



TryEngineering

Electric Switches



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Lesson Focus

Demonstrate how electric circuits can be controlled with a simple switch. Note: This lesson plan is designed for classroom use only, with supervision by a teacher familiar with electrical and electronic concepts.

Lesson Synopsis

Students will incorporate a simple switch into a battery/bulb circuit. Students will also use their knowledge of circuits to design and make their own switches using common materials. Students will also identify switches found in common appliances.

Age Levels

8-11.

Objectives

- ✦ Learn how switches control the flow of electricity.
- ✦ Learn to draw basic wiring diagrams.
- ✦ Learn to predict outcomes and draw conclusions.

Anticipated Learner Outcomes

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

- ✦ switches
- ✦ circuits and current
- ✦ basic electrical diagrams
- ✦ making predictions and testing a hypothesis

Lesson Activities

The Electric Switches activity encourages students to design a simple switch into an electric circuit. Students work in teams to create their design with wires, batteries, a bulb, and a simple switch. They also develop a schematic of their electrical diagram. Then student groups compare results and discuss findings.

Resources/Materials

- ✦ Teacher Resource Documents (attached)
- ✦ Student Worksheets (attached)
- ✦ Student Resource Sheets (attached)

Alignment to Curriculum Frameworks

See attached curriculum alignment sheet.

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Developed by IEEE as part of TryEngineering
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Internet Connections

- ✦ TryEngineering (www.tryengineering.org)
- ✦ ITEA Standards for Technological Literacy: Content for the Study of Technology (www.iteaconnect.org/TAA)
- ✦ NSTA National Science Education Standards (www.nsta.org/publications/nses.aspx)
- ✦ NCTM Principles and Standards for School Mathematics (<http://standards.nctm.org>)

Recommended Reading

- ✦ DK Eyewitness Series: Electricity (ISBN: 0751361321)
- ✦ Eyewitness Electricity, by Steve Parker (DK Publishing, ISBN: 0789455773)
- ✦ How Science Works, by Judith Hann (Readers Digest, ISBN: 0762102497)

Optional Writing Activity

- ✦ Write an essay, or a paragraph, describing how switches found on common appliances in the home make those appliances more functional, or easier to operate.

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For Teachers: Teacher Resources

◆ Materials

- Student Worksheet
- One set-up for each group of students, consisting of:
 - Different types of switches
 - Wire
 - Battery Holder
 - D size Battery
 - Socket
 - 1.5 volt bulb
 - Motors
 - Buzzers
 - Paper clips
 - Metal hair clips
 - Aluminum foil
 - Pliers
 - Discarded toys and appliances

◆ Procedure

1. Ask students for examples of how switches are used. Record their responses on chart paper or classroom board.
2. Divide students into small groups or 4 to 5 students.
3. Have students build a working circuit with just a battery and a bulb.
4. Next, ask students to add a switch in such a way that the switch turns the bulb on and off.
5. Have students draw and describe their circuits and switches in the student worksheet using schematic symbols found on the Student Resource Sheet.
6. Bring the student groups together to discuss their designs and experiences.

◆ Time Needed

45 Minutes

◆ Tips

- If students have difficulty in creating a switch, suggest they use a paper clip bent so it can just barely touch a piece of foil or another paper clip when pressed; or a paper fastener wedged in between a battery and battery holder which prevents them from making contact when pressed.

◆ Extension

Have students look for switches in discarded toys, appliances, or other electrical devices. Students can disassemble the items to see how they work.

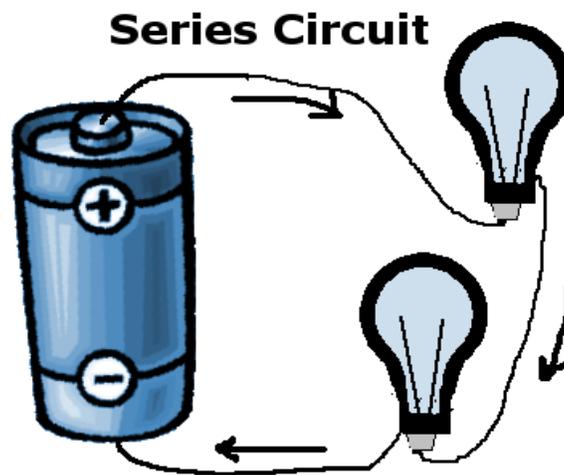
Electric Switches



Student Resource: What is a Simple Circuit?

