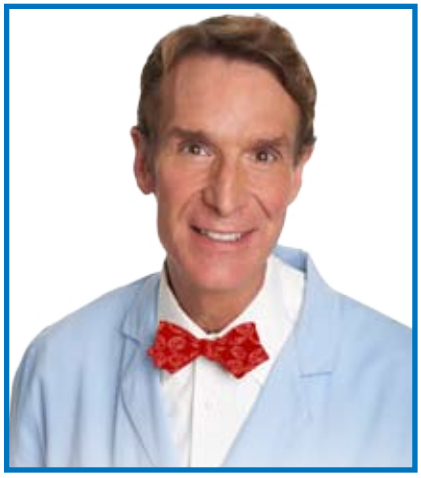
safety smart® Science

with Bill Nye the Science Guy®

Electricity



Synopsis

Students in grades four through eight join Bill Nye the Science Guy as he delves into the science behind the electrical safety.

Preview Questions:

1. What materials insulate and conduct energy?

2. How does an electrical circuit work?

3. What safety hazards accompany electricity?

On the DVD

Scene Selection

The program on this DVD is divided into five chapters. This allows the user to enter at different points in the program.

Chapter 1: Conductors, Insulators & Circuits
Chapter 2: Electrical Hazards
Chapter 3: Safety & Science
Chapter 4: Short Circuits & Safety
Chapter 5: Safety Smart Music Video

Activities

Edible Conductors

Experiment with different foods. Which are good conductors of electricity? Use a voltage regulator and record the results. Which food conducted the highest voltage? Why?

Bright Idea!

Explain how a light switch works. Take a simple circuit and make your own on/off switch.

Safety Smart® is an initiative aimed at improving the awareness and understanding of children ages 4-14 in safety and in managing themselves and their surroundings as safely as possible—by conscious action, not chance. Toward that end, Underwriters Laboratories, UL, produces multi-media public service announcements, arranges for Safety Ambassadors' visits for children to learn from professional safety experts, hosts field trips to its laboratories where students see safety engineers at work and participate in their own hands-on safety experiments, regularly take a public stance on emerging safety issues, especially regarding products that may pose a risk to consumers, and supports the development of its youth safety education programs. Through its efforts, Safety Smart cultivates safety awareness, provides opportunities for children to learn and practice safe behaviors, and helps children learn to make more informed safety choices today and in the future.

Do your part! Be Safety Smart!

Bonus Features

Safety Smart Science Quiz

See what the students have learned by having the class take the interactive quiz, where clips from the show reinforce the answers.

Know The Science: An excerpt from Electrical Current

Bill Nye teaches more about Electricity in this fun scene from *Electrical Current*, a classic episode of the wildly popular *Bill Nye the Science Guy* series.

Safety Smart Science with Bill Nye the Science Guy: Electricity and this teacher guide focus on improving safety through understanding the science concepts behind the safety. These focal concepts, described in the *National Science Education Standards* for students in grades 4-8, include observable properties of objects and substances, energy transfer and transformation, and the movement and relationships between heat, electricity, and electrical circuits.

Through the program and guide, students are first engaged by ideas related to energy transfer and materials that help and hinder that transfer. They are then encouraged to *explore* energy transfer and relationships through electric circuits. Finally, and largely because of the groundwork already established, students are challenged to *extend* on concepts underlying safety issues, learning to manage their own physical environment, and assuming responsibility for practicing behaviors that reduce injuries, all indicators addressed in the *National Health Education Standards*. The learning objectives and standards addressed are listed separately in each section of the guide.

