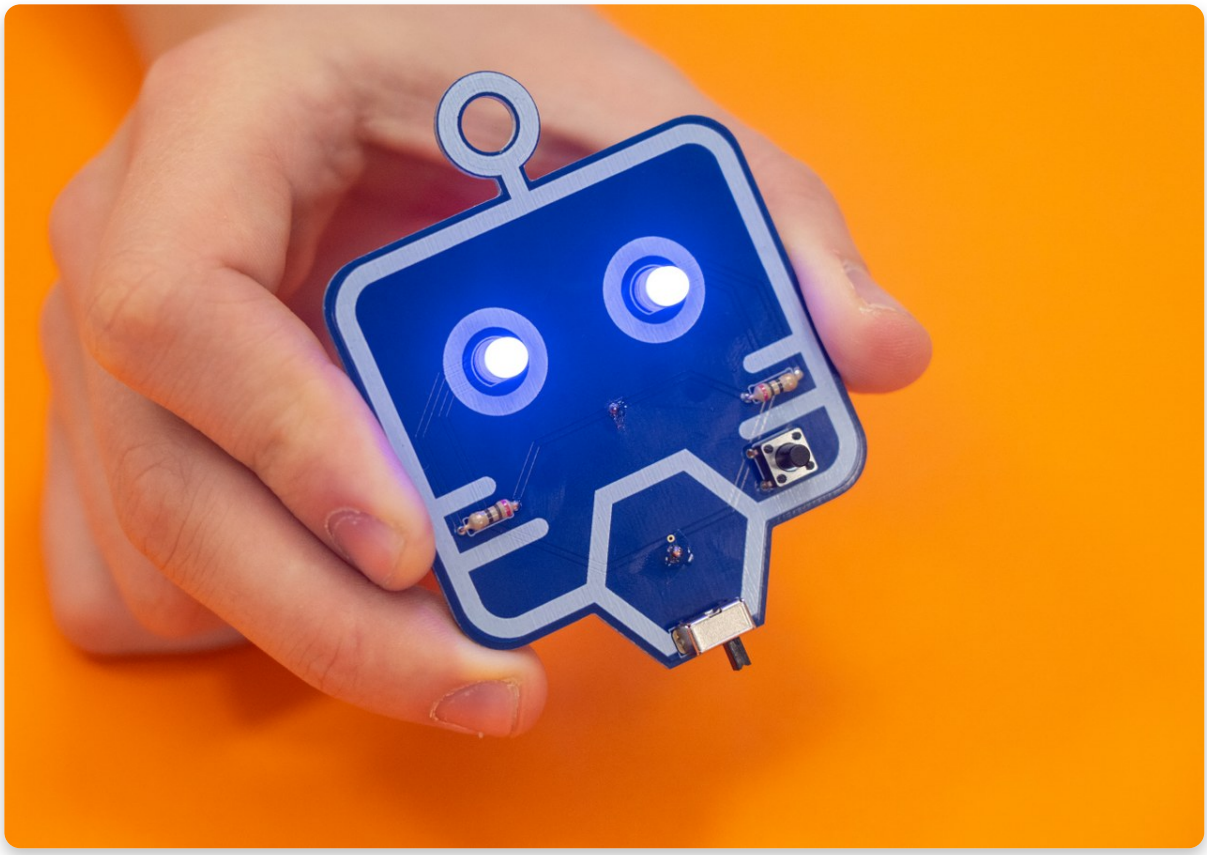
MARV, The Wacky Robot Build Guide

Introduction

The beginning

Welcome to MARV's build guide!

By following this build guide, you'll learn how to assemble your wacky robot - **Marv.**



Marv is a beginner-friendly 12-piece kit that will help you **learn about soldering and the difference between a pushbutton and a switch.**

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 MARV.

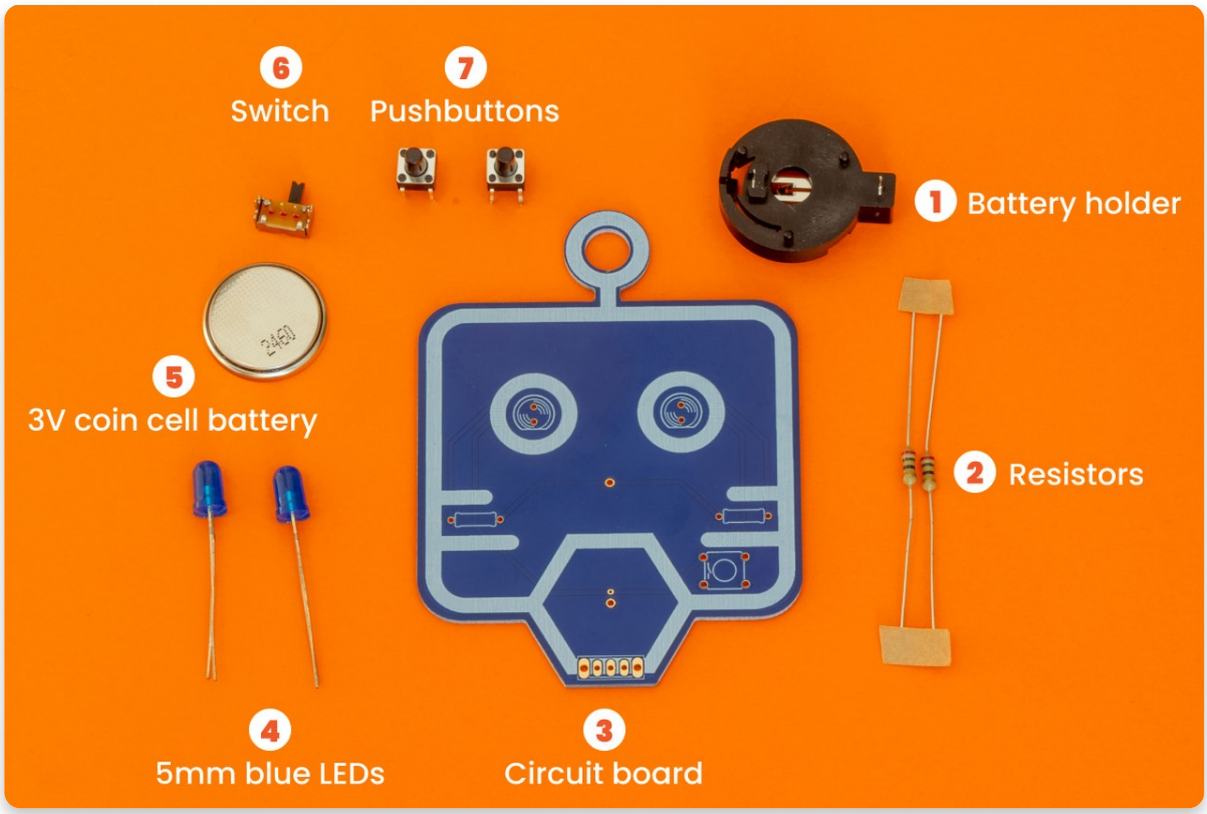
Skills

You don't need to have 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 kit?

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. **Battery holder**
2. **Resistors**
3. **Circuit board**
4. **5mm blue LEDs**
5. **3V coin cell battery**
6. **Switch**
7. **Pushbuttons**

Electronics 101

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

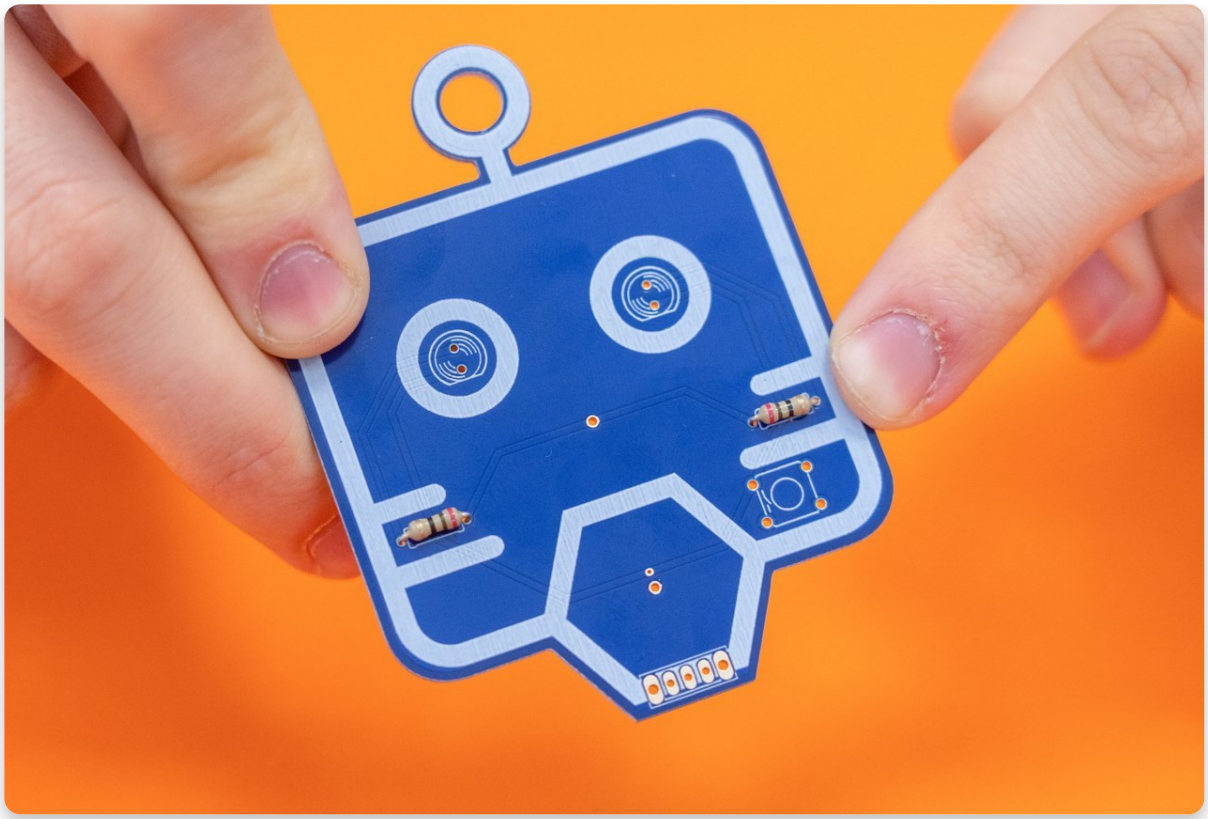
Don't worry, it won't last long, and we will try to make it fun.

1. Circuit board

The blue 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:

1. It holds all the electronic components in place.
2. 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.

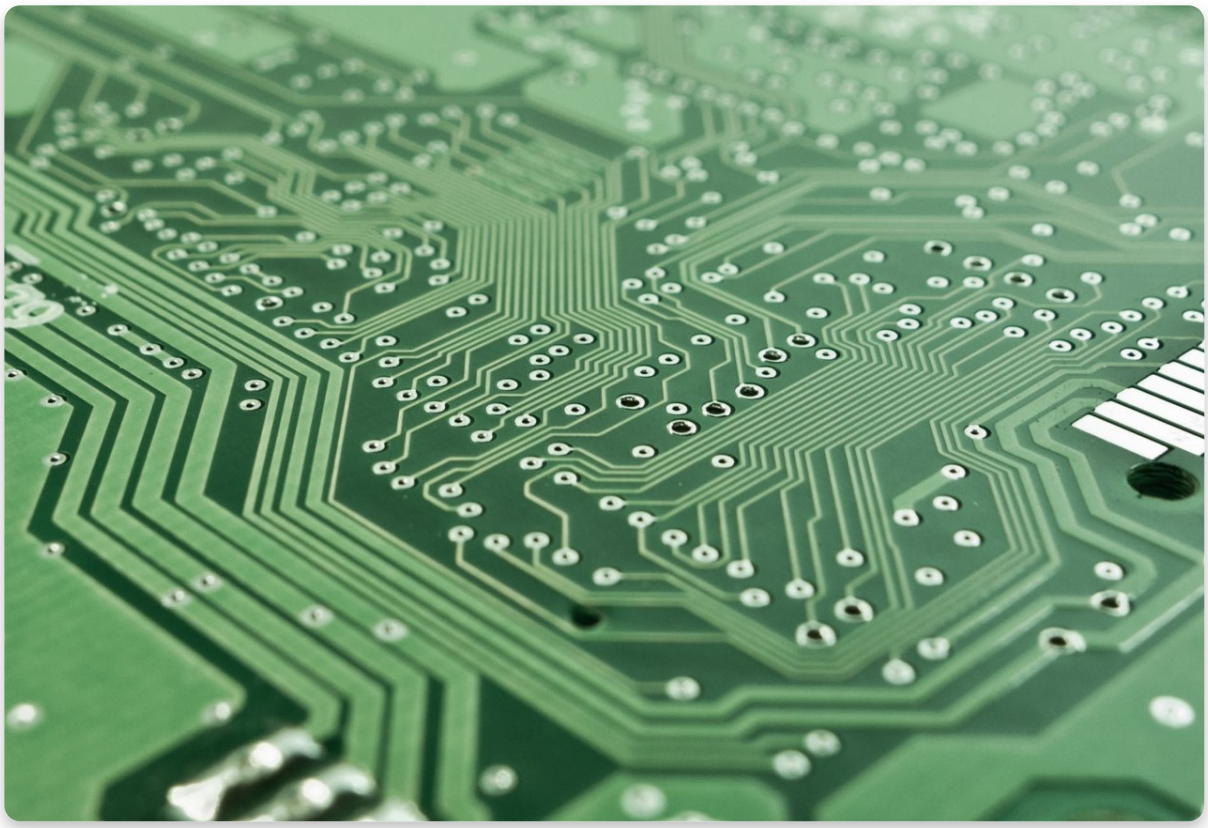
Did you know?

