ARTEMIS, The Wacky Robot Build Guide

Introduction

Welcome to CircuitMess Artemis, the Wacky Robot build guide!

By following this build guide, you'll learn how to assemble your Wacky Robot Artemis!

Artemis is a beginner-friendly 19-piece kit.

With Artemis, you'll learn, except soldering, about different electronic components and how a running light circle works.

After you finish building Artemis, you'll have fun watching it sparkle.

Age group

This product is 9+.

Make sure to have an adult helping you with the assembly process. It's okay to ask for help.

Assembly time

It should take you approximately 1 hour to fully assemble your Artemis.

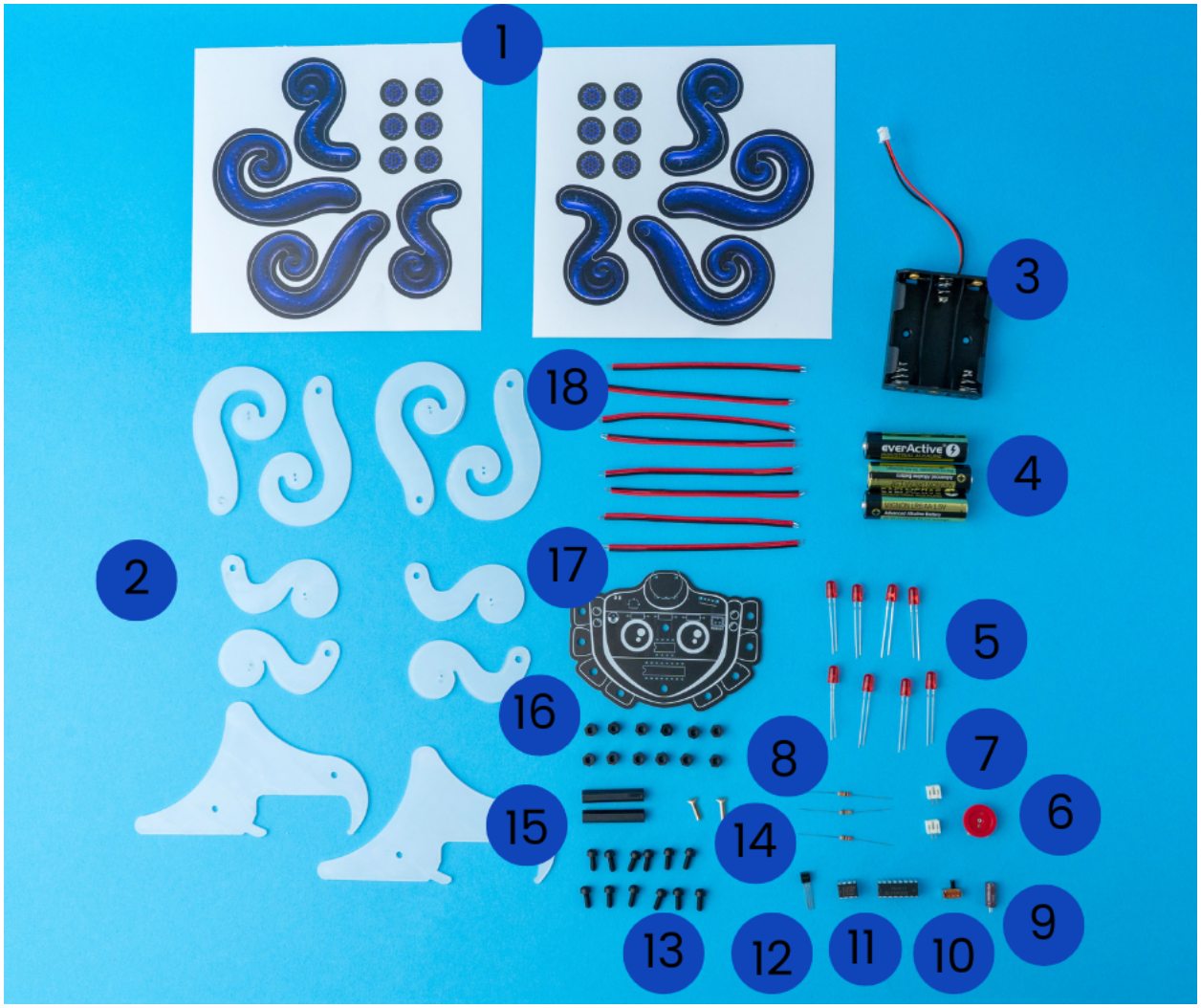
Skills

You don't need any specific skills before getting your hands dirty with this DIY project.

The main objective here is to have fun and learn something new.

What's in the box?

Let's meet all the components that arrived!



In case something is missing, please contact us at contact@circuitmess.com. Send us a photo of everything that came in the box, and we'll get back to you as soon as possible to resolve the issue.

Here's the list of components:

1. Stickers
2. Acrylic casings
3. Battery holder
4. Batteries (3)
5. LEDs (8)
6. Potentiometer
7. Connectors (2)
8. Resistors (3)

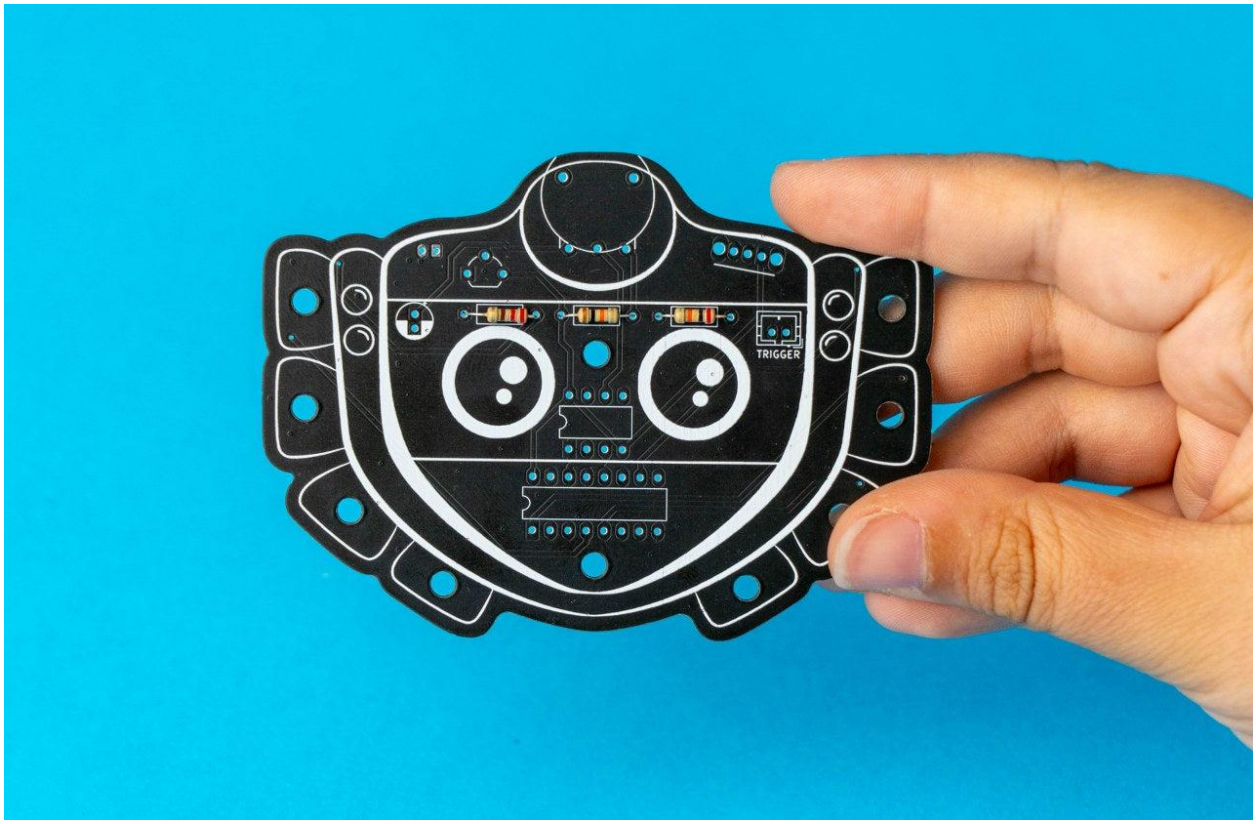
9. Capacitor
10. On/off switch
11. 555 timer (the smaller one) and 4017 digital counter (the bigger one)
12. Transistor
13. Bolts (12)
14. Metal screws (2)
15. Large standoffs (2)
16. Standoffs (12)
17. PCB
18. Wires (8)

Electronics 101

Let's learn something about the components you've got!

1. Circuit board

The black head-shaped thingy you've gotten in your kit is called a circuit board.
Professionals call this a printed circuit board or PCB.
A PCB is a laminated sandwich structure of conductive and insulating layers.



What does it do?

Your circuit board has two functions:

- It holds all the electronic components in place.
- It provides electrical connections between the electronic components.

Because of the circuit board, all electronic components can work together as a team.

What are those tiny lines on my circuit board?

They allow electrical charges to flow between components. This way, electronic components are powered, and they can do clever stuff using electricity.

What is my circuit board made of?

Circuit boards are usually made out of fiberglass-reinforced epoxy-laminated sheets.

These are also referred to as “FR4” sheets.
The FR4 sheets are used as the insulating non-conductive material, and copper is used as a conductive material.
If material is conductive, it conducts electricity; electrical charge can flow through that material easily.
FR4 and copper are both sandwiched together in thin sheets, and that’s how you get a circuit board.

Where are PCBs used?

They’re used everywhere!

In your phone, in your laptop, in your refrigerator, air conditioner. Basically, every electronic device you use has a unique printed circuit board that makes it work.

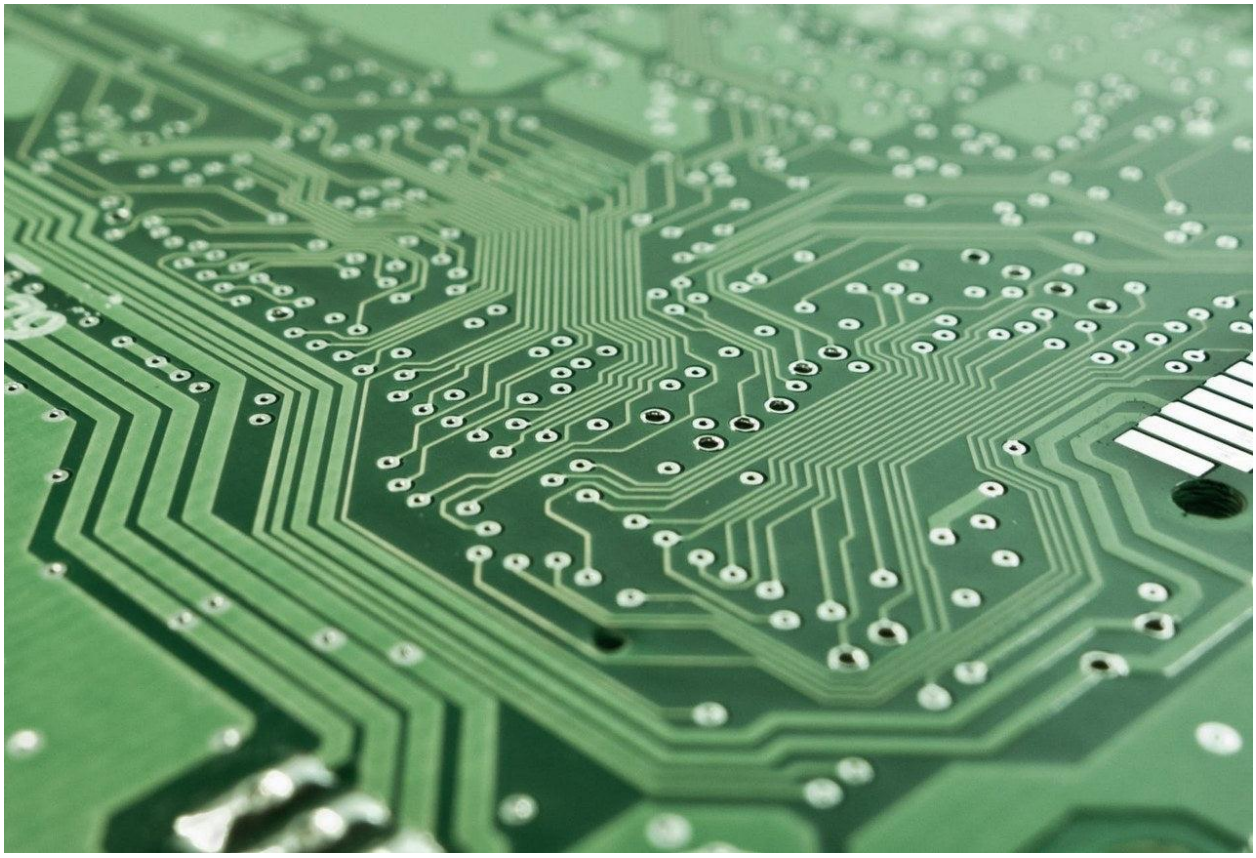
Did you know?

A PCB is one of the most important inventions of the last 100 years.

Space travel wouldn’t be possible without them.

PCBs were invented by Paul Eisler.

He invented it in the 1930s, but the predecessors of modern-day PCBs have been around since the age of gramophones and vacuum tube radios, just in a somewhat different form.



2. Resistors

Resistors are the most basic electronic components found in almost every electronic device.

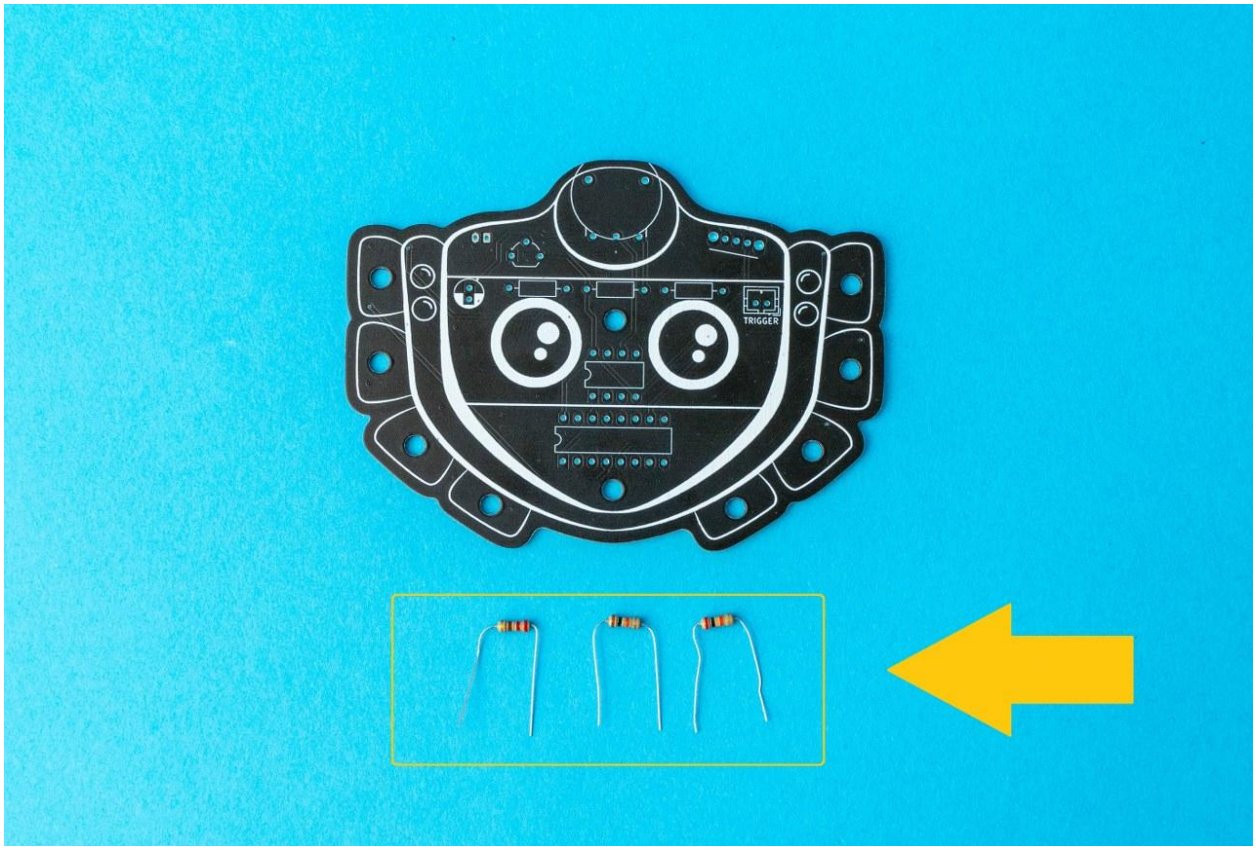
They fall in the category of passive electronic components.

Passive electronic components do not generate electrical power and do not need electrical power to work.

They just modify the flow of electrical energy in their own unique way.

Resistors that you have gotten in your package have a cylindrical shape and two tiny metal legs.

We call these legs "component leads".



Resistance

Resistors have a property of resistance - they lower the amount of electrical energy flowing through the circuit.

They “resist” the flow of electrical energy.

The unit of resistance is called ohm and it was named after German physicist Georg Simon Ohm.

Resistors are used for tasks such as adjusting the flow of electricity through an electronic circuit.

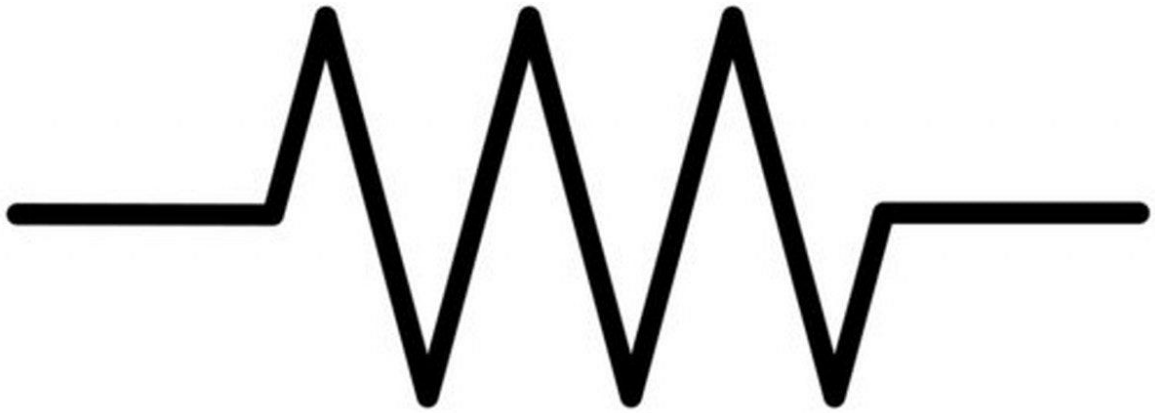
The exact value of a resistor is measured with a device called an ohmmeter.

Can we compare it to something we see in everyday life?

If we make an analogy to water flowing through pipes, the resistor is a thin pipe that reduces the water flow.

Scientists and engineers have come up with different symbols for each and every electronic component.

This is an electronic symbol for a resistor:



This is Georg Simon Ohm:

3. Switch

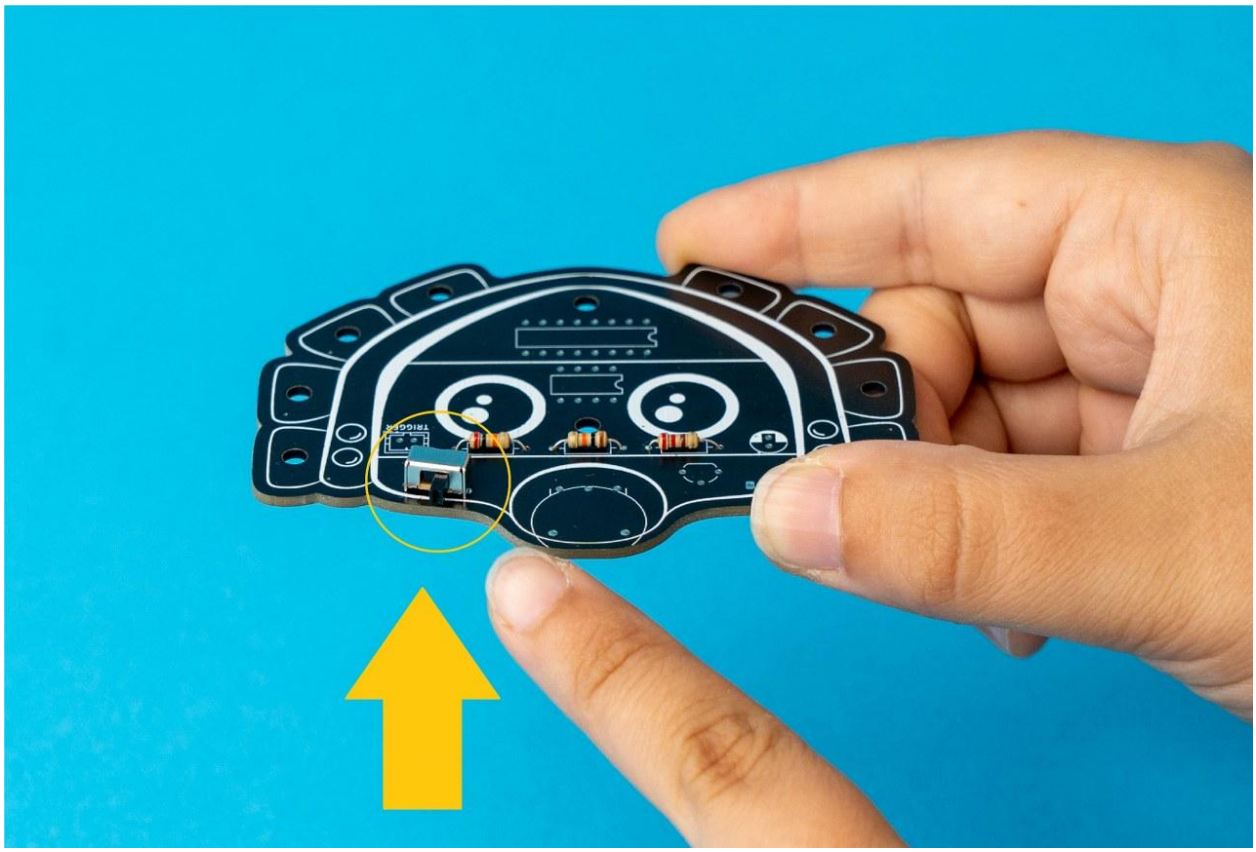
The switch you got in your kit helps you turn the device on and off. You can easily do so with one simple push.

A switch controls the flow of power to an electric device - in other words, it connects and disconnects an electrical circuit.

Switches are used in almost every electronic device. They are found in your mobile phone, computer, air conditioner, etc.

Historical fun fact:

An electrical switch was invented in 1884 by John Henry Holmes, who used it for turning lights on and off.

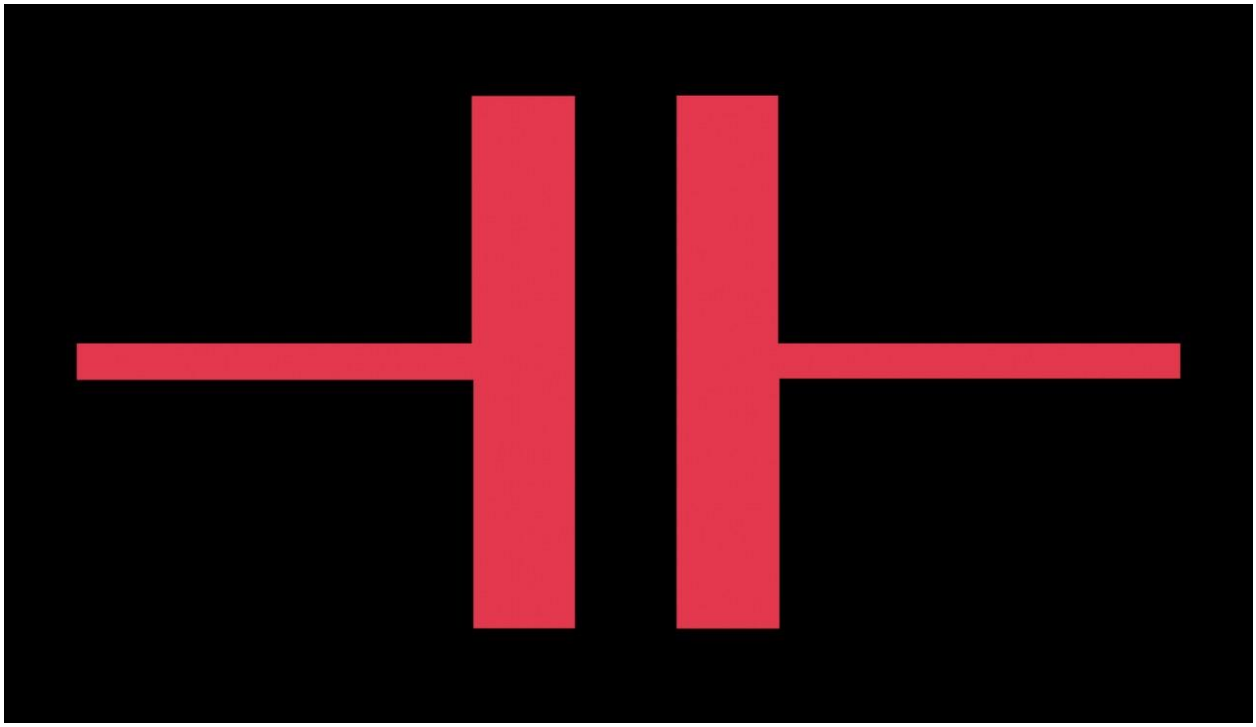


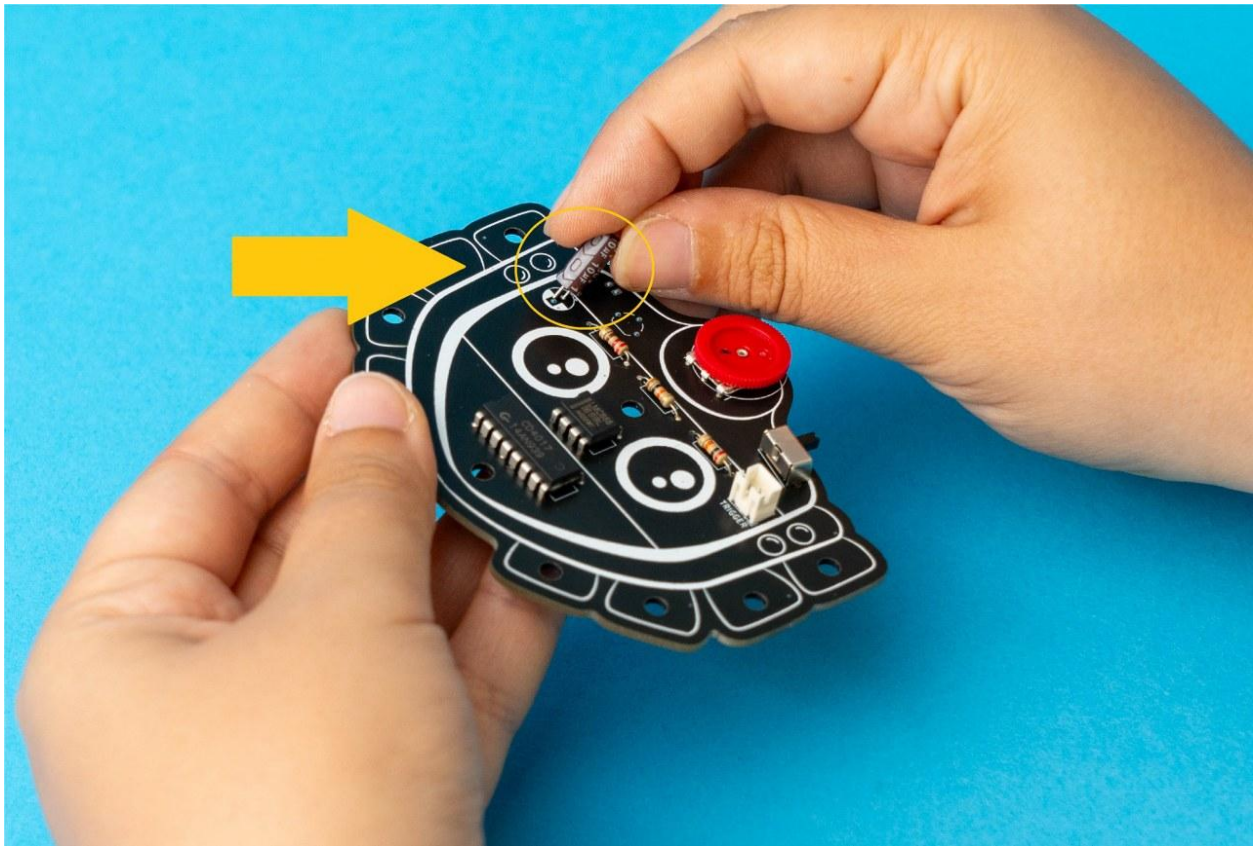
4. Capacitor

A capacitor is a component that has the ability to store energy, much like a small

rechargeable battery.

This is an electronic symbol of a capacitor:





A capacitor can absorb energy from a circuit and store it temporarily.

Later on, this stored energy can be released back to the electronic circuit.

We can measure the ability of a capacitor to store electrical energy.

We call this property - capacitance.

The unit of capacitance is called Farad (we use the letter F as a short for Farads).

This unit was named after physicist Michael Faraday.

Historical fun facts:

Capacitors were discovered by Pieter van Musschenbroek a looong time ago - in 1746.

The first capacitor was a glass jar wrapped inside and out by a thin metal foil.

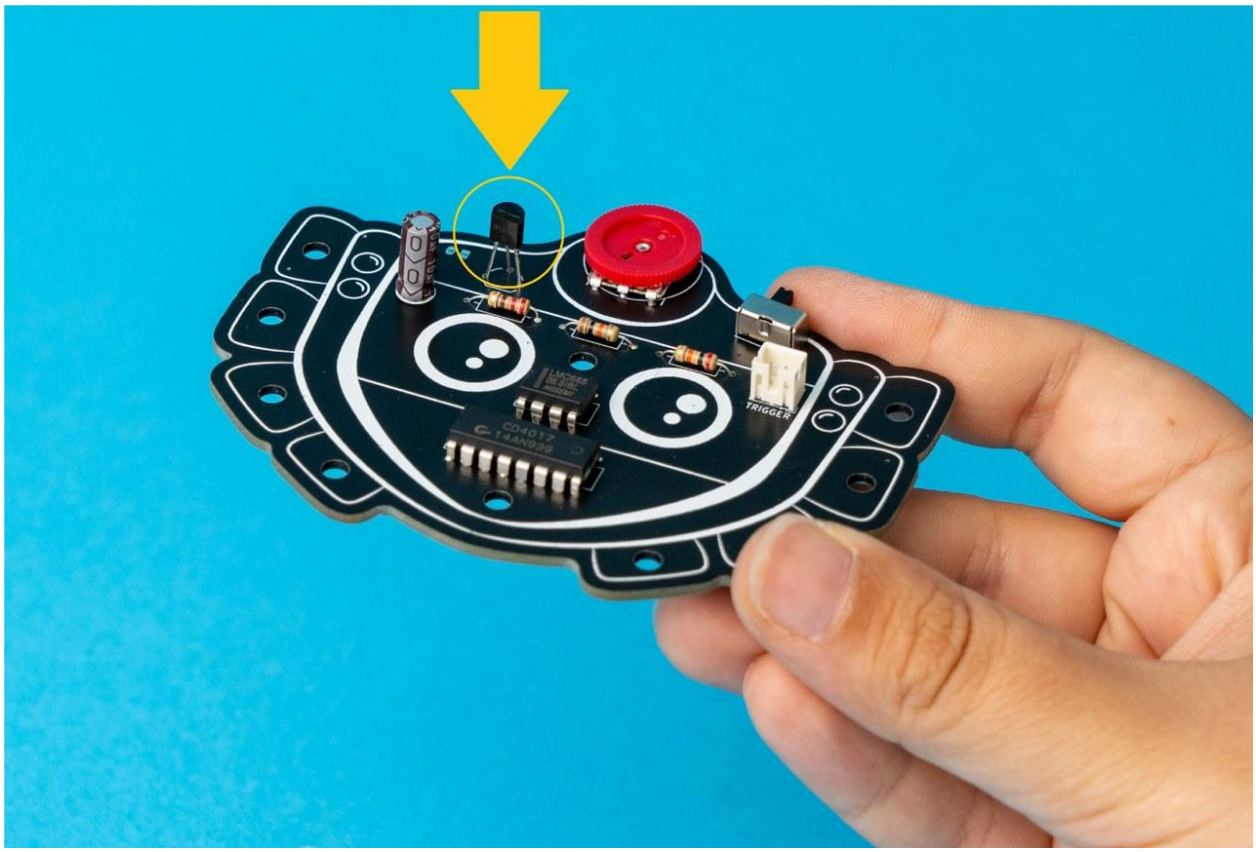
5. Transistor

The transistor is an electronic component that can be used as part of an amplifier or as a switch.

It is made of semiconductor material.

Transistors have 3 terminals: the emitter, the collector, and the base. When the emitter is connected to the negative terminal of the battery and the collector to the positive terminal, no electricity will flow in the circuit.

This is what a transistor looks like:



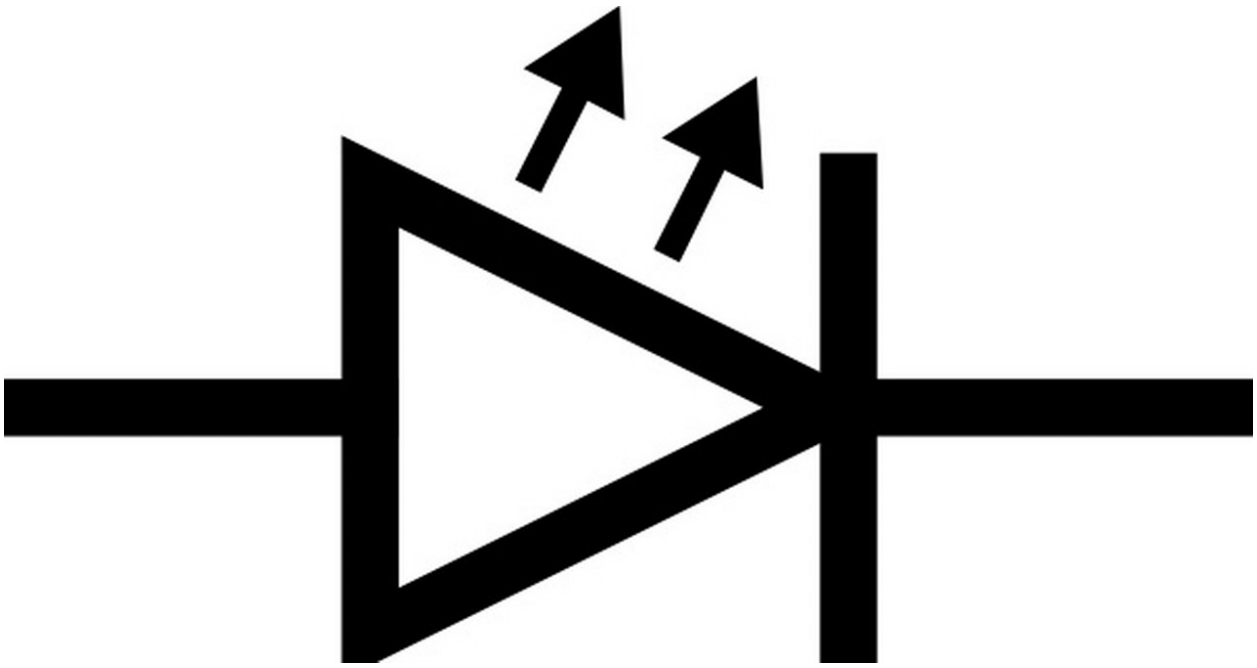
6. Red LEDs

These electronic components will make your CAPACITRON's eyes light up.

