
# lighting up the holidays

by Megan Sagely, Brittany Beshears,
Vinson Carter, and Michael K. Daugherty

## introduction

Many elementary teachers are reluctant to teach STEM activities that include content related to electricity in their classrooms because they typically lack extensive backgrounds in the field and confidence in their abilities. However, new low-voltage LEDS (light emitting diodes) provide these teachers with an easy and foolproof method for introducing their students to the vital STEM content of basic electricity in an interesting and applied manner. By integrating new content related to electricity with a traditional Christmas holiday activity completed in most elementary schools, the elementary teacher is sure to capture the attention of his/her students and expose them to concepts that they will use throughout their respective lives.

## content information

Start the lesson with a discussion of how electricity is used in our society and how electrical current is used in circuits to perform needed tasks. When a switch is connected to a circuit, electrons flow from the anode (positive/top of battery) to the cathode (negative at the bottom of the battery) and return to the positive pole. Single cells supply 1.5 volts and are what we generally mean when we say a battery (e.g., "I must change the batteries in my flashlight"). The battery provides the electromotive force (or e.m.f.) that "pushes" the electrons through the wires of the circuit. Electromotive force is measured in volts. In some ways, it is similar to the potential energy stored in a ball resting at the top of a hill. As the switch is turned on, the lightbulb ignites (lights up). When the circuit is closed by throwing the switch, the battery forces those electrons to flow around the wire, thereby creating the current. Standard units and terms used in electricity are listed in the next column.

Use these as vocabulary for the lesson:

- Volts (V): A unit of potential difference, e.m.f., or voltage.
- Ohm (Ω): A unit of resistance.
- Amps (AMPERES) (A): A unit of current.
- Watts (W): A unit of power. In electrical circuits, one watt is produced when a current of one amp flows down a potential difference of one volt.
- Circuit – a pathway for the flow of electricity.
- Current – the flow of electricity through a conductor.
- Conductor – a substance through which electricity will flow.
- Insulator – a material that prevents the flow of electricity.
- Switch – a device used to interrupt the electrons in a circuit.
- Light-emitting diode (LED) – device that emits visible light when an electric current passes through it.

The following technical procedural lesson can be a great way to teach the basics of an electrical circuit.

## lighting up the holidays: a holiday postcard activity

**Level:** Grades 4-5

**Unit:** Electrical circuits

**Paired Text**: *The Jolly Christmas Postman* by Janet and Allan Ahlberg

**STEM Content Standards:**

*Next Generation 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.

*Standards for Technological Literacy* (Technology and Engineering Standards):

**STL 12:** Students will develop the abilities to use and maintain technological products and systems.

d. Follow step-by-step directions to assemble a product.
e. Select and safely use tools, products, and systems for specific tasks.

**STL 16:** Students will develop an understanding of and be able to select and use energy and power technologies.

c. Energy comes in different forms.
d. Tools, machines, products, and systems use energy in order to do work.

*Common Core State Standards:*

**MP.2** Reason abstractly and quantitatively. (4-ESS3-1)

**MP.4** Model with mathematics. (4-ESS3-1)

**Big Ideas:**

- Understanding how electricity works
- Constructing simple circuits
- Understanding how a switch completes a circuit
- Ability to follow technical procedural instructions
- Using the five aspects of language to write a letter

**Challenge:** Follow the technical/procedural instructions to create a light-up postcard that the Jolly Christmas Postman can deliver to a loved one.

**Materials and Tools:**

| | |
|---|---|
| 1 Cardboard Piece | Batteries |
| Cardboard Frame | 2 Wires |
| Coloring Sheet | Popsicle Stick |
| Color Pencils | 1 Red LED Light |
| Electrical Tape | 1 Yellow LED Light |
| Metallic Duct Tape | Wire Strippers |
| | Scissors |
| | Hot Glue Gun |

*Note: the teacher will need to cut a piece of cardboard into frame shape with 1-inch margins (see instructions below).*

**Instructions:**

The teacher will start the activity by reading *The Jolly Christmas Postman* to the class. The teacher will then discuss how to properly write and address a letter. Once the students understand this

concept, they will be introduced to electricity and electric circuits. The teacher will need to teach the students about electricity and how it is used to produce light. Refer to the content information above, if needed. Once the students understand these concepts, the teacher will then introduce the postcard project. The students can either work independently or in groups of two. They are assigned to follow the technical/procedural instructions to make a holiday postcard that will light up. The card must illuminate using an electrical circuit and must have a switch. After the children have completed their circuits, they will need to write a short message to a friend or family member and attach it to the back of the postcard. The students will need to present their cards to the teacher at the end of this activity.

