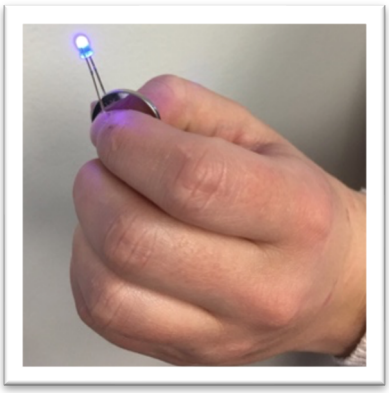
Paper Circuits Activity Instructions

Gather the following materials:

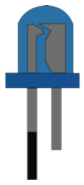
- Copper conductive tape cut into 18" pieces, four pieces per student*
- 3mm LEDs, 6 per student*
- 3-volt coin cell battery, one per student*
- Transparent tape, one per student or group of students
- Black permanent marker, one per student or group of students
- Paper Circuits Activity Instructions, 1 per student

*Items included in the Paper Circuits kit, available from agclassroomstore.com.

Activity 1: Creating a Simple Circuit



1. Locate the positive side of the battery by locating the "+" marking. The unmarked side of the battery is the negative side.
2. Examine a LED or ***Light-Emitting Diode***. A LED converts electrical energy into light. The longer leg of the LED is the *anode* or positive (+) leg, and the shorter leg is the *cathode* or negative (-) leg. Current always flows from the anode to the cathode.

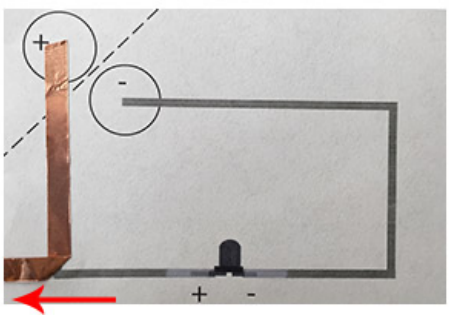


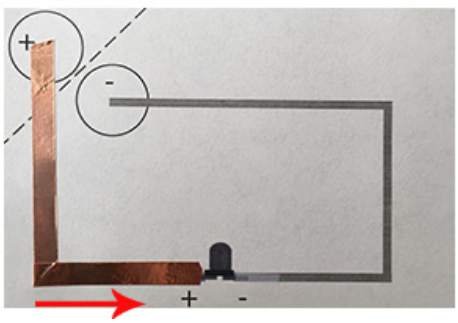
Anode, positive + Cathode, negative –

3. Straddle the LED legs around a battery, so the longer leg is touching the positive side of the battery, and the shorter leg is touching the negative side of the battery. Using your thumb and forefinger, apply a small amount of pressure to the LED legs to ensure a good connection. The LED should light up. If the LED is connected backward, it will not light up. Connecting the LED to the battery created a circuit. A **circuit** is a path through which electricity flows.
4. Mark the positive leg of all six LEDs with a black permanent marker.

Activity 2: Paper Circuits

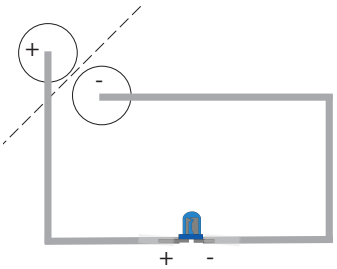
Using the paper circuits template, copper tape, LEDs, transparent tape, and a 3-volt coin cell battery, create four basic circuits. Keep the tape in one piece until you reach a gap or break in the line. To turn a corner, fold and crease the copper tape in the opposite direction of the turn. The sticky side of the tape will be facing up. Then, fold the tape back down in the direction of the turn. View the How to Turn a Corner video tutorial https://youtu.be/1Pz7MjGbP4U.



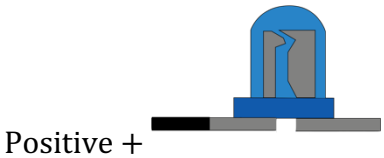


Circuit 1: Closed Circuit

A closed circuit is a complete circuit that allows current to flow.



