LED Holiday Decoration

Explore circuits and electrical energy while creating your own unique holiday decoration! Add an LED light to make your design sparkle as you discover the skill of soldering.

TEKS:

SCI 4.6A: The student is expected to differentiate among forms of energy, including mechanical, sound, electrical, light, and thermal.

SCI 4.6B: The student is expected to differentiate between conductors and insulators of thermal and electrical energy.

SCI 4.6C: The student is expected to demonstrate that electricity travels in a closed path, creating an electrical circuit.

SCI 5.6B: The student is expected to demonstrate that the flow of electricity in closed circuits can produce light, heat, or sound.

SCI 6.9C: The student is expected to demonstrate energy transformations such as energy in a flashlight battery changes from chemical energy to electrical energy to light energy.

Materials:

- Coin battery clip – can be purchased [here](#)
- 3V coin cell battery
- Heat resistant gloves
- 5 mm LED light bulb
- Pipe cleaners
- Safety goggles
- Scissors
- Soldering iron – can be purchased [here](#)
- Solder metal – can be purchased [here](#)
- Sponge
- Optional: additional decorating materials

How To:

Before you start

Review Soldering Safety Tips page at the end of the document. **Be careful when soldering, and always use adult supervision.**

Basics of soldering
1. Plug in and turn on the soldering iron. Store the soldering iron in the iron holder or stand.
2. Always wear protective goggles and heat resistant gloves when using a soldering iron. **Only use under adult supervision.**
3. To increase conductivity, tin the iron tip by coating the tip in solder.
4. Wet a sponge and use the sponge to clean the solder off the tip. **Safety: An adult should clean the iron.**
5. Prepare the circuit connections before soldering. The wires or other connections should already be in position before using the soldering iron.
6. Hold the soldering iron in your dominant hand and hold the solder metal in your other hand.
7. Touch the solder metal to the area of the circuit being connected. Slightly touch the iron tip to the solder to melt the metal and attach the circuit. Let the joint cool before touching the circuit.
8. DO NOT melt the solder onto the iron and try to touch the iron to the circuit. This can cause damage to the wires and iron and can cause splashing.
9. Return the soldering iron to the stand and unplug the iron. Let the iron cool before storing.
10. Always wash your hands after soldering because the metal can contain small traces of lead.

Making an LED holiday decoration
1. Plug in and turn on the soldering iron to pre-heat. *Be careful! Soldering irons can heat up to 700°F.*
2. Pick your favorite holiday design to create out of pipe cleaners and choose where the LED light bulb and battery clip will be placed in the design. Girlstart's example will be a LED holiday tree.
3. Prepare the pipe cleaner(s) needed to make your design. For a holiday tree, two green pipe cleaners will be used to connect a LED at the top of the tree to the battery at the bottom.
4. **Put on safety goggles!** Use the soldering iron to burn off the colored fuzz from the ends of the pipe cleaners. Try to expose about 0.5 inches of metal at each end.
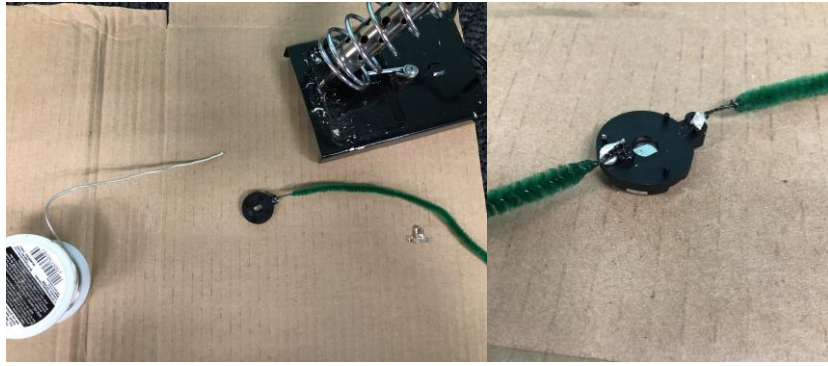

5. Position one end of a pipe cleaner at the positive lead on the battery clip and position the other pipe cleaner at the negative lead on the battery clip. Carefully melt a small drop of solder with the soldering iron and connect the pipe cleaners to the battery clip.

