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ELEKTRONIK

EN

Content

Introduction

The Makerkoffer Electronics contains information and activities related to electricity, how it works and what you can do with it.

Preparation

The field of electronics comes with a variety of specific tools, materials and techniques. They are described in the section "Tools and materials". Most of them can be obtained from your local hardware store, local suppliers of electronic goods or on the Internet. (A "shopping list" can be found in the coloured box on this page.

Activities

Each activity deals with a specific aspect of the topic of electricity. The tools and materials needed for each activity are listed on the corresponding activity sheet.

Level 1: Getting to know tools and materials

- "What conducts electricity?"
- "Figures made of wire"
- "How does a battery work?"

These activities can be done alone but are mainly suited for being carried out in a group (except for "Figures made of wire").

Level 2: Electric Circuit Part 1

- "Building an electric circuit" (with the help of circuit cards)

The "circuit cards" developed especially for this activity must be prepared beforehand. (See section on "Levels" below).

Level 3: Electric Circuit Part 2

- "Light up figures"

Levels

With each activity, learners develop new skills based on what they have learned before. Beginners should therefore start with the level 1 activities. It will allow them to playfully acquire the necessary knowledge and techniques before moving on to the electric circuit.

Through the course of three different levels of difficulty, the children gradually learn how to handle electricity and the related tools and materials.

Level 1: Beginner

What conducts electricity?

In this activity learners test the electrical conductivity of objects such as scissors with a multimeter.

Figures made of wire

Small figures are created by twisting wires or by connecting them with luster terminals.

How does a battery work?

Learners familiarise themselves with the functioning of the battery: Where are the plus and minus poles? Is the battery full or empty?

Level 2: Advanced

Building a circuit

Participants learn how to assemble an electric circuit with the circuit cards. The cards correspond to the individual components of an electric circuit. In this way, children and young people can learn the basics of the electric circuit without danger, before they start building a real one.

The cards should be prepared before starting the activities. Once they have been printed out, folded and glued together (this makes them more resistant), they can be used again and again to plan new circuits.

Level 3: Expert

Light up figures

Learners build an electric circuit to make a robot's eyes light up.

Competences to be learned

- Handling tools (e.g. pliers, multimeter)
- Handling different materials (e.g. wire, luster terminal)

Basic knowledge about the electric circuit

- Assembling a circuit
- Functioning of individual electronic components

Tool and material list for the activities

- Electronic combination pliers 180 mm
- Electronic side cutter 160 mm
- Multimeter
- Wire stripper
- Screwdriver
- Bell wire Y-wire 1x0.6 mm 20 m red
- Bell wire Y-wire 1x0.6 mm 20 m blue
- Luster terminal 1.5-2.5 mm² 12-pole 2 pieces
- LED - Basic Red 5mm (25 pack)
- AA batteries
- Battery holder with disconnector
- Resistors
- Toggle switch 1-pin 3A 125Vac

Tools and materials


Multimeter

Multimeter

The multimeter is THE tool of electronics and it is used for a wide variety of measurements. By measuring "continuity", you can check objects made of different materials for their electrical conductivity. In the activity "What conducts electricity?" you can try out the multimeter and find out which materials are conductive.

Electric wire/bell wire

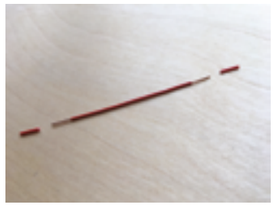
Electric wire is used to "transport" electricity. It is usually made of copper, a metal that conducts electricity very well, and a plastic insulation. The insulation is available in different colours so that you remember which wire is which in larger projects.


Side cutter

Side cutter

Since the wire usually comes in rolls of several metres in length, you have to cut off the amount you need. In technical jargon this is called "cutting to length". This is what a side cutter is for.

Wire stripper



Wire stripper

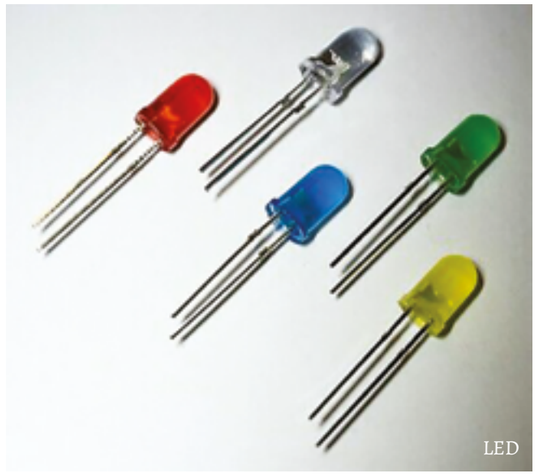
The plastic insulation around the copper wire does not conduct the current, so it has to be removed at the ends of the piece of wire, this is called "stripping". To do this, the piece of wire is inserted into the wire stripper as far as it will go and then the handles are pressed together once.

The stripped piece of wire conducts the current from one end to the other. You can check this with a multimeter.

Combination pliers
With a pair of combination pliers you can hold materials as well as cut or pinch wires.

Luster terminal
Wires often have to be connected to each other. This can be done, for example, with a luster terminal. Luster terminals consist of a plastic housing with a current-conducting material inside. The stripped wires to be connected are placed in the openings and then fastened with small screws. Luster terminals usually come in "rods", with a sharp knife you can cut off the amount that you need. (Watch out with the knife!)

The activity "Wire Figures" is about the different ways of connecting wires and applying the knowledge in a playful way.


LED

LED
Until not so long ago, incandescent bulbs produced bright light but also consumed a lot of electricity, most of which was emitted in the form of heat. To save energy, incandescent bulbs were gradually replaced by energy-saving bulbs and, more recently, by the very energy-efficient LEDs.

In the activities, we only use LEDs, but not big ones like in the picture, but small ones that can also be operated with batteries. These LEDs come in different colours and sizes:

Resistor
Resistors come in different sizes, shapes and internal construction. Blue resistors are often so-called metal film resistors, brown ones so-called carbon film resistors. For the activities in this Makerkoffer, you can use either one, what is important is the resistance value of 220Ω. Since resistors are too small to print their value on them, they have coloured rings printed on them which are a code for the resistance value. Our 220Ω resistor has the colour code red-red-brown. If you want to know more about this, search the internet for "colour code for resistors".

Switch
Everyone knows switches from home, for example for switching lamps on and off. These are quite large and usually built into a wall. The cables are also laid invisibly in the wall. For the circuits in the Makerkoffer, we use small switches.

Level 1

What conducts electricity?

Description
The multimeter is THE tool of electronics! It is used for a wide variety of measurements. The test probes of the measuring strips can be used to test a wide variety of materials for their electrical conductivity.

Time
15 minutes

Tools and materials
Multimeter
Test objects, e.g. scissors, wood, pens, etc.

Instructions
1) Insert the red test lead in the VΩHz jack and the black lead in the COM jack. The dial points to the diode symbol/sound symbol. By pressing the SELECT button once, the sound symbol))) appears in the display.

2) Try this it alone or in a group: Take the probes and test different objects in the room. In a group, you can take turns taking the probes and choosing test objects in the room: Wood, the radiator, pipes, pens, rulers....

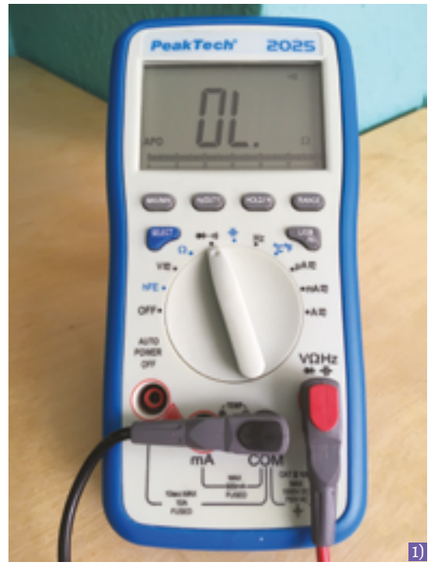
It beeps: The metallic part of the scissors conducts the current!

It does not beep: the plastic handle of the scissors does not conduct electricity!

2) What have you found out? In a group, you can sit together and discuss your observations.

Solution:
Metallic objects conduct electricity, non-metallic objects do not! But:

- An aluminium ruler does not conduct electricity if it is anodised: the oxidation layer on the surface of the aluminium is a good electrical insulator.
- A painted heating pipe does not conduct the current either because of the insulating paint layer.
- Some metallic-looking objects, such as shiny chrome ballpoint pens, are made of plastic.



1)


It beeps:


It does not beep:

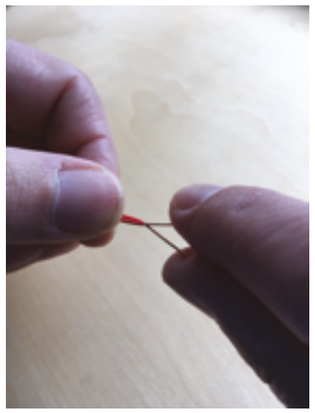
Wire figures

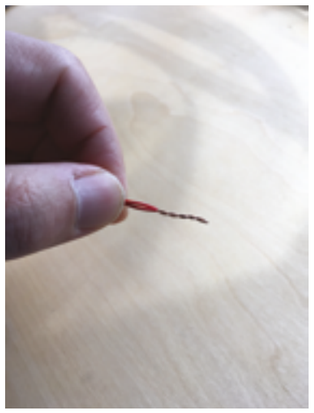
Description
There are various ways to connect components with wires or wires with each other: twisting or using luster terminals for example. Use the different ways of connecting wires to make a figure.