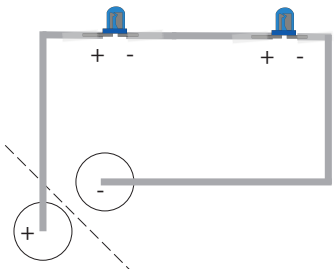
1- View the Closed Circuit video tutorial https://youtu.be/2Nzt9Pm9ATA.
2- Remove a small amount of paper backing from the copper tape. The top side of the copper tape is conductive; it allows electricity to flow through it. The sticky side of the tape is not conductive. Starting in the middle of the positive battery circle, place copper tape on the grey line, following a path toward the negative battery circle. Remove the paper backing as you lay down the tape. Leave a gap or break in the copper tape for the LED.
3- Bend the legs of the LED out so the LED will lay flat on the conductive tape.



4- Tape the legs of the LED to the copper tape path using clear tape. Be sure the LEDs' positive "+" leg sits on the copper tape coming from the positive "+" battery circle.
5- Place the battery in the battery circle marked with a negative "- ." The positive side of the battery will be facing up.
6- Fold the corner of the paper along the dotted fold line. The positive side of the circuit should touch the positive side of the battery, and the LED should light up.
7- Label the diagram "closed circuit."

Circuit 2: Series Circuit

A series circuit is a complete circuit in which the same current flows through all circuit components.

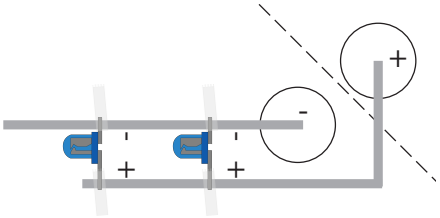


1- View the Series Circuit video tutorial https://youtu.be/CAhIGqRfZNI.
2- Place the copper tape on the grey line following a path from the middle of the positive battery circle toward the negative battery circle. Leave a gap for the LEDs.
3- Bend the legs of the LEDs out and tape the legs of the LEDs to the copper tape path using clear tape.
4- Place the battery in the battery circle marked with a negative "-."
5- Fold the corner along the dotted fold line. The positive side of the circuit should touch the positive side of the battery.
6- Did the LEDs light up? If the LEDs don't light, they require more current. Try using two batteries stacked one on top of the other.
Note: Different color LEDs draw different amounts of current.
7- Label the diagram "series circuit."

Circuit 3: Parallel Circuit

A parallel circuit is a complete circuit in which the current flows through multiple paths to the components of the circuit.

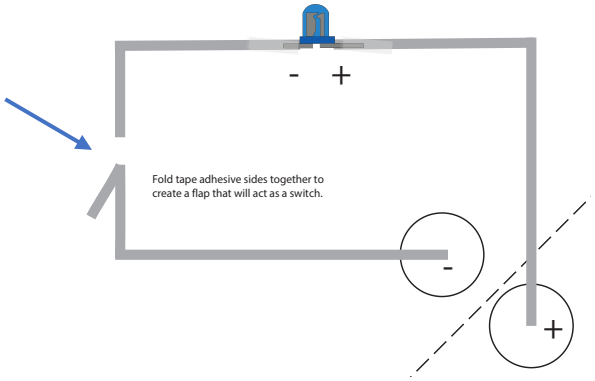
1- View the Parallel Circuit video tutorial https://youtu.be/izY5WaQzCZA.
2- Place the copper tape on the grey line starting in the middle of the battery circles. **Do not** leave a gap for the LEDs.
3- Bend the legs of the LEDs out and tape the legs of the LEDs to the copper tape path using clear tape.
4- Place the battery in the battery circle marked with a negative "-."
5- Fold the corner along the dotted fold line. The positive side of the circuit should touch the positive side of the battery, and the LED should light up.
6- How many LEDs can you add to this circuit before the LEDs look dim? How many LEDs can you add to this circuit before they won't turn on at all?
7- Label the diagram "parallel circuit."



