TURN ON THE LIGHTS: INTRODUCTION TO ELECTRIC CIRCUITS

OBJECTIVE: Students will use the scientific process to carry out an investigation to determine how an electric circuit can be created to turn on a lightbulb.

TIME: 30–40 minutes

MATERIALS: One set of the following materials for each group of students: "Turn On the Lights" student worksheet, low-voltage LED lightbulb, large piece of aluminum foil, cotton string, paper clips, AA battery, tape, scissors, pen or pencil

STANDARDS FOCUS:

Science (NGSS)

Science and Engineering Practices: Asking Questions and Defining Problems, Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions

PS3.B: Conservation of Energy and Energy Transfer

ETS1.A: Defining and Delimiting an Engineering Problem

Language Arts (CCSS)

SL1: Participate in collaborative discussions

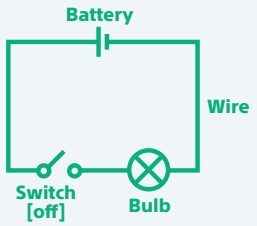
Math (CCSS)

MP1: Make sense of problems and persevere in solving them

MP5: Use appropriate tools strategically

LESSON PLAN

1. **Make Observations About Electricity and Light:** Show the class a flashlight and switch the light on and off. Ask students to describe components they can see or that they think may be found inside a flashlight. (Answers may include a bulb, a power source such as a battery, wiring, a switch, etc.) Ask students what they think happens inside the flashlight to cause the light to turn on. (They may say that electricity flows through the bulb.) Write the term "electric circuit" on the classroom board. Explain that an electric circuit is a closed loop through which electricity (moving charged particles) can flow. Draw the model of an electric circuit (below right) on the classroom board. Use the model to show that when you flip the switch to "on," it closes the loop between the battery (the electricity source) and the bulb. Once the loop is closed by turning on the switch, the electric circuit allows electricity to flow through the bulb and light it up.



2. **Conduct the Investigation:** Separate the class into small groups and hand out the student worksheet, "Turn On the Lights." Give each group the listed materials. As a class, briefly discuss which of the materials are similar to what is found in a flashlight. (For example, there is a bulb, a battery, and material [aluminum foil] that is similar to wiring.) Have students complete the activity in their groups.

3. **Analyze Results:** When everyone is finished, discuss their results. Ask the class: *What caused* bulb in a complete electric circuit. The path between the ends of the battery and the lightbulb was unbroken. The complete circuit allows electricity to flow through the bulb.) Discuss any problems students had with their designs. How did these factors prevent the light from turning on?

ANSWERS TO STUDENT WORKSHEET

Students' setups for the experiment may vary. One possibility is to cut strips of aluminum foil and fold or roll them to form two "wires." Connect one end of one "wire" to the positive end of the battery and the opposite end to one of the metal spokes on the LED light. Then attach one end of the second "wire" to the negative end of the battery and the unattached end to the other spoke on the light. If using a typical lightbulb, the ends of the aluminum foil need to touch the base of the bulb and the side of the metal case. If the light doesn't work, make sure that the battery has enough voltage for the bulb.

Conclusions:

a. Answers will vary.

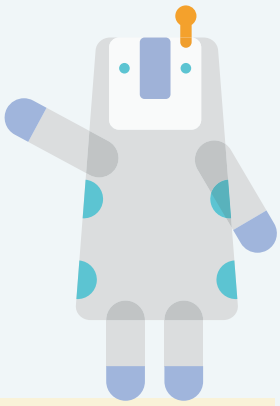
b. Answers may include that the students chose materials, such as aluminum foil, that allow electricity to flow. The electric current needs to flow from the battery to the bulb to turn it on.

DIVE DEEPER WITH KOOV

KOOV can help students learn more about circuits powering LED lights. Go to KOOV and open the Learning Course. Choose My First Robot Coding and complete Stage 2: "Getting Into Electronics." Students will be guided through the electronic components of KOOV and writing code that can turn LED lights on and off in a KOOV robot. You can also show students any of the Robot Recipes with LED lights, such as the Alligator. As you connect the blocks and configure the code, discuss how it connects to what you learned in your experiment. What provides electricity to the light? How is the electric circuit completed to turn on the light?

www.sony.com/koov

TURN ON THE LIGHTS



In this activity, you'll use the scientific process to test how everyday materials can be used to make an electric circuit to turn a lightbulb on and off.

MATERIALS: Low-voltage LED lightbulb, large piece of aluminum foil, cotton string, paper clips, AA battery, tape, scissors

ASK A QUESTION How can we use everyday materials to create an electric circuit to turn on an LED lightbulb?

WRITE A HYPOTHESIS Consider the materials you have been given. Make a **prediction** about how some or all of the materials can be connected in an electric circuit to light up the bulb. Draw a model below that shows the arrangement that you think will work. Be sure to label the different materials. Use separate paper if necessary.

Make a prediction: _____

_____

Draw your model:

Write your hypothesis: _____

_____

CARRY OUT AN INVESTIGATION Use the materials to create the design you sketched above. When you connect your materials, does the bulb light up? If it does not work, try modifying your design until it is successful.

DRAW CONCLUSIONS

a. Did your final design match your model in your hypothesis? If not, how was it different?

_____

_____

b. What materials did you use to connect the bulb to the battery? Explain why you chose these materials.

_____

_____

IMPROVE YOUR DESIGN Evaluate your design. How does it compare to a typical flashlight? Could you make it sturdier or make it easier to turn the light on and off? Think about other materials you could use to improve your design.