Zapped!

Science Standard IV:
Students will understand the features of static and current electricity.

Objective 1:
Describe the behavior of static electricity as observed in nature and everyday occurrences.

Intended Learning Outcomes:
1. Use Science Process and Thinking Skills
2. Manifest Scientific Attitudes and Interests
3. Understand Science Concepts and Principles
4. Communicate Effectively Using Science Language and Reasoning

Content Connections:
Language Arts VII-5, 6

Science Standard IV

Objective 1

Connections

Background Information

When you shuffle across a carpet and touch a metal doorknob you may get zapped! You may feel a tiny electric shock as a spark jumps from you to the metal. This sort of electricity is called *static electricity.* It can make your hair stand on end, attract dust to the television set, or stick a balloon to the wall. It can cause your clothes to stick together as they come out of the dryer. Static electricity builds up charges in one place. It is stationary. When it discharges, it becomes *current electricity.*

Invitation to Learn

"Romeo, Romeo, where art thou, Romeo?" (Juliet flings left arm out and bends right arm with hand on chest and exclaims . . .

"I'm Juliet Electron and I'm looking for Romeo Proton. Will you (point to students) help me find him?"

When you walked across the carpet on a dry winter day and touched someone . . . Zap! . . . a small electrical shock happened. This is called static electricity, or the story of Romeo Proton and Juliet Electron. Static electricity is a buildup of charges on non-metallic materials. When objects are rubbed, their electrons move from one atom, or material, to another causing an unbalance in charges and creating an electric current. Electrons have a negative charge and the materials that lost the electrons become positively charged by the same amount. Electrons aren't really lost, they just move.

When you walked across carpet you picked up extra Juliet Electrons. When you extended your finger to touch Romeo Proton, the extra electrons on you caused the electrons on neutrally balanced Romeo to move away from your finger. This caused a positive charge on Romeo.

"A-ha!" exclaims Juliet.

Romeo now has a positive charge and all the extra electrons on Juliet are attracted to positively charged Romeo. (opposite charges attract)

Your lovebird, Juliet Electron, is not going to stay stationary any longer. An electric current has developed. When she sees Romeo Proton getting closer, she runs to him and gives him a shock! (Juliet, spying Romeo, runs toward him, extends her finger, touches his ear and he pretends to receive a shock.) It's static electricity! (End of play. Thunderous applause!)

Instructional Procedures

Materials
- *Station Directions*

Students are given the same opportunity to experiment with static electricity. The room is setup into six stations- two of each as outlined below. Place materials for each station on a table, including a station sign and *Station Directions* (p. 8-7). Students rotate from one station to the next approximately every seven minutes until they have participated in each station. They write what they observe at each station include drawings in a science journal.

Materials
- Ten strings 15 inches long (five cotton and five yarn)
- Five balloons, blown up and tied
- Wool cloth

Station 1-Snake Charmer

1. Charge the end of the balloon with the wool cloth by rubbing it for 60 seconds.
2. With the end of the balloon, pick up the string without touching it.
3. What did you observe? See how high you can raise the string. Try picking up the yam with the end of the charged balloon without touching it. Record your observations in a science journal.

Explanation: The charged end of the balloon gains electrons from the wool cloth, thus building up a negative charge. The string is neutral until attracted by induction to the balloon. (OPPOSITES ATTRACT.)

Station 2-Romeo and Juliet

1. Pick one Romeo and Juliet from your group. Don the appropriate necklaces. Juliet Electron shuffles his/her feet on the carpet and heads for Romeo Proton with an extended finger. Try building up a charge and touching other metallic items in the room.
2. Write a paragraph about what you observed. Include opposite charges attract, static electricity is stationary, it is a build up of charges until it discharges, then it becomes current electricity. Record your observations in a science journal.

Explanation: Juliet builds up a negative charge from the electrons gained from the carpet. Romeo becomes positively charged by induction. (OPPOSITES ATTRACT)

Materials
- ❑ *Romeo Proton* and *Juliet Electron* necklaces
- ❑ *Wool Socks or nylons (optional)*

Station 3-Balloon Games

1. Hang both balloons by their strings from a student's desk about two inches apart. Tape the string to the desktops. How do they react to each other? Record your observation in a science journal.

Explanation: The balloons are neutral and should not react to each other.

2. Charge the side of one balloon that faces the other balloon by rubbing it with a wool cloth for one minute. Make a drawing showing how the balloons react to each other. Label the drawing, telling what you did and how they reacted.

Explanation: The charged balloon will attract the other balloon because the wool cloth will have left extra electrons on the balloon, giving it a negative charge. When the negatively charged balloon is brought near the neutral balloon, it induces a positive charge near the surface of the balloon. The negative charges on the neutral balloon will separate and run away, and the positive charges will be attracted to the charged balloon. (OPPOSITE CHARGES ATTRACT.)

3. Rub both balloons for one minute with a wool cloth on the sides FACING each other. Draw how they reacted to each other and record what you did to the balloon to cause that reaction.

Explanation: Rubbing creates a gain of electrons on both balloons, causing them to repel. (LIKE CHARGES REPEL.)

