MAINE MUSEUM OF INNOVATION LEARNING + LABOR

Energy Innovation Kit

Teacher's Guide:
Lesson 4

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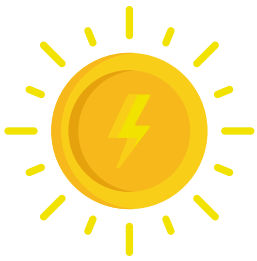
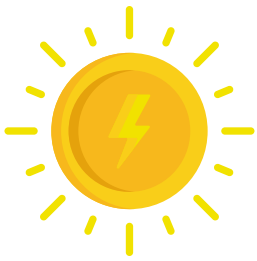


From Sun to Circuits
Circuit STEAM Challenge

Innovation Kit Lesson 4



Time: 1 - 50-60 min. class period

Learning Objectives:

- Students will understand how a residential solar power system works.
- Students will be able to create a complete circuit by connecting a battery, lightbulb and switch with wires.
- Students will be able to explain the difference between an open and closed circuit.
- Students will be able to draw a diagram of their electrical circuit.
- Students will be able to explain an electrical current.

Materials Needed:

Each student will need:

- Lightbulb holder
- Battery pack with wires
- Lightbulb
- 2 AA batteries
- From "From Sun to Circuits" student lab packet

Extra materials included in kit:

- Lightbulbs
- Batteries
- Battery packs

Set Up

1. Have a computer with a projector set up before students arrive with ReVision Energy video "How Solar Power Works." and a countdown timer ready to project. There are many fun, free countdown clocks available with a simple internet search or select a game show theme to play for one minute.
2. Have enough copies of "From Sun to Circuits" student lab packets for each student.
3. Place a piece of scrap paper or a notecard at each student's seat.
4. Have enough lightbulb holders, lightbulbs, battery packs, and 2 batteries per student ready to distribute.
5. Have a box of paper clips ready to distribute when students reach this part of the activity.

Introduction

1. Once the class period has begun, turn off the lights and ask students to take out a pencil.
2. Project a countdown clock on the board and set for one minute or have your game show music ready to go.
3. Tell students that you are going to give them 1 minute to write down as many electrical devices they use in a day as they can. Prompt them to think about all the things they use that require being plugged into the wall or use batteries, think about how they communicate, work, travel, keep their food fresh, etc.
4. Start the timer or play game show music for one minute.
5. Do a quick "pair and share" to have students share and compare their results.
6. Ask the class if they noticed any similarities in the devices that their peers used. Anything they had not thought of before? Ask them to think of a time when they have lost power in their home. What did they find to be the most challenging? What item did they miss having them most?
7. Ask students to share the ways that electricity can be generated for their homes. If students completed the "Sources of Energy Jigsaw Activity" this is an opportunity to check for knowledge retention or to establish prior knowledge for those who did not complete the lesson. Answers should include fossil fuels, wind, biomass, nuclear, hydropower and solar.
8. Explain that today they are going to explore how solar cells power an individual home and also can contribute energy back into the power grid. Then they will have a chance to experiment with how circuits are used in homes to allow electricity to flow to each device we use everyday.

Instructions, Teacher Modeling, Guided Practice

1. Together as a class watch "How Solar Power Works."
2. Following the video, ask students to name the power source for the home (the sun) and to summarize in their own words how solar panels work to power your home. Answers should include variations of "the solar panels convert the energy of the sun into electricity then it FLOWS through the wires into your home."
3. Explain that electricity must flow through a loop, or unbroken connection, in order to travel down the wires. Any break or disconnect in that loop can cause the electricity to stop flowing. Ask students to consider the playground game where a group of students stand in a circle holding hands with a hula hoop looped around the connection between two students' hands. The goal of the game is to move the hula hoop around the circle of hands without breaking the connection until it reaches its original starting point.

What happens to the hula hoop when the chain of hands is broken? Answer: the hula hoop falls to the ground and progress stops. As the students move the hula hoop around the circle are there places where the hula hoop's progress around the circle slows down? Answers should include where students have to work their bodies through the hoop. Where does the hula hoop's progress seem to be the easiest or meet the least resistance? Answers should include the space across the students arms. If you would like to (or time allows) it is recommended that you try playing this game with your students. It also makes a great warm up or team building activity.

