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iBIO STEM Kits: Build a Simple Circuit Flashlight

iBIO STEM Kits welcomes you to a SCIENTIFIC JOURNEY!

This kit contains the materials you will need to build a simple circuit flashlight. The purpose of this kit is to challenge you to understand a simple circuit. However, we also challenge you to build and design as a scientist would. What does this mean?

Scientific exploration is different than just playing around because it asks you to think about HOW you investigate. This means you need to do your investigation by observing what happens when you change an element of your design that you have carefully chosen. Good observation will help you to understand WHY something happens. Scientific exploration also means that you record WHAT you see or measure so that you can alter your design based upon what works for you. The STEM Kit Notebook that you are holding will help to guide your investigation and give you a place to record your observations and your design changes.

Follow the QR code at the top of the page for additional resources on this activity. There are many resources for you to use on our website. This type of investigation is associated with some very exciting careers! We hope that you will explore these resources while you are doing your investigation!

Let's Get Started!

FIRST, you will need to prepare your workspace. Having a clear space where you can see all of your materials and tools is very helpful. A kitchen table will work nicely. To make your clean up easier, you should protect your surface by laying out some used newspaper or opening up a paper grocery bag.

SECOND, you want to unpack your materials. Use the list below to identify which materials are used in each part and organize them in your workspace.

Kit Materials for Part A:

2 AA batteries	Battery holder	2 - 1ft of Insulated Wire
Aluminum foil	1 plastic cup	Sheet protector
Electrical tape	Duct tape	Construction Paper
Holiday light		

Kit Materials for Part B:

- 2 copper brads
- Electrical tape
- Paper Clips
- Aluminum foil

General Supplies:

- Toilet paper tube or paper towel tube
- Markers
- Scissors

LAST, you need to be prepared for experimenting safely. You should do your building without your battery. In order to conserve your battery, only use your battery to test your work and then remove it again when you are ready to work.



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Part A: BUILD: Making a simple circuit flashlight

Here is what you need from your STEM Kit:

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
Construction paper
Duct tape
Aluminum foil
Roll of electrical tape

General Supplies:

Toilet paper tube or paper towel tube
Markers
Scissors

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. When you build your flashlight, you will be creating a simple circuit in 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.



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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 on hand.

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.

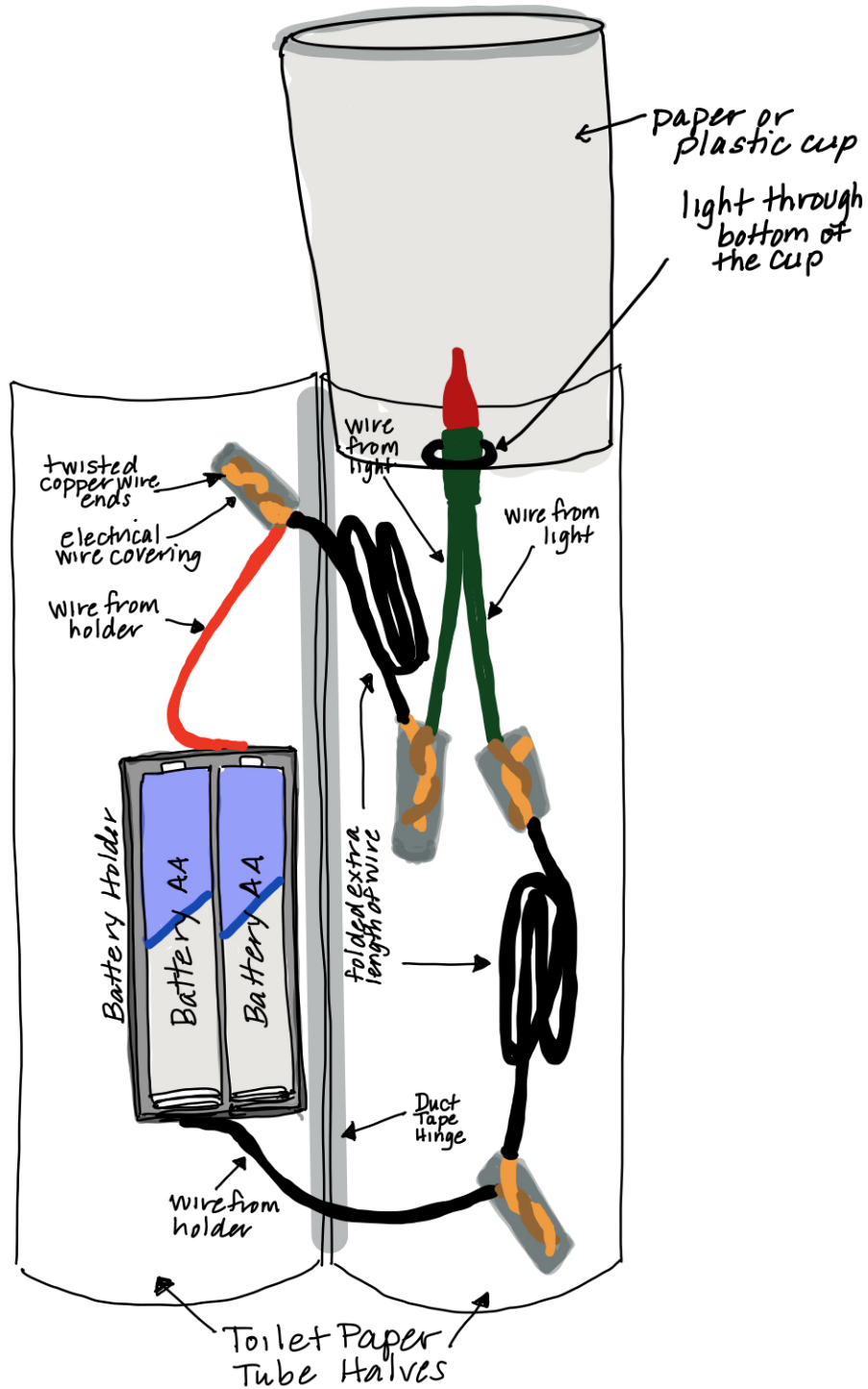
- a. Punch a hole in the bottom of the cup with a pen or pencil. If you are using a plastic cup, be slow and gentle so that you do not split the cup. Make the hole large enough that the light bulb will extend through and will be held in place by the cup.
- b. If it fits, put the bottom of the cup inside 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!!!!