◆ Simple Circuit

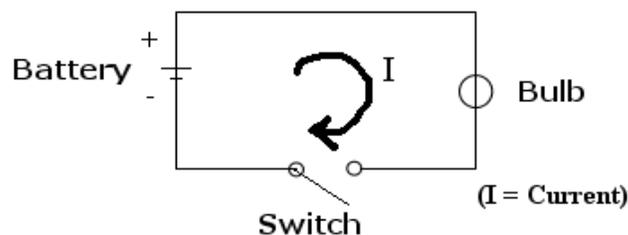
A simple circuit consists of three minimum elements that are required to complete a functioning electric circuit: a source of electricity (battery), a path or conductor on which electricity flows (wire) and an electrical resistor (lamp) which is any device that requires electricity to operate. The illustration 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



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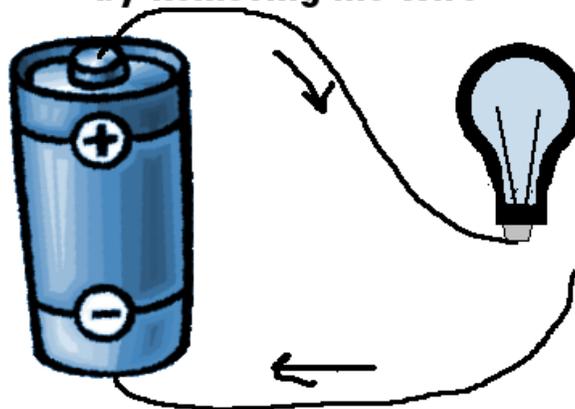


Student Resource: Simulating a Switch

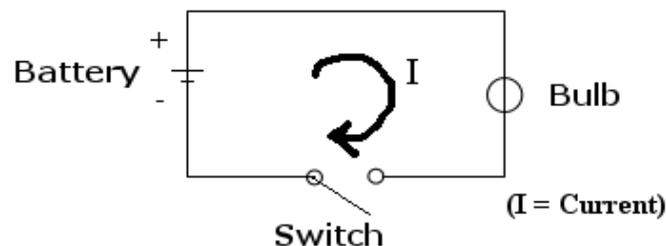
◆ Simulating a Switch by Disconnecting a Wire

You can make a crude switch just by disconnecting one of the wires and alternately touching it and removing it from the metal case of the bulb. Why does the light go off when the wire is no longer touching? When the wire is removed, the electrons would have to flow through the air in order to complete the circuit. To make electrons flow through air requires a lot more energy than is available, because nearly all the electrons in the air are tightly bound to atoms. The same is true of all the other materials known as insulators. The makeshift switch that is made by disconnecting and reconnecting the wire does exactly the same thing as a manufactured switch, except that manufactured ones are more reliable. All they do is disconnect and reconnect the wires when you move the lever, push the button, turn the knob, or slide the button.

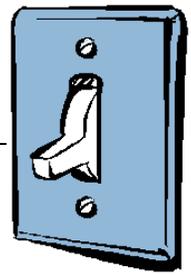
Simulating a Simple Switch by Removing the Wire



Schematic Diagram of a Simple Circuit



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Student Worksheet: Identifying Switches in the Home

◆ Challenge

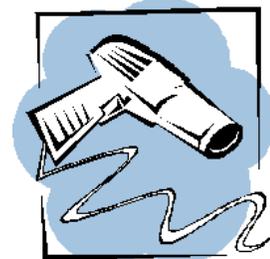
Describe the function of switches on the following household appliances. Is there more than one switch on any of these items?



Portable Vacuum



Toaster



Hair Dryer



Coffee Maker



Electric Fan



Desk Lamp

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Student Worksheet:

◆ You are the Engineer!

Instructions:

1. You need to design a system that will turn a light on and off in the hallway of a new office building.
2. Build a working circuit with just a battery and a bulb.
3. Next, add a switch in such a way that the switch turns the bulb on and off.
4. Draw and describe your circuits and switches in the space below using the schematic symbols shown on the Student Resource Sheet.
5. Discuss your designs and experiences with the class.

Circuit Without Switch	Circuit With Switch

◆ Describe what you did to make the bulb light up using the switch:

◆ What materials did you use to make your own switch?

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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

- ✦ 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)

Energy

Students who demonstrate understanding can:

- ✦ 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

Engineering Design

Students who demonstrate understanding can:

- ✦ 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- ✦ 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

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For Teachers: Alignment to Curriculum Frameworks

◆ Next Generation Science Standards - Grades 6-8 (Ages 11-14)

Engineering Design

Students who demonstrate understanding can:

- ✦ MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- ✦ MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

◆ Standards for Technological Literacy - All Ages

Design

- ✦ Standard 8: Students will develop an understanding of the attributes of design.
- ✦ Standard 9: Students will develop an understanding of engineering design.
- ✦ Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.