Foundation.

Name _____

Response Sheet for Experiments

What I predict will happen:

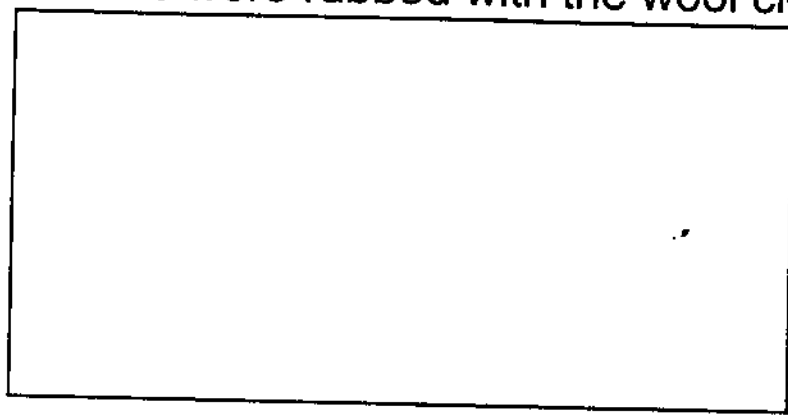
++

What did happen:

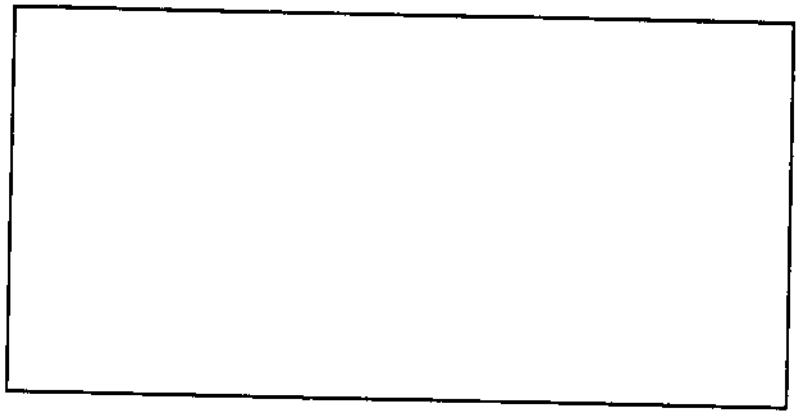
Name_____

Attracting Balloons Response Sheet

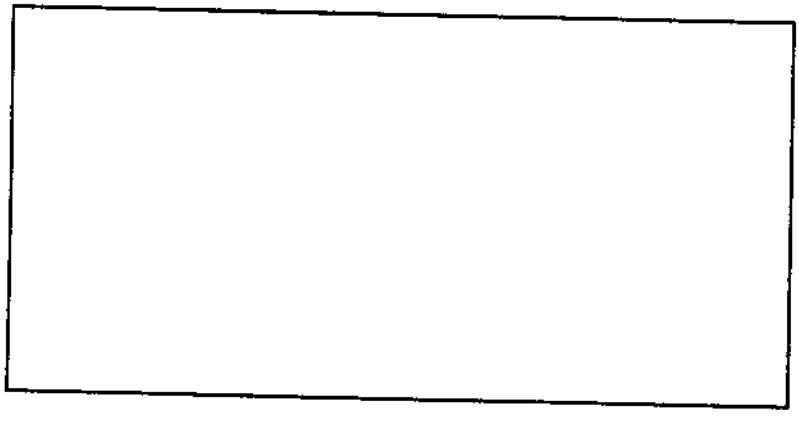
1. Draw a picture and write about what happened when the two balloons were rubbed with the wool cloth and put together.



