

Electronics 101

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

1. Circuit board

The red square-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.

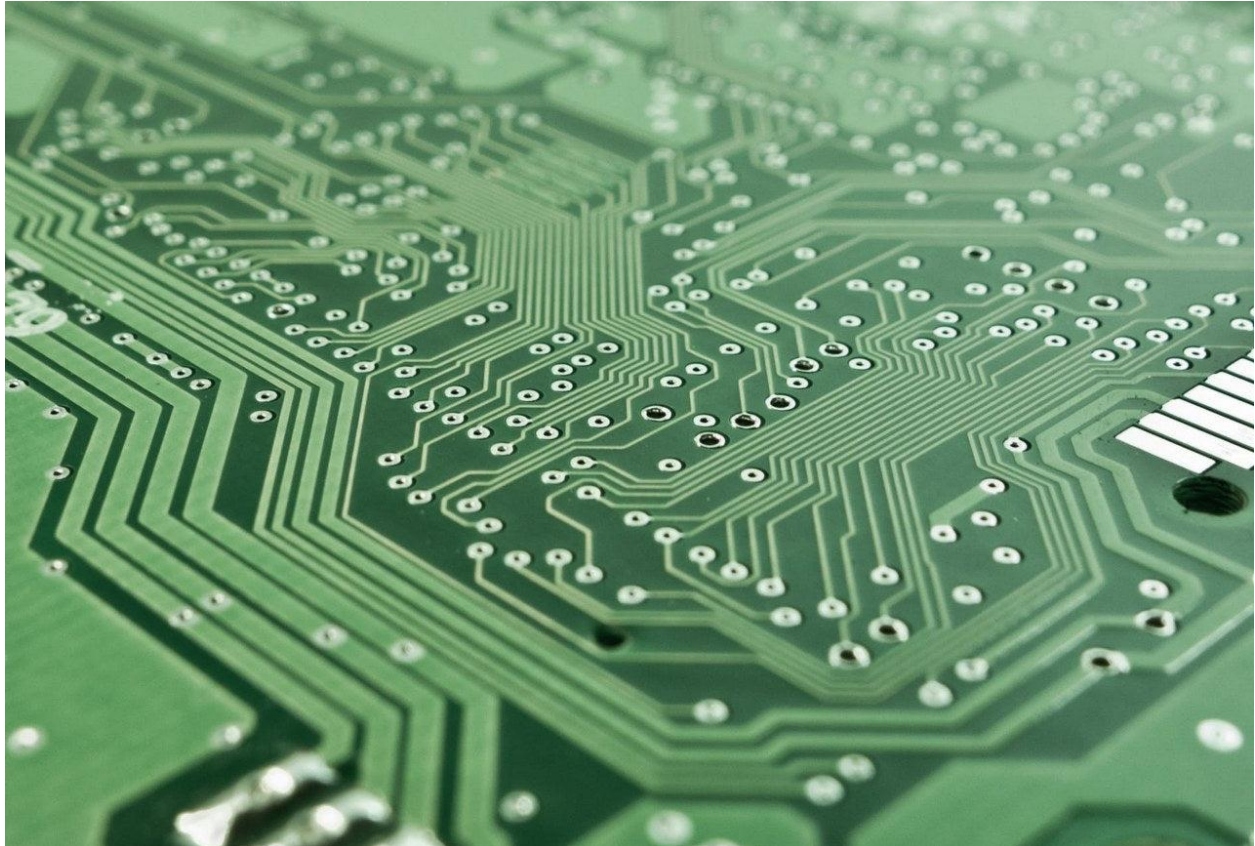
Did you know?

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.