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.

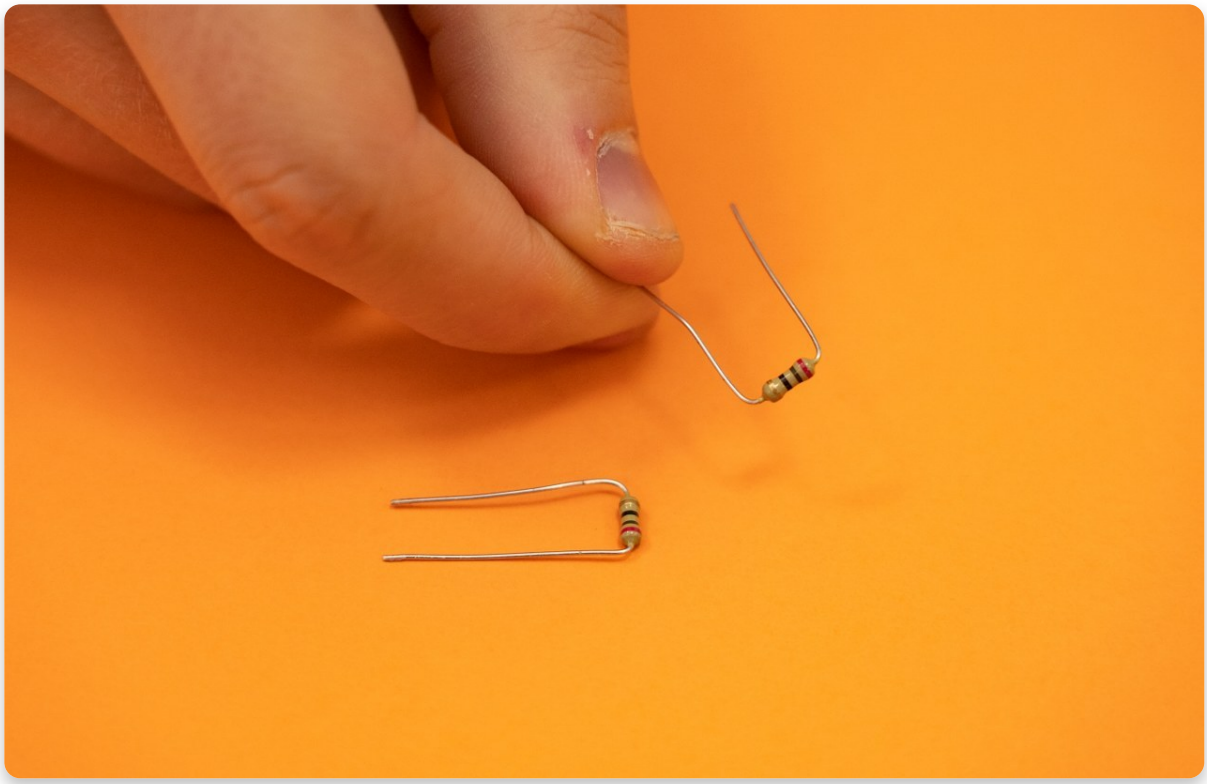
They fall in the category of **passive electronic components.**

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.

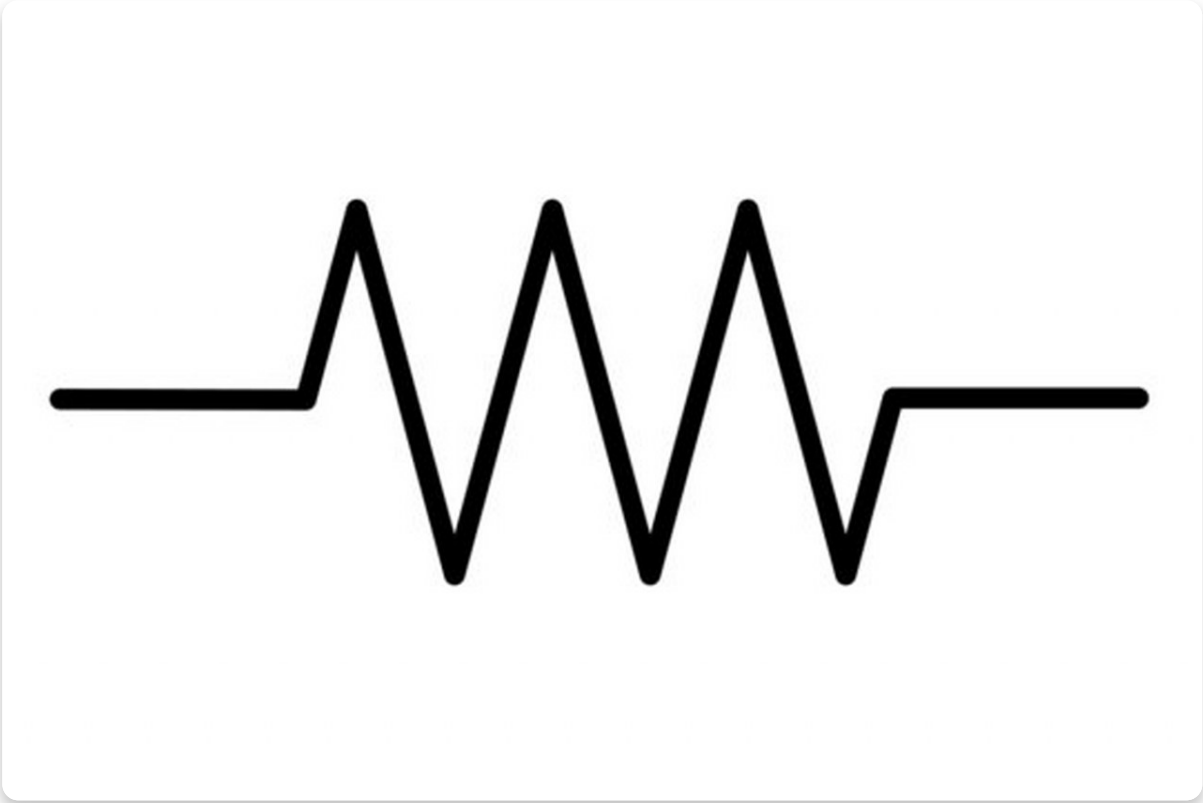
The exact value of a resistor is measured with a device called an ohmmeter.

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. 3V coin cell battery

A battery is a source of electric power consisting of electrochemical cells.

Every battery stores chemicals. These chemicals cause chemical reactions and generate electrical energy.

This battery is made out of a material called lithium.

Do you see the tiny “3V” written on the battery?
This is read as “three volts”.

Volts are the units used to describe electrical voltage.

You will see the number of volts written on almost every battery as it’s one of the most important pieces of information about the battery.

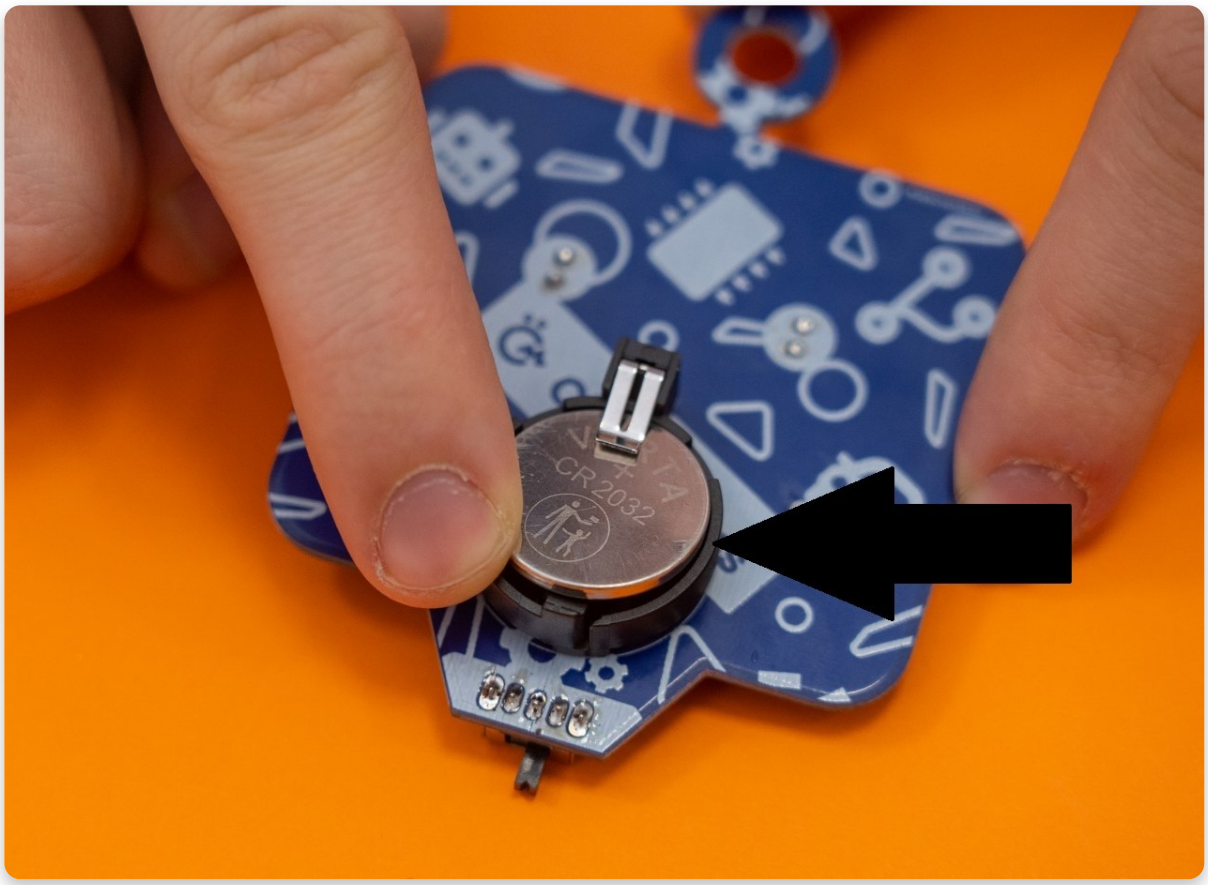
Voltage is a type of “pressure” that drives charge through an electrical circuit.

Different electronic devices have different batteries with different voltages.

For example, a mobile phone has a battery of 3.7 volts, and a car has a battery with a voltage of 12 volts.

