

THE “SHOCKING” TRUTH ABOUT ELECTRICITY

Grade Level: 4th Grade

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Length of Unit: 8 Lessons

I. ABSTRACT

Electricity is a part of our lives that we often take for granted. We think nothing of flipping a light switch or hitting the power button on our remote control. Young children generally do not realize that there was a time period when electricity was nonexistent. This fourth grade science unit takes students back to the very beginnings of electricity. Hands-on experiments involving the use of the scientific method as well as cooperative learning activities allow students to more fully understand the abstract concept of electricity and recognize its importance in our daily lives. Students will ask questions, make observations, and share reflections as they work to define and interpret electricity in their own usable, workable terms.

II. OVERVIEW

A. Concept Objectives

1. Students will understand that electricity is one of the most important themes in the physical sciences because almost all physical phenomena and interactions involve electricity.
2. Students will recognize electricity as a luxury and appreciate its importance in their daily lives.

B. Core Knowledge Content:

1. Students will define electricity as the flow of electrons.
2. Students will define, understand, and experiment with different types of static electricity.

C. Skills to be taught:

1. Students will create an electric circuit and perform experiments involving open and closed circuits.
2. Students will carry out experiments using conductors and insulators.
3. Students will build an electromagnet and identify its common uses.
4. Students will understand the importance of using electricity safely.

III. BACKGROUND KNOWLEDGE

For Students: This unit assumes student experience and/or knowledge in the following:

1. Use of the scientific method in performing simple experiments
2. Research skills
3. The nervous system (*Third Grade Core Knowledge Sequence*)
4. Chemistry, specifically the make-up of atoms (*Fourth Grade Core Knowledge Sequence*)

IV. RESOURCES:

Books:

1. Hirsch, E.D. (1992). *What Your Fourth Grader Needs to Know*. New York: Dell Publishing. ISBN 0-385-31260-1

2. Taylor, B., Poth, J., & Portman, D. (1995). *Teaching Physics With Toys*. Ohio: Learning Triangle Press. ISBN 0-07-064721-6

Science Kits:

1. Educational Insights. (1993). *Electricity*. Dominguez Hills, CA: Educational Insights. ISBN 1-56767-002-4

Web Sites:

1. Bill Nye the Science Guy World Wide Web Home Page:
<http://nyelabs.kcts.org>

V. LESSONS

Lesson 1: What's So "Shocking" About Electricity?

A. Objectives:

1. The student will begin to acquire a working knowledge of electricity.
2. The student will recognize electricity as important to everyday life.

B. Materials: Short video containing a general overview of electricity (Suggestions include *Bill Nye the Science Guy: Electricity* or Scholastic's *The Magic School Bus Gets Charged*), chart paper, student journals

C. Background Information

D. Key Vocabulary: electricity, electrons, magnetic field

E. Procedures:

1. Introduce the electricity unit to the students by showing a short video containing general information about electrical concepts.
2. Discuss video to allow students to begin formulating ideas about what electricity actually is.
3. Following the discussion, ask students, "What is electricity?" Record their ideas on the chart paper and post it in the classroom.

Note: This chart will be refined at the end of each electricity lesson. Students will add new ideas to the chart and remove those that they no longer consider accurate. This allows the children to formulate an accurate definition of electricity as they continue to experiment with it throughout the unit.

4. For closure, have the students record two to three questions and answers about electricity in their journals.

5. For homework, have students brainstorm five ways to use electricity safely. This will prepare them for the next day's mini-lesson on safety.

F. Evaluation: The teacher should use student journals as well as informal observation to assess student learning.

Standardized Test Connections: fact and non-fact, inference, making generalizations

Lesson 2: How Do You Get a "Charge" out of Static Electricity?

Mini-lesson: Using Electricity Safely

A. Objective: The student will recognize the importance of using electricity safely.

B. Materials: poster board, art supplies

C. Background knowledge

D. Procedure:

1. Discuss the importance of using precaution when working with any type of electricity.
2. Allow time for some students to share ideas on how to stay safe around electricity.