Table of Contents

Instructional Procedures

Educator's Guide written by Designed Instruction ... providing research-based learning solutions

National Science Education Standards

Grades K-4	Grades 5-8
For full text, see the following: http://www.nap.edu/readingroom/books/nses/6c.html **Content Standard A: Science as Inquiry** Abilities Necessary to do Scientific Inquiry **Content Standard B: Physical Science** Properties of Objects and Materials - Objects have many observable… - Objects are made of one or… Light, Heat, and Magnetism - Heat can be produced in many ways… - Electricity in circuits… **Content Standard F: Science in Personal and Social Perspectives** Personal Health - Safety and security are basic needs…	For full text, see the following: http://www.nap.edu/readingroom/books/nses/6d.html **Content Standard A: Science as Inquiry** Abilities Necessary to do Scientific Inquiry **Content Standard B: Physical Science** Properties and Changes in Properties of Matter - Chemical elements… Transfer of Energy - Heat moves… - Electrical circuits provide a means… **Content Standard F: Science in Personal and Social Perspectives** Personal Health - The potential for accidents…

National Health Education Standards, Second Edition: Achieving Excellence

Standard 1: Comprehend concepts related to health promotion and disease prevention to enhance health.

Grades 3-5	Grades 6-8
1.5.1 - Describe the relationship between healthy behaviors and personal health. 1.5.3 - Describe ways in which a safe and healthy school and community environment can promote personal health. 1.5.4 - Describe ways to prevent common childhood injuries and health problems.	1.8.1 - Analyze the relationship between healthy behaviors and personal health. 1.8.3 - Analyze how environment affects personal health. 1.8.5 - Describe ways to reduce or prevent injuries and other adolescent health problems.

Standard 7: Demonstrate ability to practice health-enhancing behaviors and avoid or reduce health risks.

Grades 3-5	Grades 6-8
7.5.1 - Identify responsible personal health behaviors. 7.5.3 - Demonstrate a variety of behaviors that avoid or reduce health risks.	7.8.1 - Explain the importance for assuming responsibility for personal health behaviors. 7.8.3 - Demonstrate behaviors that avoid or reduce health risks to self and others.

Part A - Engage: Insulators and Conductors

(1) Open the lesson by showing the teaser at the beginning of Chapter 1of **Safety Smart Science with Bill Nye the Science Guy**. Stop after Bill says "Shocking!"

(2) Ask students what they saw in the segment that caused it to be so "shocking." Suggestions will reference the number of plugs and adapters connected to a single outlet. You may wish to show a close-up frame at this point to accompany the discussion. Explain to students that though much of the show is very humorous and that they should enjoy watching it, there are also some very serious messages through out the program that they should watch for and learn from. Emphasize as well that understanding the reasons why something is dangerous is a very important part of avoiding or eliminating that danger.

(3) Show Chapter 1 of the program. Ask students if any of them have ever heard of Underwriters Laboratories. Most will not recognize the name, but some will remember seeing the letters UL on various appliances, like televisions, computers, video games, wall outlets, and so forth. Recall the things that Bill mentioned about what they do at Underwriters Laboratories (e.g., drop 'em, smash 'em, twist them around, burn 'em, shock 'em, even explode them into a million pieces), and how he said that was "cool." Suggest that it is cool, because it keeps the heat down when something goes wrong during an energy transfer. Introduce the idea that keeping it safe is keeping it cool. Write the words energy transfer on the board or transparency.

(4) Ask students to suggest what they think the words mean. During the process, record students' responses on the board or on a transparency. After five to six suggestions, tell students that when trying to determine the meaning of a two-word phrase (e.g., energy transfer), it sometimes helps to address one word at a time, and then assemble the two meanings. Begin this process by breaking their suggestions into those that relate to the word energy and those that relate to the word transfer. Afterward, in assembling the meanings, the class should come to the realization that energy, or the ability to perform work or to get something done, can transfer, or move, from one place to another. Tell them that there are many types of energy and ways in which energy can transfer. Allow students to suggest a few types of energy (e.g., heat, light, electrical, mechanical, or even nuclear) and modes of transfer (e.g., conduction, convection, radiation). Explain that this lesson is mostly concerned with electrical energy and heat energy, and the type of transfer known as conduction.

Learning Objectives:

- Gather, analyze, and interpret data, and use that data to explain and predict.
- Understand that objects and substances can be described by measurable properties that make them useful in a number of ways.
- Understand that heat energy moves from warmer to cooler objects and can transfer from object to object through conduction.

