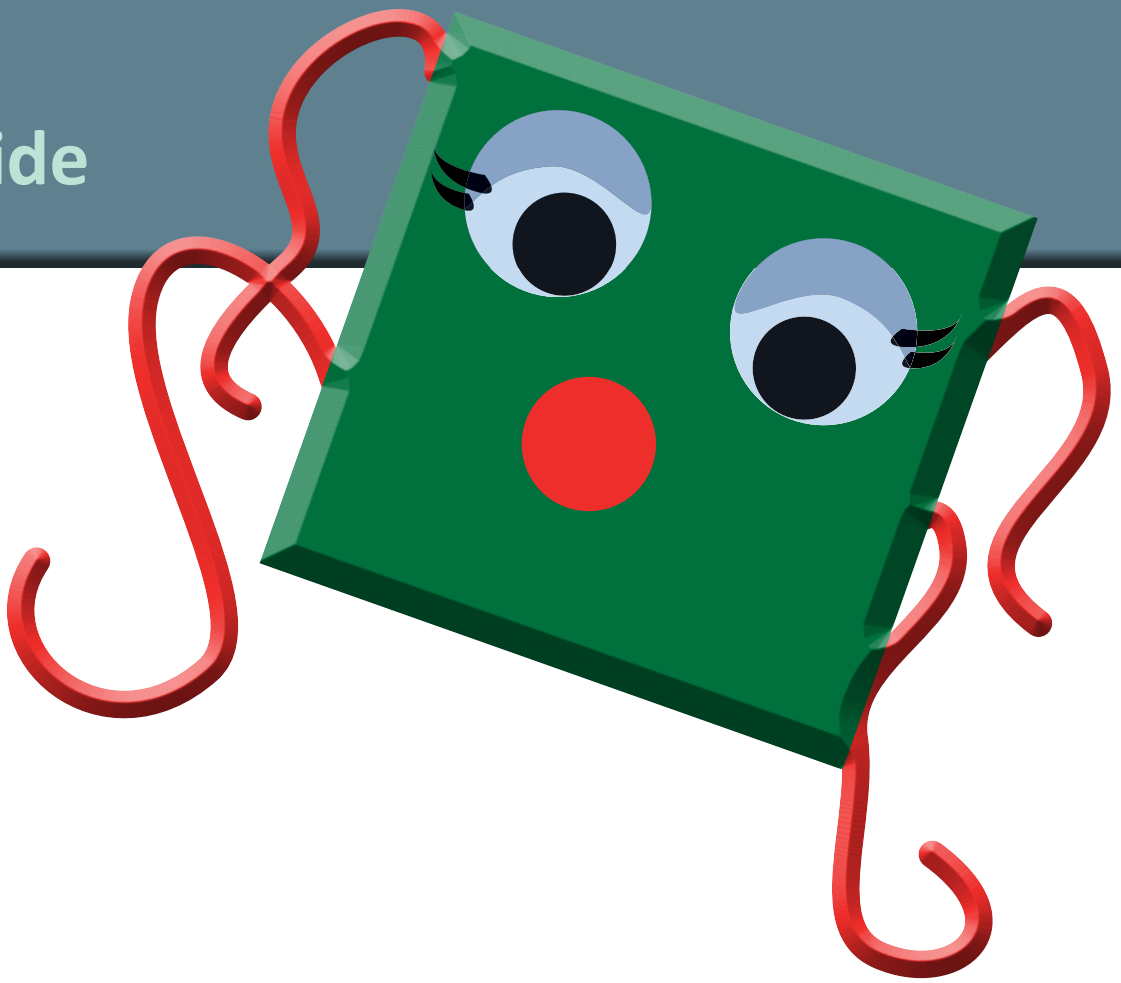
Learn how to Solder a Jiggybot

Mini-Guide



n3.sonoma.edu

Acknowledgement:

Adaptations of the original Jiggy Bot instructions have been supported by NASA's Neurodiversity Network under award number 80NSSC21M0004.

The JiggyBot circuit and kit were created by Prof. Bob Twiggs. Kits may be ordered from: *https://twiggs-space-lab.myshopify.com/products/jiggy*

The material contained in this document is based upon work supported by a National Aeronautics and Space Administration (NASA) grant or cooperative agreement. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of NASA.

Partner

SAFETY ALERT

SAFETY GLASSES Wear Safety Glasses; be aware of the hot temperature of the soldering iron, inform your instructor immediately if burned; DO NOT go ahead of the instructor as they lead you through the assembly; hold your hand over leads when clipping and/or trimming.

Please rewrite each of these safety tips in your own words on a separate piece of paper (or below). Sign the paper and hand it to your teacher.

Safety Tips I Agree to

- I will wear safety glasses.
- I will read the user's manual for my soldering iron and make a list of specific information important to ensure I use it correctly.
- I will keep the tip of the soldering iron away from my hands and anything it could melt or burn.
- I will solder in a well-ventilated area (outdoors, a room with a fume hood, or a large room with a solder fume) or I will wear an N95 mask.
- I will keep my head away from the solder fumes.
- I will use the wire striper to only cut or strip the wire provided to me.
- I will keep the wire striper closed when I take a break from using it.
- I will turn off the soldering iron off when I take a break from using it.
- I will ask for help from a classmate if I need help.
- I will listen carefully to my teacher.
- I will inform my teacher immediately if I get burned or cut.