LED stands for light-emitting diodes.

LEDs convert electrical energy into visible light.

This is an electronic symbol for a light-emitting diode:



Watch out - LEDs are polarized!

Light-emitting diodes (LEDs) are polarized.

This means that they only allow current to flow in one direction.

Because of this, you need to pay attention to how you are going to place your LED in the electronic circuit.

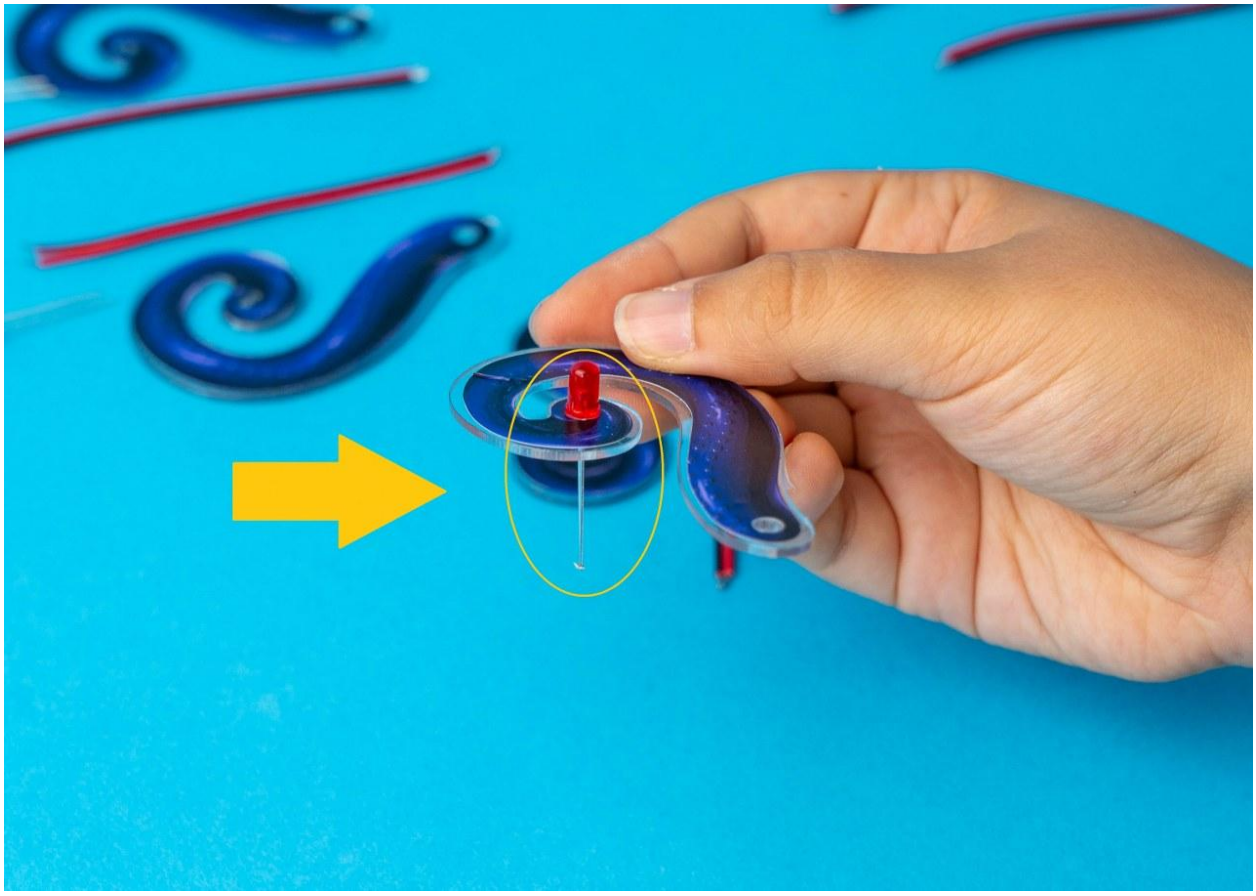
The tiny metal legs of every LED are not the same length.

They mark polarity!

The positive leg is longer (we call this one the anode), and the shorter one is negative (this one has a funny name - cathode).

If you put the LED in the wrong way, it won't light up because the electrical energy will not be able to flow through it.

Electrical energy flows from the anode to the cathode and not in the opposite direction.



Resistors and LEDs make a great team!

LEDs can be damaged if they receive too much energy.

Oh no! The coin cell battery supplied with your CAPACITRON is too much for the poor little LEDs.

But don't worry, we sent resistors to the rescue!

Resistors will limit the amount of electrical energy flowing through the circuit and save your LEDs from getting damaged.

Historical fun facts:

A Russian inventor Oleg Vladimirovich Losev made the first LED in 1927.

Did you know?

LED lightbulbs are the most efficient type of lightbulbs.

Unlike “regular” “old” bulbs (we call these incandescent lightbulbs), which release 90% of their energy as heat, LEDs use energy far more efficiently with very little wasted heat.

Meet the tools!

Soldering iron

For Artemis' assembly, any entry-level soldering iron will suffice.

Although, if you plan to dive into the world of DIY projects, you should consider getting a more expensive one with more features.

You’ll also need a soldering iron stand and a small reel of rosin-cored solder.

Soldering sponge

Make sure your soldering toolkit has a sponge that can be used for wiping your soldering iron clean. Make sure that the sponge isn't dripping wet or bone dry - it should be damp.

Diagonal cutter pliers

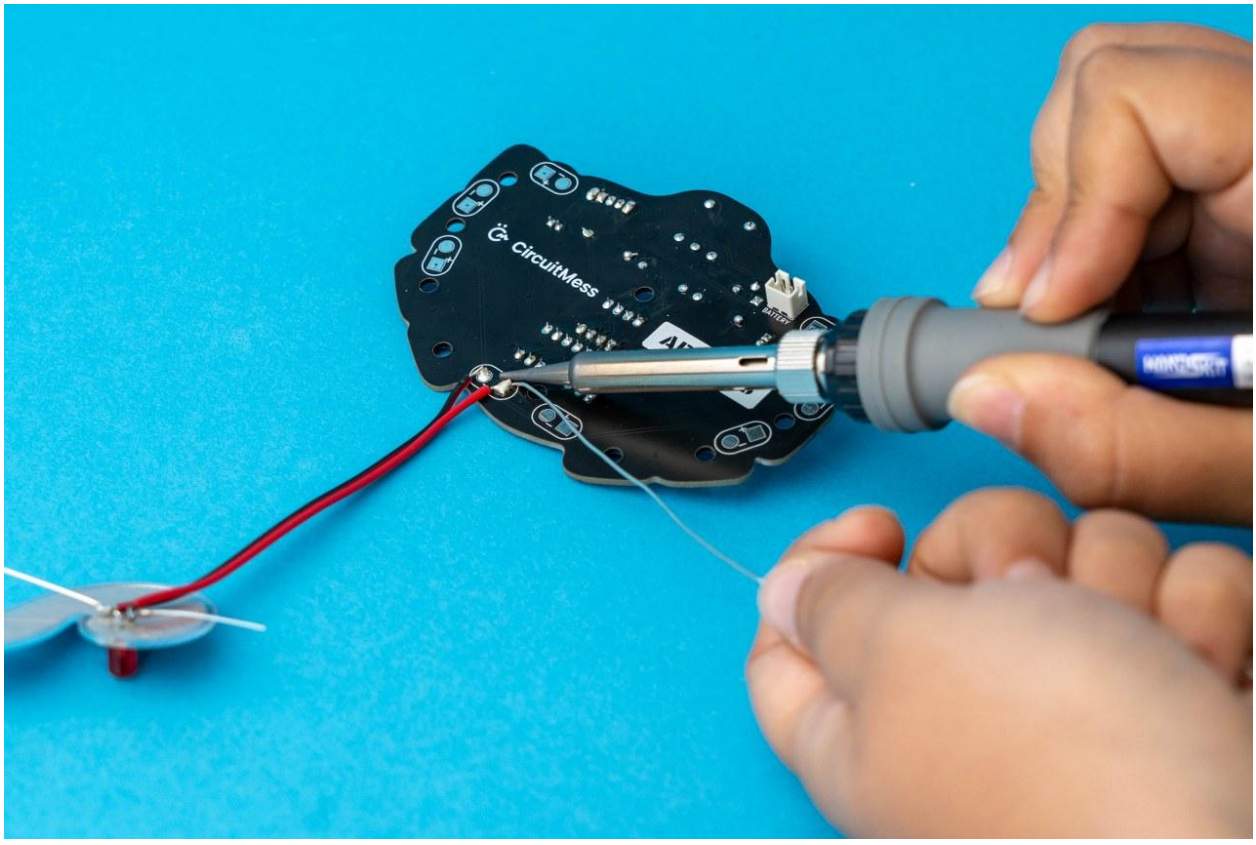
We prefer this type shown in the picture (Plato, model 170), but any other type will do.

How do I solder?

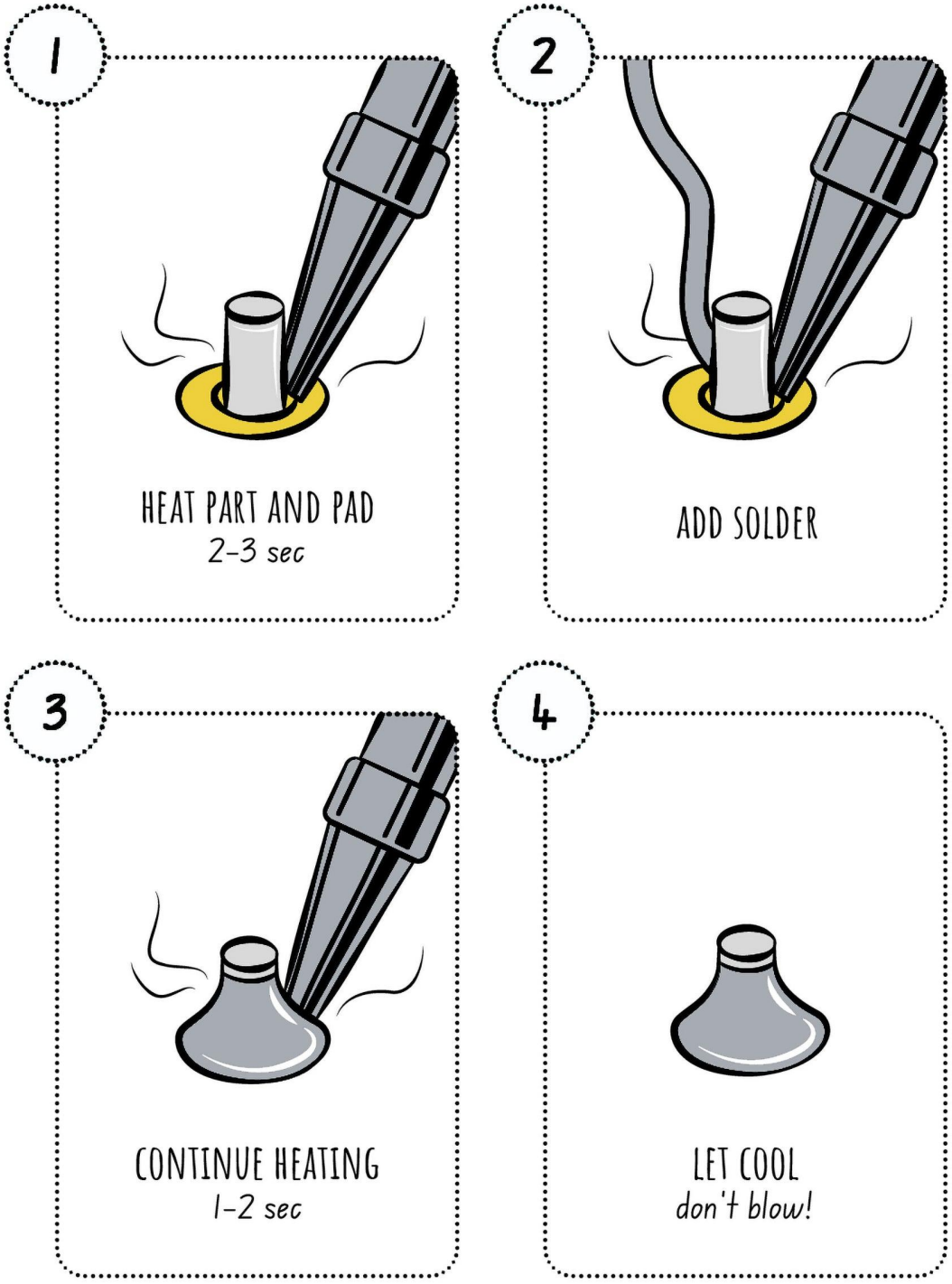
One of the things you'll do as a part of Artemis' assembly process is soldering!

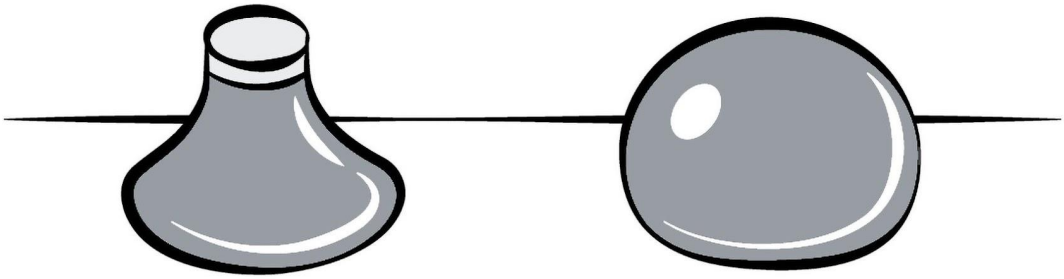
Have you ever done that before? If your answer is no, we suggest you look at the following few links where you'll find useful tutorials and blogs about soldering. It will only take you 10 minutes to get into the zone and understand how it's done. Here are the links:

- Adafruit's video tutorial featuring Collin Cunningham - A tutorial featuring Collin Cunningham, a super charismatic electronics guru.
- Adafruit's standard soldering tutorial - A great and thorough video tutorial. An absolute must-read, even if you know how to solder. Make sure to check the "common soldering mistakes" section at the end.
- Sparkfun's video soldering tutorial - Another well-made how-to-solder video tutorial.
- Sparkfun's standard soldering tutorial - A detailed tutorial made by Sparkfun.



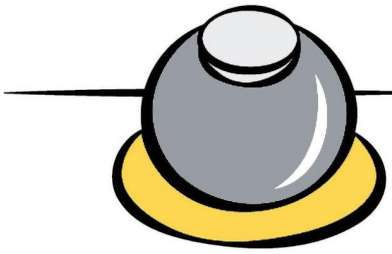
Here are the pictures that can help you recognize good and bad solder joints:



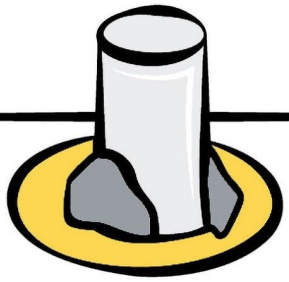


PERFECT

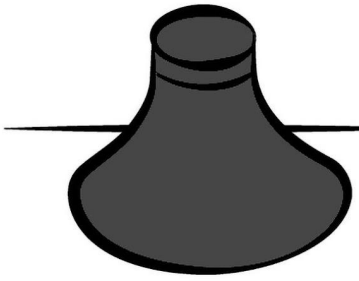
TOO MUCH SOLDER



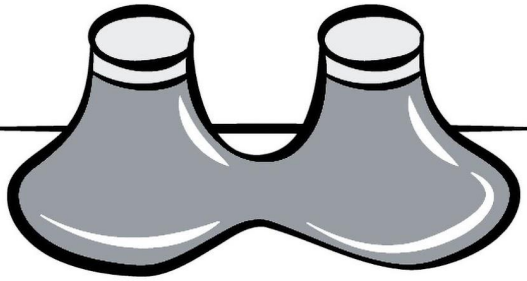
COLD JOINT



NOT ENOUGH SOLDER



TOO MUCH HEAT



SHORT

These are the rules for soldering you should follow every time:

- Never inhale the dust and the fumes that can be produced by the soldering iron!
- Soldering iron gets hot! Do not touch the tip of the soldering iron! Even if the soldering iron is turned off or completely disconnected from the power source, there is still a possibility that it's very hot and, therefore, can cause very uncomfortable pain if touched. Always keep the soldering iron facing away from your hands. If you're finished soldering, unplug the soldering iron from the power source and leave it to cool off for at least five minutes before putting it back in your toolbox.
- Clean the soldering iron! Make sure to use the sponge often and clean your soldering iron if you wish to have an easy and simple soldering experience. Carefully hold an end of the sponge with one hand and wipe the tip of the soldering iron on the other end of the sponge to remove the extra solder. Repeat the process until the tip of the iron is nice and clean.
- Check your solder joints twice (at least)!
- Keep the soldering iron on the stand when you're not using it.
- Know how much solder is needed! Make sure to put just enough solder. Not too much, and not too little, since both can cause your newly-made device to malfunction.
- Don't leave any residual solder on the board! The solder should only be on the parts where the pins connect to the board. Keep the rest of the board clean!

Using the soldering iron

If you're using your soldering iron for the first time or need help with cleaning its tip, check our video tutorial.

The soldering iron is very easy to use but only when used properly.

Step 1 - plug it in

Put the soldering iron on a soldering iron stand, and plug it into a power outlet.

Step 2 - Select the right temperature

The temperature will be set to 390 degrees Celsius by turning the soldering iron on.

Step 3 - Don't forget to turn it off when you're finished

We'll tell you when you're done with soldering, and you'll unplug the iron from the power outlet to turn it off.

Please use the metal stand every time you are not using the soldering iron to make sure you don't burn the surface or the circuit board.

Make sure to not touch the soldering iron tip for at least five minutes after you have turned it off.

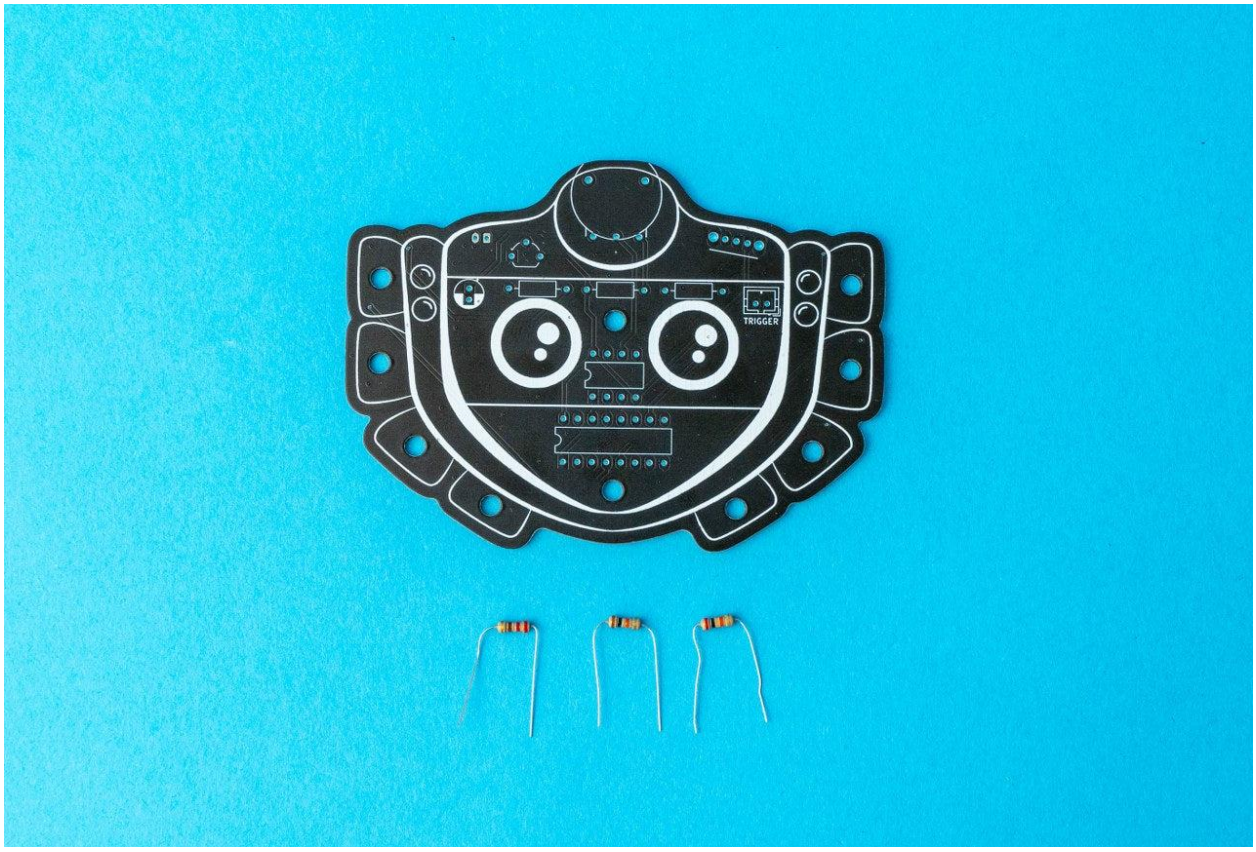
Artemis, meet your maker!

Part one - Resistors

The first components you will need for assembling Artemis are resistors.

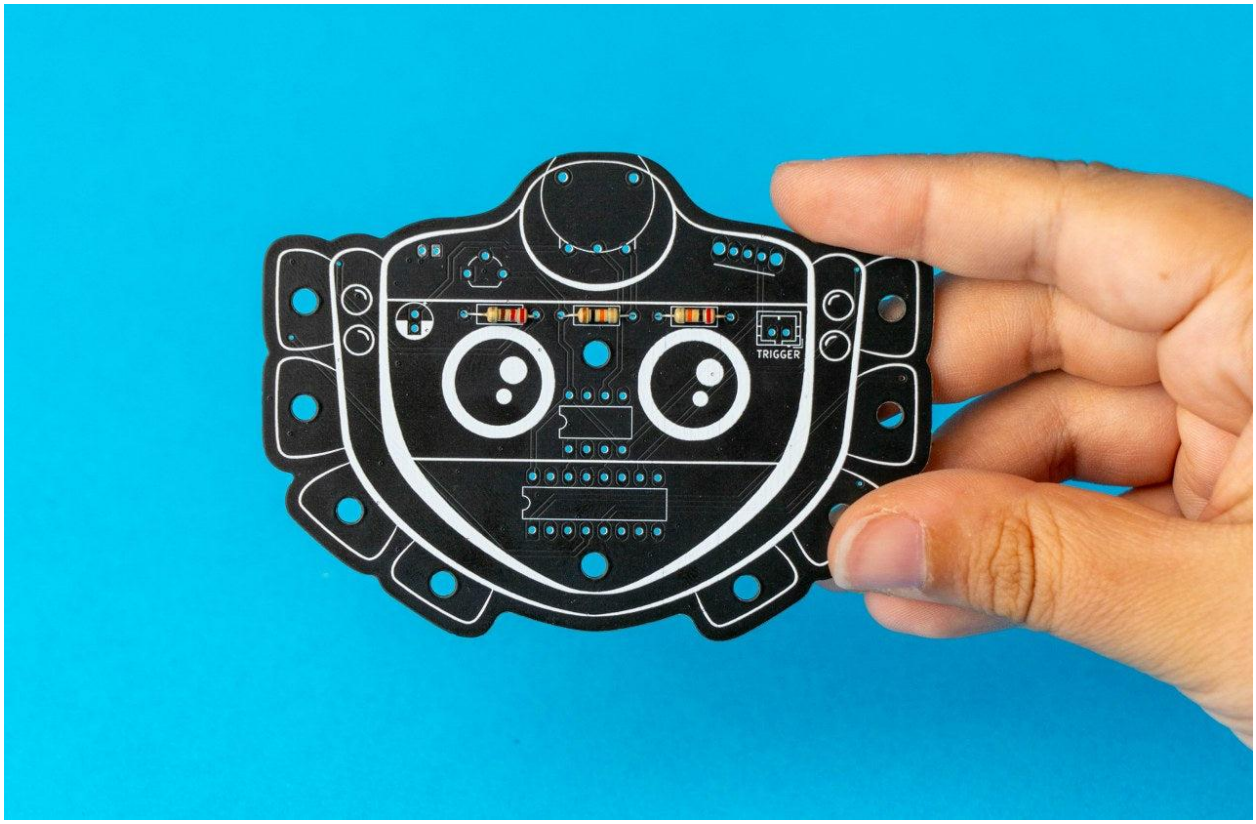
There are three different resistors with different color bands.

This is how they should be placed (left to right):



1. Golden-brown-red-red
2. Brown-blue-orange-golden
3. Golden-orange-blue-red

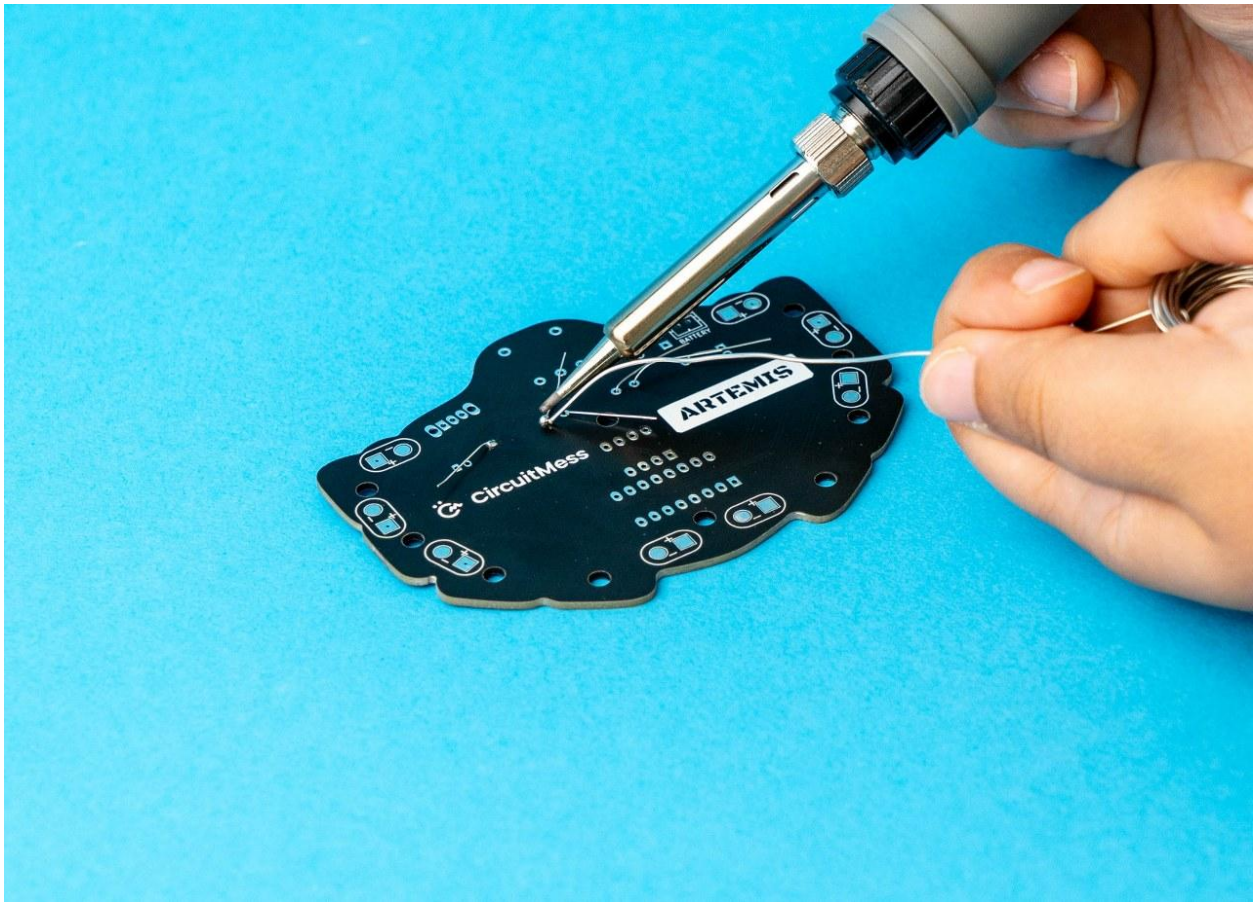
Carefully bend them into a U-shaped form.
Take them one by one, and place them onto the circuit board.



Insert it one at a time, or all three at once, making sure that they are pushed all the way to the board, and then flip the board around.

If this is your first time soldering, go over the rules, videos and photos once again.

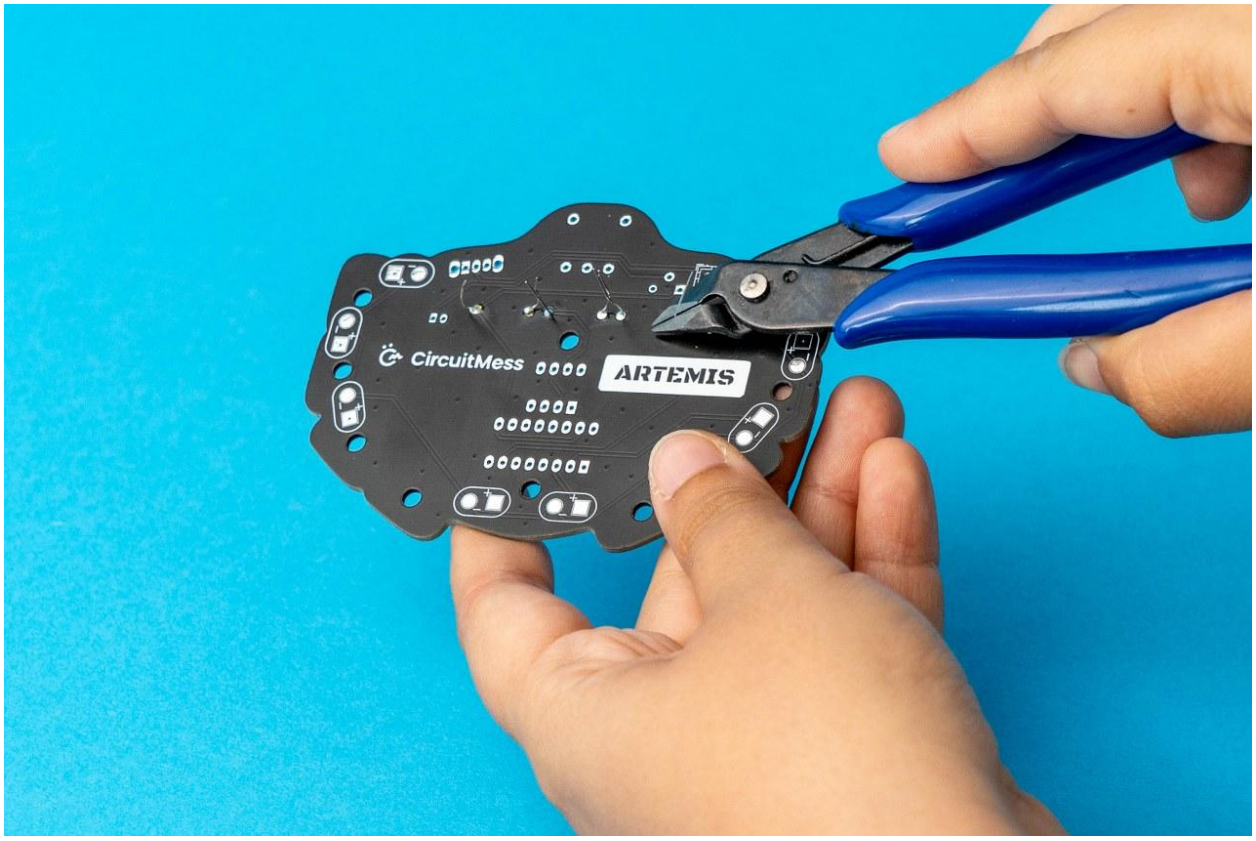
To ease the soldering process, bend the resistor's legs like this:

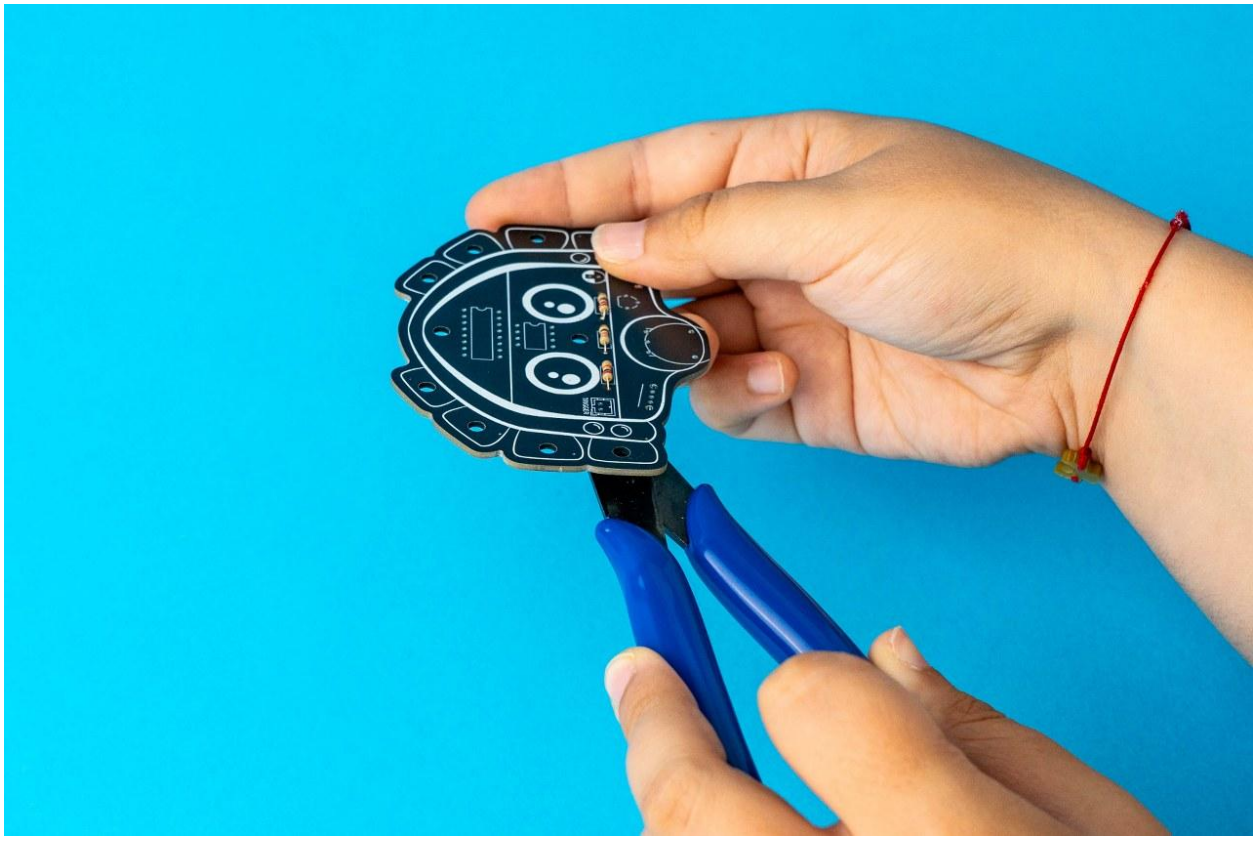


Check if all the soldering joints look clean, and if there are no soldering bridges.