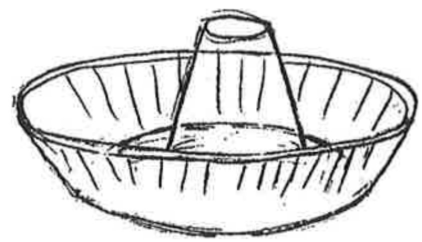
Materials
- ❑ Ten balloons blown up and tied
- ❑ Wool Cloth
- ❑ Ten pieces of string cut 24 inches long, one tied to each balloon

Possible Extensions/Adaptations/Integration

Floating Halo

Since Juliet was practicing devilish pranks on Romeo, let's end by seeing how "near to the angels" some of you may become with a halo activity.

1. Rub the Styrofoam for 60 seconds with the wool cloth.
2. Holding the pie plate by the plastic cup, set it on the Styrofoam.
3. Place your finger close enough to the pie plate to receive a shock. Don't touch the pie plate.
4. Pick up the pie plate by the cup handle, tum it over and hold it away from you.
5. With the other hand, hold the circular icicle six inches above the pie plate.
6. Let go of the icicle. It will float after it hits the pie plate. Move the plate around to keep the halo floating.
7. Explain what you observed.



Materials

- One Christmas tree icicle tied into a small circle (the thin hanging kind)
- One 9-inch square of 1/2-inch Styrofoam building insulation
- One 8-inch aluminum pie plate with a plastic drinking cup taped to the center (see diagram).

Additional Resources

Book

Hands-on Physical Science Activities, by Marvin N. Tolman; ISBN 0-13-230178-4

Web site

www.usoe.k12.ut.us/science/core/5th/sciber/5/romeo/default.htm

Family Connections

- Build an electroscope using the *Making Electroscope* handout (p. 8-9). Students design an electroscope with their family and conduct the experiment at the bottom of the page. Complete the *Electroscopes* handout (p. 8-10) and share with the class. Encourage students to design additional electroscope experiments.

Station Directions

Station 1 -Snake Charmer

1. Charge the end of the balloon with the wool cloth by rubbing it for 60 seconds.
2. With the end of the balloon, pick up the string without touching it.
3. What did you observe? See how high you can raise the string. Try picking up the yarn with the end of the charged balloon without touching it. Record your observations in a science journal.

Station 2-Romeo and Juliet

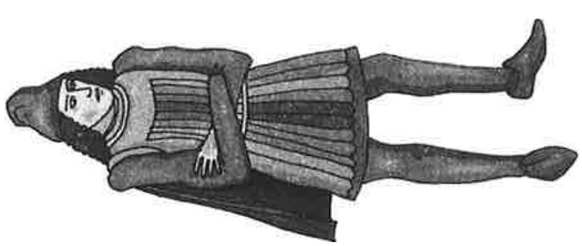
1. Pick one Romeo and Juliet from your group. Don the appropriate necklaces. Juliet (electron) shuffles his/her feet on the carpet and heads for Romeo (proton) with an extended finger. Try building up a charge and touching other metallic items in the room.
2. Write a paragraph about what you observed. Include opposite charges attract, static electricity is stationary, it is a build up of charges until it discharges, then it becomes current electricity. Record your observations in a science journal.

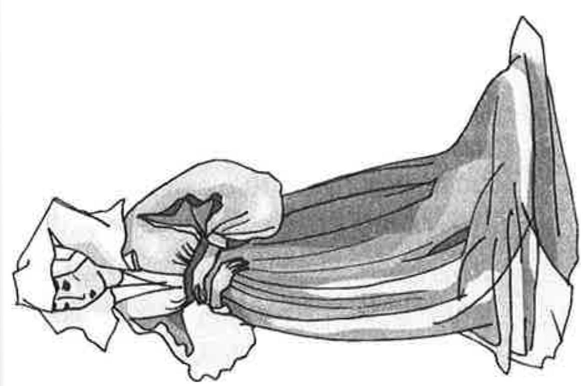
Station 3-Balloon Games

1. Hang both balloons by their strings from a student's desk about two inches apart. Tape the string to the desktops. How do they react to each other? Record your observation in a science journal.
2. Charge the side of one balloon that faces the other balloon by rubbing it with a wool cloth for one minute. Make a drawing showing how the balloons react to each other. Label the drawing, telling what you did and how they reacted.
3. Rub both balloons for one minute with a wool cloth on the sides FACING each other. Draw how they reacted to each other and record what you did to the balloon to cause that reaction.

Romeo and Juliet Necklaces

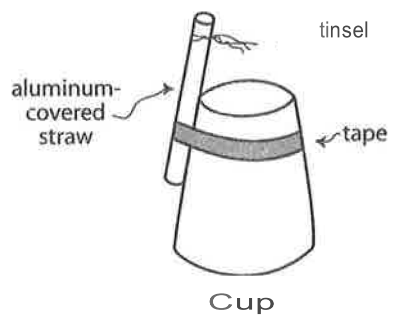
Romeo **Proton**	**Juliet** **Proton**

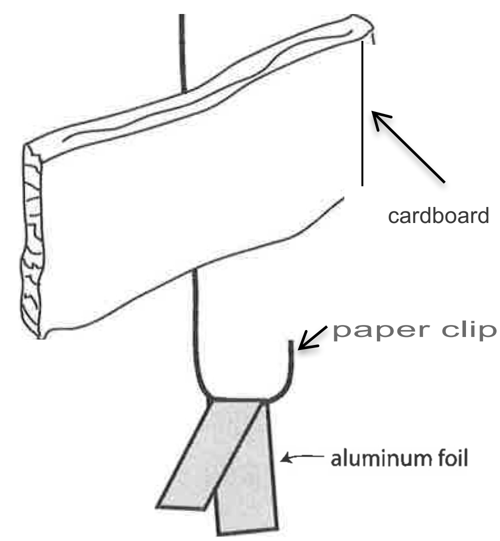




Making Electroscopes

An electroscope detects the presence of static electricity. Use the following illustrations to create electroscopes for use in the following experiment. Or be creative and design your own electroscope.





