Science & Safety of Electricity - Teacher's Guide

Introduction

Science & Safety of Electricity uses articles, experiments, and puzzles to explain science concepts related to electricity, and how to use electricity safely in daily life.

Science and Safety of Electricity addresses many state and national science and health education standards for grades 6-8. These standards are met through a variety of content, including features, assessments, activities, checklists, and hands-on investigations.

This presentation guide provides the objective for each page spread, suggestions for experiment setup and completion, and ideas for classroom discussion. Activities can be done with materials listed in the booklet; electrical components are available from neighborhood hardware stores or electronics retailers.

Pages 2 & 3: Table of Contents, Word Search, and Fascinating Facts

Objective: To interest students in booklet contents, introduce relevant vocabulary words, and review electrical safety tips students already know. This page also serves as a "post-test" to see which new safety tips students have learned from reading the booklet.

Word Search Key (The first letter of each word is underlined and italicized.)

									N			
E								O				
L							R					M
E					I	T					O	
C	O	N	D	U	C	T	***I***	V	I	T	Y	
T				E	F		O		***A***	I		
R			L		***G***		N			U		
O		***E***								C		
L										R		
Y	S	R	O	T	A	L	U	S	N	***I***		
T										***C***		
E												

Tips for Discussion

Review the vocabulary words in the word search. Ask students to read aloud the electrical safety rules they wrote on page 3 and then tally them on the board. Note which tip(s) recurred most often and discuss why that may be. (Perhaps the tips are easy to remember, or they refer to a situation in which students often find themselves, etc.) Be sure to bring students back to this page after they finish the booklet so they can list additional safety rules they've learned.

Pages 4 & 5: The Body Electric

Objective: To explain what electricity is, how electric shock affects the body, and conductivity.

Keep Your Ion the Bulb Experiment
Setup: Make sure students strip enough insulation from the ends of the wires to allow for good contact with the battery and the beverages. Remind them to wipe off the tips of the wires between each test.
Answers: Students' answers to the questions will vary depending on the beverages they choose to test. Students may think that only salty-tasting beverages will contain enough salts to make the bulb light brightly, but this is not the case. Any beverages with sodium, potassium, magnesium, and/or calcium will make the bulb light. Beverages with a higher concentration of these substances (such as sports drinks) will conduct electricity better and should make the bulb light up more brightly than those with a lower concentration.

Questions for Discussion
Because the human body conducts electricity so well, you can be seriously hurt if you contact electricity from an appliance or power line. Ask students: What is likely to happen to you if you contact electricity from a household appliance? *(Heart attack, or muscle contractions that lock you to the source of electricity.)* What is likely to happen if you contact electricity from a power line? *(Fatal shock or fall.)* Ask students to tell about anyone they know or have read/heard about who survived an electric shock. How could the incident have been prevented/avoided? *(Answers will vary.)*

Pages 6 & 7: World of Wires

Objective: To teach about power lines and outdoor electrical safety, the characteristics of an electrical circuit, and the difference between conductors and insulators.

Who Can Resist? Experiment
Setup: Strip the wires ahead of time and make sure the batteries are fresh. Though the illustration does not show it, it's helpful to use electrical tape to stick the wires to the ends of the battery. Students are likely to know that metals are good conductors, but they may be unaware that things with a lot of liquid in them also conduct well. Some things to have on hand include lemons, pickles, and potatoes. When testing these, make sure students stick wires into the wet part of the item.
Answers:
#4: Students' answers will vary.
#5: If students choose an insulator that is porous enough to absorb water, such as a Popsicle stick, it will conduct electricity after being soaked overnight. However, an insulator that is not porous, such as a piece of plastic, will not absorb enough water to conduct electricity.

Questions for Discussion
Why is it important to know the difference between conductors and insulators? *(If you know about some common objects that are conductors, you might be more likely to keep these objects out of electricity's path, i.e., you would know not to stick a metal fork into an outlet or toaster or touch a power line with a metal ladder.)* Do you ever use ladders or long tools when working outside around your home? What precautions should you take to stay safe? *(Answers may include use non-conductive fiberglass ladders and*

tools; keep all tools and equipment at least 10 feet away from any power line.) What precautions do you think utility line workers take to avoid electric shock? *(They use nonconductive gloves, tools, and equipment, and are specially trained.)*

Pages 8 & 9: Dangerous Waters

Objective: To emphasize the dangers of using electricity near water, and how we protect ourselves from shock by the use of ground fault circuit interrupters (GFCIs).

You're Grounded! Activity
Setup: Some new homes may have GFCI-protected circuit breakers, rather than GFCIs in individual outlets. In this case, students should not attempt the activity.
Answers:
#2: Students should notice that GFCIs are placed in areas near sinks or outdoors. If their home is older, they may find many outlets that should have GFCIs but don't. Appliances with GFCIs in their cords are typically those appliances used near water, such as hair dryers.