Straighten the resistor's legs, and take the cutter pliers.

Here, it is very important to turn the board around when cutting the legs off to avoid getting anything in your eyes.

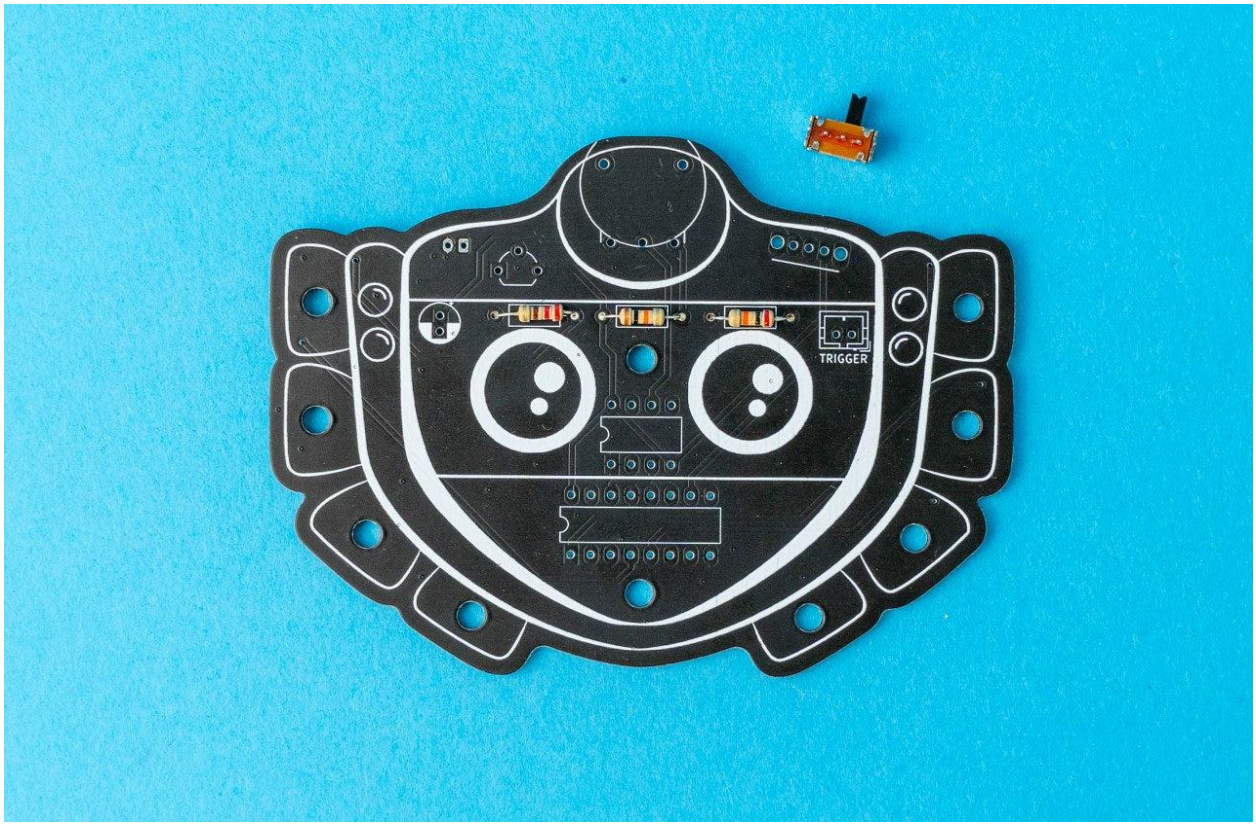

CircuitMess
ARTEMIS



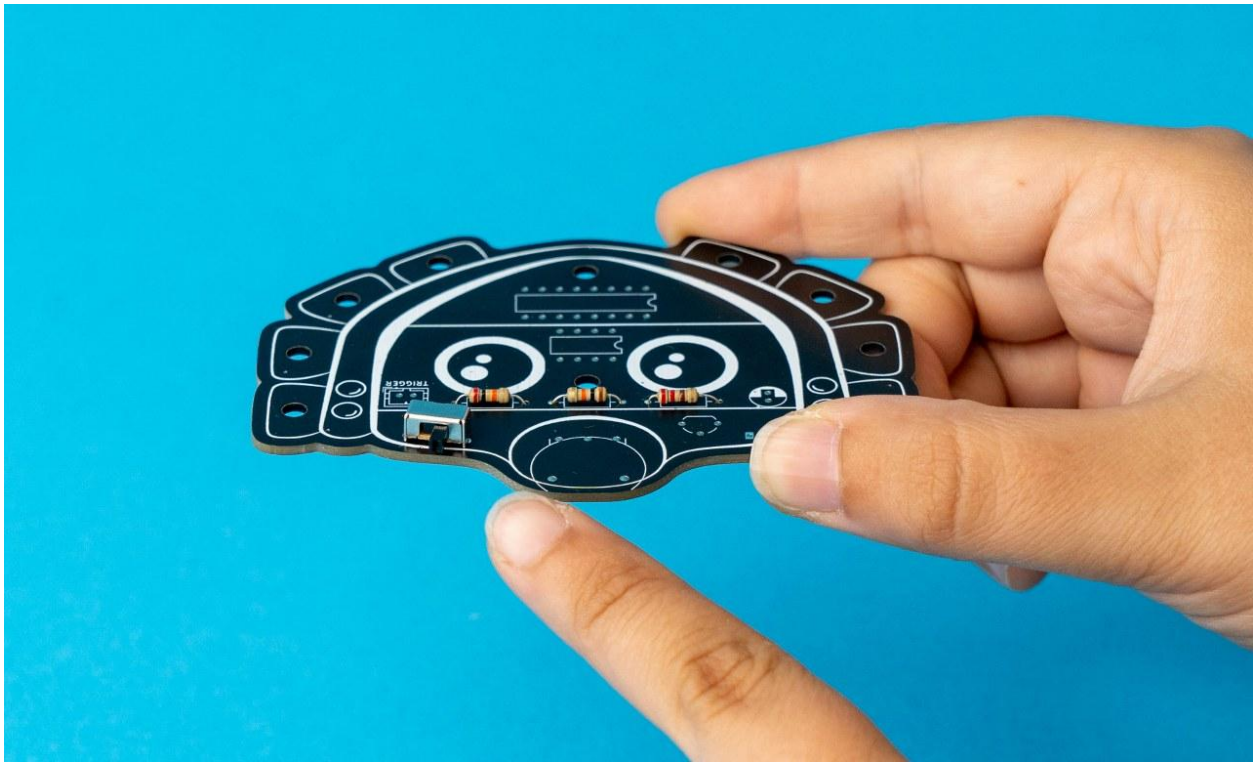
Part two - Switch

If you successfully soldered the resistors, it's time for the switch.

These are the components you'll need for this part:



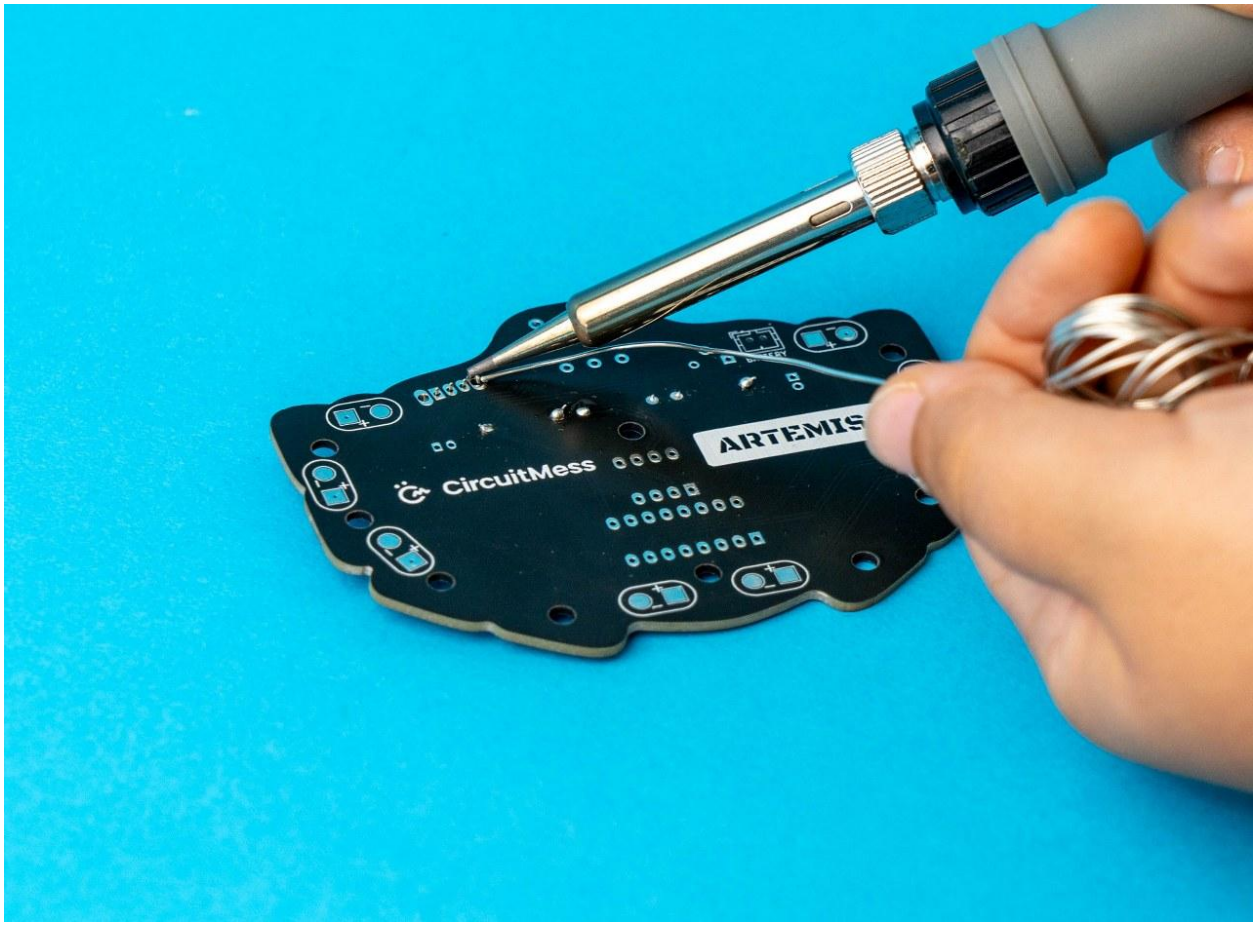
Place the switch here:



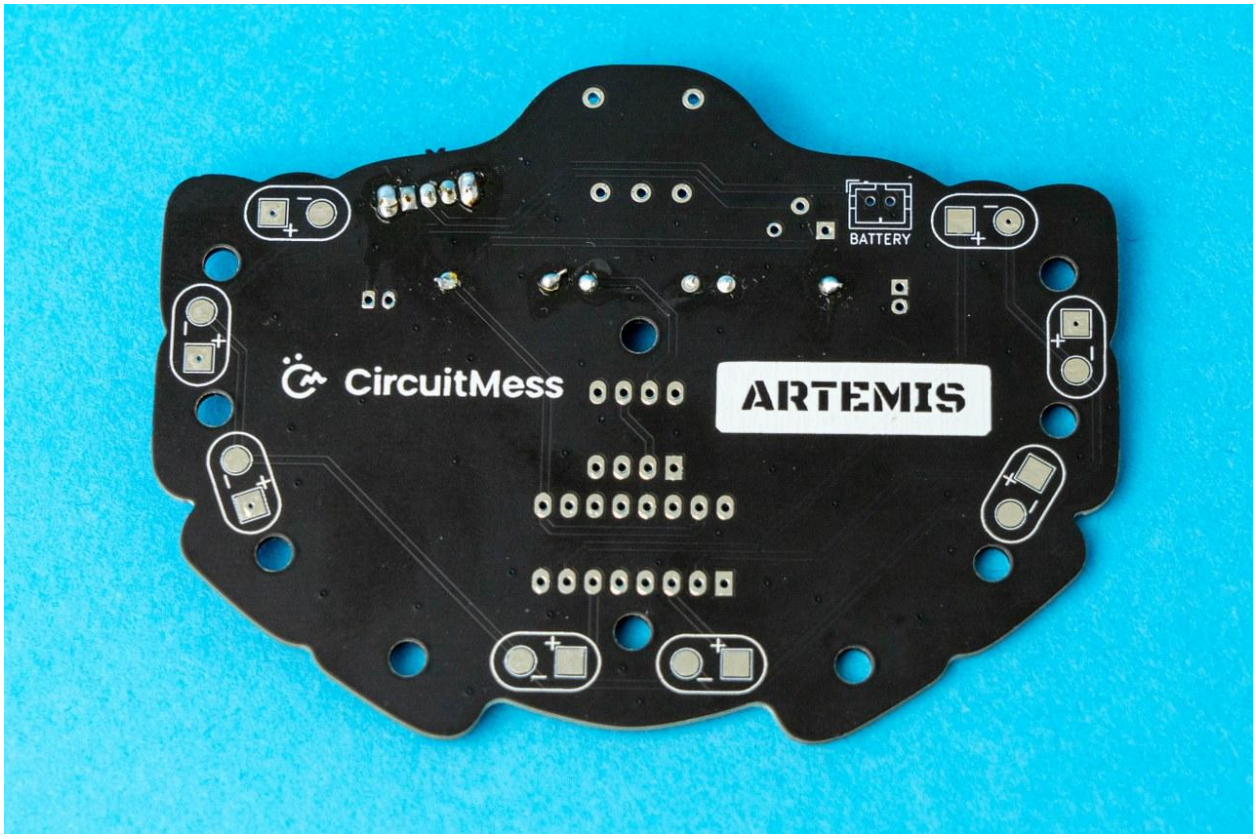
Turn it around and start soldering.

It will ease the soldering process to solder the far-left and the far-right pins first, and then those in the middle.

Check that the switch is vertical to the board after connecting the first pin. If it isn't, move it with your fingers.

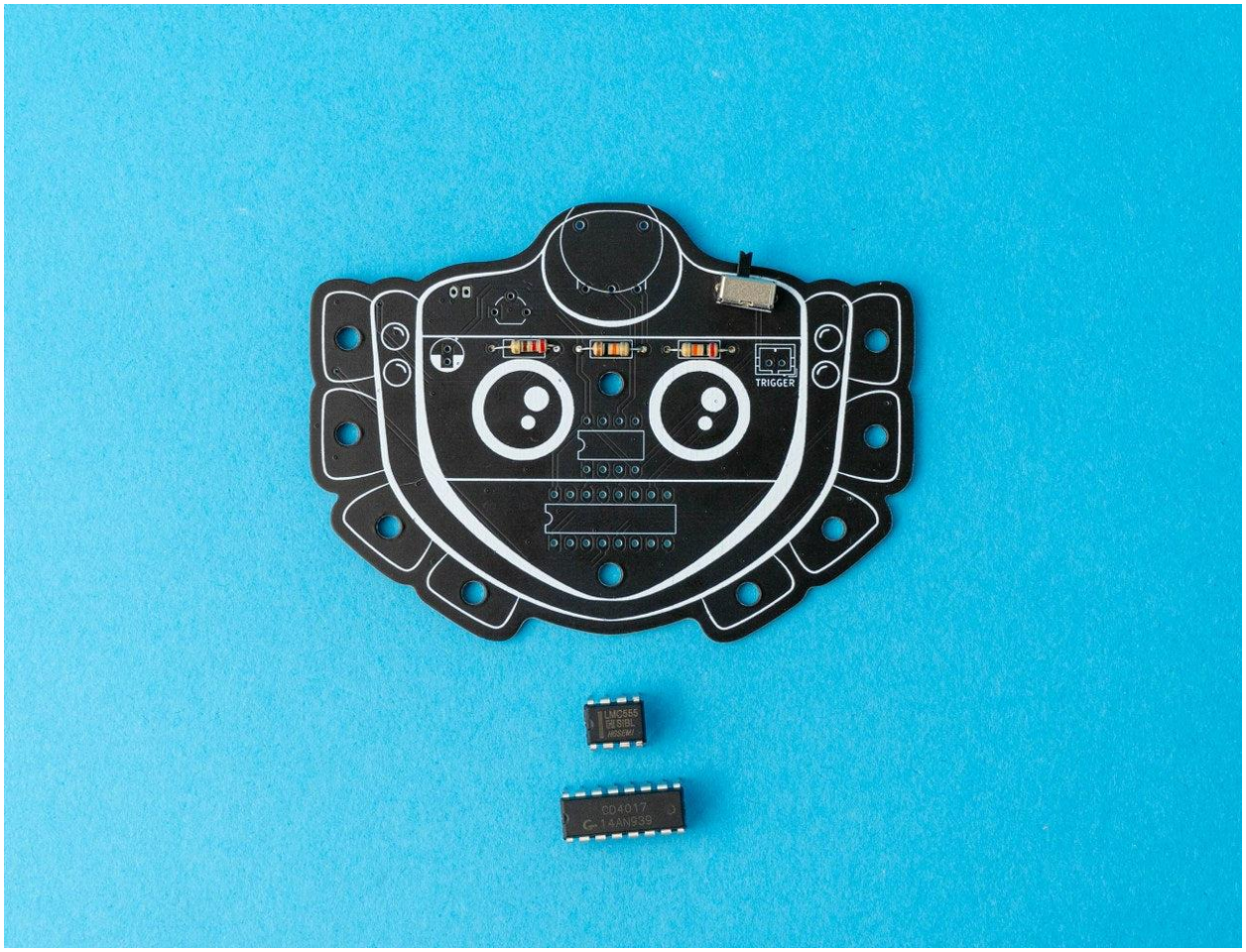


This is what the back of Artemis should look like by now:

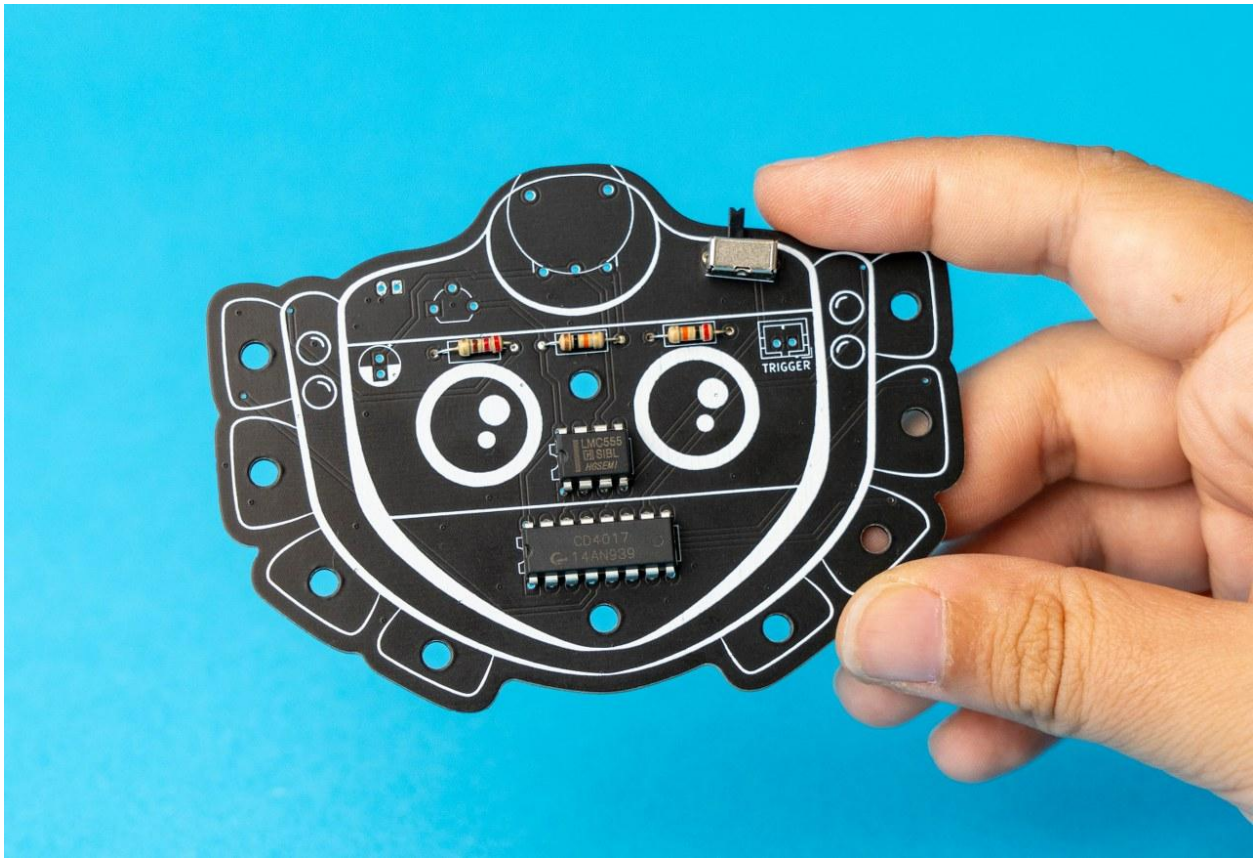


Part three - 555 timer and 4017 digital counter

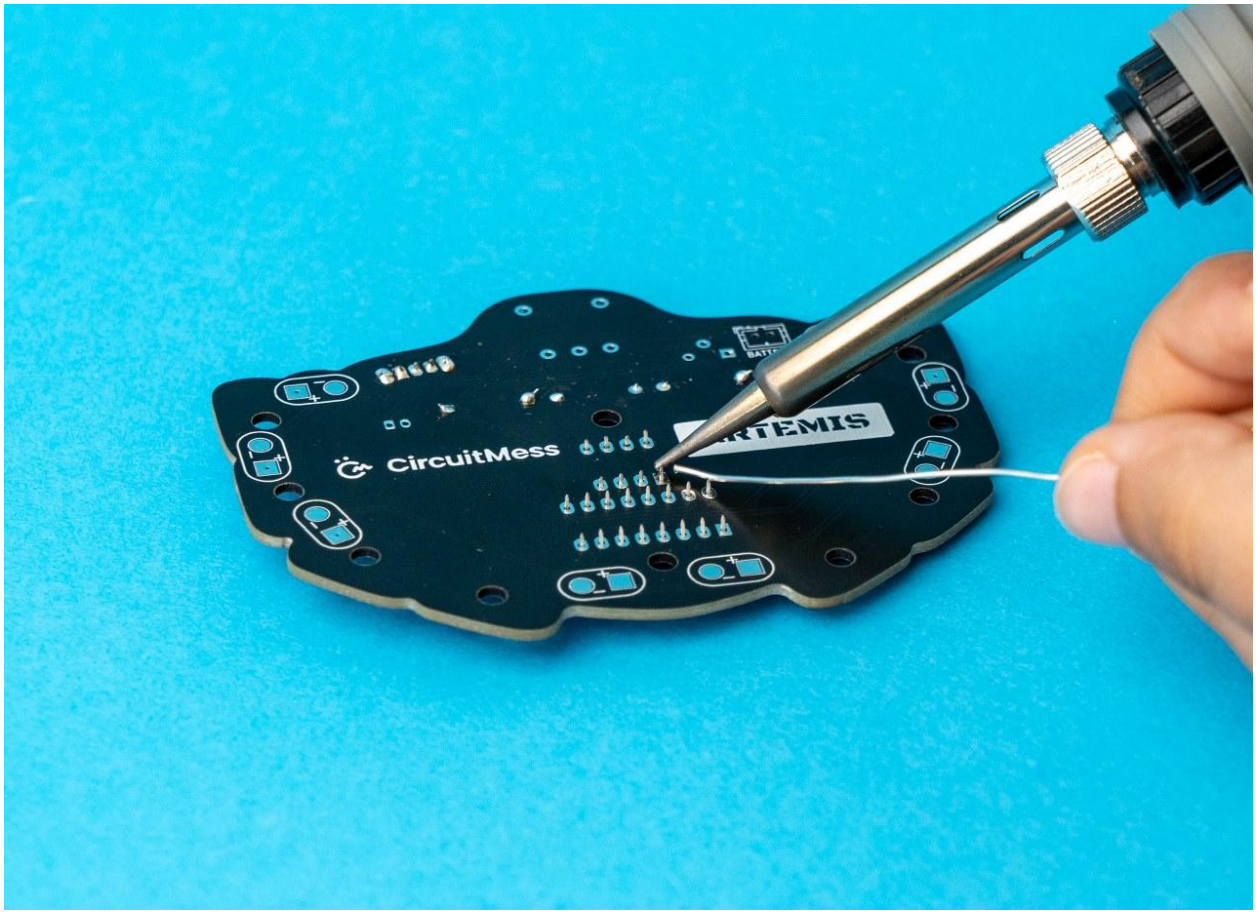
For the next step, we'll need these two components.



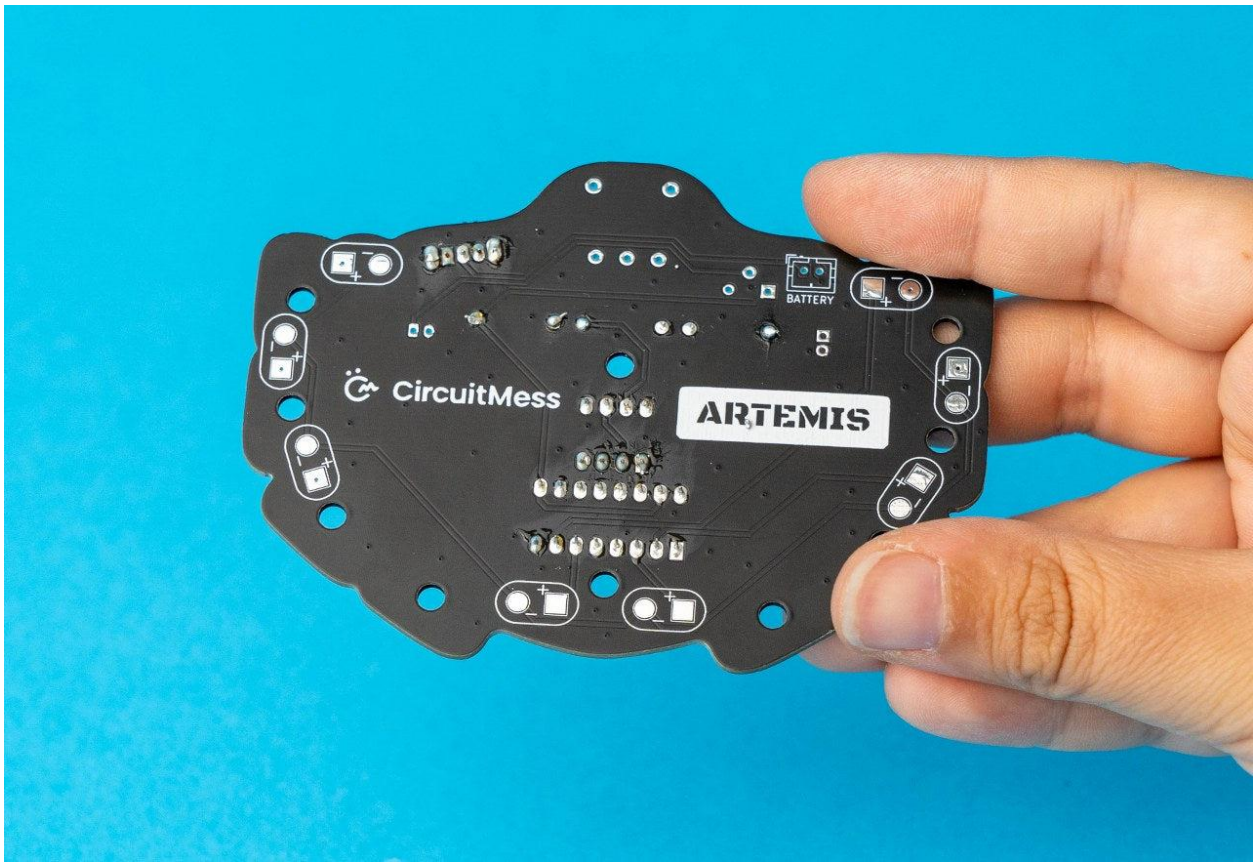
Place them here, and make sure that the cut-off part on the components matches the cut-off part on the board.


TRIGGER
LMC555
CD4017

Flip the PCB, and start soldering.

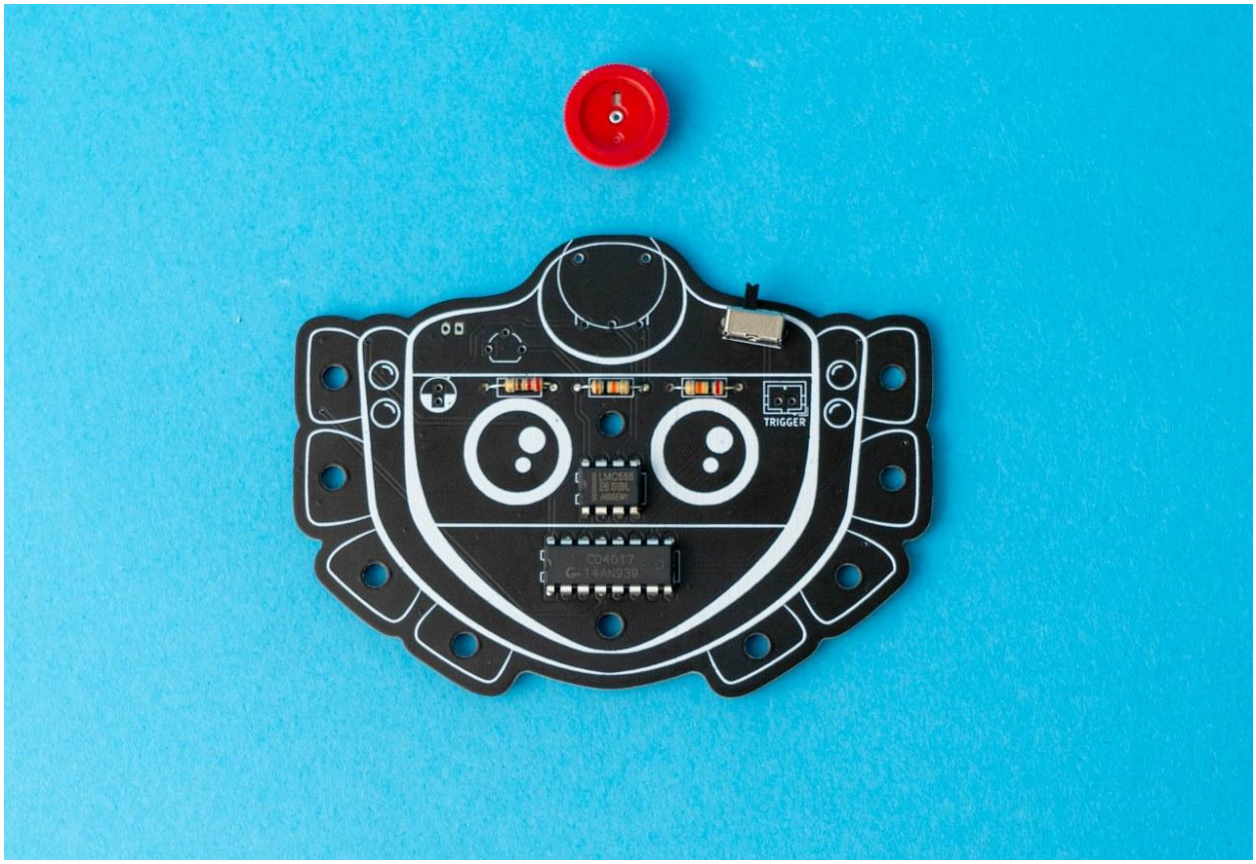


This is what the back of Artemis should look like right now:

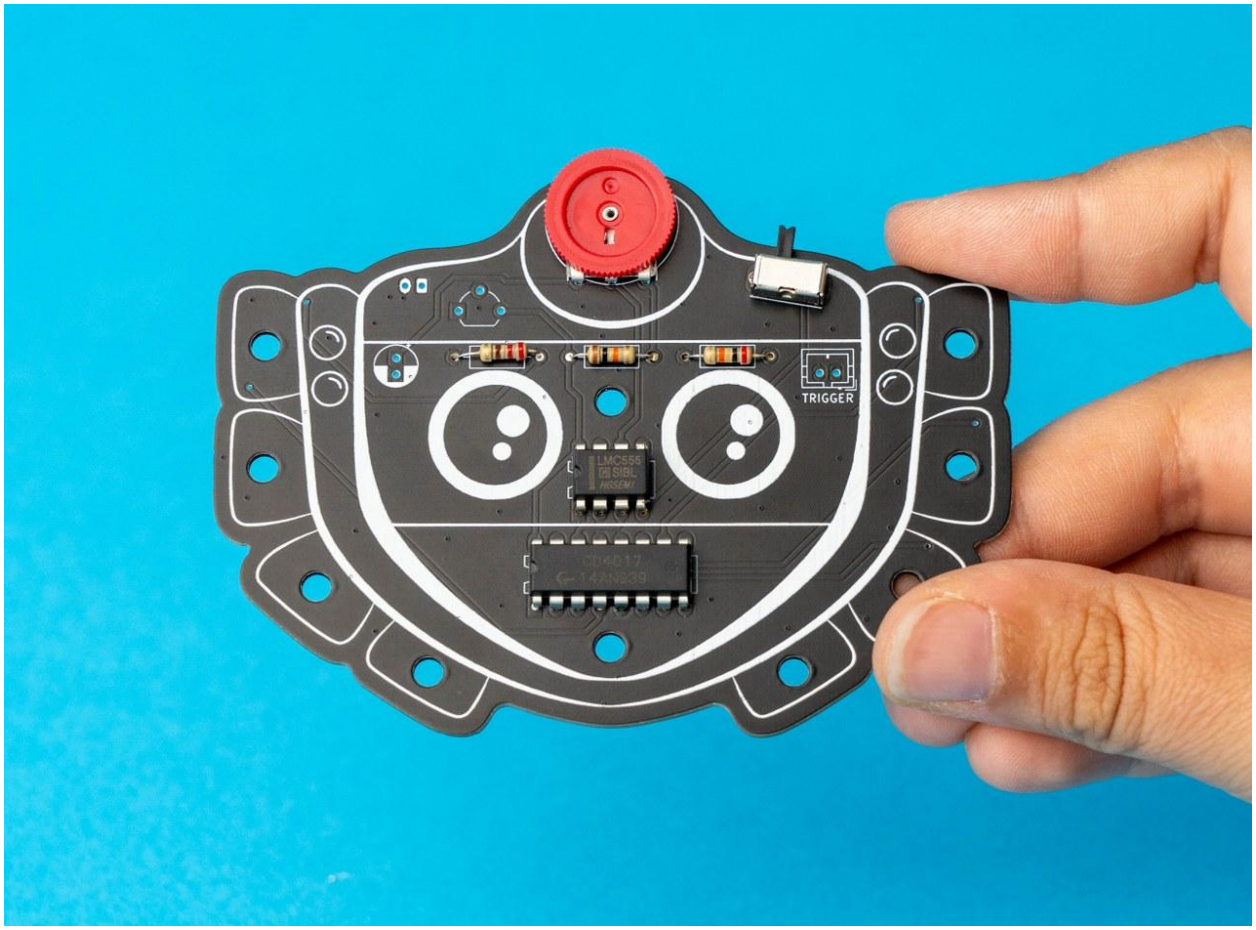


Part four - Potentiometer

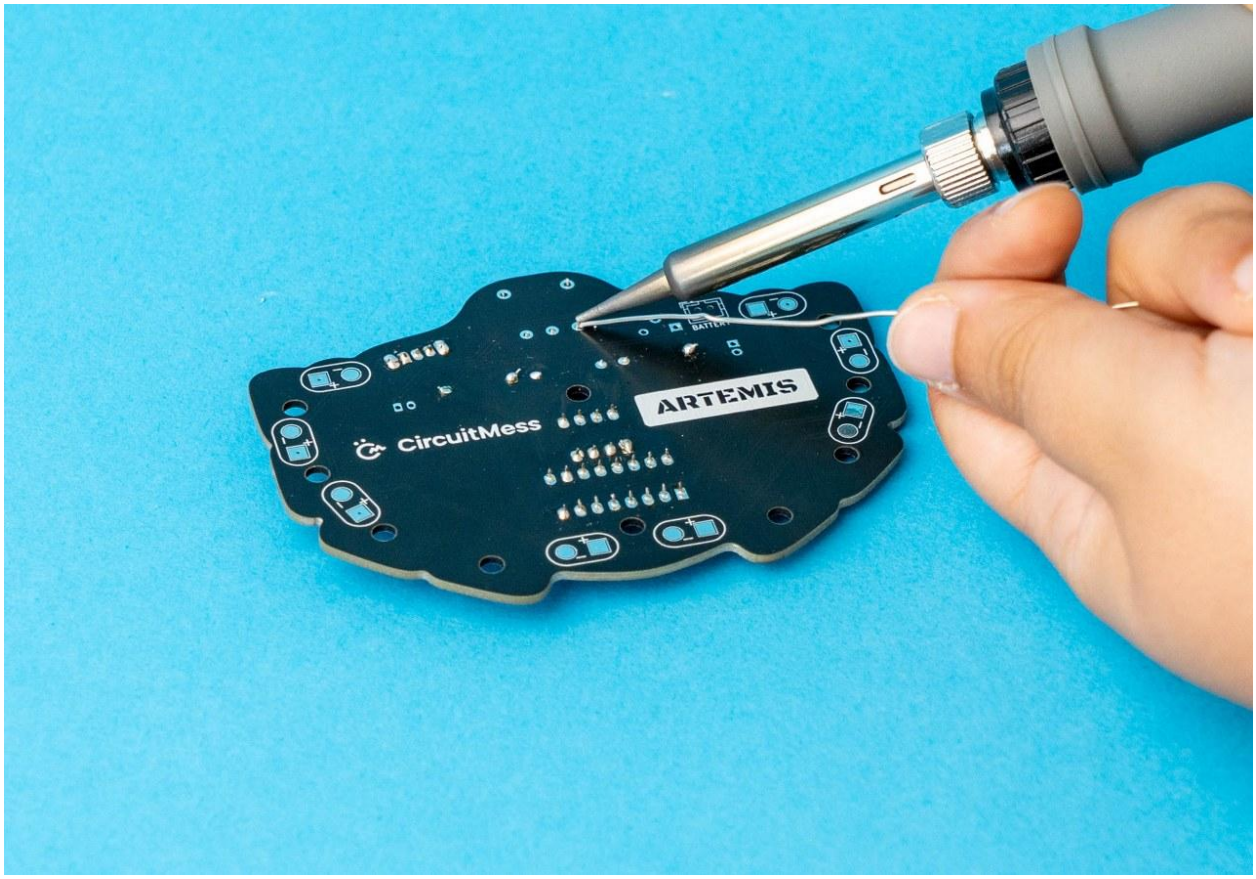
The potentiometer (the round red thingy) will be soldered next.

