EVs and Electric Circuits

Objective

Students will learn about EVs (electric vehicles), conservation of energy and energy transfer by experimenting with electrical circuits.

Curriculum Focus

Science
Social Studies
Language Arts
Art
Math

Materials

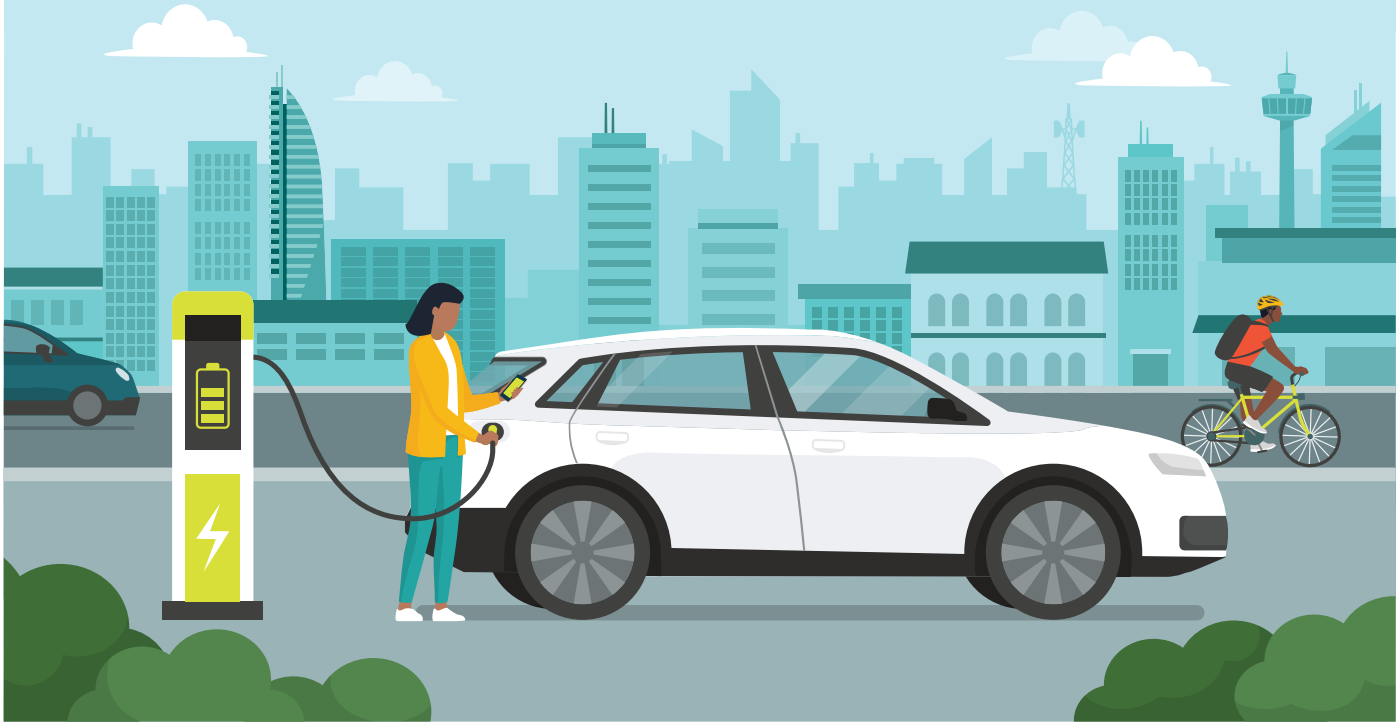
- Playdough or homemade salt dough
- 9V batteries
- 9V battery clips with red and black cables
- 2V LED miniature light bulbs
- Insulating material - cardboard, packaging plastic or dough made from sugar, not salt (optional)
- Copies of the Student Sheet

Key Vocabulary

Energy transfer
Electric current
LED (light-emitting diode)
Electric circuit
Insulator
Conductor