**Deliverables:**

Each student will present a light-up postcard to the teacher that demonstrates his or her ability to: follow technical procedural instructions, construct a simple circuit with a switch, and provide a description of how the electrical current in their postcard uses an electrical current to transfer energy. Additionally, students must have a well-written letter/postcard that incorporates the five aspects of language and is properly addressed.

**The Parameters:**

The letter must:

- Be completed within the assigned time period.
- Be built by following the technical procedural instructions.
- Light up only when the switch is turned on.
- Consist of a well-written letter that is properly addressed.

**Evaluation:**

| | |
|---|---|
| Displays the student's understanding of electric circuits. | /20 |
| Followed procedural instructions to complete the postcard | /20 |
| Effective use of tools | /20 |
| Displays understanding on how to write and address a letter | /20 |
| Completion of assignment | /20 |
| Total | /100 |

## technical/procedural Instructions

**Teacher Prep work:** Cut the wires into two 3-inch wires and two 1½-inch wires. Using the wire strippers, strip the ends of the wires to expose the wire (about 3/8") at the end. Prepare the cardboard and card template for students to color and write a letter to a loved one (Figure 1).

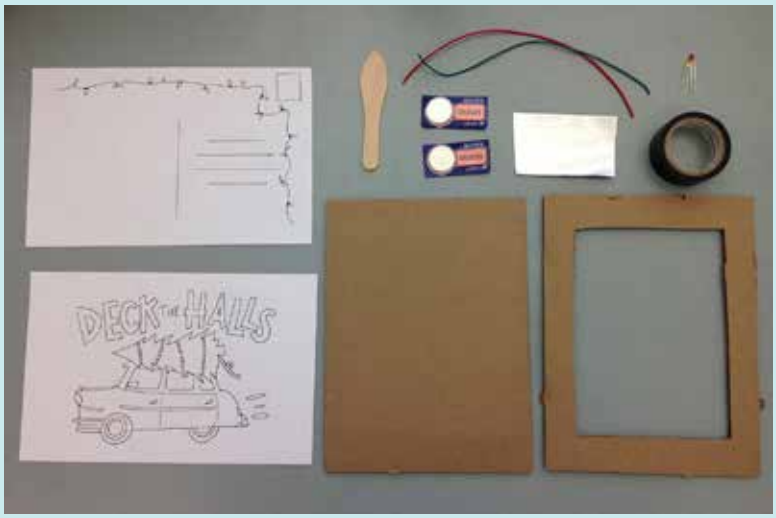


**Figure 1.** Teacher Preparation

**Step 1:** Students will need to paste the "deck the halls" postcard template onto the cardboard pieces. With the "deck the halls" postcard template facing up, use the tip of a paper clip or paper drill to press two holes directly on top of the car lights. Make sure that these holes go through both the paper and the cardboard (Figure 2).

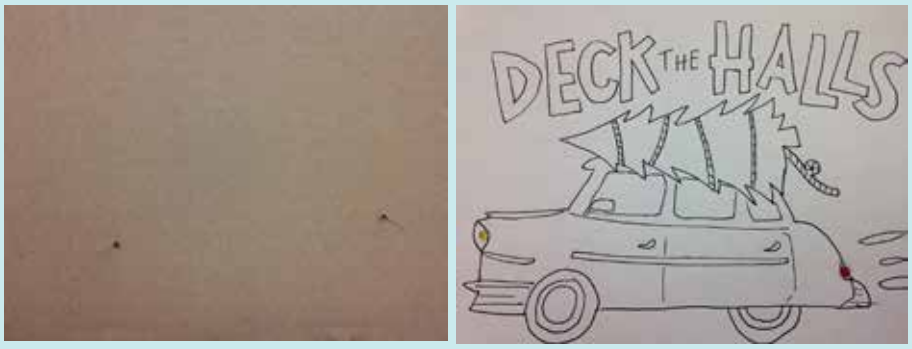


**Figure 2.** LED Placement

**Step 2**: Flip the postcard upside down and stick the red and yellow lights into the holes. Make sure that the yellow light is in the front of the car and the red is in the back of the car (Figure 3).