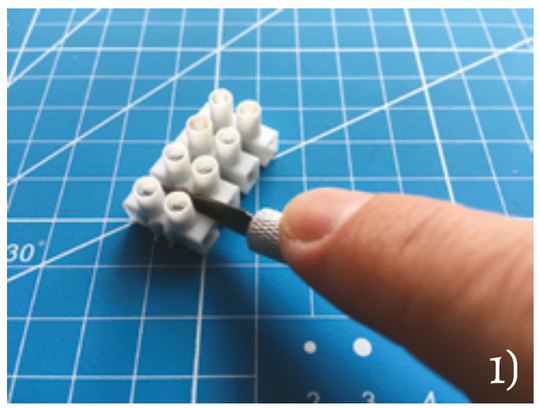
Time
15 minutes

Tools and materials
Bell wire
Luster terminals
Screwdriver

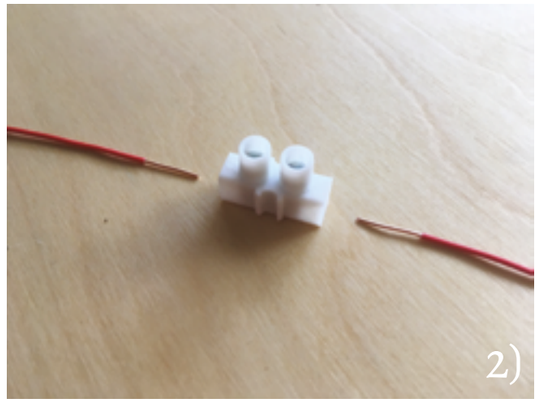
Instructions
To twist two wires together,
1) Strip the ends of the two (or more) wires to be connected (remove 10-15mm, about the width of a finger or thumb, of the plastic insulation on each side).
2) Then you cross both ends, hold them with one hand and twist them with the fingers of the other hand.



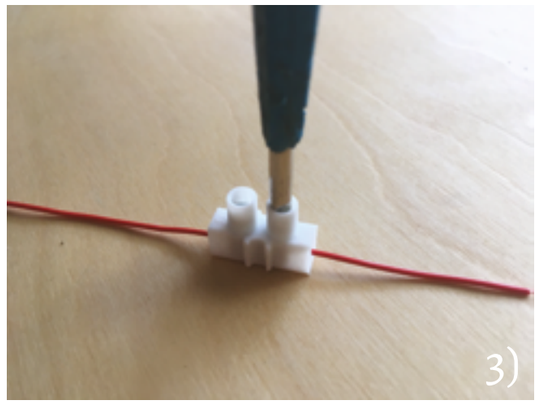




1) To connect wires with a luster terminal , cut the required number of luster terminals from the "bar" with a sharp knife or craft scalpel. If you have never used one before, ask someone with experience for help.



2) Insert the stripped ends of two pieces of wire into the luster terminal, one from each side.



3) Tighten the screws: this creates a firm and, most importantly, detachable connection.

4) Now you're ready to go! Use the different ways of connecting wires to make a figure.

Tip: To obtain a wire spiral, wrap the wire around a pencil or pen, then pull it apart as far as you want.

How does a battery work?

Description
The battery has two connections, called poles: a plus pole (+) and a minus pole (-). There is a voltage between the two poles, measured in volts (V). With the multimeter you can find out whether the battery is full or empty.

Time
15 minutes

Tools and materials
1 AA battery
Multimeter

Instructions
1) Look at the information on the battery. Where is the + pole? Where is the - pole? What voltage can the battery deliver?

2) You can measure the voltage of the battery with the multimeter. First, you need to switch the dial of the multimeter to voltage (V).

Expert knowledge 1: VOLT is the unit with which electrical voltage is measured. It is, so to speak, the pressure with which the current is "pressed" through the cable. Volts have nothing to do with the energy consumption or the power of a device.

Expert knowledge 2: AA batteries are also sometimes called mignon batteries.

3) Hold the test probes of the multimeter to the poles of the battery: The red one to the + pole and the black one to the - pole.

4) The display shows the voltage delivered by the battery.

For brand new batteries this is slightly above 1.5 volts, for batteries that have been used for some time the voltage is below 1.5 volts. Values below 1.3 volts indicate that the battery is empty.

5) Optional:
What else do you know about batteries?
Exchange information in the group.

Do you know any other types of battery?

How are batteries disposed of? Why?

What do you need to watch out for when handling batteries?

Level 2

Building a circuit

Description

Why do we speak of an electric “circuit”? What does this word mean? Does electricity only flow in circles and not around corners?

Electric current flows through electric wire; the shape of the wire is irrelevant. However, the current can only flow in a closed circuit, i.e. when it finds a way from the + pole of a battery to a lamp for example, and from there back to the - pole of the battery. In a circuit there is a producer, in this case the battery, and a consumer, for example a lamp.

Learn about the individual parts of a circuit and build your first circuit!

Time

1 hour

Tools and material

Phase 1:
Electric circuit cards

Phase 2-4:
- 2 AA batteries
- 1 battery holder
- 1 resistor
- 2-3 LEDs
- luster terminals
- 1 switch

Instructions

Phase 1: Circuit on paper

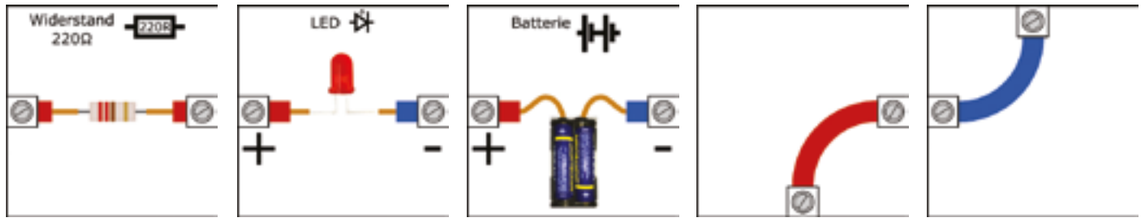
1) Have a look at the circuit cards: They represent the different elements of the circuit: battery, wire, LED, resistor. You already know what battery and wire do from the previous activities. LEDs are small lights that glow with electricity. The resistor limits the current that flows through the LED and prevents it from burning out too quickly or overloading the battery.

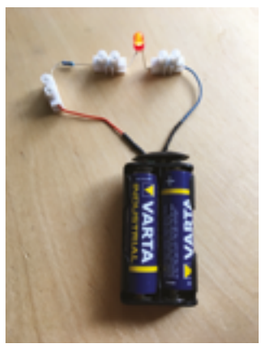
2) In order for the same electric current to flow through several elements, these elements must be connected to each other. On the cards you can see that the two elements are connected with a luster terminal. Choose the appropriate cards and put them together, following these clues:

- LEDs should never be connected directly to a battery, but should be connected in series via a resistor. The resistor used here has a resistance value of 220 Ohm (Ω).
- The LEDs (consumers) need a voltage of 2V to 3V (V stands for volt), depending on the colour, to shine brightly. To generate this voltage, we use two AA batteries (one has only 1.5V!), which are connected in series ia battery holder. So we get a voltage of 3V.
- One of the two legs of the LED is longer than the other. The long leg is the + pole (the anode) and the short leg is the - pole (the cathode). The resistor has no + or - pole and can be turned either way.
- Now try to connect the battery card to the resistor card and the LED card, so as to create a closed circuit.

Tip: You can find the solution on the back of the activity.

Expert knowledge:
Ohm (Ω) is the unit for electrical resistance, i.e. how much the current is hindered on its way through the circuit.





Phase 2: Setting up the circuit

3) Now try to translate the card circuit to reality. First check whether you have all the necessary materials: 2 AA batteries, 1 battery holder, 1 resistor, 1 LED, luster terminals.

4) Now think about how many luster terminals you actually need for the circuit.

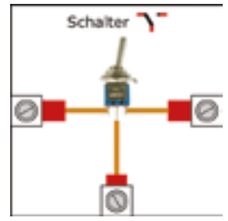
Tip: If you are not sure, you can count them in the photo.

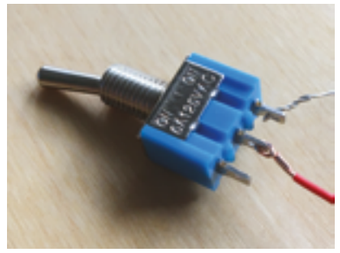
Phase 3: Circuit with switch

5) The LED from Phase 2 will light until the batteries are empty or until you remove them from the battery holder. You could also break the circuit by removing the wire from one of the luster terminals. To open a circuit and close it again, you can also install a switch.

The circuit card set contains two switches: one pointing to the left and one pointing to the right. The switches have 3 connections: The middle one is the connection for the + pole of the battery. If the lever of the toggle switch is pointing to the right, the current flows to the left connection. If the lever is pointing to the left, the current flows to the right connection.

6) Now try to install the switch card in your circuit.
Tip: Pay attention which direction the lever is facing to and where the current is flowing.





