Do Space Summer 2021
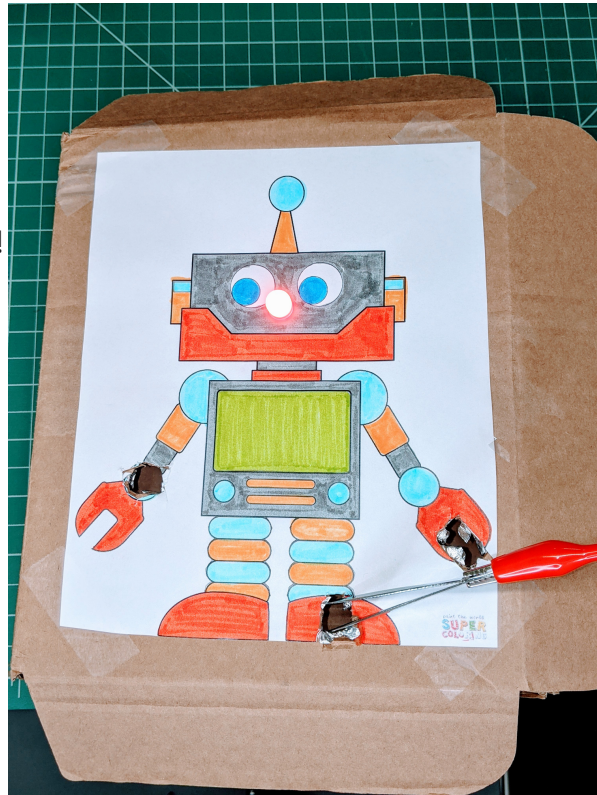
INTRODUCTION

You may have played the Operation game before and now your can make your own! This project uses basic components to recreate this classic game and help you learn how circuits work!

Subjects:

- Circuitry
- Engineering
- Crafting

Standards:

- PS3.D
- ETS1.A
- ETS1.C

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Maker Capacities:

- Tinker to Explore
- Finding Opportunities

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Key Terms

- Circuit
- LED
- Conductive
- Switch

WHAT YOU'LL NEED:

Here's what you'll find in the kit:

- 1 LED bulb
- Battery Holder
- 2 AA Batteries
- Buzzer
- Robot Template
- Crayon Pack
- Electrical Tape
- Aluminum Foil
- 2 Alligator Clips
- Tweezers

Other supplies you will need:

- Scissors
- Chipboard box like snack box
- Tape
- Small objects to pick up with the tweezers

Let's Make This!

Start by pulling out all of the pieces of the kit and checking to make sure they are all there.

I put all of my supplies and equipment at right angles to each other. This is a technique known as knolling. Knolling lets you easily see if you're missing a piece.
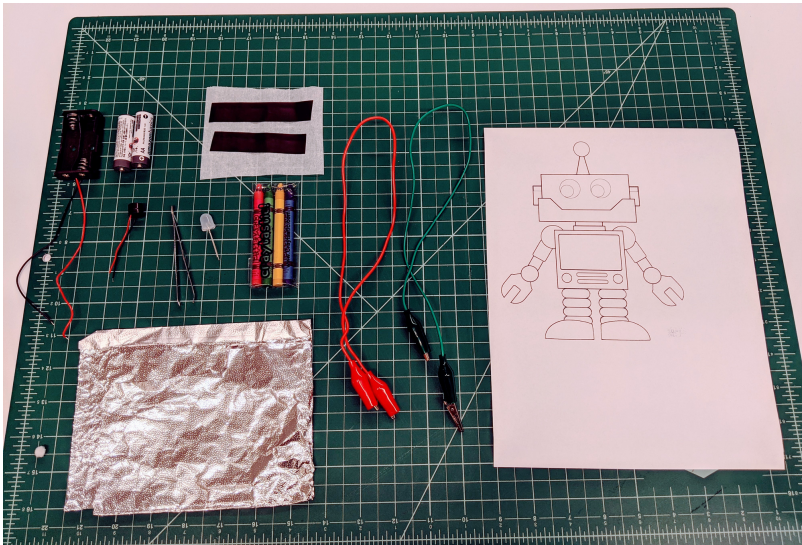
Draw your character or use the robot template.