3. Divide students into cooperative groups. These groups will continue to work together throughout the course of the unit.
4. Cooperative Groups: Have students choose five rules and create a poster displaying these rules.
5. Display the posters around the classroom.

Lesson: Static Electricity

- A. Objectives: The student will be able to identify static electricity and its uses. The student will use various experiments to demonstrate the force exerted by static electricity and that like charges repel each other.
- B. Background Knowledge
- C. Materials (Teacher Demonstration)
 - Saw (for teacher use only)
 - 40 - 45 cm section of 1/2 inch PVC water pipe.
 - 1 sheet of 3/8 inch thick foam, as sold for mattress pads, cut into a 25 cm x 40 cm piece and a 10 cm x 15cm piece.
 - 1 of the following combinations:
 - half a plastic soda straw and a ball of clay 1 inch in diameter
 - cork to fit the end of the pipe and a toothpick or pipecleaner
 - a 2.5 cm x 50 cm strip of 1/32 inch polyethylene packing material. This material can be found on items that have been packed or shipping or at a store that sells packing materials.
 - hot glue gun and glue sticks
 - transparent tape.

To make the device --

1. To make the plastic rod, cut the PVC pipe to a length of 40 - 45 cm using a saw.
2. The pipe needs a tip in order to pick up the charged ring because it will cling to you if you pick it up. A cork with a toothpick will work. Clay and a section of a drinking straw will work also, but the clay may get messy when rolled over the foam.
3. To make the foam slide, wrap the smaller piece of 3/8 inch thick foam padding around the rod and put a bead of hot glue on the overlap line. Be careful to leave it loose enough to slide easily.
4. The larger piece of foam will be the mat.
5. To make the ring, tape the ends of the packing material together.

Directions to Demonstrate

1. Lay the ring flat on the mat
2. Move the slide back and forth along the rod about a dozen times using a complete stroke from one end to another. This will charge the rod. Finish with the slide at the top of the rod.
3. Keeping the slide near the top of the rod, roll the slide several times across the ring as it lies on the mat. Turn the ring over and roll the slide over it several more times. This gives the ring the same charge as the rod.
4. Once again, move the slide several times back and forth along the rod. This time, end with the slide at the bottom of the rod.

5. Do not touch the ring with your hand. Use the tip to pick it up and toss it in the air. Move the top of the rod underneath the ring. The ring will stay in the air because of static electricity.

Group Experiment #1: A Hair-Raising Experiment

Materials:

- a rubber balloon
- a piece of wool clothe
- a mirror

Procedure:

1. Blow up and tie the balloon
2. Rub the wool against the balloon very quickly.
3. Look in the mirror and bring the balloon near, but not touching, your hair.
4. Observe and record what happens.

Group Experiment #2: The Paper Puzzler

Materials:

- a comb
- a piece of wool clothe
- a piece of paper

Procedure:

1. Rip the paper into very small pieces and put them on the table.
2. Rub the comb with the piece of wool (the harder, the better).
3. Hold the comb near the pieces of paper.
4. Observe and record what happens.

Group Experiment #3: Tricks with a Rubber Balloon

Materials:

- 2 balloons
- 2 3ft pieces of nylon string
- a piece of wool clothe
- a marking pen
- a piece of paper
- table or desk

Procedure:

1. Blow up the two balloons and tie them.
2. Tie a piece of nylon string to each balloon and tape them to the edge of the desk.
3. Let the balloons hang so that they barely touch.
4. Mark an X on each balloon at the point where they touch.
5. Rub the two balloons with the piece of wool.
6. Let go of the balloons and watch carefully. Record what happened.

Group Experiment #4: Pass the Salt, Please

Materials:

- a pair of salt and pepper shakers
- a comb
- a piece of paper

Procedure:

1. Shake some salt on the piece of paper.

2. Now shake some pepper on the salt.
3. Rub the comb on your hair several times.
4. Bring the comb close to the salt and pepper mixture.
5. Observe and record what happens.

