

Make:

Making Simple ROBOTS

2nd Edition Starter Pack

**EASY
ROBOTICS
PROJECTS FOR
KIDS USING
EVERYDAY
STUFF**



Welcome to the Making Simple Robots Starter Pack!

In this pack you'll find all the electronics you need to make the projects in the book *Making Simple Robots, 2nd edition* by Kathy Ceceri (sold separately), and much more. Let the materials inspire you to create your own simple robots and designs!

Basic Electronics

- LEDs – Test these tiny lights “throwie” style – some of them blink, and one changes color!
- Mini Pancake Motor – Popular for making vibrobots that shake and dance around.
- Coin Cell Batteries – 3V batteries that can power LEDs and vibrating motors. The positive side is marked with a +. **CAUTION:** Do not connect the positive and negative sides with any conductive material to avoid short-circuiting the battery.
- Coin Cell Battery Holder with on/off switch – Good for building tiny circuits. Glue it to paper, sew it to fabric, or snap it onto a LEGO brick. (See the bonus projects sheet) The white ring is the negative terminal; the red ring is positive.
- Copper Tape Roll – The “wires” in a paper circuit, can be connected to a coin cell battery holder or directly to the battery. Has conductive glue on the back, so you can make connections by overlapping pieces. **Tape Tips:**
 - To keep the roll neat, place it in a zip-top bag and leave an opening for the end of the tape. Cut off only as much as you need.
 - Cut the end at an angle – the pointy tip will make it easier to peel off the backing paper.
 - When laying strips of tape along your circuit design, peel off the backing paper as you go to avoid tangles.

Programmable Electronics

- BBC micro:bit v.2 – A pocket-sized computer that lets you play around with using software (computer code) and hardware (electronic parts) together. You can:
 - make it display words and numbers on its grid of LED lights (which also detects outside light levels)
 - measure tilt and speed with accelerometer
 - play music and respond with its built-in speaker and microphone
 - program it in Microsoft MakeCode, MIT Scratch, and many other computer languages.

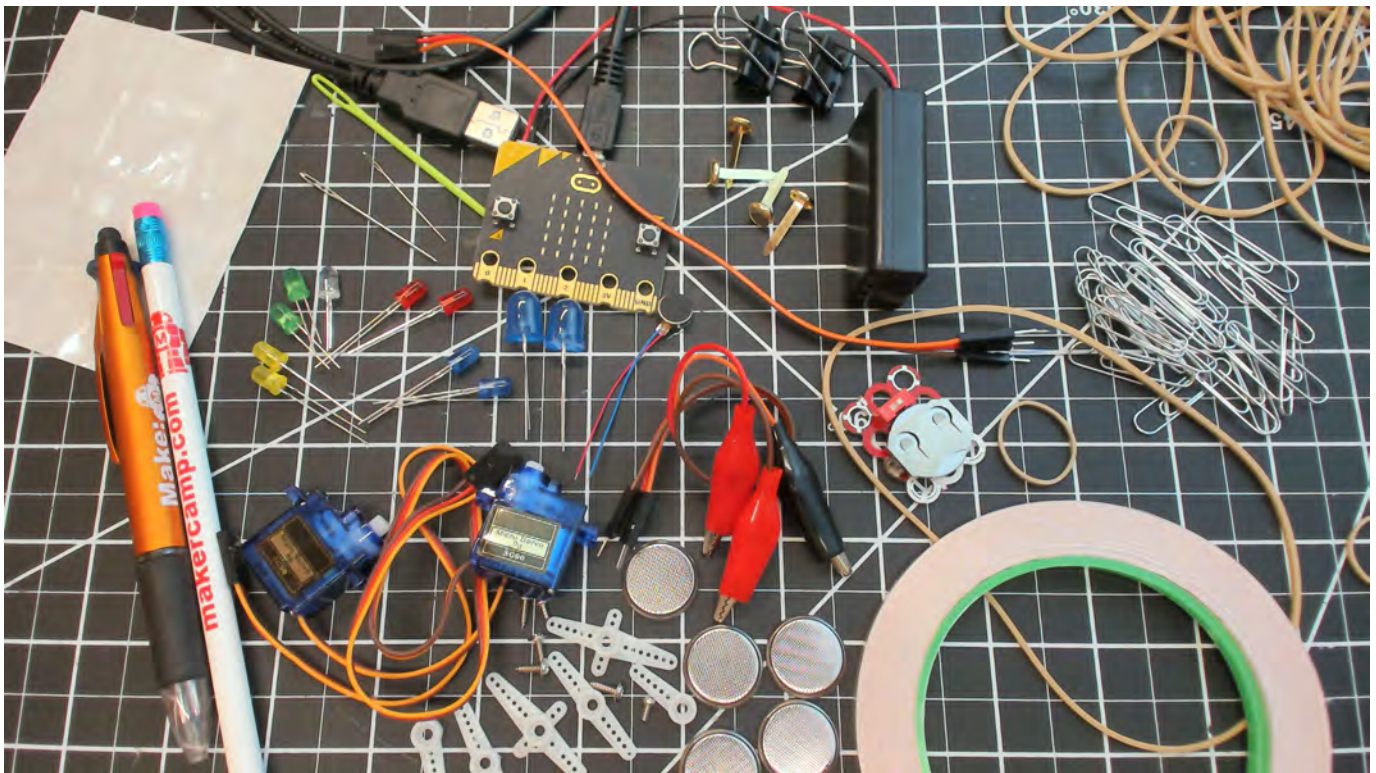
To get started, see the sections on micro:bit in *Making Simple Robots* or go to microbit.org