Think up a character and draw it on your box! It can be a person, an animal, an alien, a robot. If you don't want to draw, you can use the included robot template instead! Just decorateit, cut it to size, and paste/tape it to the front of your box.
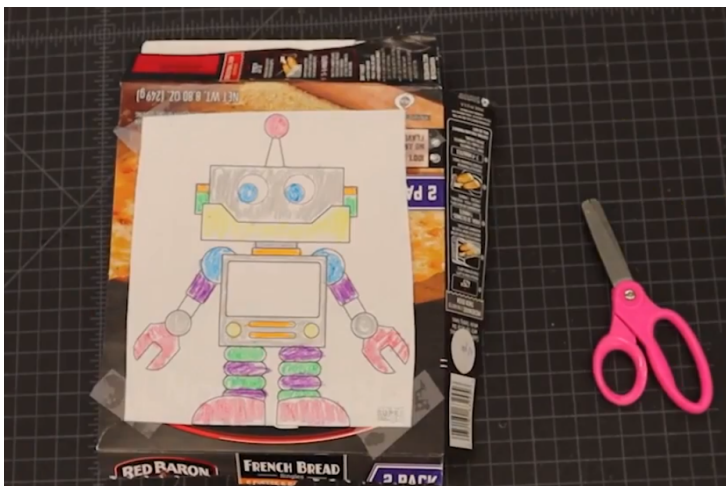
Why does it work?

A circuit is a path that electricity (or electrons) flow though. We are connecting a electricity source, the battery, to different conductive components, things that let the electrons pass through them.

They're Polarized!

Our batteries, LED bulb, and buzzer have polarity, or they have two poles: positive (+) and negative (−). In short, it is the directional flow of electrons from one pole to the other. We need to connect the positive to positive and negative to negative to make our circuit
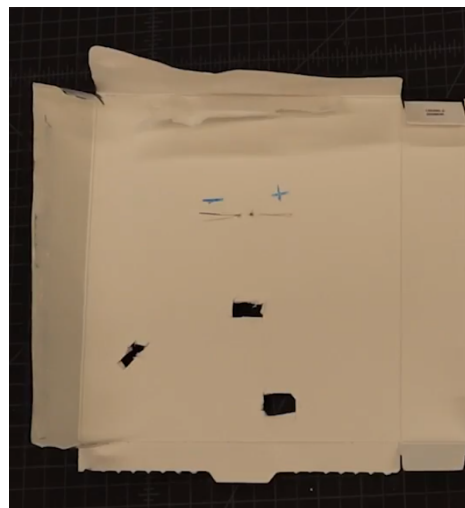
Let's Make This!

Cut the operation holes

In the bottom half of your character, cut out 3-5 spots of different sizes. If you need to, ask a grown up for help with the scissors while cutting out the holes.

Adding your LED bulb.

Pick a spot for your LED. Poke the box with the tweezers to make two small holes for the LED legs or leads to go into. On the inside of the box, label the + positive leg(the long one),and the - negative leg(the short one).
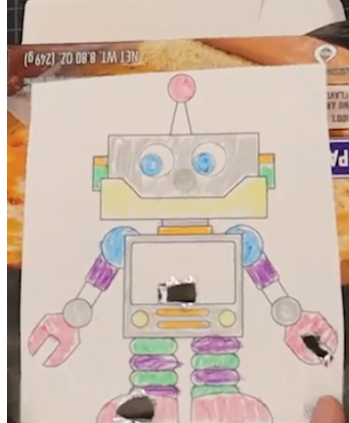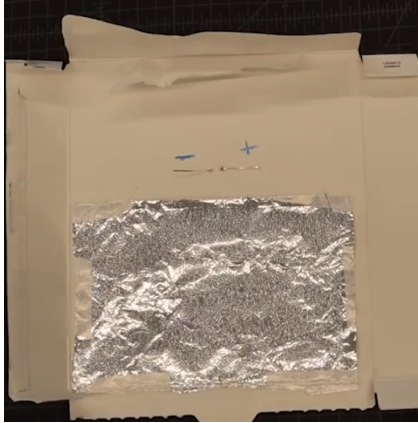
Let's Make This!

Attach the foil

On the inside of your box (the side that does not have the picture of your character) tape a large piece of foil on the lower half. Make sure it does not go above the highest operation hole you cut. Use your scissors to make a hole in the foil where your operation holes are, and pressing the foil towards the picture and around the holes.