When engineers build from a design, they make changes when it does not work in the way they envisioned. These changes are recorded on their plans so that they can communicate with other people. If you make changes to your design, make notes on your diagrams!





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

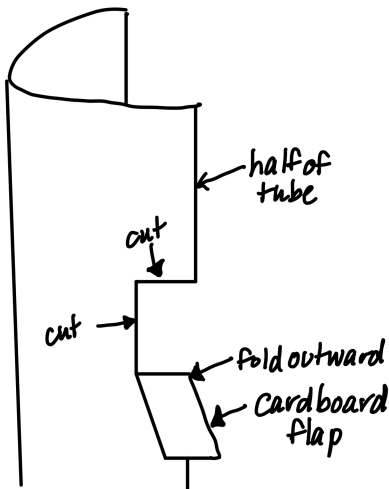
Here's what you will need in your workspace:

2 copper brads	Paper clips
Electrical tape	Aluminum foil
Roll of electrical tape	Duct tape
Scissors	

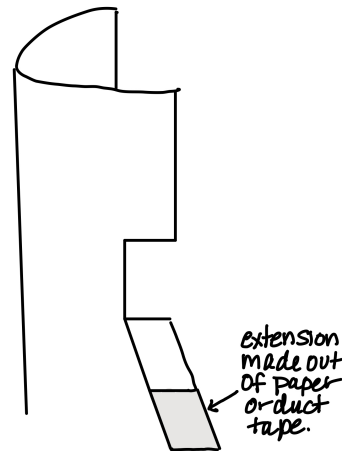
What is a switch?

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!!!

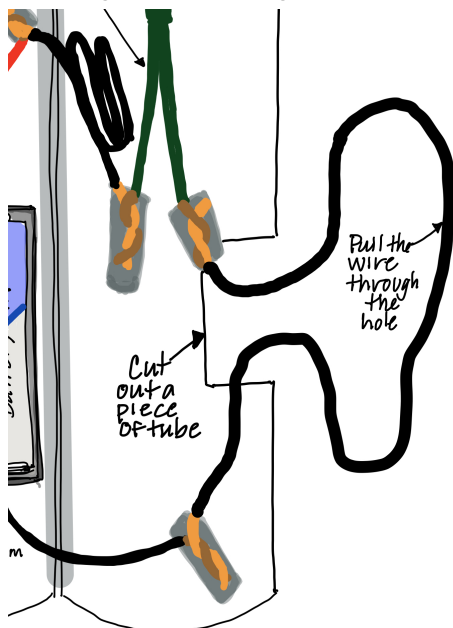
1. Cut a flap into one edge of the tube.