National Science Education Standards

K-4 Content Standard A: Science as Inquiry

Abilities Necessary to do Scientific Inquiry

K-4 Content Standard B: Physical Science

Properties of Objects and Materials

- Objects have many observable…
- Objects are made of one or…

Light, Heat, and Magnetism

- Heat can be produced in many ways…

5-8 Content Standard A: Science as Inquiry

Abilities Necessary to do Scientific Inquiry

5-8 Content Standard B: Physical Science

Properties and Changes in Properties of Matter

- Chemical elements…

Transfer of Energy

- Heat moves…

State-level Connection:

The concepts of power, force, and work can be very difficult for students at this age. They are, however, closely related to energy, and may at this point be addressed should your state standards dictate, either conceptually or formulaically.

(5) Tell students that they are first going to explore energy in the form of heat, along with materials that act as conductors or insulators. Divide the class into groups of 3-4 students. Provide each student with a copy of the **Student Activity Sheet: Insulators and Conductors** (pp. 11-12). Ask a volunteer to read the introduction to the entire class, and then introduce the materials they will use in the investigation. Finally, before they begin, ensure that each student has read and understands the safety note included on the student sheet. Different students (and classes of students) will need different amounts of time to complete the activity, but approximately 15-20 minutes should be sufficient. Allow a couple of minutes for students to clean their work areas once the investigation has been completed.

(6) Discuss students' responses to the questions at the end of the activity. Note that though the metal may have started at a different temperature (expect this, and perhaps even a lower temperature for metal), the metal conducted heat energy much faster. Emphasize that though different types of energy behave differently, and that different types of materials insulate or conduct different types of energy, the functions are still similar—a material or substance that acts as a conductor allows energy to pass through, while an insulator does not.

(7) Ask students to recall various types of energy discussed earlier, and tell them that electrical energy is similar in some ways to heat energy, but different in others. Tell them that this is also true of conductors and insulators. Ask students to suggest materials that they think will act as insulators and those that will act as conductors of electrical energy. Ask them to pay close attention as you show Chapter 1 of the program in which Bill begins to discuss these concepts related to electricity, insulators, and conductors.

(8) Briefly review the contents of Chapter 1 and types of materials that act as conductors of electricity and that act to insulate electricity from surroundings—including us. Recall the latter portion of the chapter in which Bill talks about how electricity, which refers to electrical energy, is often converted into heat, both wanted and unwanted. Ask students if they think heat could build up and pose an unsafe situation if electrical energy, such as that carried in wires, is not properly insulated. Tell them that they will investigate that question more thoroughly the next day.

(9) Provide each student with a copy of the **Student Home Guide: Insulators and Conductors** (p. 13), and go over the instructions for completing the activity at home with their parents. Tell them that the activity will help to get them in the habit of looking around their home with a different perspective, and that their parents might enjoy it as well. Tell them that the entire class will review the results of their work the following day.

State-level Connection:

Most states require students at this age to describe conduction, radiation, and convection, and distinguish between these three types of energy transfer. A variety of different materials and activities will be needed, but this is a good point in the lesson to address this ability.

Part B - Explore: Electrical Circuits

(1) Review students' work on the home guide from the previous day, focusing on helping students transfer their decisions on number 3 to other good uses for insulators and conductors. Ask students why these choices are also **Safety Smart**, and tell them they will continue today to look into the science behind the safety. Lead into the next step by directly pointing out the examples from the previous day that deal not only with heat, but also energy in the form of electricity. Explain that this relationship is very important when they are trying to be **Safety Smart**.

Looking ahead to your supplies!

Note that if you want students to experiment with many unique circuit arrangements, they'll need enough wire to practice, and possibly (at least for older students) a means to strip the wire insulation. Note also that solid core wire provides extra durability, which could come in handy with student explorations.

(2) Show Chapter 1 where Bill reveals that air can carry energy, and so can electricity. Tell students that they will return later to unsafe ideas like "overloading" circuits. Explain that for now, however, they are going to build a simple circuit so that they can better understand what it is and how it works to transfer energy.

(3) Divide class into groups of 3-4 students. Provide each student with a copy of the **Student Activity Sheet: Making a Simple Circuit** (pp. 14-15). Allow time to pick up supplies if those are in a central location. As groups construct a circuit using a battery, wires, and light bulb, show the Report From the Classroom at the end of Chapter 1. The show uses a process that parallels the instructions in Part A, and can be paused at points along the way. Stop after students touch the bulb to the top of the battery, completing the circuit and lighting the bulb.

