Building Simple Circuit Flashlight

Part A: EXPLORE: Making a simple circuit that WORKS!

Here's what each camper will need:
2 ft of copper tape (conductor)
1 lithium battery (power)
Set of three LED stickers (device)

Here's what you will share:
Markers
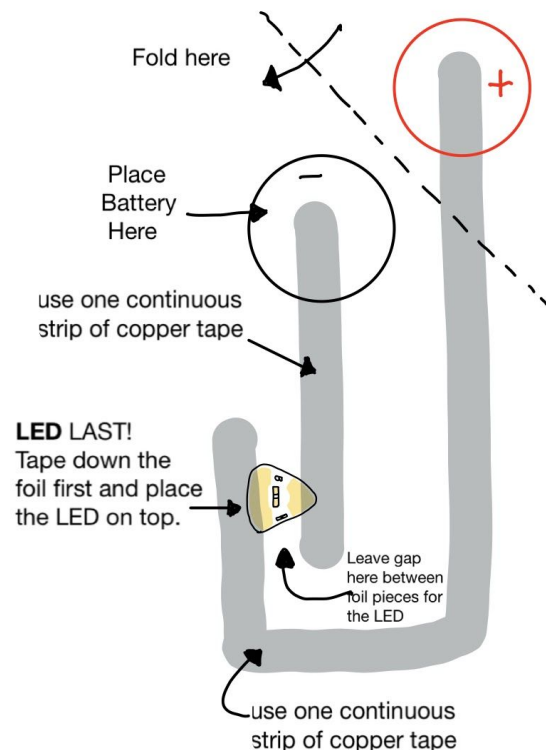Construction paper
Scissors

What is a circuit?
A circuit is a complete path around which electricity can flow. An electric circuit has to have a **power** source, a **conductor** for the electricity to flow through, and a **device**, such as a light, that uses the electric current.

We are going to create a circuit to light an LED. Our battery will be connected to the LED using copper tape and the LED will be connected back to the battery using a second piece of copper tape. Electricity only flows in loops. Your copper tape is made of metal so it is a great conductor of electricity.   This flow of electricity, called current, will cause the LED light to turn on and shine.

Procedure:

1. Turn to the template on your Engineering worksheet. We will be using the corner of the worksheet, so you may need to turn your page upside down to build your circuit.
2. Locate the two gray lines on your template. Measure and cut two pieces of copper tape to match the length of the gray lines.
3. Peel the sticker off the tape and stick the foil tape over the gray lines on the template. Both pieces of copper tape must remain intact. When turning corners, you should fold the tape rather than cut it. A connection works best when made with a continuous strip of tape.
4. Stick the LED sticker onto the foil, over the picture on the template.
5. Fold the page corner along the dotted line and place the battery "+" side up over the "-" circle.
6. Fold the corner flap over so that the foil on the red circle touches the "+" of the battery. The light should turn on!!!

Fold here

Place Battery Here

use one continuous strip of copper tape

LED LAST!
Tape down the foil first and place the LED on top.

Leave gap here between foil pieces for the LED

use one continuous strip of copper tape

Extension:
You have leftover copper tape and two additional LED lights. Design a NEW simple circuit pattern that will also light an LED. You can make it look like a heart, or a butterfly or a robot. You could use construction paper to make a card and make the card light up!

There are some great ideas and templates at https://chibitronics.com/educators/ as well as some kits that would help you to learn more about circuits and programming circuits to do other tasks.

Part B: BUILD: Making a simple circuit flashlight

Here's what each camper will need:
Toilet paper tube or paper towel tube
2 AA batteries
Battery holder
Two 1 ft pieces of insulated copper wire
1 holiday light with end stripped
1 plastic cup
Clear acetate sheet or sheet protector

Here's what you will share:
Markers
Construction paper
Duct tape
Aluminum foil
Roll of electrical tape
Scissors
Utility knife (ADULTS ONLY)
Paper clips

What can we make with a simple circuit?

A FLASHLIGHT!!!