Time to experiment! Conduct this experiment on a dry day. Moisture in the air acts like a conductor, carrying electricity away as fast as it is produced.

Procedures

1. Rub each object on the wool cloth for 60 seconds. This produces a static charge on each object.
2. Hold the electroscope by the cardboard.
3. Use various objects in testing for static electricity.

Name ___________________________________

Electroscopes

We made an electroscope at home. Today we all brought them to class. This is what the electroscopes in my group look like:

We used ___________________________ to charge them.

The following illustrations show some of the experiments we tried:

Stuck on You

Science Standard IV:
Students will understand features of static and current electricity.

Objective 1:
Describe the behavior of static electricity as observed in nature and everyday occurrences.

Intended Learning Outcomes:
1. Use Science Process and Thinking Skills
3. Understand Science Concepts and Principles
4. Communicate Effectively Using Science Language and Reasoning

Content Connections:
Language Arts VIII-2, 3

Science Standard IV

Objective 1

Connections

Invitation to Learn

Begin with a riddle.

Clues

1. I like to move from place to place.
2. When the toaster and TV are on, I am there.
3. When the doorbell buzzes, I am there.
4. I amaze, delight, and help people every hour, day after day.
5. I have a home in various places.
6. You can't see or hear me.
7. I light up things.
8. I am present in thunderstorms.
9. Can you guess who I am? If you're right it could be downright shocking to you! (electricity)

We will be studying electricity for the next few weeks. First, let's assess what you already know by creating a foldable called a K-W-L-H chart. It stands for:

What you already Know.

What you want to find out.

What you Learned.

How you can learn more.

We will add new information to our chart throughout the unit.

K-W-L-H Chart

What We Know	What We Want to Find Out	What We Learned	How We Can Learn More

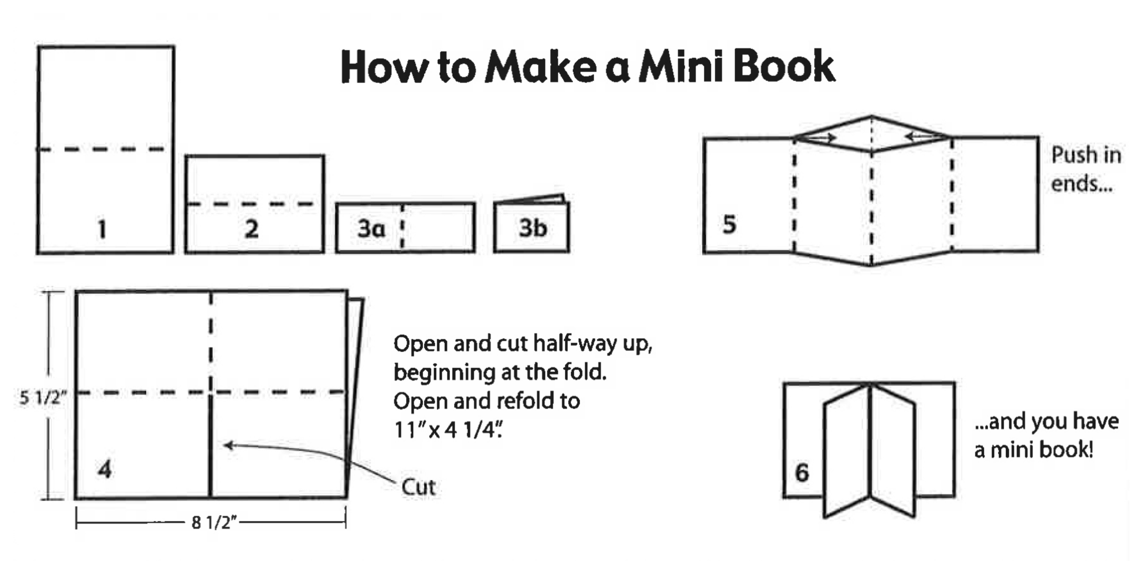
Instructional Procedures

Materials

- ❑ Two sheets of colored bond paper for each student
- ❑ Elmer's glue
- ❑ Scissors

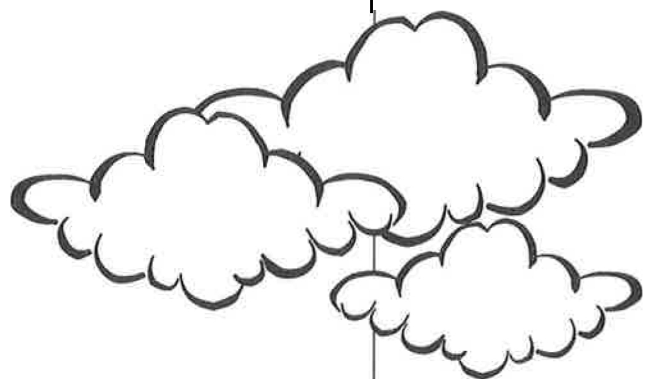
How to Make A Mini Book

1. To make a mini book, fold a sheet of paper in a horizontal fold (hamburger fold).
2. With the paper horizontal, and the fold of the paper up, fold the bottom edge to the top (hotdog fold).
3. With the fold of the paper up, fold in half again (hamburger fold).
4. Open the mini book to the first fold, with the folded edge at the bottom. Cut the along the fold half-way to the top of the paper.
5. Open and refold as shown, making a book!