7) You can now try the same with the real circuit. The connections of the switch have holes through which the wire and one connection of the resistor fit. You can make the connections by simple twisting.

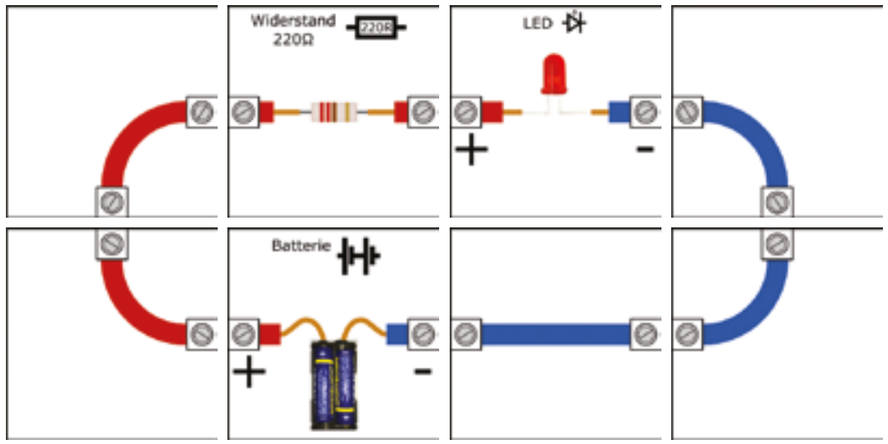
8) If the switch is installed correctly, you can now switch the LED on and off!

Phase 4: Circuit with switch and several LEDs

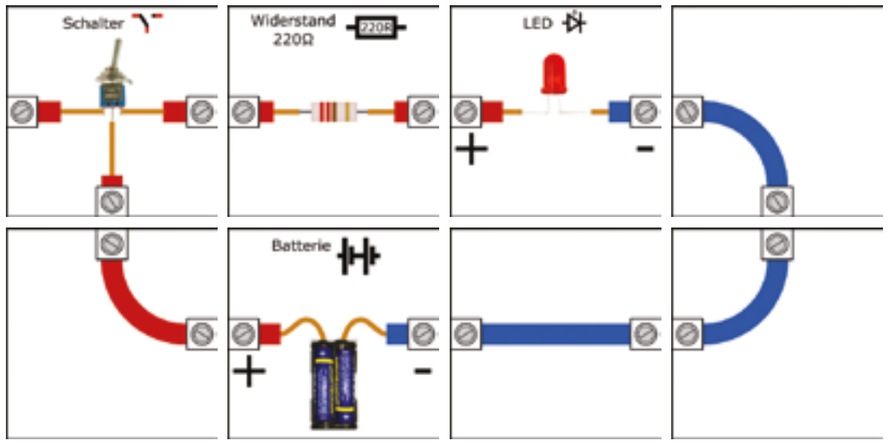
9) A battery holder with two AA batteries is sufficient to light up several LEDs simultaneously. The LEDs are connected in parallel. Each additional LED and its series resistor are connected in parallel to the previous LED. Try to extend the circuit by one (or more) LEDs, first with the circuit cards.

Tip: You can check if your card circuits are correct on the back of this page.

Solutions

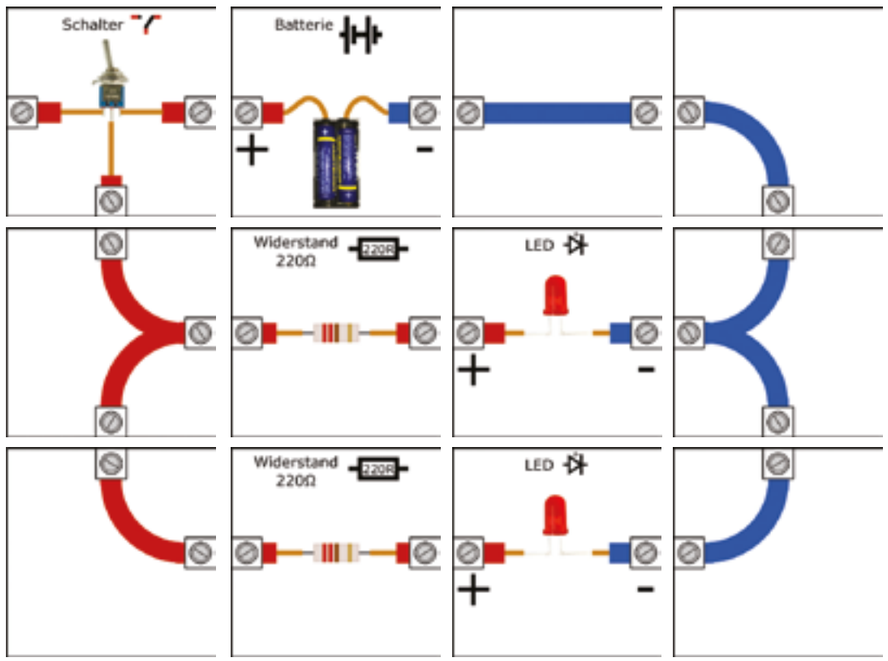


Card circuit



Card circuit with switch

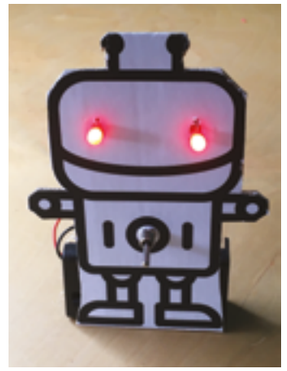
Here, the lever is pointing to the right. The current is therefore conducted from the battery to the left connection of the switch, but cannot continue to flow there. The right connection of the switch is open: the LED does not light up! You can imitate the opening and closing of the switch with the cards by changing the card of the switch. If the lever is pointing to the left, the current flows, the circuit is closed and the LED lights up!



Card circuit with switch and several LEDs

Level 3

Light up figures



Description

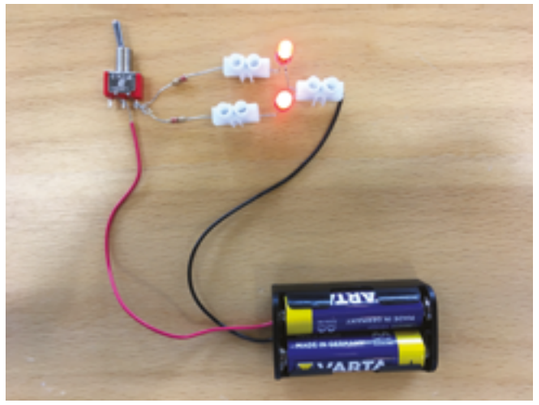
How do you make a robot's eyes light up? In this activity, you can use all your knowledge about the electric circuit to make two LEDs light up and set them off to great effect.
You can choose to make a robot, pumpkin, lighthouse or car light up. In the Makerkoffer you'll find templates to cut out and glue onto cardboard. Or just invent your very own new figure!

Time

1.5 hours

Tools and materials

- 2 AA batteries
- 1 battery holder
- 2 resistors
- 2 LEDs
- Luster terminals
- Templates (robot, pumpkin, lighthouse or car)
- Paper
- Paperboard/cardboard
- Glue
- Hot glue



Instructions

1) Prepare your tools and materials.

2) Print out the template for the figure you want to make.

3) Cut out the template and glue it onto cardboard.

4) Using a sharp object (for example a sharp pencil), pierce two holes where the LEDs are to be placed later, and another hole for the switch. Then you can put the figure aside for the time being.

5) Build an electric circuit as you have learned in the activity "Building an electric circuit". Note the following additional explanations about the circuit:

- The + pole of the battery (red wire) leads to the middle connection of the switch.
- The series resistors of the LEDs come together at one of the outer connections of the switch.
- The + poles of the LEDs (long legs) are connected to their series resistors with luster terminals.
- The - poles of the LEDs (short legs) are combined and connected to the - pole of the battery (black wire) with a luster terminal.

Your structure could look something like the one on the picture on the left.

6) Now it is time to find out how the circuit can best be adapted to your figure. Mark the location of the different elements on the back of the figure for later on.

For a robot with 2 LEDs, the circuit could look like on the picture on the left.
7) Fix the switch and the battery holder with hot glue at the marked places.

8) Insert the legs of the LEDs from the front through the holes you previously made in the cardboard.

Tip: Put the - poles of the LEDs (short legs) through the upper hole, so that they are not in the way of the rest of the circuit.