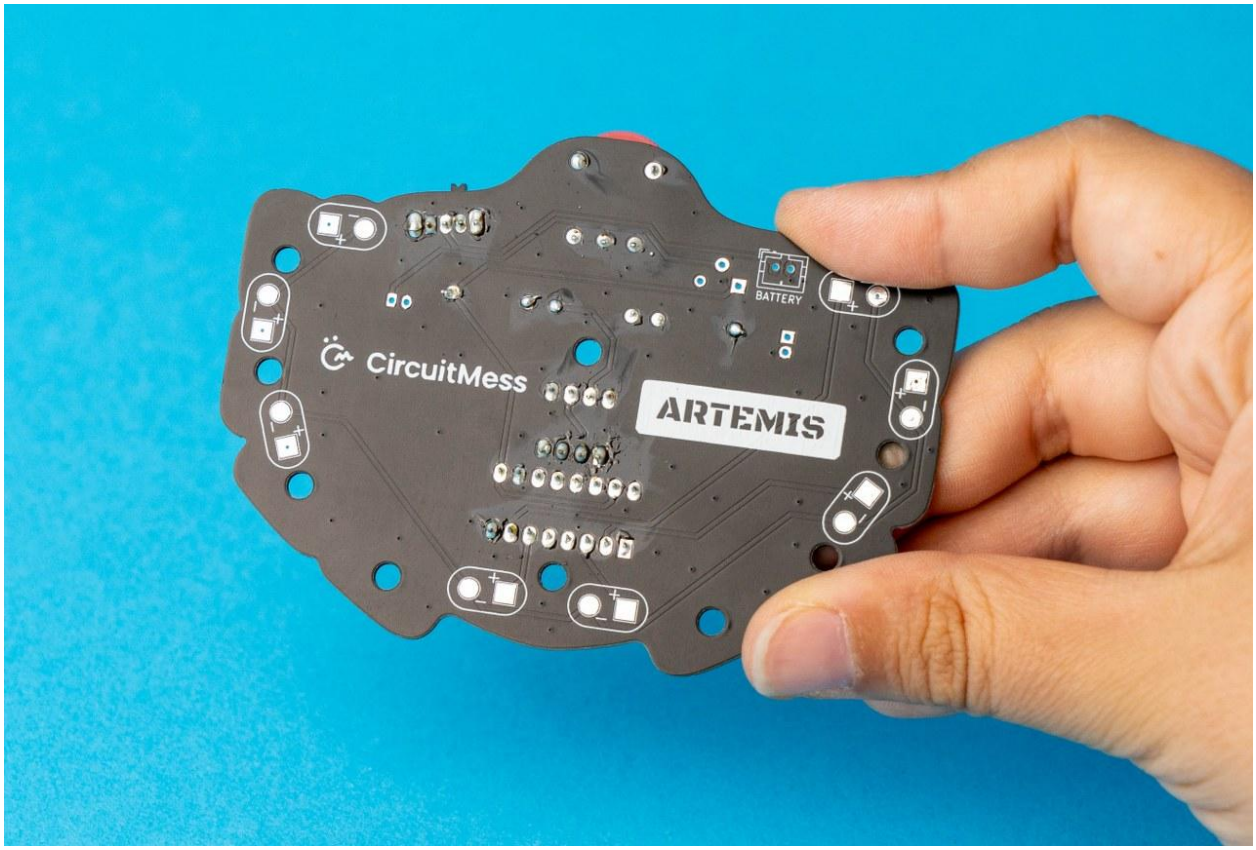


Place it here:



Turn the PCB around and start soldering:

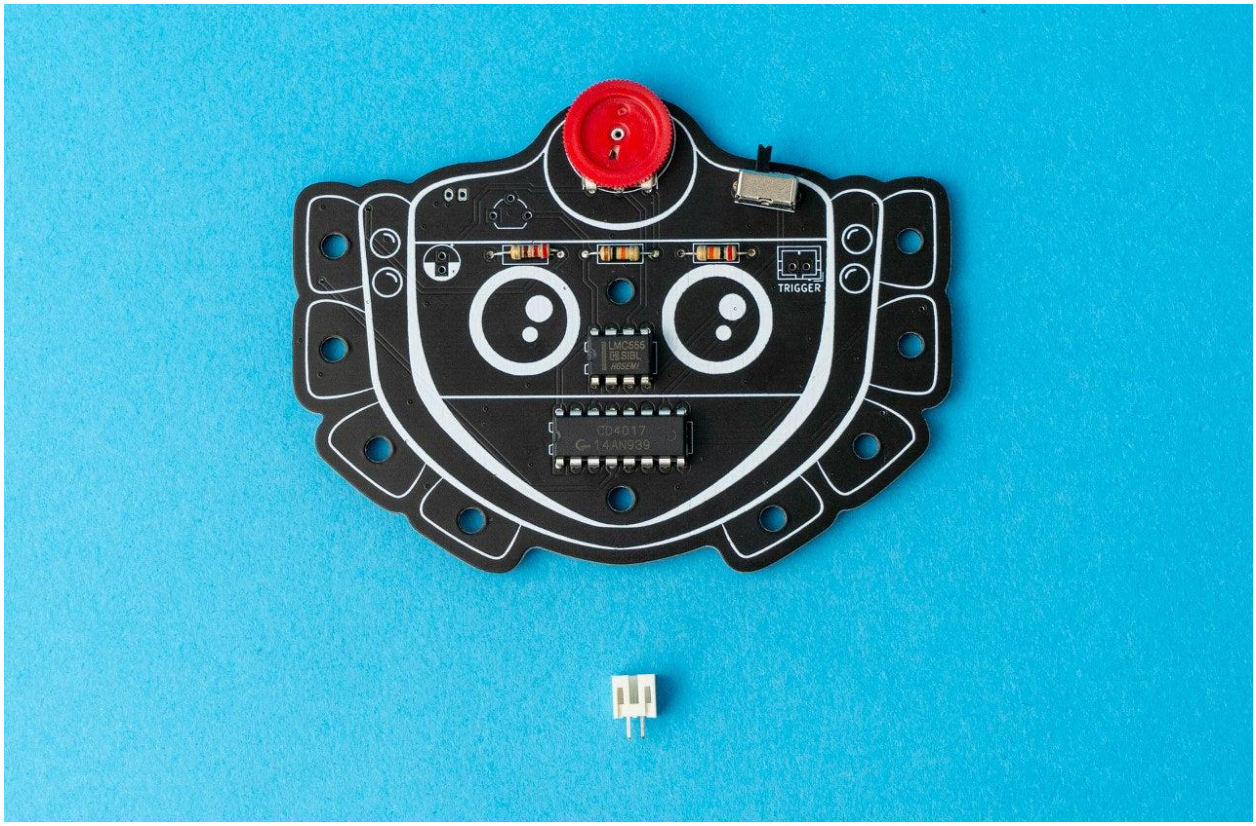

CircuitMess
ARTEMIS



Part five - Connector

The kit contains two connectors, however you'll only use one right now.

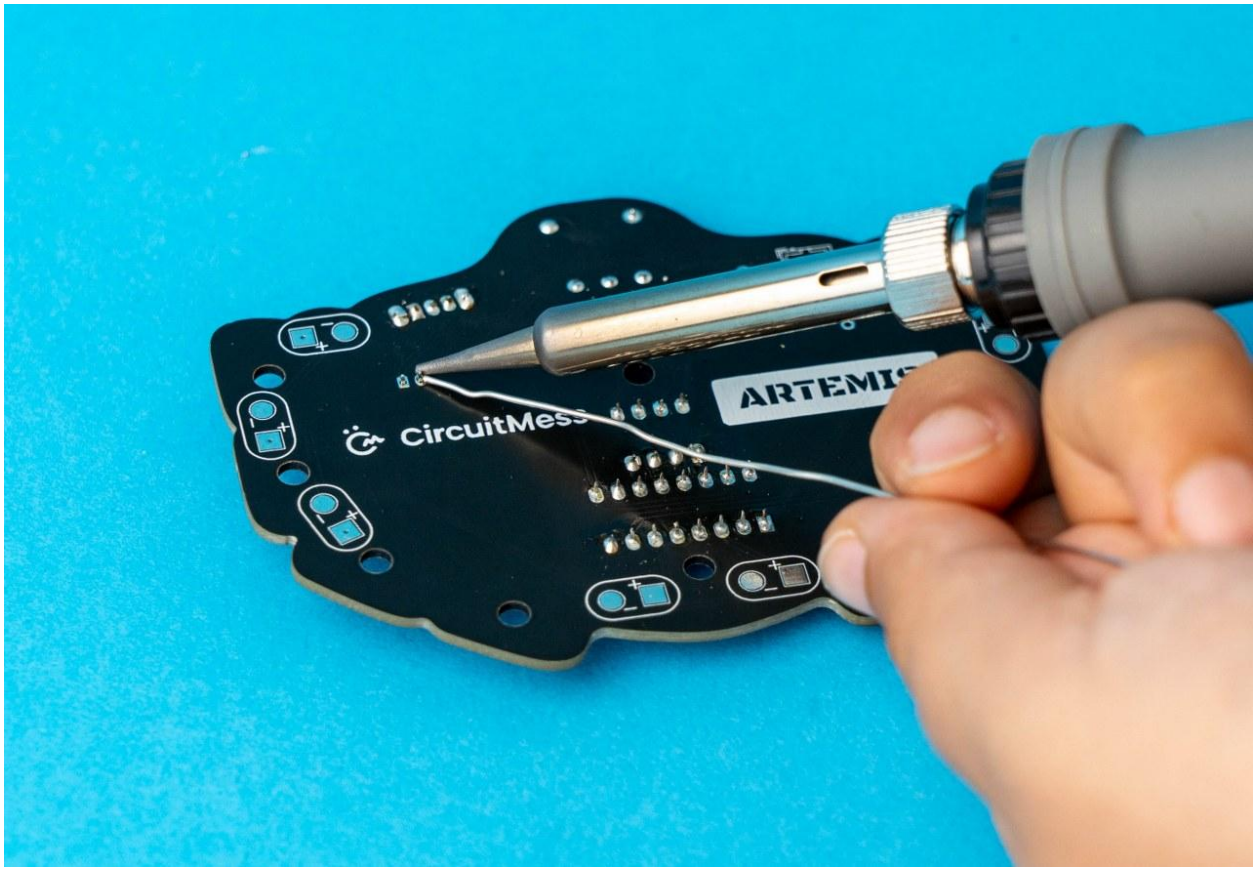
One will be placed on the front of the PCB, and the other one will go at the back.

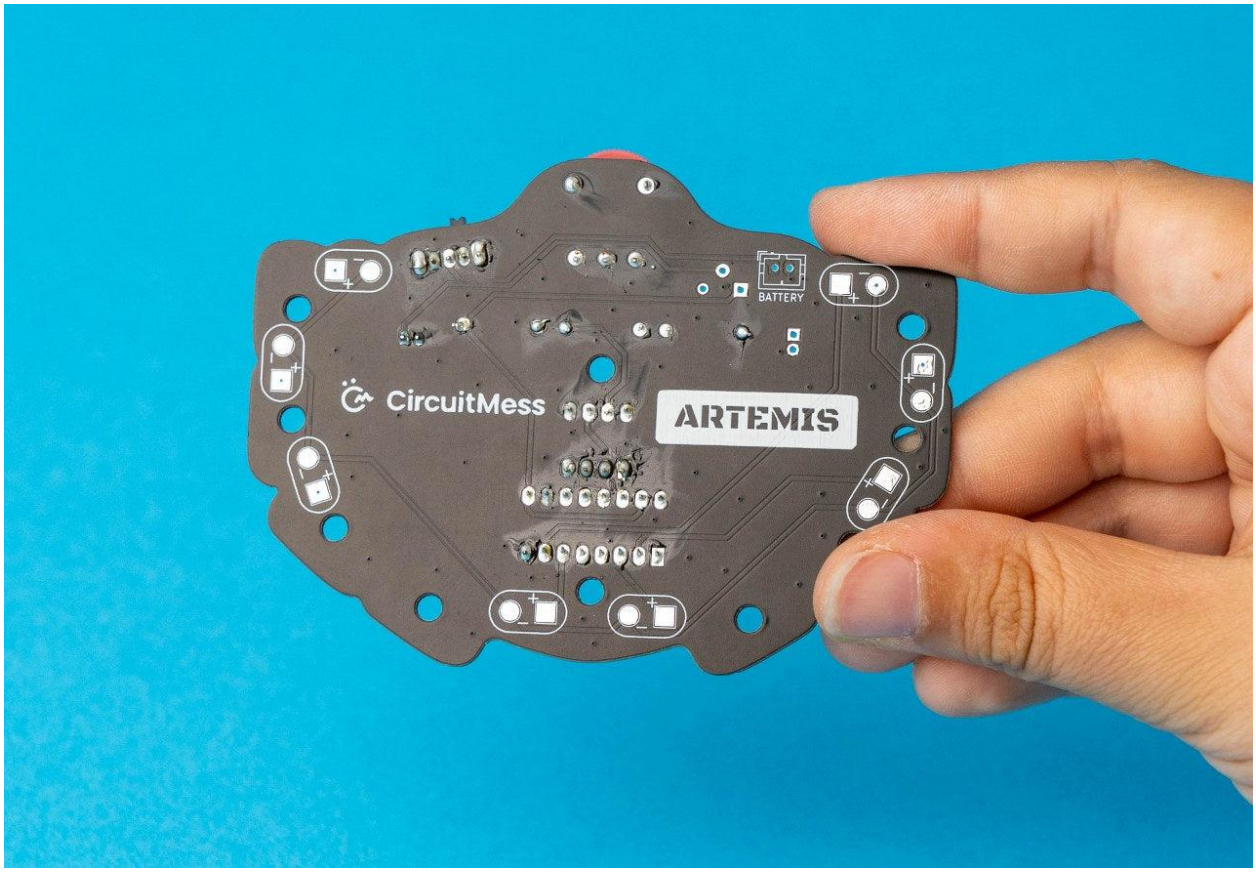


Place this one here:

Make sure that the cut-off side of the component matches the cut-off side on the PCB.

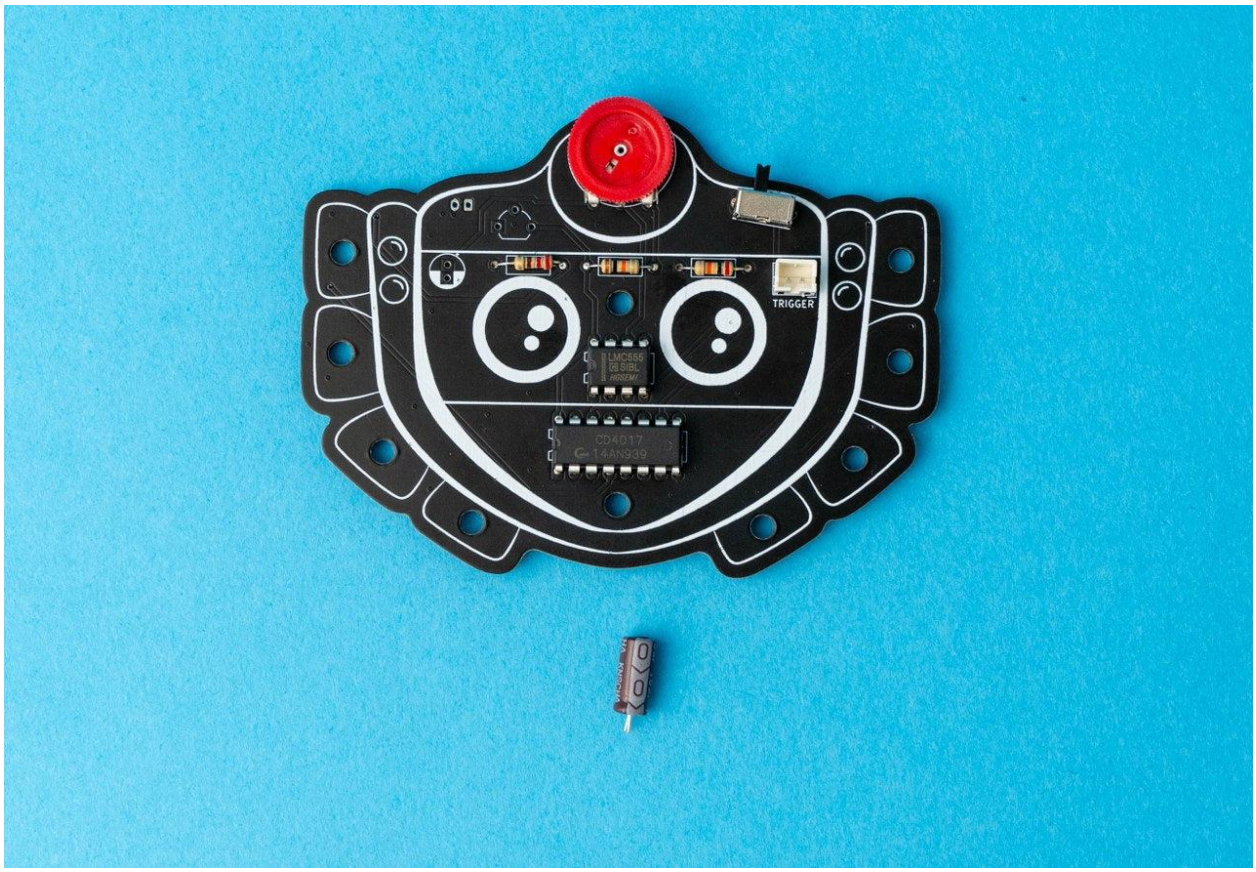
Turn it around and start soldering:


CircuitMess
ARTEMIS



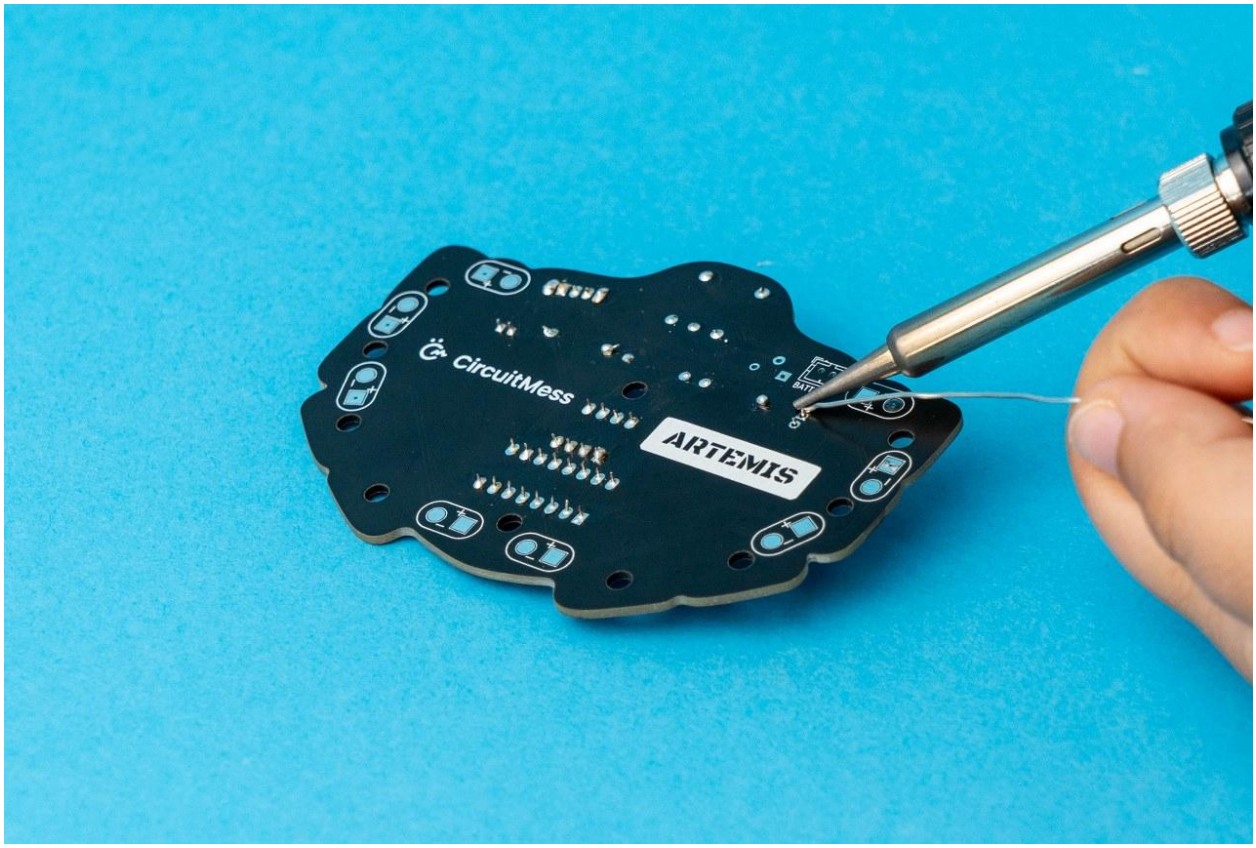
Part six - Capacitor

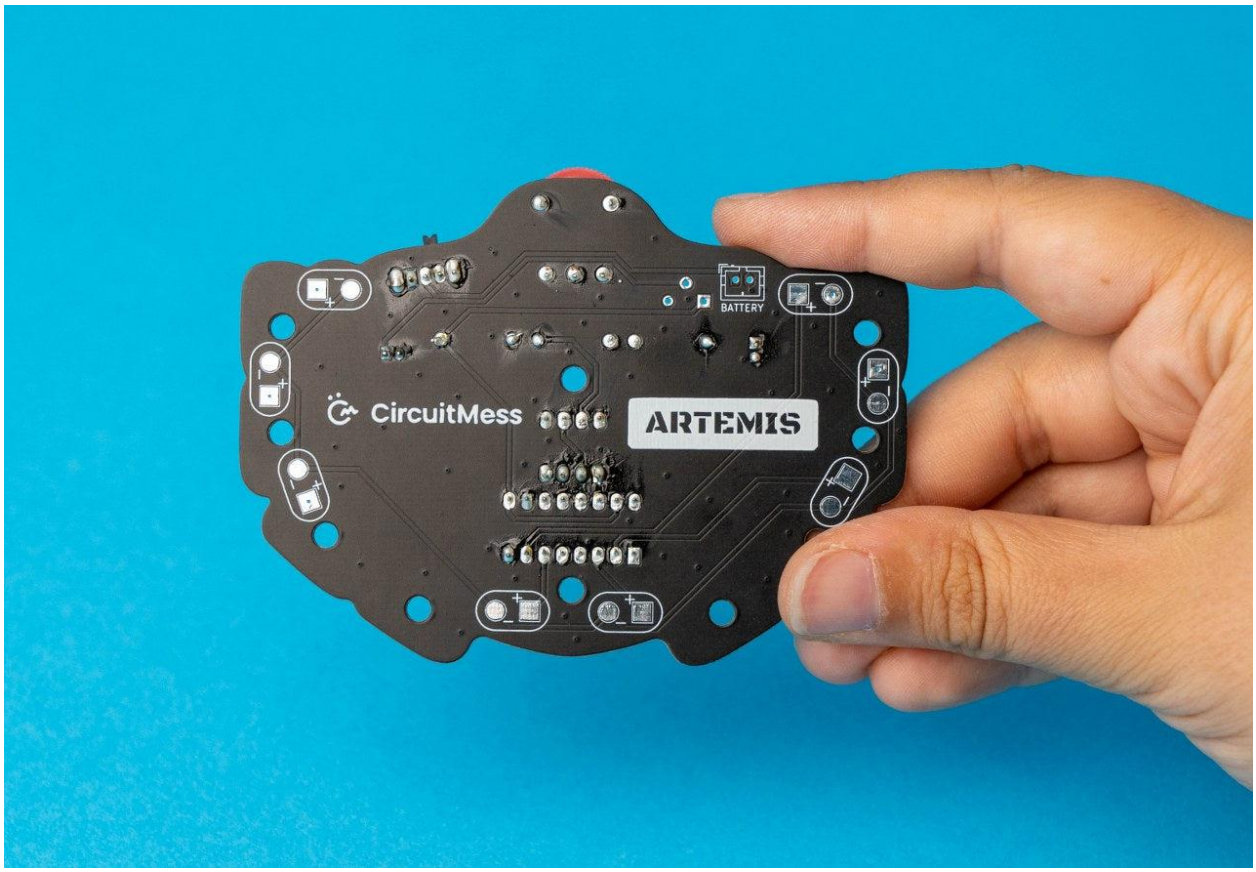
These are the components we'll need for the next step:



Place it here, making sure the white side of the capacitor matches the white side of the PCB:

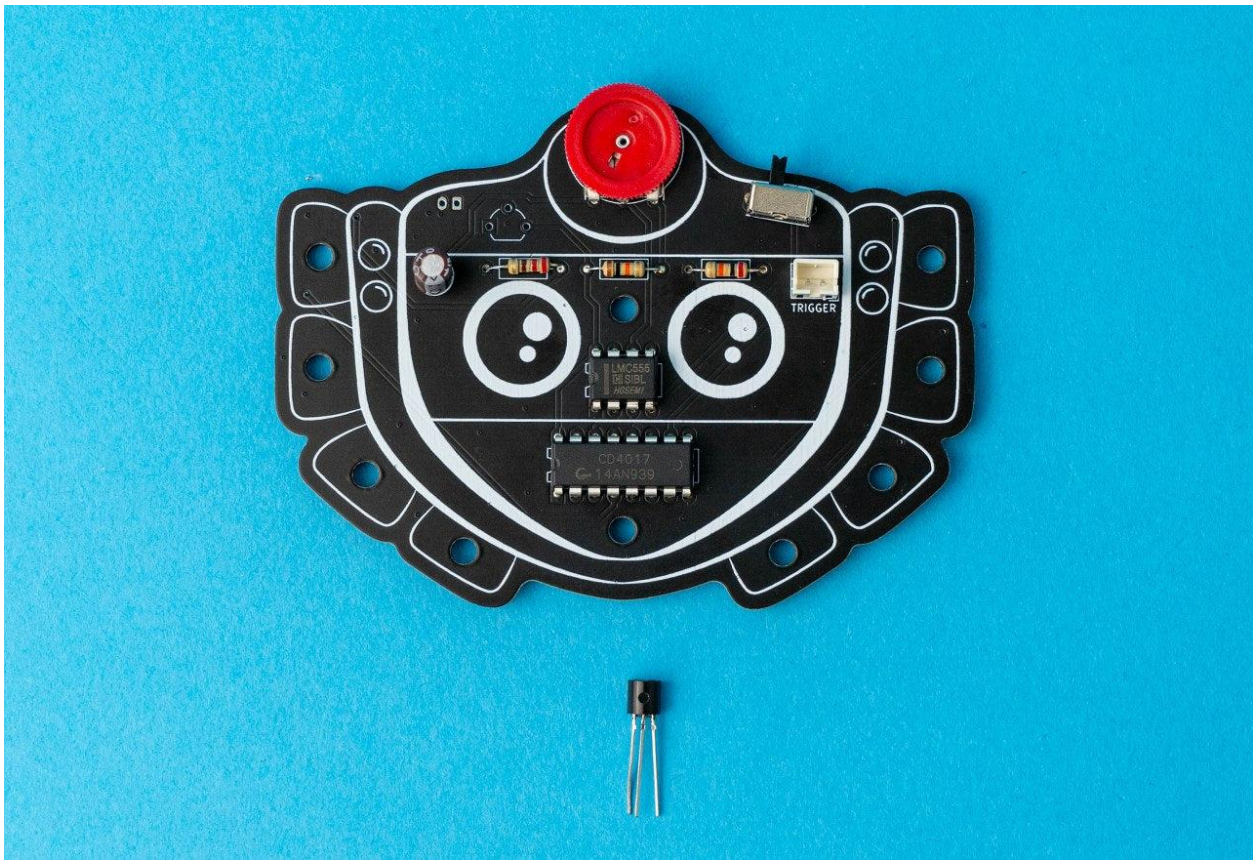
Turn it around and start soldering:


CircuitMess
ARTEMIS



Part seven - Transistor

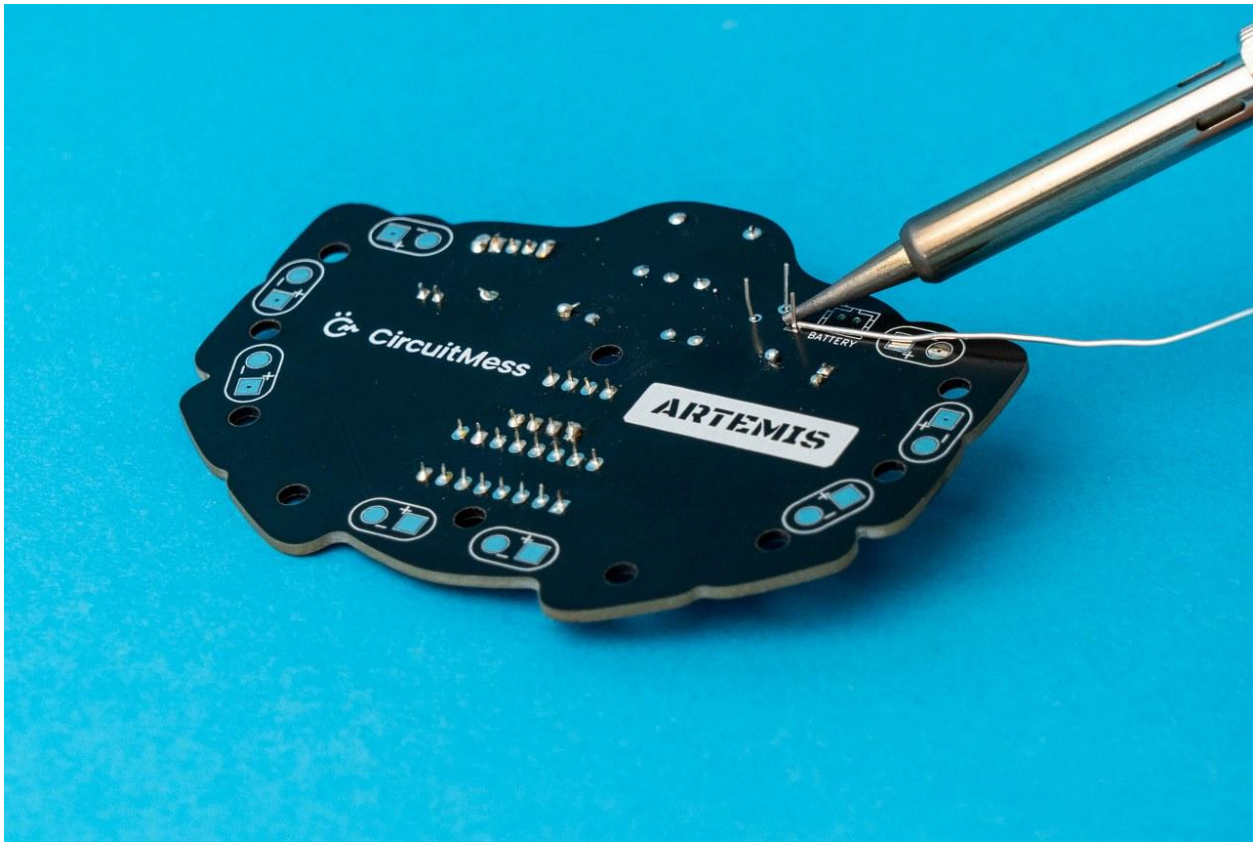
Take the PCB and the transistor:

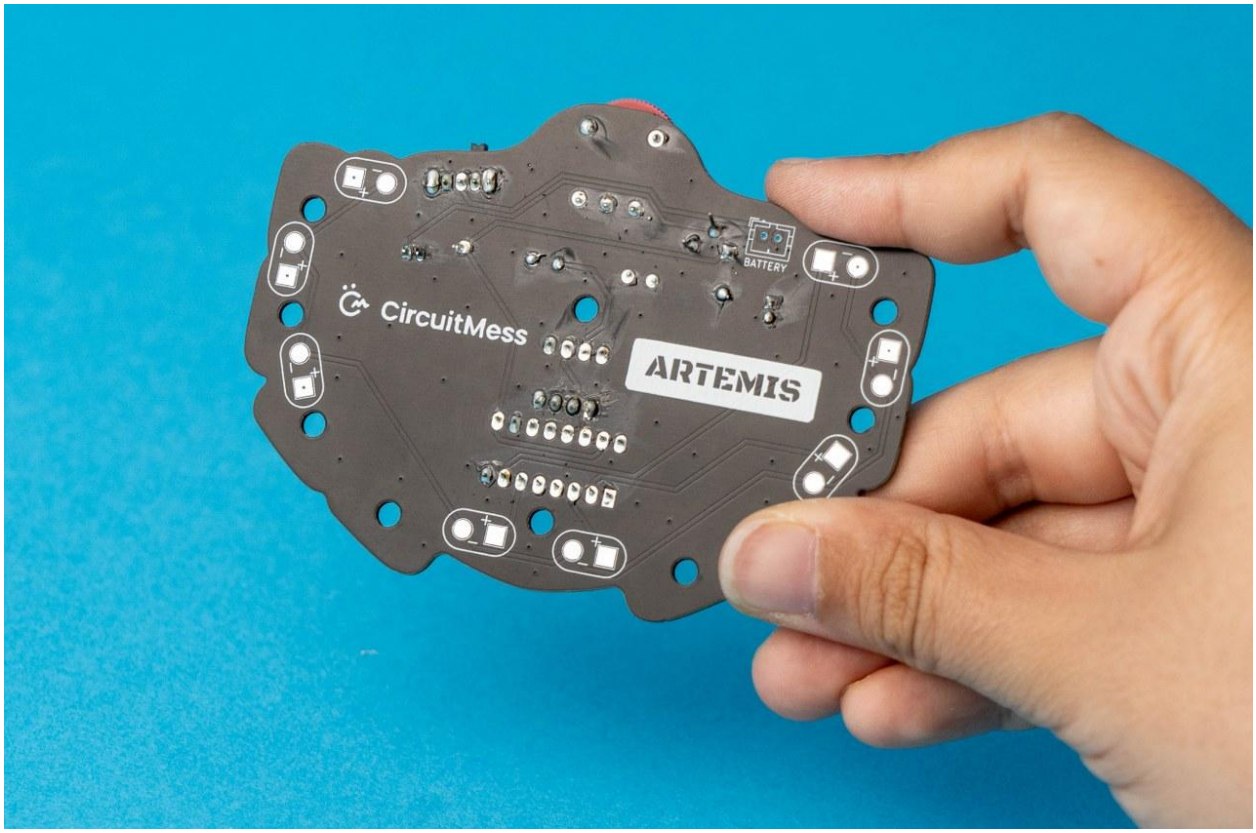


Place it here, and as always, make sure that the cut-off side matches the cut-off side on the PCB.