4. Show the students the battery pack, lightbulb holder and wires. Review cell (battery pack, the source of power), conductors (wires, what the electricity moves through), load (lightbulb, what needs to be powered). Explain these are the basic materials required to power their homes. Point out that the battery pack is like a solar panel, the wires allow the electricity generated to flow through your home and the lightbulb represents an electrical appliance in their home.

5. Distribute battery packs, lightbulb holders and wires.

6. Tell students their task is to figure out how to manipulate those materials to get the lightbulb to light up.

7. Circulate throughout the room while students are working out how to do this. To light the lightbulb touch the wires to the lightbulb holder (the wires should touch the metal plate underneath the two screws). Allow students to work on this challenge, helping to problem solve as needed.

8. Once all students have successfully lit up the lightbulbs, review the fact that metal conducts electricity and that they have created a complete loop, or circuit to allow the electricity to flow through the wires.

9. Have students draw a diagram of the now complete circuit in "From Sun to Circuits" lab sheet, in the first box.

10. Distribute a few paper clips to each student. Explain to students that the paper clips can make the light turn on and off just like using a light switch. More light switches in a house mean expanding the electrical circuit more and more just like adding paper clips to the students' circuit.

Independent Work Time

1. Challenge the students to place paper clips on lightbulb holder in a way that the lightbulb will light up when the students touch the wires to the paper clips, not the light bulb holder. Explain that they may need a partner to help hold the paper clips in place. Assist students as needed.
2. Challenge students to continue to build out their circuits with more paper clips. Can they use 6 paper clips total in the circuits? More?
3. 10 minutes before the end of the independent work time have students draw their completed circuit showing the maximum number of paper clips they were able to use and answer the questions.

Closing and Homework

1. Explain to students they can use the sun and solar panels as the cell. Instead of using the battery pack, it can be replaced with a solar panel for the same result. This segues into the solar cars in the next lesson. In this case, the cell is the solar panel and the sun, the conductors are the wires, and the load is the motor.
2. Have students disassemble the circuit kits and return materials to a designated area.
3. Any unfinished portion of the "From Solar to Circuits" lab sheet should be completed for homework.

Standards

Maine Learning Results

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.

3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Next Gen Science Standards

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

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

Name: _____

From Sun to Circuits

Student Lab Sheet

Have you ever wondered what happens when you flip a switch to turn on a light? Or pressed a button to turn on your TV, computer or phone? Why do these devices turn on? In all of these cases, you are completing an electric circuit, allowing a current, or flow of electrons, through the wires. In order for a device to work, electricity must come from a source (like a battery or solar panel), flow down the wires, through the device (or load) and back out again, in a complete loop. The switch completes the loop or circuit when the device is turned on. This is called a closed circuit. When the switch is off, the circuit is incomplete. This is called an open circuit.

A simple circuit includes an energy source, wires and a load.
A closed circuit conducts electricity, and an open one does not.
A switch is a device that opens and closes a circuit.

Challenge #1
Using only the materials provided to you by your teacher assemble your materials to make a complete circuit. You will know that your circuit is complete when the lightbulb on the holder lights up.

In the box below DRAW A DIAGRAM of your assembled complete circuit. Label the power source, wires and load.

Answer the questions below

1. Describe what you had to do to make the lightbulb light up.

2. How many connections to the battery are required for the lightbulb to light up?

3. Did you notice a change in the temperature of the lightbulb at the start of the challenge and at the end? Explain.

Challenge #2

The paper clips act like a switch, opening and closing the circuit. Place the paper clips on the lightbulb holder in a way that the lightbulb will light up when you touch the wires to the paper clips, not the lightbulb holder. You may need a partner to help you hold them in place. Keep trying until you close the circuit and the lightbulb lights up!

In the box below DRAW A DIAGRAM of your assembled complete circuit. Label the power source, wires, load and switch.

******Extra challenge!!!******

How many paper clips can you string together to make a complete circuit? 3?4?6? More?

Answer the questions below

1. What was the maximum number of paper clips you could add and still get the lighbulb to light up? _____
2. Do you think that adding more switches to the circuit will affect the lightbulb in any way? Explain.

3. What did you find to be particularly challenging about this activity and why?