Make Your Circuit

- Flip your box over to the back. Tape down the battery holder near the top of the box. Attach one alligator clip to the red wire(+) on the battery pack. This will be your positive(+) path.
- Clip the tweezers to the other end of the alligator clip.
- Tape a strip of foil over the negative(-), shorter leg of the LED, pressing down to make sure the foil is touching the leg. Make sure the foil is accessible and not completely covered by the tape.
- Tape the black(-) wires of the buzzer and battery holder to the negative(-) foil strip.
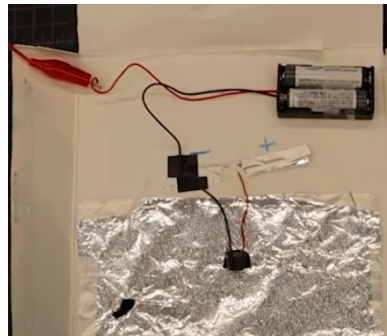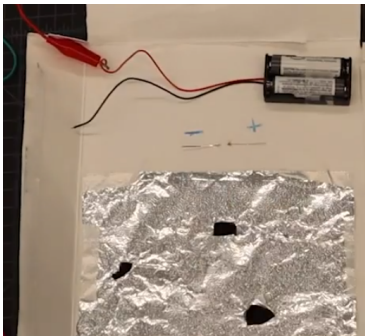
How should we set up the LED and the buzzer?

When you're just connecting one thing to a power source, it's pretty easy to plan. Just connect the LED...to...the battery. Boom. But when you're connecting more stuff, you have more options. The simplest way is a series circuit. In a series circuit, you just put everything in a row. It's easy, but the problem is if one thing breaks, nothing works. So, we're going to put the LED and the buzzer in a parallel circuit. In a parallel circuit, each component has its own branch from the power source. If one piece breaks, the other one keeps on working. So, for our game, we'll have two branches: one for the buzzer, one for the LED. We're going to attach strips of foil to each end of the power source so we can send power to each branch.

Let's Make This!

- Tape a strip of foil over the positive(+), longer leg of the LED, pressing down to make sure the foil is touching the leg. Make sure the foil is accessible and not completely covered by the tape.
- Attach one end of the second alligator clip to the positive(+) foil. Clip the other end to the foil on the lower half of your box.
- Tape the red(+) wire of the buzzer to the positive(+) foil.
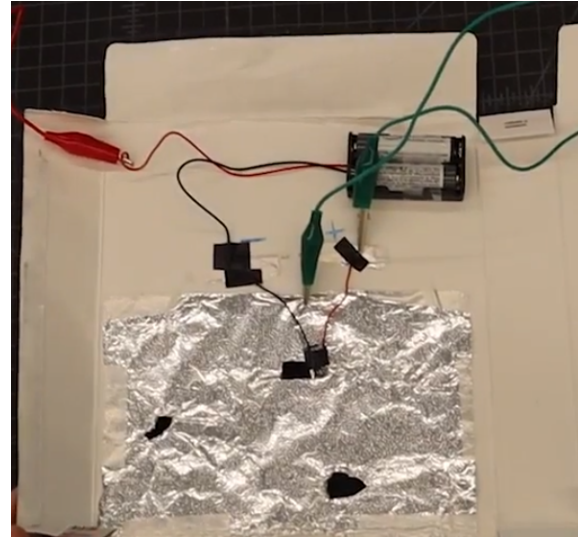
Test Your Circuit and Play!

Test your circuit by touching the tweezers to the foil in one of your spots.
If the LED lights up and the buzzer goes off, you're good to go! Add small objects to the bottom of your box, and try to grab them through the holes on the front. Can you get them without setting off the buzzer and light?

Not lighting up or buzzing? Here are some things to check:

- If your LED or buzzer doesn't work, make sure all the conductive parts are touching. you have the foil strips taped to the metal parts of the wires (not the plastic insulated parts).
- Double check your positive parts (long LED leg, red wires) are connected and the negative parts (short LED leg, black wires are connected and not switched around.
- What's going on here? For the LED to light up and the buzzer to make noise, they need power. When the tweezers touch the foil around the operation holes, the circuit is complete, the power flows, the lights go off, the buzzer buzzes, woo! In other words, the tweezers and the foil act like a big switch.