The transistor does not have to get all the way to the board.

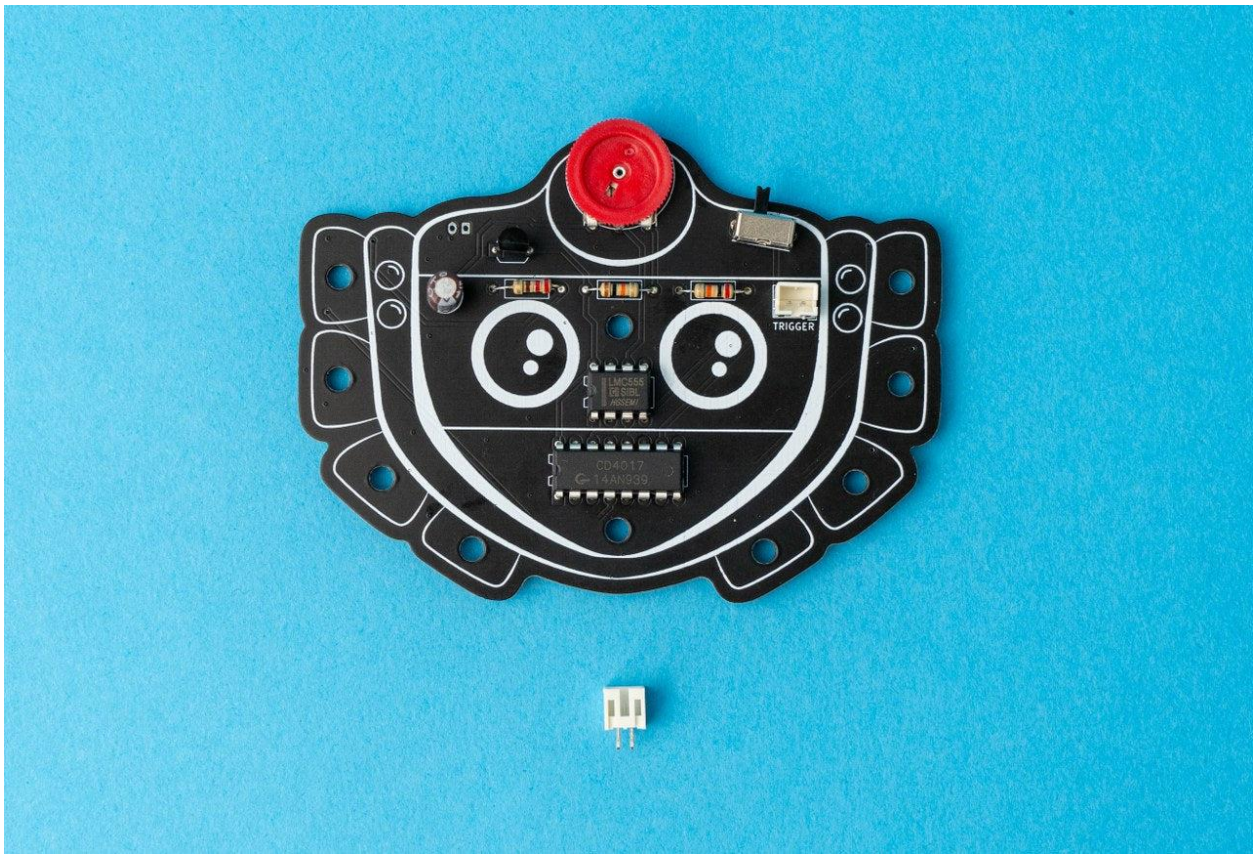
Turn the board over and start soldering:


CircuitMess
ARTEMIS
BATTERY


CircuitMess
ARTEMIS
BATTERY

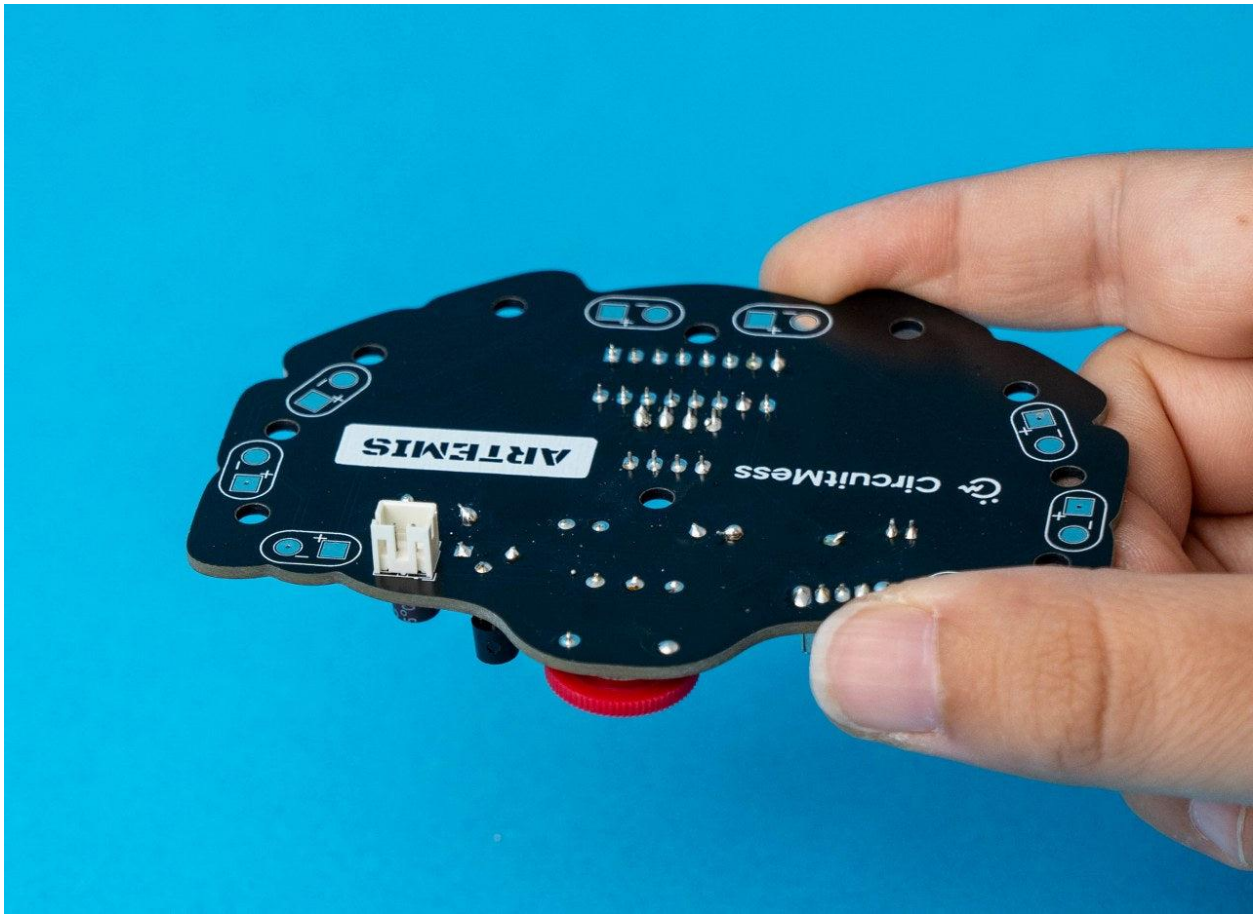
Part eight - Second connector

Take the second connector now:



This one will go on the back of the PCB.

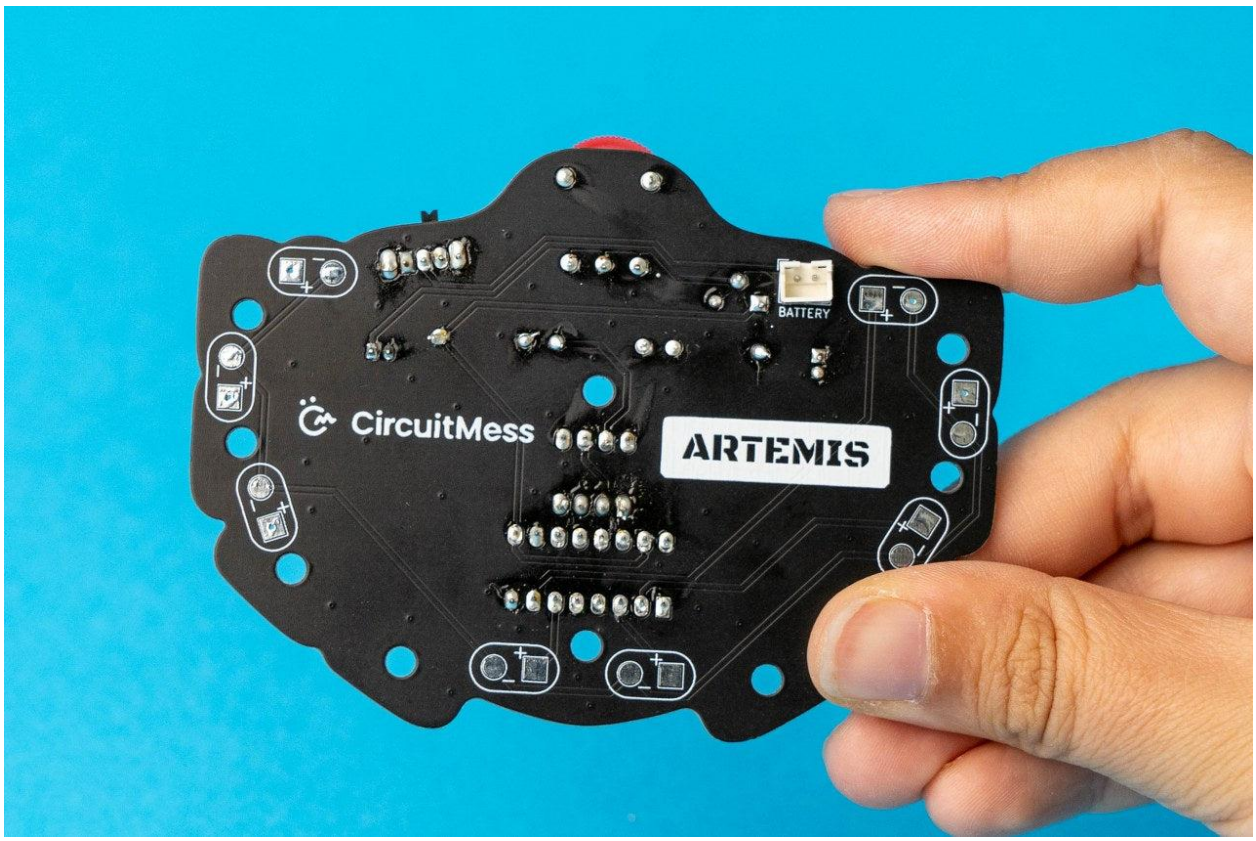
Ensure that the cut-off side of the connector matches the cut-off side on the board:



Flip the board and start soldering:

This is what the board should look like right now:

TRIGGER

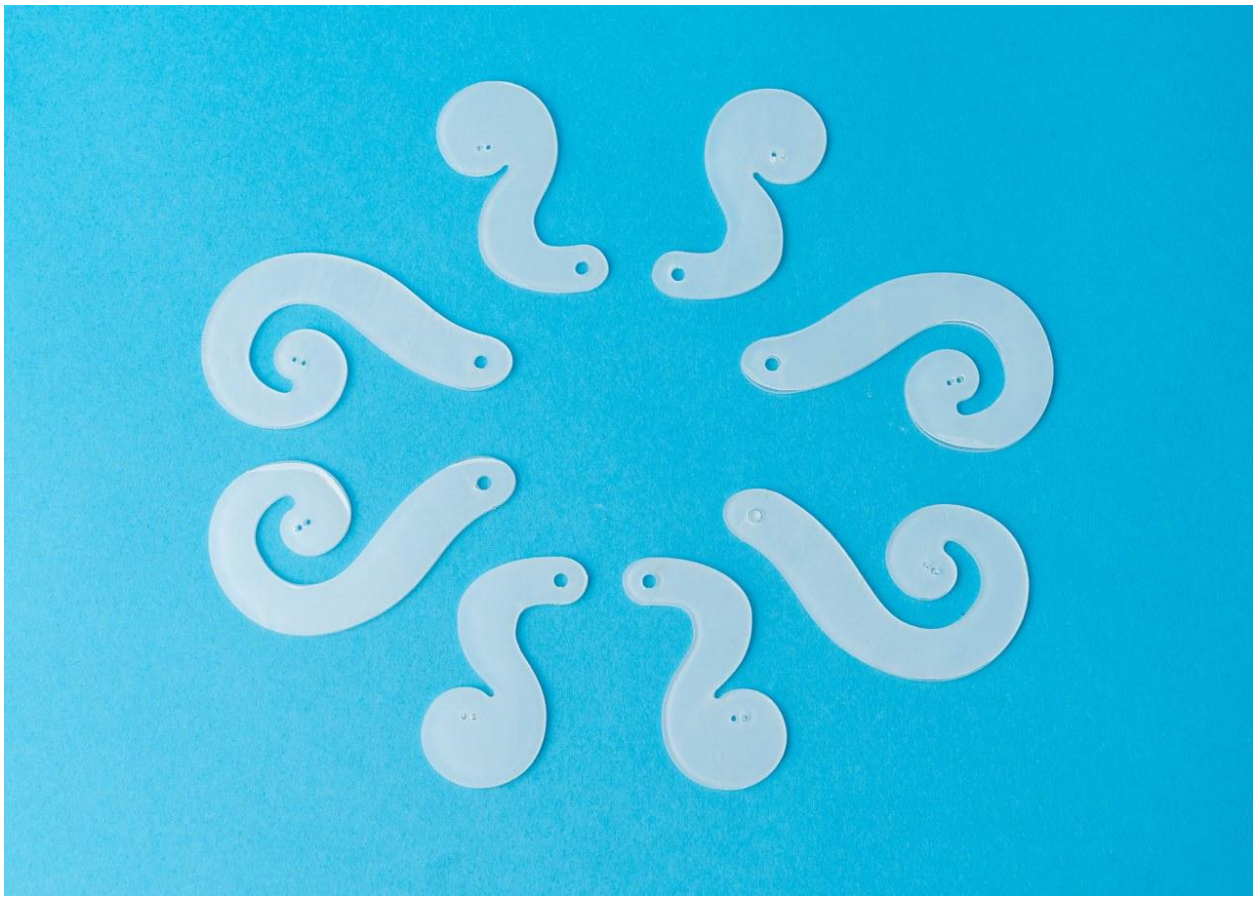

BATTERY
CircuitMess
ARTEMIS

Let's give Artemis a crazy look!

Now, we'll put the casings on Artemis.

But don't turn off your soldering iron just yet; we'll need it again.

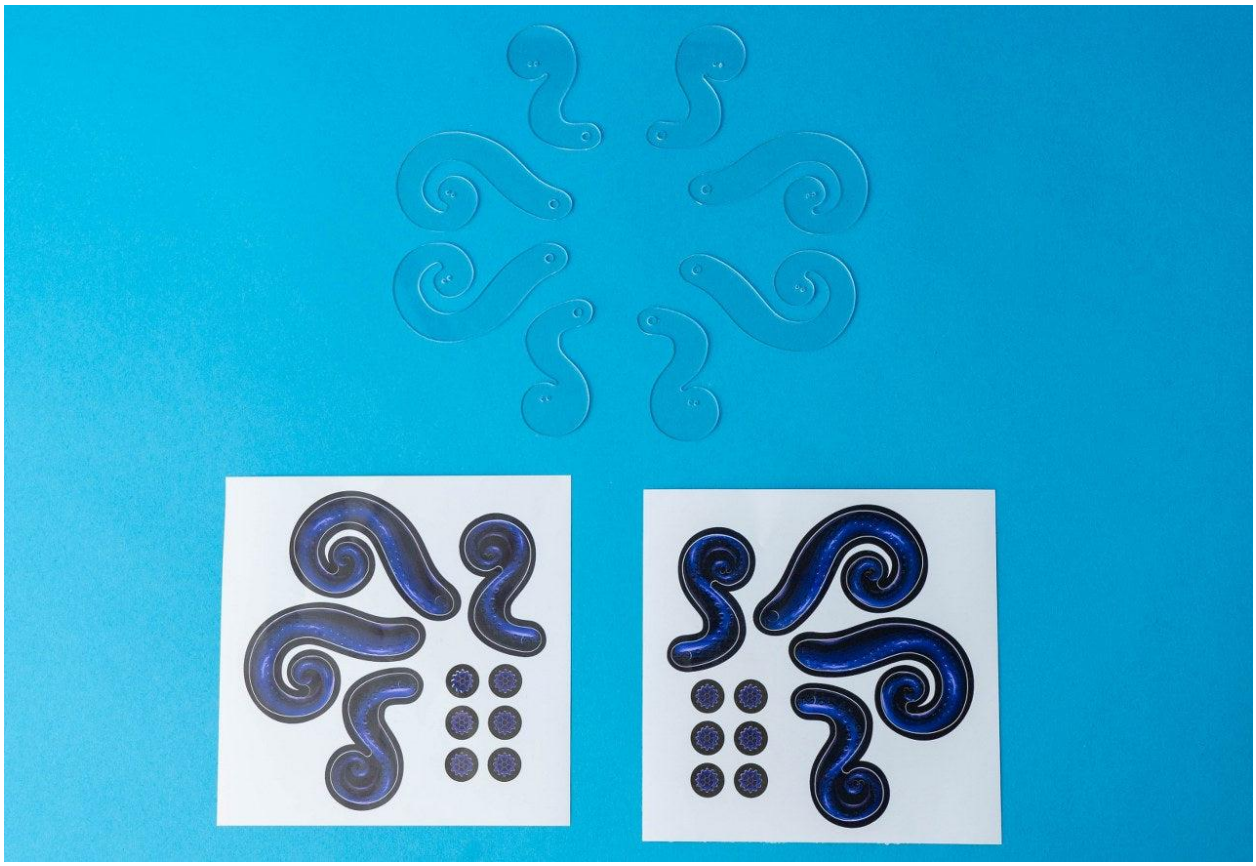
Firstly, take all of the acrylic casings that look like this.
There should be eight of them:



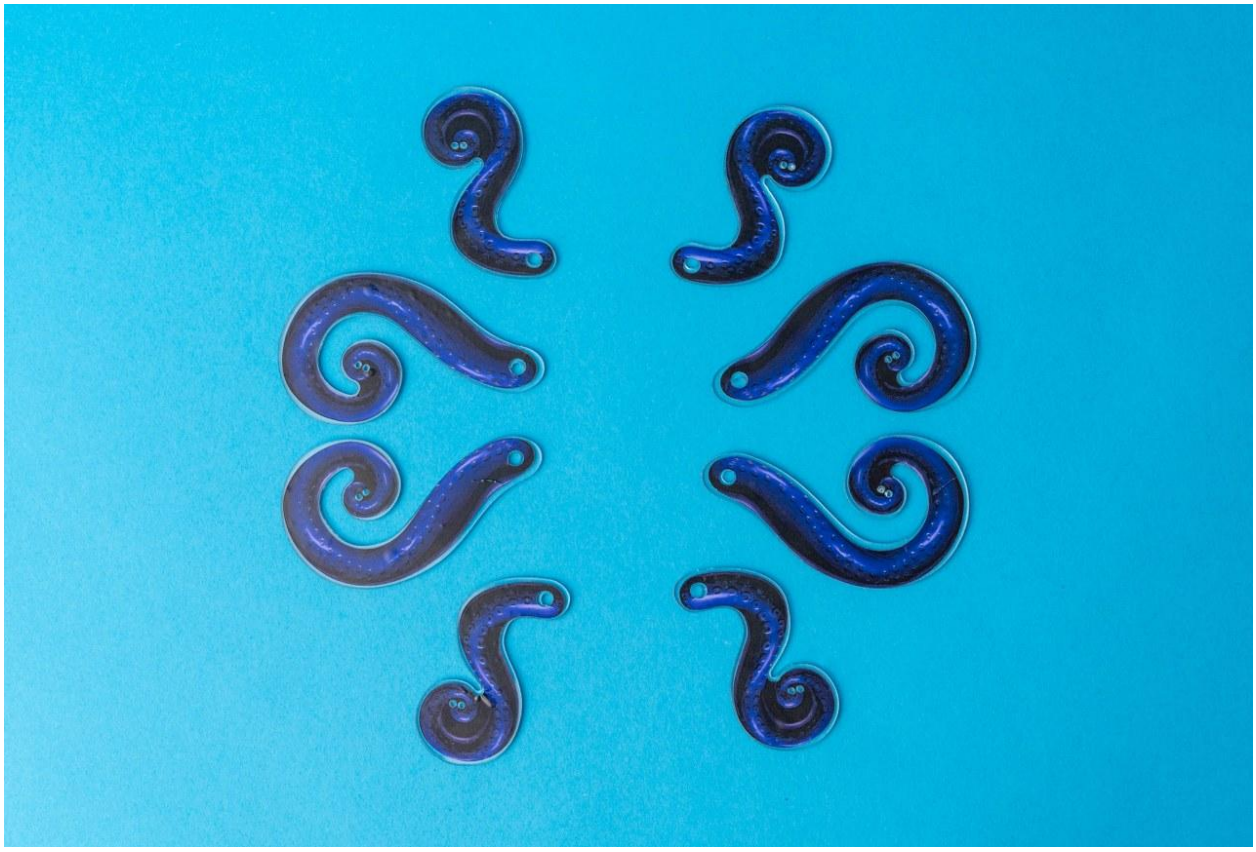
Make sure to remove the acrylic parts' protective layers:

Don't forget the other side:

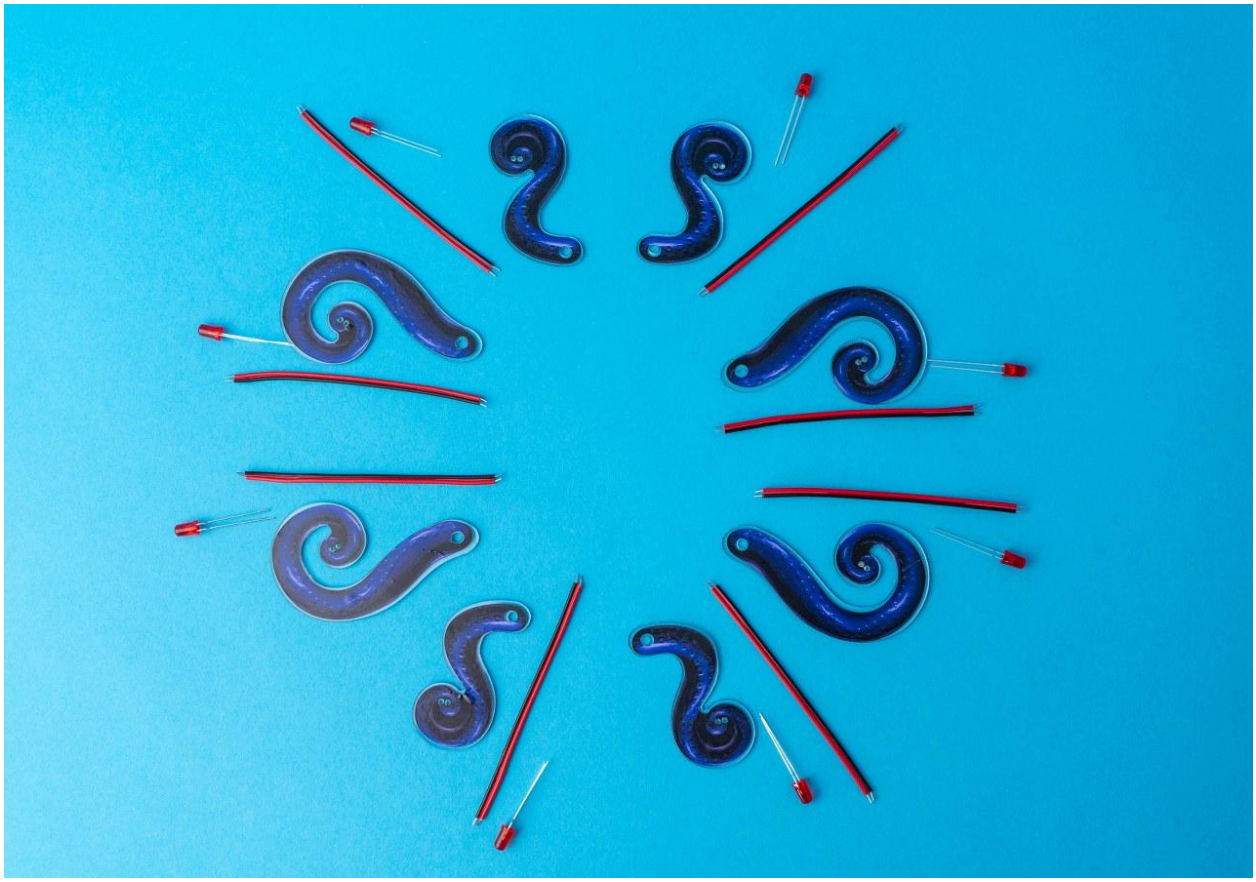
It's time to give those parts a crazy look with the stickers you got in the kit:



Take a close look at this photo and make sure that this is the way you placed the stickers on the acrylic parts:

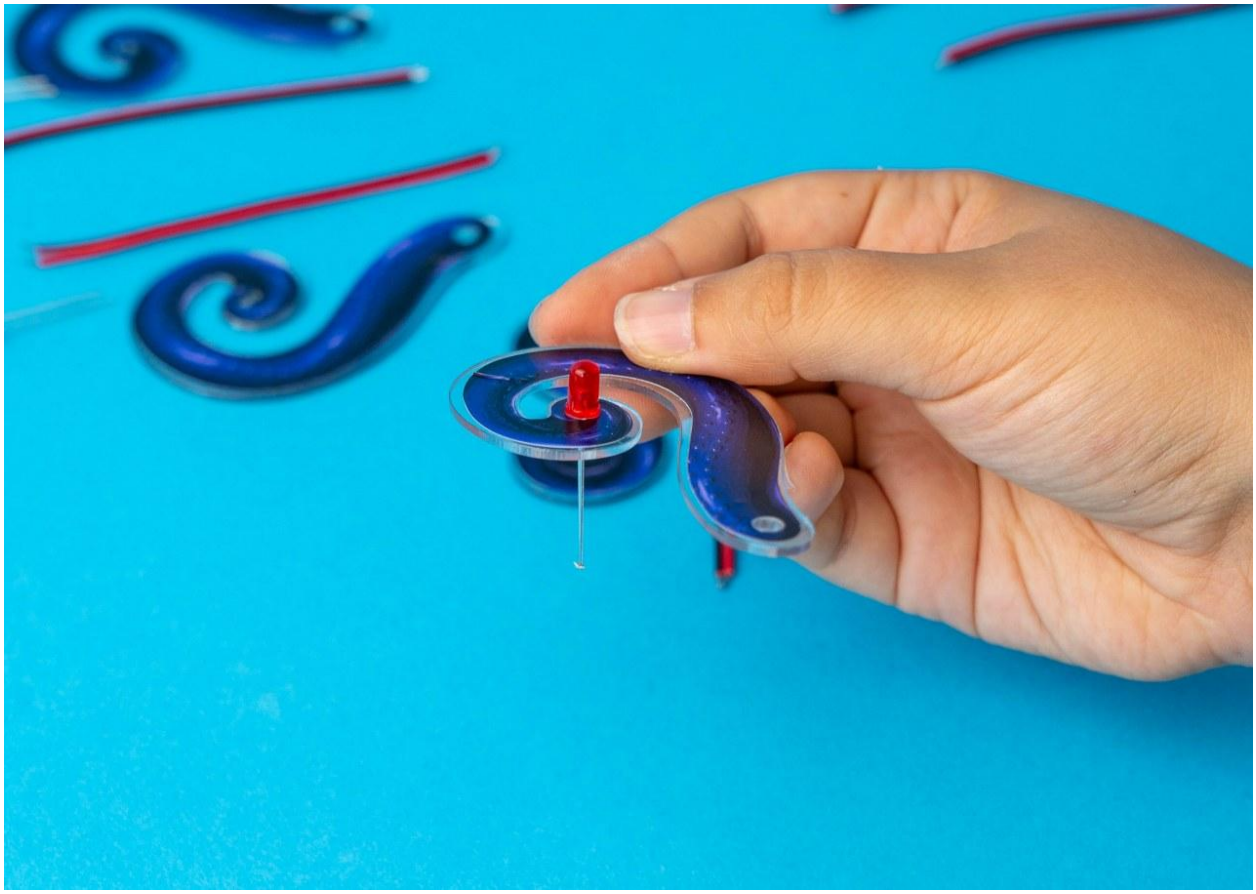


If everything looks like in the photo above, take the wires and the LEDs.



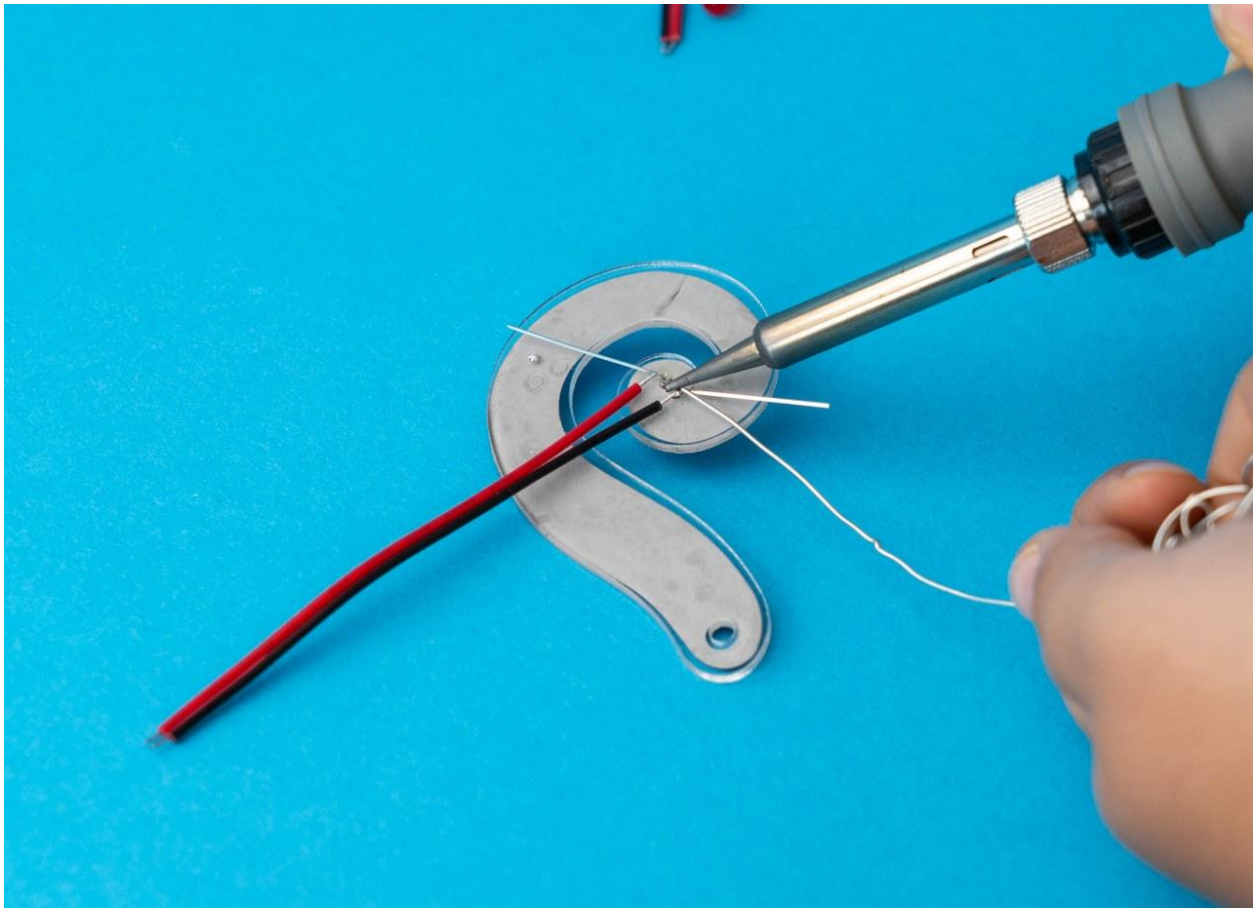
Now, we need your full attention!