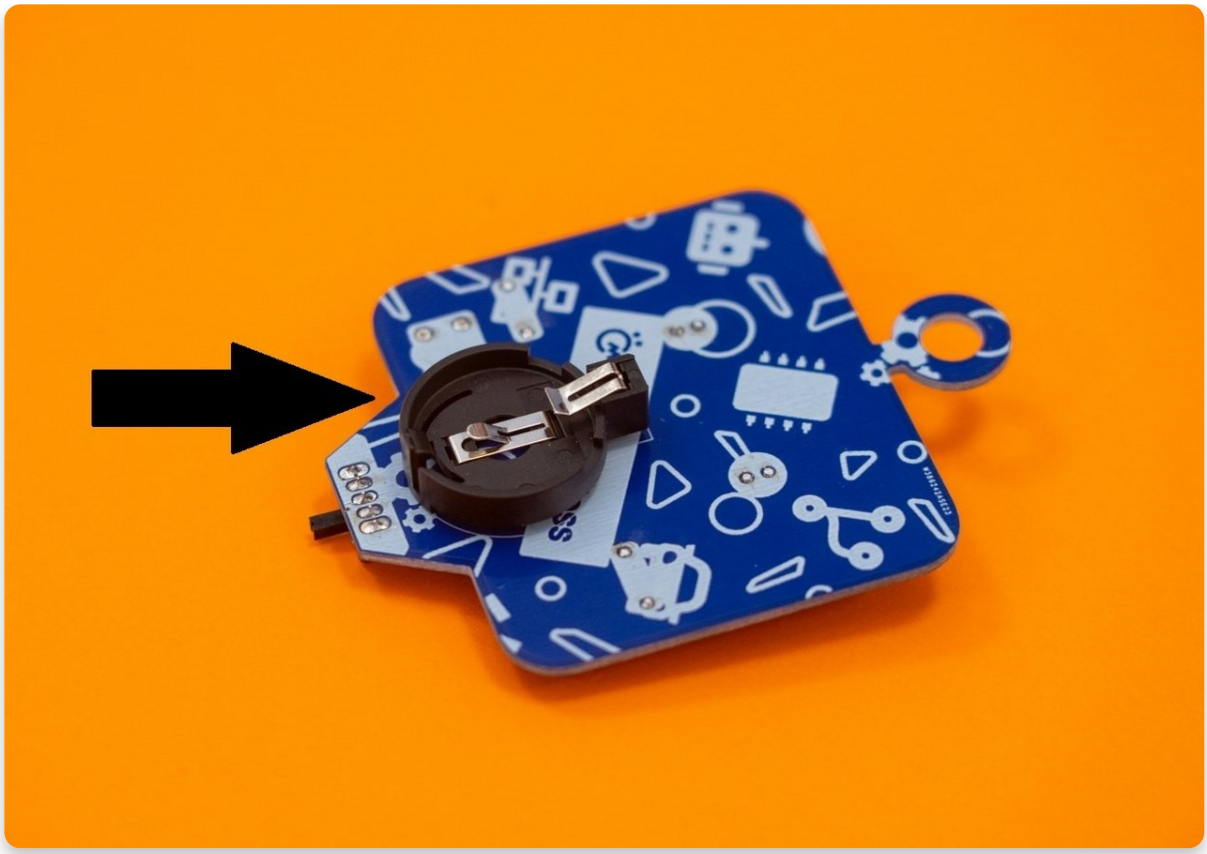
Useful tip:

This particular battery size and model is called a **CR2032 coin cell battery.**



4. Battery holder

The battery holder is not as complex as the rest of the components, but it deserves a word or two.
It's made out of plastics and has two pins that you'll have to solder in order to keep it on Marv's body.
The battery holder will be used for holding the battery and giving life to your wacky robot.



5. Switch

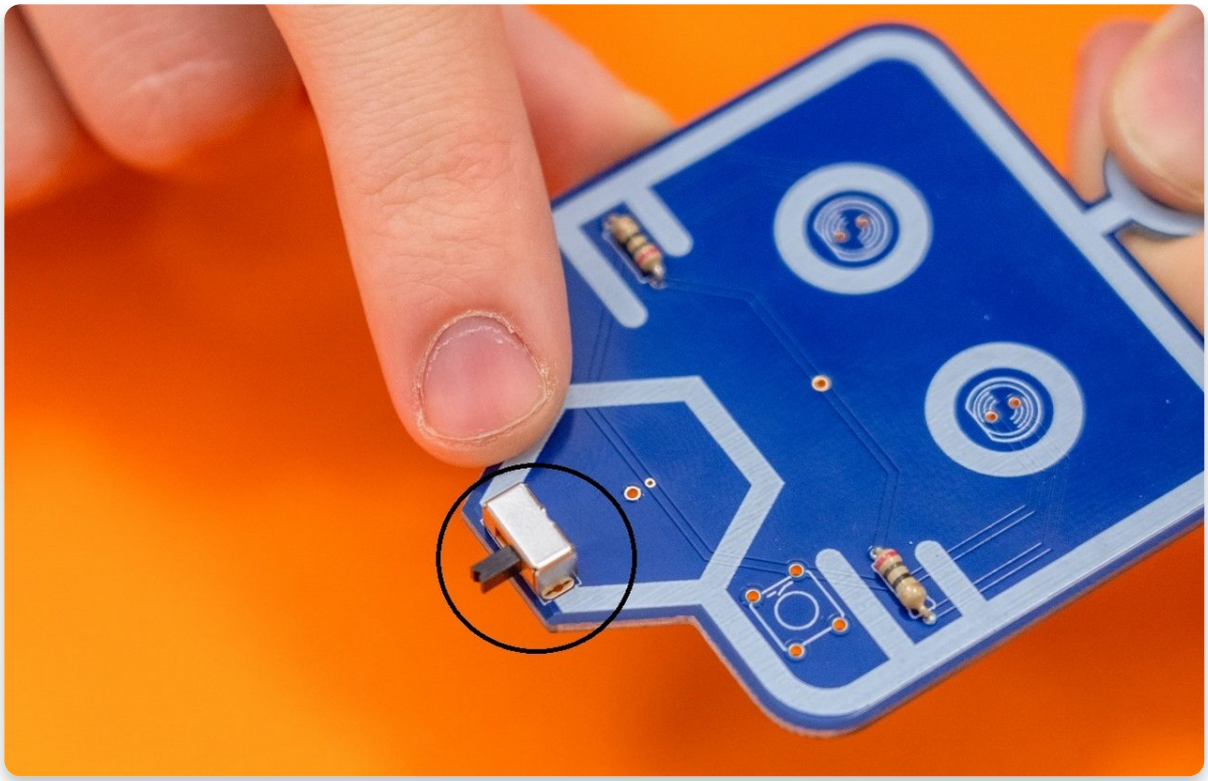
The switch you got in your kit is a power switch, and **it helps you turn Marv on and off**. You can easily do so with one simple push.

The power 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.

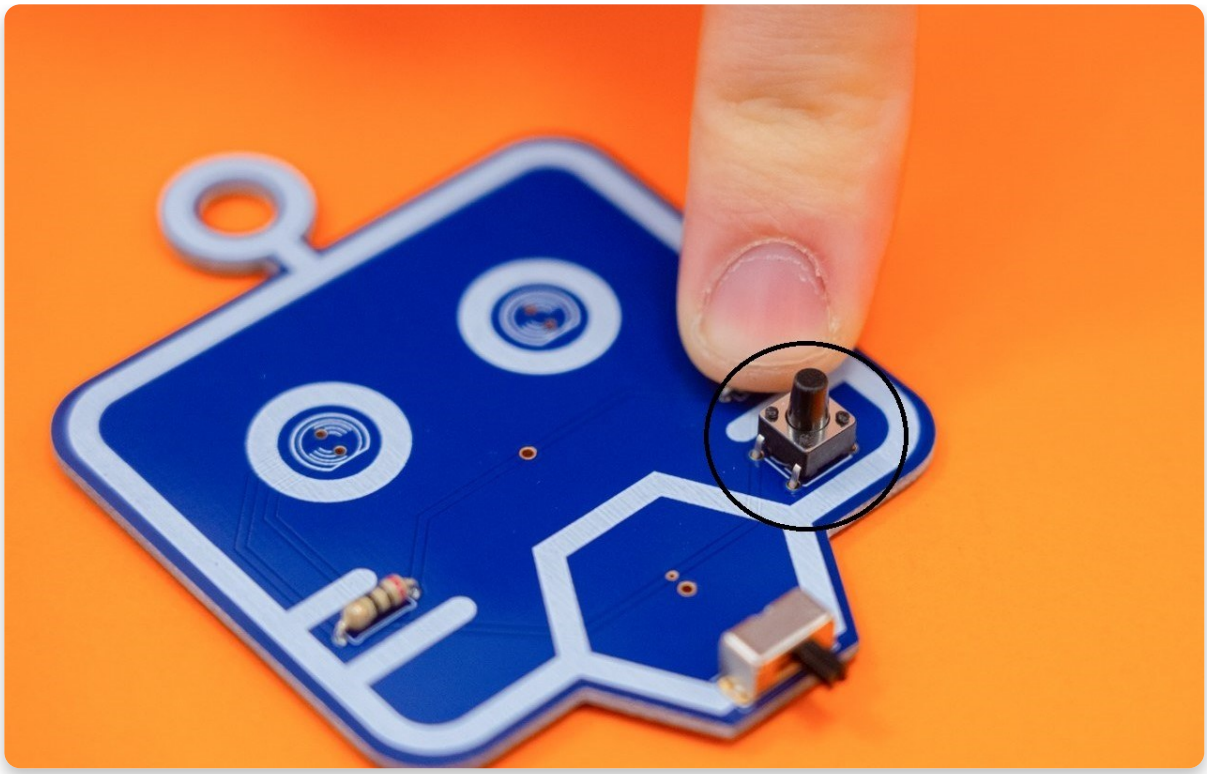


6. Pushbuttons

A pushbutton switch is a small, sealed mechanism that completes an electric circuit when you press on it.

When a pushbutton is pressed, a small metal spring inside makes contact with two wires, allowing electrical energy to flow.

When you release your finger from the pushbutton, the spring retracts, the electrical contact is interrupted, and electrical energy won't flow through the switch.



What's the difference between a switch and a pushbutton?

Switches have an on and off state that can be switched between by pushing the switch with your finger.

A pushbutton also has two states - on and off. A pushbutton will change its state if you push it with your finger, but it will automatically retract back to its original state when you remove your finger.

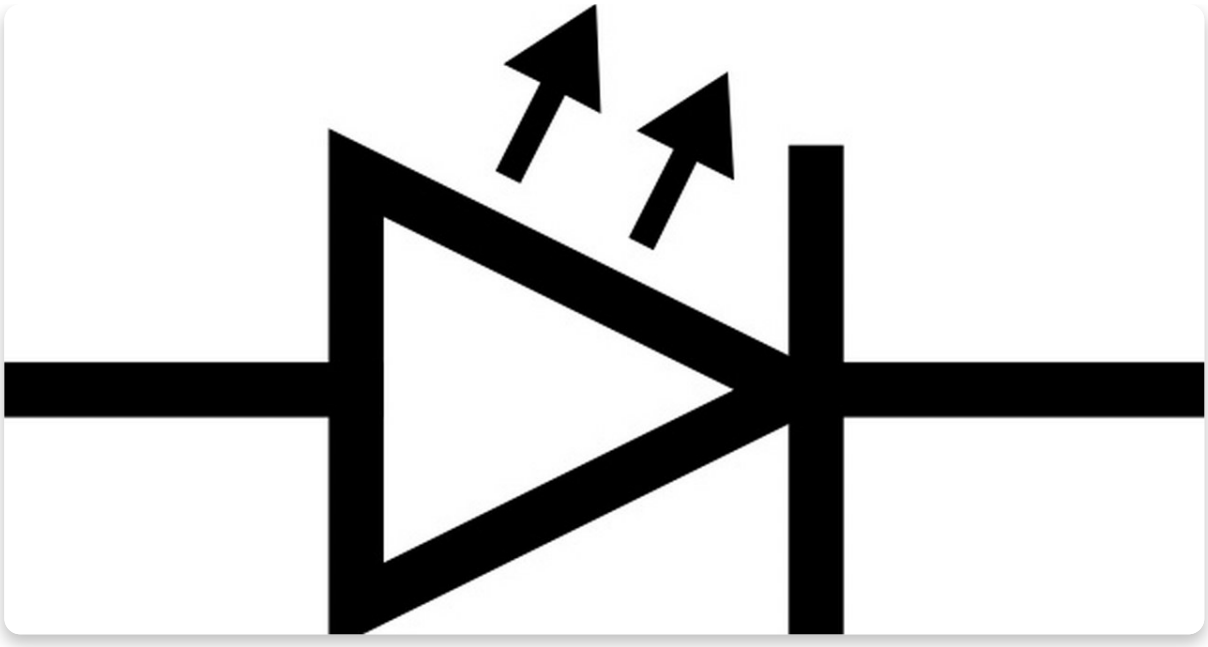
7. Blue LEDs

These electronic components will make your MARV'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.