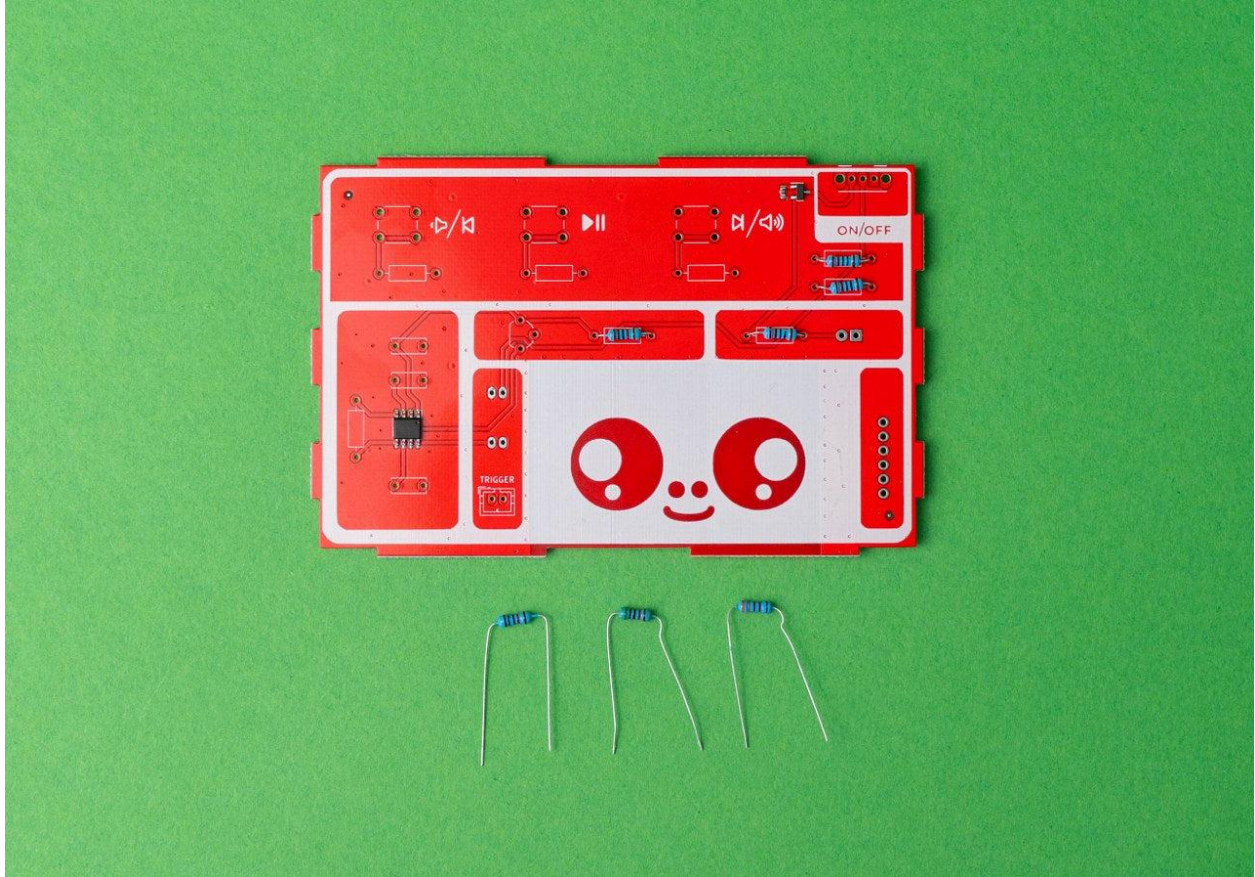
They fall in the category of passive electronic components.

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.

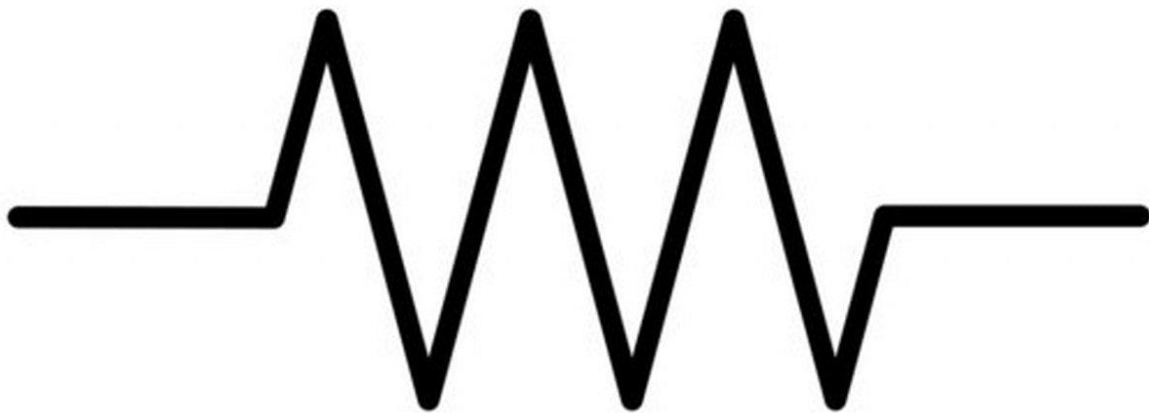
The exact value of a resistor is measured with a device called an ohmmeter.