Questions for Discussion
Why is it so dangerous to use electricity near water? *(Because water conducts electricity.)* What is the safest way to use electricity in areas near water? *(Use battery-powered appliances. If you must use corded appliances, make sure they are plugged into a ground fault circuit interrupter, also called a GFCI. These devices monitor the flow of electricity in a circuit and if any is escaping the circuit, they quickly shut off power to prevent serious shock.)*

Pages 10 & 11: Survivor Tales

Objective: To make students aware that dangerous behavior around electricity can cause severe injury or death, even to young people as Cliff (20) and Curt (16) were when they were injured. Students at this age may do odd jobs around the house that could involve working around overhead or underground power lines, so it is important to stress that they take personal responsibility for avoiding power lines and other electrical equipment.

Suggested Activity
Have students research other electrical accidents at the library or on the Internet to find someone who survived an electric shock and report back to the class. Discuss the accidents and how they might have been prevented.

Questions for Discussion
Where are underground power lines located? *(You can't tell by looking! Underground power lines run through neighborhoods and farms, and under city streets. Construction companies must get professional help locating underground power lines before they begin excavating for buildings or highways or even planting trees.)* How might Cliff Meidl's accident have been avoided? *(Before digging, Cliff or his boss should have asked the local one-call utility locator service for help to locate the underground power lines.)* Curt Brinkman knew it was dangerous to climb a utility pole, but he did it anyway. If students had been present when Curt began to climb the power pole, what would they have said to convince him not to climb? *(Students' answers will vary.)* Both Cliff and Curt are remarkable athletes despite their disabilities. How do students think they might cope

if such accidents happened to them? *(Students' answers will vary.)*

Pages 12 & 13: You've Got the Power

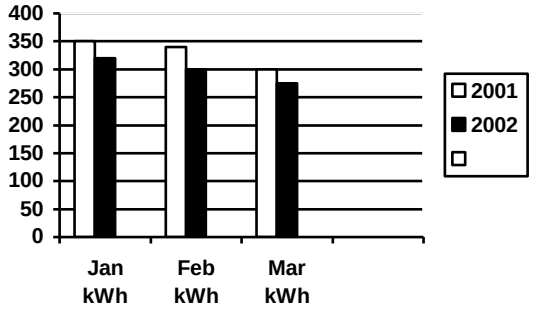
Objective: To make students aware of how electricity is used in their homes today and how it might be used differently in the future. To explain that people pay for the electricity they use, and that this usage can be reduced with some simple energy conservation measures. And finally, to encourage students to bring to their parents' attention any electrical hazards in their homes.

Save Energy Activity
Setup: Make sure students understand why they should compare the same three months of this year's and last year's bills—so they are comparing periods that have roughly the same weather patterns and family habits. Make sure students are comparing actual energy used, not dollar costs. Help them look for these totals, which will show up in kWh used.

Answers:
#1: In some cases students may find that even though their household energy use went down for the months they saved energy compared to those months in the prior year, their bills went up due to increased energy costs.

#2: Students' graphs showing the difference in energy use should include each of the three billing periods for both years. Below is a sample showing one hypothetical family's kWh usage; students can easily adapt this sample to include their own energy use data.

#3: Some students may find that despite their energy conservation efforts they were not able to reduce household energy use compared to last year. Solving this mystery will take some detective work. Have students think carefully about the activities in their home that might have contributed to this. For example, if students had more people living in their home or visiting in the current year period, this means more energy was used to run dishwashers, clothes washers and dryers, and water heaters for hot showers. If the current year period was a lot hotter or colder than the prior year period, this means more energy was used to run the AC or heat for longer periods of time or at higher settings. Or, if the household added some new appliances (such as a second refrigerator or freezer) in the current year, this will also increase energy use.



(Sample chart of kWh usage. Students can use this as a model for activity on p. 13.)

Questions for Discussion
Have you ever done an electric safety inspection of your home? Use the Home Safety Inspection list on p. 13 to do this with an adult in your family, and report your findings to the class. *(Answers will vary.)*

Pages 14 & 15: Fire in the Sky

Objective: To learn how to avoid a lightning strike. This spread also teaches about static electricity.

Charge It! Activity
Answers:
#1: When students hold the balloon near their hair, the hair should fly up toward the balloon.
#2: Students should be able to conclude that unlike charges attract. This may be a good opportunity to discuss the common phrase "opposites attract."
#3: As you move one balloon toward another balloon that is sitting on a table, the balloons repel each other. This is because the balloons have like charges (both have a negative charge.)
#4: Like charges repel.
#5: The paper sticks to the balloon.
#6: The electrons, which are negatively charged, moved to the other end of the paper, leaving the positive charges closest to the balloon. This is why the paper was attracted to the negatively charged balloon.

Questions for Discussion
Find out about someone who has been struck by lightning. What were the circumstances? How was the person affected? How could the strike have been prevented? What's the best way to stay safe when lightning is approaching? *(Get indoors. Stay away from windows. Because lightning can travel through plumbing pipes and electrical and telephone wiring, stay away from tubs, sinks, anything electrical, and corded phones.)*

Back Cover
Objective: To review some key information and get students to think about what they've learned.

Questions for Discussion
With a partner, share the most useful or surprising thing you learned from this booklet.