Key Vocabulary: static electricity

Procedure:

1. Review material from previous lesson.
2. Teacher demonstration-levitation apparatus
3. Discuss with the children what happened and why, leading them to an accurate definition of static electricity.
4. Cooperative Groups: Assign each group a static electricity experiment. Groups will complete this experiment using the scientific method.
5. Allow groups to present their experiment to the class.
6. After each presentation, discuss the results with the class. Make sure that students understand what caused these results (opposite charges attract, like charges repel).
7. Journal: Have students record new definitions and two new questions about electricity in their journal. Also have them respond to the following: How do we use static electricity in our daily lives? Share some responses.
8. For closure, allow time for students to add statements to or remove statements from their "What is Electricity?" chart. Children must justify the addition or removal of an item with an explanation.

Evaluation: Teacher should use student journals as well as informal observation to assess student learning.

Standardized Test Connections: inference, drawing conclusions, vocabulary/context clues, recall factual information

Lesson 3: What Goes Around Comes Around. What is a Circuit?

A. Objectives:

1. The student will identify the three main parts of a circuit.
2. The student will create a circuit.

B. Materials:

Each group of four will need:

- shoebox or other suitable cardboard container
- one fresh D-cell battery
- 3 to 5 feet of insulated wire
- 1 flashlight lightbulb
- tape

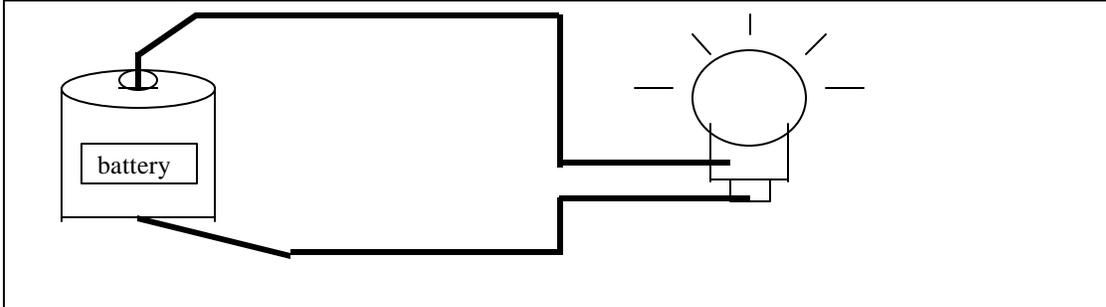
C. Background Knowledge

D. Key vocabulary: electric current, circuit, source, receiver

E. Procedures for Building a Simple Circuit:

1. Tape the D-cell battery on to the inverted lid of the shoebox.
2. Strip 1/2 to 1 inch of insulation off of both ends of a 6 to 8 inch section of wire.
3. Tape one end of the wire to one end of the battery.
4. Strip of 1/2 to 1 inch of insulation off a 1foot section of wire.
5. Tape one end of the wire to remaining end of battery.
6. Hold end of one wire to the metal end of the lightbulb and the other wire to the part of the bulb that sticks out (see diagram).

NOTE: The light bulb should light. If it does not, check connections at both battery and bulb. When bulb lights, a closed circuit has been formed.



7. Students join hands and form a circle. Facilitator squeezes hand of person to right. That student then proceeds to squeeze the hand to their right. Each student in turn passes the squeeze, or **impulse**, around the circle until it returns to facilitator. The impulse is then sent in the opposite direction.
 8. Ask students leading questions that allow them to form a working definition as to what a circuit might be.
 9. Students begin working in groups to build their simple circuits.
 10. Journal: Have students record new definitions and two new questions about electricity in their journal.
 11. For closure, allow time for students to add statements to or remove statements from their “What is Electricity?” chart. Children must justify the addition or removal of an item with an explanation.
- F. Evaluation: The teacher should use student journals as well as informal observation during the creation of the circuit to assess student learning. Standardized Test Connections: drawing conclusions, making generalizations, inference, predicting outcomes