- USB Data Cable – Connects the micro:bit to your computer so you can download code. Will also power the board while you test your code.
- Battery Holder (2 AAA) with on-off switch – For projects where you want to make your micro:bit mobile.

- Servo Motors – Can be programmed to stop at specific position or sweep back and forth. Span half a circle (180 degrees).
- Alligator Clips to Male Pin – Connect servo motors to the micro:bit, matching wires to the colors of the servo cable. **NOTE: Wire colors may not match plastic hoods!** Don't let them confuse you when connecting the servo to the micro:bit.
- Jumper Wire Male to Female – Extend the wires between the servo and the micro:bit.

Office and Craft Supplies

- Brads – Make movable pivot points that connect pieces of paper or cardboard or use as a conductive button.
- Paper clips – Besides holding sheets of paper together, useful for adding weight to paper projects, or straighten to use as a wire.
- Binder Clips – Hold folded paper or cardboard closed (often used to hold coin batteries in place), add to cardboard legs as “feet,” use the handles as connection points, and more.
- Glue Dot Sheets – Handy for attaching electronics or neatly stacking layers of paper.
- Rubber Bands – Create connections that stretch, twist, snap back, and vibrate.
- Sewing Needles – Sew fabric, paper, or poking small holes where needed.



Making Simple Robots Starter Pack Bonus Projects

Here are a couple quick projects to get you started creating simple circuits. They use the lectrify.it battery holder included in your starter pack.

Bonus Project 1: Light Up a Color Changing LED Circuit!

This is the simplest paper circuit you can make, but extra cool because it has an on/off switch, and the light automatically changes colors while you watch.