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. Pushbuttons

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

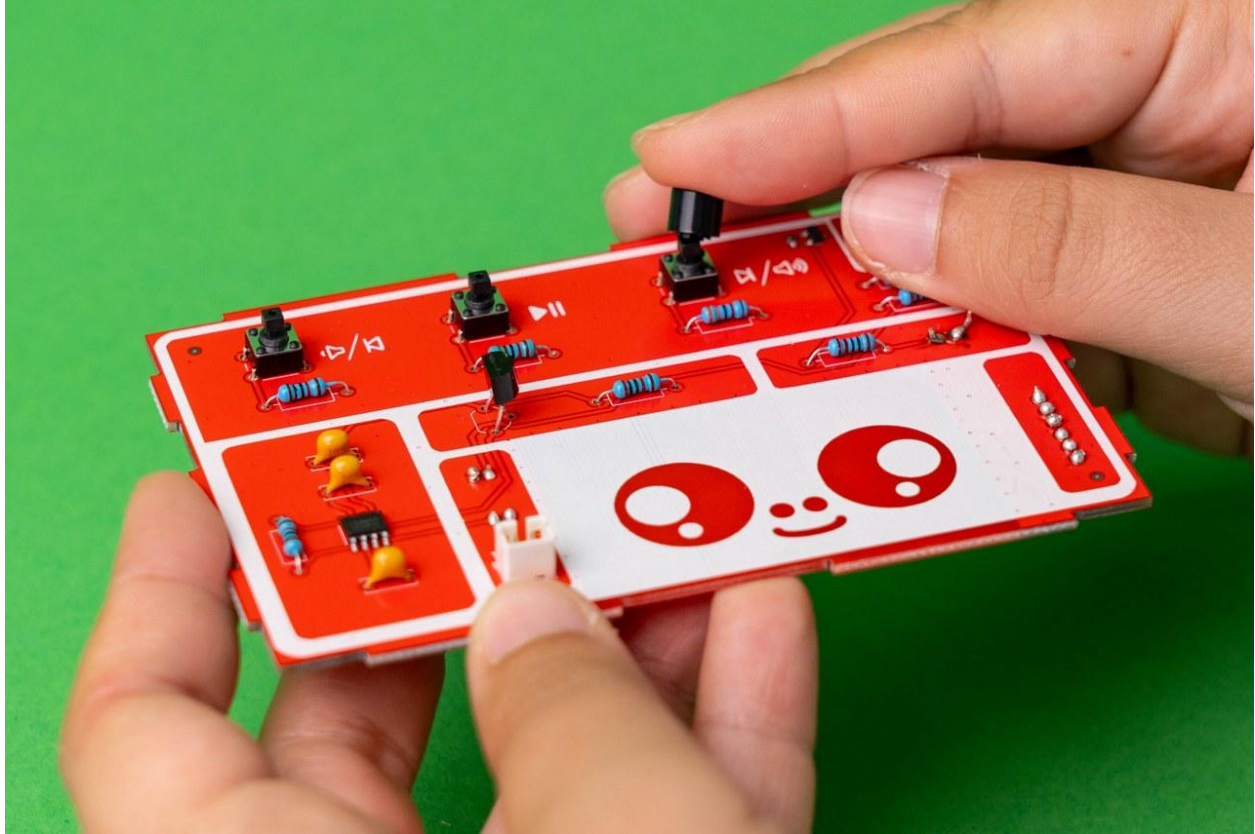
When a pushbutton is pressed, a small metal spring inside makes contact with two wires, allowing electrical energy to flow.

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.