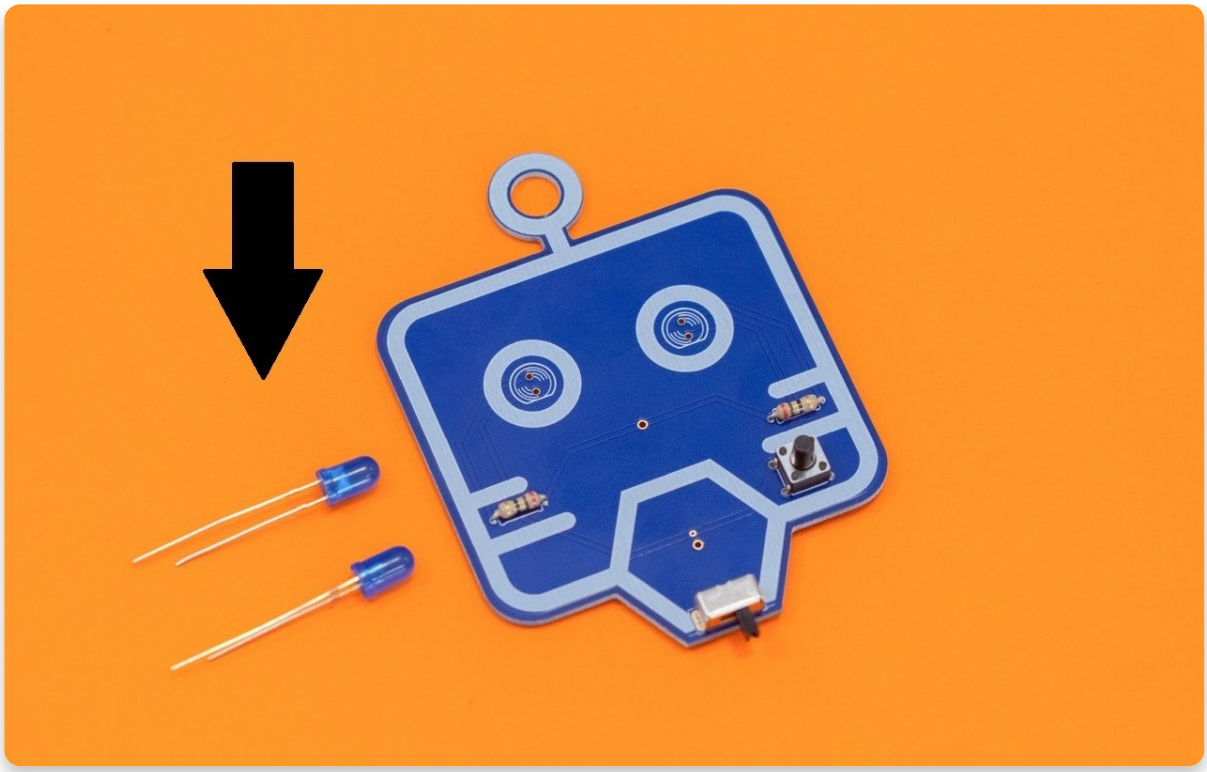
Because of this, you need to pay attention to how you are going to place your LED in the electronic circuit.

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).

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

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.



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 MARV 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!

Let’s assemble your wacky robot! First, we’ll need some tools!

Soldering iron

For the 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.

Assembly

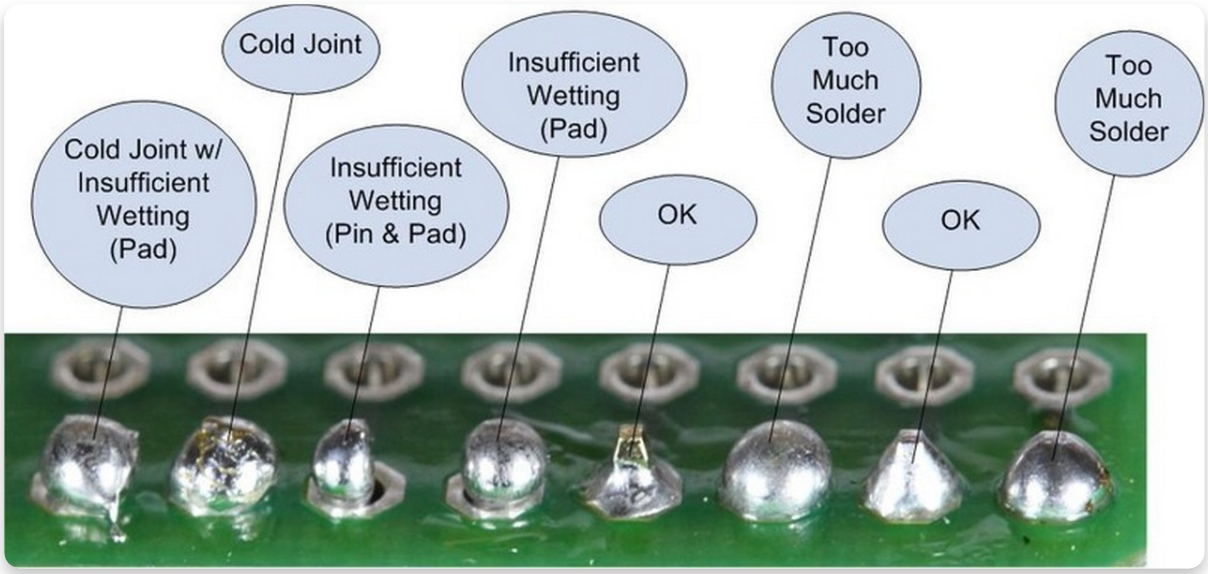
How do I solder?

One of the things you'll do as a part of Marv's 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 is an awesome picture by Adafruit industries that can help you (thank you Adafruit!):



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!

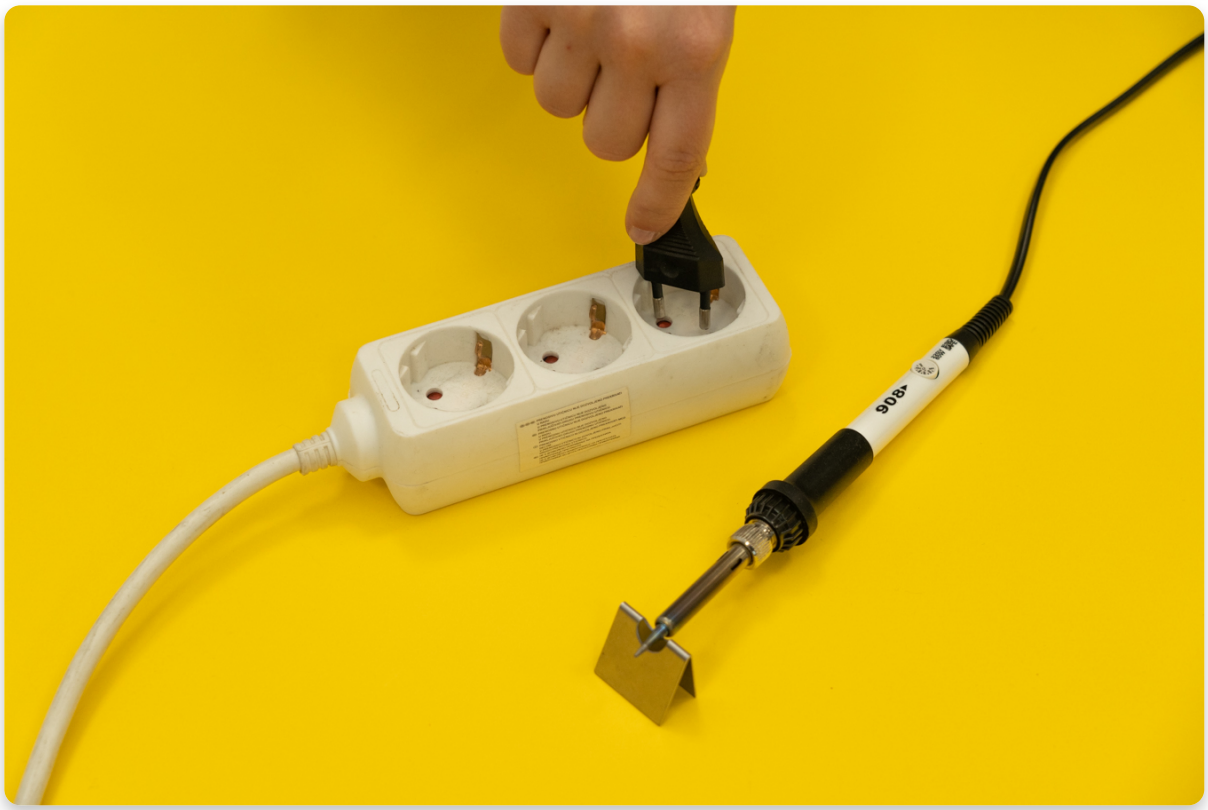
Using the soldering iron

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

Set the temperature to **350 degrees Celsius** by turning the temperature regulation knob on your soldering iron.

Make sure that the small black arrow points to the correct temperature, as in the photo.

Your soldering iron is now ready to use, but give it a minute or two, so it can heat up.

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.

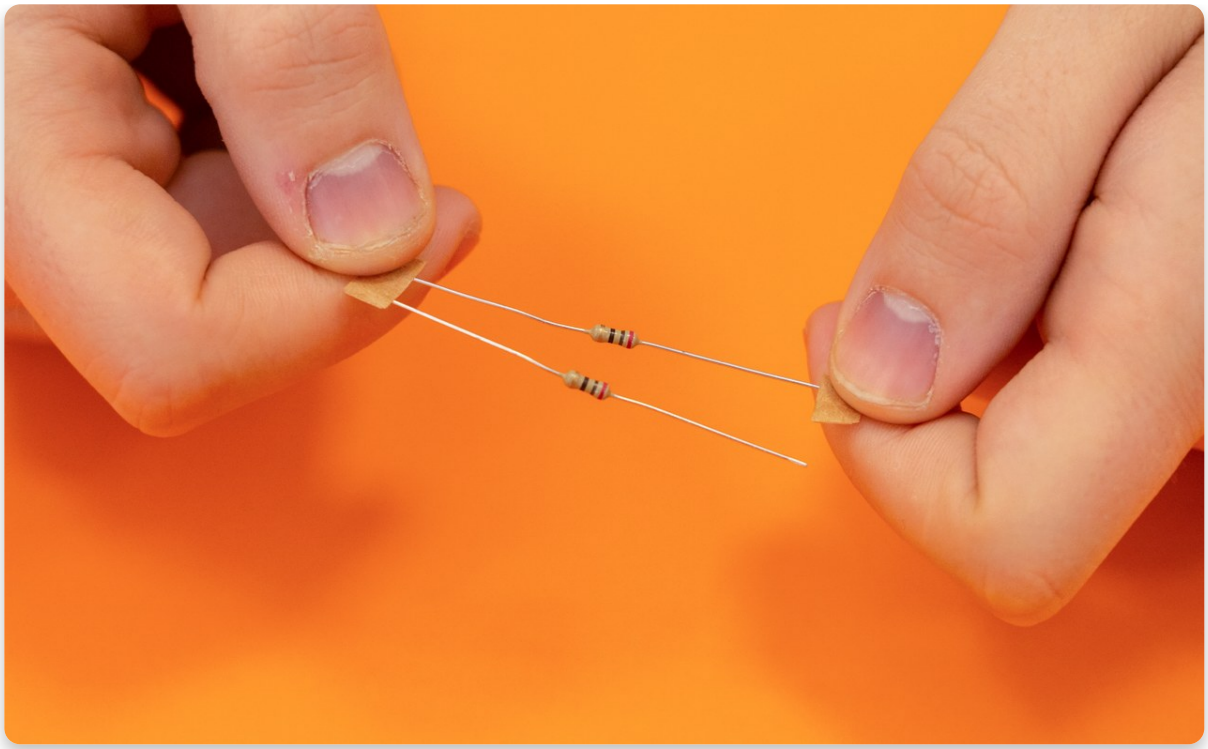
Make sure to not touch the soldering iron tip for at least five minutes after you have turned it off.

Let's make MARV!