Circuit 4: Open Circuit

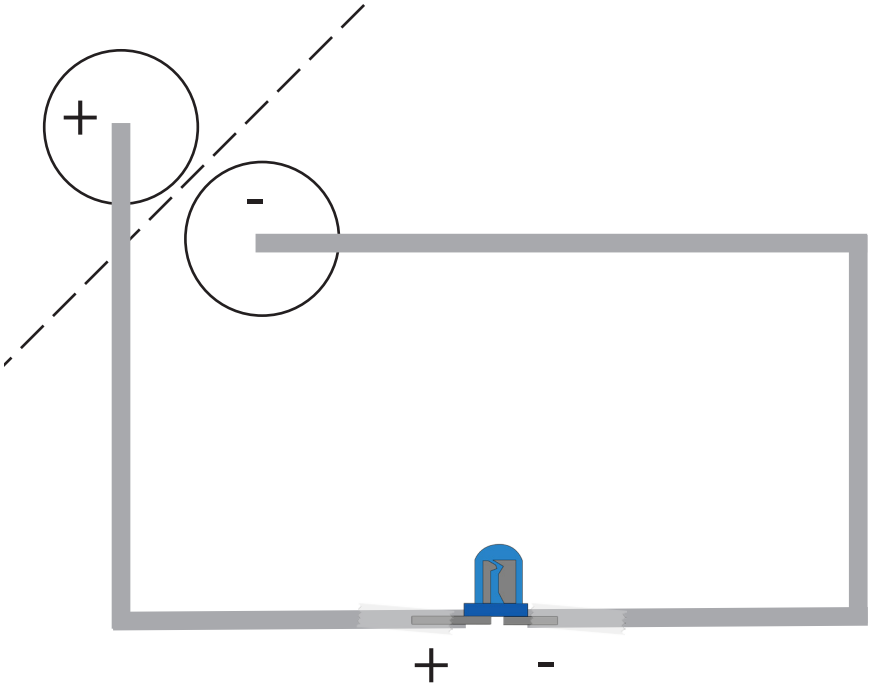
An open circuit is a broken circuit. Current cannot flow through the circuit until it's closed with a switch. Create a switch that will close the open circuit.

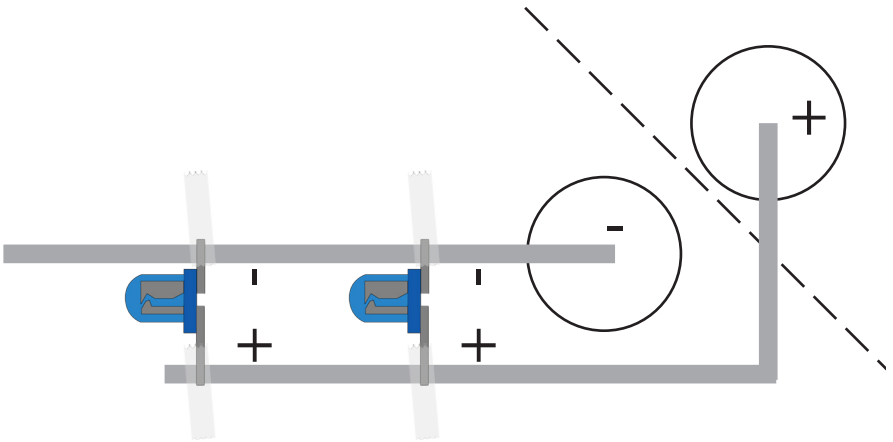
1. View the Open Circuit video tutorial https://youtu.be/rO3voO-UUdk.
2. Starting at the gap in the circuit, create a flap. Fold 1" of tape adhesive sides together with the paper backing attached. Open the fold and remove the backing. Refold the tape on the same fold allowing the adhesive to adhere. **Do not** tear the tape. Leave the flap attached to the strip of tape. Place the tape on the grey line following the path to the negative battery circle. The flap will become a **switch** in the completed circuit.
3. Place the copper tape on the grey line following a path from the positive battery circle toward the negative battery circle. Leave a gap for the LED.
4. Bend the legs of the LED out and tape the legs of the LED to the copper tape path using clear tape.
5. Place the battery in the battery circle marked with a negative "-."
6. Fold the corner along the dotted fold line. The positive side of the circuit should touch the positive side of the battery, and the LED will **not** light up.
7. When the flap is sticking up, the circuit is open or broken. The LED will not light up.
8. When the flap is down, the circuit becomes a closed circuit, and the LED will light up.
9. Label the diagram "open circuit