Lesson 4: Open for Business? Open and Closed Circuits

- A. Objectives:
 - The student will explain the difference between an open and closed circuit.
 - The student will create various open and closed circuits.
 - The student will explain the difference between conductors and insulators.
 - The student will complete an experiment involving conductors and insulators.
- B. Materials:
 - simple circuits from previous lesson
 - 2 nails
 - various objects to test for conductivity (paper clip, Styrofoam, water, etc.)
 - electrical tape
- C. Background Knowledge
- D. Key Vocabulary: open circuit, closed circuit, conductor, insulator, resistance
- E. Procedure:
 1. Students join hands in circle. Facilitator squeezes hand of student to right. That student then proceeds to squeeze the hand to their right. Each student, in turn, passes the squeeze or impulse around the circle so that it returns to the facilitator. The impulse is then sent in the opposite direction. Facilitator informs the class that

this is a closed circuit and then asks is anyone has any ideas as to what an open circuit could be.

2. Discuss. Students join hands again. This time, however, two students are NOT to hold hands. The class will notice that the impulse stops at the break, an open circuit.

3. Students are then asked questions in order to form working definitions of open and closed circuits.

4. Students will add probes (nails) to their simple circuit in order to test items for conductivity:

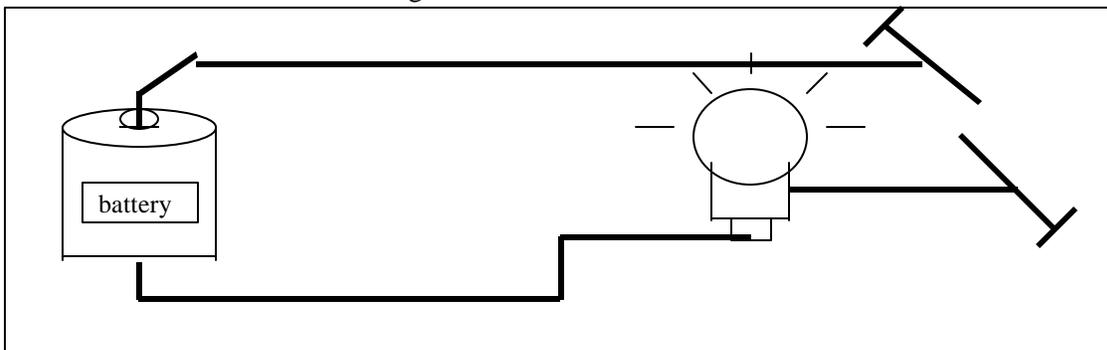
- Untape top wire from light bulb. Wrap the wire around one nail (you may need to strip more insulation off of the wire).

- Strip both ends off of a one foot section of wire.

- Tape this section of wire to the metal part of the light bulb.

- Wrap the loose end of the wire around the second nail (see diagram).

-Touch the two nails together. The bulb should light, indicating a closed circuit. If the bulb fails to light, check the connections.



SAFETY NOTE: Be sure to wrap some electrical tape around the exposed ends of wire to provide a safe place for the children to grasp the nails.

5. Students are now ready to touch the probes (nails) by placing the nails at opposing ends of objects to see if they conduct electricity or if they are insulators.

6. Provide each group with a variety of objects to test.

7. Groups should use the scientific method in performing this experiment. Hypotheses should be made as to which item will conduct electricity and which will not.

NOTE: If bulb lights, a closed circuit is present and the object is a conductor. If the bulb does not light, then the object is an insulator.