Correlations

Next Generation Science
4-6-PS1 – 3
4-6-ETS1 – 1-2
MS-PS1-6
MS-PS2 – 3,5
MS-P3 – 1-5
Technology & Engineering STEL
3-5 1 F,H; 2 F,
3-5 3C; 4J; 5E; 7I-O
6-8 4K, N; 7Q-W
Math
CCSS.Math.
Content.6.SP.B.5A,B



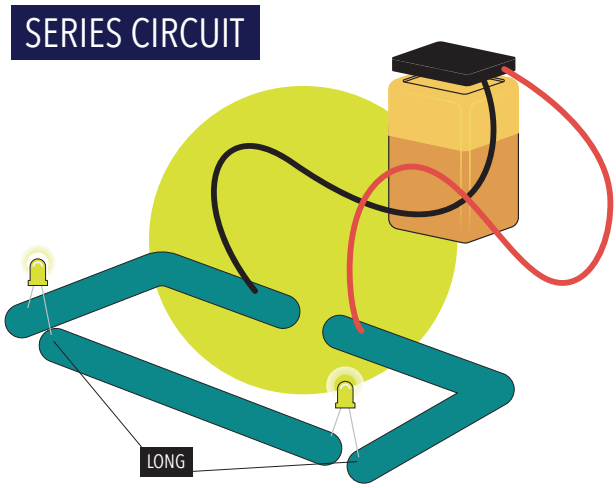
Introduction

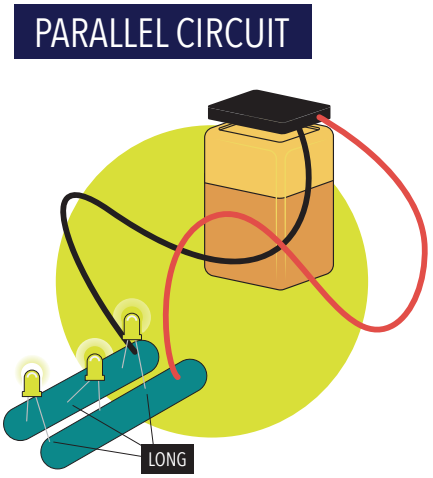
Electric vehicles (EVs) use motors to move cars down the road. Motors use electricity and receive the electricity from the battery. Batteries are charged by plugging into a power source either at home, a parking lot or a public street charger. Materials that allow a flow of electric current to pass through them more easily are called conductors. Aluminum, silver and copper are examples of conductors. Insulators block the flow of electricity. Nonmetallic materials, such as rubber, plastic, wood, cloth and dry air are insulators. An electrical circuit is a path of conductors through which electric current flows. Energy can be transferred from place to place by electric current.

In this activity, students will use salt dough, which is a conductor, to design circuits that will transfer electrical energy. If they are successful, the electricity will be transformed to light and heat energy in a miniature LED bulb.

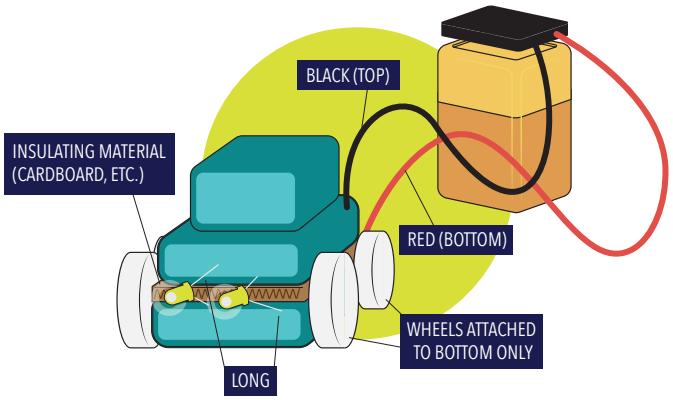
Procedure

1. Introduce students to their materials:
    a. Attach the battery to a battery clip with red and black cables. The red lead is the positive terminal and the black lead is the negative terminal.
    b. Examine the LED bulb. Two wires (or legs) extend from the bulb. The longer wire is the positive side of the LED and the short wire is the negative side. The LED should only be connected to dough, never directly to the battery terminals, which will cause the bulb to burn out.
2. Tell students that electricity can only go through the circuits they will create in one direction. The positive terminal of the battery (red lead on battery clip) must be nearest a positive (long) leg of the LED. A battery pushes electricity around the circuit through the positive leg and out the negative (short) leg, then repeating through the next positive leg (if there is more than one LED in the circuit).
3. Explain that electricity will take the path of least resistance. It is easier for electricity to travel through the dough than through the LED, so if two pieces of dough are touching, the LED will not light.
4. Challenge students to design a simple circuit like the ones below.