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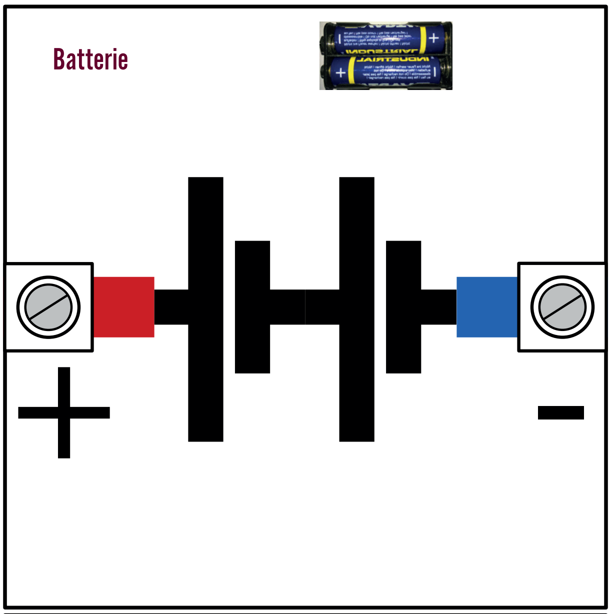
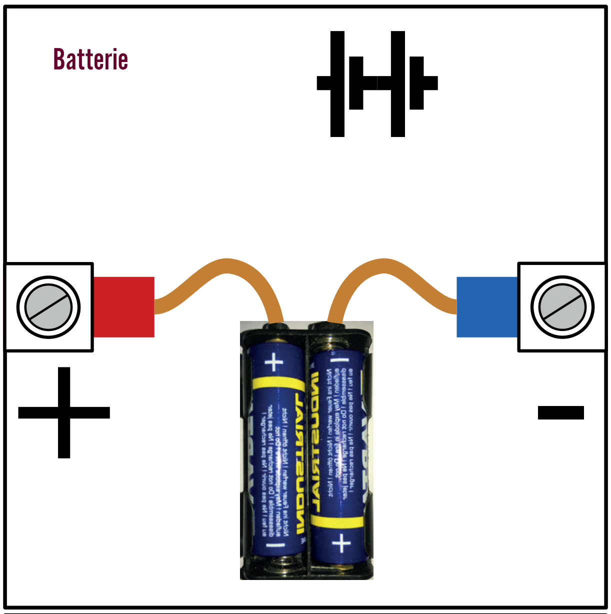
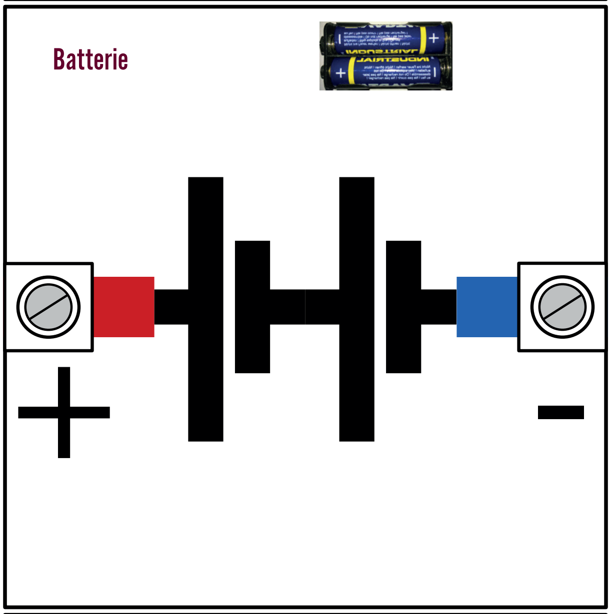
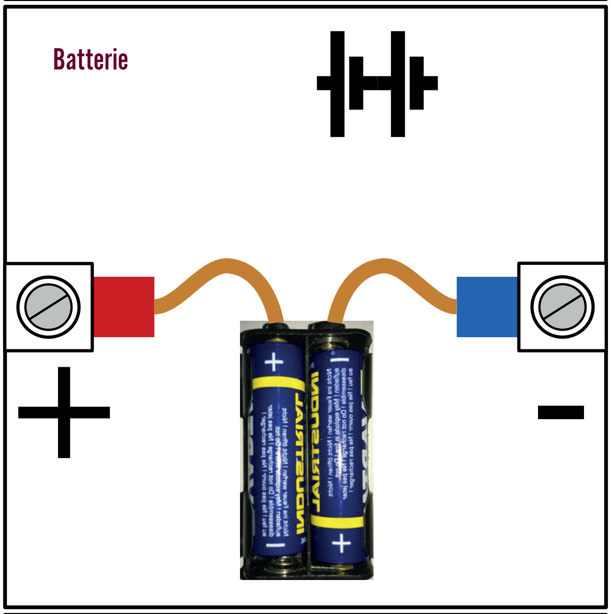
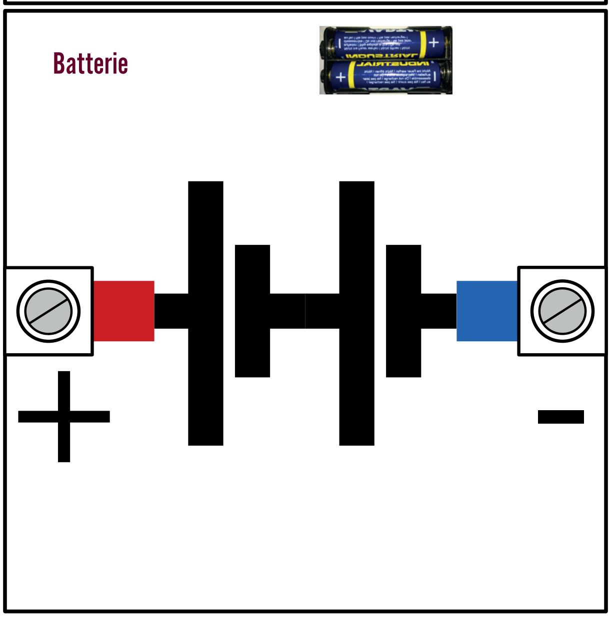
BATTERY

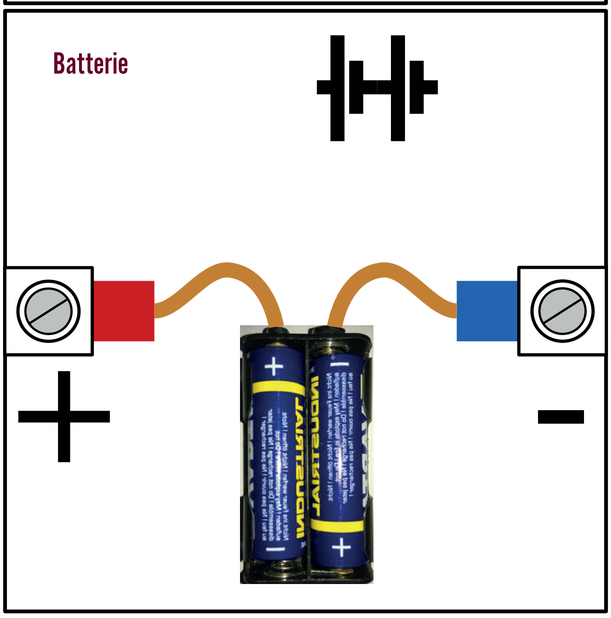












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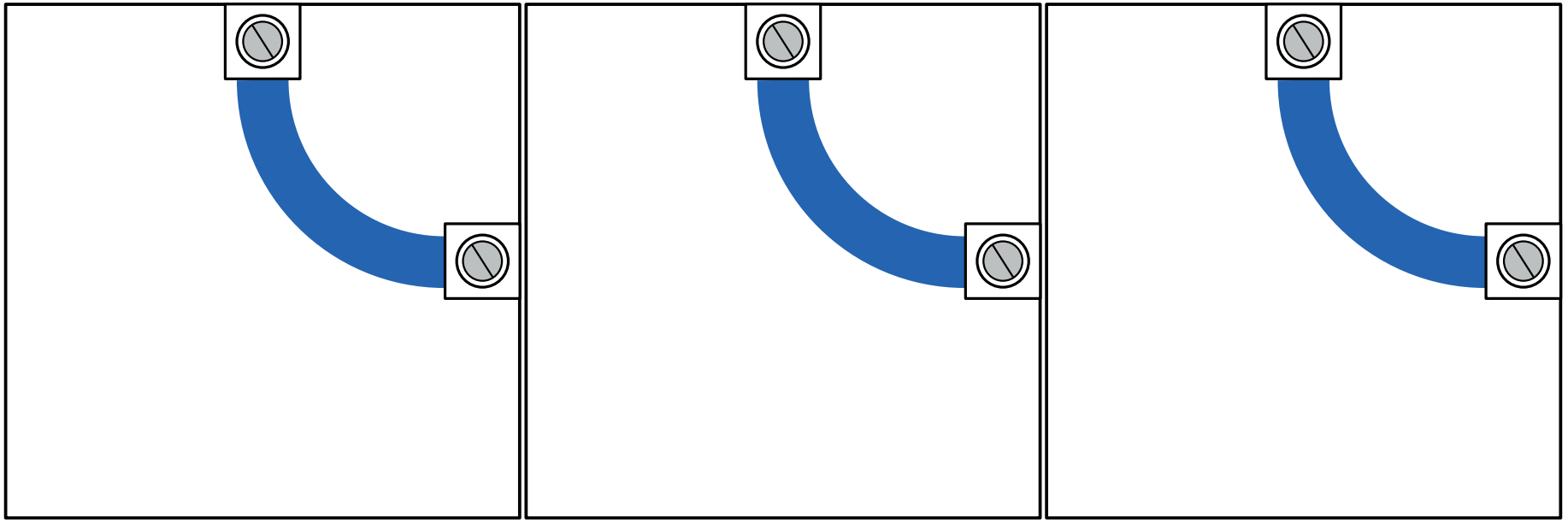