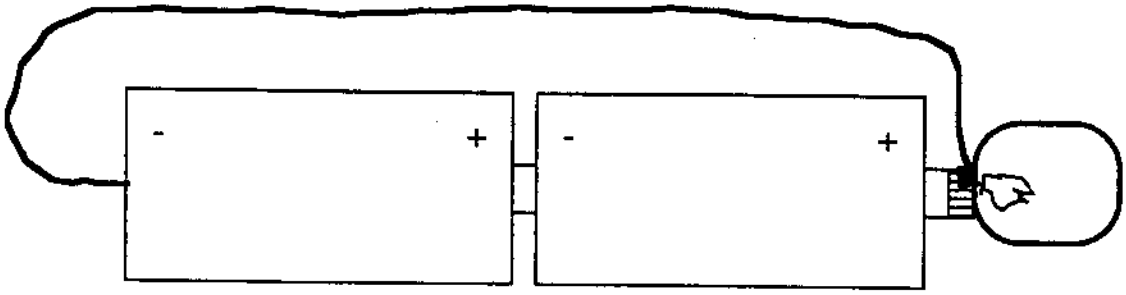
2. Draw a picture and write about what happened when one of the balloons was misted with water and then put together.



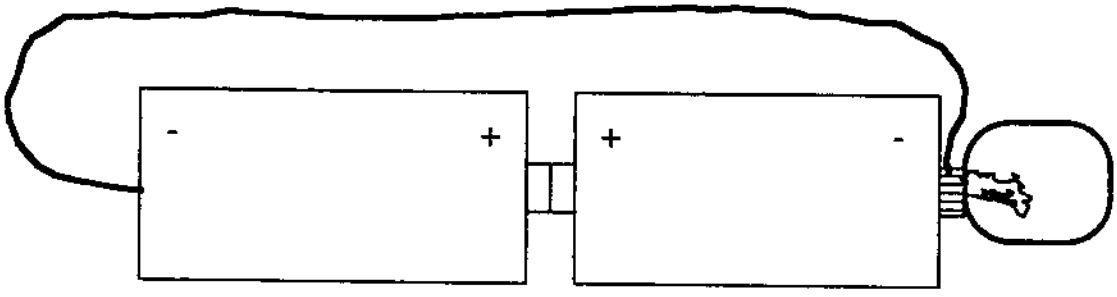
3. Draw a picture and write about what happened when both balloons were misted and put together.



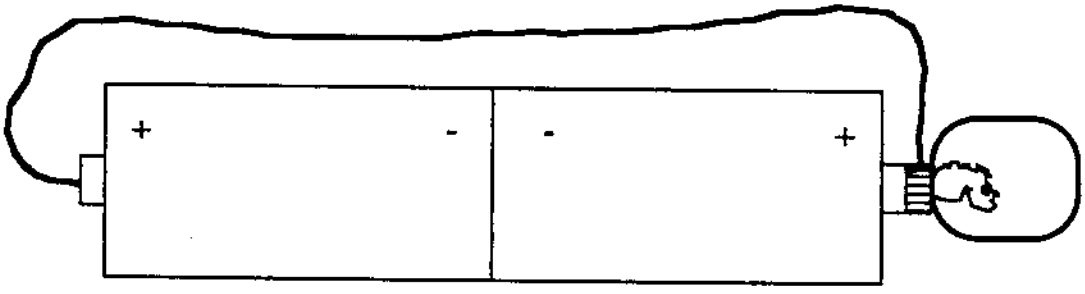
Will It Work?



