Paper Circuit Helicopter

Learning Objectives

- Students will learn what a circuit is, and the difference between a series and parallel circuit.
- Students will explore conductive materials.
- Students will learn about the X-57, NASA's experimental, all-electric plane.

Activity Overview

- Students will learn about circuitry by creating a paper circuit helicopter out of conductive tape and LEDs.

Standards Addressed

- ***SC.5.P.11.1*** – Investigate and illustrate the fact that the flow of electricity requires a closed circuit (a complete loop).
- **SC.5.P.11.2** - Identify and classify materials that conduct electricity and materials that do not.
- ***SC.5.P.10.4*** – Investigate and explain that electrical energy can be transformed into heat, light, and sound energy, as well as the energy of motion.

Materials

Item	Quantity Needed	Notes
Helicopter Template	30	*1 per student*
Conductive tape	2 rolls	
LEDs	50	*Various colors*
Coin cell batteries	30	
Scissors	Class set	
Paperclip	30	*Can also use small binder clips*

Preparation

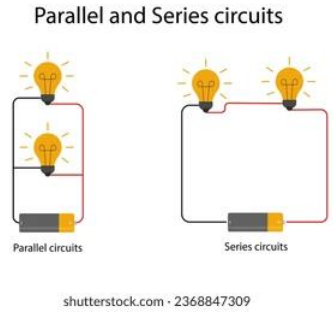
- Cut pieces of conductive tape for each student
- 3.25" piece
- 2, 2.75" pieces
- 2.5"
- 1.25"
- 1"
- 0.75"
- 4, 0.5" Pieces

Science Content

NASA's X-57 Maxwell is a small, experimental aircraft powered completely by batteries. It is NASA's first full-sized all-electric experimental aircraft, or X-plane. Compared to standard fuel-powered airplanes, the X-57 is designed to have increased high-speed cruise efficiency, zero in-flight carbon emissions, and flight that is much quieter for the community on the ground. One of the primary goals of this project is to develop all-electric technology that will make flying quieter, cleaner, and more sustainable. The X-57 requires banks of batteries to produce enough electricity to power its fourteen wing-mounted engines. There is an extensive electrical distribution system that distributes electricity to each motor.

Electricity is the flow of electrons, one of the sub-atomic particles that make up atoms. Electrons flow through a materials called a conductor. Conductors make up the wiring in the X-57 that carries electricity through electric circuits, to the different parts of the plane. Batteries, like the ones in the X-57, need to be attached to an electrical circuit for electricity to flow and do work. A simple electric circuit is a complete path that includes a power source, conductive material, and an item that requires energy, such as a light, motor, or other instrument.

In a series circuit, electricity flows out of the battery, through the light, then back to the battery to complete the circuit, following one pathway. In this type of circuit, if the circuit is broken, the light will not be on. In a parallel circuit, electricity flows out of the battery then flows through each of the lights separately. In other words, there are now two different pathways electricity can take to get back to the battery. In this type of circuit, if one of the lights stops working, electricity can still flow to the other one and keep it lit.



Source: http://www.nasa.gov

Facilitation Guide

Engage (10 minutes)

1. Ask the students if they have ever heard or worked with circuits before? Explain that a circuit is a complete path that includes a power source, conductive material, and an item that requires energy, such as a light, motor, or other instrument.
2. Demonstrate by turning on and off the classroom light. Explain that when the switch is turned off, the circuit is broken, and electricity cannot flow to power the lights. When the switch is turned on, the circuit is complete, allowing the electricity to flow to the lights.
3. Explain to the students that we can make a miniature circuit to take home today by creating a paper circuit that doubles as a helicopter model. Introduce them to the X-57 plane and give some background information on it.

Activity (30 minutes)

1. Hand out a helicopter template to each student. Instruct them to cut around the outer rectangle of the helicopter and the three solid lines. DO NOT cut along the dashed lines.
2. Pass out each length of conductive tape to each student, as done in the prep section. For each piece of tape, peel off the adhesive backing and place on the helicopter template in the designated areas.
3. Fold the flaps labeled X and Y towards the back. The fold should be on the dashed lines. Run your finger down the fold to make sure the crease is tight.
4. Have students choose 1-2 LEDs. LEDs are polar, meaning they have a positive and negative side. The longer wire on the LED must be connected to the positively charged copper strip, while the shorter wire must be connected to the negatively charged side.
5. Bend the wires outwards so that each wire overlaps one of the tape lines on the helicopter blade.
6. Place the LED with the long wire to the left and the short wire to the right. Use the smallest pieces of conductive tape to connect each wire to the appropriate strip of copper tape.
7. If attaching two LEDs, repeat steps 5 and 6 with the second light.
8. Place the coin cell battery on the circle on the helicopter template. It is important that the positive side of the battery is down (touching the paper and tape). To determine which side of the battery is positive, look at the face of the battery to see which side is marked with a "+".
9. Fold the bottom of the helicopter towards the front along the dotted line, creating a pocket for the battery, so that the circuit is completed. The LEDs should light up as long as both pieces of conductive tape are touching the battery.
10. Put a paperclip or small binder clip on the bottom of the helicopter to keep the circuit intact.
11. Fold the blades in opposite directions along the dashed lines. For the blade that has the conductive tape on it, make sure the tape is facing upward.

Reflect (10 minutes)

1. Students can test out their helicopters!
2. What kind of circuit did you create? (if 1 light, series; if 2 lights, parallel)

Ideas for Extension or Adaptation

- Adjust the circuit by using different numbers, colors, or sizes of the LEDs. You can also use different sizes of button batteries.
- You can adjust the helicopter itself to change the speed in which it rotates and falls. Try folding or cutting the blades to change the shape or fold the blades at different angles.

PAPER CIRCUIT HELICOPTER TEMPLATE

Cut on the solid lines and fold on the dashed lines.