In your own words:

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Signature: _____

Learn How to Solder a Jiggy Bot

Overview:

In this mini-guide, you will learn how to:

1. Cut and strip wires
2. Solder wires and other components onto circuit boards
3. Build the JiggyBot
4. Troubleshoot Electrical Circuits

A video demonstrating how to build the JiggyBot can be found at the following URL:
https://youtu.be/2iPcyWh_MQI

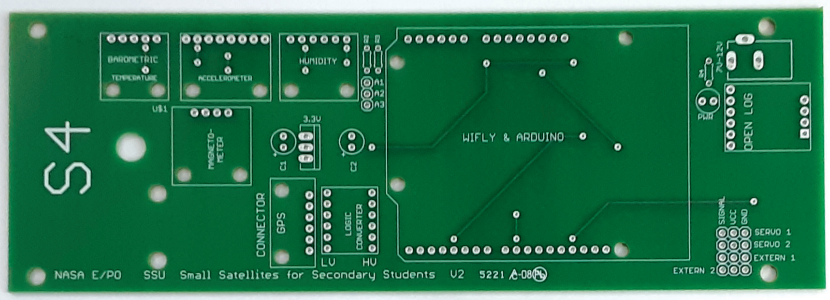
Kits Provided:

Solder Practice Kit:

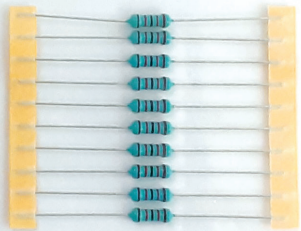
- Green S4 board
- Resistors
- Practice wire legs

Jiggy Bot Kit:

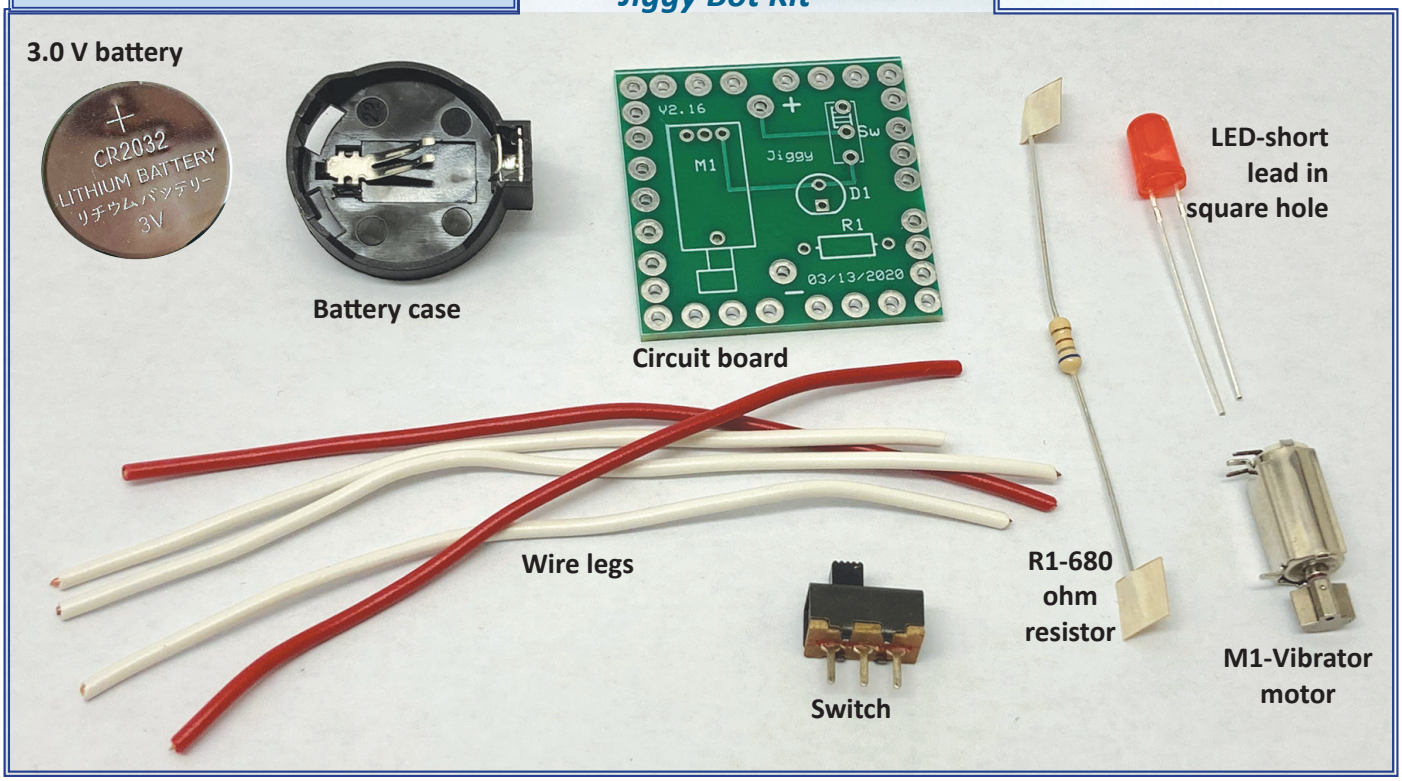
- Circuit board
- LED
- R1-680 ohm resistor
- Switch
- 3.0 V battery
- Battery case
- M1-Vibrating motor
- Wire legs