If time allows, have students create a circuit work of art like the an EV model. Since the conductive dough cannot touch, use insulating material between layers.



Discussion

- How does your dough circuit light the LED compared to the circuits in an EV?
- In a series circuit with multiple LEDs, what happens to the brightness of the LEDs that are further from the battery? Why?

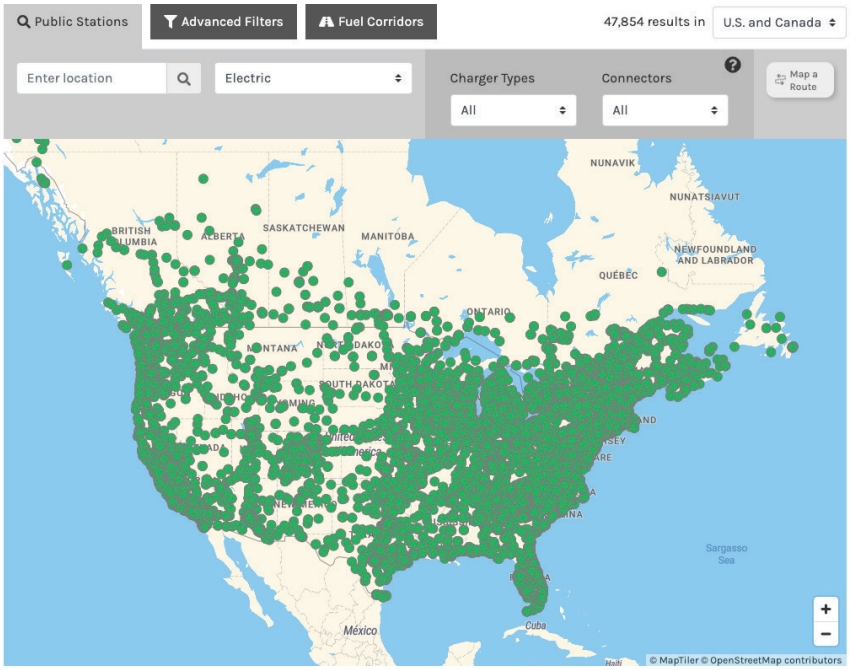
To Know and Do More

In an EV, other parts like batteries and controllers are needed to power the motor. Go to *afdc.energy.gov/vehicles/how-do-all-electric-cars-work* to learn more and see the parts of an EV so that you can complete the Student Sheet below.

Using the outline of the EV provided and a pencil, identify the battery, motor, controller and charging port. Use the color red to trace the electrical circuit from the charging port to the battery, then the color yellow from the battery to the motor, then orange from the motor to the power controller.

Find the nearest public charging stations to your location.

Go to *afdc.energy.gov/stations/#/find/nearest?fuel=ELEC*. Have students enter their zip code in the "Enter location" box. Have students choose a "charger type" from the drop down menu (level 1, 2 or DC fast). Have students create a chart of the number of charging stations, their charger types (level 1, 2 or DC fast) within a 10 mile radius. The list to the left of the map will give you the distance from their zip code. Have students compare the chargers in their location with the next largest city to their location. Have students make scaled bar graph of the data for each charger type.



Student Sheet

Identify the battery, motor, controller and charging port on the drawing. Write the words in the appropriate blanks. If you need help to identify parts, go to *afdc.energy.gov/vehicles/how-do-all-electric-cars-work*.

Use crayons or colored pencils to do the following:

- Red to trace the electrical circuit from the charging port to the battery
- Yellow from the battery to the motor
- Orange from the motor to the power controller