

Computational Thinking



4th Grade Science

Lemon Batteries

Overview

In this module, students will write a set of rules for identification of conductors and insulators of electricity. Students will apply their conductivity rules to build a working battery from available materials.

Grade Level

4th grade

Cyber Connections

- Computational Thinking
- Hardware and Software

Lesson Outline

Decomposition

First, let's research how electricity works, things that use electricity, and the path that electricity follows to power things.

Read the articles provided by your teacher. Write down three facts that give you a better understanding of electricity. Then, share with the class.

1. _____

2. _____

3. _____

Learn from your classmates! Use the space below to list any additional information your classmates learned about electricity from the articles.

You may have read that electricity is actually electrons moving from atom to atom, but what are atoms and electrons?

In your own words, describe an atom

In your own words, describe an electron.

Atoms are the basic units of matter. This means that everything is made up of atoms. Atoms consist of a nucleus and negatively charged electrons in a cloud around the nucleus. The nucleus consists of protons and neutrons, but for this lesson we will focus on the electrons that are floating around the nucleus. Electrons are negatively charged particles that provide us with electricity.

Some atoms easily give up or share their electrons with other atoms. Atoms that can easily share their electrons with neighboring atoms are called conductors. Atoms that hold on tightly to their electrons and do not share them are called insulators.

Now let's go online and research the types of materials that are conductors and insulators. In the space below, list three examples of each from your home or classroom. After you have created your list, trade with a classmate to see if you both agree on conductors and insulators.

Conductors

1. _____
2. _____
3. _____

Insulators

1. _____
2. _____
3. _____

The following demonstration will help you learn more about conductors and insulators. Your teacher will attempt to light up a small light bulb using various objects in the classroom as a conductor. If the object is a good conductor, it should illuminate the bulb. However, if the object is actually an insulator, the bulb will not illuminate. Use the table below to make your predictions on whether the object is a conductor or an insulator and record the actual outcome. As a class, determine at least five objects for your teacher to test.

Object	Prediction (Insulator/Conductor)	Result (Insulator/Conductor)

How many of your predictions were correct? _____

How many of your predictions were incorrect? _____

Did you notice any similarities in the objects that are conductors? If so, what are the similarities?

Did you notice any similarities in the objects that are insulators? If so, what are the similarities?

This demonstration will further emphasize the concept of conductors and insulators. Use a 9V battery, small light bulb, alligator clips, and different objects from the classroom to complete the circuit. The bulb will light up if the object is a conductor and will not light up if the object is an insulator. Below are some suggested objects for you to test:

- Plastic ink pen
- Metal ink pen
- Water bottle
- Desk leg
- Penny, nickel, and quarter
- Notebook
- Salt water*

**Salt water is particularly good to demonstrate. Begin by showing the students that water alone does not light up the bulb. Then, add ¼ teaspoon of salt. The light will illuminate, but it will be very dim. Gradually add more salt, and the light will get brighter.*

Five steps for the setup of this demonstration are included below and continue on the next two pages.



Step 1: Collect all parts.

(1) 9V battery, (2) 9V battery clip, (3) two to four alligator clips, (4) small light bulb socket, and (5) small light bulb.

Switch will not be used in this module



Step 2: Assemble light bulb.



Step 3: Assemble 9V battery and battery clip. Connect alligator clips to the 9V battery clip wires.



Step 4: Connect alligator clips to the light bulb as shown above, and watch it light up!
 Step 5 is continued on the next page.



Step 5: Now add a conductor. Pictured above is a penny used as a conductor in the circuit. Allow the students to suggest objects for you to test as conductors. To test if something is a conductor, touch the alligator clip to the object and the wire of the battery clip to another location on the object. If it is a conductor, the bulb will light up. Do not worry about being shocked. The 9V battery is not strong enough to hurt you.

WARNING: Discuss the importance of safety and let students know that incorrect wire attachments can create dangerous situations. The red and black wires of the 9V battery clip should never be connected directly to each other. An item like a light bulb should always be connected between the wires to prevent the battery from overheating and becoming dangerous to touch.

Use your current knowledge to decide if each object listed below is a conductor or an insulator. Write your answer as either C to indicate conductor or I to indicate insulator. If you do not know the answer to any of the materials listed below, you may need to do additional research on conductors and insulators.

- | | | | |
|------------------|-------|-------------------|-------|
| 1. Gold Necklace | _____ | 6. Paper Airplane | _____ |
| 2. Silverware | _____ | 7. Window Pane | _____ |
| 3. Wood | _____ | 8. T-Shirt | _____ |
| 4. Keys | _____ | 9. Ocean Water | _____ |
| 5. Aluminum Foil | _____ | 10. Human Body | _____ |