Jiggy Bot Kit



Solder Practice Kit



Tools:

Provided:

- Digital Multimeter
- FTDI cable
- Glue
- Helping hands
- Hobby Knife
- Sandpaper,
- Screwdriver
- A soldering iron
- Solder
- Wire cutter/stripper

Also Useful:

- Bright light
- Extension Cord
- Needle nose pliers
- Safety goggles
- Tape (Scotch, masking or painters)

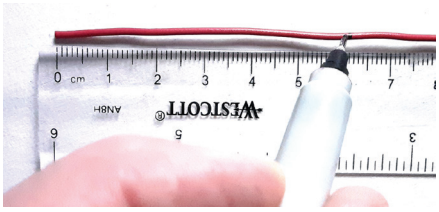
1. Cutting and Stripping Wires

For this practice session, you will use the green circuit board that says S4 on it (rather than a white plastic breadboard like the one shown in the photos below). Choose any two holes to practice cutting and stripping wire. Cut and strip at least one wire and stick the cut ends through the holes.

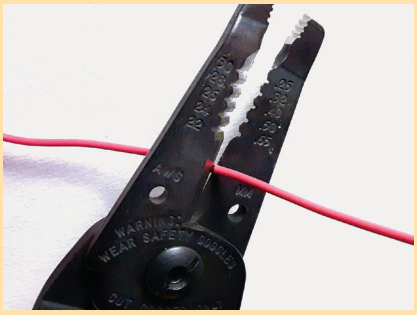
Cutting wires to length and stripping their insulation for use on a breadboard or protoboard is a basic skill needed for building test and experimental circuits. These photos show one way to do it.

1. Gather your ruler, insulated wire, and wire stripper. The wire stripper can be used to strip off insulation from the metal wire, as well as cut wire.

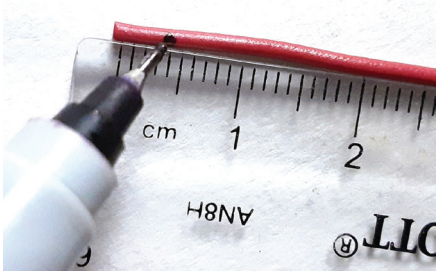
2. Measure the length of insulated wire you need and mark where to cut with a marker or pen. For the Jiggy Bot, the length of wire you choose will be the legs on the Jiggy Bot.



3. Cut the insulated wire using the wire cutter portion of the wire stripper.

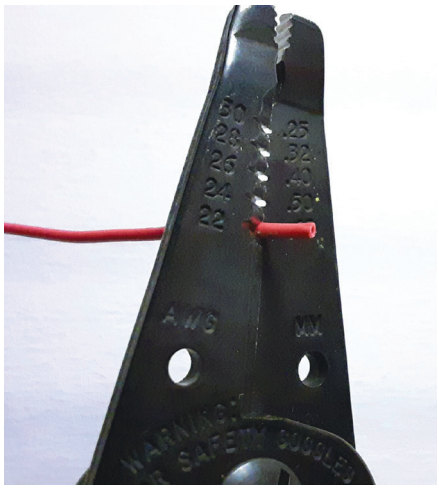


4. At each end of the wire, measure and place a mark 4 mm from the end of the wire.

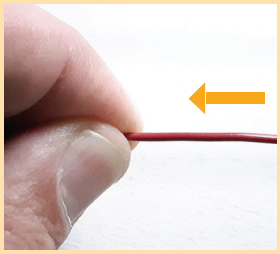


5. The wire used in this project is 22-gauge wire or also known as 22 AWG wire. Look for the gauge on the wire stripper. Use this stripping blade slot to strip the wire. Note: the 22 gauge on your wire stripper may be a different notch than shown here.

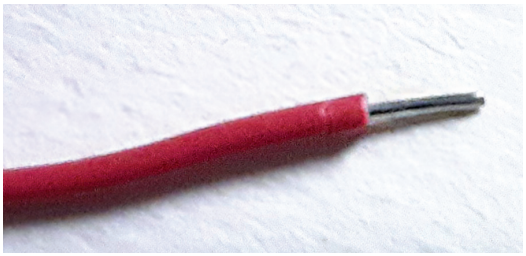
6. Place the wire up to the mark between the stripping blade slot and close the handles.