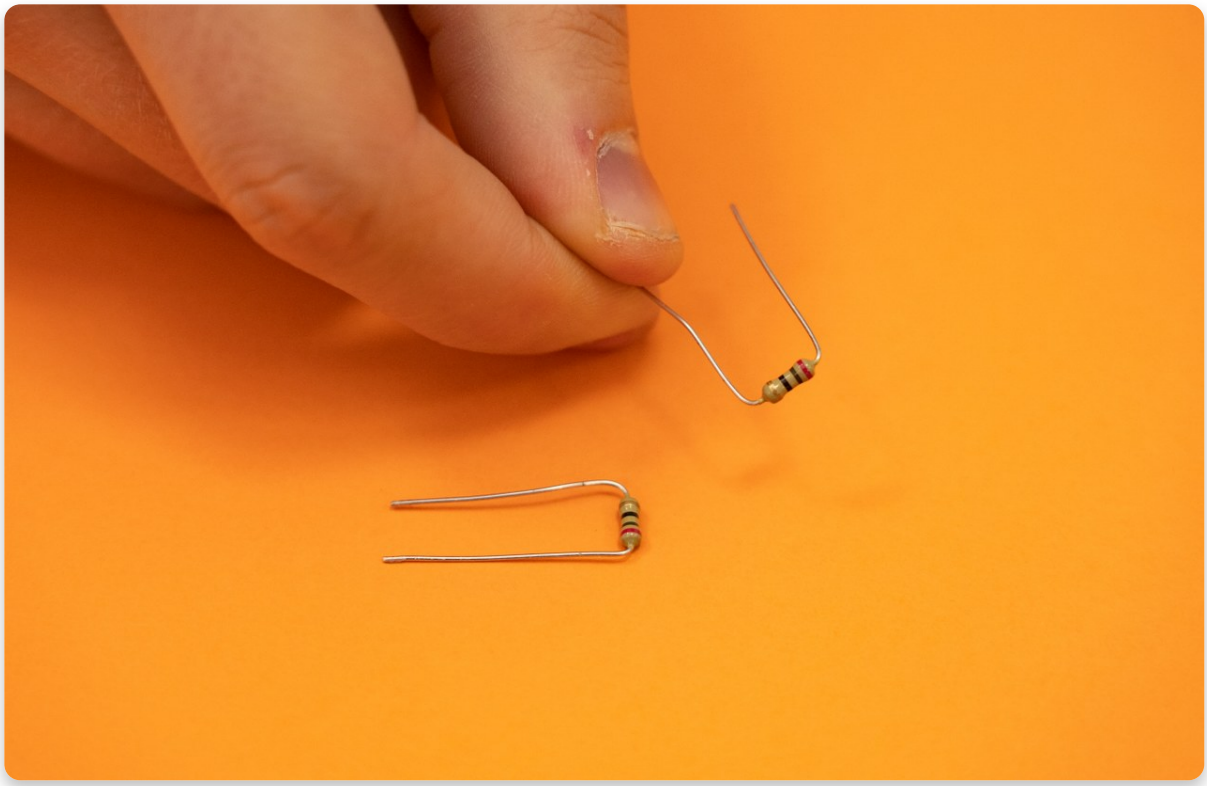
Part one - Resistors

The first components you will need while assembling MARV are resistors.

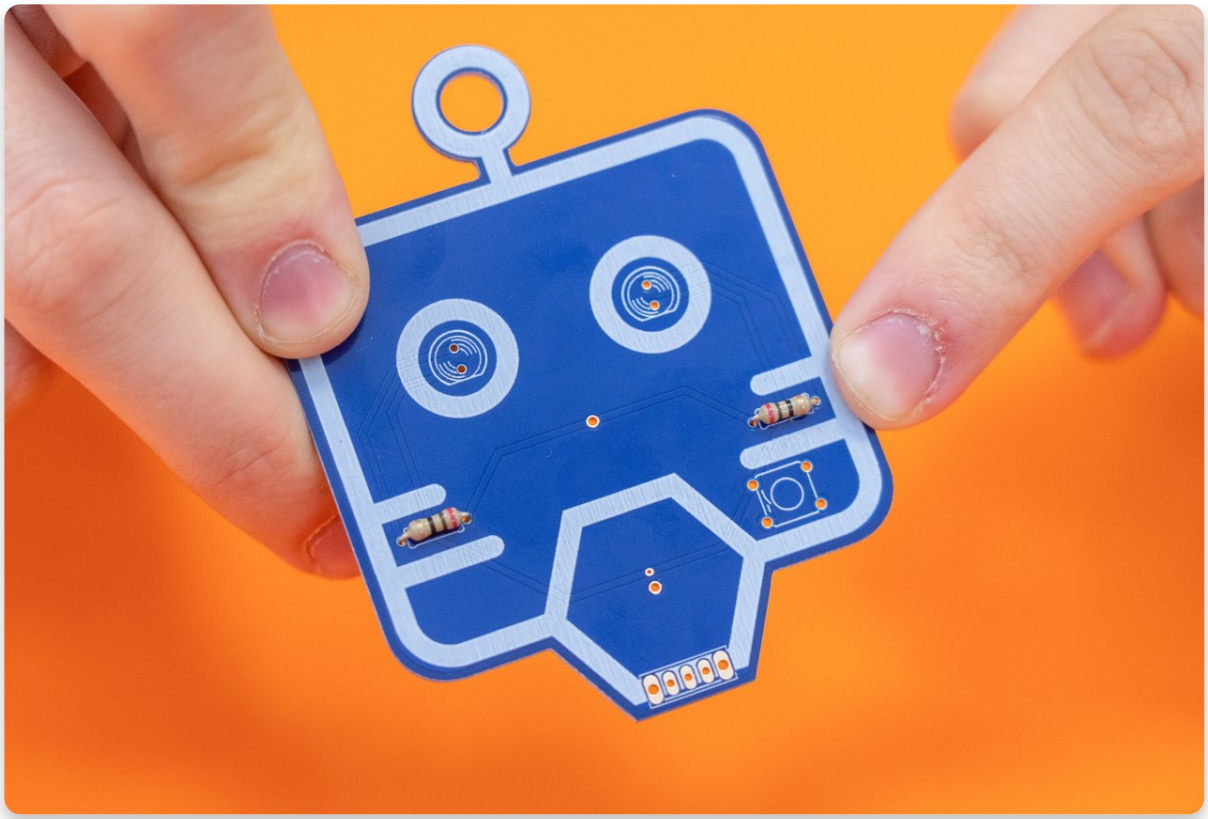
First, take off the paper packaging placed on both ends of resistors.



Now, you should gently bend them in the shape of the **letter U,** but be careful because they could break easily.



Place them as shown in the picture below:



Now is the time to use your soldering iron and solder resistors on MARV's back.

After you solder all resistors, **take one more look at the solder joints** to ensure there are no cold joints.

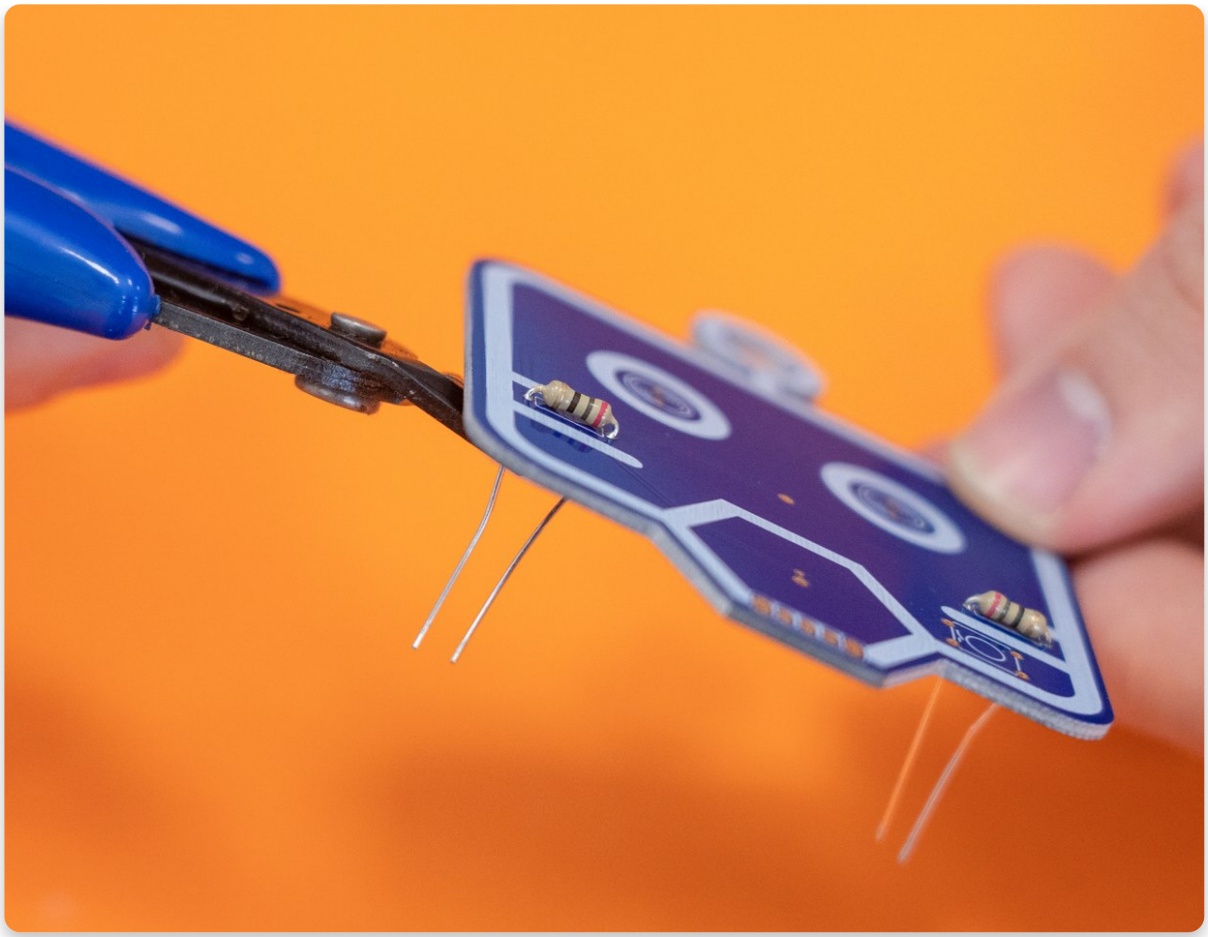
Watch out! Cutting off the resistors' legs must be done with caution!

Take out your cutter pliers. You will use them for cutting off the excess legs of your resistors.

Be careful!

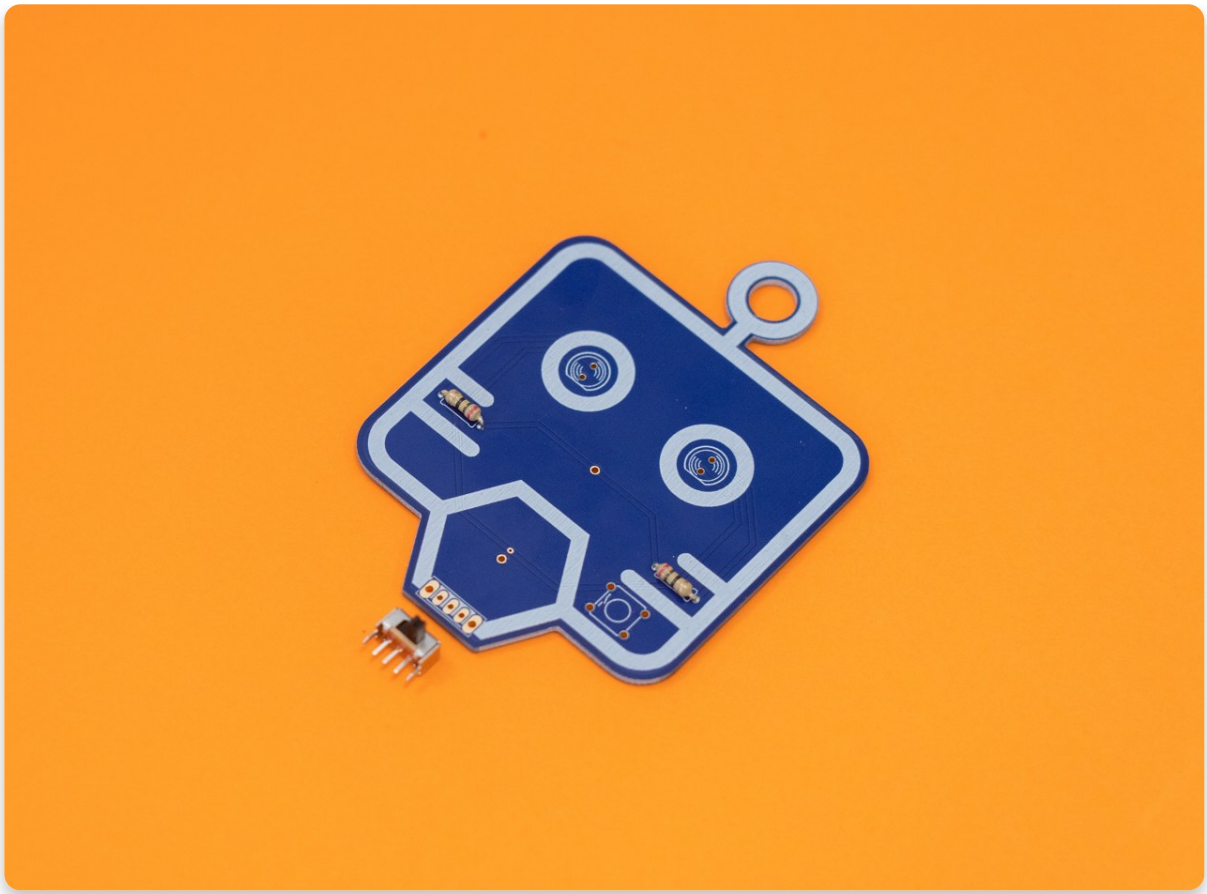
Do not point the legs upwards when cutting them!
They might fly away and hurt someone!

When cutting them off, always turn the legs of the electronic component towards your table like this:



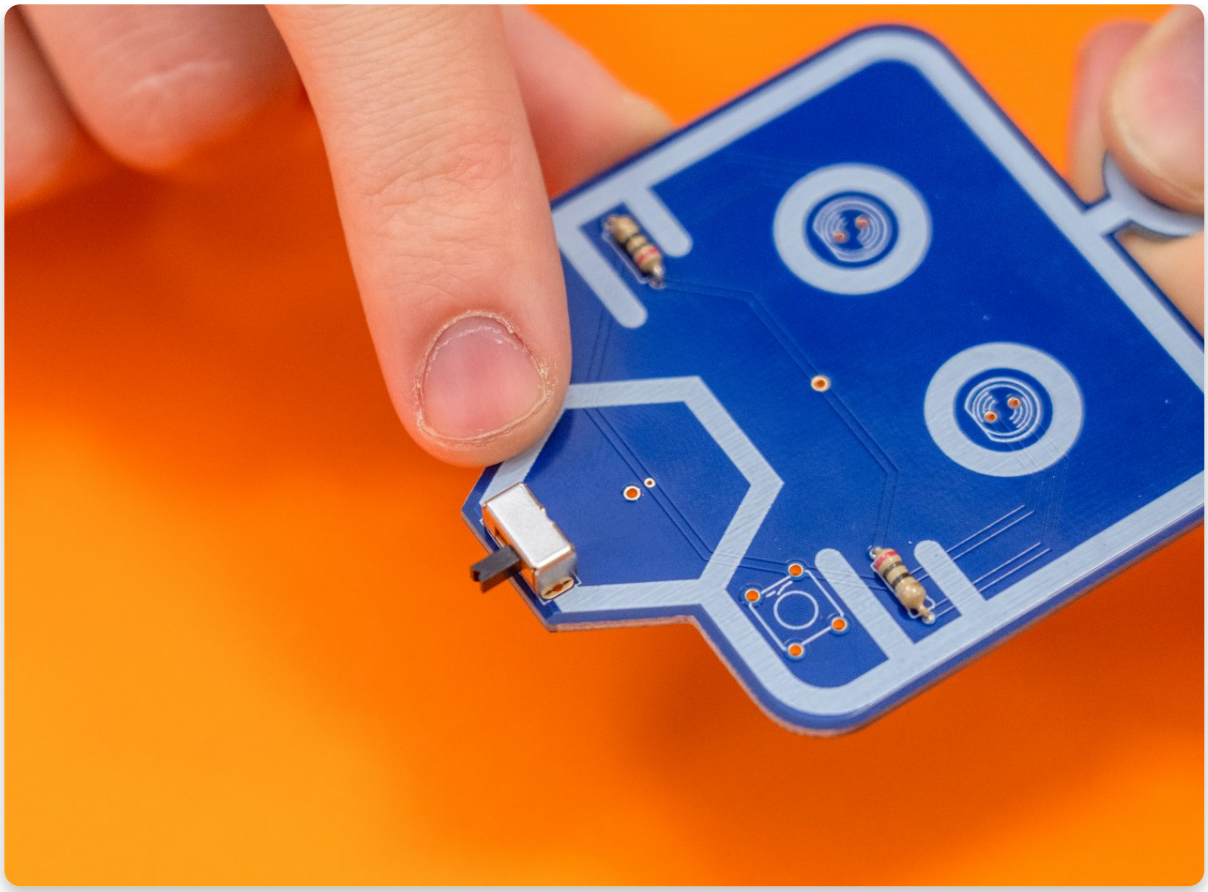
Part two - The switch

Now you'll be soldering the switch.



Place the switch on the front side of MARV’s head.

You'll need to use a bit of strength for this since it can be a bit hard for the switch to come into the circuit board.



Now is the time to solder the switch to the circuit board.

Before you do so, please make sure that the switch is vertical to the circuit board.

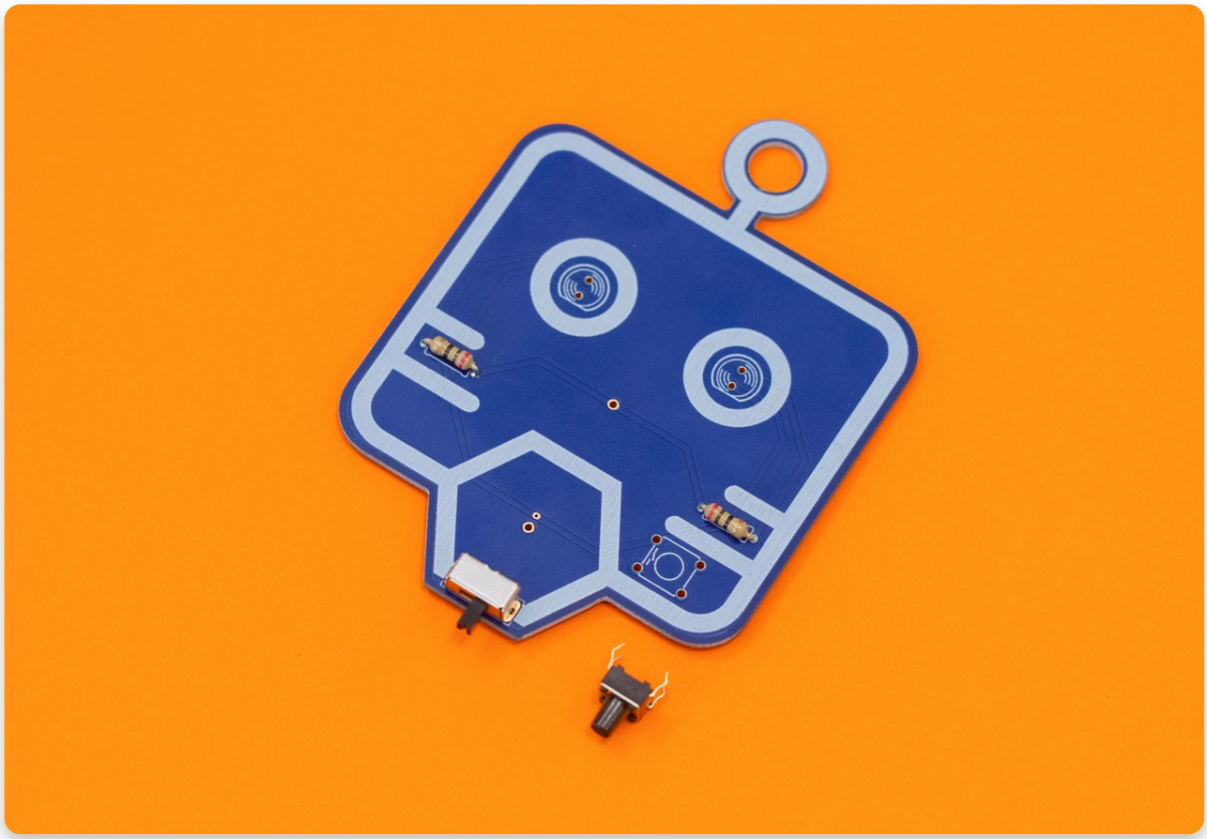
Please clean your soldering iron tip with the sponge before soldering the switch.

Soldering these pins requires a bit more precision since they are very close together.

The switch's soldering joints should look like this after you have successfully soldered them:

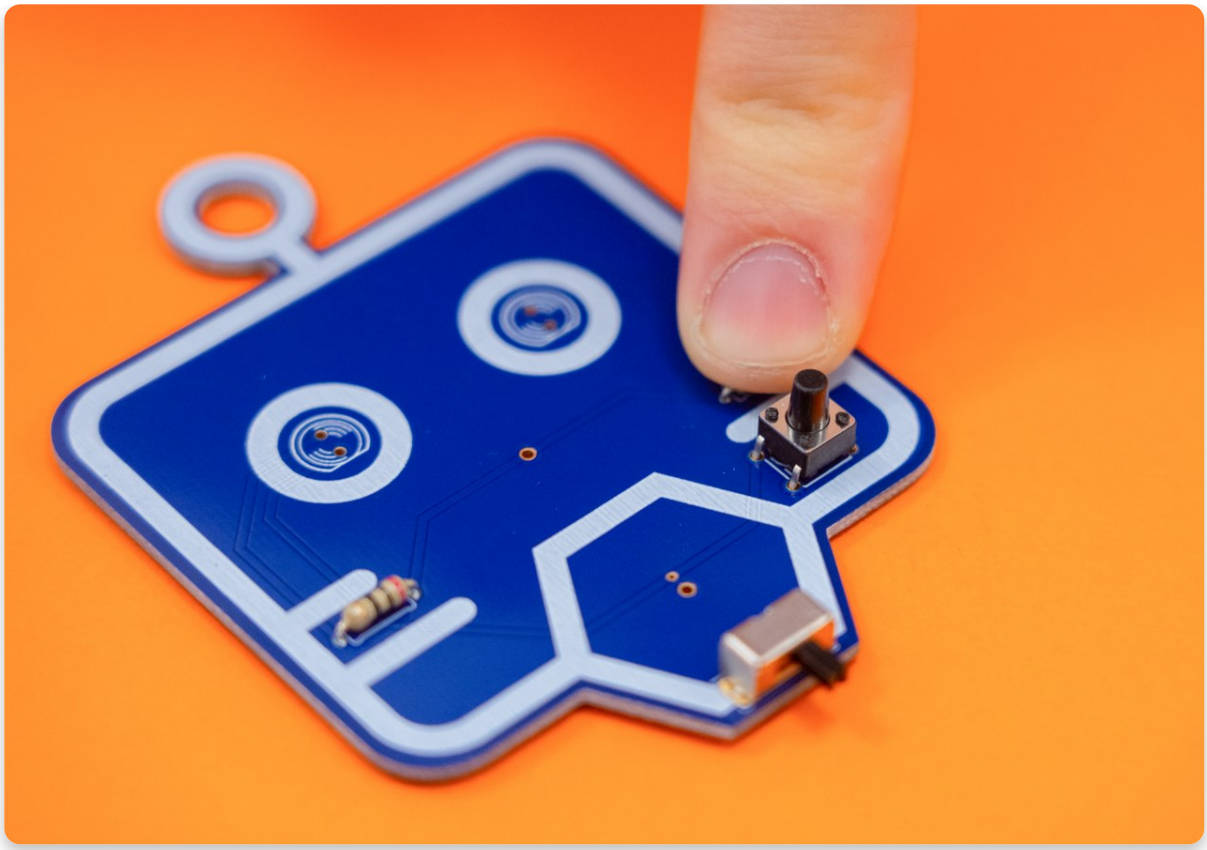
Part three - The pushbutton

Now, let’s solder the pushbutton!