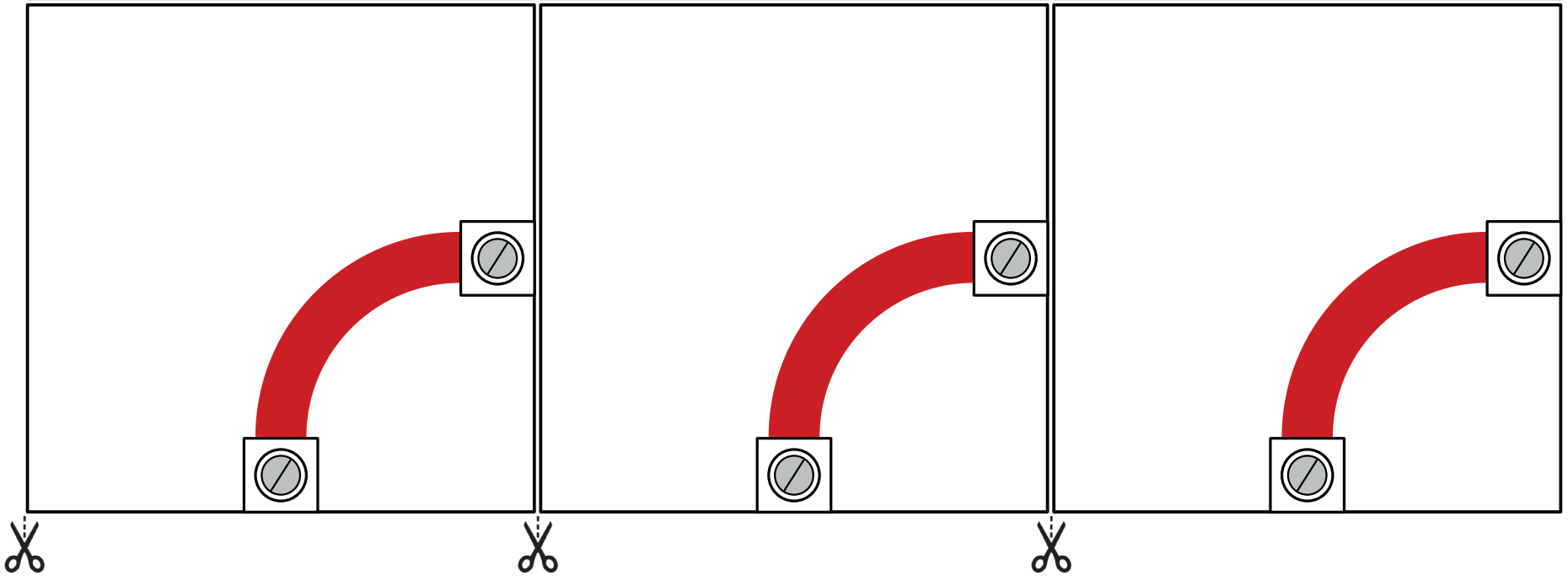

CURVED BLUE RED

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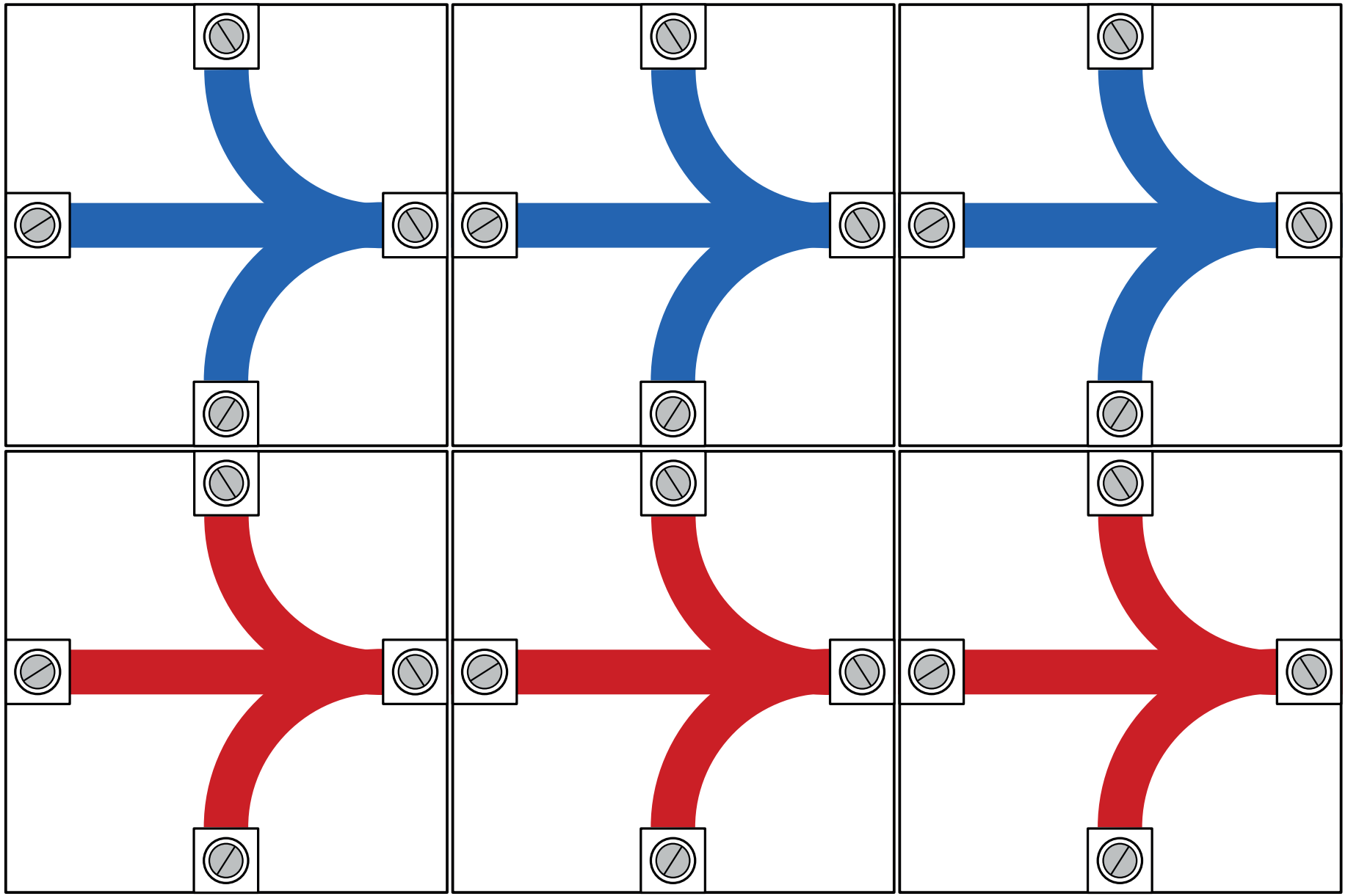

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FOUR BLUE RED

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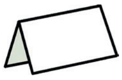
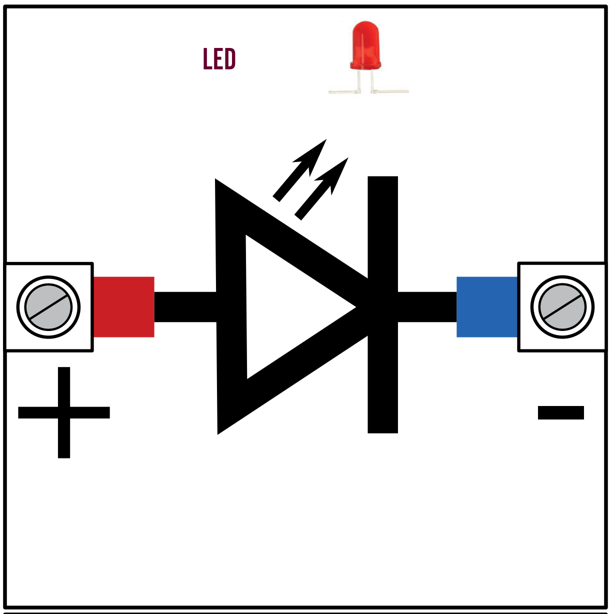
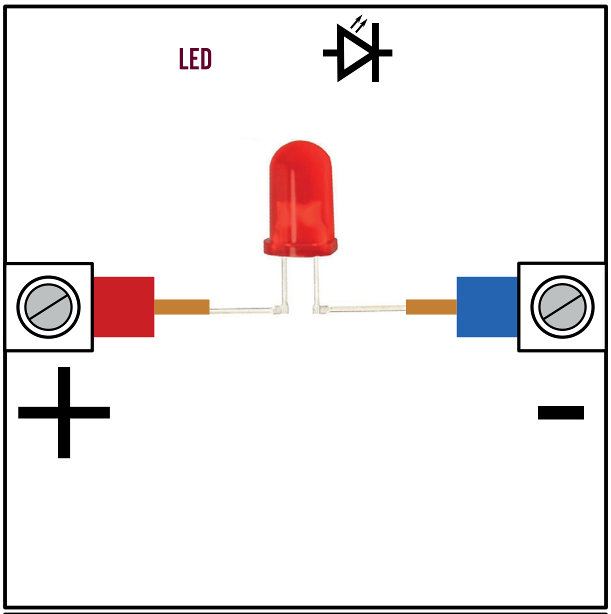
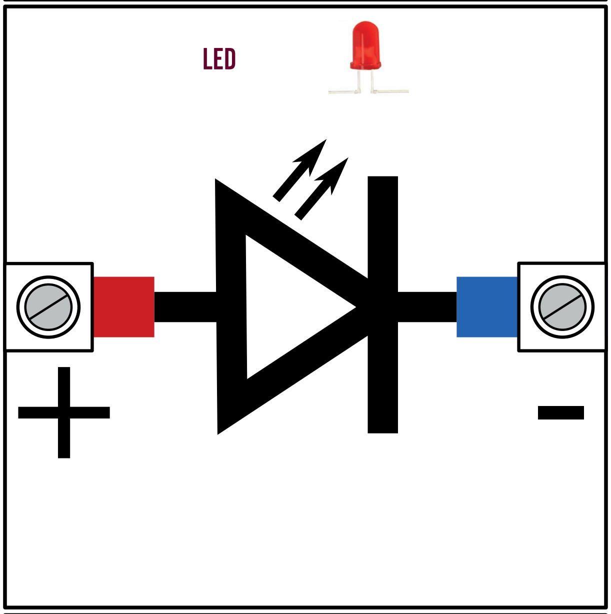
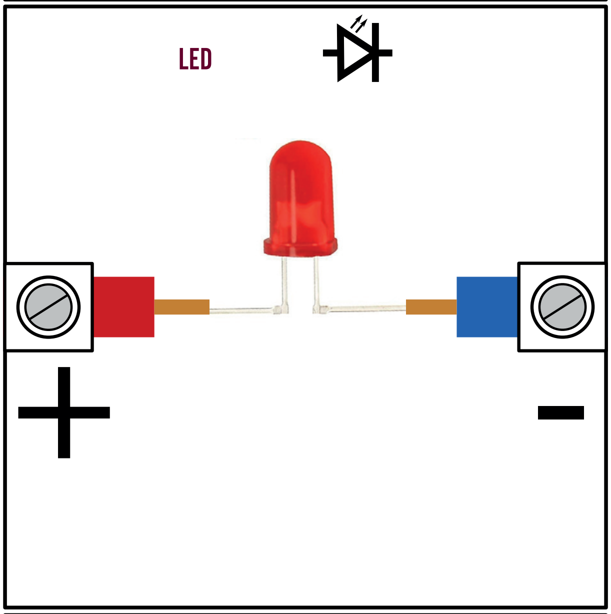
LED