Take one LED and one of the acrylic parts and do this:



As you can see, one of the LED's legs is longer than the other. The length represents polarity. The longer leg (+) is positive, while the shorter leg (-) is negative.

Make sure the red wire is soldered on the longer leg and the other side of the red wire is soldered on the PCB's plus sign.



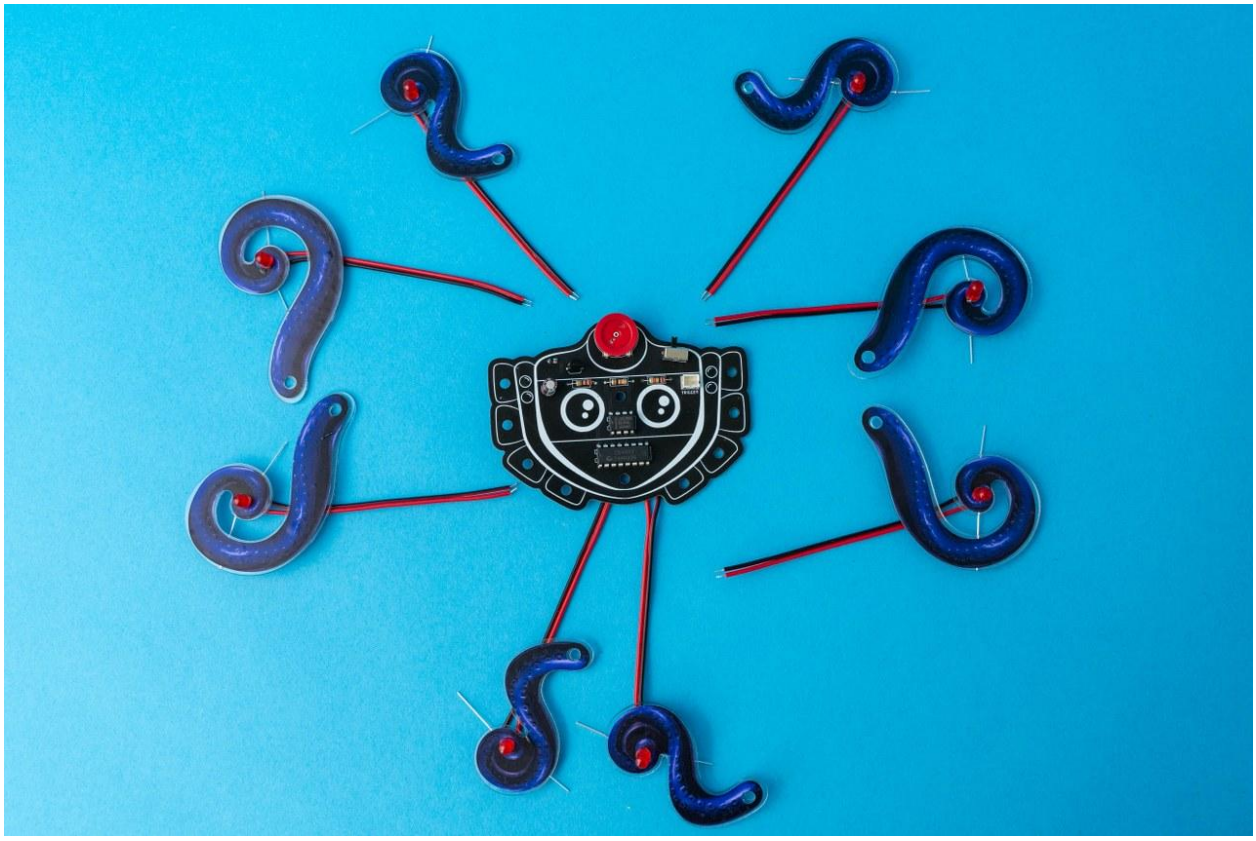
To begin, solder all of the LEDs and wires together.

Make sure not to place the tip of the soldering iron directly on the acrylic part because it will start melting.

The best way to do it is to attach the tip of the wire to one of the LED legs (preferably closer to the acrylic part) and begin soldering on that connection.

You only need a small amount of solder to connect them.

This is what you should have once you solder all the wires and LEDs together.



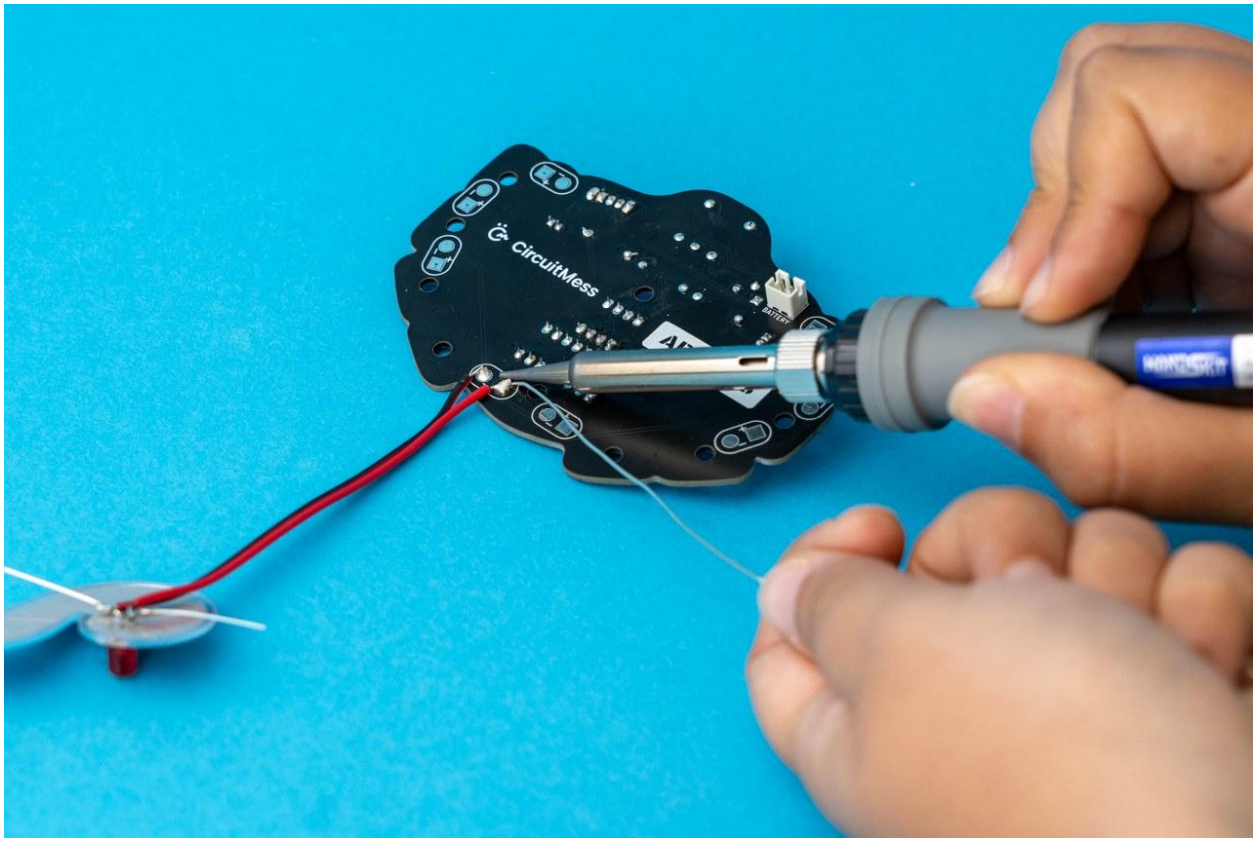
Now is the time to connect the other end of the wire to the PCB.

As mentioned previously, the red part of the wire (the one connected to the longer LED leg) goes to the plus sign.

Put the wire on the silver part and start soldering.
You don't need to use a lot of solder. Just enough to connect the wire.

Let it cool for 2 seconds after applying solder to ensure that everything is linked and nothing is falling off.

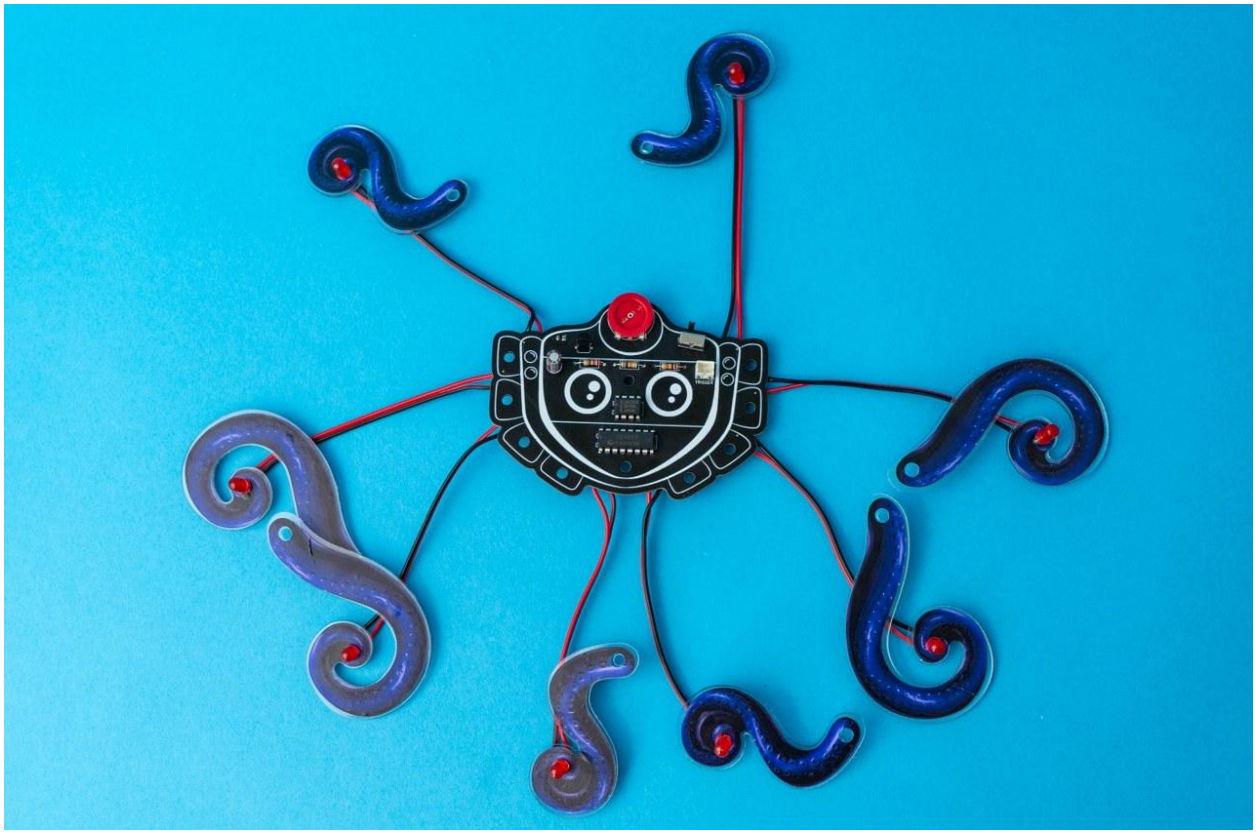
Check it by gently pulling the wire.

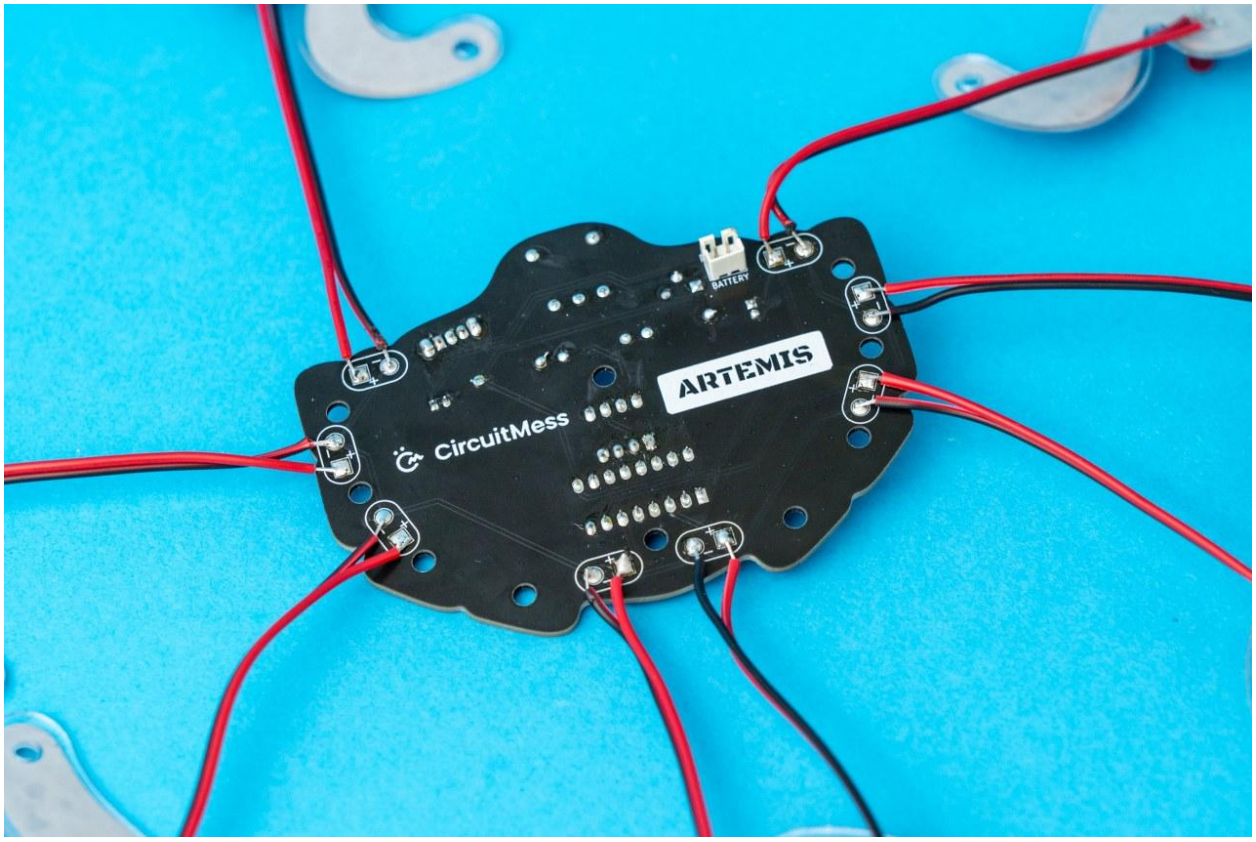


Now, take the pliers and cut the rest of the legs of the LED.

Make sure to turn it away from your eyes.

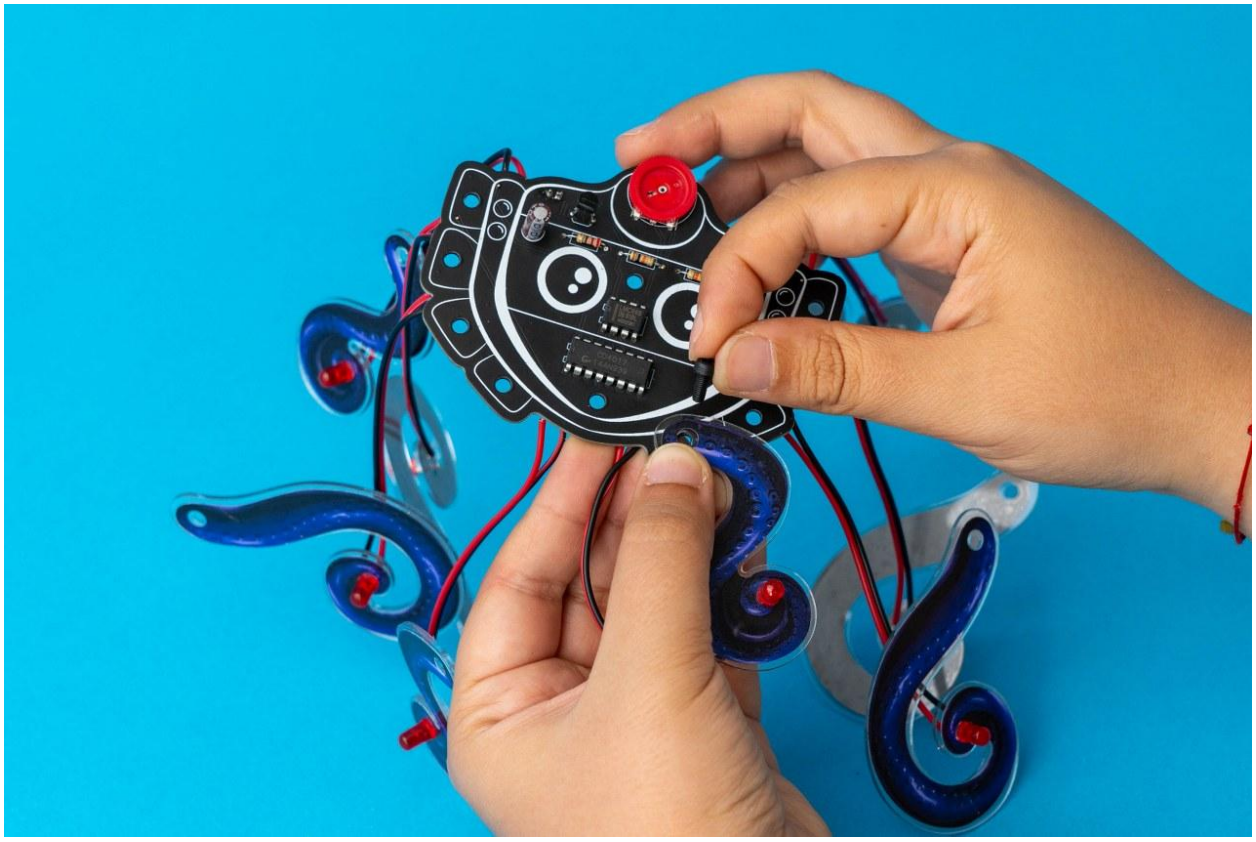
When you connect all of the wires and LEDs to the board, your Artemis should look like this.

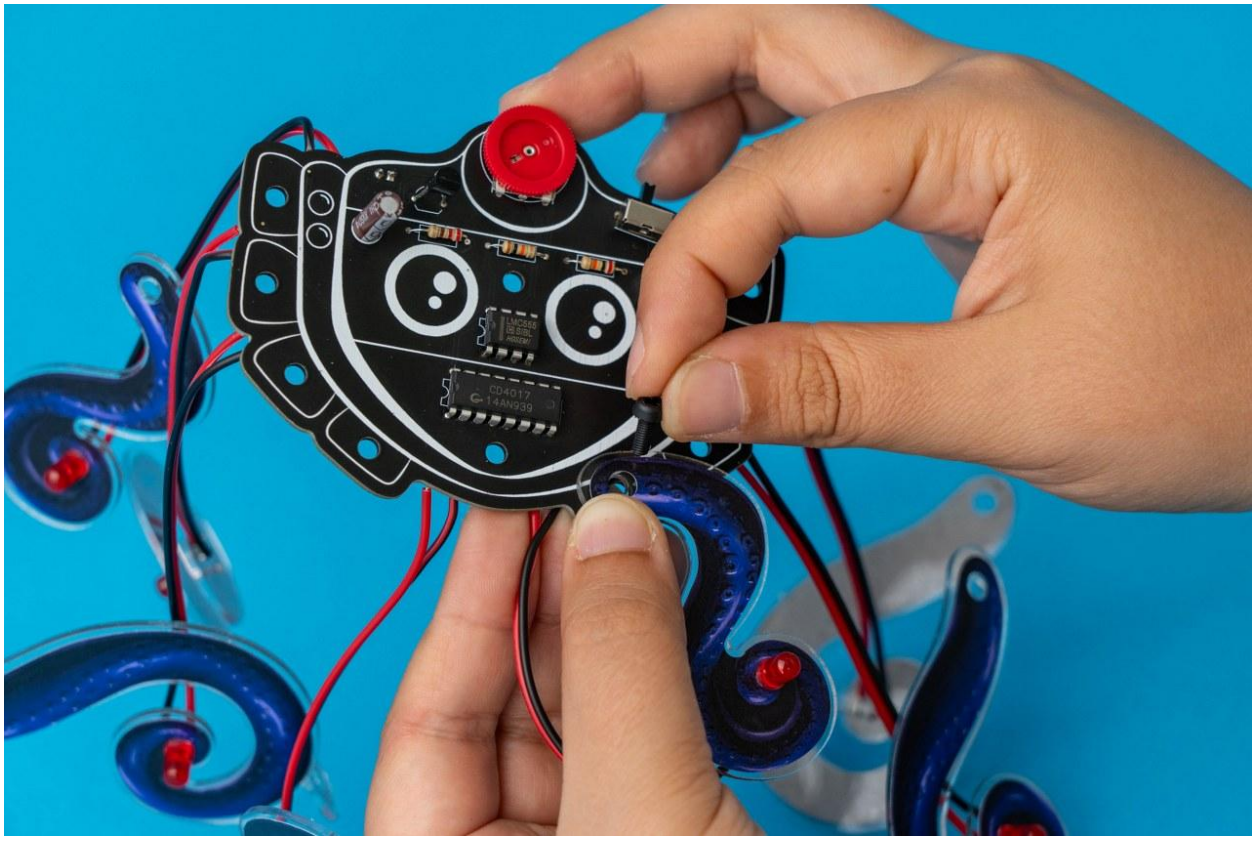



BATTERY
ARTEMIS
CircuitMess

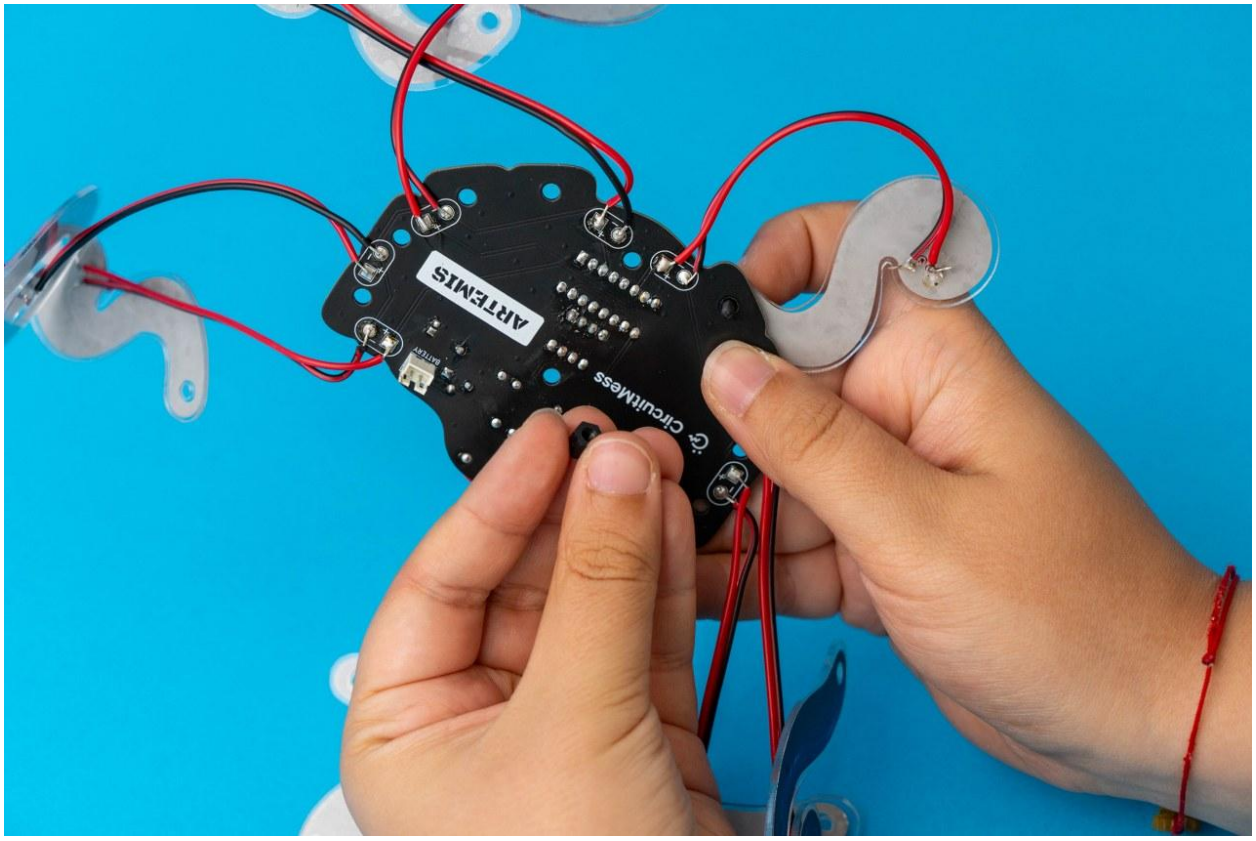
Take the black bolts now and the little black spacers.

Put the bolts through the acrylic part and the PCB like this:

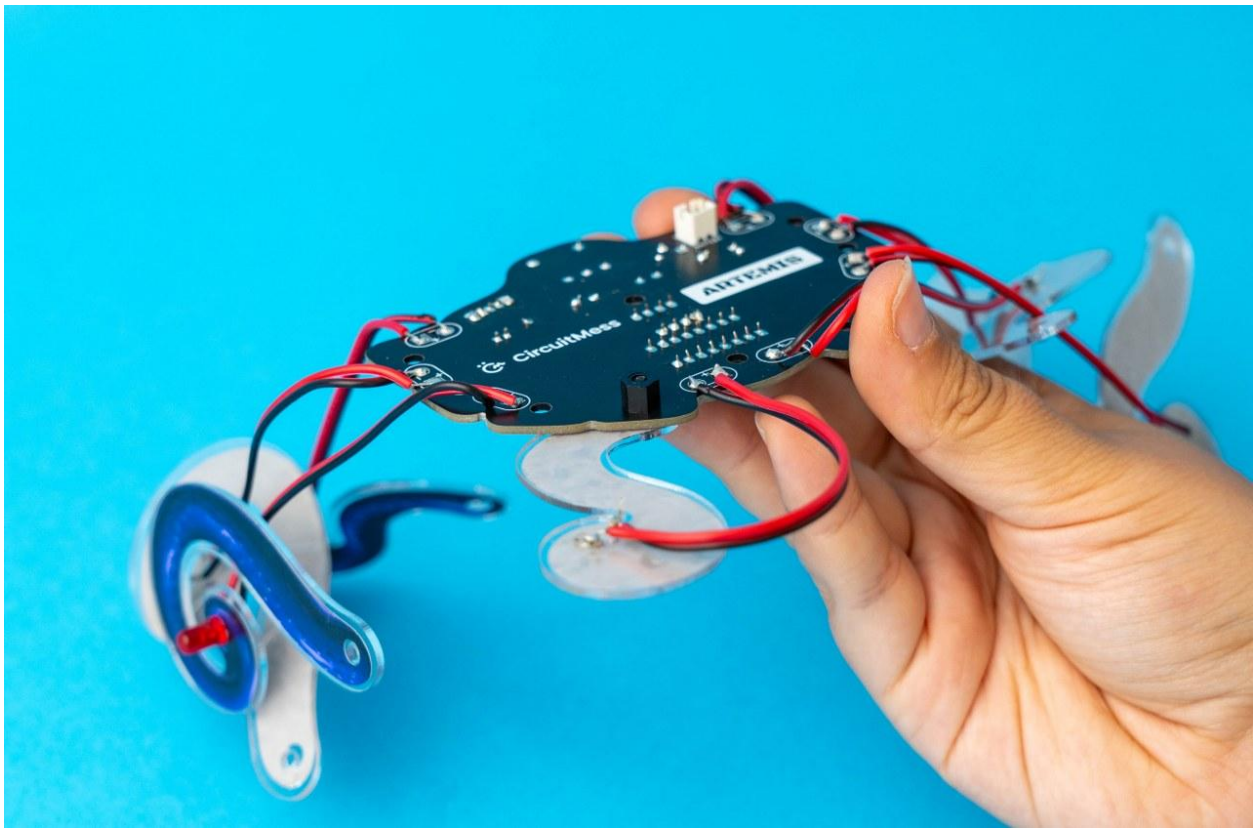




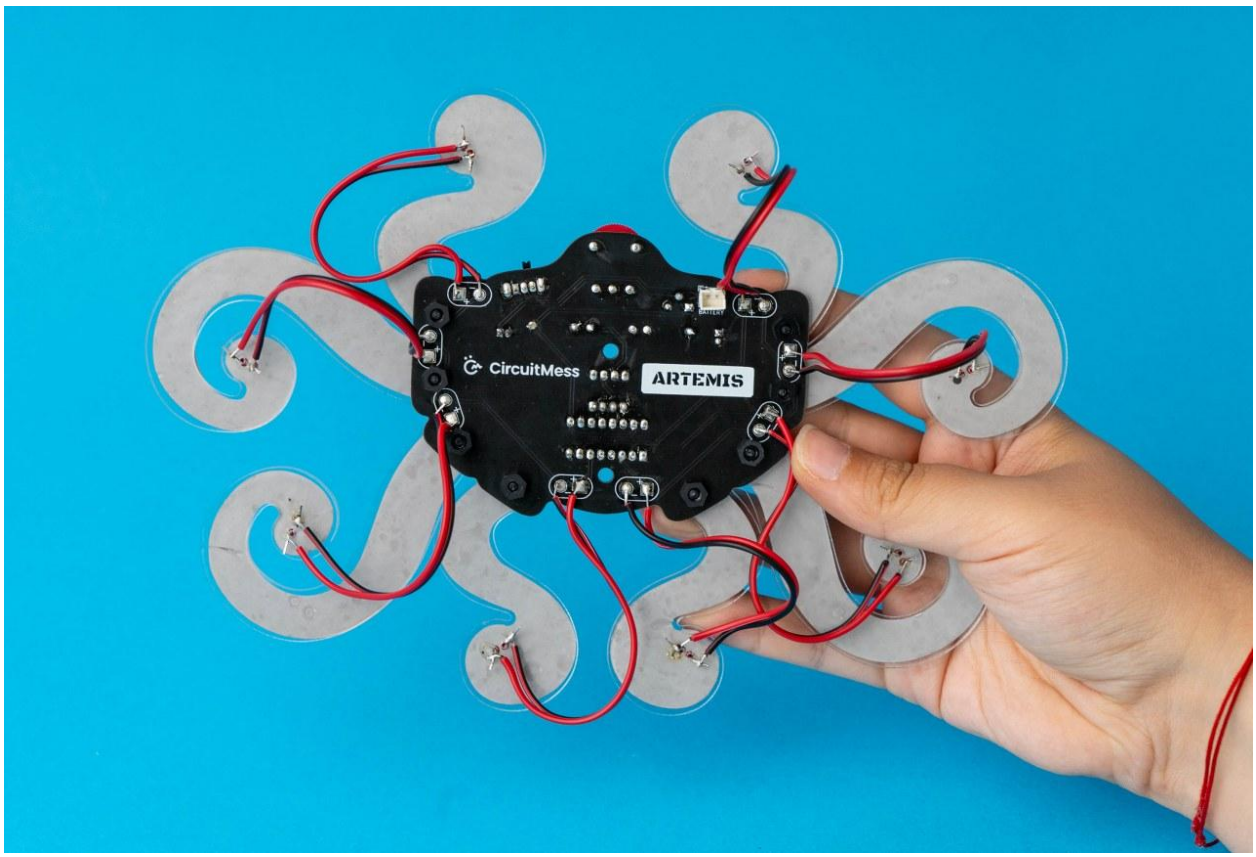
Take the spacer and fasten it with your fingers on the back side:



This is what it should look like:

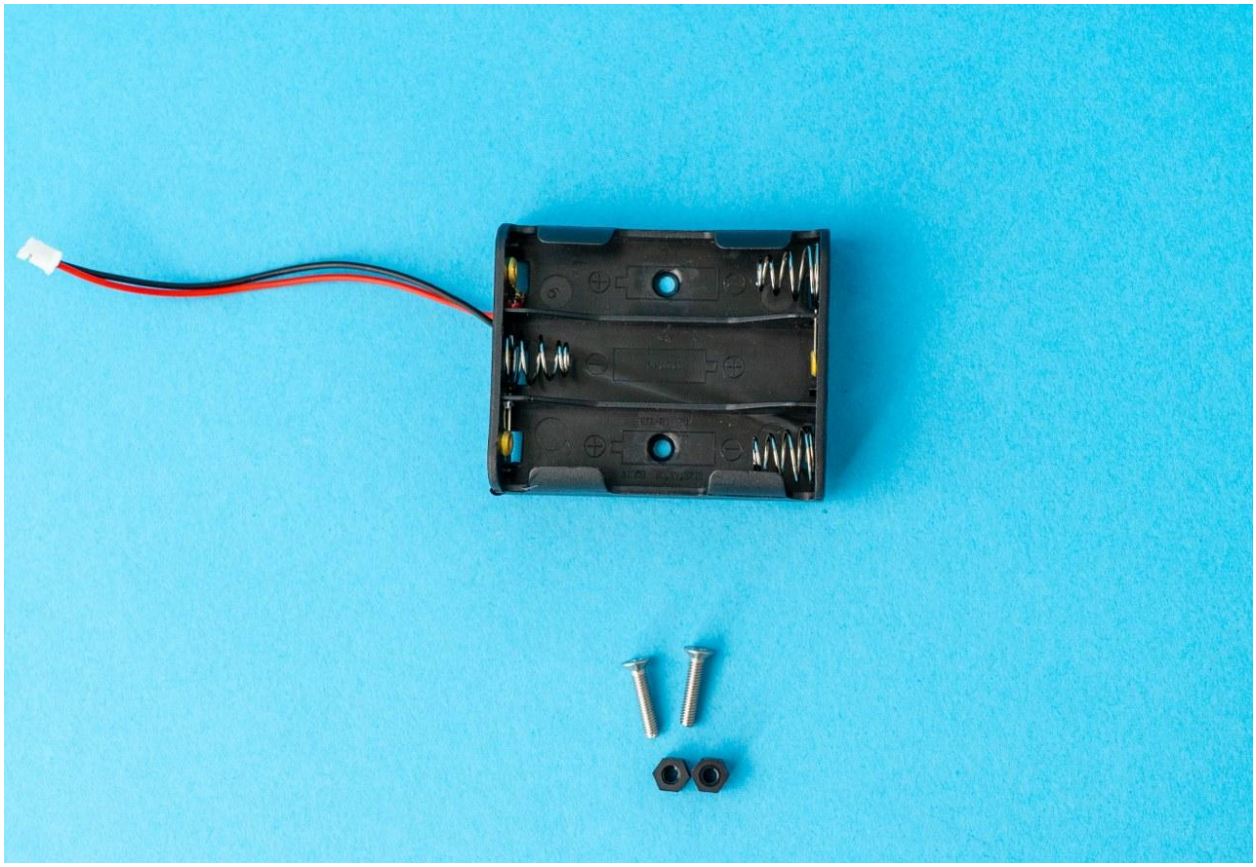


Repeat the step for all acrylic parts:

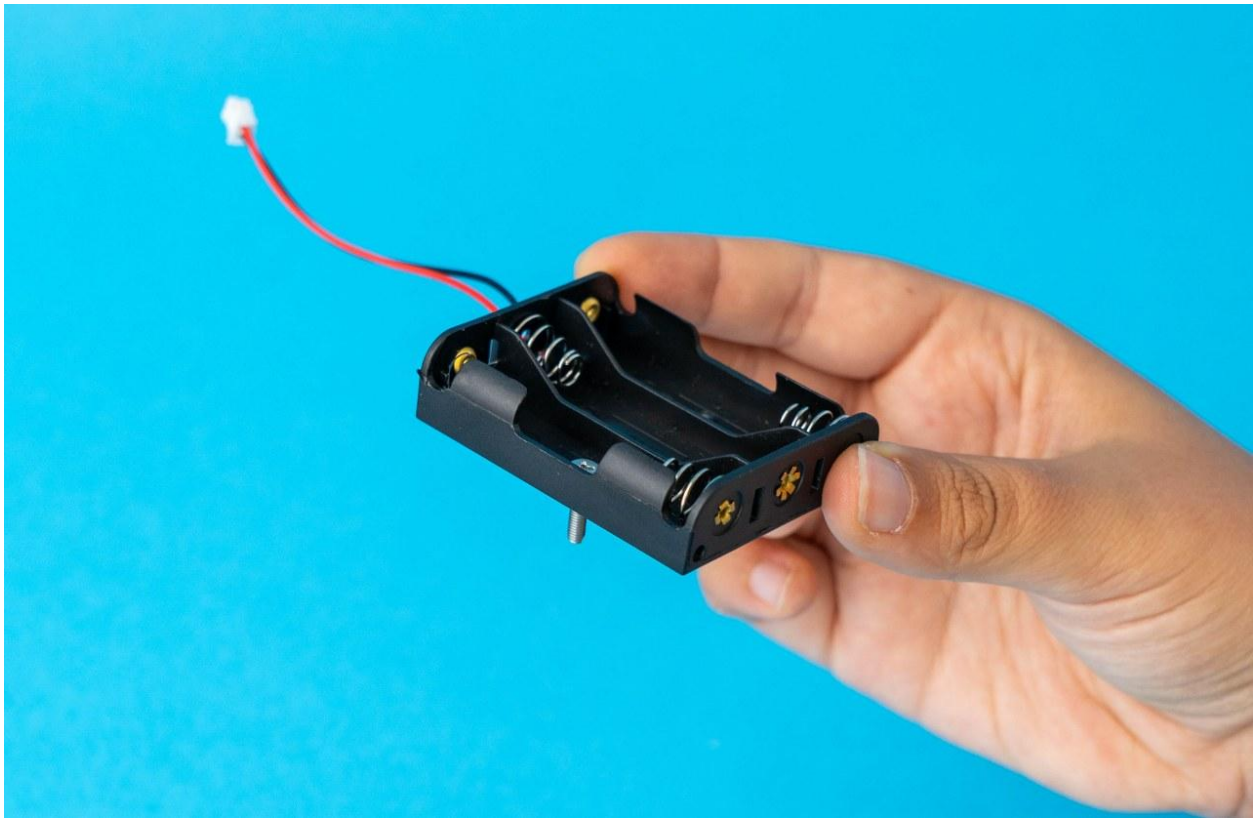

CircuitMess
ARTEMIS

One thing that's missing is the battery holder.