(4) Ask students to describe the word circuit. Allow suggestions and record each (e.g., path, journey from place to place, act of moving or going around). Work with students to assemble suggestions until they understand that a circuit is a complete loop through which electricity travels. Tell them that when they touched the bulb to the batter top, they closed the circuit, allowing the electricity to flow uninterrupted. Contrast this with the observation that when they removed the light bulb from the top of the battery, they opened the circuit, interrupting the flow of electricity and therefore stopping it from reaching the light.

(5) Ask them to predict other arrangements that will light the bulb. Record predictions and let students discuss which they think will work. Tell them to explore these ideas, keeping safety precautions in mind, and to be sure to illustrate their favorite working model in the Illustration section provided. If supplies are available, allow students to conduct further investigations using 6-volt batteries instead of 1.5-volt D-cell batteries. Note one possible arrangement below (left), and the close-ups of the terminals (middle) and the wires at the base and bottom of the bulb (right).

Make the most of your supplies!

Kids will love the batteries, and that will mean… run-down batteries. To get more power, a wider variety of arrangements, and extended battery life for other activities, try 6-volt batteries and a variety of bulb types.

(6) Ask students to connect their circuit again. Point out the pieces of rubber, metal (penny), and plastic, and ask students to predict which will act as an insulator and which as a conductor of electrical energy. Most will recall the materials that insulated and conducted heat energy the day before. Tell them that there are differences between heat and electrical energy, and between materials that insulate or conduct each, but there are also many similarities. Tell them to check how each affects the flow of electricity by inserting one at a time between the battery top and the light bulb. Note the result—the metal penny conducts electricity, whereas the rubber and plastic do not. Show the rest of the Report From the Classroom in Chapter 1 in which a similar test is performed and same results achieved.

(7) Tell groups to connect the circuit again, and when the bulb is lit, to hold their fingers close to the bulb. Ask them to describe what they feel (heat), and tell them that circuits and conductors can provide heat with electrical energy. Ask them to consider safety issues this raises.

(8) Discuss how materials that we don't often consider can also conduct electricity. Solicit thoughts, and when the idea of water comes up, explain that water around electricity poses a hazard that rivals heat. Show Chapter 2 in which Bill demonstrates the danger using the "Water and Electricity Don't Mix Lab Apparatus of Science." Provide each student with the **Student Home Guide: Electricity, Water, and My Home** (p. 16), and go over instructions for completing the activity at home.

State-level Connection:

If your state includes concepts related to properties of water, this is a good point to address some of these understandings.

Consider allowing students to explore transfer of electricity through water. In addition to materials already used, you will need salt water and a container to hold water. Cut the wire in one place. Remove insulation, and submerge the leads. The bulb lights because the salt water (and tap water to a lesser extent) contains dissolved ions

Part C - Extend: Ground Fault Circuit Interrupters and Safe Homes

(1) Remind students of the types of energy given off by the light bulb. Explain that devices like the light bulb transform electrical energy to light and heat energy, and that this is a valuable aspect of electricity—we can use it in many ways to give us what we need. Tell them that this same aspect can, however, present problems. Show the scene in Chapter 2 in which Bill is using heat generated by electricity to roast marshmallows, but finishes by showing how heat from a frayed cord shorting out under a carpet can cause a fire. Show the following scenes through Electricity Week.

(2) Recall the ad in the previous scene and how "being grounded is a good thing." Most have seen three-prong plugs, but will not know why some have three prongs instead of two. Explain that electricity naturally flows to the earth, or ground, and that the third prong is for safety—it provides a path for electricity to flow to the ground so that it will be less likely to flow through a person to reach the ground. Tell them that this often helps to avert disasters, but that the device will not work if a plug is removed or damaged. Show the Luv-a-Plug Commercial in Chapter 3.