Yes____ No____



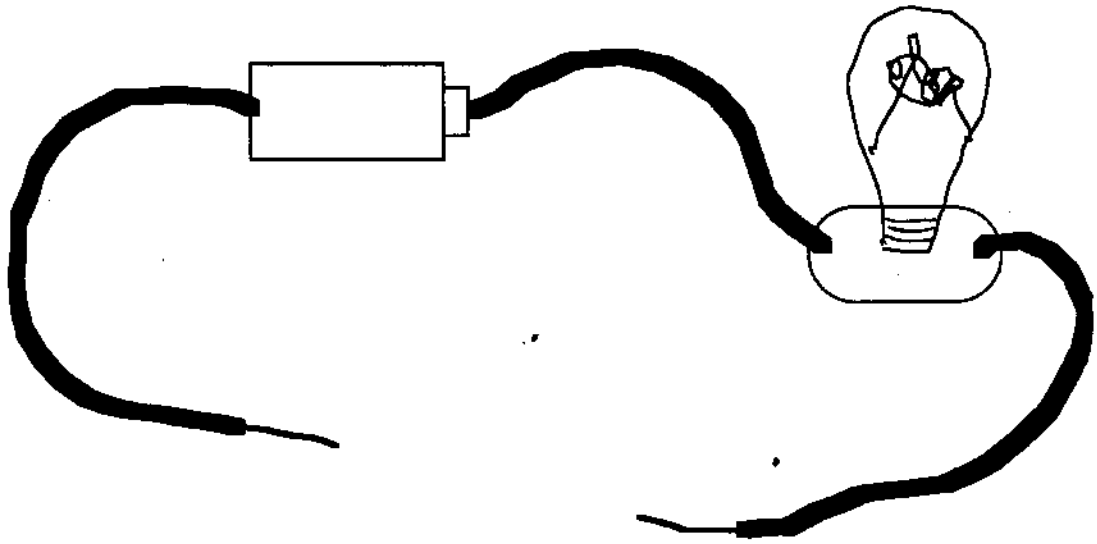
Yes____ No____



Yes____ No____

Appendix D

Model for circuit to be used for Conductor/Insulator Experiment.



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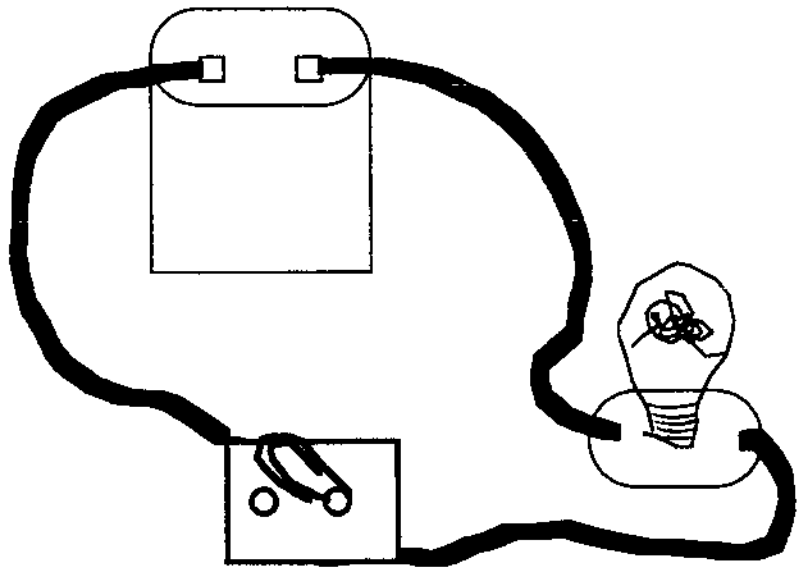
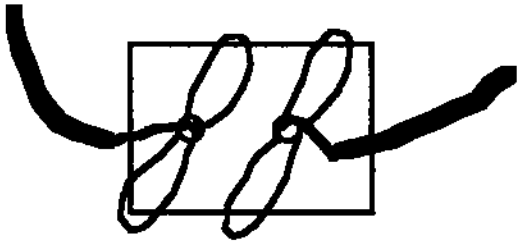
Model for making a switch:



Underside of switch



Name_____

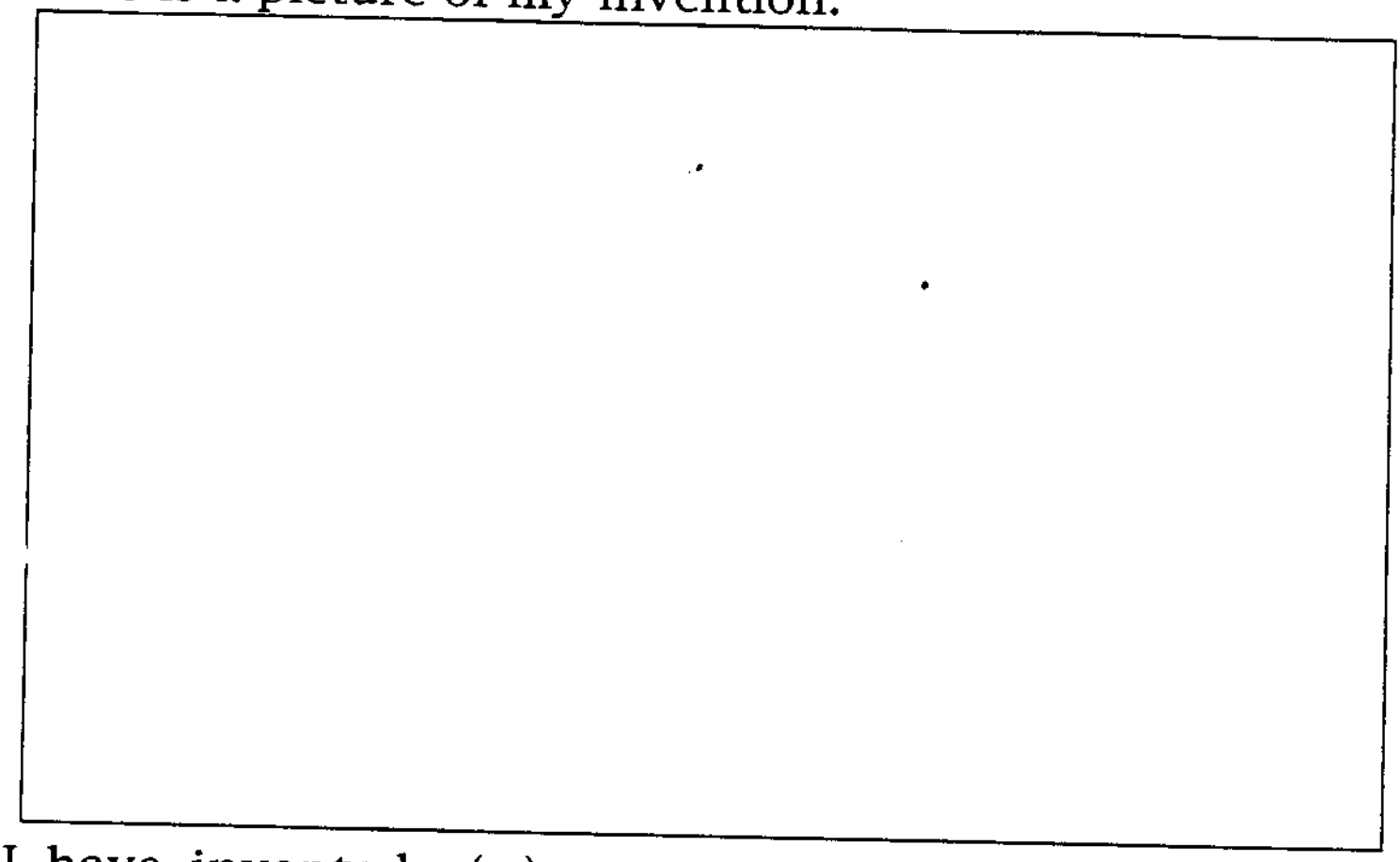
Insulators and Conductors

These objects let electricity pass through. They are conductors.	These objects did not let electricity pass through. They are insulators.