7. Using your other hand, pull the opposite end of the wire in a direction away from the wire stripper.



8. Insulation on the wire should be removed as shown in the image. We call the bare wire the **wire lead**. This is the part that will get inserted into a circuit board hole.



For the Jiggy Bot, you only need to strip insulation off only one end of the wire. For other projects, like building rocket payloads, you will need to strip insulation off of both ends of the wire.

9. Practice with the different notches on the wire stripper if that notch did not cut through the insulation or cut through the metal wire.

10. If both ends need bare wire, repeat steps 6, 7, and 8.

The following link also has information about stripping wires:
https://learn.sparkfun.com/tutorials/working-with-wire/how-to-strip-a-wire

2. Practice Soldering

Instructions: Read the directions carefully. Follow the steps in order with your instructor. Soldering a wire lead onto a circuit board hole should be done quickly, in approximately 5 seconds. When you have your component into the proper place, ask for a check of placement from your instructor before soldering.

General Tips:

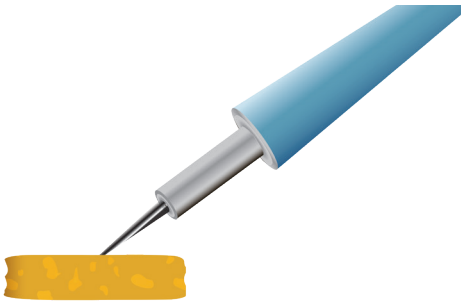
Before you begin:
- Be sure to remove the plastic protective cap from the tip.
- Turn on the soldering iron so that it is hot enough when you are ready to begin soldering.

Warning: If you hold the soldering iron against the circuit board too long, you can damage the board. If your soldering leaves a black mark near the holes, you may have damaged the board.

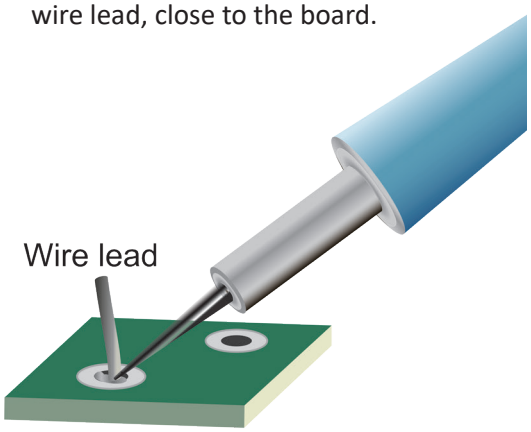
Soldering Steps:

1. Wet the soldering iron sponge before you begin.
2. Set up the Helping Hands and use the clips to hold the circuit board off the table. You may need to remove a small piece of paper from the battery area of the little flashlight on the Helping Hand.
3. Set up the magnifying glass so the circuit board is visible.
4. Put a wire lead through a circuit board hole so it can be seen through the magnifying glass. The insulated part of the wire lead should be under the circuit board.
5. Tape the insulated part of the wire to the circuit board to keep it from moving. You are now ready to solder the wire lead to the circuit board.

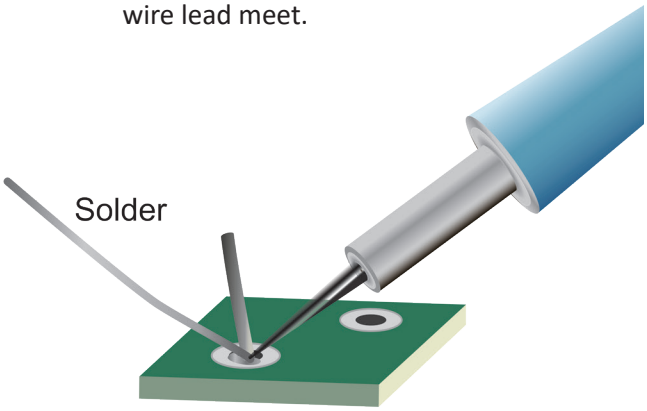
6. Touch the tip of the soldering iron on the wet sponge to be sure it is hot, clean, and ready.



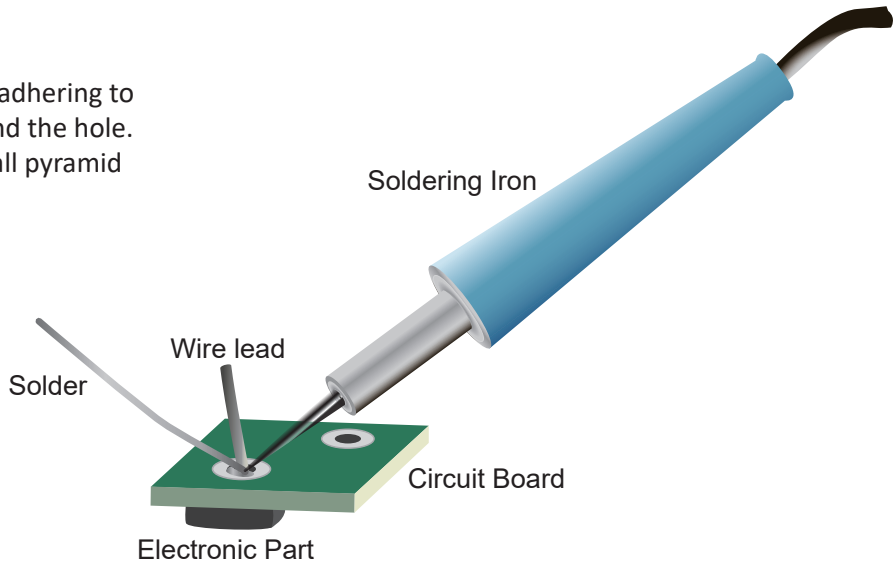
7. Hold the soldering iron against the wire lead, close to the board.