Remember that a simple circuit is just a complete path around which electricity can flow. If you look inside a flashlight, it has batteries as a **power** source, copper wiring as the **conductor** for the electricity to flow through, and a bulb as the **device** that uses the electric current to light up.

Since you already know how to make a circuit that lights an LED, let's put that knowledge to use to transfer our simple circuit into a tube!

In this case, you will be following a set of "blueprints" to build your simple flashlight. You will need to look at the diagram to help you to assemble your flashlight. You may use the order suggested below, OR you can build it in your own order, OR you can use the basic design, but make it in your own way.

Suggested Order:
1. **Make your simple circuit first.**
   a. Attach one wire to one side of the light bulb by twisting the copper wires together.
   b. Use a piece of black electrical tape to cover the exposed wire.
   c. Repeat on the other side of the light bulb with the second wire. Cover with tape.
   d. Take the other end of one of the copper wires and attach it to a wire that is attached to the battery holder by twisting the copper wires together. If you do not have enough copper wire exposed, you may need to peel off some of the plastic.
   e. Use a piece of black electrical tape to cover the exposed wire.
   f. Repeat on the other side of the battery holder with the second wire. Cover with electrical tape.
   g. You should now be able to SEE a complete circuit, even though it is not lighting up.
   h. Test the circuit by putting the batteries in the battery holder. If it lights, you have made a closed circuit! Congratulations! Now take the battery out so that we do not drain it while we build the rest of the flashlight.
   i. If it does not light up, it means you have an open circuit. Open circuits do not light! This is where you will need to TINKER. Check each of your junctions (where the wires are twisted together). Make sure that the copper is touching the copper so that the

electricity will flow. Play with your materials until you can get the bulb to light. And don't give up! It may take some patience to get it to work.

    j.   Once you know the circuit works, remove the batteries.