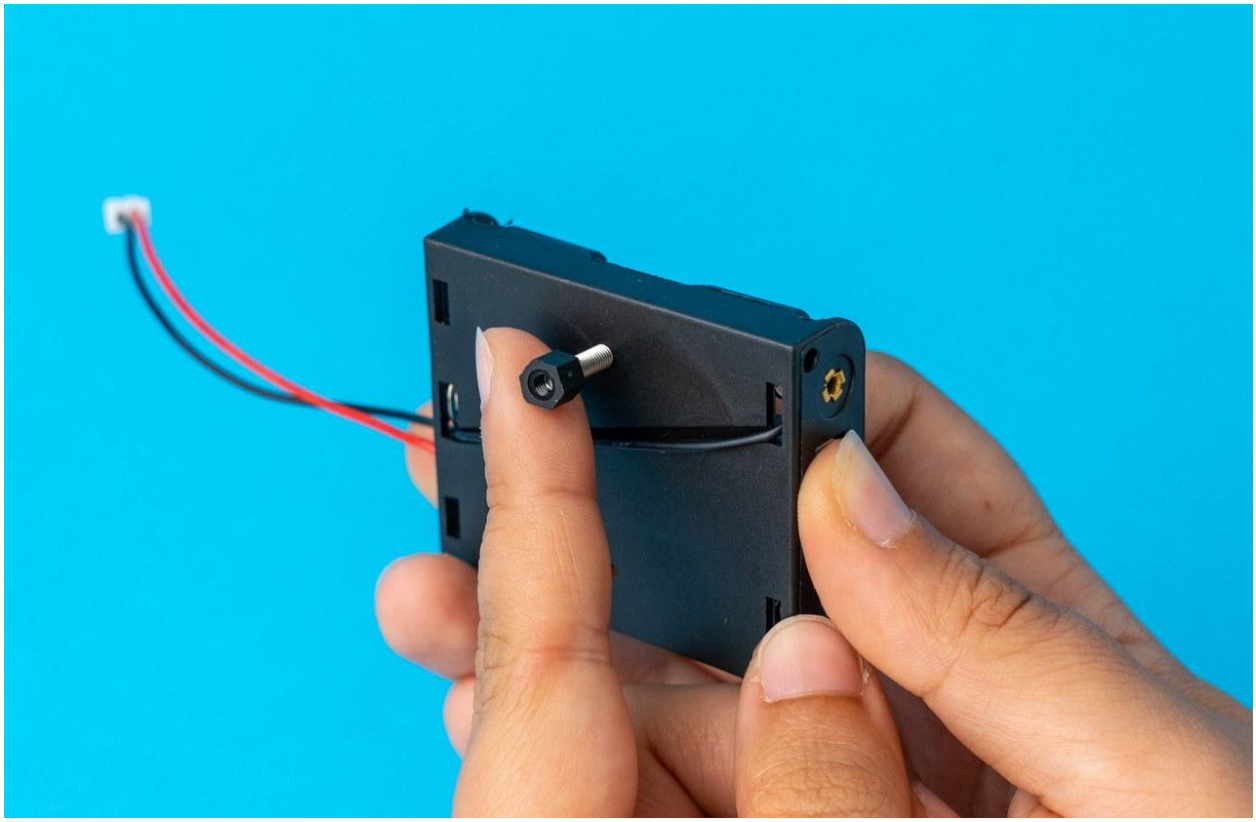
Take these components:



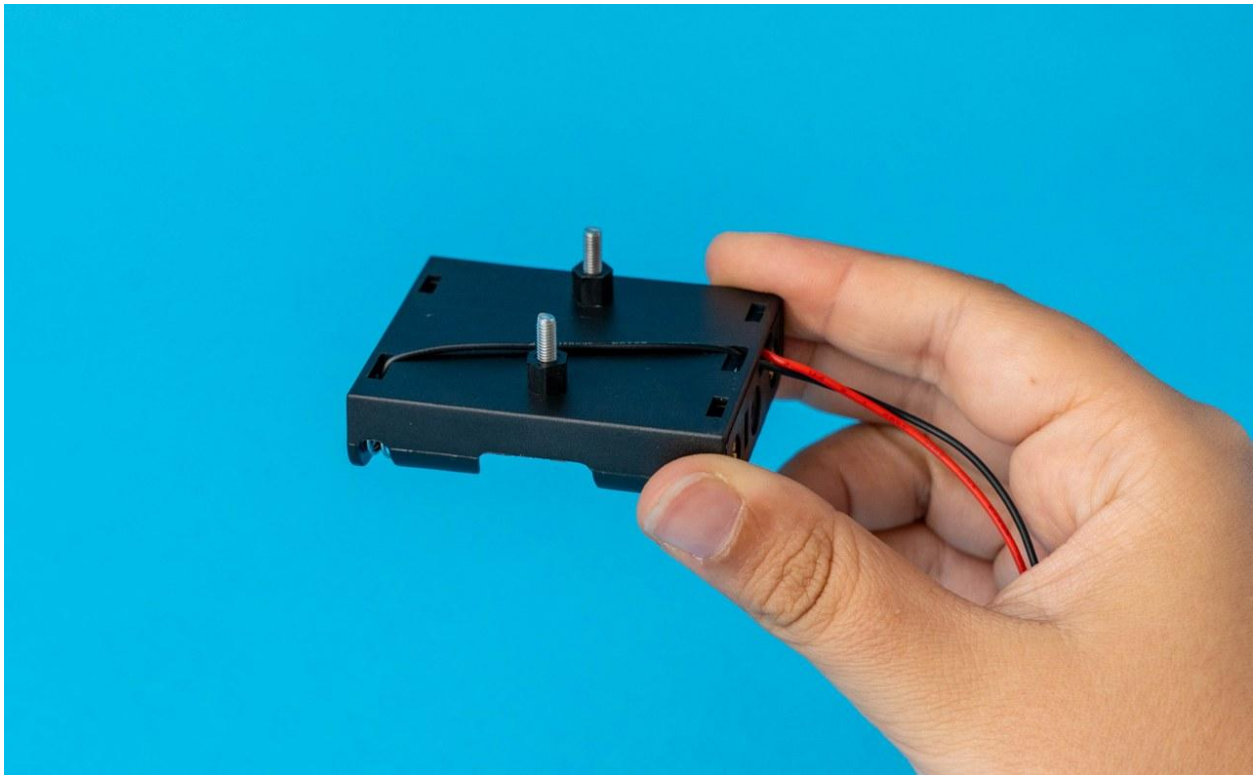
Put the metal screws through the battery holder like this:



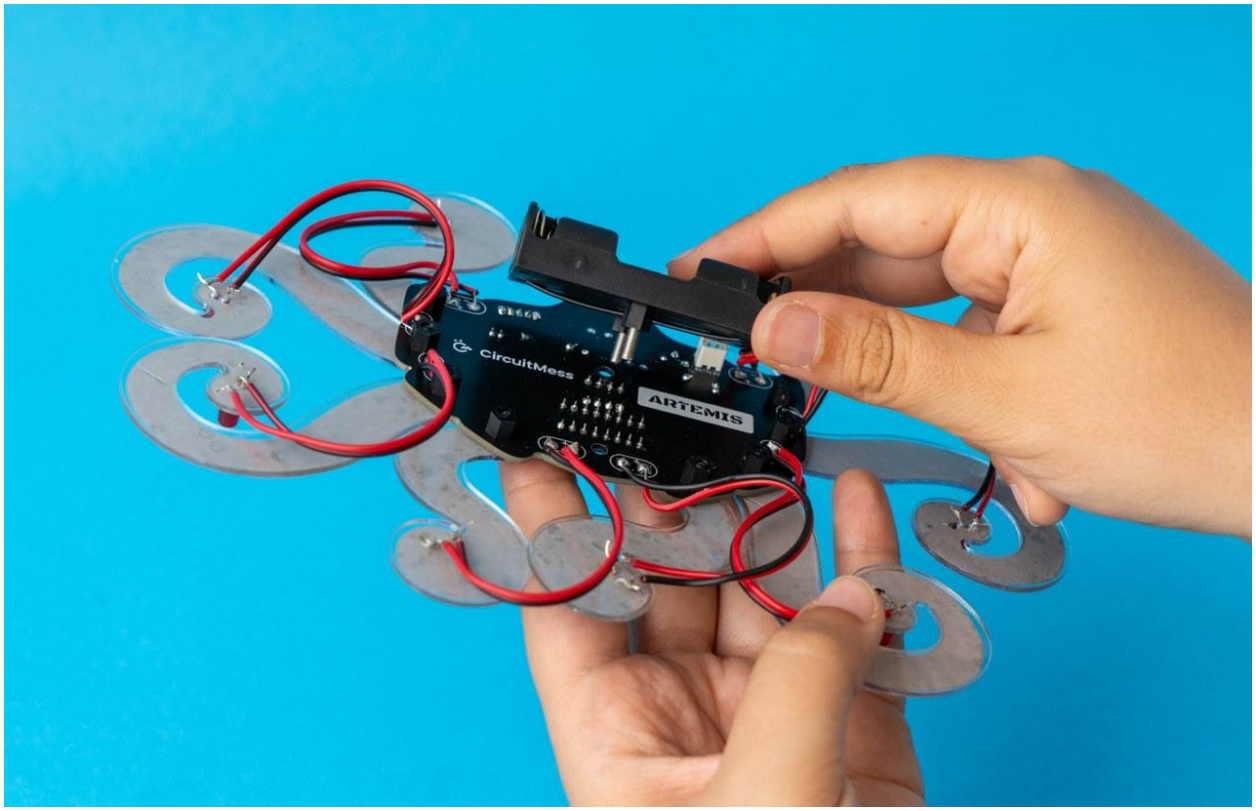
Add the spacer at the back and fasten it with your fingers:



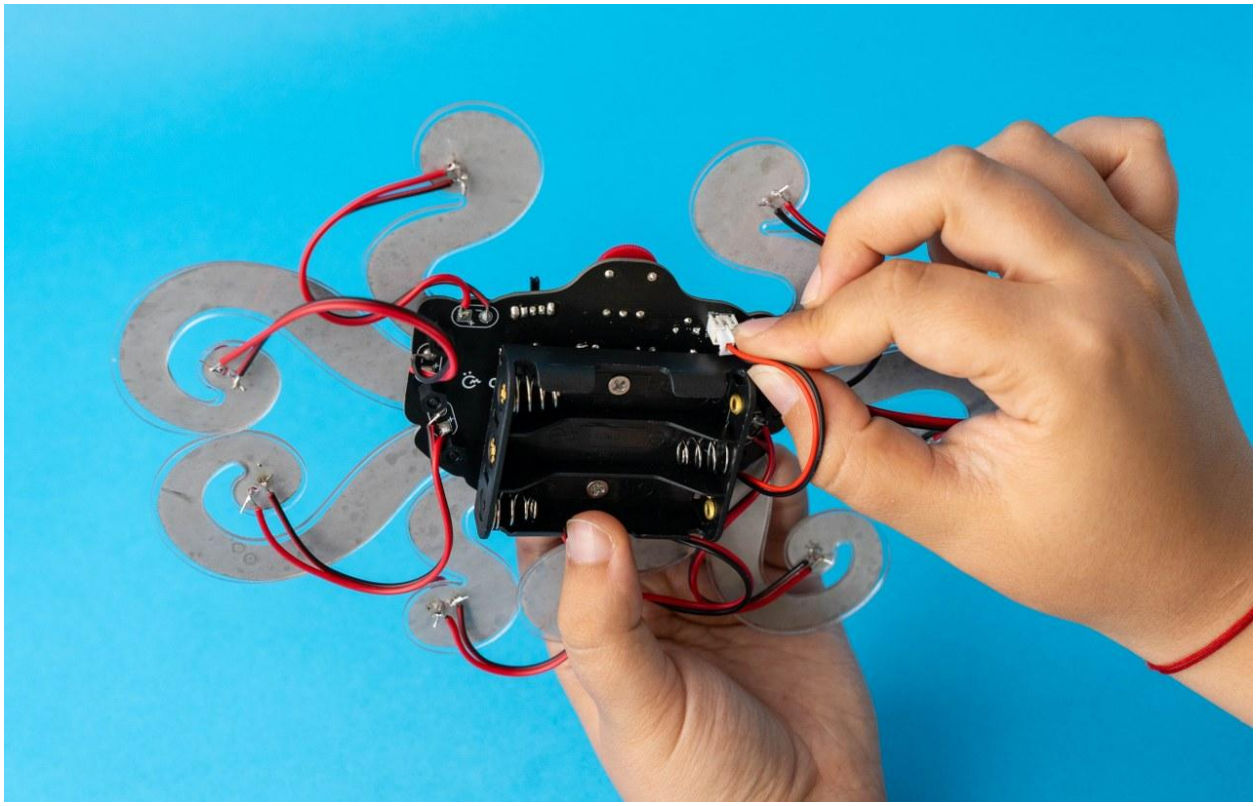
What your battery holder should look like:



This is how you need to put the battery holder on the PCB:

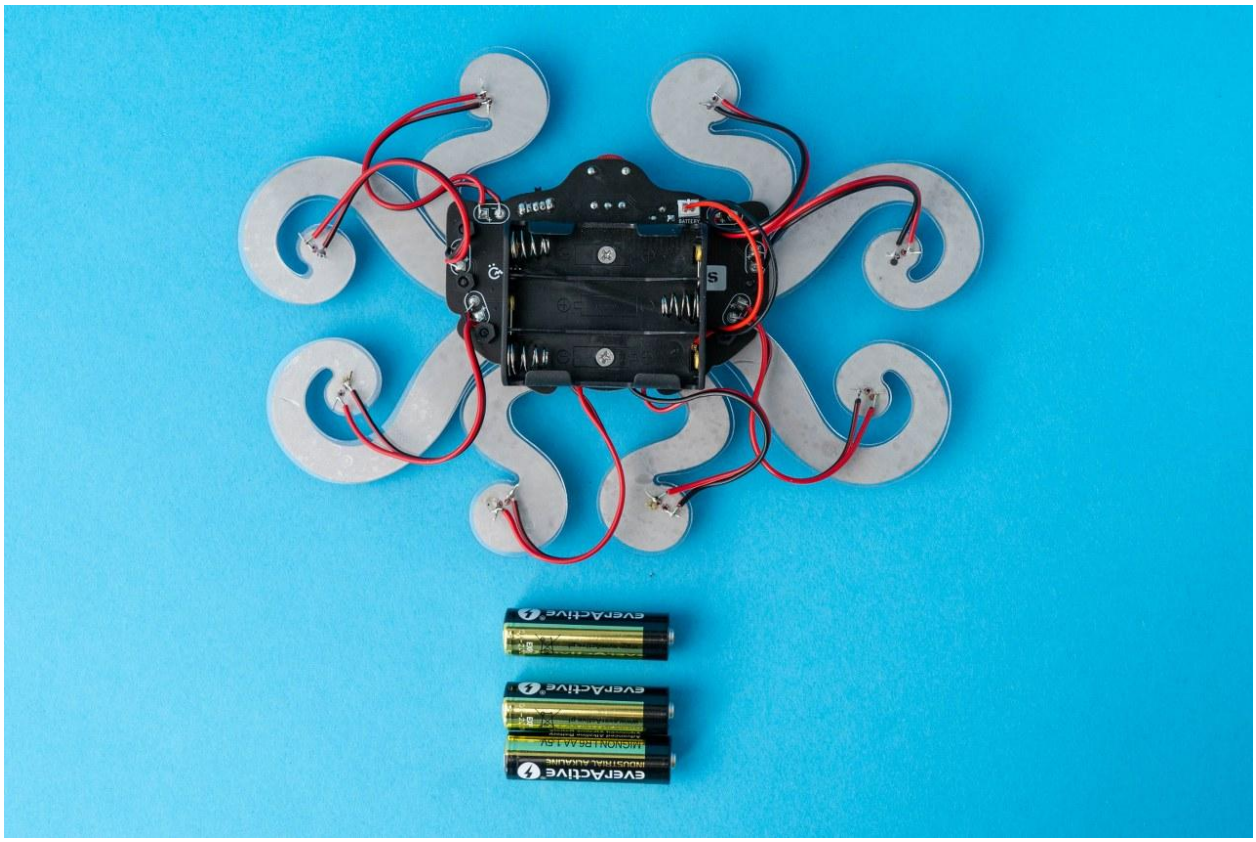


Connect the battery holder to the connector:

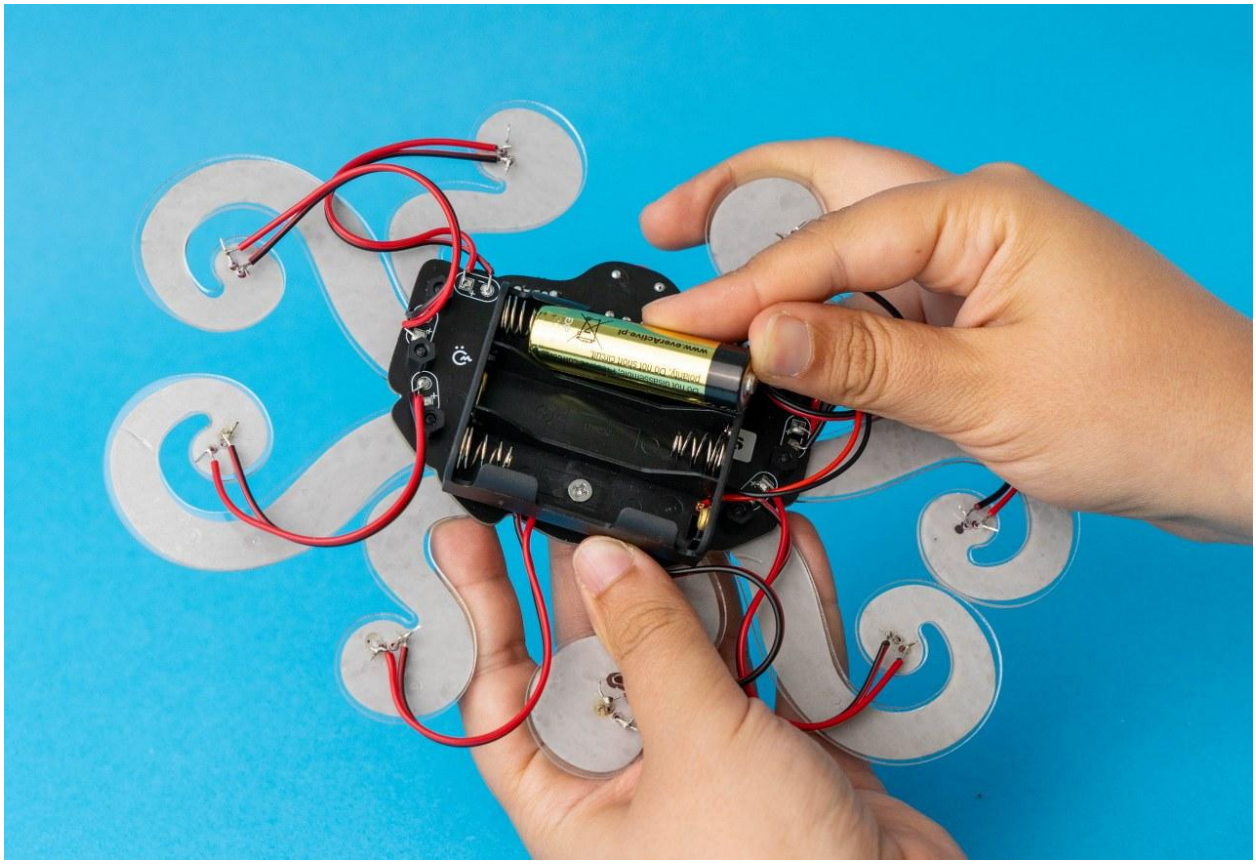


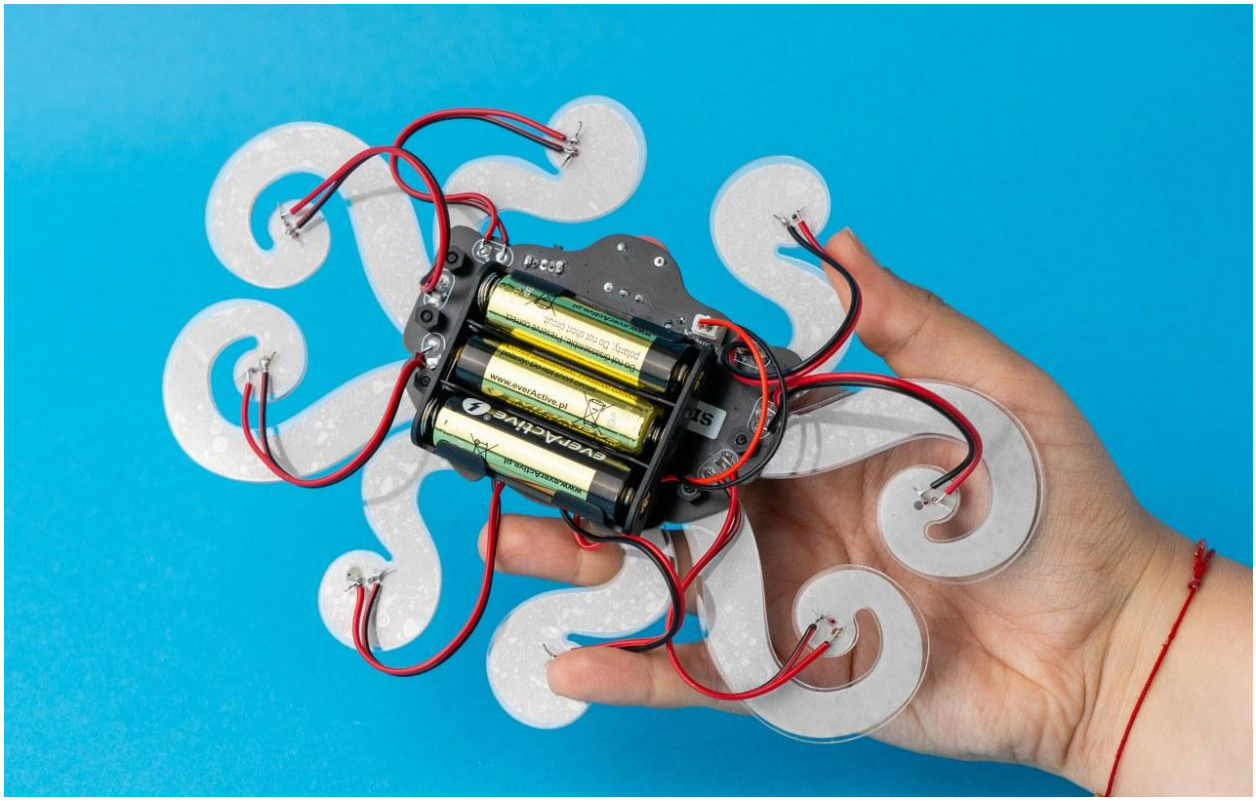
Add the spacers on the front:

And, finally put the batteries in:



Make sure you put them on the right side (check the + and - signs).




everActive

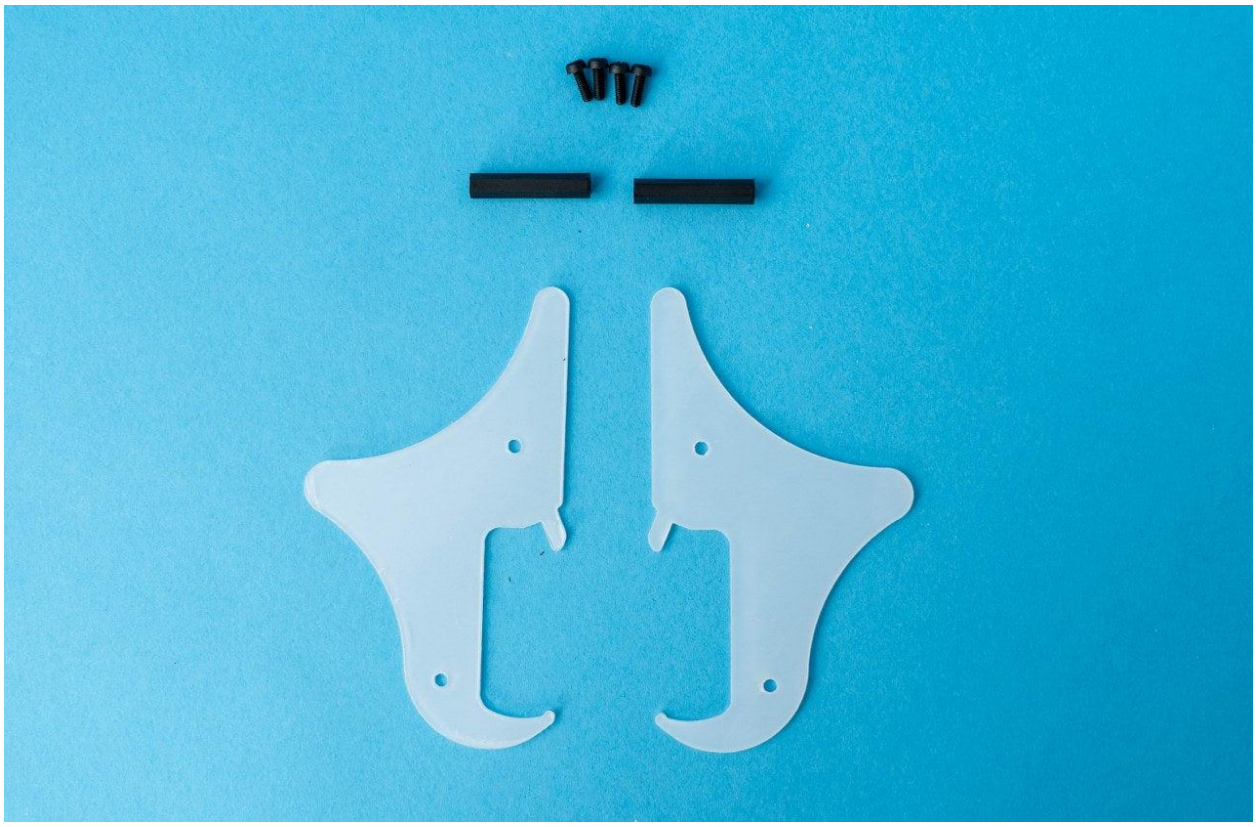
Amazing!

Turn on Artemis and see whether the LEDs light up in a circle one by one.

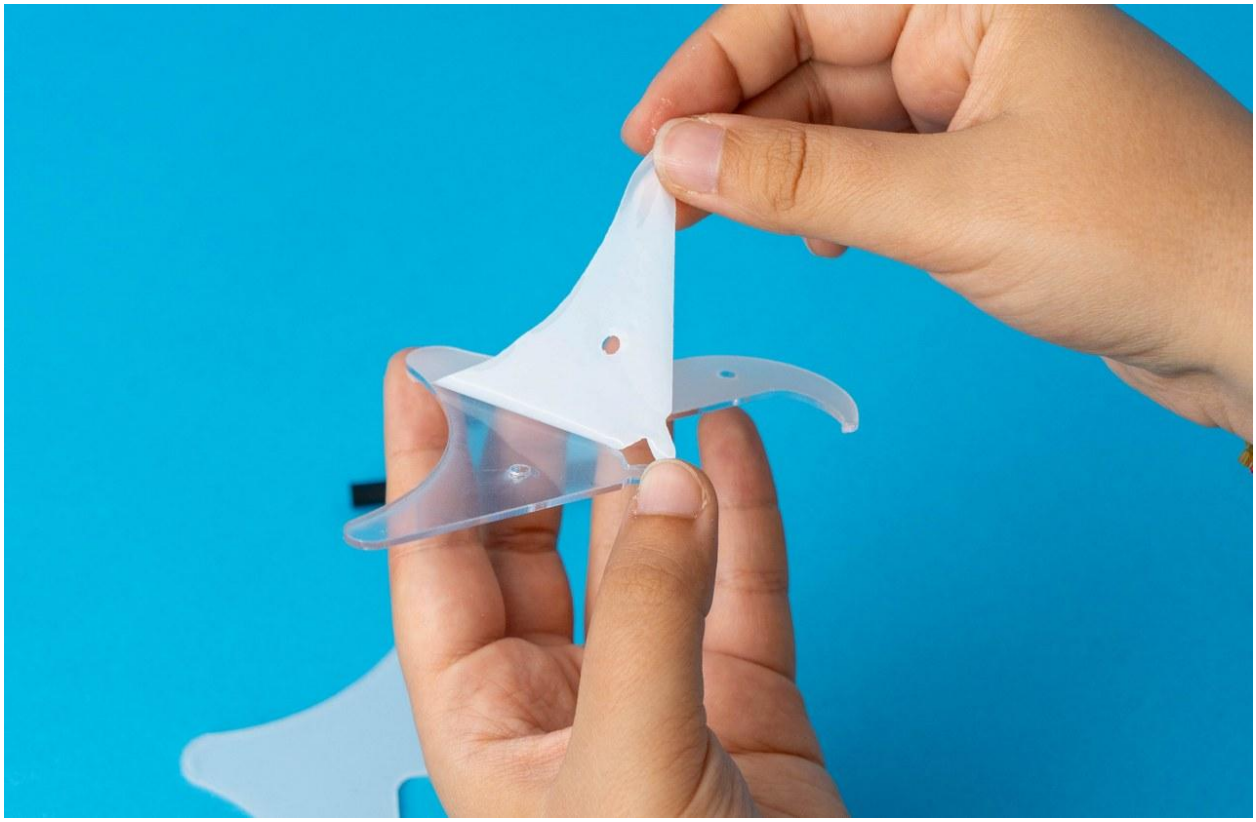
If they are, you did a good job!
If some of the LEDs (or none of them) are not lightning up, check the soldering joints or contact us at contact@circuitmess.com and we'll help you.

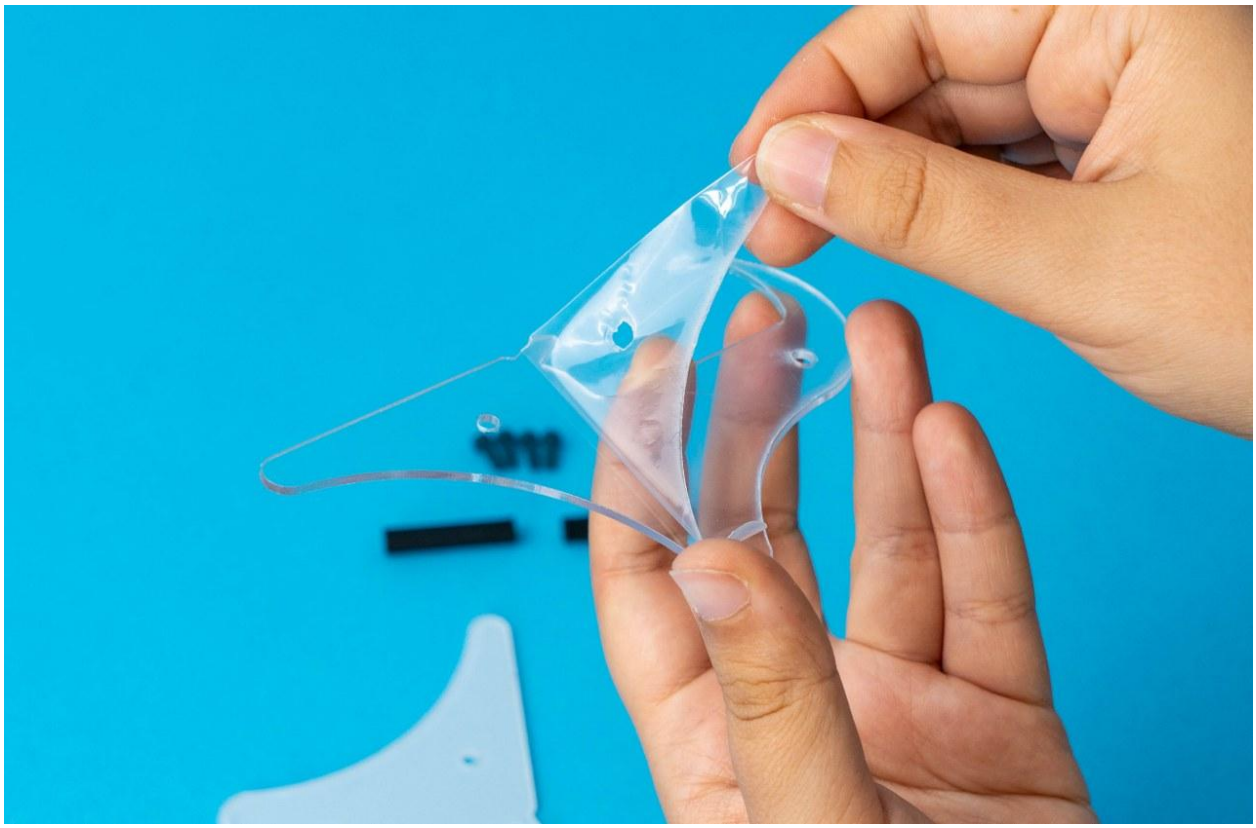
The final step is to make the stand for your Artemis.