6. Insert the coin cell battery into the battery clip. Test the LED light bulb at the free ends of the pipe cleaners. Touch each free end of the pipe cleaners to one of the LED light bulb's pin legs. If the LED does not turn on, try turning it around. Remember the LED orientation because the direction matters when creating a circuit; electrical energy must flow in one direction, from negative to positive.
7. After the LED is tested, you can temporarily remove the battery. While keeping the LED in the correct position, attach each LED leg to the free ends of each pipe cleaner by twisting them together.
8. Secure the LED to the pipe cleaners by soldering the LED pin legs to each pipe cleaner.
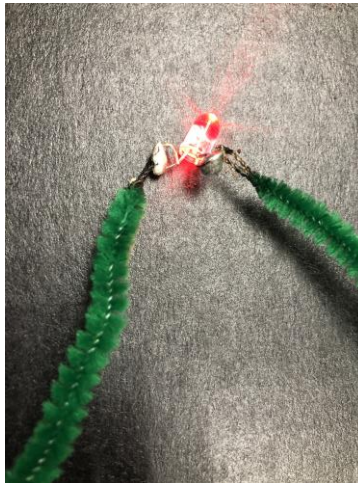
9. Turn off and unplug the soldering iron.
10. Bend the pipe cleaners into the shape of a holiday tree. Be careful when bending the pipe cleaners to avoid a break in the solder connections. Add any additional decorations if desired.

11. After the design is complete, insert the coin cell battery into the battery clip and watch the holiday tree shine! To turn off the LED, simply remove the battery. These instructions can be followed to make any other holiday décor!

STEM Explanation:
The circuit created in this activity is composed of a battery, a battery clip, wires, a LED bulb, and solder. Electrical energy is stored in the battery and travels through the wires to transform into light energy as the LED bulb shines. The electrical current travels in one direction, negative to positive, to make a complete, or closed, circuit. When the circuit is incomplete, or open, there is a disconnect of wires or no energy source; therefore, there is no flow of electricity. The construction of the holiday decoration circuit is unique because it makes use of different conductors to build its circuit. Conductors are materials that easily allow the transfer of electricity, and insulators are materials that inhibit the flow of electricity. In this activity, the metal center of a pipe cleaner is used as circuit wires because the metal can conduct the flow of the circuit's electricity. Additionally, solder is used to connect portions of the circuit as a conductive metal. The skill of soldering is used to design simple and complex circuits in many everyday products. Soldering metal can be used to close big circuits like this holiday decoration, as well as microscopic circuits inside electronics like cell phones!

Career Connection:
Circuit designers work with small scale circuits that are put in larger products. They are given requirements to follow, need to stay within a budget, and meet deadlines. Their circuits are used in cell phones, TVs, toaster ovens, computers, and many other devices.

Resources:
https://www.instructables.com/id/Pipe-Cleaner-LED-Christmas-Decorations/
https://www.amazon.com/MAIYUM-63-37-solder-electrical-soldering/dp/B075WB98FJ/ref=sr_1_6?ie=UTF8&qid=1533857332&sr=8-6&keywords=solder
https://www.amazon.com/YAOGONG-Electronic-Soldering-industrial-Precision/dp/B078W8PY2Q/ref=sr_1_21_sspa?ie=UTF8&qid=1533857244&sr=8-21-spons&keywords=soldering+iron+and+solder&psc=1
https://www.amazon.com/VNDEFUL-CR2016-Button-Battery-Holder/dp/B01J5FY2GI/ref=sr_1_6?ie=UTF8&qid=1533857451&sr=8-6&keywords=coin+cell+battery+holder

Soldering Safety Tips

- Wear safety goggles and gloves when working with or near solder. Hot metal or water can splash while soldering.
- Tin the solder tip by coating it with a thin layer of solder. This helps the heat transfer between the tip and the components.
- Wipe off excess solder on the wet sponge. Make sure to keep the cleaning sponge wet during use.
- Be careful when you wipe the iron on the sponge so hot water does not splash. But do not touch the iron to the sponge too long.
- Avoid breathing in the smoke by keeping your head to the side of your work, not right above it.
- Apply solder directly to the metal/copper wires (not to the soldering iron) – hold the iron to one side of the components you are trying to join and feed the solder from the other side.
- Hold the flat edge of the iron's tip to the joint, not just the point of the iron.
- Don't put a blob of solder onto the iron and try to transfer it to your joint – it causes the flux to burn away, which helps the solder to stick.
- DO NOT TOUCH THE IRON – it's around 700°F!
- Don't grab your joint while it's hot. It can take about one minute to cool down.
- Avoid holding the metal part of a component with your fingers. Metal is a conductor so the heat will transfer from the solder.
- Hold wires with tweezers, clamps, or playdoh.
- Always return the soldering iron to its stand when not in use. Do not just set it down on the work surface.
- Turn off unit and unplug when finished using.
- Wash your hands after using solder because the solder contains lead.
- Used solder sponges must be disposed of as hazardous waste.