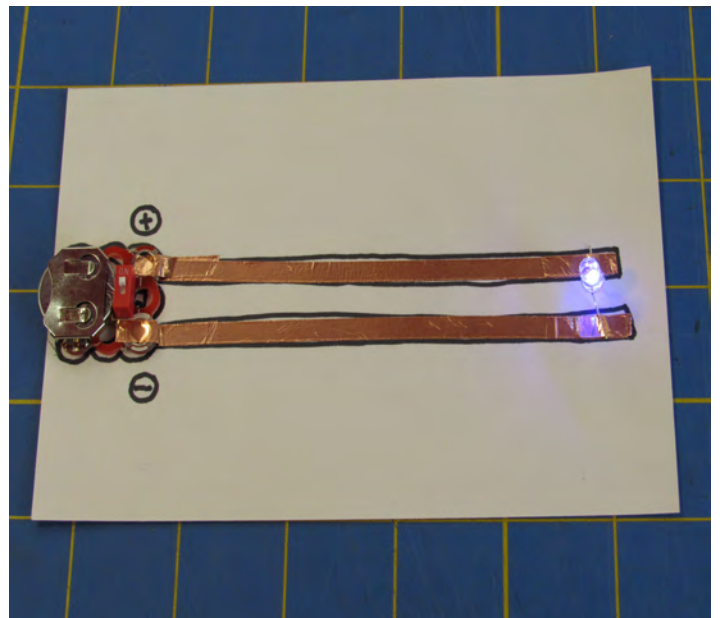
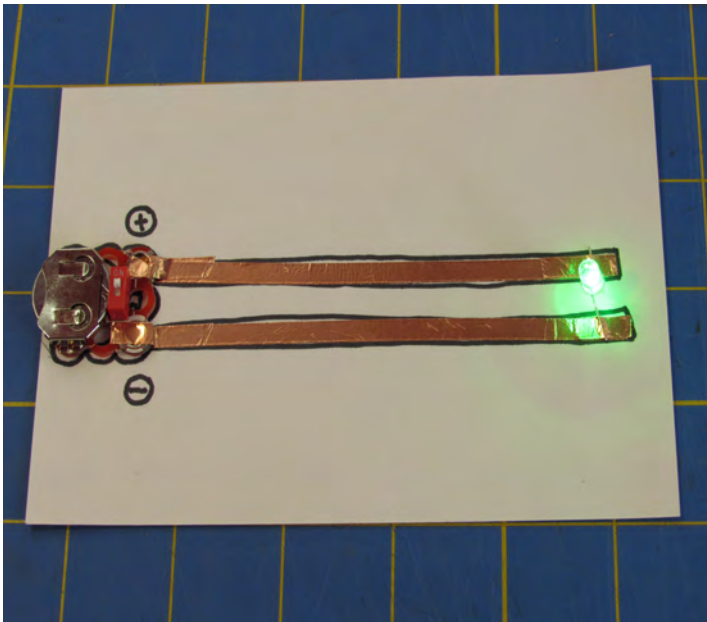
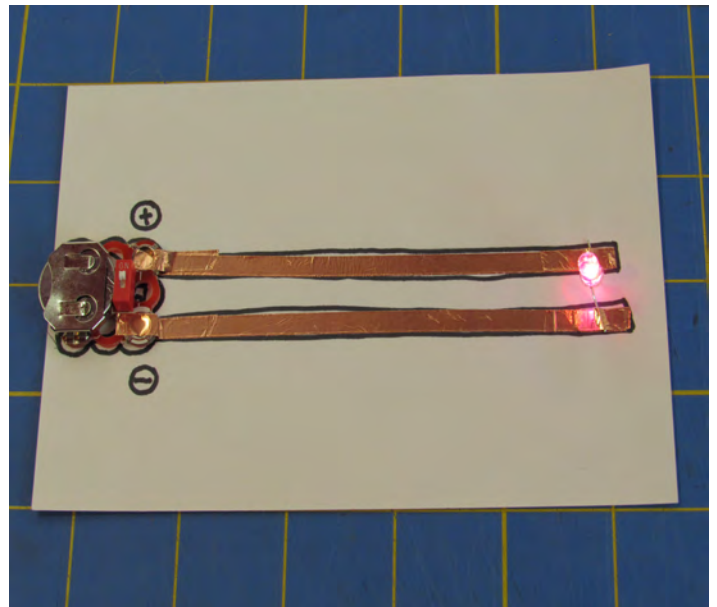
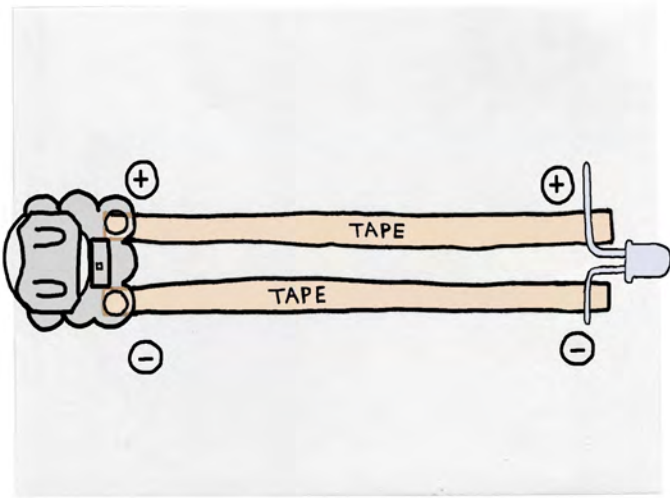
This project also introduces you to the idea of *polarity*. Some electrical components, including LEDs, won't work unless they're connected to a circuit in the right direction. To make this project work, you'll need to pay attention to the polarity of the LED. That means you have to match up the positive and negative wires (also called leads) on the LED with the positive and negative sides of the battery.

