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Lesson Focus

Demonstrate the concept of conducting or insulating electricity. Note: This lesson plan is designed for classroom use only, with supervision by a teacher familiar with electrical and electronic concepts.

Lesson Synopsis

The Insulators and Conductors activity encourages students to test different classroom materials to determine if they are conductors or insulators of electricity. Students work in teams testing their predictions about each material, then groups compare results and discuss findings.

Age Levels

8-11.

Objectives

- ✦ Learn about the electrical properties of different materials.
 - ✦ Learn how conductors and insulators react to electric current.
 - ✦ Solve simple algebraic manipulations involving squares and square roots.
 - ✦ Learn to make predictions and draw conclusions.
 - ✦ Learn about teamwork and working in groups.
-

Anticipated Learner Outcomes

As a result of this activity, students should develop an understanding of:

- ✦ electrical properties
 - ✦ conductors and insulators
 - ✦ circuits and current
 - ✦ making and testing predictions
 - ✦ teamwork
-

Lesson Activities

Students test a variety of materials in a circuit to determine whether each item behaves as an insulator or a conductor. Students make predictions about each item and discuss the results in teams and as a class. Student teams also construct their own circuit tester using wires, batteries, and a bulb.

Resources/Materials

- ✦ Teacher Resource Documents (attached)
- ✦ Student Worksheet (attached)
- ✦ Student Resource Sheet (attached)

Alignment to Curriculum Frameworks

See attached curriculum alignment sheet.

Internet Connections

- ✦ TryEngineering (www.tryengineering.org)
- ✦ National Institute of Standards and Technology (NIST) (www.nist.gov)
Information about measurements and measurement uncertainty.
- ✦ ITEA Standards for Technological Literacy: Content for the Study of Technology (www.iteaconnect.org/TAA)
- ✦ NSTA National Science Education Standards (www.nsta.org/publications/nse.aspx)
- ✦ NCTM Principles and Standards for School Mathematics (<http://standards.nctm.org>)

Recommended Reading

- ✦ DK Eyewitness Series: Electricity (ISBN: 0751361321)
- ✦ Make Cool Gadgets for Your Room by Amy Pinchuk and Teco Rodrigues (ISBN: 1894379128)
- ✦ My World of Science: Conductors and Insulators by Angela Royston (Heinemann Educational Books, ISBN: 0431137269)

Optional Writing Activity

- ✦ Write an essay (or paragraph depending on age) describing a product which would not operate well if alternate materials were used in its construction. For example, a light bulb built with a plastic thread for a filament would not operate.

Insulators and Conductors

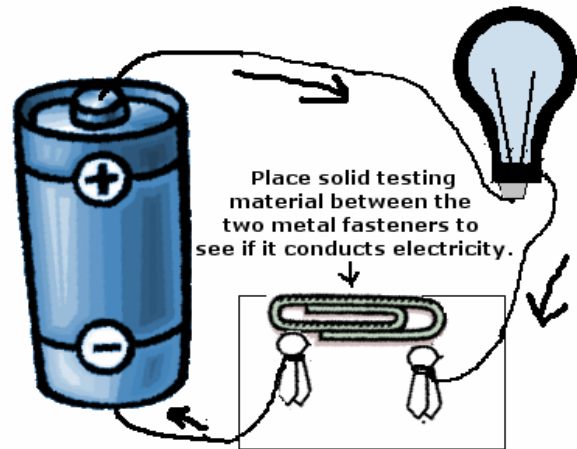


For Teachers: Teacher Resources

◆ Materials

- Student Resource Guide and Student Worksheet
- 3 pieces of wire (strip the ends)
- Battery (size D)
- 1.5 volt bulb and socket
- paper fasteners
- Variety of materials that are either conductors or insulators; enough for each team to select ten items from a pool of at least 40 (Suggestions: metal paper clip, paper, eraser, aluminum foil, metal pen, rubber band, pencil, coin, hairclip, key.)

Solid Conductor Testing Setup



◆ Procedure

1. Set up for the class a model of an electric circuit, using wires, bulbs, and a battery. Demonstrate the properties of insulation and conductivity by testing several different materials.
2. Provide the Student Reference Sheets to each student. (Note: these could be distributed as reading homework prior to the classroom activity.)
3. Have one set-up displayed along with an object that insulates and one that conducts electricity.
4. Divide students into small groups of 3-4 students.
5. Provide each group with wires, a bulb, and a battery and have them assemble their own conductivity tester.
6. Ask student groups to select five materials they believe will conduct electricity from the assorted materials available (see materials list). Groups will also select five materials they believe will not conduct electricity. Selected items will be listed on the Student Worksheet.
7. Student groups will provide their predictions to another team for testing - so each team will be testing another team's predictions.
8. Results are recorded on the Student Worksheet and shared with the group.

◆ Time Needed

1 - 2 Classroom Sessions

◆ Extension Ideas

- Have students gather materials from home to test.