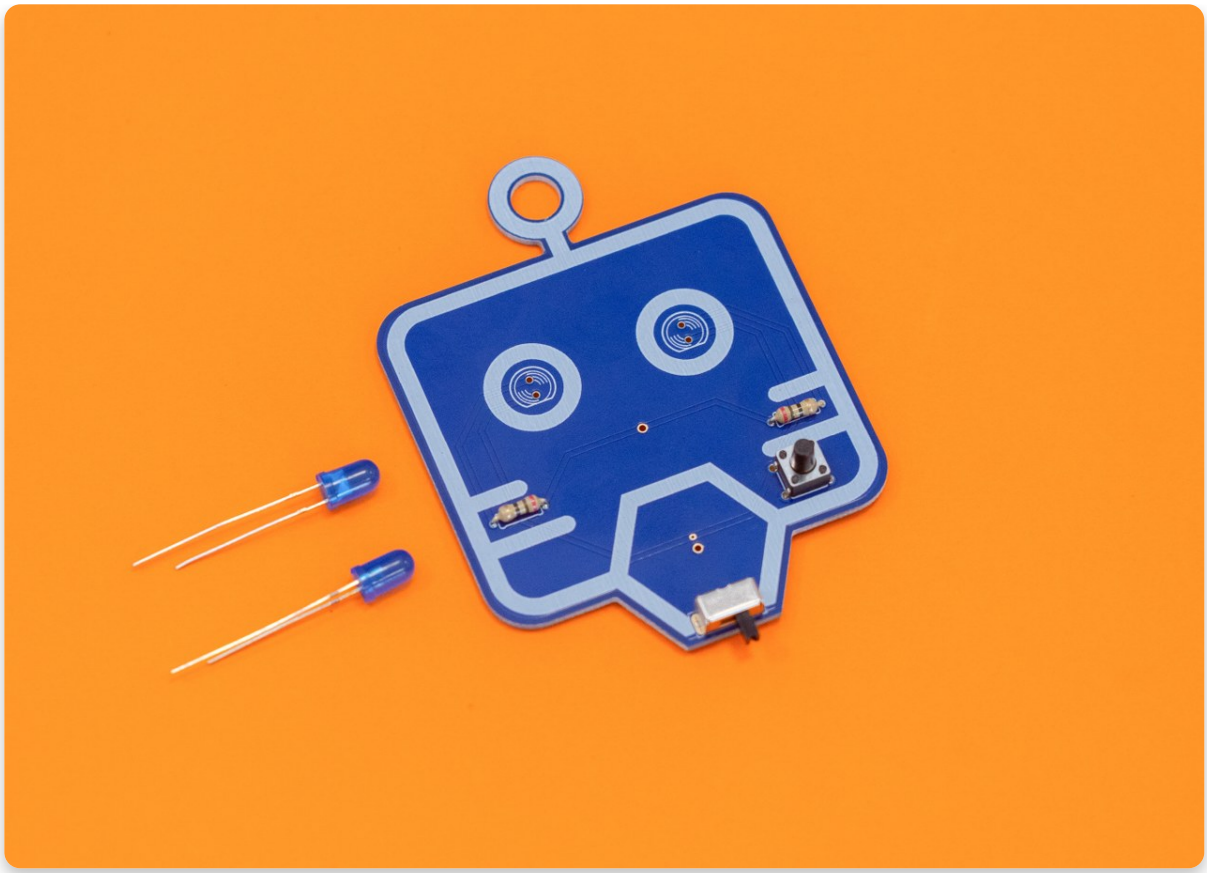
Make sure the pushbutton is placed vertically to the board before soldering.

After putting it on the circuit board, press the pushbutton a few times to check that everything is okay.

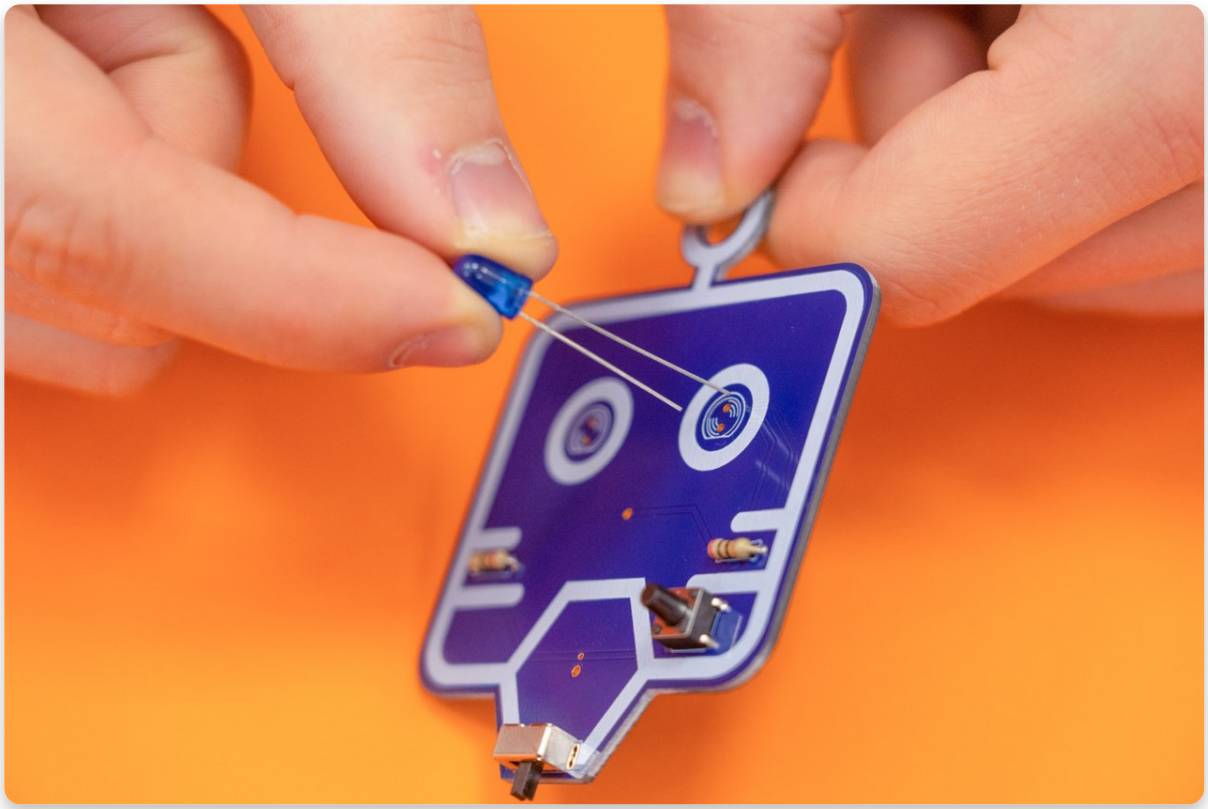


Turn MARV around, take the soldering iron, and solder away.

Part four - The LEDs

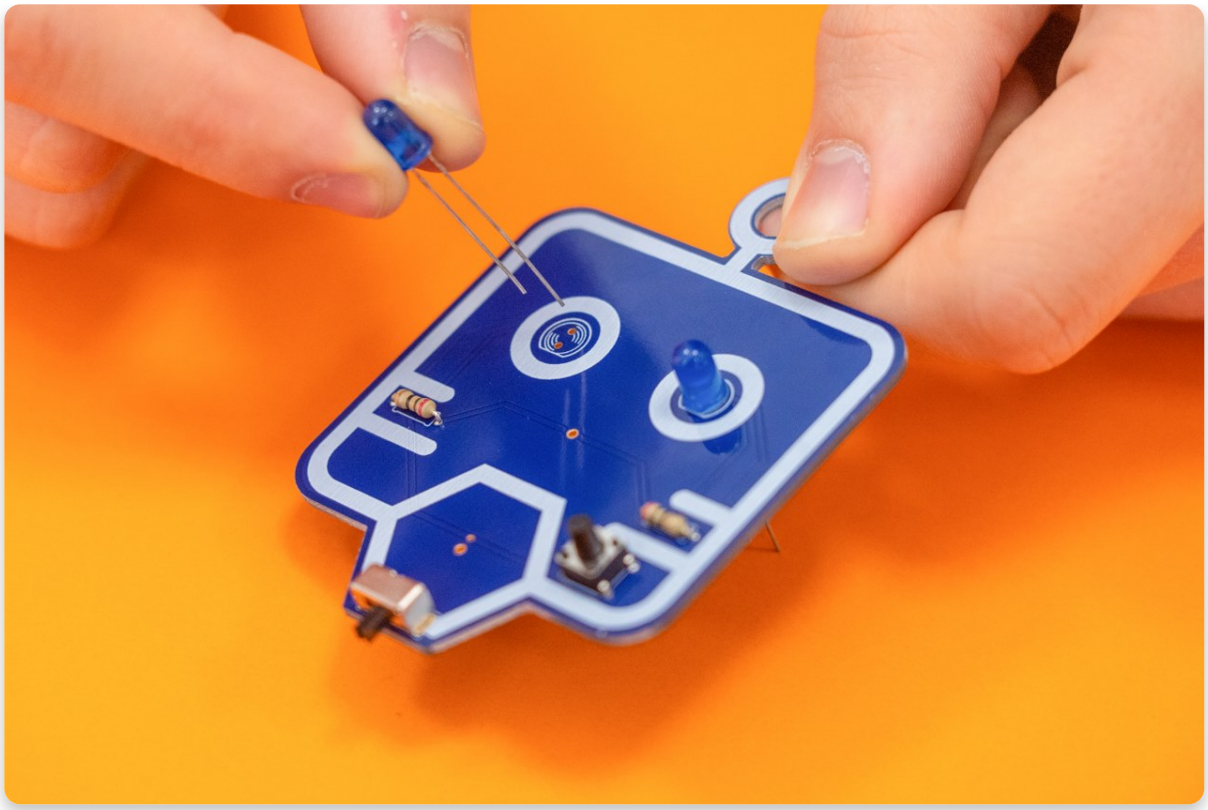


Now, take the LEDs and place them in MARV's eyes.



We need to watch out for the polarity of the LEDs, or they won't work.

The shorter leg of the LED should face the switch like this:

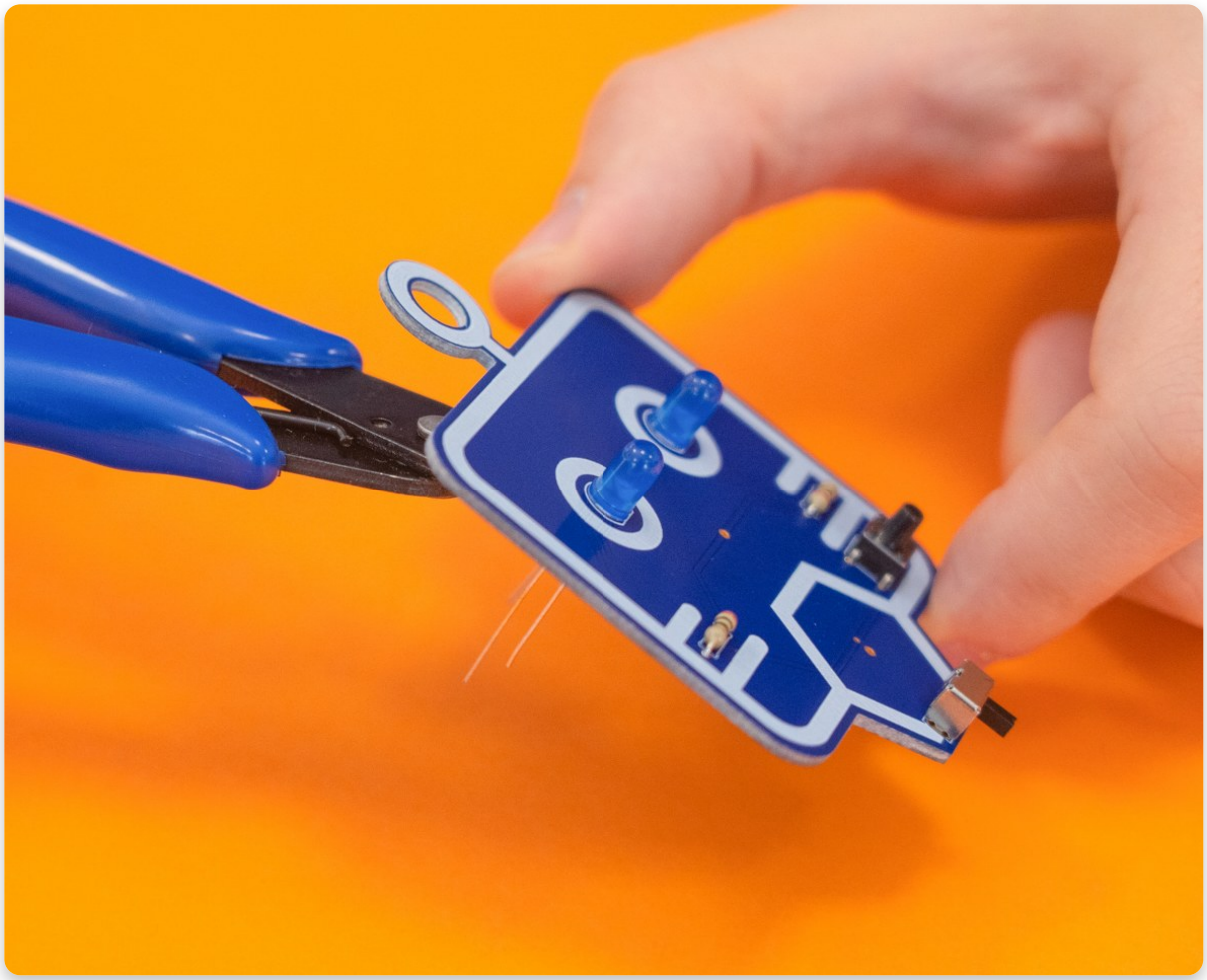


Flip your MARV and solder away.