6. 3808_001 12.pdfWrite **K** on the first tab, **W** on the second, **L** on the third, and **H** on the fourth. Have students list what they *know* about electricity under the **K** tab. Then list what they *would like to know* under the **W** tab. This book should be used throughout the unit to assess what students have learned and what they would still like to know.
7. Teacher may appear dressed as Ben Franklin, complete with wig, spectacles, jacket, and a kite in one hand. Read pp. 3-10 in *Who Was Ben Franklin?* Share pictures that show life with and without electricity.

8. *Lightening* is a giant spark of static electricity that forms in the clouds. *Clouds* can be made up of ice crystals (light) and water droplets (heavy). *Ice crystals* have a positive charge; each water droplet has a negative charge. During a thunderstorm, negative charges move from the cloud to the ground and positive charges move from the ground to the cloud. These moving charges are called lightening. Lightening can also move within a cloud, or from one cloud to another.



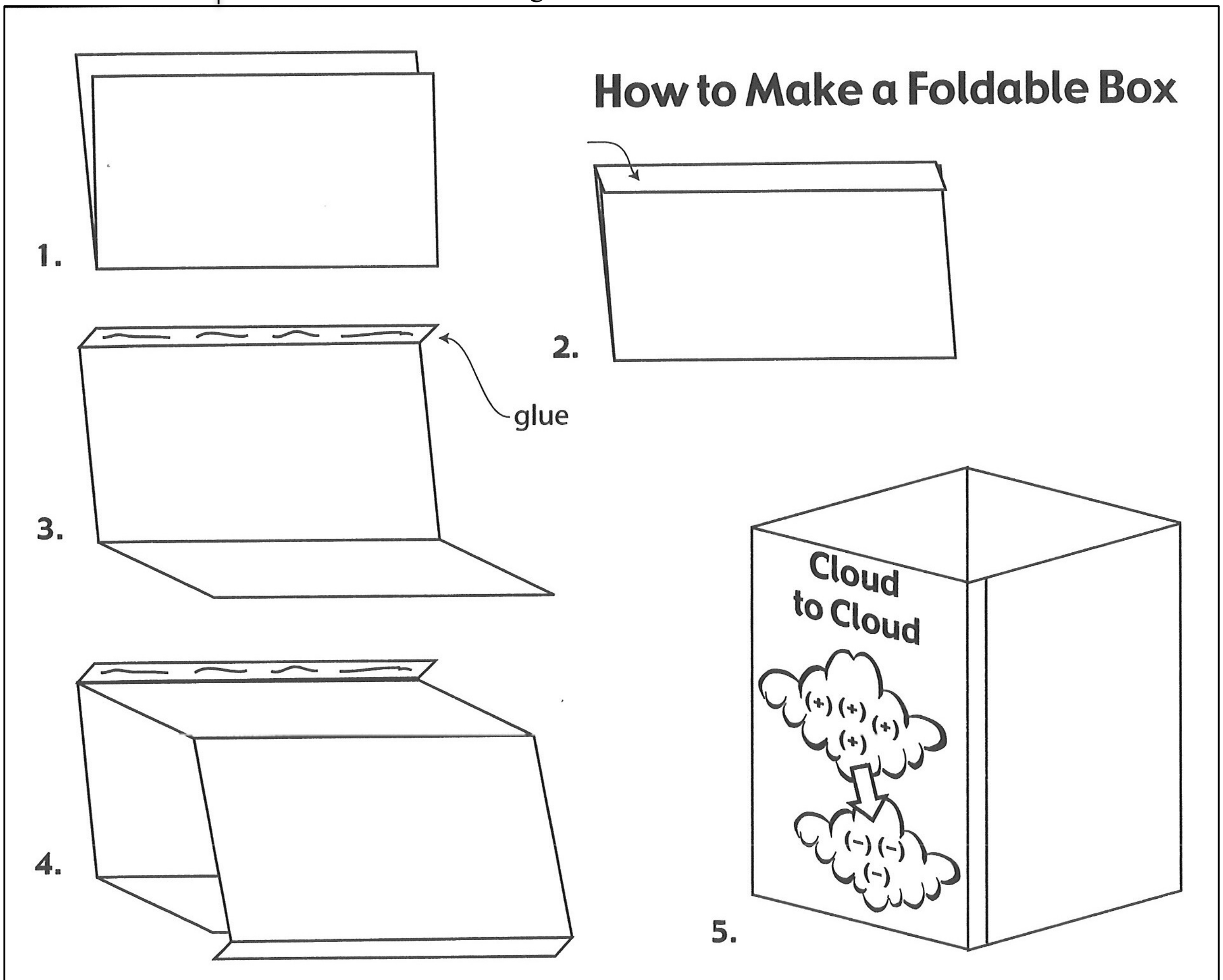
Cloud to Ground

Ground to Cloud

Within the Cloud

Cloud to Cloud

9. Draw and label the four ways lightening can move. Make a foldable box (see below) to illustrate this principle. Include the charges. Use the titles as headings for each of the four sides of the box. Draw and label the clouds under each heading, include the charges.