2. **Make the tube assembly second.**
   a. Cut the tube in half. Use duct tape to create a hinge on one side of the tube so that you can open and close the tube. Putting duct tape on the inside and outside will prevent the tube from coming apart later. You can use a small piece of duct tape to hold the other side closed, but still allow you to open the tube when you need to.
   b. Open the tube so that it looks like the blueprint. Use a marker to draw the lines for the circuit inside the tube. This will make it easier to arrange the wires, battery holder and light bulb when you do your final assembly.
   c. Optional: Decorate the outside of the tube with construction paper or other materials you may have at home.
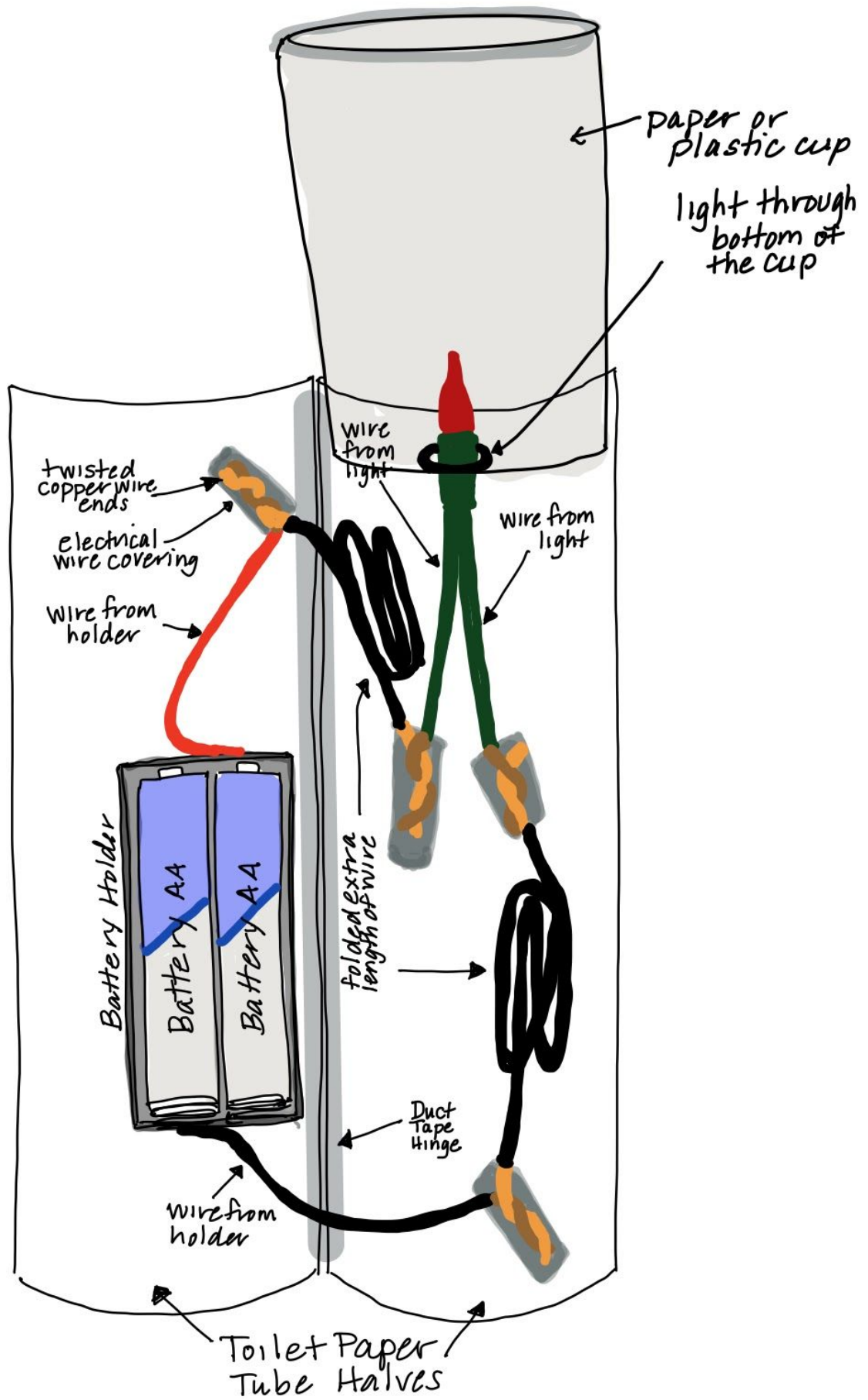
3. **Put the circuit into the tube.**
   a. Use the lines you have drawn in the cardboard tube to arrange your circuit.
   b. Use duct tape to secure the battery holder in one side of the tube.
   c. Tape down the wires in the toilet paper tube as shown in the diagram.
   d. The light bulb will need to be in the center of the tube, so do not tape it directly on the toilet paper tube.
   e. Open and close the tube so that you know that the circuit will not fall apart.

4. **Add the cup to direct the light.**
   a. Punch a hole in the bottom of the cup with a pen or pencil. If you are using a plastic cup, be slow and gentle so that you do not split the cup. Make the hole large enough that the light bulb will extend through and will be held in place by the cup.
   b. If it fits, put the bottom of the cup inside the tube and secure it in place with duct tape.
   c. If the cup does not fit inside the tube, secure the cup at the top of the tube with duct tape.
   d. Make sure that the tube will open and close. You may have to trim the cup or the tube so that it fits smoothly.
   e. Optional: You may choose to line the inside of the cup with foil to magnify the intensity of the light. You may use the acetate or sheet protector to seal the top of the cup.

NOW….

Put the batteries in the battery holder and see if your flashlight works!!!!

paper or plastic cup

light through bottom of the cup

twisted copper wire ends

electrical wire covering

Wire from holder

wire from light

Wire from light

Battery Holder

Battery AA

Battery AA

folded extra length of wire

Duct Tape Hinge

wire from holder

Toilet Paper Tube Halves

Part C: EXTEND YOUR DESIGN: Making a switch for your flashlight

Here's what you will share:

|	
2 copper brads	Paper clips
Electrical tape	Aluminum foil
Roll of electrical tape	Duct tape
Scissors	
Utility knife (ADULTS ONLY)	

What is a switch?