(3) Recall the effect of water on the flow of electricity. Briefly discuss the students' home guide work, and potentially unsafe situations involving electricity and water. Ask what could happen if the frayed cord under the carpet in previous chapters happened to be in a pool of water. Allow a few comments, and then tell students that a frayed cord leaves exposed wires that can touch and cause a short, which could lead to a fire. When exposed wires are in water, even if they are not physically touching one another, the water acts as a conductor and causes a short. Tell them to watch as Bill answers this issue and discusses a device that can protect them in the event of such a disaster. Show the comic book sequence in Chapter 3 up to the point where the program shows a close up of the GFCI as it trips, and then stop at that point. Leave the close up image on the screen for a moment.

Learning Objectives:

- Understand relationships between behaviors and injuries, and practice strategies to reduce risks and manage physical environments.
- Understand that electrical circuits require a complete loop through which an electrical current can pass, and that a break or short in this loop can pose dangers.

National Science Education Standards

K-4 Content Standard B: Physical Science

Light, Heat, and Magnetism

- Heat can be produced in many ways...
- Electricity in circuits...

K-4 Content Standard F: Science in Personal and Social Perspectives

Personal Health

- Safety and security are basic needs...

5-8 Content Standard B: Physical Science

Transfer of Energy

- Electrical circuits provide a means...

5-8 Content Standard F: Science in Personal and Social Perspectives

Personal Health

- The potential for accidents...

National Health Education Standards

See page 2 for full text of specific indicators.

Grades 3-5 and 6-8

Standard 1

Grades 3-5 - Performance Indicators 1, 3, 4

Grades 6-8 - Performance Indicators 1, 3, 5

Standard 7

Grades 3-5 - Performance Indicators 1, 3

Grades 6-8 - Performance Indicators 1, 3

You're Grounded

Explore how grounding and the ground pin work. Reference: http://electronics.howstuffworks.com/question110.htm

Why do the plugs on some appliances have two prongs and others have three prongs?

In a standard outlet, the left slot is "neutral" and the right slot (slightly smaller) is "hot." The hole below is "ground." The ground slot and the neutral slot of an outlet are identical. They both connect back to ground. If you look around your house, what you will find is that just about every appliance with a metal case has a three-prong outlet. This may also include some things like your computer. It has a metal-encased power supply inside even if the device itself comes in a plastic case. The idea behind grounding is to protect the people who use metal-encased appliances from electric shock. The casing is connected directly to the ground prong.
If that wire comes loose inside an ungrounded metal case, the loose wire could touch the metal case. If the loose wire is hot, then the metal case is now hot and anyone who touches it will get a potentially fatal shock. With the case grounded, the electricity from the hot wire flows straight to ground, and this trips the circuit breaker in the box or blows the fuse in the box.

(4) Ask students to describe what happens when exposed wires in an electrical circuit come in contact with water. With prompting, students will note that some of the electricity flowing through the circuit will begin to flow through the water. Point to the close up of the GFCI on the screen and explain to students that this device—a Ground Fault Circuit Interrupter—senses the amount of electricity flowing through the closed circuit, and that when the amount suddenly becomes different from what it expects, it trips, opening the circuit and stopping the flow of electricity. Tell them this occurs in 1/40th of a second, which is less than a heartbeat. Remind students of the meaning of the terms closed and open as they pertain to electric circuits. Tell them that with a GFCI, there is a much better chance that the circuit is quickly opened, shutting down the flow of electricity and thus protecting us, and even protecting Bill. Show the rest of the comic book scene. Follow by telling students to listen and watch the next chapter closely as Pamela Gwynn, a UL safety engineer, discusses and demonstrates the GFCI and show the following scene.

Consider the following...

Brainstorm a variety of conditions that can cause short circuits, and things to look for at home.

(5) Write the words short circuit on the board. Based on the meaning of the word circuit established earlier, ask volunteers to describe a short circuit. Explain that this is a circuit in which electricity takes a shorter path than intended. Point out a circuit like those with which students have worked, only with worn insulation. Ask them to consider what could happen to cause a short in this circuit. Remind them of the earlier discussion of dangers related to the frayed cord under the carpet. Let them view the circuit up close and show them the worn insulation. Some students will begin to suggest that the wires could touch. Show the Report From the Classroom in Chapter 4 in which a short circuit of this type is demonstrated.

Consider the following...

