Light-up Robots to Demonstrate Energy Transfer
(Science and Arts Integration Lesson)

By Jennifer Parks

Grade Level: 4th Grade
Subject: Science/Art

Objective:

- Students will understand how energy can be transferred through electrical currents and light.
- Students will demonstrate their understanding by creating light-up robot artworks using paper circuits.

Aligned Standard:

- **Utah Standard 4.2.3**
  Plan and carry out an investigation to gather evidence from observations that energy can be transferred from place to place by sound, light, heat, and electrical currents. Examples could include sound causing objects to vibrate and electric currents being used to produce motion or light.
- **NGSS 4-PS3-2**: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electrical currents.
- **Standard 4.V.CR.1**:
  Brainstorm multiple approaches to a creative art or design problem.

Materials Needed:

- Cardstock
- Pencils and erasers
- Markers or colored pencils
- Conductive copper tape
- LED Diodes
- Coin cell batteries
- Tape
- Switch—paperclips and brads (optional)
- Clear tape
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Procedure:

This Project should be completed in 2 phases.

Part 1

This phase should be a demonstration and explanation of circuits. Depending on the needs of the class, this should include a simple circuit with and without the use of a switch and can include series and/or parallel circuits as well.

Part 2 will allow students to apply what they learn as they make a purposeful circuit that will light up a robot drawing of the students' own designs.

Procedure (continued)

Part 1: Building a Circuit (40 minutes)

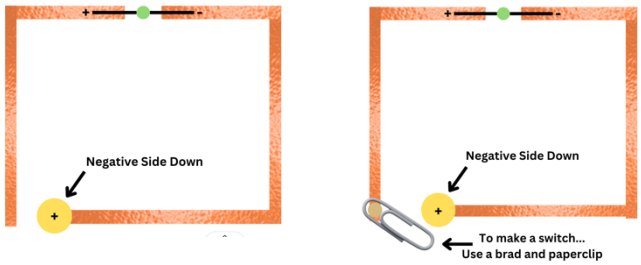
1. Introduction (about 5 minutes):

    - Begin by introducing students to the concept of circuits and electrical currents. Explain that a circuit is a pathway for electricity to flow, and electrical currents are the movement of electric charges along this pathway.

2. Modeling and Demonstration (15 minutes):

    - Set up materials for building a simple paper circuit using an LED light, coin cell battery, copper tape, and a paperclip and brad for a switch.

- Begin by demonstrating how to build a simple circuit using an LED diode, copper tape, and a coin cell battery on a piece of cardstock. Show how to connect the positive (+) side of the LED diode to the positive (+) side of the battery using copper tape, and similarly connect the negative (-) sides. (Be sure to test that the diode and the battery both work before building the circuit). If necessary, a small amount of clear tape can by used to tape down the leads to secure them. If using a switch, include it in the circuit to control the flow of electricity. The circuits should follow a diagram similar to the following...



    - Observe the light bulb lighting up to demonstrate the flow of electricity through the circuit.
    - Explain how the circuit uses energy that is transferred through electrical currents and light.

3. Guided Practice (20 minutes):

    - Provide students with the opportunity to build their own simple circuits using the provided materials (copper tape, diode, button battery, and paper clip and brad. Circulate around the room to assist and ensure that all students are successful in building their circuits.

Things to keep in mind…

-the leads need to be on the correct side, or the circuit will not work! If the light(s) do not work flip them 180 degrees and see if that fixes it.

-sometimes students will inadvertently make a crack in the copper tape. Make sure the tape is connected properly without breaks!

-For best results use a single and continues piece of copper tape. Due to the adhesive on the tape not always being a good conductor, the circuit will work better if you do not cut the copper tape but instead bend and fold it.

-If the battery is dead or weak, the LED lights will not light up. Batteries can drain power if they are touching another conductor, so be sure to be aware of this happening.