8. Have students tape their objects to a class size T-chart divided into columns for insulators and conductors.

9. Follow with a class-wide discussion of results and the importance of insulators.

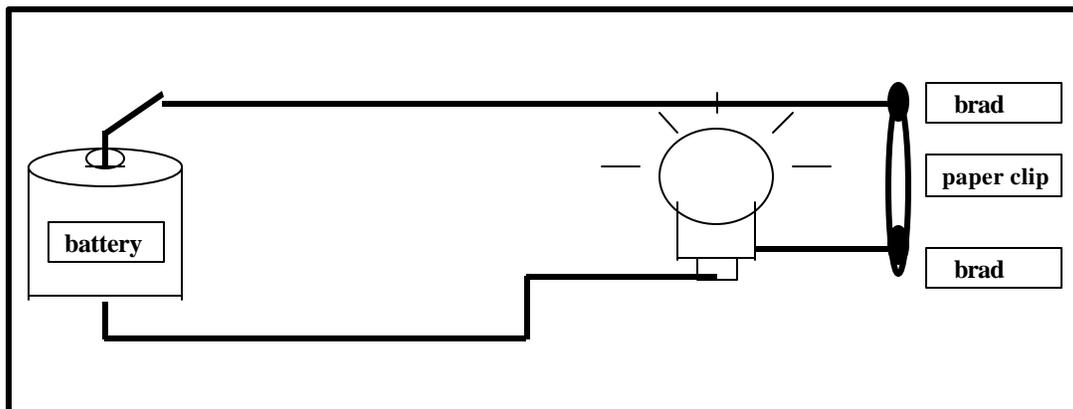
10. Journal: Have students record new definitions and two new questions about electricity in their journal. Also have them respond to the following: How do we use insulators and conductors in our daily lives? Share some responses.

11. For closure, allow time for students to add statements to or remove statements from their "What is Electricity?" chart. Children must justify the addition or removal of an item with an explanation.

- F. Evaluation: The teacher may use student journals as well as informal observation during the experiment to assess student learning.
Standardized Test Connections: compare/contrast, inference, predicting outcomes, making generalizations

Lesson 5: "Switching" Topics

- A. Objectives:
The student will identify the purpose of a switch as part of a circuit.
The student will create a switch.
- B. Materials:
-simple circuit from previous lesson
-various objects to test for conductivity
-one paper clip per group
-two brads per group
- C. Background Information:
- D. Key Vocabulary: switch
- E. Procedure:
1. Review material from previous lesson.
 2. Question students so as to lead them to the realization that their simple circuits could benefit from the addition of a switch. (Do you turn on your lights, radio, etc. at home by touching two probes together?) Discussion should focus in on the importance of using a switch to control the flow of electricity.
 3. Brainstorm ideas for the addition of a switch to the students' simple circuits.
 4. Students will work in groups to add a switch to their circuits as follows:
 - Untie wire from probes.
 - Poke two holes in the cardboard lid. Spacing should be 1/4 inch less than the length of the paper clip.
 - Wrap one wire around a brad and place brad through hole in cardboard. Open brad underneath lid.
 - Bend paper clip slightly in middle.
 - Wrap second wire around remaining brad. Place brad through paper clip before inserting into the second hole in box. (See figure below)



5. Journal: Have students record new definitions and two new questions about electricity in their journal.

6. In closure, allow time for students to add statements to or remove statements from their “What is Electricity?” chart. Children must justify the addition or removal of an item with an explanation.

F. Evaluation: The teacher may use student journals as well as informal observation to assess student learning.

Standardized Test Connections: making generalizations, predicting outcomes, recalling information, drawing conclusions

Lesson 6: Electromagnets

A. Objectives:

The student will demonstrate knowledge of the connection between electricity and magnetism by creating an electromagnet.

The student will identify uses of an electromagnet.

B. Materials:

-simple circuits from previous lessons

-one nail

-three feet of insulated wire

-metal objects such as paper clips, bobby pins, etc.

C. Background Knowledge

D. Key Vocabulary: magnet, magnetism, magnetic field, electromagnet

E. Procedure:

1. Review material from previous lesson.

2. Discuss with the students the relationship between electricity and magnetism.

3. Groups will create an electromagnet as follows.

-Remove top wire from battery and switch

- Strip one inch of both sides of the three foot wire

- Wrap the middle of the wire around the nail about 35 times, leaving the ends of the nail uncovered.

-Connect one loose end of the wire to the top of the battery.

-Connect the other end to the switch like before.

4. Have students test the electromagnet by holding the wrapped nail near one of the metal objects and closing the switch for a second or two. The nail should pick up the objects.

5. Journal: Have students record new definitions and two new questions about electricity in their journal. Also have them respond to the following: How do we use electromagnets in our daily lives? Share some responses.

6. In closure, allow time for students to add statements to or remove statements from their “What is Electricity?” chart. Children must justify the addition or removal of an item with an explanation.