For advanced students, the K-W-L chart can be applied to efforts to find solutions to real community issues.

(6) **Use the Teacher Demonstration: Short Circuit!** (p. 17)
This demonstration will tie the concept of the short circuit to students' previous learning about the hazards of water, and also reintroduce the idea of safety as a responsibility. Refer to earlier discussion in step 3 regarding the potential hazards of using electricity around water. If you choose to use a sport drink in the demonstration, briefly discuss electrolytes—a medical/scientific term for salts, specifically ions. The term electrolyte means that this ion is electrically charged and moves to either a negative (cathode) or positive (anode) electrode. An electrolyte is a substance containing free ions that behaves like an electrically conductive medium—hence conductive. This is the reason that salt water also works well as an alternative to a sport drink in this demonstration. Show Bill's Habit of Mind rant in Chapter 4, and then guide a discussion regarding the importance of each of us taking responsibility for safety in our homes and communities. Provide each student with a copy of the **Student Home Guide: Safety and Responsibility** (p. 18) in which they and their parents (or older brothers or sisters) will be challenged to determine what they can do to make safer use of electricity in their home and community. Explain the K-W-L chart provided in the guide. Help them identify a couple of "safe electricity" topics that might be of interest to them, how they can use what they know about a topic to identify what they want to know, and finally, how they can explain what they have learned after gathering information and studying the topic. You may use groups or have students perform their own research. Modify the duration and complexity of requirements to suit the age and abilities of your students.

Consider the following...
Encourage Safety Smart solutions to a variety of everyday situations (e.g., frayed cords, using indoor extension cords outdoors, burned out light bulb, etc.).

(7) Before they begin, reassure them that sometimes solutions are not as hard as they may seem. Show Cooking with Cuisina in Chapter 4 to the point where the toast gets stuck, just before Cuisina says, "Oh, oh…" Pose the question, "How can we get the toast unstuck without getting the electricity into us?" Take a couple of suggestions, and then encourage students to always use their best defense against accidents involving electricity—common sense. Continue with Cuisina's suggestion that they unplug the toaster! Show the remainder of Chapter 4 and Chapter 5 to complete the program.

Student Activity Sheet:
Insulators and Conductors

Explore and understand the transfer of energy, the effect of different materials on the transfer of energy, and the meaning of the terms "conductor" and "insulator."

MATERIALS:

- Three containers or cups, each of a different material (e.g., glass, metal, paper, plastic, etc.)
- Source of hot water (provided by teacher)
- Two spoons or tubes (one plastic, one metal)
- Heat resistant glove
- Two thermometers
- Watch with a second hand
- Other optional as required by teacher

Hey Kids:

Watch for signs and symbols in your science classroom!

Note to the Safety Smart®

1. Never touch a surface that may be hot. Only touch what you are told to touch, and use a heat resistant glove.
2. Tie back long hair, and don't wear loose clothing. Ask if you aren't sure if your clothing and hair are safe.
3. Keep all hot things near the center of your table or work surface, and never reach or lean over any source of heat.

Look for signs and symbols when dealing with heat, fire, or hot surfaces!

PROCEDURE:

Part A - Predicting insulation and conduction of heat energy

1. If the materials needed to conduct your investigation are in a central location, gather those materials now before proceeding.

2. Place the cups in the center of your table or work area. Leave a few inches between each cup. Predict which cup is made of material that best conducts heat energy, and which is made of material that best insulates against transfer of heat. Write your prediction in the Part A of the Data and Questions section.

3. Signal your teacher when your group is ready. Your teacher will pour hot (not boiling) water into each cup. Touch the outside of each cup lightly with your hand, and then respond to the second question in part A of the Data and Questions section.

Part B - Measuring insulation and conduction of heat energy

4. Place one of the cups in the center of your table or work area. Put the two spoons in the cup, on opposite sides of the cup. Tape one thermometer on each spoon so that the bulb is near the top of the spoon handle. See the arrangement in step 5.

5. When you signal that your group is ready, your teacher will add boiling hot water to your cup, just covering the bowl of the spoon. Begin timing at that point (0 minutes), and take one temperature reading for each spoon each minute. Record the data as it is collected and respond to the questions in part B of the Data and Questions section. If your teacher allows, you may repeat the experiment and record data for another spoon made of a different material.