Part 2: Lighting up a Robot Drawing Artwork with a Circuit (75 minutes)

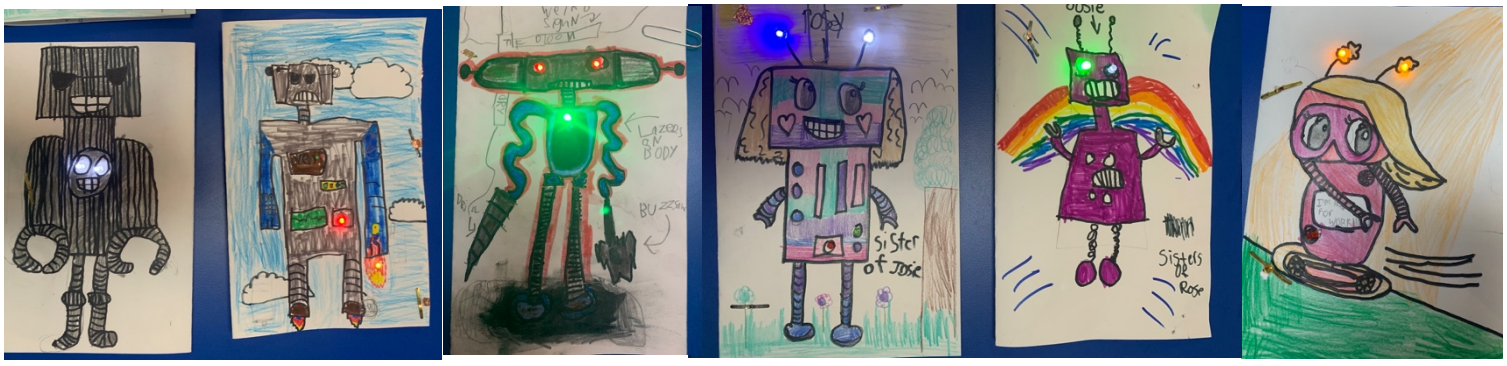
Lesson Procedure:

1. **Introduction (5-10 minutes):**

    - Start the main lesson by reviewing the concept of energy transfer through electrical currents and light, which was introduced during Part 1.
    - Connect the discussion to the standard by emphasizing the importance of understanding energy transfer in various forms such as sound, light, heat, and electrical currents.

2. **Designing the Robot Artwork (20-25 minutes):**

    - Make sure students have the supplies to design their robot. They will need cardstock and drawing tools (pencils, erasers, markers or colored pencils).
    - Instruct students to brainstorm ideas for their light-up robots, keeping in mind the concepts of energy transfer through electrical currents and light. Show examples of robots designs that are illuminated with the LED lights.



- Students will need to fold their cardstock piece in half and then draw their designs, considering how they will incorporate LED lights and paper circuits to add illumination to their artworks. Students can make more than 1 circuit to get the effect they want or to light up more than one area of the robot if they want. They can prepare for their design to use simple, parallel, or series circuits.

3. Creating Paper Circuits (25-30 minutes):

- Explain to students that they will be adding LED lights to their artworks using paper circuits to demonstrate energy transfer through electrical currents.
- Have students create their own circuits on their artworks. Encourage them to be creative with the placement and arrangement of the LED lights to enhance their designs.
- Circulate around the room to provide assistance and ensure that all students are successfully creating their paper circuits.
- Encourage students to observe the illumination of their artworks and make necessary adjustments to ensure that all components are functioning properly.

4. Assessment (10 minutes):
   Choose the assessment that best meets the needs of the class

Verbal Assessment:
Facilitate a discussion about how the paper circuits demonstrate the transfer of energy from the battery to the LED lights, providing evidence for the standard.
Written Assessment:
Have students write a paragraph or draw and label a diagram explaining how the paper circuits demonstrate the transfer of energy from the battery to the LED lights,

5. Reflection and Conclusion (5 minutes):

- Have students reflect on how the activity demonstrated energy transfer through electrical currents and light. Allow them to share what they learned about energy transfer and how it relates to the creation of their light-up robots.
- Conclude the lesson by reinforcing the connection between energy transfer and the concepts of sound, light, heat, and electrical currents, as outlined in the standard.