**Figure 3.** Securing the LEDs with Electrical Tape

**Step 3:** Once the lights are in place, spread the positive and negative wires apart and place tape over the hole to secure the light. Make sure that the positive wire is facing upward and the negative wire is facing downward. Remember the long wire on the LED is always the positive end. Cut the metallic duct tape into four small squares and tape them onto the cardboard. Make sure that these are placed under the LED wires (Figure 4).

**Figure 4.** Securing the LEDs with Tape

**Step 4:** Cut the metallic duct tape into 1½ in. x 1 in. and place this about 1½ inches from the bottom of the cardboard. Be sure not to overlap the metallic tape. This will cause a short circuit (Figure 5).

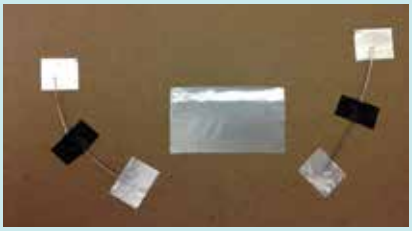

**Figure 5.** Adding the parts of the switch

**Step 5:** Take the 1½-inch wire and overlap it onto the bottom wire of the LED light. Secure these wires together using the electrical tape. Make sure that these are taped on top of the metallic duct tape (Figures 6 and 7). Repeat this process on the other light.

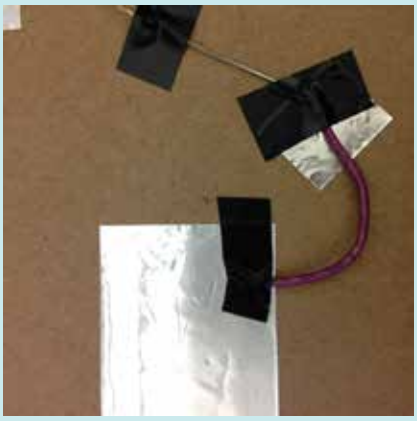

**Figure 6.** Wiring it Up

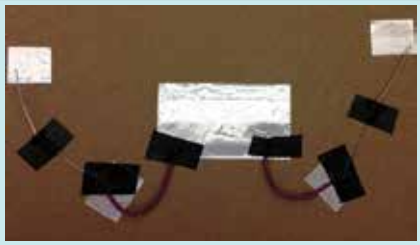

**Figure 7.** Wiring it Up

**Step 6:** Take the 3-inch wires and tape them to the LED lights' positive wire. This should be the wire located at the top of the postcard. Make sure that these wires are overlapping and taped onto the metallic duct tape. Repeat this process for both lights (Figure 8).

**Figure 8.** Connecting the Wires

**Step 7:** Use the electrical tape to connect the 3-inch wires onto the positive side of both batteries. Note: the positive end of the wire must be connected to the positive side of the battery (Figure 9).

**Figure 9.** Connecting the Batteries

**Step 8:** Place the Popsicle stick in between the two batteries. Place the electrical tape across the top of the batteries and Popsicle stick so that they are secure (Figure 10).

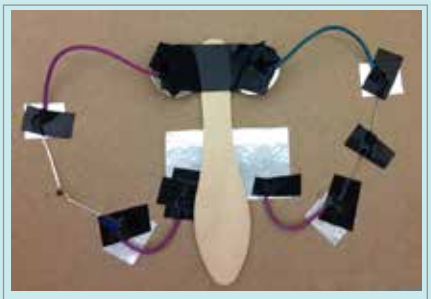

**Figure 10.** Connecting the Batteries

**Step 9:** Place the cardboard frame onto the postcard and draw two lines where the Popsicle stick extends off the side. Cut along the drawn lines to create a hole in the frame. Using a hot glue gun, glue the two cardboard pieces together (Figure 11).

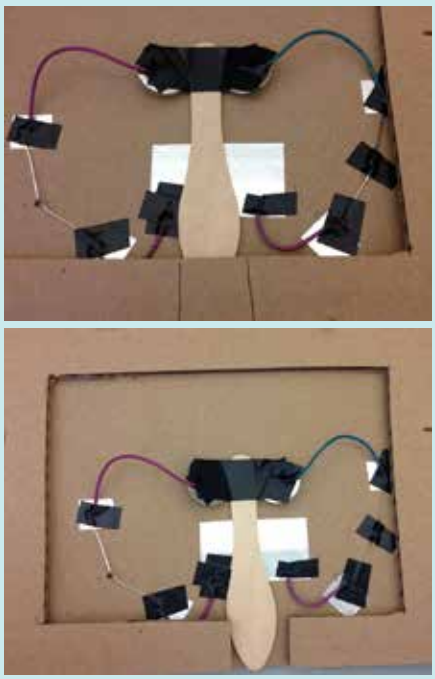

**Figure 11.** Adding the Finishing Touches

**Step 10**: Take the back of the postcard and glue it onto the cardboard frame. The circuit should not be visible. Figure 12 displays both sides of the finished project.

