Insulators and Conductors

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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.

Year Levels

Year 6 – Term 2; Year 9 – Term 1

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.
- Curriculum links (www.acara.edu.au)

Recommended Reading

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

Optional Writing Activity

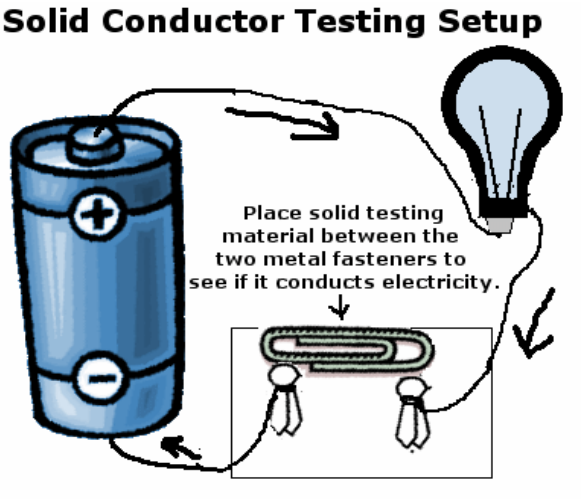
- Write an essay (or paragraph depending on age) describing a product which would not operate well if alternate materials were used in its construction. For example, a light bulb built with a plastic thread for a filament would not operate.

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
- 2 paper fasteners (split pins)
- 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.)



◆ 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

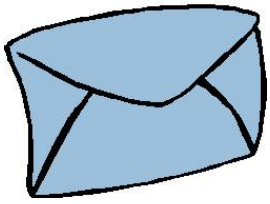
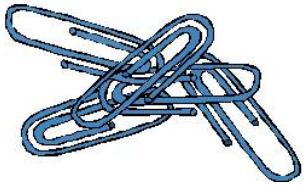
Conductivity is the ability or power to conduct or transmit heat, electricity, or sound. Conductors are materials that electricity easily passes through, that do not resist the flow of electricity. Examples are copper, aluminum, steel, silver, gold, electrolytes. Not all materials conduct electricity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

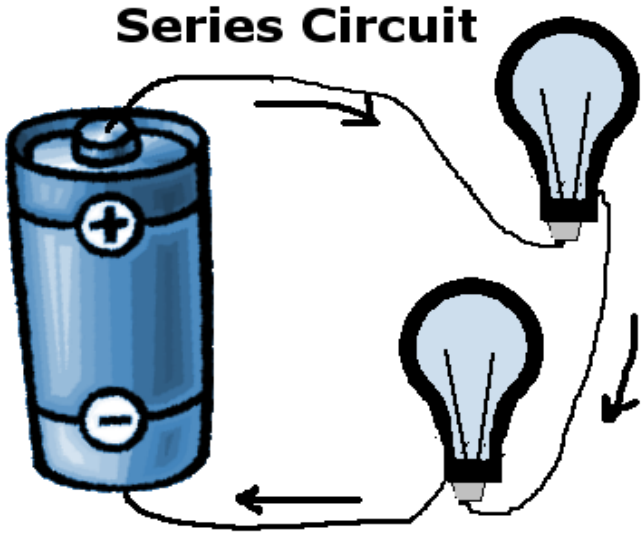
 **Eraser** ☐ Conductor ☐ Insulator	 **Metal Pen** ☐ Conductor ☐ Insulator	 **Paper Envelope** ☐ Conductor ☐ Insulator
 **Pencil** ☐ Conductor ☐ Insulator	 **Paper Clip** ☐ Conductor ☐ Insulator	 **Chalk** ☐ Conductor ☐ Insulator
 **Coin** ☐ Conductor ☐ Insulator	 **Spoon** ☐ Conductor ☐ Insulator	 **Nail** ☐ Conductor ☐ Insulator

Insulators and Conductors

Student Resource:
What is a Simple Circuit?

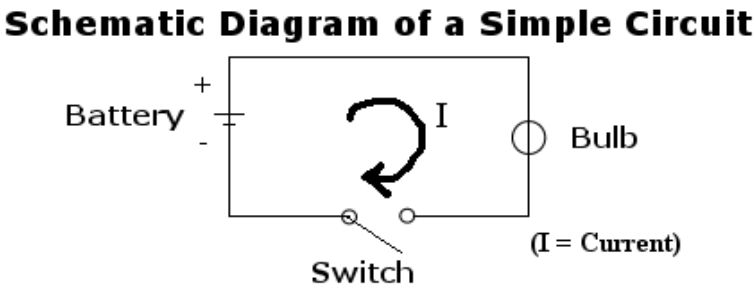
◆ Simple Circuit

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.