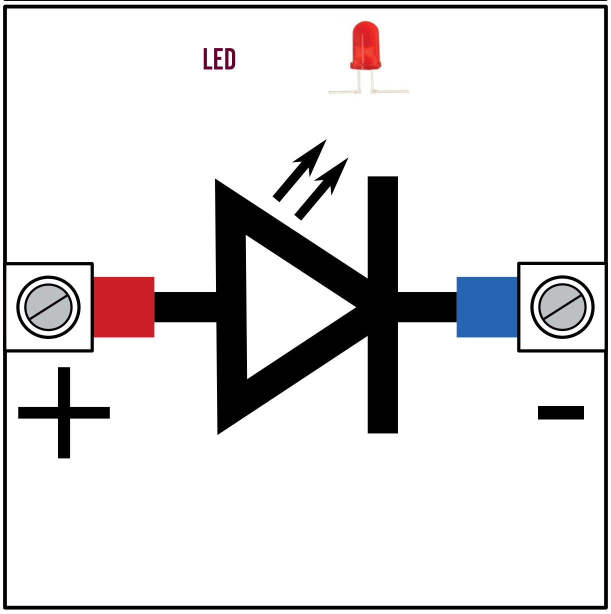


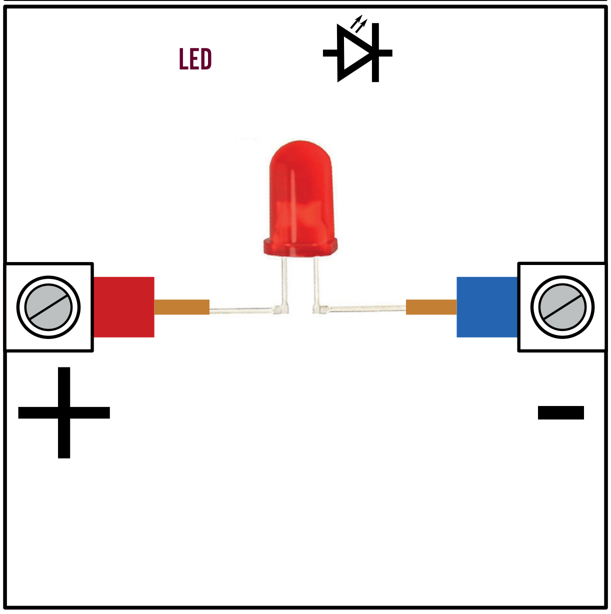












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BEE CREATIVE

Widerstand
220 Ω

Widerstand
220 Ω

220R

Widerstand
220 Ω

Widerstand
220 Ω

220R

Widerstand
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BEE CREATIVE

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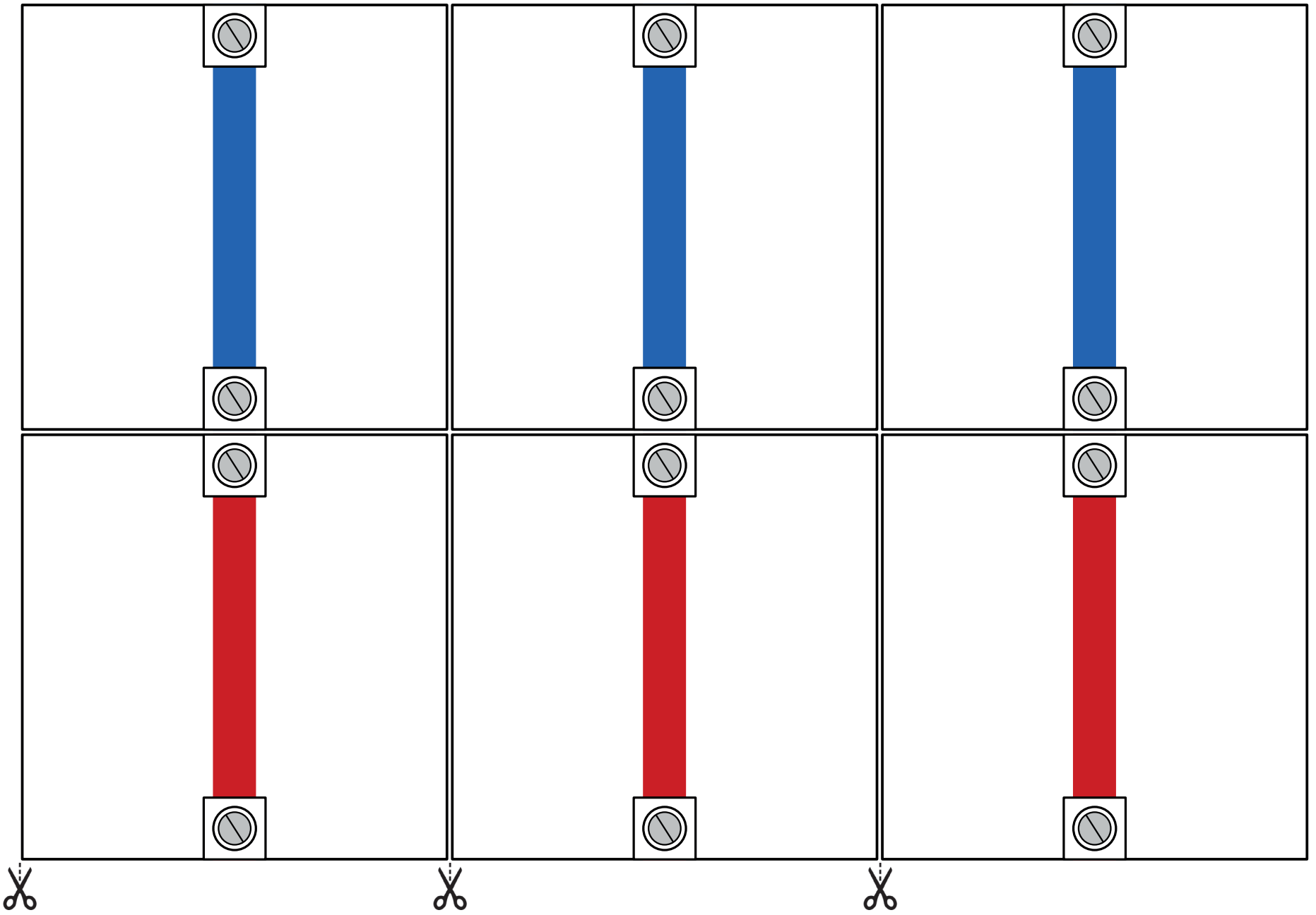
MAKERKOFFER