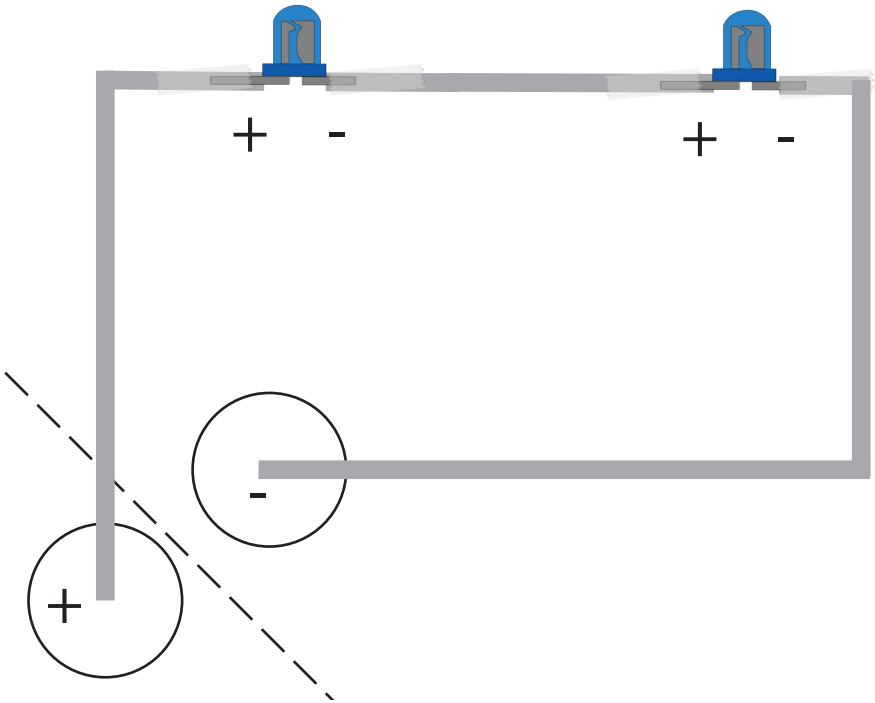


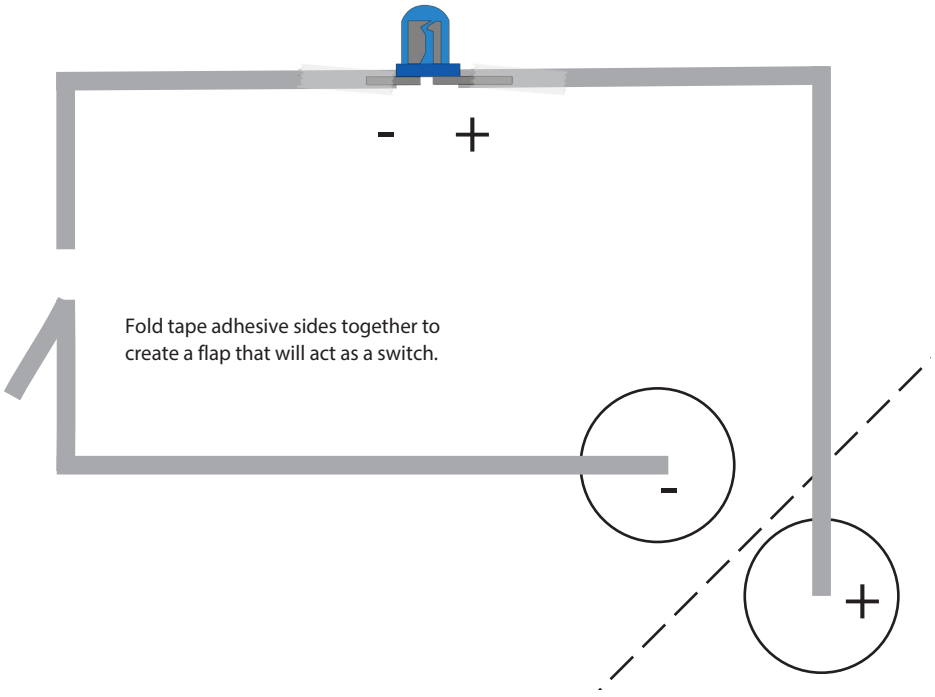
Troubleshooting tips:

- Smooth any wrinkles out of the copper tape
- Make sure the corners are as flat as possible
- Make sure the copper tape isn't crossing itself
- Make sure there are no breaks in the tape
- Make sure the legs of the LED have a good connection to the copper tape
- Make sure the battery is positive to positive, negative to negative
- Try a new battery
- Try a new LED
- Use the same color LEDs when a circuit requires more than one LED
- Use a multimeter to check continuity and polarity
- Solder the LED leads to the copper tape


+
-
+
-


+
-
+
+


+
-
+
-
-
+


-
+
Fold tape adhesive sides together to
create a flap that will act as a switch.
-
+