Possible Extensions/Adaptations/Integration

- Construct a timeline of electrical discoveries.
- Assign a biographical report on Thomas Edison, Ben Franklin, Guglielmo Marconi, Andre-Marie Amphere, Nikola Tesla, Alessandro Volta, James Watt, Michael Faraday, or Georg Simon Ohm. Write about the individual's life and experiments with electricity.
- Host a biography party where students dress as their inventor and make a mini replica or bring a picture of their invention.

- Create trading cards of their inventor.
- List the three ways to know that static electricity is present:
  1. A crackling sound may be heard.
  2. A spark can be seen and can shock you.
  3. Items cling together with static cling
- Brainstorm a list of everyday occurrences in which static electricity is present.
- Students may write a newspaper article on the lightening storm that hit your town last night using the *News Article Frame* (p. 8-17) as a graphic organizer.
- Create a class newspaper using the inventor biographies or newspaper articles.

Assessment Suggestions

- Make a *Discovery Box* to extend inquiry on questions about electricity. Include items that would make exploration of electricity possible. Include a list of *Inventor-Testable Questions* (p. 8-18) for investigation.
- Using the *Problem/Solution Outline* (p. 8-19) or *Discovery Log* (p. 8-20), have each group write a testable question to research. Go through the steps of the scientific method and come up with a conclusion. Record the investigation in a science journal.

Additional Resources

Books

Hands-on Physical Science Activities, by Marvin N. Tolman; ISBN 0-13-230178-4

Teaching Science with Foldables, by Dinah Zike (Glencoe McGraw- Hill); Student Edition ISBN 0-07-828238-1, Teacher Classroom Resources ISBN 0-07-828642-5

Lightening, by Seymour Simon; ISBN 0-590-12122-7

Thundercake, by Patricia Polacco; ISBN 0-698-11581-3

Who Was Ben Franklin? , by Dennis Brindell Fradin; ISBN 0-448-42495-9

Nurturing Inquiry: Real Science for the Elementary Classroom, by Charles R. Pearce (Heinemann); ISBN 0-325-00135-9

Web Sites

www.dinah.com

http//www.uen.org.5thgradescience (lesson plans Greenwood Biographies)

Family Connections

- Read *Thundercake* as a family on a day that thunder and lightening storms could happen. Make the cake and serve. While eating, count between the thunder and lightening bursts to see how close the lightening is.

Name ___________________________________

News Article Frame

Topic ____

Who	What	Where

When	Why

Important Facts

1. ____
2. ____
3. ____
4. ____________________________________
5. ________________________________

Details

1. _________________________
2. _____________________
3. _________________
4. _____________
5. _________

Name ____________________________________

Inventor-Testable Questions

We have been writing testable questions. These are questions that you can answer by experimenting or doing something.

"Is It Possible?" Questions

- Is it possible to make a buzzer ring?
- Is it possible to light up a model community?

Comparing Questions

- When comparing C batteries with D batteries, which will light a bulb the longest and the brightest?
- When comparing conductors and insulators which materials will allow electricity to flow through them the easiest?

"What If?" Questions

- What if I added one more battery to a series circuit?
- What if I added more lights to a series circuit and kept the same amount of batteries?
- What if I made a circuit using a lemon, potato, or used liquids? Will electricity pass through salt water, Gatorade, orange juice, or colored water?

"How Can We?" Questions

- How can we create a newspaper using the results from all our discoveries in electricity?
- How can we discover which batteries last the longest?
- How can we use a telegraph to communicate with the other classroom?

"What Is?" Questions

- What is a series circuit?
- What is an AC/DC current?
- What is lightening?

Name________________________________

Problem/Solution Outline

Inventor ____

Problem

WHO
WHAT
WHERE
WHEN
WHY
HOW

Solution

Attempted Solutions	**Results**
1.	**1.**
2.	**2.**

End Results

Name ________________________________

Discovery Log

Inventor ____

Questions you are searching (Testable Question) ______________________________

____

____

Flowing Electrons

Science Standard IV: Students will understand features of static and current electricity.
Objective 2: Analyze the behavior of current electricity.
Intended Learning Outcomes: 1. Use Science Process and Thinking Skills 3. Understand Science Concepts and Principles 4. Communicate Effectively Using Science Language and Reasoning
Content Connections: Language Arts VII-6

Science Standard IV

Objective 2

Connections

Background Information

In order to create a current, electrons jump continuously from one atom to another. Show a model of an atom and locate the position of the electrons.

Invitation to Learn

Hold a D-cell battery up for the students to see. We are going to discover how electricity flows by playing a game called *Flowing Electrons*. Students become an electron moving in a circuit.

Instructional Procedures

1. Students sit in a large circle. Each person is given a Styrofoam ball representing an electron. Their hands are atoms, and the circle represents a pathway, or wire, that the electron must travel on.
2. The teacher positions herself between two students, with the box holding the extra electrons to the teacher's left. On the box (battery) is a + sign at one end and a – sign at the other end, representing the two ends of a real battery.
3. With the command of "pass," students pass the electron to their right with their right hand. At the same time, students receive an electron with their left hand. The teacher takes electrons from the box. The student to the teacher's left passes electrons into the box. Interject the word "and" between the word "pass" as students move the ball from the left hand to the right, thus being ready to hand the ball to the person on the right with the next command of "pass." Don't drop the balls. Students can't pass unless they receive at the same time. A person may never have more than one ball in each hand at a time.