8. Touch the tip of the solder to the point where the soldering iron and wire lead meet.



9. Let a small amount of solder melt, adhering to the wire lead and circle pad around the hole. The melted solder will form a small pyramid shape of solder around your lead.

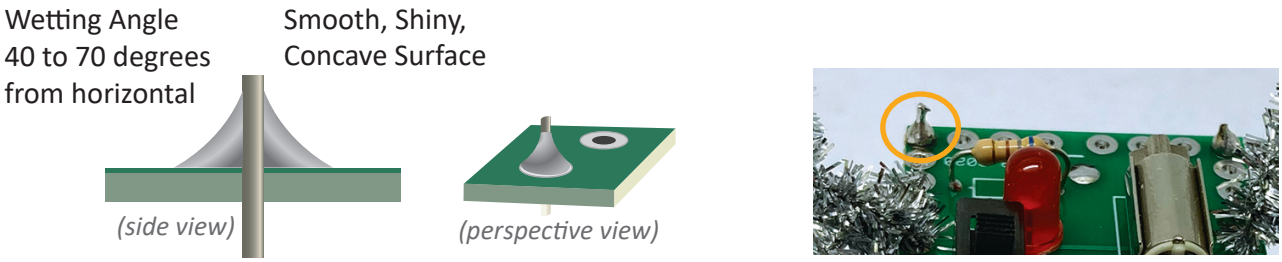


10. Remove the solder.

11. Remove the soldering iron. Set up the magnifying glass so the circuit board is visible.

12. Place the iron back in its holder and look closely to make sure you've made a good connection. If you are finished soldering, turn off the iron.

13. Inspect your solder joints. They should look like this:



14. If the joints are not connected, solder on more solder.

15. When a good connection is made, gently remove the tape from the circuit board.

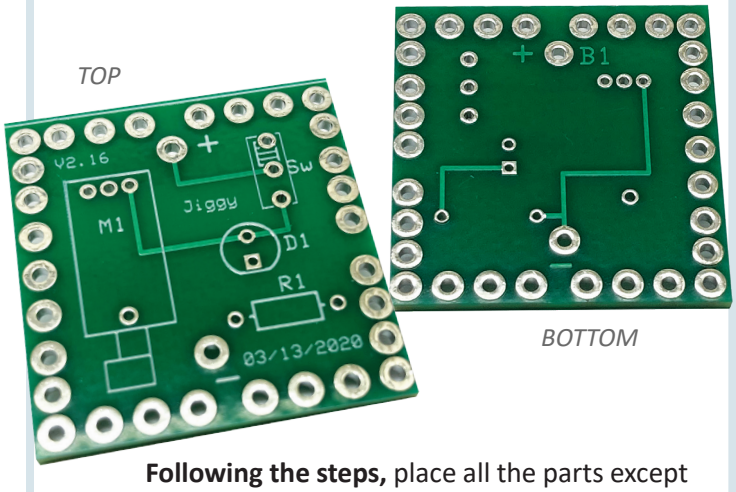
16. Find a resistor. Remove the safety tabs on the resister, if they are on the ends of the wire leads. The wire leads of the resistor are the bare wires on each side of the resistor.

17. Follow steps 4-15 with the resistor. Then repeat as many times as you need to make a good solder connection between wire leads and the circuit board.

For more information about good techniques and solving soldering problems, see ***https://learn.adafruit.com/adafruit-guide-excellent-soldering/common-problems***

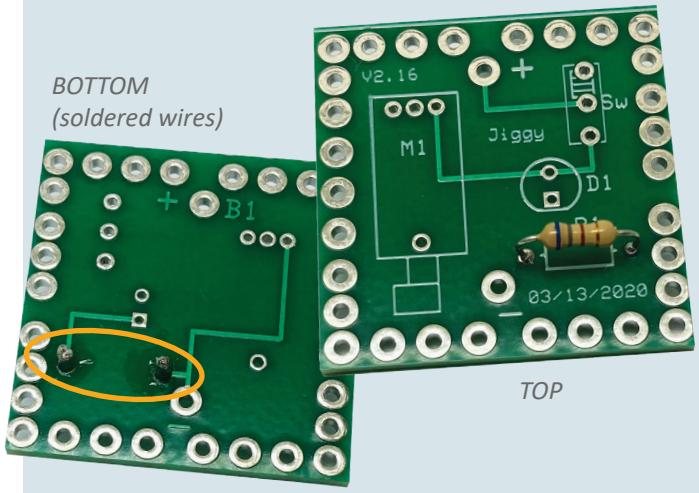
3. Build your JiggyBot!

