Robotics Badges: *Programming Robots 1*

Pressure Sensor Instructions

Follow these instructions to make a pressure sensor, just like the kind that tells a robot when it has bumped into something! These instructions are for the activity in Step Three: Build a Robot Part: Simple Sensors.

THINGS TO KNOW:

About circuits:

- A circuit is a path for electricity to flow. It is made of conductive material such as metal which carries electricity easily. It is surrounded by insulating material such as paper or plastic that doesn't carry electricity.

- A closed circuit is a continuous path that allows electricity to flow. That's because electricity always needs to be a place to go. Usually a circuit is designed in a loop, so that the electrical energy flows around and around.

- An open circuit occurs when there is a gap anywhere in the circuit. This interrupts the flow of electricity.

- A battery (or other power source) has a positive (+) end where the electricity comes out and a negative (-) end where it goes back in. For electricity to flow, the circuit must be connected to both ends of the battery.

- A switch controls the flow of electricity by opening and closing the circuit. It's like a drawbridge over the gap in the circuit.

- A sensor works like an on-off switch. When a sensor is activated, it closes the circuit and allows electricity to flow. This sends a signal to a computer or other kind of electronic controller.

- A sensor can also act like a dimmer switch that lets varying amounts of electricity through. A robot's computer brain can be programmed to do different things depending on the sensor reading.

About LEDs:

- **An L**ED (short for "light emitting diode") is a tiny electronic component that acts like a low-energy light bulb. They are found in flashing toys and as indicator lights in most electronics. LED flashlights and light bulbs for lamps are actually made up of many smaller LEDs put together. You can buy individual LEDs from electronics parts retailers.

- All electrical components have positive and negative ends. On LEDs that come with two wires, or leads, the longer wire is usually positive. There is sometimes also a flat spot on the edge of an LED bulb to indicate the negative lead.

- LEDs will only work when the positive and negative ends are in the same direction as the battery or other power source.
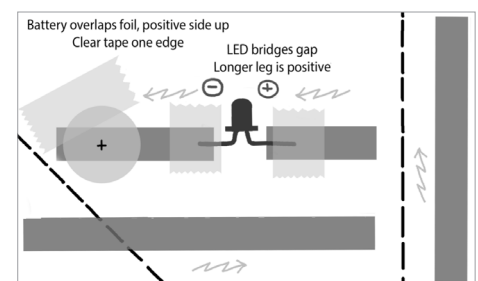
(continued)

Materials:

- Pressure Sensor Template (copied onto cardstock or stiff paper if possible)
- Optional: 1 index card, stiff paper, or cardstock 1 foot long, ¼ inch wide strip of aluminum foil tape (available in duct-tape-sized rolls in the heating duct section of hardware stores) OR roughly ¼-inch-wide copper foil tape (available from electronics websites); in a pinch, glue regular aluminum foil to sheets of paper, cut into strips, and glue the strips to the template
- 1 3V coin battery (such as CR2032)
- 1 LED (preferably red 5mm size, with wire leads at least ½ inch long)
- 1 medium paperclip (must be metal, with no plastic or paint covering it)

Steps:

1. Cut out the template from the printout.

2. Cut a long strip of foil tape about ¼ inch wide. You will cover the dark gray lines on the template with the foil. To attach it, first peel the backing paper off on end. Then line up the glued end of the foil strip on the end of one line and press it down firmly. Keep peeling the paper off as you smooth the foil tape down along the line. At the other end, carefully tear or cut the strip. Do all the lines the same way, being sure to leave gaps where shown.

3. Take an LED and insert a battery between the wire legs. Then turn the battery around. Note which wire is touching the positive side (+) of the battery when it lights up. This is the positive wire. It is usually the longer wire.

4. Carefully bend the LED wires out to the sides. Place the LED in the spot shown on the template with the positive wire is facing the (+) sign. Make sure the wires are touching the foil strips. Use clear tape to hold them securely in place.

Safety Notes:

- The battery used in this project is too small to give you a shock. However, if the positive and negative sides are connected accidentally, the battery may get hot or cause a fire. This is called a short circuit. Don't connect the positive and negative sides of the battery to each other unless there is an LED in the circuit. Also, don't let the aluminum foil line on the positive side of the circuit touch or overlap the foil line on the negative side. That allows the electricity to bypass the LED and also creates a short circuit. To insulate the foil strips and keep them from connecting, you can cover them with clear tape.

- Caution: Coin batteries are dangerous if swallowed! Do not leave them where small children and pets can get to them.
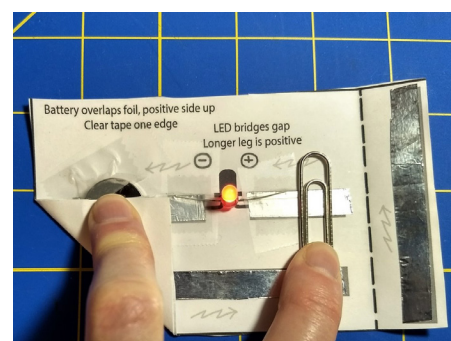

Paper Template

5. Place the battery on top of the foil strip in the spot indicated on the template, positive side up. Fold the corner flap down along the dotted line, pressing it against the battery. Hold it closed with your finger while you lay a paperclip across the ends of the two horizontal strips of foil. The metal in the paperclip bridges the gap to close the circuit so the LED lights up. If it doesn't, flip the battery over to check whether the LED is in backwards. (If it is, just leave battery upside down as well.) Use clear tape to attach one edge of the battery to the template as shown. Leave the rest of the battery exposed

6. Fold the corner flap back over the battery. Use the paper clip to keep it closed. You can use clear tape to hold it down as well.

7. Fold the right side of the template down along the dotted line. This will be the "switch" that closes the circuit when it is pressed. Like the paperclip, the foil strip on the inside of the flap bridges the gap between the other strips. The flap should pop back up when you let go and turn the LED off. Try it!

8. Save your sensor for Activity 5: Make a Box Model Robot With Sensors.
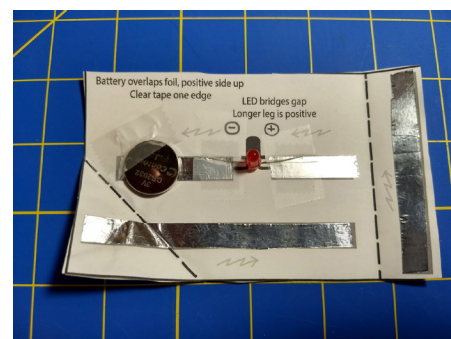
Open Sensor
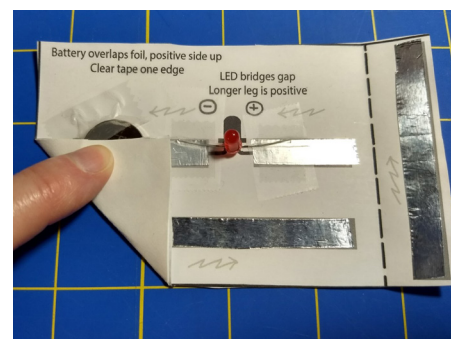
Battery Pouch Closed

Paperclip Bridge