Insulators and Conductors



Student Resource: What Are Conductors and Insulators?

◆ Conductors/Conductivity

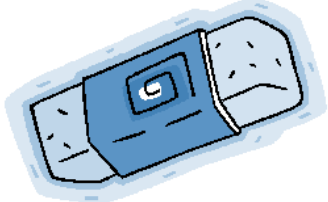

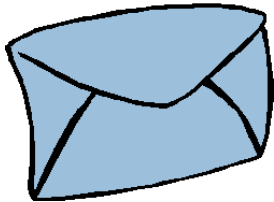

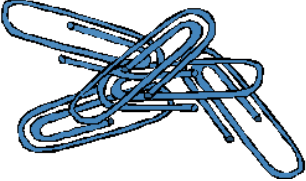




Conductivity is the ability or power to conduct or transmit heat, electricity, or sound. Conductors are materials that electricity easily passes through, that do not resist the flow of electricity. Examples are copper, aluminum, steel, silver, gold, electrolytes. Not all materials conduct electricity equally well.

◆ Insulators

Insulators are materials that resist the flow of electricity, so electricity does not easily pass through. Examples are plastic, wood, rubber, cloth, air, glass. Some materials are better electricity insulators than others.

◆ Challenge

Do you think the following items are more likely conductors or insulators?

| | | |
|---|---|--|
|  Eraser <input type="checkbox"/> Conductor <input type="checkbox"/> Insulator |  Metal Pen <input type="checkbox"/> Conductor <input type="checkbox"/> Insulator |  Paper Envelope <input type="checkbox"/> Conductor <input type="checkbox"/> Insulator |
|  Pencil <input type="checkbox"/> Conductor <input type="checkbox"/> Insulator |  Paper Clip <input type="checkbox"/> Conductor <input type="checkbox"/> Insulator |  Chalk <input type="checkbox"/> Conductor <input type="checkbox"/> Insulator |
|  Coin <input type="checkbox"/> Conductor <input type="checkbox"/> Insulator |  Spoon <input type="checkbox"/> Conductor <input type="checkbox"/> Insulator |  Nail <input type="checkbox"/> Conductor <input type="checkbox"/> Insulator |

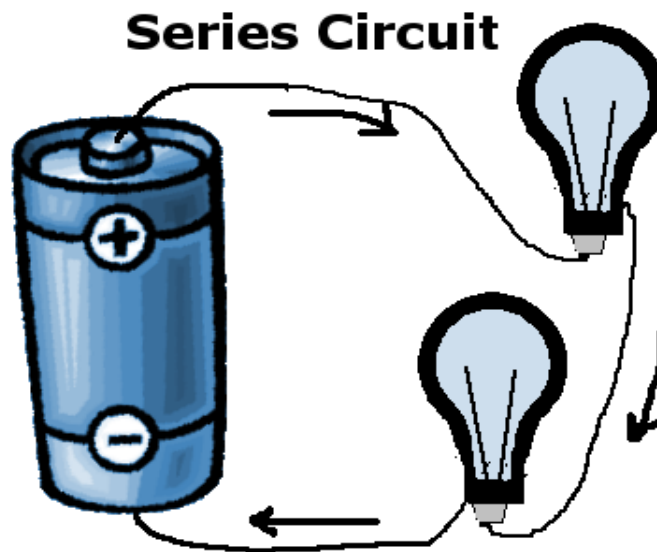
Insulators and Conductors



Student Resource: What is a Simple Circuit?

◆ Simple Circuit

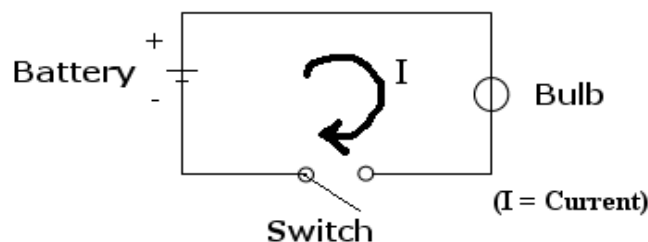
A simple circuit consists of three minimum elements that are required to complete a functioning electric circuit: a source of electricity (battery), a path or conductor on which electricity flows (wire) and an electrical resistor (lamp) which is any device that requires electricity to operate. The illustration below shows a simple circuit containing, one battery, two wires, and a bulb. The flow of electricity is from the high potential (+) terminal of the battery through the bulb (lighting it up), and back to the negative (-) terminal, in a continual flow.



◆ Schematic Diagram of a Simple Circuit

The following is a schematic diagram of the simple circuit showing the electronic symbols for the battery, switch, and bulb.