Note: It is important to always clean up your work area after you have completed an investigation. Did your group leave things the way they found them, or not? You don't need to answer, but if you didn't get things clean, then you should get **Safety Smart**!

DATA and QUESTIONS:

Part A:

Prediction of best conductor - _____

Prediction of best insulator - _____

What were the results of your test?

How close were your predictions to the actual results?

Part B:

Time (minutes)	0 minutes	1 minute	2 minutes	3 minutes
°F - Plastic				
°F - Metal				
°F - Other				

Which type of material was the best conductor of heat energy?
Which was the worst? How can you tell?

Of the materials used in this investigation, can you tell which would be the best insulator?
Why?

Student Home Guide:
Insulators and Conductors

Explore and understand the types of materials that are used around the home as insulators and conductors, how some of these materials are used, and why they are good choices.

INSTRUCTIONS:

Get together with one or more partners (parent, guardian, older brother or sister). Follow each of the instructions below, and write your comments in the space provided. You should search around your home for your examples and discuss what you write with your partner(s), but you should do the actual writing!

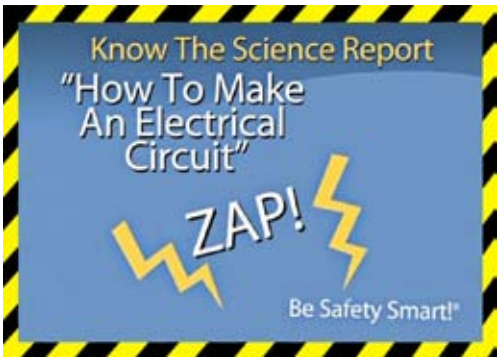
(1) Identify and list at least three examples of materials around your home that are used to conduct energy. Beside each, describe how it is used.

(2) Identify and list at least three examples of materials around your home that are used to insulate against transfer of energy. Beside each, describe how it is used.

(3) Pick three of the six materials listed in numbers 1 and 2 above. Be sure that the three you pick include at least one conductor and at least one insulator. List your selections below. For each, decide why you and your partner(s) think this type of material is particularly good at "doing its job." Beside each type of material, explain your decision beside each material you listed.

Student Home Guide:
Making A Simple Circuit

Explore and understand the transfer of electrical energy through a simple circuit and the role of insulators and conductors in the circuit.



MATERIALS:

- Electrical wire
- D-cell (1.5-volt) Battery
- Small light bulb
- Rubber gloves
- Tape
- Piece of plastic
- Penny
- Other optional as required by teacher

Hey Kids:

Watch for signs and symbols in your science classroom!

PROCEDURE:

Part A - Building a basic simple circuit

1. If the materials needed to conduct your investigation are in a central location, gather those materials now before proceeding.

2. Wrap one end of the wire around the metal base of the light bulb. If necessary, wrap a small piece of tape around it to hold it in place.

3. Tape the other end of the exposed wire to the bottom of the battery. Make sure that the wire is actually touching the battery surface.

4. Touch the base of the bulb to the top of the battery. Respond to the questions in Part A of the Data and Questions section.

Part B - Trying alternative circuit arrangements

5. Use other materials provided by your teacher to try a variety of circuit arrangements. Only try one at a time, and take care to not keep a bulb lit for too long or you will run down your battery. When you find a configuration that you really like (and that works very well to light the bulb!) illustrate it in Part B of the Data and Questions section.

5. When you signal that your group is ready, your teacher will add boiling hot water to your cup, just covering the bowl of the spoon. Begin timing at that point (0 minutes), and take one temperature reading for each spoon each minute. Record the data as it is collected and respond to the questions in part B of the Data and Questions section. If your teacher allows, you may repeat the experiment and record data for another spoon made of a different material.

Note: It is important to always clean up your work area after you have completed an investigation. Did your group leave things the way they found them, or not? You don't need to answer, but if you didn't get things clean, then you should get **Safety Smart**!

DATA and QUESTIONS:

Part A:

What happens when the base of the bulb is touched to the top of the battery?
What happens when it is removed?