E. Evaluation: The teacher should use student journals as well as informal observation to observe student learning.

Standardized Test Connections: drawing conclusions, inference, making predictions, drawing conclusions

Lesson 7 Culminating Evaluation “Electrifying Evaluation”

A. Objective - The student will demonstrate knowledge of electricity concepts.

B. Materials

- Group circuit board

- 8 1/2 ”x 11” cardboard sheet

- 10 one inch pieces of insulated wire
- 20 metal paper clips
- 20 small pieces of paper 1/2" x 2"
- C. Background information: All concepts that were taught in this unit will be evaluated.
- D. Procedures**
 1. Students will work with one partner to create their boards.
 2. Attach 10 paper clips down each 11" side of the paper.
 3. Strip the ends off the insulated wire.
 4. Connect the wires from a paper clip on the left to a paper clip on the right that is not directly across.
 5. Cover each wire with masking tape.
 6. Students choose 10 questions that they have written in their journal over the course of the unit and write them on small slips of paper. Put the small slips of paper under the paper clips.
 7. Put the answers under the corresponding paper clip.
 8. Cover the back of the board with another piece of card stock.
 9. Touch one probe from the circuit board to the question and the other to the answer. If the answer is correct, the light will turn on.
 10. Collect all test boards. During class research time, use the test boards to test students individually or in small groups.
- E. Evaluation - Teacher observation
Standardized Test Connections -- Recall facts, context clues, cause and effect, fact /non-fact, generalization

Lesson 8 -- The Final Day "Pulling The Plug "

- A. Objective - To celebrate the students work and learning throughout the unit.
- B. Materials-
 - Student projects-
 - Snacks if you choose
- C. Procedures:
 1. Have students summarize what they have learned in the unit.
 2. Make any needed adjustments to the definition of electricity.
 3. Have students stand in front of the class and share what they did for their project.
 4. Comment and discuss as needed.
 5. Summarize again what students have learned.
 6. Distribute snack and give students a chance to walk around and look closely at everyone's project.
- D. Evaluation

Rubric for projects

25 points- Validity: Are their conclusions correct?

25 points –Creativity: Is their project presented in a unique manner?

25 points -- Depth and Detail: Did their project involve in depth research or just skim the surface?

25 Points - Final Draft: Were the directions followed? Spelling and neatness count here.

TOTAL 100 points

Standardized Test Connections- Cause and effect, summarization, context clues, fact/non-fact, generalizations.

VI. CULMINATING ACTIVITY/ONGOING ACTIVITIES

Ongoing Student Activities

1. Journal -Each student should have a question/ reflection journal. This journal will be a part of their evaluation. At the end of every lesson, students should write at least two questions that will be used to create an electronic test at the end of the unit. Vocabulary words will also be defined in this unit.

2. Independent Projects - To compliment the group work, each child will be responsible for turning in a project at the end of the unit. The projects should reflect each child's individual learning style. Time should be given every day for children to work on their research project. It is assumed that students have had experience in doing independent research projects. Some examples of projects are:

1. Videotaped interview and biography with student role-playing Ben Franklin.
 2. Building a doorbell, radio, or other simple electronic device.
 3. Creating a song about electricity.
 4. Research local electric companies.
 5. Research uses of hydroelectricity.
 6. Create a timeline of electricity.
- 3. Definition of electricity** -- This should be a bulletin board or a chart that can be changed and altered easily. The student will tell what they perceive the definition to be at the time. The definition will be changed every day as the student's knowledge grows. Each lesson should end with a revision of this definition.

VIII. BIBLIOGRAPHY

Books:

1. Hirsch, E.D. (1992). *What Your 4th Grader Needs to Know*. New York: Dell Publishing. ISBN 0-385-31260-1
2. Taylor, B., Poth, J., & Portman, D. (1995). *Teaching Physics With Toys*. Ohio: Learning Triangle Press. ISBN 0-07-064721-6

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2. Ideal. (1986). *Science Experiments for Elementary Grades*. IL: Ideal School Supply Company. ISBN 0-89099-518-4

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1. Bill Nye the Science Guy World Wide Web Home Page
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