For that, you'll need these parts:

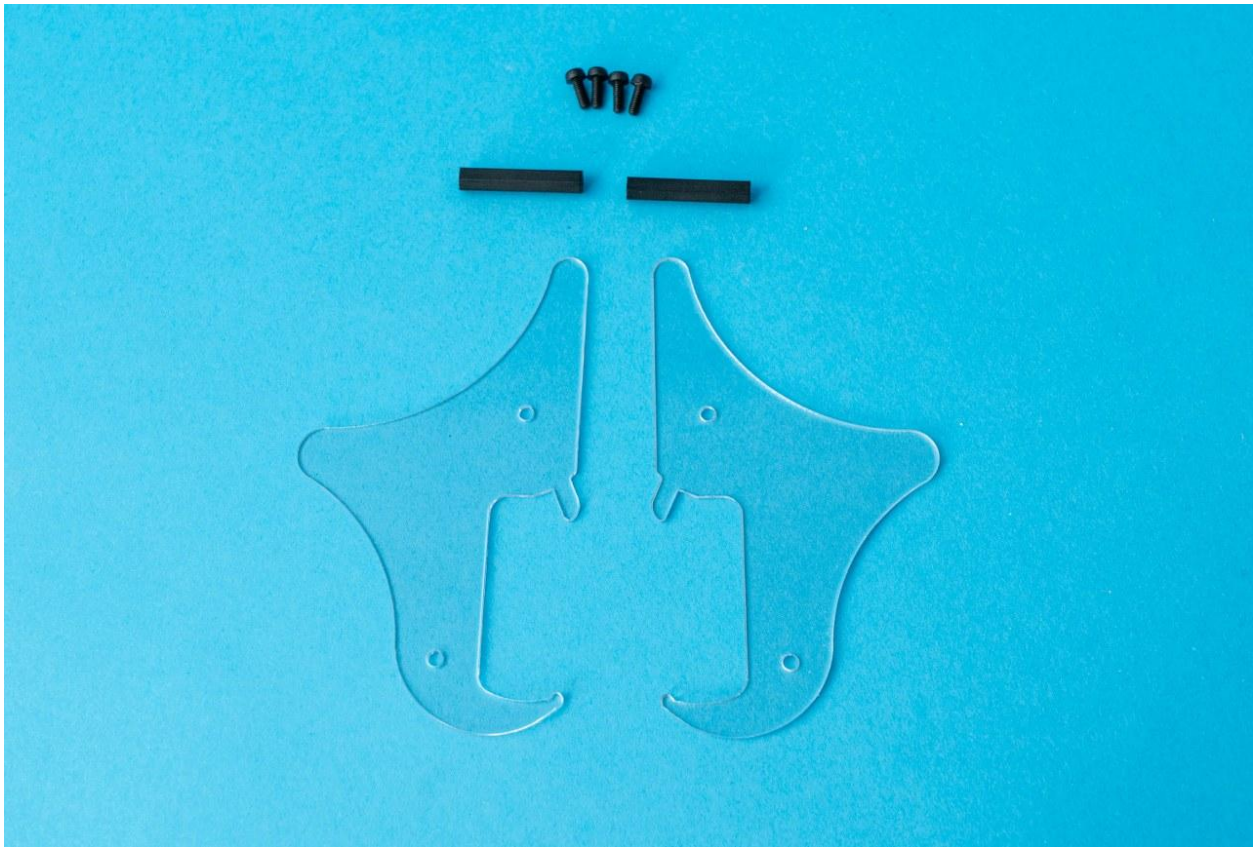


Firstly, remove the protective foil from both sides of the acrylic parts:

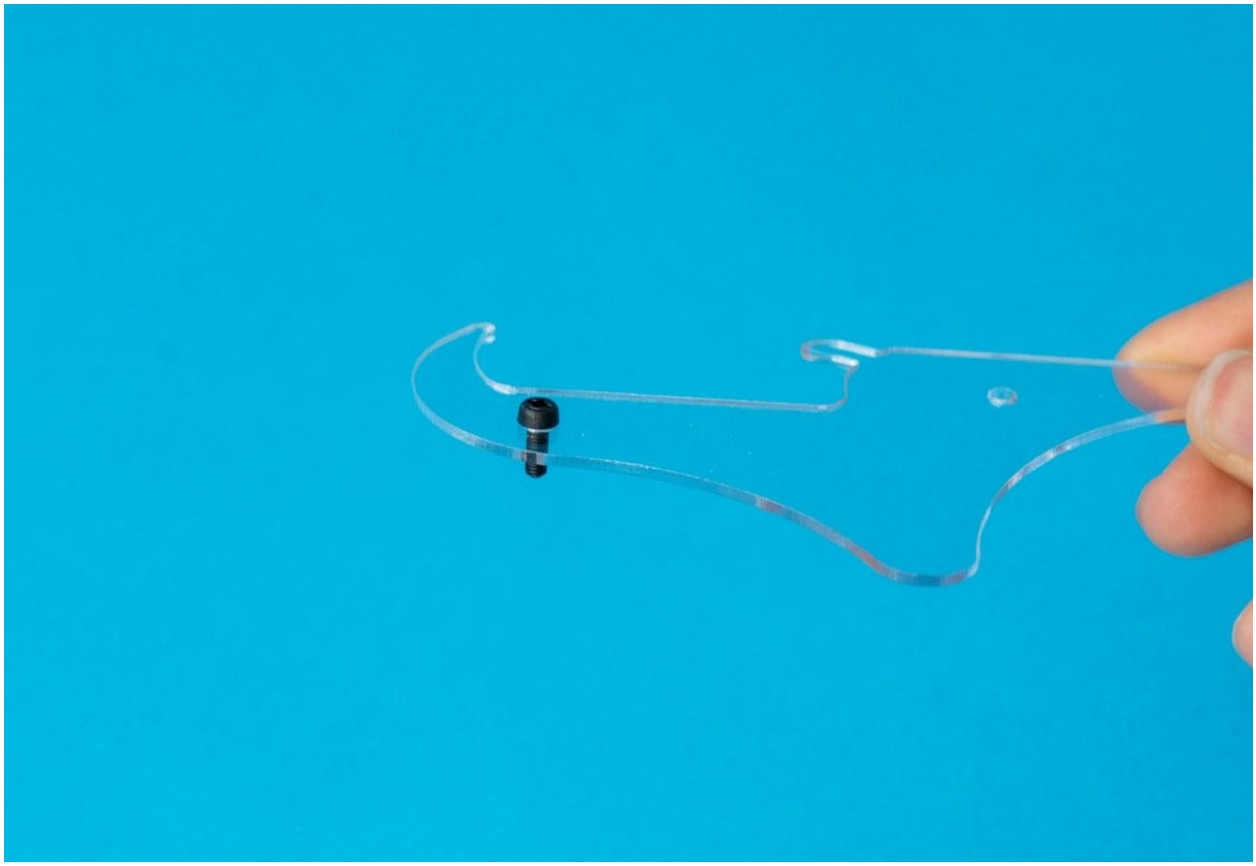




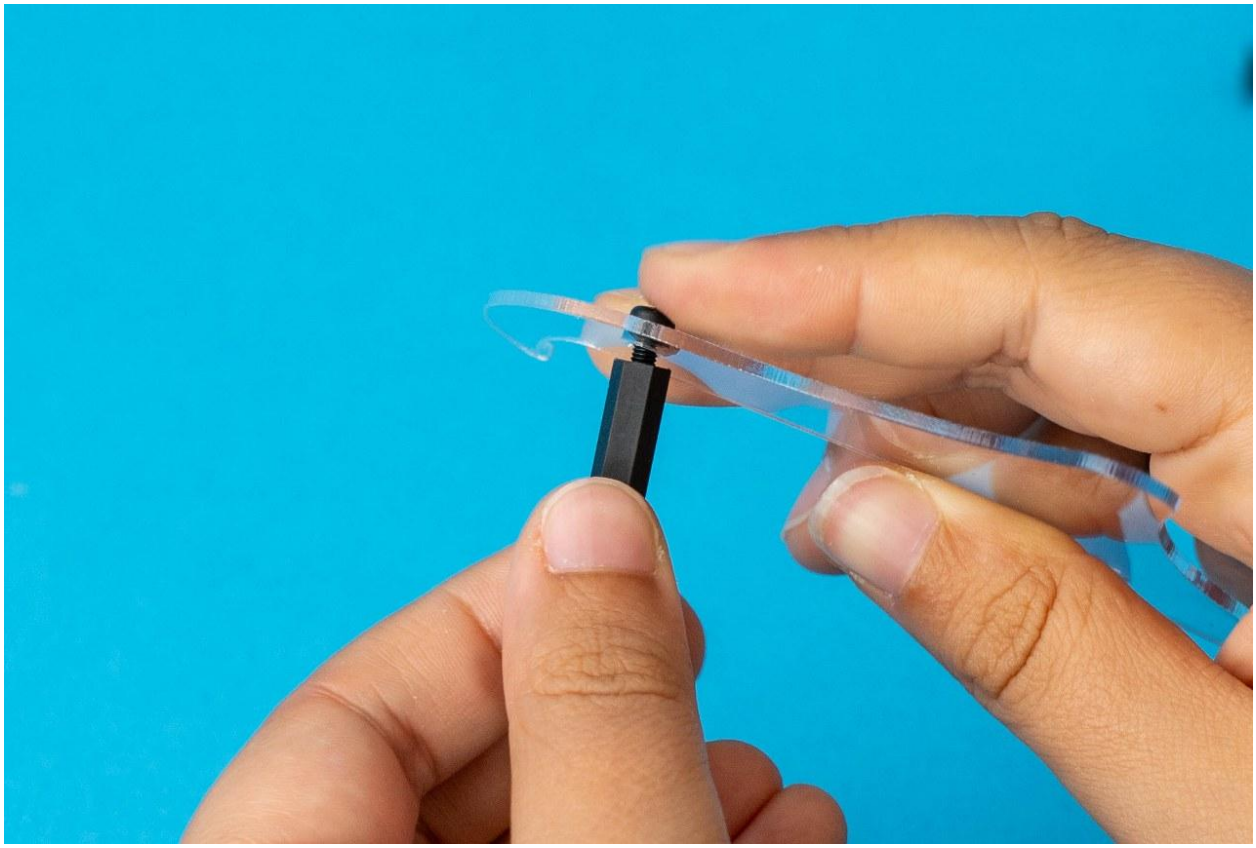
This is what the components should look like. They need to be completely transparent:

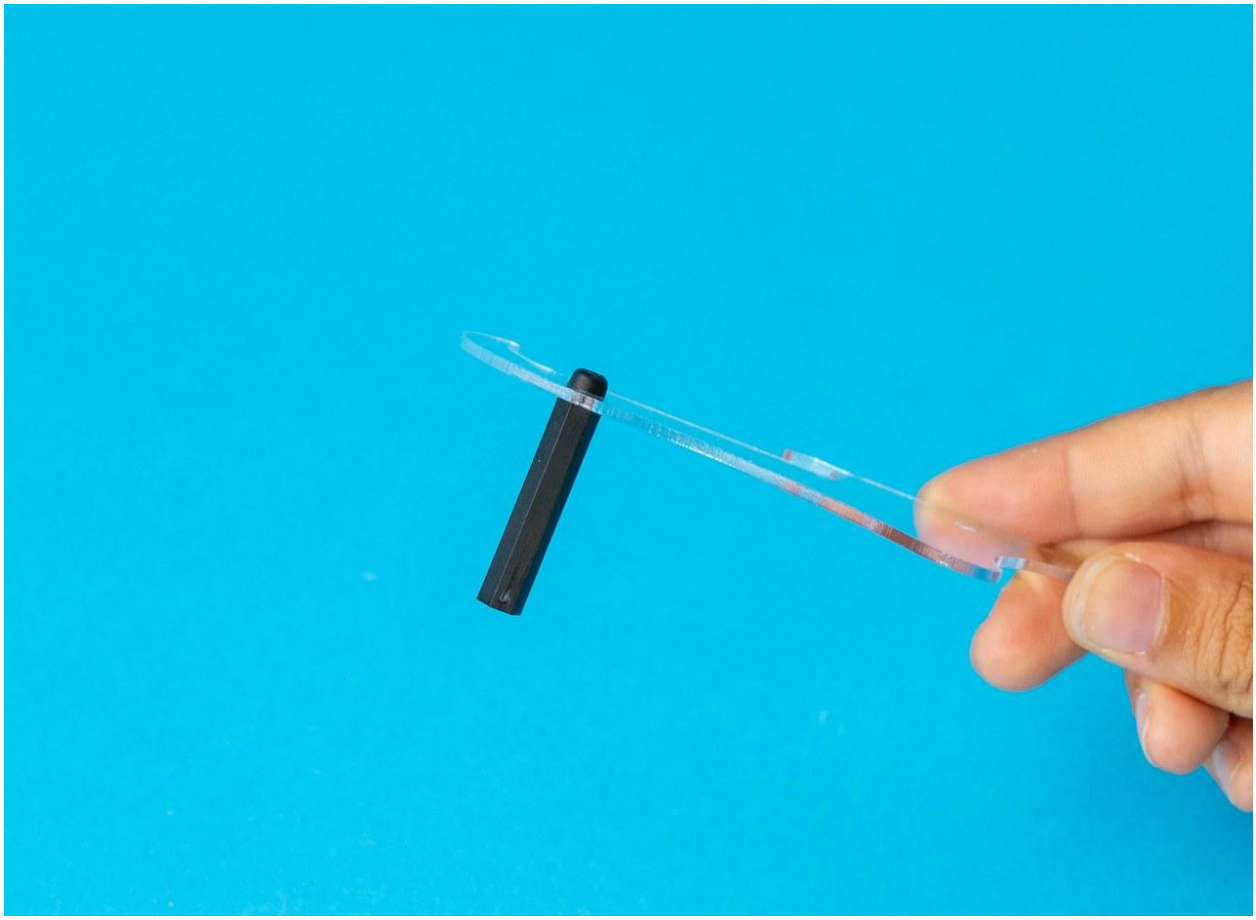


Take one of the black bolts and place it like this:

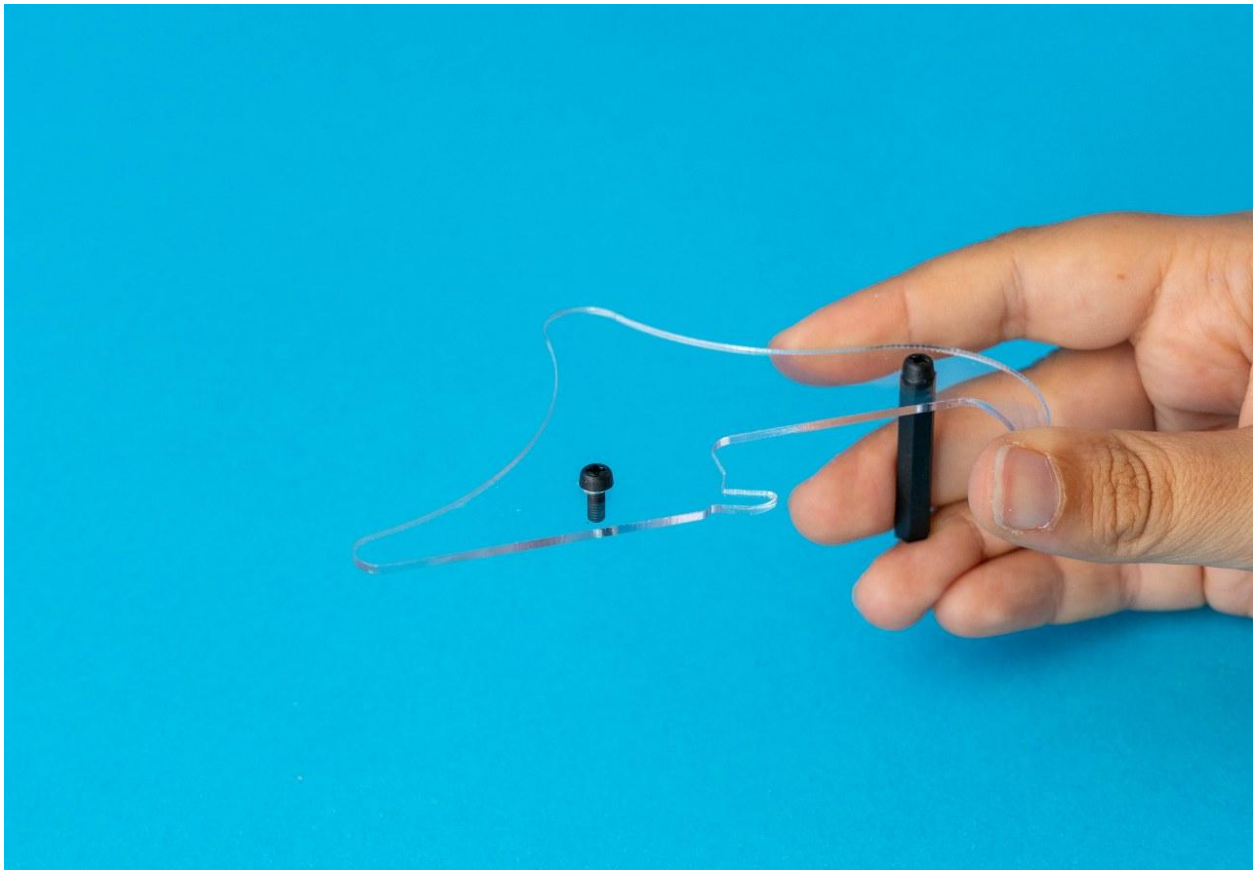


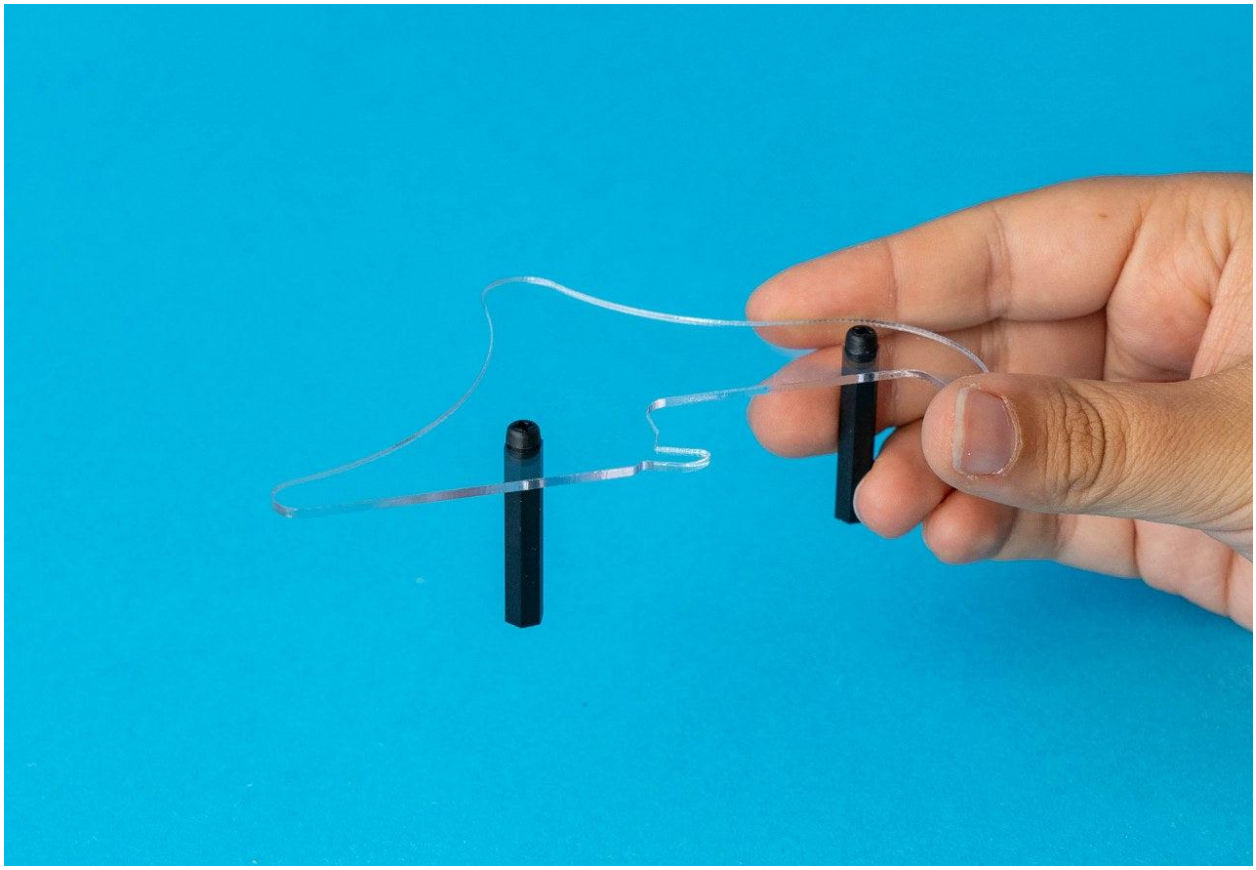
Add one of the long spacers and fasten it with your fingers:



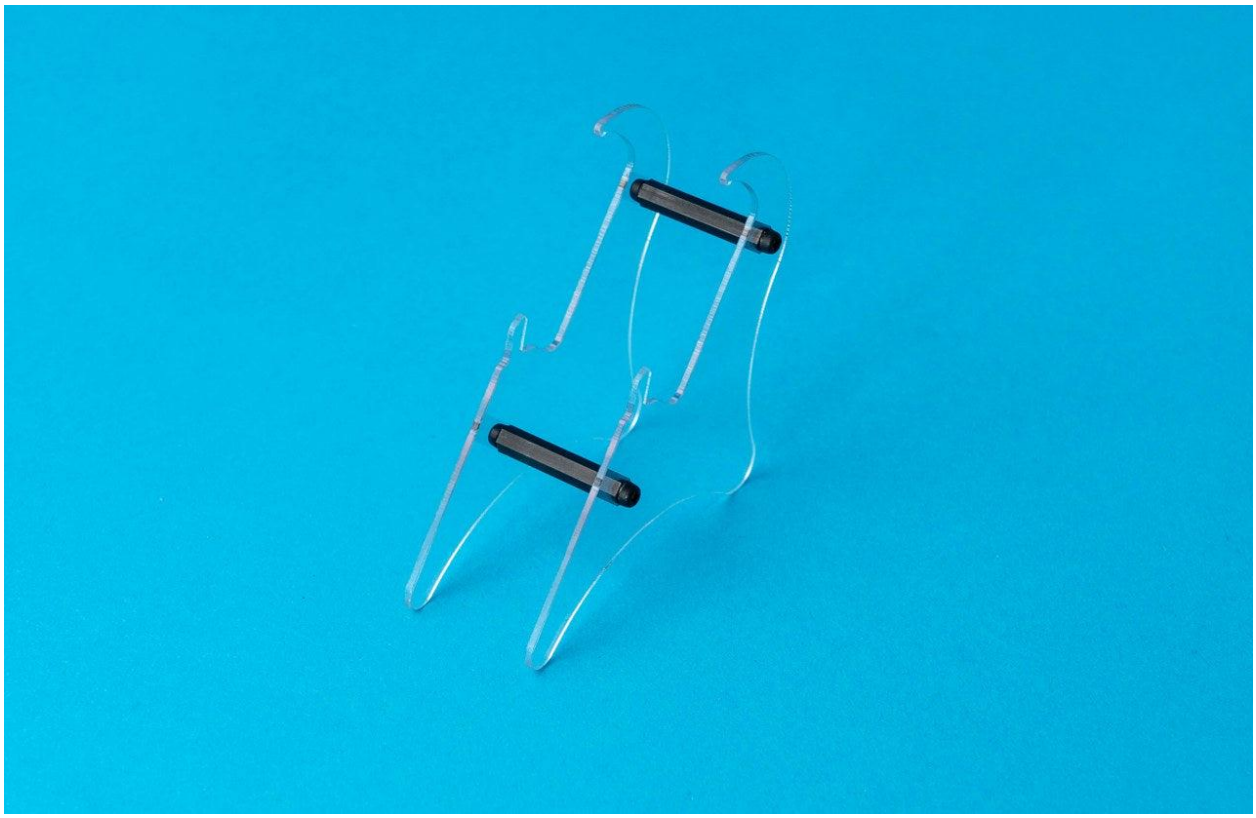


Repeat the process for the second bolt and spacer:

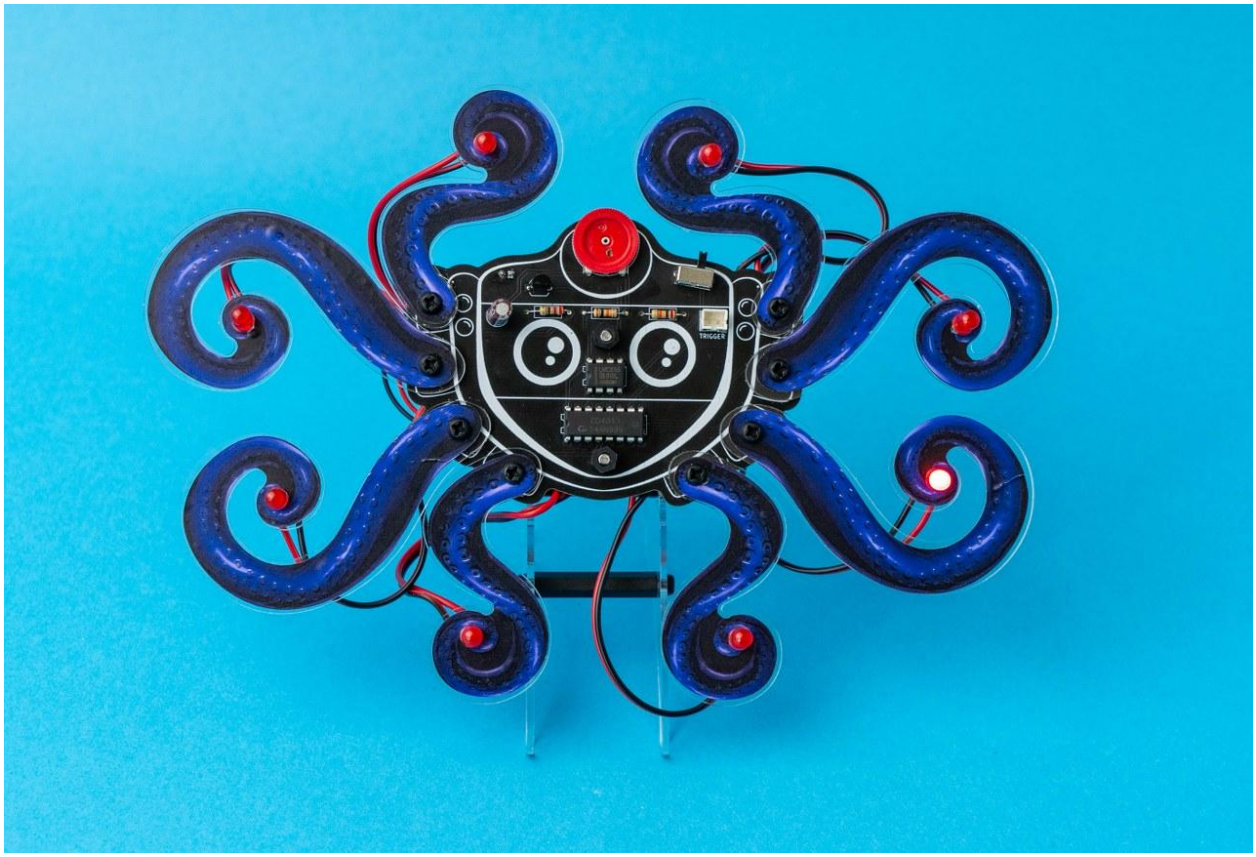


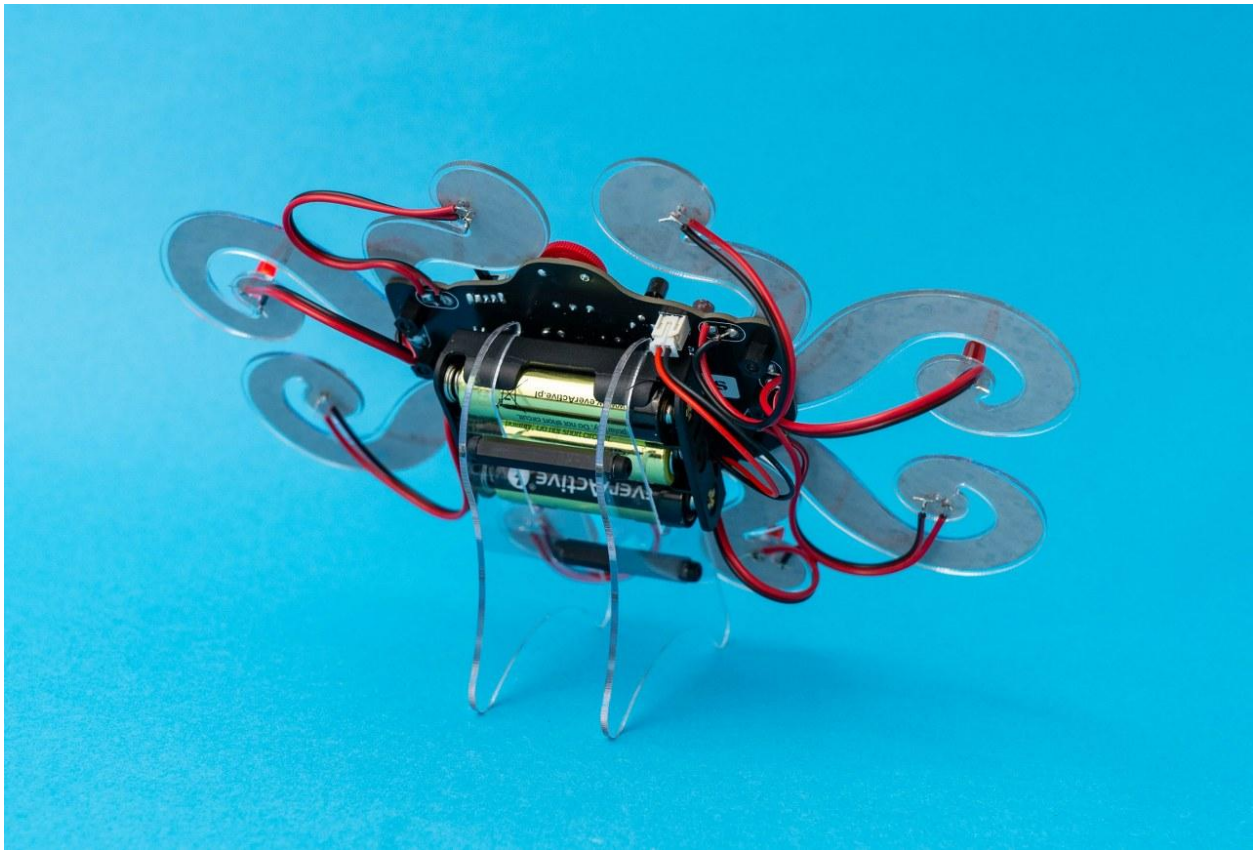


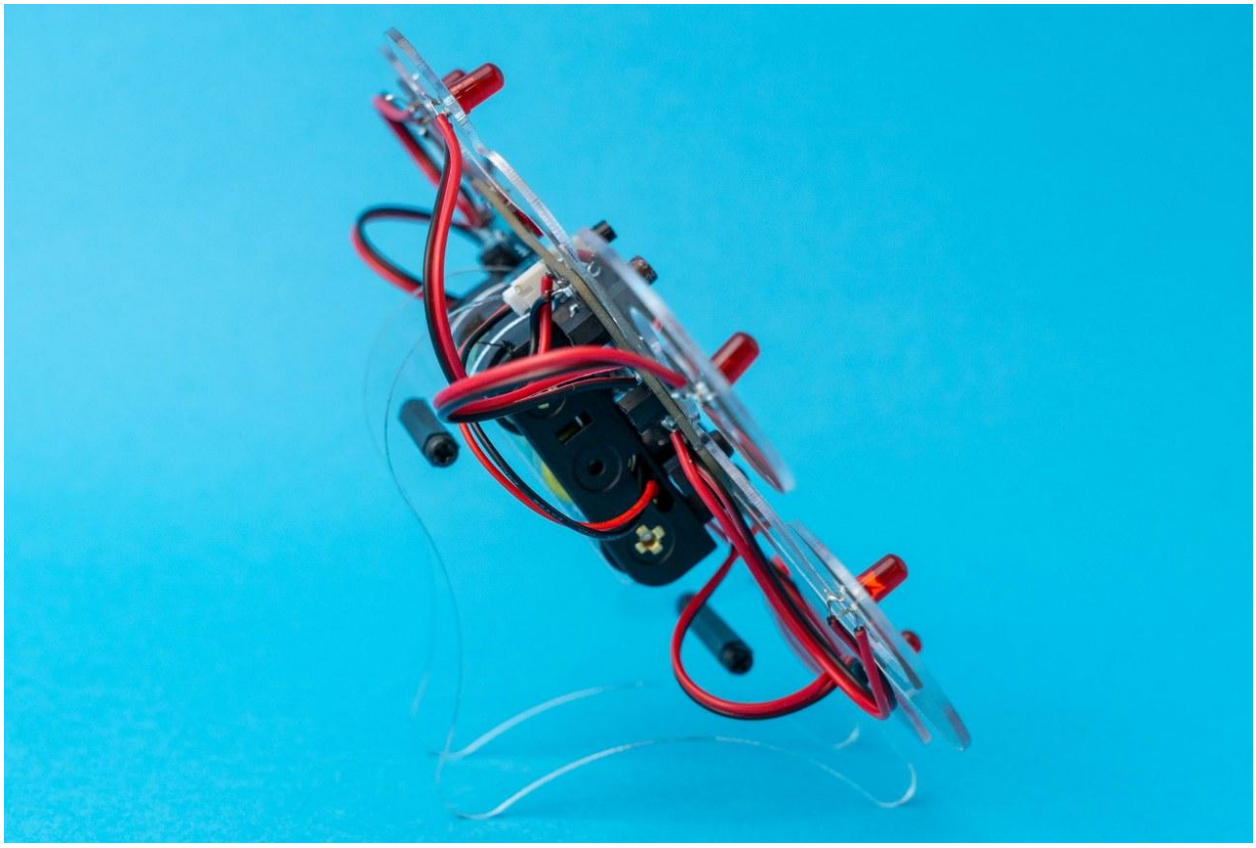
Connect it with the other acrylic part and fasten the bolts with the long spacers:



Put Artemis on the stand like this:


TRIGGER





Don't worry if you need to use a bit of strength to put it on the stand, that's normal.

If everything is working and Artemis is on its stand, you successfully completed this guide!

Congrats.