Part B:

Illustrate the circuit arrangements that worked well for your group. Be sure to show all wires, batteries, and bulb(s).

Part C:

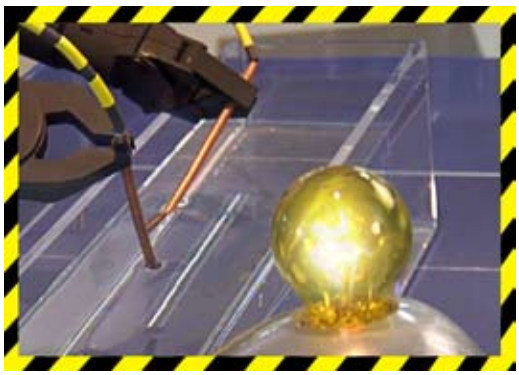
Item between bulb and battery	Rubber glove	Piece of Plastic	Penny
Bulb lit? (yes/no)			

Which type of material(s) conducted electrical energy well?
Which did not? Which would be best used to insulate wires?

Student Home Guide:
Electricity, Water, and My Home

Explore and understand the types of situations involving water and electricity that exist around homes, and the things that individuals and families can do to make these conditions as safe as possible.

INSTRUCTIONS:



Get together with one or more partners (parent, guardian, older brother or sister). Follow each of the instructions below, and write your comments in the space provided. You should search around your home and discuss what you write with your partner(s), but you should do the actual writing!

(1) Identify and list at least three examples of situations around your home in which electricity and water are near one another or could possibly come in contact with one another. Briefly describe each

(2) Pick one example from number 1 above, and describe specific things you and your family can do to make sure that the situation is as safe as possible. Please use the back of this page if you need additional space.

Teacher Demonstration:
Short Circuit!

Understand the way in which electricity seeks the shortest route to complete a circuit, and the result

MATERIALS:

- Electrical wire (two strands worn at the midpoint)
- Battery
- Small light bulb
- Tape
- Rubber kitchen gloves
- Eye goggles
- Shallow pan (shoe box lid with a liner will work)
- Sport drink with electrolytes (or salt water)

PROCEDURE:

1. Arrange the circuit as in the **Student Activity Sheet: Making a Simple Circuit** (p. 14-15). Most of the arrangements used the previous day will work. You may wish to use one of the arrangements invented by one of your student groups. The only difference in this demonstration arrangement is that the insulation has been removed from the wires near the midpoint. As in the demonstration in Chapter 13, tape the wires down so that the exposed wires near the midpoint are immobile and not touching. But for this demonstration, make the surface to which they are taped a small, shallow pan.

Note: Be sure to wear goggles and gloves. A smaller battery is recommended (e.g., D cell, etc.), as there may be a small amount of smoke or odor. The demonstration is perfectly safe, but do not allow students to be too close. Remember, you're a role model!

2. Gather the students close enough so that they can actually see the circuit and the lit bulb. If you have a very large class, consider a camera and screen to make the demonstration easily viewed throughout the classroom. You may also wish to dim the lights in the room for added effect.

3. Tell the students that we are now going to perform the short circuit demonstration ourselves. Ask them if anyone has a good conductor on them that will work for connecting the wires. As they hesitate, take out the sport drink, ask if anyone has ever spilled one of these, and pour it into the shallow pan. You may instead use salt water and ask what would happen if the wires were exposed in a pool of water.

4. Conclude the demonstration by briefly discussing the fact that there are numerous reasons and conditions that make a short circuit a safety hazard, and one that should be immediately repaired by a qualified professional.

5. Start to clean up, make a show of remembering to use your gloves before disconnecting the wires, removing them from the pan, and cleaning off the rest of the work surface. Don't miss the opportunity to model being **Safety Smart®**!

Student Home Guide:
Safety and Responsibility

Pose questions, explore electrical safety in the home and community, seek information to answer questions, and summarize learning

INSTRUCTIONS:

Get together with one or more partners (parent, guardian, older brother or sister).
Select a topic of interest and complete the K-W-L chart.

State the Topic: _____

(K) **What I know:**	
(W) **What I want to know:**	
(L) **What I have learned:**	