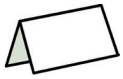
STRAIGHT BLUE RED

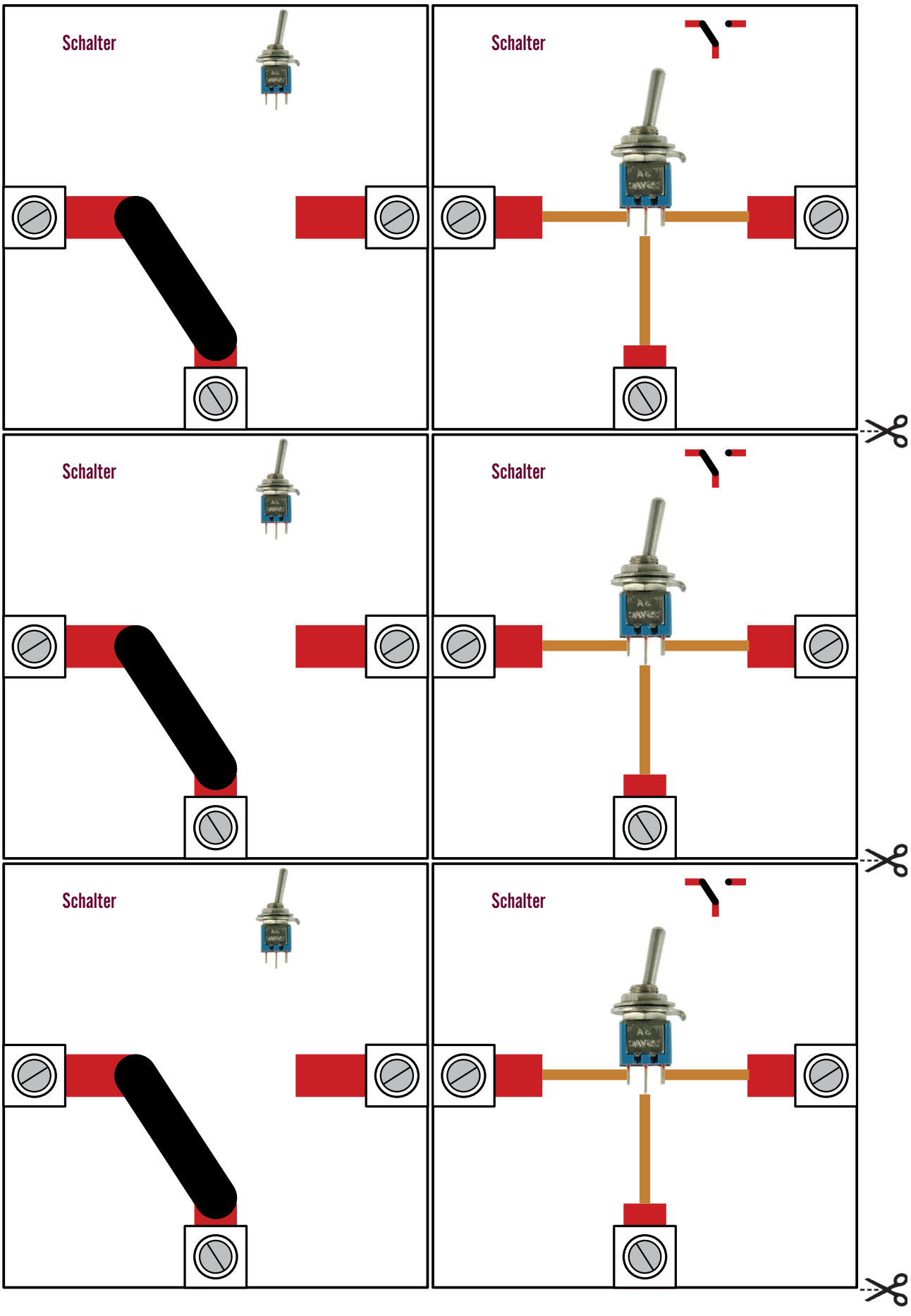
ELEKTRONIK

MAKERKOFFER

SWITCH LEFT

ELEKTRONIK





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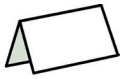
MAKERKOFFER

SWITCH RIGHT

ELEKTRONIK

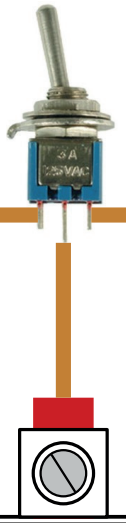


Schalter

Schalter

Schalter

Schalter



Schalter

Schalter

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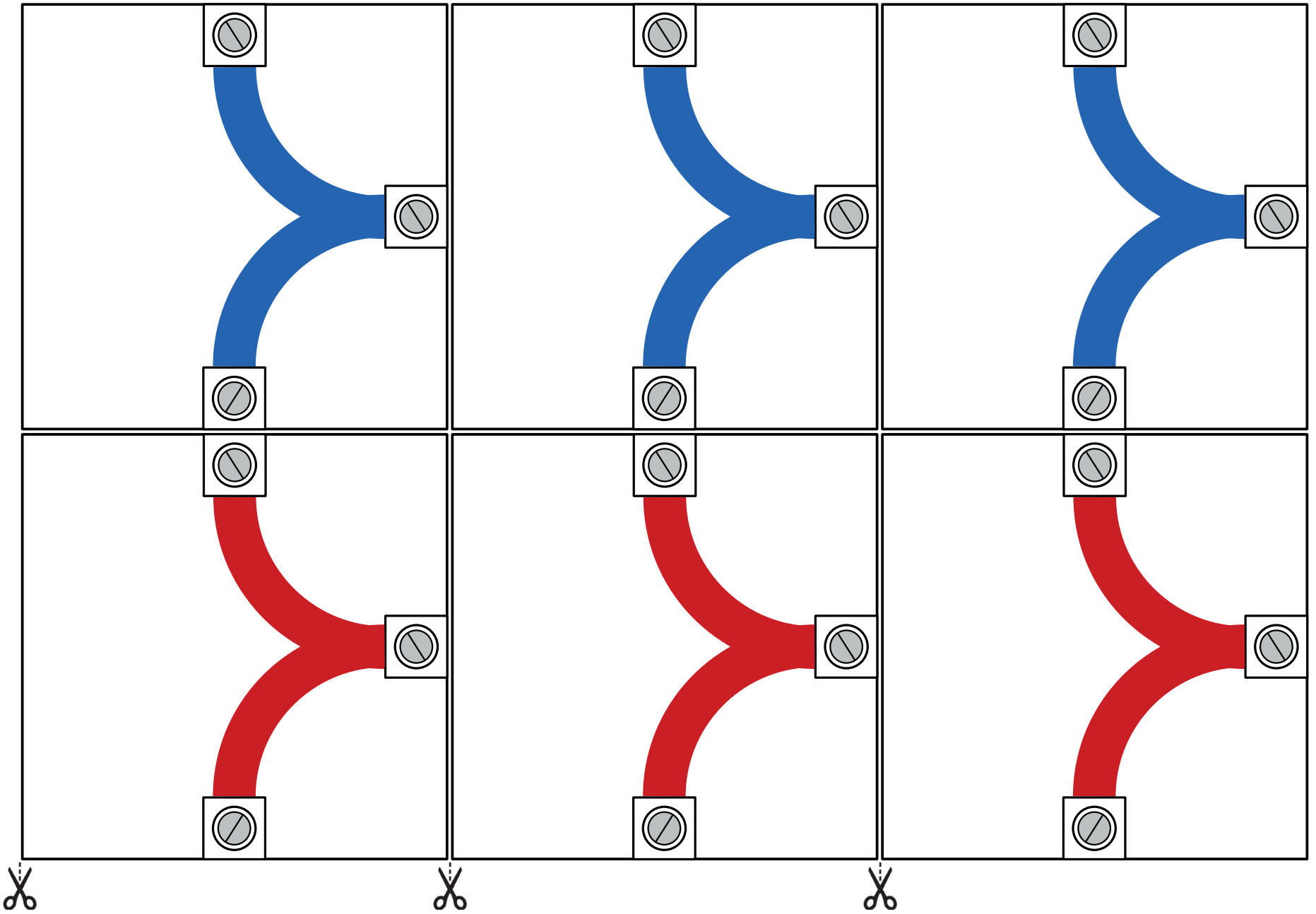
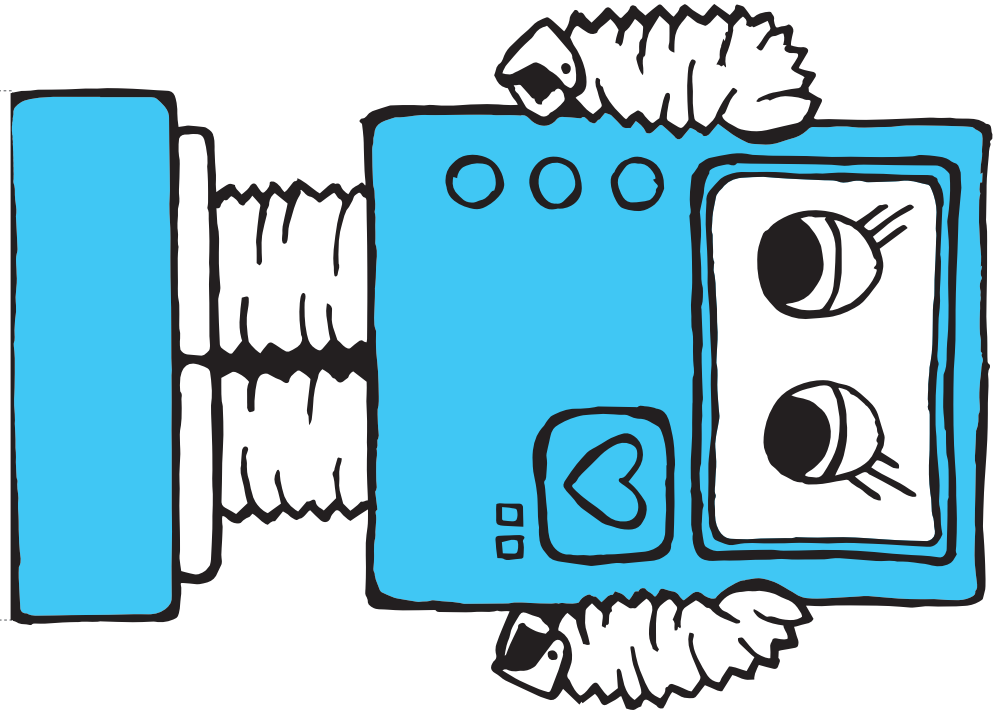
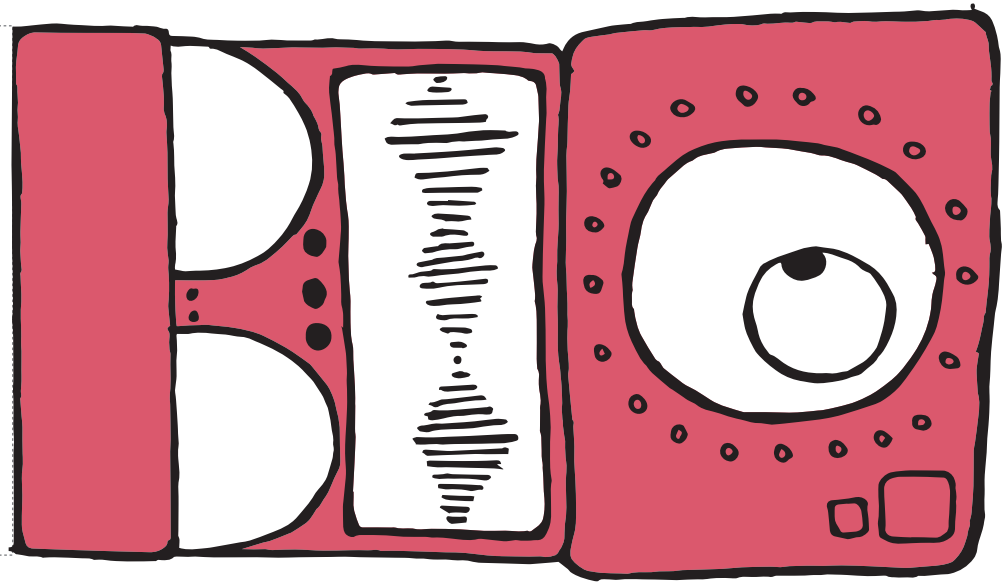
MAKERKOFFER