A **switch** is a component which controls the open-ness or closed-ness of an electric circuit. **A switch** is an important component in our flashlight circuit because it will allow us to turn the flashlight on and off without having to open the flashlight to insert or remove the batteries. You can use our simple design OR make your own!!!
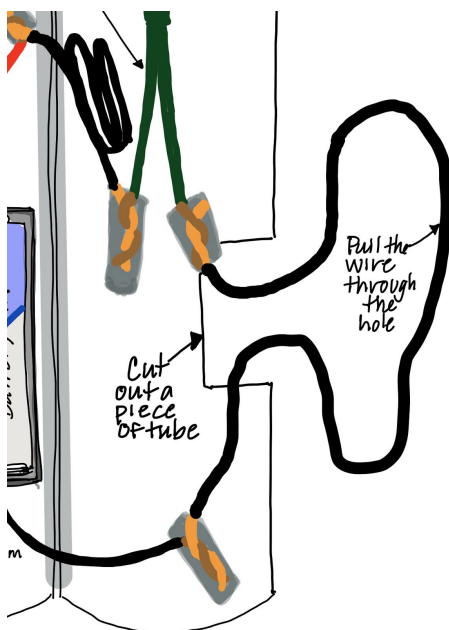
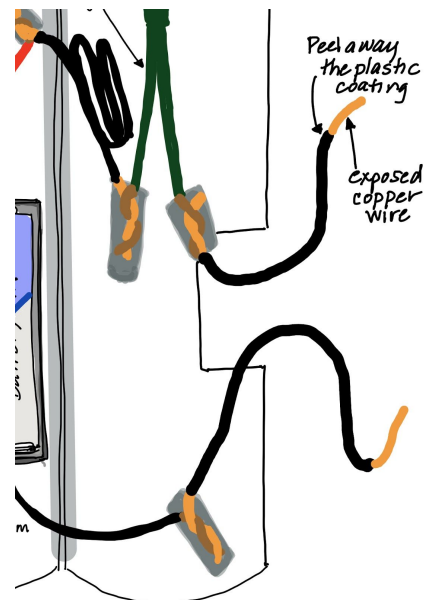1. Cut a flap into one edge of the tube.

half of tube
cut
cut
fold outward
Cardboard flap
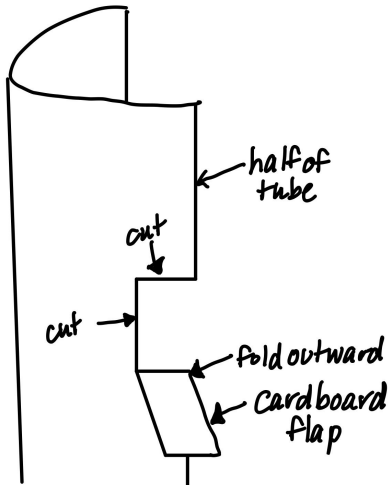
2. Use paper, duct tape, cardboard or a paperclip to create an extension to make the flap TWICE as long. Cover the flap with duct tape.

extension made out of paper or duct tape.
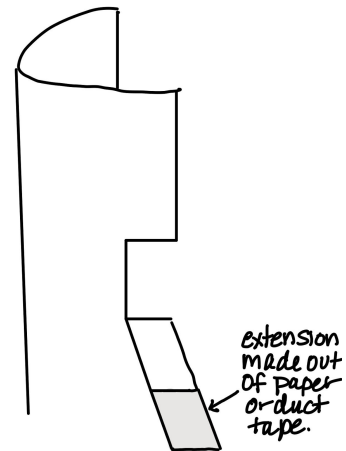
3. Pull wires through the opening.