The postcard template may be used (https://www.iteea.org/118465.aspx), or the teacher or students may create their own card design.

## references


International Technology Education Association (ITEA/ITEEA). (2007). *Standards for technological literacy: Content for the study of technology*, (3rd Ed). Reston, VA: Author.

National Governors Association Center for Best Practices & Council of Chief State School Officers [NGA/CCSSO]. (2010). *Common Core State Standards.* Washington, DC: Authors. Retrieved from www.corestandards.org/read-the-standards/

NGSS Lead States. (2013). *Next generation science standards: For states, by states.* Washington, DC: National Academies Press.



**Megan Sagely** *is an undergraduate student at the University of Arkansas and can be reached at smsagely@uark.edu.*



**Brittany Beshears** *is a graduate student at the University of Arkansas and can be reached at bnbeshea@uark.edu.*


***This is a refereed article.***


**Vinson Carter, Ph.D.,** *is an Assistant Professor in the Department of Curriculum and Instruction at the University of Arkansas. He can be reached at vcarter@uark.edu.*



**Michael K. Daugherty, Ed.D.,** *is Director of Innovative Career Education and Professor, Department of Curriculum and Instruction, at the University of Arkansas. He can be reached at mkd03@uark.edu.*


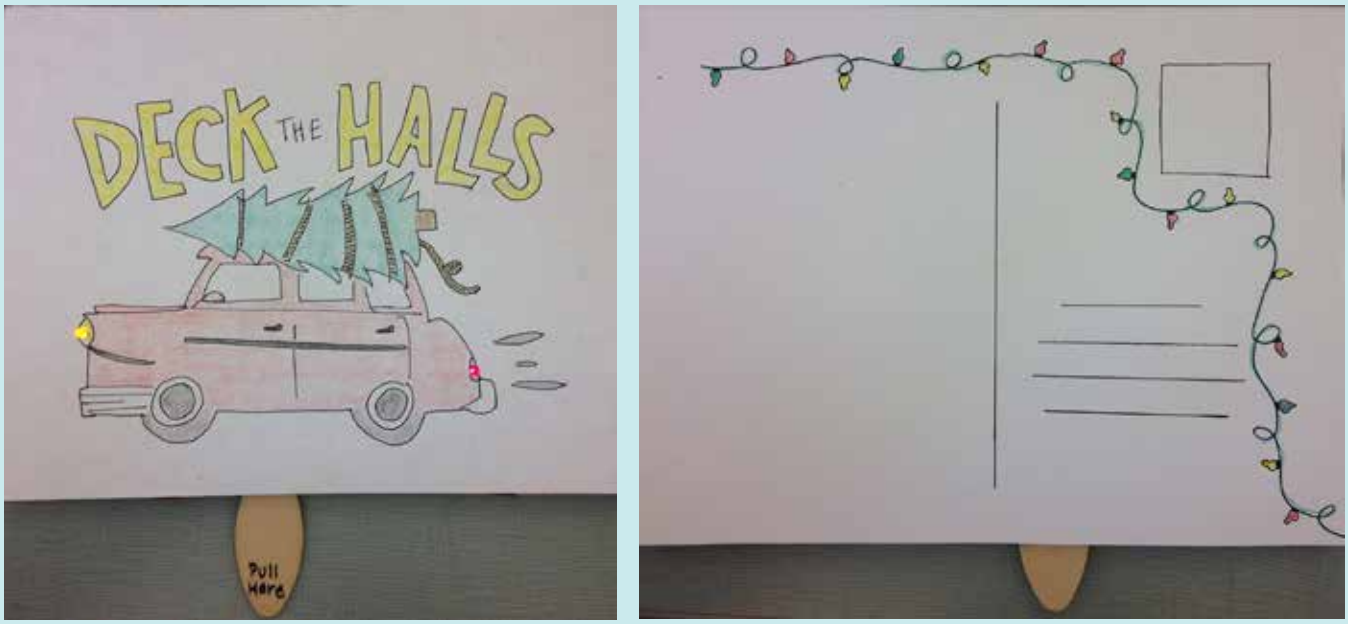


**Figure 12.** The Final Product