Schematic Diagram of a Simple Circuit



Insulators and Conductors



Student Worksheet: Insulators and Conductors Activity

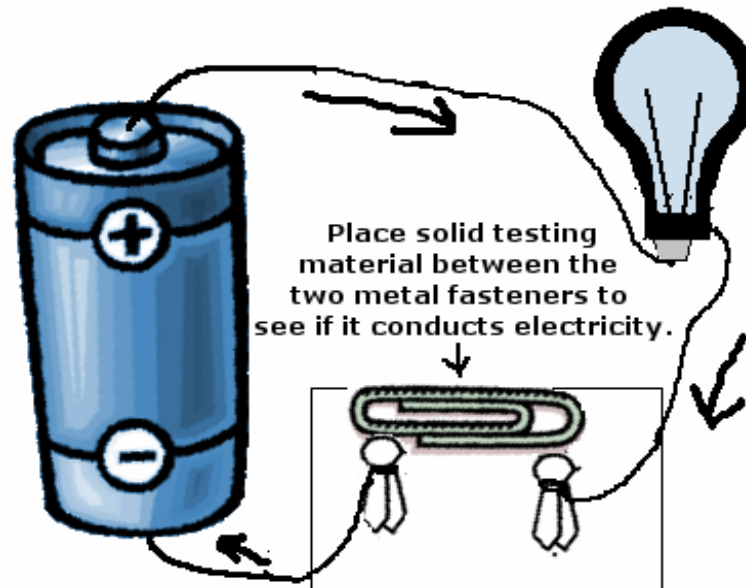
◆ Procedure

Your team will be provided with wires, a bulb, and a battery. Assemble a conductivity tester similar to the one below.

Then, as a team agree on five materials you believe will conduct electricity (conductor), and five others you with will not (insulator). List these on your Student Worksheet. Exchange your completed Student Worksheet with that of another team. You will test each other's predictions.

Test each material, and provide the results back to the team whose predictions you tested. Discuss as a group your findings. What surprised you?

Solid Conductor Testing Setup



You can make a solid conductor testing set up with a battery, three wires, and a bulb as seen above. If a material is placed between the two metal fasteners that does conduct electricity, the bulb will light up. If the material placed between the fasteners does not conduct electricity, the bulb with not light up. In a way, by introducing a solid conductor into the circuit, and then removing it, you are creating a simple switch.

Insulators and Conductors



Student Worksheet:

Student Team One Predictions:

| Materials Team One Predicts are Conductors | Materials Team One Predicts are Insulators |
|--|--|
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4 |
| 5 | 5 |

Student Team Two Outcomes:

Test the materials selected by team one, then list each in the appropriate box.

| Conductors | Insulators |
|------------|------------|
| | |

Questions:

1. What percentage of Team One's predictions were correct?
2. Why would civil engineers, or other designing a structure, have to be very familiar with insulators and conductors.

Insulators and Conductors



For Teachers: Alignment to Curriculum Frameworks

Note: Lesson plans in this series are aligned to one or more of the following sets of standards:

- U.S. Science Education Standards (http://www.nap.edu/catalog.php?record_id=4962)
- U.S. Next Generation Science Standards (<http://www.nextgenscience.org/>)
- International Technology Education Association's Standards for Technological Literacy (<http://www.iteea.org/TAA/PDFs/xstnd.pdf>)
- U.S. National Council of Teachers of Mathematics' Principles and Standards for School Mathematics (<http://www.nctm.org/standards/content.aspx?id=16909>)
- U.S. Common Core State Standards for Mathematics (<http://www.corestandards.org/Math>)
- Computer Science Teachers Association K-12 Computer Science Standards (<http://csta.acm.org/Curriculum/sub/K12Standards.html>)

◆ National Science Education Standards Grades K-4 (ages 4 - 9)

CONTENT STANDARD A: Science as Inquiry

As a result of activities, all students should develop

- ✦ Abilities necessary to do scientific inquiry
- ✦ Understanding about scientific inquiry

CONTENT STANDARD B: Physical Science

As a result of the activities, all students should develop an understanding of

- ✦ Light, heat, electricity, and magnetism

CONTENT STANDARD E: Science and Technology

As a result of activities, all students should develop

- ✦ Understanding about science and technology

◆ National Science Education Standards Grades 5-8 (ages 10 - 14)

CONTENT STANDARD A: Science as Inquiry

As a result of activities, all students should develop

- ✦ Abilities necessary to do scientific inquiry
- ✦ Understandings about scientific inquiry

CONTENT STANDARD B: Physical Science

As a result of their activities, all students should develop an understanding of

- ✦ Properties and changes of properties in matter
- ✦ Transfer of energy

CONTENT STANDARD E: Science and Technology

As a result of activities, all students should develop

- ✦ Understandings about science and technology

◆ Next Generation Science Standards Grades 3-5 (Ages 8-11)

Matter and its Interactions

Students who demonstrate understanding can:

- ✦ 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- ✦ 5-PS1-3. Make observations and measurements to identify materials based on their properties

Insulators and Conductors



For Teachers: Alignment to Curriculum Frameworks

◆Standards for Technological Literacy - All Ages

Design

- ✦ Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.