Insulators and Conductors

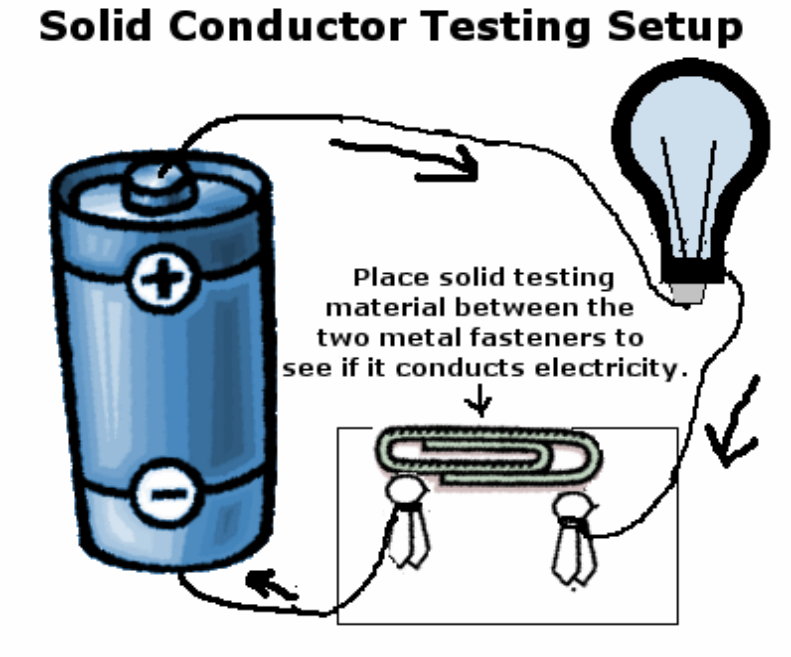
Student Worksheet:
Insulators and Conductors Activity

◆ 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?



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
Developed by IEEE as part of TryEngineering
www.tryengineering.org

Modified and aligned to Australian Curriculum by Queensland Minerals and Energy Academy

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.

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For Teachers:
Alignment to Curriculum Frameworks

Note: All lesson plans in this series are aligned to the Australian Curriculum for both Science and Mathematics.

	Year Level			
	5	**6**	**9**	**10**
Science Understandings		Electrical circuits provides a means of transferring and transforming electricity **(ACSSU097)**	Energy transfer through different mediums can be explained using wave and particle models **(ACSSU182)** *Investigating factors that affect the transfer of energy through an electric circuit*	
Science as a human endeavour	Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena **(ACSHE098 – Yr 6)** Science understandings, discoveries and inventions are used to solve problems that directly affect peoples' lives **(ACSHE220 – Yr 6)**		Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries **(ACSHE158 – Yr 9)**	
Science Inquiry Skills	With guidance, select appropriate investigation methods to answer questions and solve problems **(ACSIS103 – Yr 6)** Decide which variable should be changed and measured in fair tests and accurately observe, measure and record data **(ACSIS104 – Yr 6)** Use equipment and materials safely, identifying potential risks **(ACSIS105 – Yr 6)** Compare data with predictions and use evidence in developing explanations **(ACSIS221 – Yr 6)** Communicate ideas, explanations and processes **(ACSIS110 – Yr 6)**		Plan, select and use appropriate investigation methods, including lab experiments, to collect reliable data; assess risk and address ethical issues **(ACSIS165 – Yr 9)** Select and use appropriate equipment, to systematically and accurately collect and record data **(ACSIS166 – Yr 9)** Analyses patterns and trends in data, including describing relationships between variables and identifying inconsistencies **(ACSIS169 – Yr 9)** Use knowledge of scientific concepts to draw conclusions that are consistent with evidence **(ACSIS170 – Yr 9)** Evaluate conclusions, identify sources of uncertainty and possible alternative explanations, describe specific ways to improve the quality of the data **(ACSIS171 – Yr 9)**	

		Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations **(ACSIS174 – Yr 9)**

Math Curriculum Links

Activity	Concept / Year Level							
	Number and Algebra				Measurement and Geometry		Statistics and Probability	
	Number and place value	Real numbers	Money and financial maths	Linear and non-linear relationships	Using units of measurement	Geometric reasoning	Data and representation and interpretation	Shape
Insulators and Conductors	Yr 5 - 10	Yr 7 - 10					Yr 5 - 10	

Mathematics Links with Science Curriculum (Skills used in this activity)	General Capabilities	Cross-Curriculum Priorities
• Process data using simple tables • Data analysis skills (graphs) • Analysis of patterns and trends • Use of metric units • Calculating percentages	• Literacy • Numeracy • Critical and creative thinking • Personal and social capacity • ICT capability	• Sustainability

Science Achievement Standards

Year 6

By the end of Year 6, students compare and classify different types of observable changes in materials. They analyse ***requirements for the transfer of electricity and describe how energy can be transformed from one form to another to generate electricity***. They explain how natural events cause rapid changes to the Earth's surface. They decide and predict the effect of environmental changes on individual living things. Students explain how scientific knowledge is used in decision making and identify contributions to the development of science by people from a range of cultures.

Students follow procedures to develop investigable questions and design ***investigations into simple cause-and-effect relationships***. They ***identify variables to be changed and measured and describe potential safety risks when planning methods***. They ***collect, organise and interpret their data, identifying where improvements to their methods*** or research could improve the data. They ***describe and analyse relationships in data using graphic representations*** and construct multi-modal texts ***to communicate ideas, methods and findings***.

Year 9

By the end of Year 9, students explain chemical processes and natural radioactivity in terms of atoms and energy transfers and describe examples of important chemical reactions. They ***describe models of energy transfer and apply these to explain phenomena***. They explain global features and events in terms of geological processes and timescales. They analyse how biological systems function and respond to external changes with reference to interdependencies, energy transfers and flows of matter. They ***describe social and technological factors that have influenced scientific developments and predict how future applications of science and technology may affect people's lives***.

Students design questions that can be investigated using a range of inquiry skills. They design ***methods that include the control and accurate measurement of variables and systematic collection of data and describe how they considered ethics and safety***. They analyse ***trend in data, identify relationships between variables and reveal inconsistencies in results***. They ***analyse their methods and the quality of their data, and explain specific actions to improve the quality of their evidence***. They ***evaluate others 'methods and explanations from a scientific perspective and use appropriate language and representations when communicating their findings and ideas to specific audiences.***