Materials

One per student

- ❑ Two-inch Styrofoam balls
- ❑ *Battery Book Cover* handout
- ❑ Four sheets of bond paper

4. Balls can't be passed unless the receiving student is directly to the right of the passing student.
5. To play, students pass an electron with the command "pass." They are acting out current electricity. The teacher's command turns the flow of electricity on and off.
6. To add a bulb, one person is chosen to represent a light bulb in the line. When he receives an electron, he runs around the desk before passing to the next person in line. The student must then run back around the desk to receive the next electron. After a few times of the student running, ask him how he feels. He should be getting warm. Tell the students that the light bulb offers a resistance to the flow of electrons, and is called a *load.* Anything that uses electricity is a load. It slows the flow down, so the bulb heats up and lights up.
7. Introduce a *switch* by having three students sitting by each other. At the command "off," move forward so they can't receive or pass electrons. This is called an *open switch* because the wire has been interrupted. Switch it on again or close the switch so the electrons can flow in a circuit.
8. Repeat the activity; this time students explain. Students return to their seats.
9. Give each student a wire, bulb, bulb holder, battery and a switch. They are to make:
   - a complete circuit.
   - an incomplete circuit.
   - a closed circuit with a bulb.
   - an open circuit with a bulb.
10. After creating the different types of circuits, students design a *Battery Book Cover* (p. 8-24) and label it *Energy Sources.* Cut it out and trace around it on four sheets of paper so students may have a battery-shaped book. Staple the pages together at the top. On page one, draw a *complete circuit.* Label the parts. Include the vocabulary words *pathway, load,* and *power source.* On page two, draw an *incomplete circuit.* Explain why it doesn't work. Label the drawing. Draw a *closed circuit with a bulb* on page three, and an *open circuit with a bulb* on page four. Label the parts on both pages using the vocabulary words. Include the word *switch* on the last two drawings. Explain the difference between an open circuit and an incomplete circuit. Add any reflections on the last page about any new discoveries about circuits.

Possible Extensions/Adaptations/Integration

- Give each student a Kit Kat that has a foil component to the wrapper, a light bulb, and a battery. Have him/her make the bulb light four different ways.
- Students write testable questions about other areas they want to experiment with and present their list to their teacher for approval and a supply of materials. Proceed with further experimentation.

Assessment Suggestions

- Students learn *How to Make An Electric Puzzle* (p. 8-25) and are quizzed on what they learned in the electricity unit. Have students write ten questions with answers and cut them into two strips or use the *Electricity Puzzle Pieces* (p. 8-26). Place the questions in one pile and the answers in another. Using a piece of cardstock, center the circuit board worksheet and glue down. Punch ten holes on each side by each question and each answer. Place a paper clip over each hole (to hold their questions and answers) and insert a brad. Flip the cardstock over and attach wires to the brads from the back of the matching questions and answers. Wire ends should be stripped of insulation covering about 1 inch on each end before wire is wrapped around brads.
- To test the puzzle, unbend a paper clip. Secure it to the positive end of the battery using a wide rubber band. Place a wire with the copper ends exposed to the negative end of the battery and tape it down with masking tape. Wrap the other end of the wire around the metal connection on the bulb. Touch the end of the bulb to the question side and the paper clip to the answer side. When the bulb lights, you have a match.