Materials

- Template for Project 1 printed on a piece of cardstock, index card or other heavy paper
 - Coin battery holder
 - 3V coin battery
 - Copper tape
 - Color-changing RGB LED (it's clear – see below for how to test it)
 - Clear tape
1. Attach two strips of conductive copper tape as shown. Make sure they do not touch!
 2. Take a glue dot and attach it to the back of the battery holder.
 3. Attach the battery holder to the circuit so that the two connecting rings are over the copper tape strips. Let the back hang off the paper to make it easier to get the battery in and out.
 4. Add short strips of copper tape on top of the rings to make a secure connection. If needed, write (+) and (-) next to the rings as shown.
 5. Take a coin battery and the color-changing LED. Slide the battery between the LED wires. It should light up and slowly change colors. If nothing happens, reverse the battery. Make a note of which wire is touching the positive (+) side of the battery. It is usually the longer wire.
 6. Hold the LED over the end of the copper strips, with the positive wire over the positive strip. Bend the lower half of the wires out to the sides, like little feet. Place the feet right on the copper tape and attach them with extra pieces of tape. Press firmly. Make sure the positive and negative strips – and anything conductive attached to them – do not touch each other!
 7. Insert the battery, positive side up, into the battery holder. Turn on the battery hold switch. The LED should light up. If everything's working, you can add some clear tape to hold the

battery holder and the LED on the circuit. Be sure to leave the copper tape in the middle of the circuit uncovered for the next project!

8. If the circuit doesn't work, here are some troubleshooting tips:
 - a. Check that the battery holder LED wires make a good connection with the copper tape strips. Add more copper tape if needed.
 - b. Make sure the strips are not touching each other and causing a short circuit.
 - c. Try a different battery – if the voltage is low, the LEDs might not light up.
 - d. If it still doesn't light up, remove the LED and check that you have the positive wire on the right piece of copper tape.



Bonus Project 2: Make a Color Changing FlipBot

Robots react to the environment around them, including where they are. And robots that work together with humans need to communicate with them. The FlipBot lets you know when it's facing the proper direction by its expression and the color of its light. If it's facing the right way, it shows you a happy face and lights up green. If not, it looks unhappy and shines red. Can you figure out why it works? The trick has to do with the polarity of the LEDs.

Materials:

- Color Changing LED Circuit from Project 1
 - Template for Project 2 printed on a piece of cardstock, index card or other heavy paper
 - Copper tape
 - Red LED and Green LED (non-flashing – see Project 1 for how to test them)
 - Clear tape
 - Marker
1. Use template or piece of heavy paper. Fold the ends up along the dotted lines as shown on the template. Fold under along the inner dotted lines. Open the folds enough to stand the FlipBot up, like a tunnel. Flatten again for the next few steps.
 2. Draw a reversible face in the middle of the FlipBot. Use the design shown here or create your own. It should look happy one way and sad the other.
 3. Flip the FlipBot over so the underside is facing you. Attach two strips of conductive copper tape on each side as shown. Make sure they do not touch! On one end, mark one piece of tape positive and the other negative. Mark the other strips of copper tape the opposite way.
 4. Turn the FlipBot so the happy face is right side up. Looking at the copper tape on the underside of the FlipBot, attach the green LED to the end that has the positive tape strip above the negative tape strip. (See Project 1 for how to test and attach LEDs.)
 5. Attach the red LED to the tape strips at the other end.
 6. Flip the FlipBot over so the face(s) are visible. Line up the tape strips with the tape strips on the Color Changing LED Circuit. Turn it on. Press down the ends of the FlipBot to make a good connection with the Color Changing LED Circuit. If the face looks happy, the bot's face should shine green. If it's unhappy, it should shine red.
 9. If the circuit doesn't work, here are some troubleshooting tips:
 - e. Try the troubleshooting tips for Project 1.
 - f. If the lights are shining but they're too dim to see, try the bot in a darkened room.
 - g. Removing the color changing LED from Project 1 may make the FlipBot work better.

Play around with these ideas and see what you can come up with. Have fun!