Observe both the TOP and BOTTOM surfaces of the circuit board. The TOP side has all the printing. The words, figures, and shapes will help guide you to where the components should be soldered.

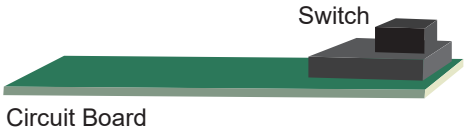


Following the steps, place all the parts except for the battery case on the TOP (printed) side of the board. Then turn the board over and solder the pins or wire ends on the BOTTOM side of the board.

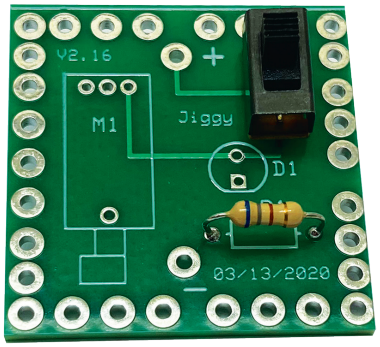
1. Solder the 680-ohm resistor onto the circuit board in the space labeled R1. The resistor body sits on the top (printed) side of the board, and the leads go through the holes. If there are safety tabs on the ends of the leads, remove them. Turn the board upside down, and spread the leads out to help hold them in place. Solder leads on the back (not printed) side. Then shorten the leads with wire cutters right above the solder joint.



2. Solder Switch: Place the switch so it is on the outside of the circuit board. The switch body goes on the top of the board, and the leads go through the board.

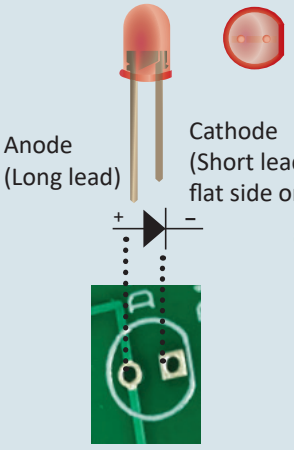


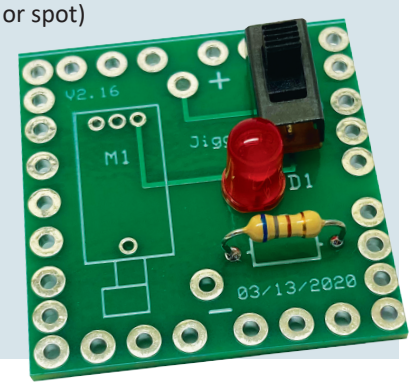
Turn the board over to do the soldering. To hold the switch on the board, you can ask your neighbor for help or use the helping hands to hold the board. You can also use tape to keep the switch in place when you turn the board over to solder. Be careful not to use too much solder.



3. Solder the LED onto the top side of the circuit board. The LED sits on the top side of the board, and the leads go through the holes. Make sure to get approval **BEFORE** soldering because:

a. LEDs have one short and one long lead.
b. Always insert the short lead into the square hole and the long lead into the round hole.
c. Line up the flat side of the LED with the shape on the board.



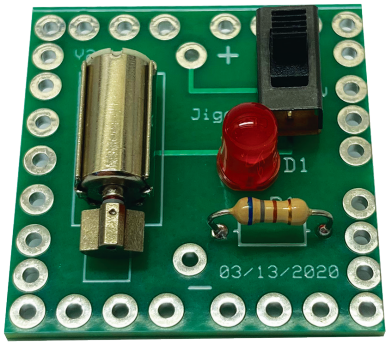


4. Solder Motor:

a. Find the M1 shape on the board.

b. Place the motor in the appropriate position on the top of the board and stick the wire leads through the holes.

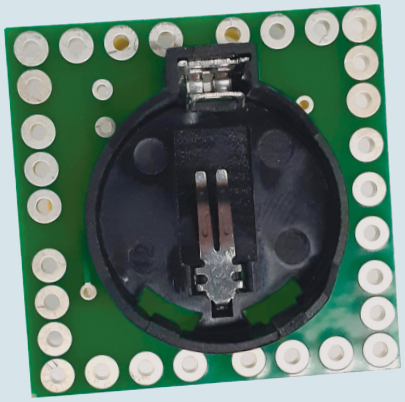
c. Turn the board over and solder the leads on the back side.



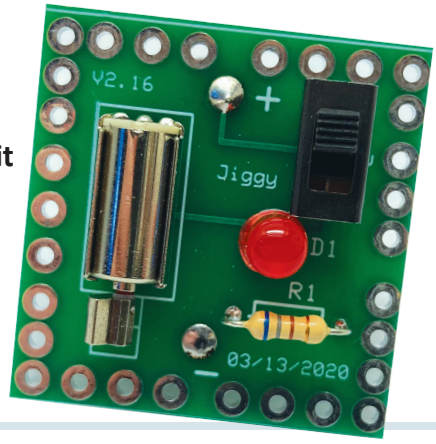
5. Solder Battery case:

a. Examine the back of the board and trim all leads right above the solder joint.

b. Put the battery case on the back of the board so that the leads go through the two remaining holes towards the top. Make sure placement is correct. DO NOT put the battery in the case yet. Solder when ready.