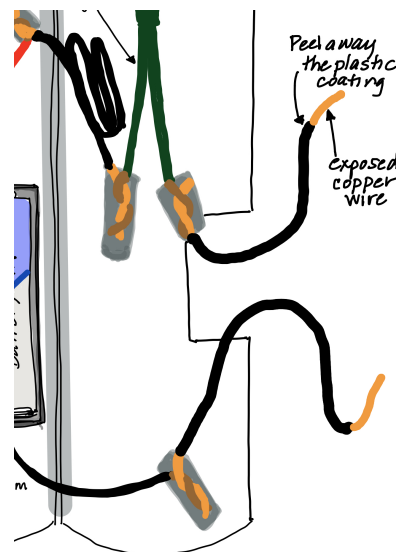
2. Use paper, duct tape, cardboard or a paperclip to create an extension to make the flap TWICE as long. Cover the flap with duct tape.



3. Pull wires through the opening.

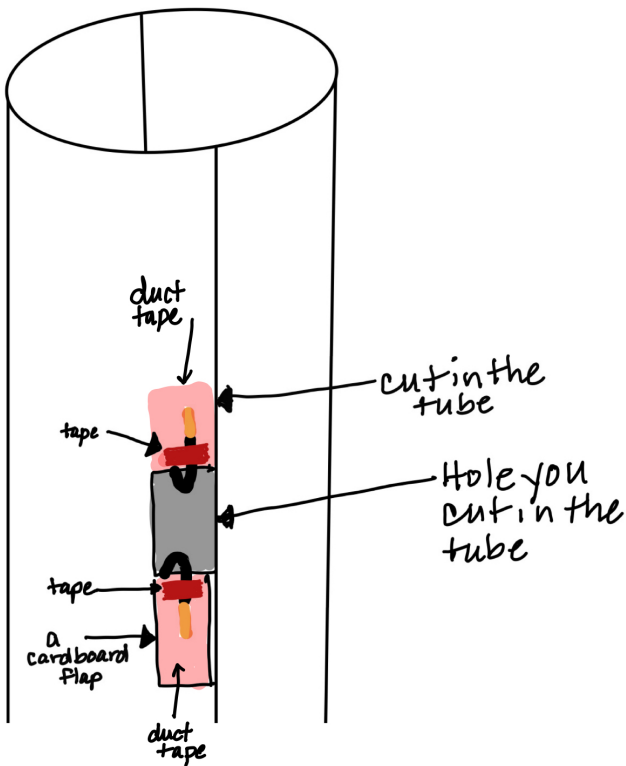


4. Cut the wire and strip the plastic off of the cut ends, being careful not to damage the wire.

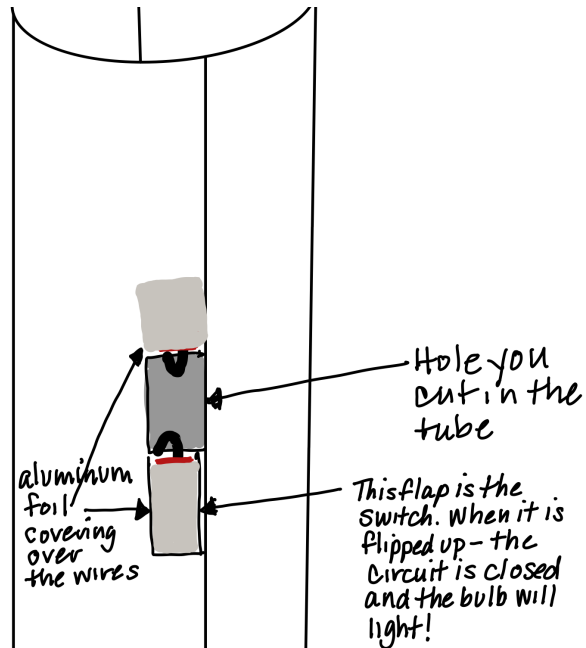




5. Tape one wire (on the plastic insulator) to the inside of the flap. Place duct tape on the outside of the tube. Tape the second wire (on the plastic insulator) to the outside of the tube above the opening.



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



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!

Challenge:

This is a **basic** flashlight design. There are many ways to build single circuit flashlights. Different shapes. Different sizes. Different materials. Now that you have made one, make a new one! A better one!

There are also many ways to make a switch. Can you design a sliding switch? Or a switch that pops in and out to make the connection? Engineers are constantly redesigning simple devices to make them more effective or to better fit the specific job we want them to do. You are limited only by your creativity! Good Luck!