Name_____

MY INVENTION

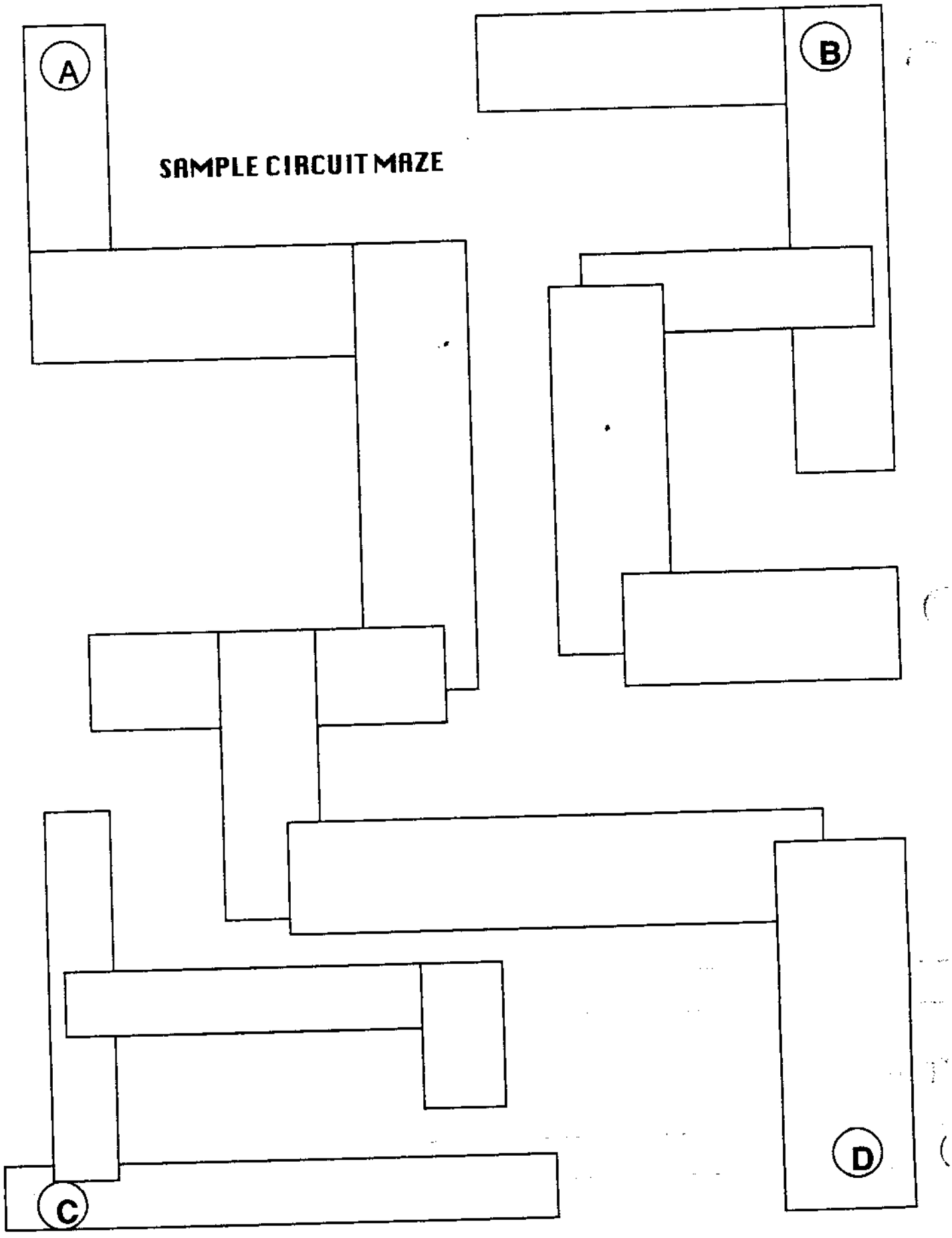
This is a picture of my invention.



I have invented a(n) _____.

You use it to_____
_____
_____.

It is made with _____
_____
_____.


A
B
SAMPLE CIRCUIT MAZE
C
D