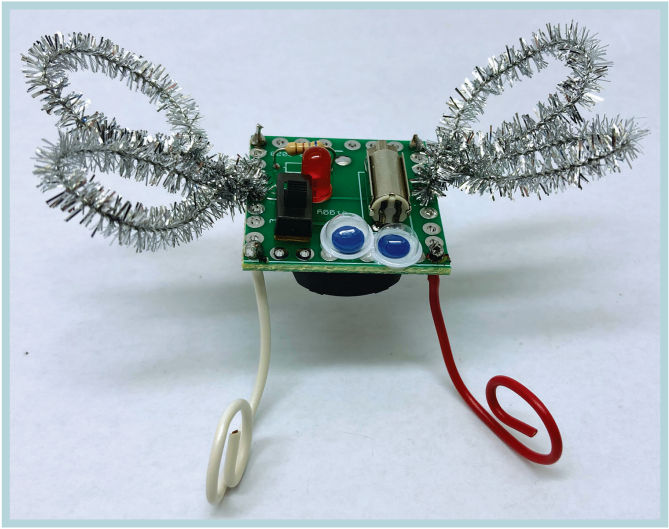
Complete Circuit

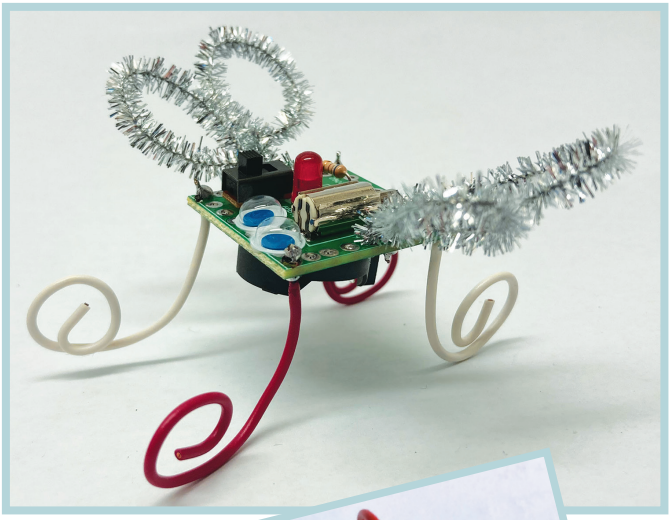


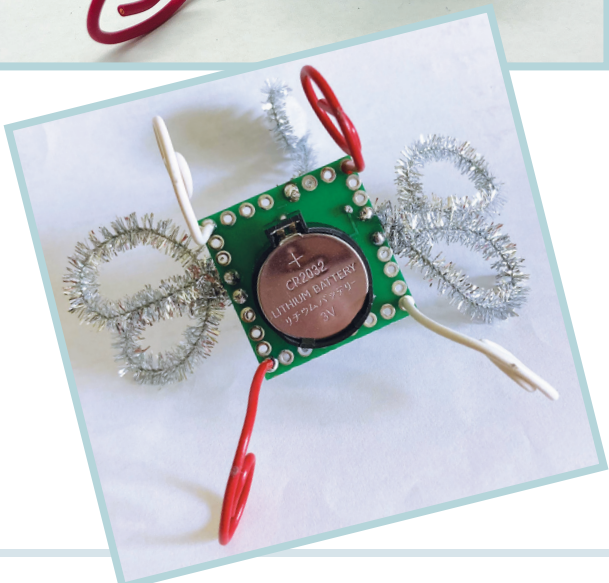
6. Leg Design: Use your creativity and the four wires to add legs onto the Jiggy Bot. Strip one end off each of the four wires and solder on the body. You may use any available holes. This is also a good time to add tails, wings, and googly eyes!

a. Glue the pipe cleaners and googly eyes.

b. Then put your battery into the battery case and turn on the switch to watch the Jiggy bot dance!





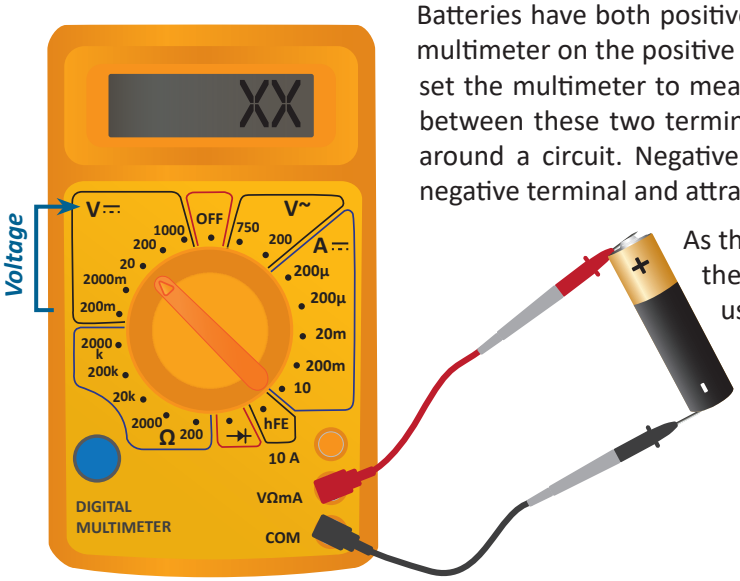


4. Troubleshooting Electrical Circuits

If your circuit does not work as expected, it is time to troubleshoot! Here are some steps you can take:

A. Check the Power

To test the power in a circuit, you can use a digital multimeter to measure voltage from a battery or other power source. Voltage is a type of electrical force that makes current move through a wire. This force is often provided by a battery. Measured in units of volts, this quantity tells you how much energy each individual electric charge carries throughout a circuit. In your kit you have a CR2032 coin cell battery for the JiggyBot power and in the payload box, there are three AAA batteries.



Here is an example of a multimeter measuring the voltage of AA battery..

Batteries have both positive and negative terminals. If you put the red lead of your multimeter on the positive terminal and the black lead on the negative terminal and set the multimeter to measure V⎓ the readout will display the voltage difference between these two terminals. This voltage difference causes the charges to move around a circuit. Negative charges, like electrons, will be pushed away from the negative terminal and attracted to the positive terminal of the battery.

As the electrons travel from atom to atom through the circuit, they carry electrical energy with them. This energy can be used to light LEDs, run motors, turn on/off switches and many other useful tasks.

1. What voltage do you get when you measure one of the AA batteries?

2. Where would you put the leads to measure the voltage from the CR2032 battery? What is its voltage?

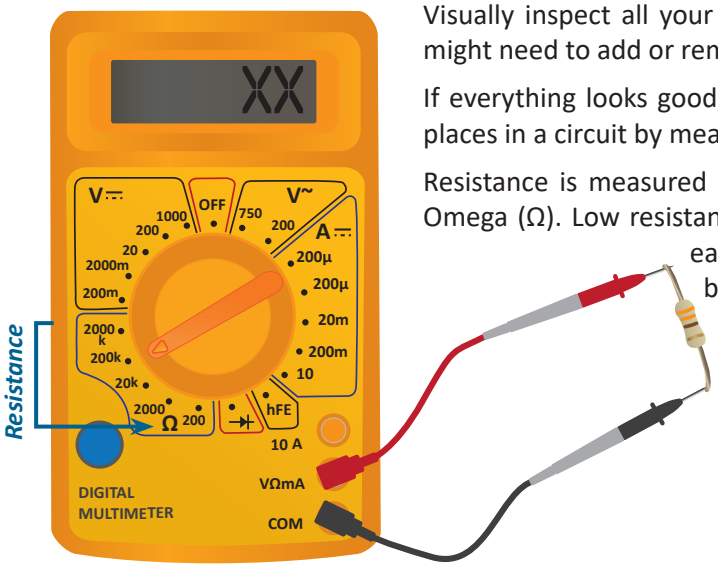
3. What happens if you reverse the leads (put the red lead on the negative terminal of the battery and the black lead on the positive terminal of the battery)?

Notes on reading these meters:

- The scales on the voltage dial range from 200m (milli or thousandths) volts to 1000 volts full scale.
- For the most accurate results, set the dial on the meter to a value greater than you expect to measure.
- If you choose a scale that is too low, the meter will display the number 1. If that happens, turn the dial to the next larger scale on the meter.

B. Check for Bad Connections

In order for a circuit to function properly, there must be continuous electrical connections around the entire circuit. Any break in the connectivity will stop the current flow. Breaks in the circuit could be due to bad solder joints or poor connections.



Here is an example of a multimeter measuring the resistance of a resistor.

Visually inspect all your solder joints. Do they look like the examples? If not, you might need to add or remove some solder.

If everything looks good, you can measure the connectivity between two different places in a circuit by measuring the resistance between them.

Resistance is measured in ohms, which are abbreviated by using the Greek letter Omega (Ω). Low resistance (no more than a few ohms) means that current will be easily able to flow. Infinite resistance means that there is a broken path somewhere along the circuit. When you measure resistance, it does not matter which color lead (red or black) you use to touch each end of the wire, resistor or circuit path that you are testing.

1. What resistance do you get when you measure one of the resistors that are included in your payload parts box?

2. What resistance do you get when you measure one of the wires?

Notes on reading these meters:

- The scales on the resistance dial range from 200 Ω to 2000k (thousands) Ω full scale. (2000 KΩ = 2MΩ or 2 millions ohms)
- For the most accurate results, set the dial on the meter to a value greater than you expect to measure.
- If you choose a scale that is too low, the meter will display the number 1. If that happens, turn the dial to the next larger scale on the meter. If the number 1 is still displayed on the highest scale, there is a break in the circuit.