Pull the wire through the hole
Cut out a piece of tube
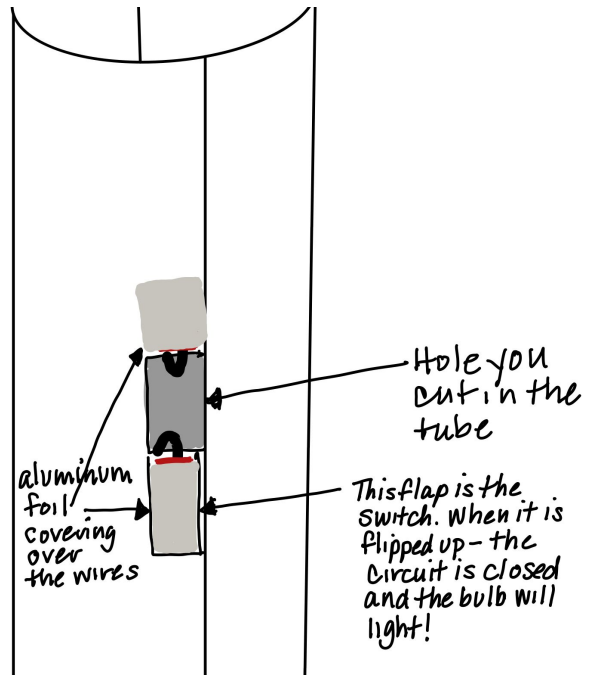
4. Cut the wire and strip the plastic off of the cut ends, being careful not to damage the wire.

Peel away the plastic coating
exposed copper wire

5. Tape one wire (on the plastic insulator) to the inside of the flap. Place duct tape on the outside of the tube. Tape the second wire (on the plastic insulator) to the outside of the tube above the opening.

duct tape

tape

tape

a cardboard flap

duct tape

cut in the tube

Hole you cut in the tube
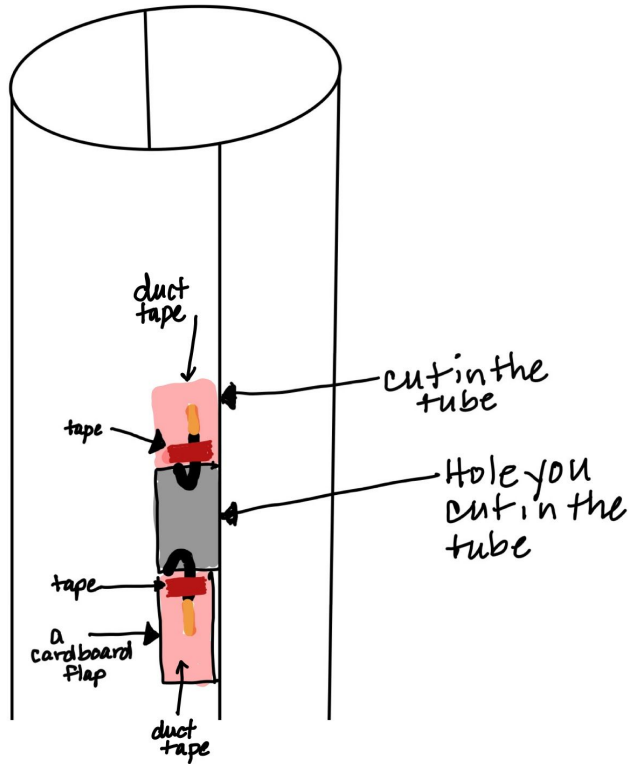
6. Cover the copper wires with pieces of aluminum foil. Foil is a conductor and will help to make a connection between the wires.

aluminum foil covering over the wires

Hole you cut in the tube

This flap is the switch. When it is flipped up - the circuit is closed and the bulb will light!

7. Open the tube and put your batteries in the battery holder. Close the tube and tape it shut. When the flap on your switch is down so that you can see the opening, you have an open circuit and your flashlight should be OFF. When you flip the flap up so that there is a connection between the foil conductors, it will close the circuit and the flashlight should be ON! Don't forget - Electrical connections are sometimes tricky. If it doesn't light right away, tinker until it does!