THREE BLUE RED

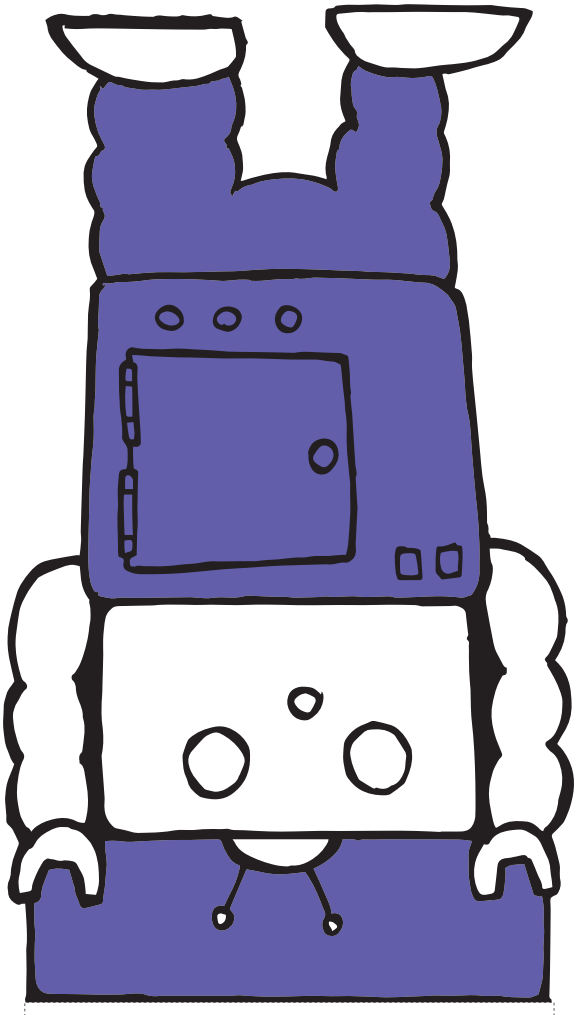
ELEKTRONIK

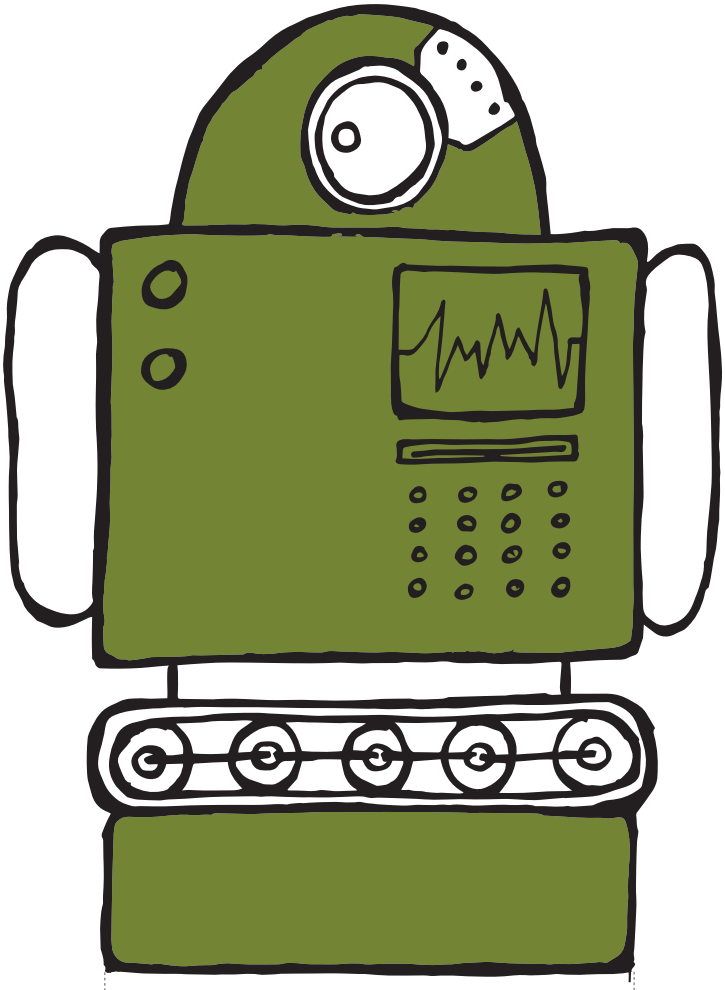




MAKERKOFFER

ELEKTRONIK





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Feedback MAKERKOFFER - Supervisor

We would be very pleased to receive your feedback! You can fill out the form below and send it by e-mail to info@base1.lu.

Date of the activity				
Age				
Gender	M	W		
Institution	☐ Maison relais / Foyer scolaire ☐ Primary school ☐ Secondary school ☐ Youth centre ☐ Other:			
Role	☐ Educator ☐ Teacher ☐ Coach, Expert ☐ Other :			
Makerkoffer	☐ Coding ☐ Wearables ☐ Electronics			
Level	☐ 1 ☐ 2 ☐ 3			
Why did you choose the activities of the Makerkoffer?				
Did the Makerkoffer meet your expectations?	☺☺	☺	😐	☹
What did you like about the activities?				
What was not so interesting?				
What has been difficult to understand?				

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Did you learn anything new?	☺☺	☺	😐	☹
Did the activity help you to understand the Makerworld better?	☺☺	☺	😐	☹
Are you interested in researching/making further?	☺☺	☺	😐	☹
Would you do the Makerkoffer activities again?	☺☺	☺	😐	☹
Would you recommend the Makerkoffer to others?	☺☺	☺	😐	☹
Further comments / proposals:				

Feedback MAKERKOFFER - Participant

We would be very pleased to receive your feedback! You can fill out the form below and send it by e-mail to info@base1.lu.

Date				
Age	☐ 8-10 ☐ 11-13 ☐ 14-16 ☐ 17-18 ☐ >18			
Gender	👦	👩		
Institution	☐ Maison relais / Foyer scolaire ☐ Primary school ☐ Secondary school ☐ Youth centre ☐ Other:			
Cycle/Group				
Makerkoffer	☐ Coding ☐ Wearables ☐ Electronics			
Level	☐ 1 ☐ 2 ☐ 3			
Did you like the Makerkoffer?	☺☺	☺	😐	☹
Did you learn anything new?	☺☺	☺	😐	☹
Did you understand the tasks?	☺☺	☺	😐	☹
Are you interested in learning more about the theme?	☺☺	☺	😐	☹
Would you do the Makerkoffer activities again?	☺☺	☺	😐	☹
What else would you like to share with us?				

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