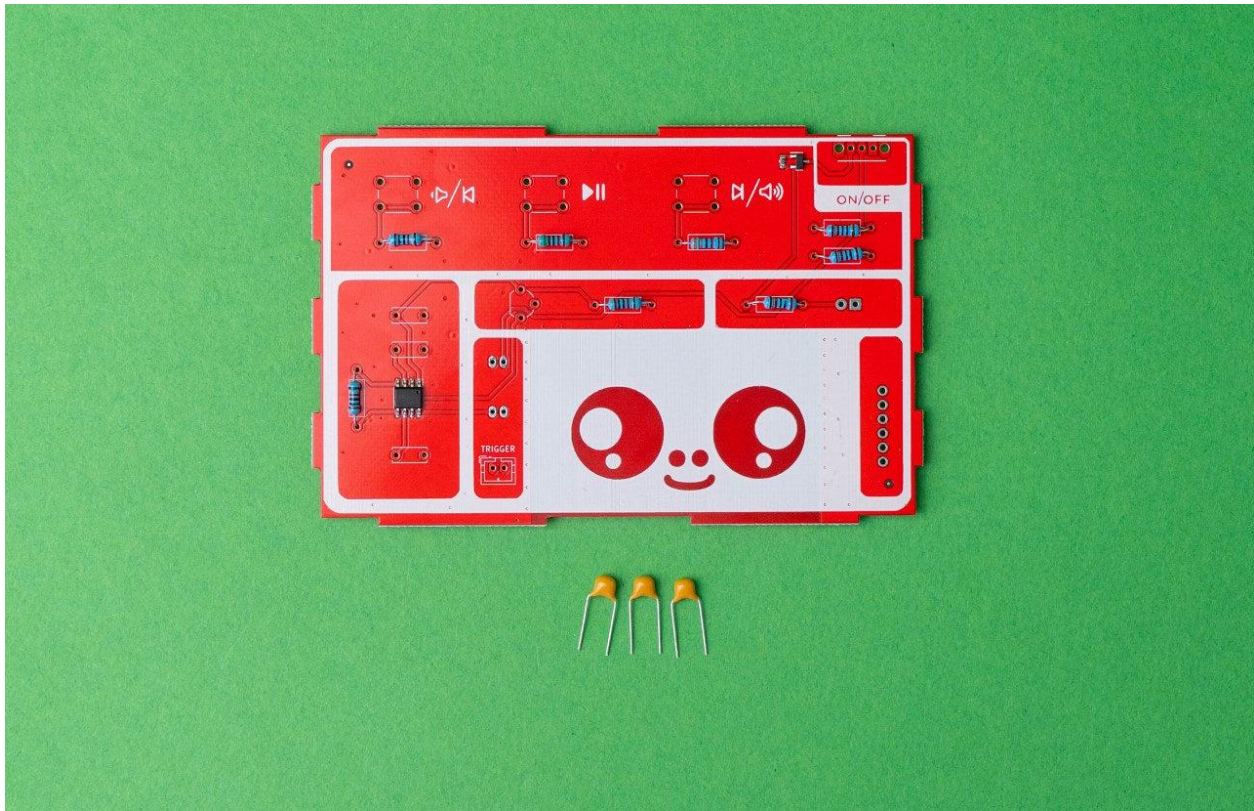
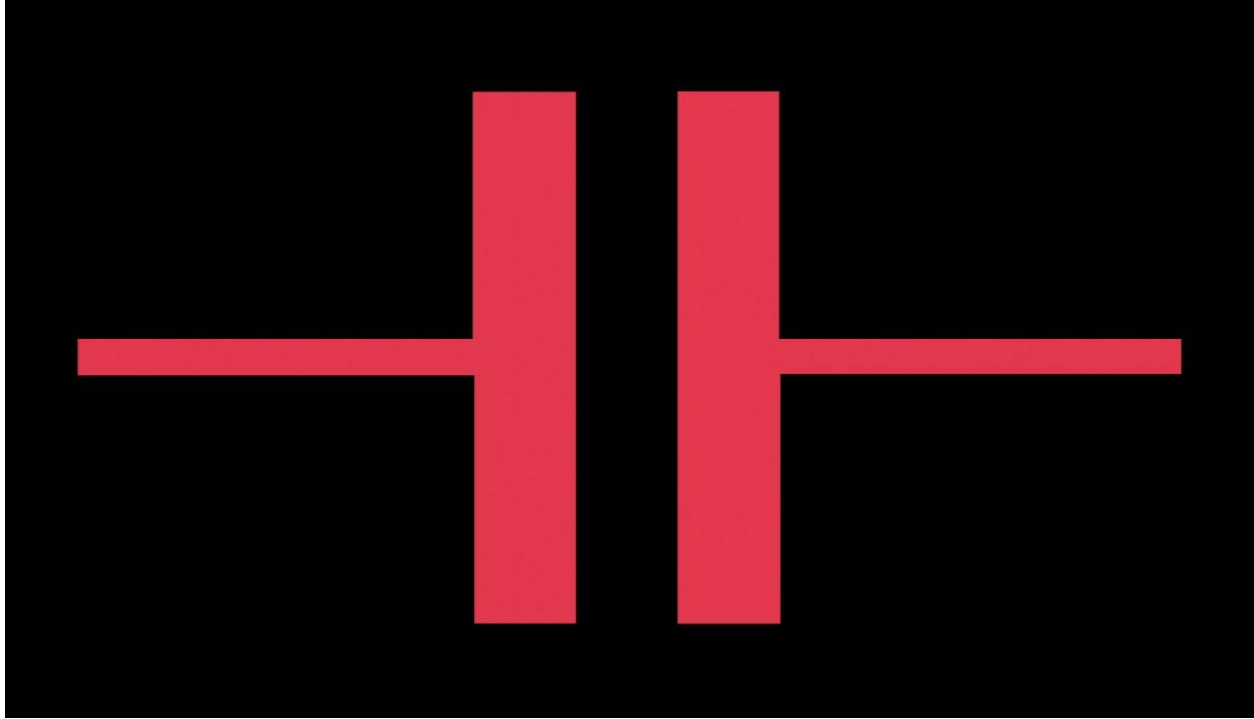
A pushbutton also has two states - on and off. A pushbutton will change its state if you push it with your finger, but it will automatically retract back to its original state when you remove your finger.