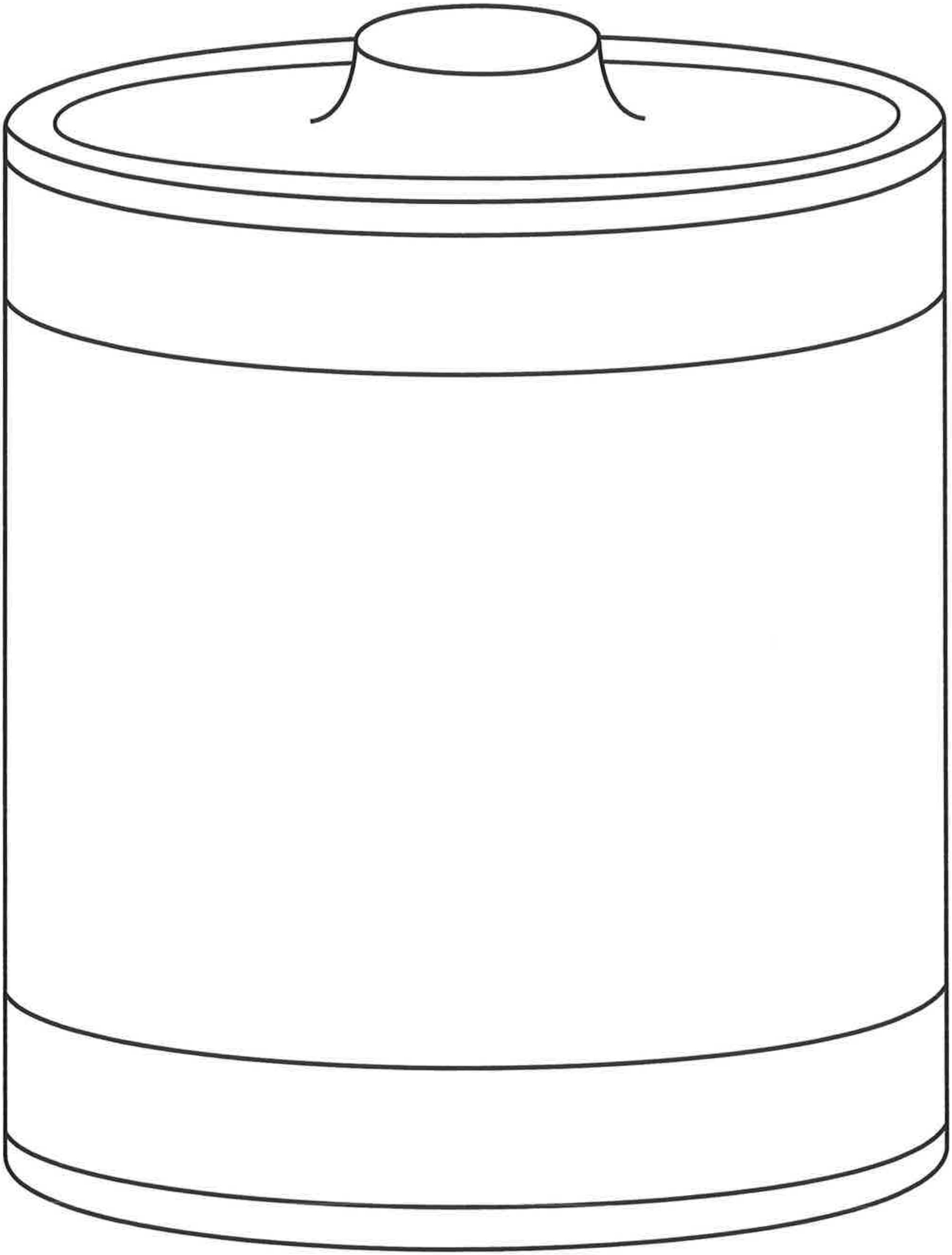
Additional Resources

Electricity, by Ron Marson (Tops Learning Systems, http://www.topscience.org/order.html); ISBN 0-941008-32-0

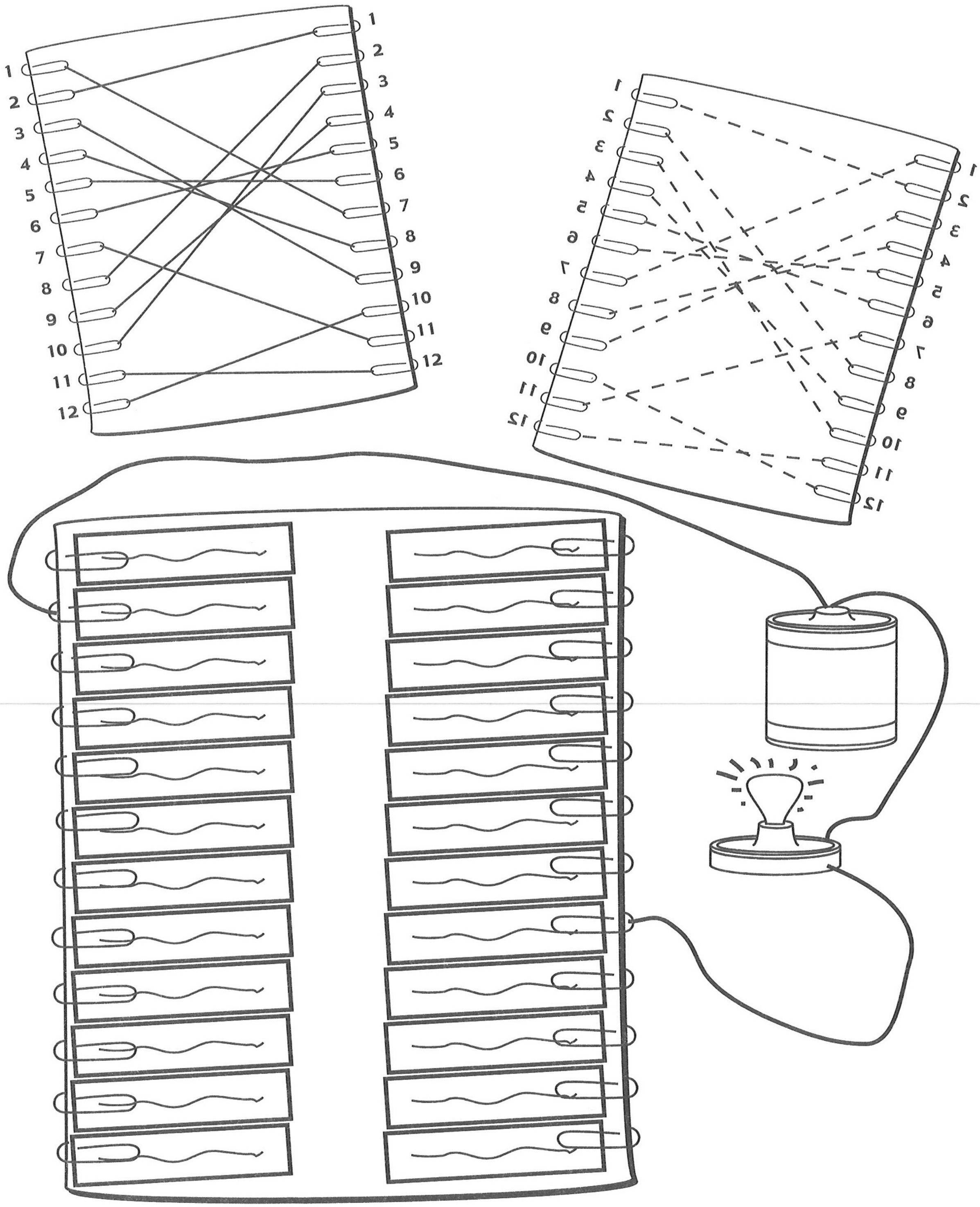
Family Connections

- Students teach their families the *Flowing Electrons* activity.
- Make a list of the items that use electricity in their home during a 24-hour period.

Battery Book Cover



How to Make An Electric Puzzle



Electric Puzzle Pieces

1. The word "electricity" comes from the Greek Word _______________.	A. Like charges repel and unlike charges attract.
2. Static electricity is __________.	B. Amber
3. When the Greeks saw lightning, they thought it was __________.	C. A continuous flow of electrons.
4. Benjamin Franklin was responsible for the first practical use of static electricity by inventing the __________.	D. A yellowish translucent solid made from fossilized tree sap.
5. Law of Electrical Charges.	E. Charged particles that are on the surface and stay in one place.
6. Current electricity is __________.	F. Zeus hurling thunderbolts.
7. Amber is __________.	G. Lightning Rod
8. Conductors are __________.	H. Materials, like rubber or plastics, that do not let charges flow through them. They hold the electric charge on the surface.
9. Insulators are __________.	I. Small parts of the atom that moves around the outside shell. It has a negative charge.
10. A circuit is __________.	J. Object that allows electric charges to move through like many of the metals.
11. An electron __________.	K. A pathway that allows electricity to flow continuously.

Name ____

Conductors

OBJECT	Conductor/Insulator	What did you observe?
1. Penny		
2. Yarn		
3. Aluminum Foil		
4. Paper Clip		
5. Straw		
6. Rubber Band		
7. Popsicle Stick		
8.		
9.		
10.		
11.		

Analyze your data. Draw a conclusion about the type of material that makes a good conductor and the type of material that would make a good insulator.

____

____

List Items that are found at home that make good conductors. What are their uses?

____

____

Clustering

Science Standard IV

Objective 2

Science Standard IV:
Students will understand features of static and current electricity.

Objective 2:
Analyze the behavior of current electricity.

Intended Learning Outcomes:
3. Understand Science Concepts and Principles
4. Communicate Effectively Using Science Language and Reasoning

Content Connections:
Language Arts VII-1, 2

Background Information

Vocabulary is an essential tool in understanding the concepts of electricity. As students attempt to organize unknown words into related groups, they are faced with a dilemma-they lack the knowledge to complete the task accurately. A purpose for reading non-fiction text is created- specific information is needed.

Invitation to Learn

Each group is given the opportunity to cut apart the vocabulary cards for the electricity unit and arrange them in a web or cluster design. Provide tape and markers to aid groups in developing an organizational pattern of how these words fit together. Each table shares their design when finished.

Instructional Procedures

Materials
For each group
- ❑ Vocabulary Cards
- ❑ Markers
- ❑ Poster
- ❑ Masking tape (about 15 inches)

For each student
- ❑ ABC Electricity handout

1. Arrange students in cooperative groups of no more than five people. Pass out a set of *Vocabulary Cards* (p. 8-30), markers, and a poster to each team. As a group, organize the *Vocabulary Cards* into a web design and create a *Cluster Poster* (allow five to seven minutes for this task). Groups share their *Cluster Posters* and display them on the wall.
2. After sharing, the class is assigned to read in a non-fiction text about electricity. During reading, fill out the *ABC Electricity Words* worksheet (p. 8-31) with vocabulary words embedded in the text. Include in each box a short definition of a word inferred from context clues in the text.
3. With new knowledge gained from the reading selection, groups may revisit their *Cluster Posters* and make adjustments.

Possible Extensions/Adaptations/Integration

- *ABC Words* worksheets work well when taking notes during a video, filmstrip, or discussion.

Assessment Suggestions

- Adjustments made to *Cluster Posters* upon completion of reading are a visual representation of knowledge gained.

Additional Resources

Electricity and Magnetism, by Mary Atwater (MacMillan/McGraw-Hill); ISBN 0-02-276128-4

Family Connections

- The *Cluster Posters* and the *ABC Words* worksheets are two useful tools to organize informational reading at home.

Vocabulary Cards

Electricity	**Current Electricity**	**Load**
Pathway	**Lightening**	**Conductor**
Insulator	**Power Source**	**Attract**
Repel	**Incomplete Circuit**	**Battery**
Static Electricity	**Complete Circuit**	**Switch**

Name ______________________________________

ABC Electricity Words

A	**B**	**C**	**D**
E	**F**	**G**	**H**
I	**J**	**K**	**L**
M	**N**	**O**	**P**
Q	**R**	**S**	**T**
U	**V**	**W**	**XYZ**