After making sure there's no bridging between the solder joints, take your pliers and cut off the rest of the LEDs' legs that you don't need.

Watch out!
The legs of the LEDs must face towards the table when you are cutting them.

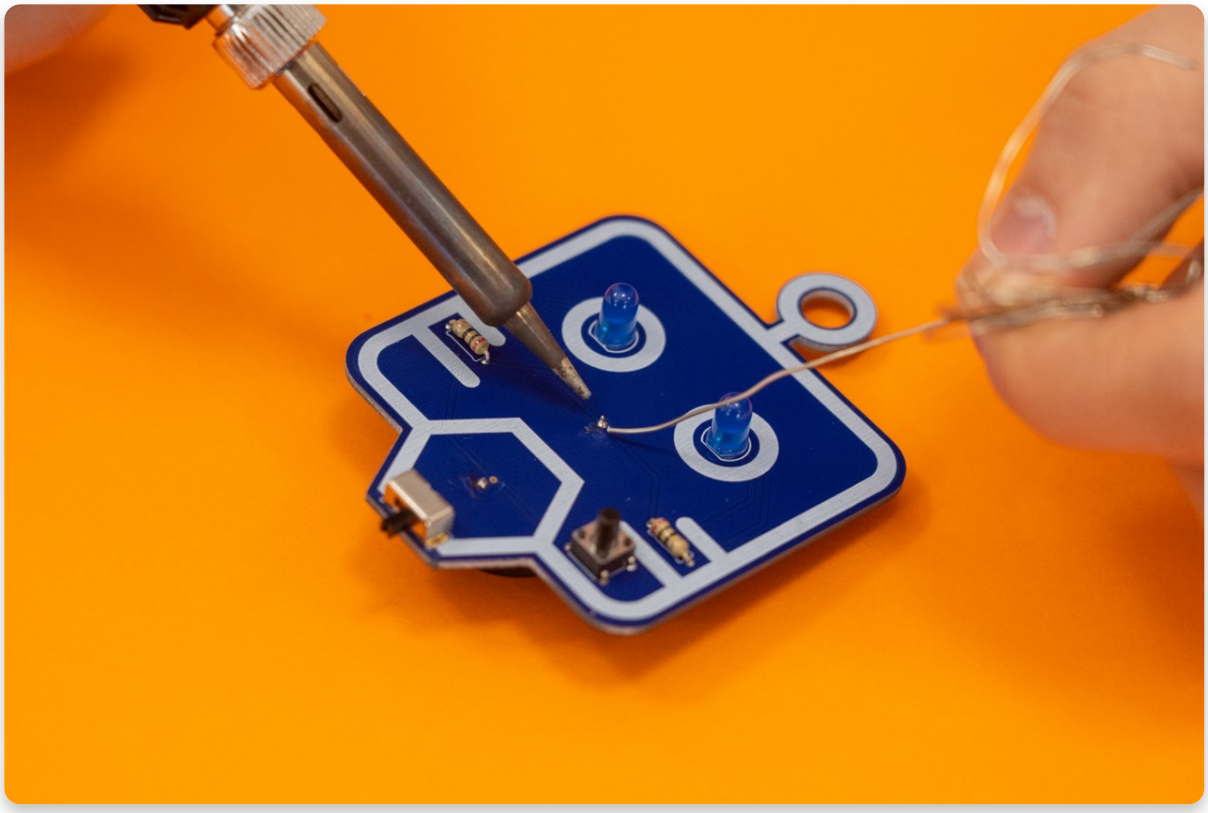
This way, they won’t fly away and hurt you!



Part five - The battery holder

Place the battery holder like this:

Now, turn MARV around and solder the battery holder's two pins.



And we're done with soldering!

Please turn off your soldering iron by unplugging it from the power outlet.

Leave it on the soldering iron stand for at least five minutes, so it cools off before you put it away.

If you need help with cleaning the tip of your soldering iron, please check our video tutorial.

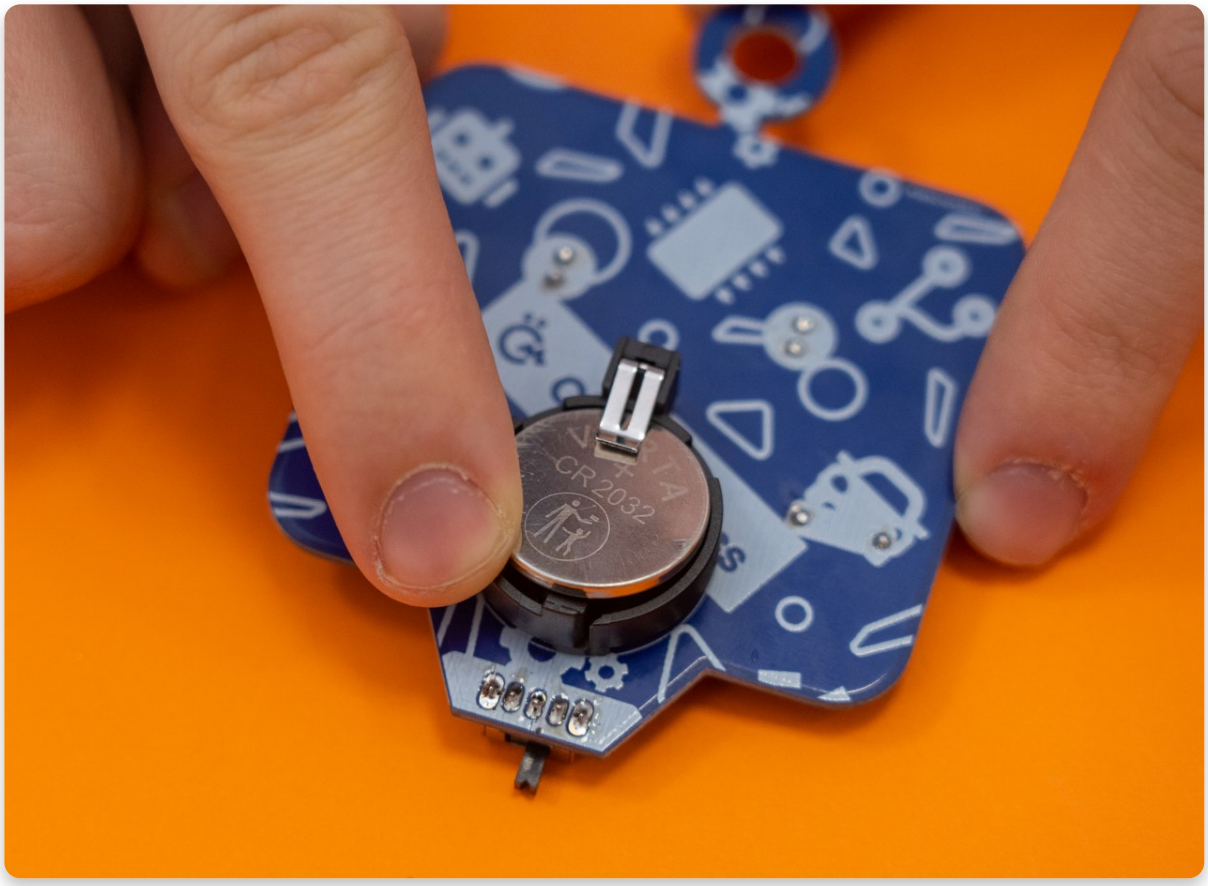
Batteries first

Now you can **put the coin cell battery into the battery holder!**

Watch out; the battery needs to be put in on the right side.

The tiny plus (+) sign on the battery must be facing upwards!

Check the photo:



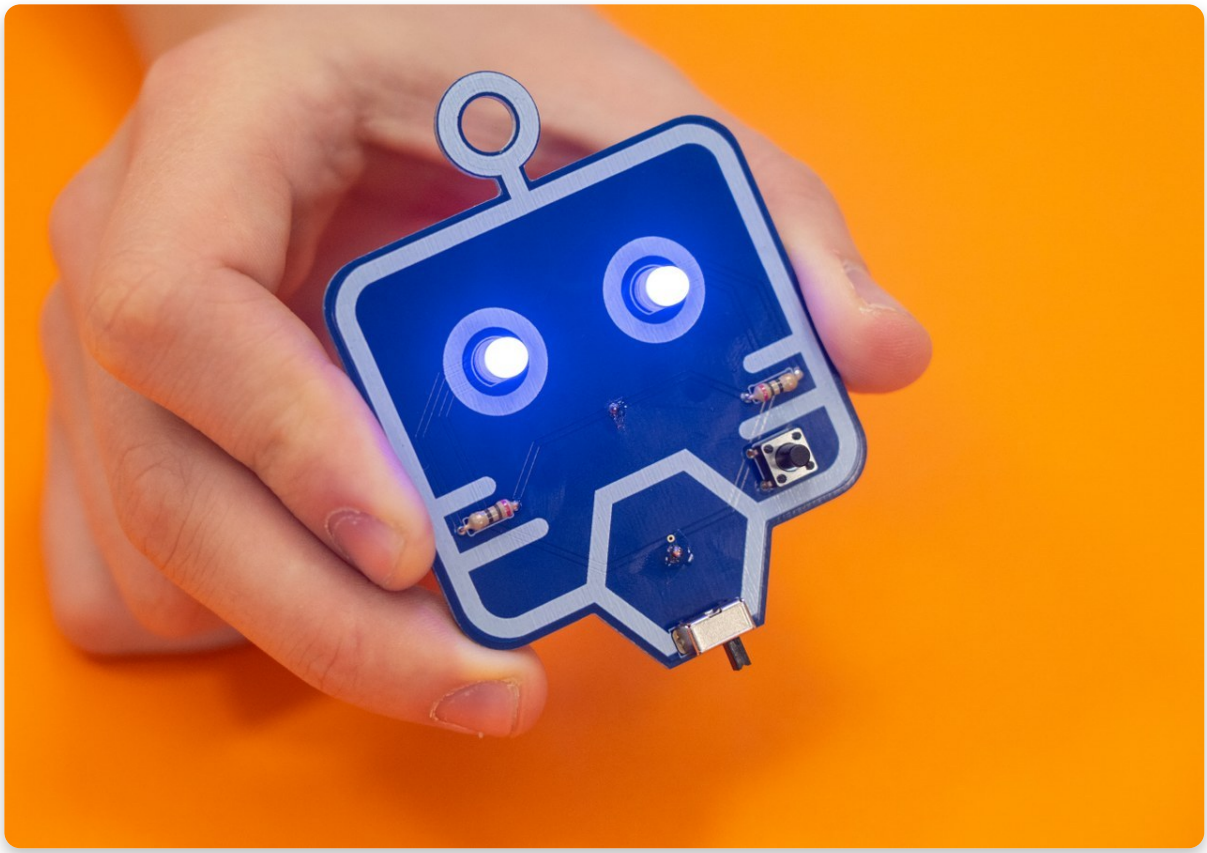
You did it! MARV, the wacky robot, is assembled.

Let's turn it on!

The difference between a switch and a pushbutton

Now that you assembled your wacky robot, it's time to see how it works!

Once fully assembled, your MARV should look like this:



MARV will demonstrate to you the difference between a pushbutton and a switch in a practical way.

If you press the pushbutton, MARV's eyes will light up for a moment and then turn off.

If you push the switch, his eyes will remain shining until you push the switch back to the original position.

If you have any questions, you can contact us at **contact@circuitmess.com**, and we'll help you!