5. 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.

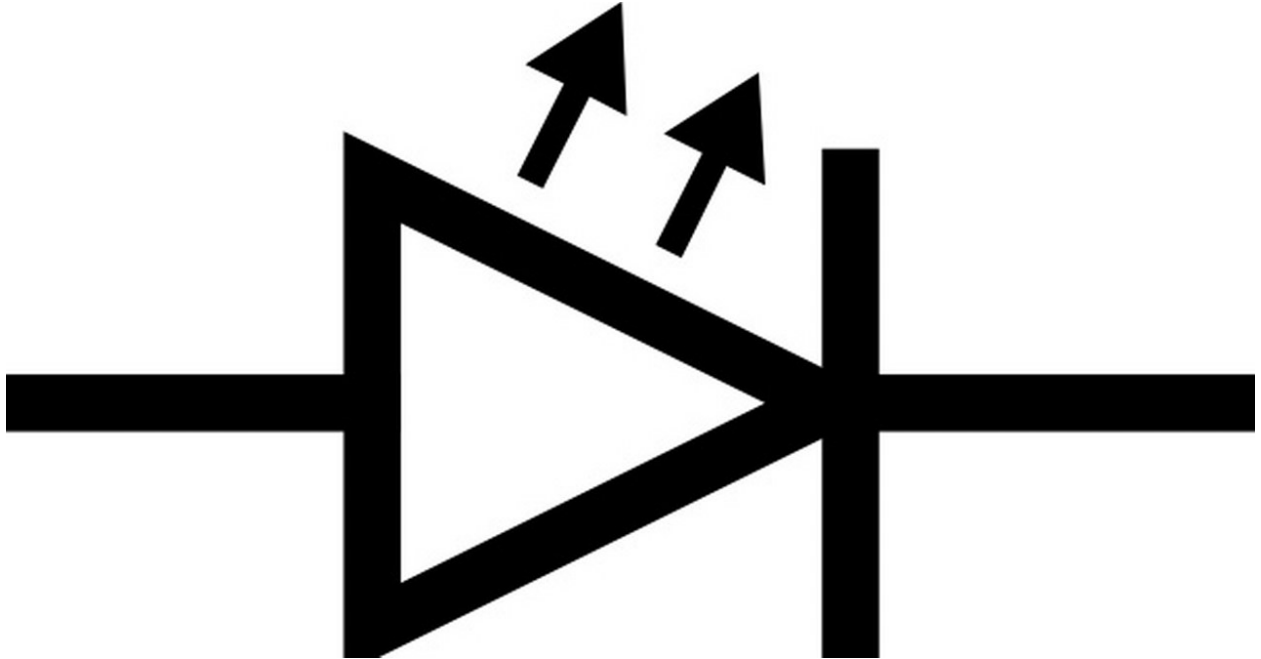
The first capacitor was a glass jar wrapped inside and out by a thin metal foil.

6. RGB LEDs with built-in color changing chip

LED stands for light-emitting diodes.

LEDs convert electrical energy into visible light.

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



RGB in the name stands for Red, Green, and Blue.

This means that these particular light-emitting diodes can light up in three different colors.

These LEDs are very special because they have a tiny built-in color-changing chip. Look closely into an LED and you'll see a black dot - the chip that controls the colors.

Please, make sure to put the LEDs in the circuit board properly!

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.



7. 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:

