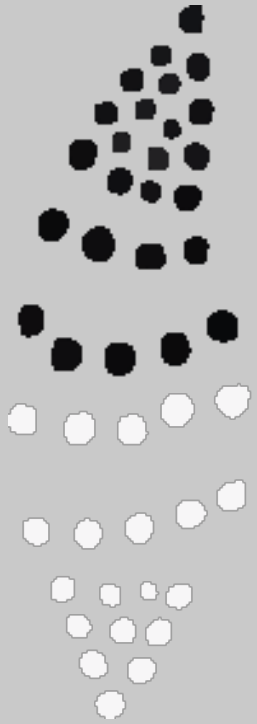
ELECTRONICS BENCH INDUCTION - THE EDGE

State Library of Queensland

Queensland Government



Acknowledgement of Country

We acknowledge Aboriginal and Torres Strait Islander peoples and their continuing connection to land and as custodians of stories for millennia. We respectfully acknowledge the land on which we all meet today, and pay our respects to elders past, present and emerging.

INDUCTION SUMMARY

The Edge at State Library of Queensland offers the public use of an electronics workbench.

In this induction you will learn;

- Health and safety information
- Basic understand of circuits and common components
- Safe and efficient use of equipment
- Soldering practice
- Booking procedures

Once you've completed the induction you can book and use the Electronics Bench at The Edge during Open lab.

Open Lab sessions are a chance to meet up with like-minded makers and tinkerers at The Edge with facilitators to support your creative needs in the space.

Bookings are required to use the equipment and you will be able to book with your SLQ account once you have completed the relevant induction.

Wednesday 1.30pm – 8pm
Thursday 1.30pm – 8pm
Saturday 12pm – 6pm

For more info and to book, head to https://www.slq.qld.gov.au/visit/spaces/edge

INDUCTION RUN THROUGH

1. **Safety**
2. **Equipment overview**
3. **How a circuit works**
   - Flow
   - Ohm's law
   - Components
   - Activity with breadboards
   - Activity with multimeter
4. **Soldering / Desoldering**
   - Types; Surface mount, through hole soldering, good solder joint, bad solder joint
5. **Practical demonstration of soldering**
   - populate board
   - good solder joints
   - diagnose fault
6. **Diagnostic tools**
7. **Hand tools**
8. **Hands on activities**

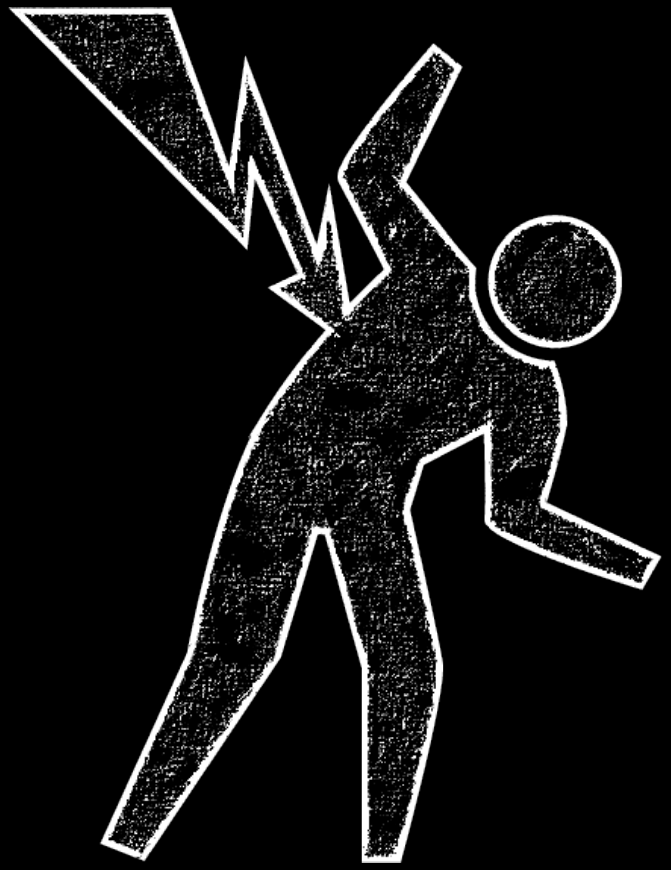
SAFETY

Be confident in your Electrical Safety

In Queensland, it's illegal for anyone to undertake unlicenced work on any electrical equipment over the ELV threshold.

Voltage range	AC voltage (V)	DC voltage (V)
High voltage (HV)	> 1000	> 1500
Low voltage (LV)	≤ 1000	≤ 1500
Extra Low voltage (ELV)	≤ 50	≤ 120

Electricity can kill

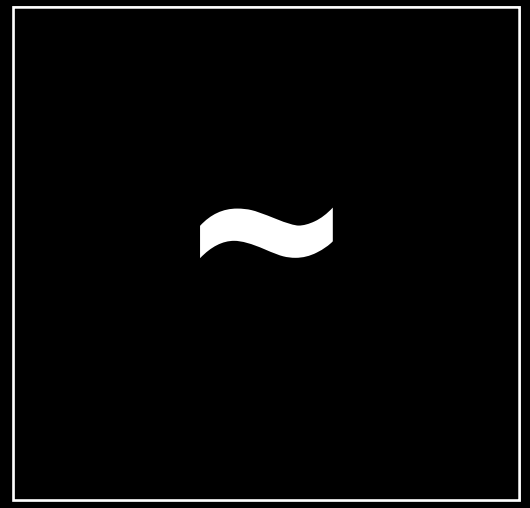


WHAT'S AC-DC ?

- **AC** stands for Alternating Current
- It's the type of electricity that we have in our houses and office environments.

How does it work? Instead of just ramping up to 240 V the current reverses 50 time a second from 240 V+ to 240V- and back again.

The symbol for AC is

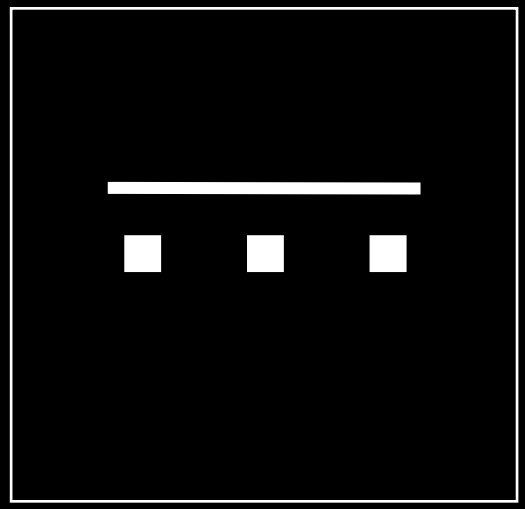


If in doubt check before you disassemble any electrical appliance or equipment.

WHAT'S AC-DC ?

- **DC** stands for Direct Current
- It's the type of energy used in cars and electronics.

The symbol for DC is



DC gets used in battery operated devices and Consumer Electronics

But lots of consumer electronics plug into the wall..? How are they different. The power pack that that you power these with generally steps this voltage down and flattens it out. That's why in Australia these don't have an earth.

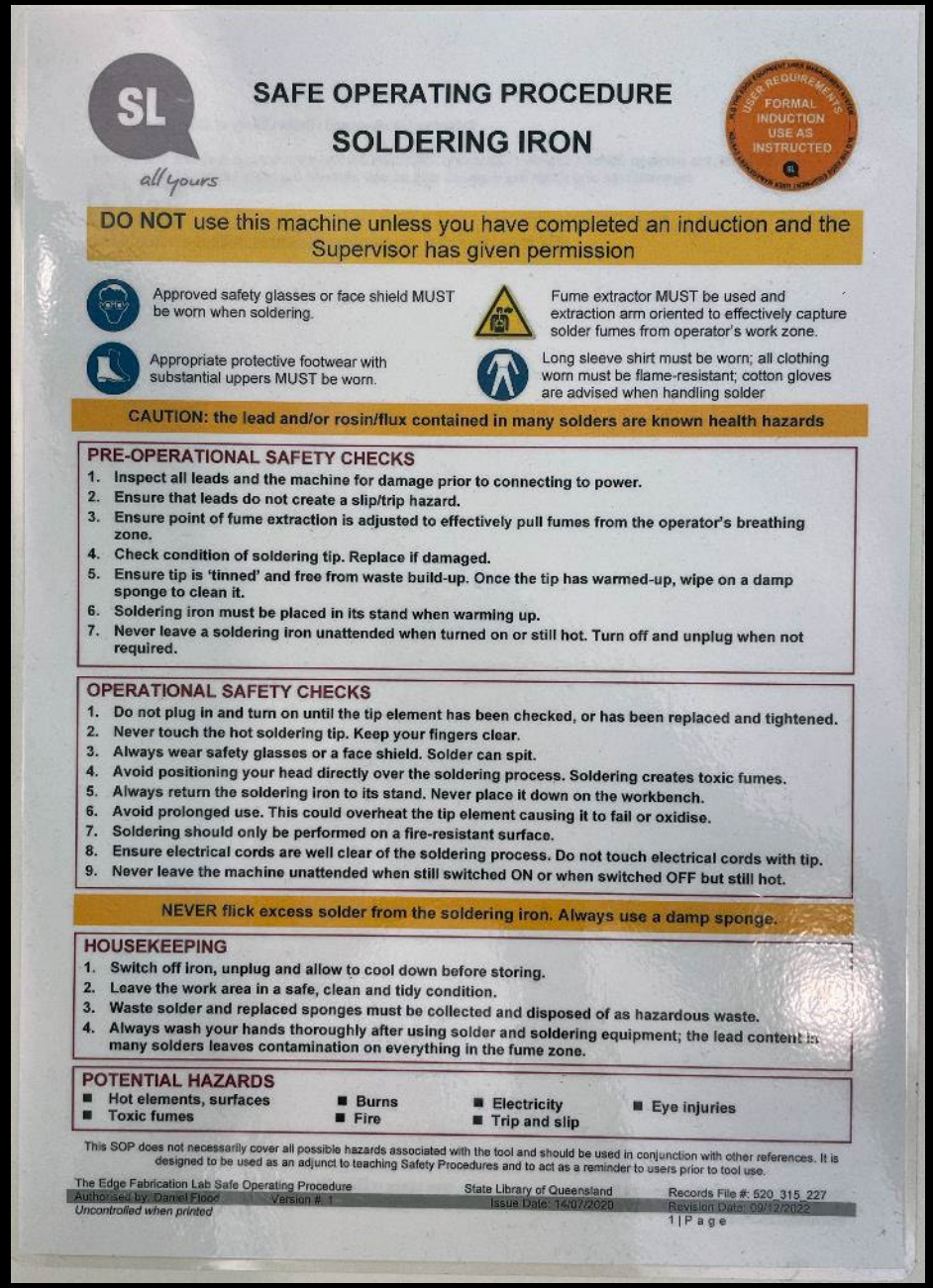
If in doubt check before you disassemble any electrical appliance or equipment.

SAFETY CONT.

Soldering and general tools

- Only use the Electronics Bench tools under direct staff supervision.
- Read and understand SOPs for the tools.
- Understand the risks;
  - Electric shock
  - Burns and fire
  - Hazardous materials (Lead solder, flux, isopropyl, fumes)
  - Eyes (eye strain and flying foreign objects)
  - Cuts and abrasions
  - Brain explosions

Check the safe operating procedures regularly and ask a staff member for help if you have any problems or concerns.



SL all yours

SAFE OPERATING PROCEDURE

SOLDERING IRON

FORMAL INDUCTION USE AS INSTRUCTED

DO NOT use this machine unless you have completed an induction and the Supervisor has given permission

Approved safety glasses or face shield MUST be worn when soldering.

Fume extractor MUST be used and extraction arm oriented to effectively capture solder fumes from operator's work zone.

Appropriate protective footwear with substantial uppers MUST be worn.

Long sleeve shirt must be worn; all clothing worn must be flame-resistant; cotton gloves are advised when handling solder

CAUTION: the lead and/or rosin/flux contained in many solders are known health hazards

PRE-OPERATIONAL SAFETY CHECKS

1. Inspect all leads and the machine for damage prior to connecting to power.
2. Ensure that leads do not create a slip/trip hazard.
3. Ensure point of fume extraction is adjusted to effectively pull fumes from the operator's breathing zone.
4. Check condition of soldering tip. Replace if damaged.
5. Ensure tip is 'tinned' and free from waste build-up. Once the tip has warmed-up, wipe on a damp sponge to clean it.
6. Soldering iron must be placed in its stand when warming up.
7. Never leave a soldering iron unattended when turned on or still hot. Turn off and unplug when not required.

OPERATIONAL SAFETY CHECKS

1. Do not plug in and turn on until the tip element has been checked, or has been replaced and tightened.
2. Never touch the hot soldering tip. Keep your fingers clear.
3. Always wear safety glasses or a face shield. Solder can spit.
4. Avoid positioning your head directly over the soldering process. Soldering creates toxic fumes.
5. Always return the soldering iron to its stand. Never place it down on the workbench.
6. Avoid prolonged use. This could overheat the tip element causing it to fail or oxidise.
7. Soldering should only be performed on a fire-resistant surface.
8. Ensure electrical cords are well clear of the soldering process. Do not touch electrical cords with tip.
9. Never leave the machine unattended when still switched ON or when switched OFF but still hot.

NEVER flick excess solder from the soldering iron. Always use a damp sponge.

HOUSEKEEPING

1. Switch off iron, unplug and allow to cool down before storing.
2. Leave the work area in a safe, clean and tidy condition.
3. Waste solder and replaced sponges must be collected and disposed of as hazardous waste.
4. Always wash your hands thoroughly after using solder and soldering equipment; the lead content in many solders leaves contamination on everything in the fume zone.

POTENTIAL HAZARDS

- Hot elements, surfaces
- Toxic fumes
- Burns
- Fire
- Electricity
- Trip and slip
- Eye injuries

This SOP does not necessarily cover all possible hazards associated with the tool and should be used in conjunction with other references. It is designed to be used as an adjunct to teaching Safety Procedures and to act as a reminder to users prior to tool use.

SAFETY CONT.

Equipment & component safety

- Read and understand SOPs for each piece of equipment and component you are using
- Understand the voltage limits of components and the equipment
- Don’t overload!

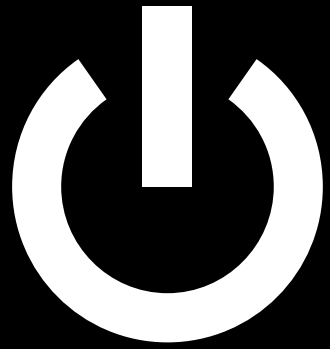
PLEASE REMEMBER!

- Don't blow stuff up! If you are not sure, just ask.
- Turn things off when you're finished, reset instruments to the lowest default setting when finished.
- Clean up after yourself.

Check the safe operating procedures regularly and ask a staff member for help if you have any problems or concerns.

MITIGATION STRATEGIES

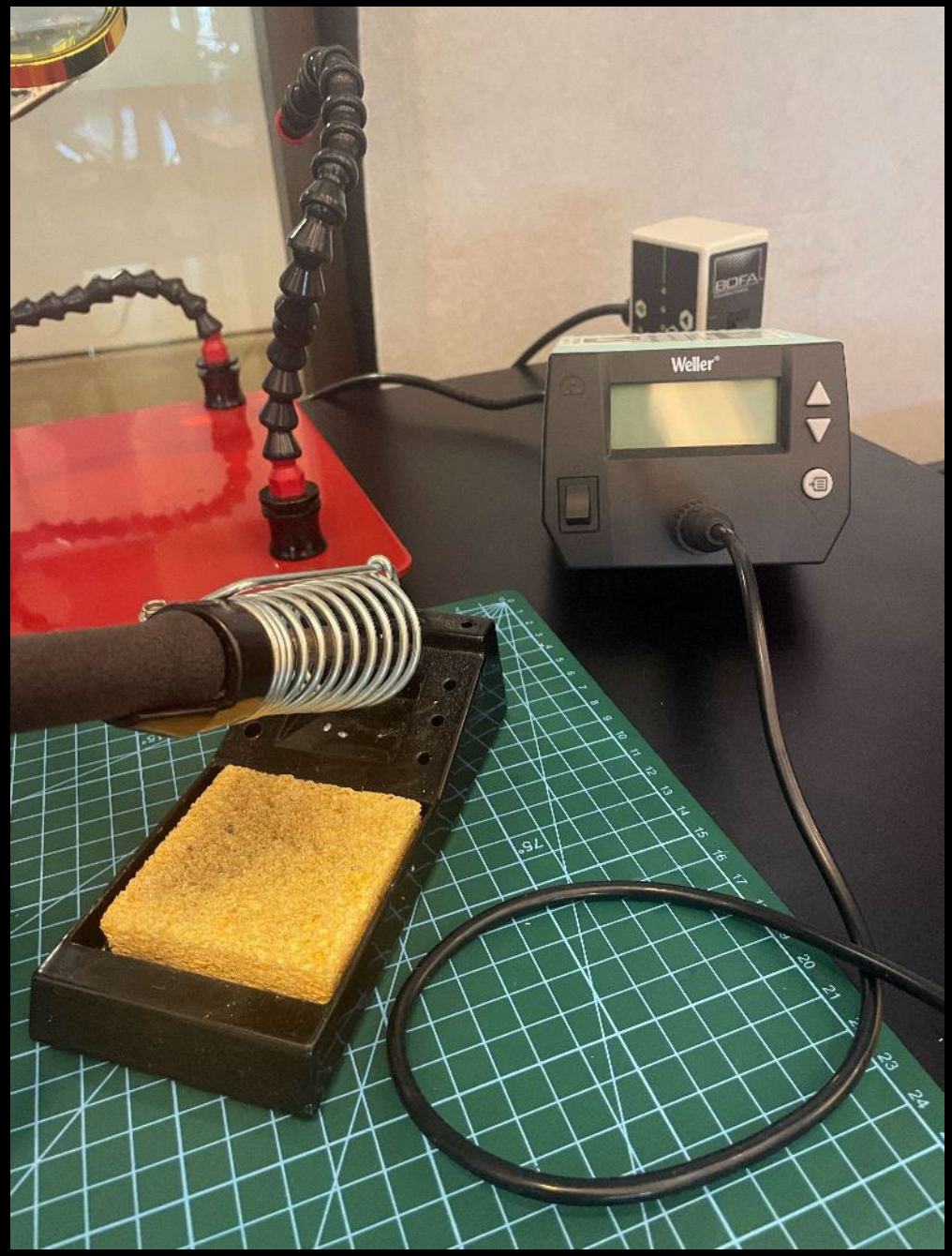
- Wear the appropriate clothing and PPE
- Use the fume extraction properly
- Use good hand hygiene practices (wash your hands; NO eating)
- Always turn off hot tools before walking away
- Don’t force it or rush – ask for assistance
- If you’re getting stressed grab 5 min of fresh air



EQUIPMENT OVERVIEW

Weller Soldering irons

- Adjustable temperature
- Replicable tips
- High wattage for rapid heating



EQUIPMENT OVERVIEW

Helping hands

- Because you're not an octopus
- Holds components for you
- Magnify glass

EQUIPMENT OVERVIEW

Bofa Soldering Fumes Extractor

- HEPA and Activate Charcoal filtered
- Extracts the fumes safely

EQUIPMENT OVERVIEW

EEVBlog branded Brymen BM235 Digital Multimeter

- a measuring instrument that can measure multiple electrical properties
- accuracy of 0.3% and fulfills the requirements of CAT II to CAT IV safety classes

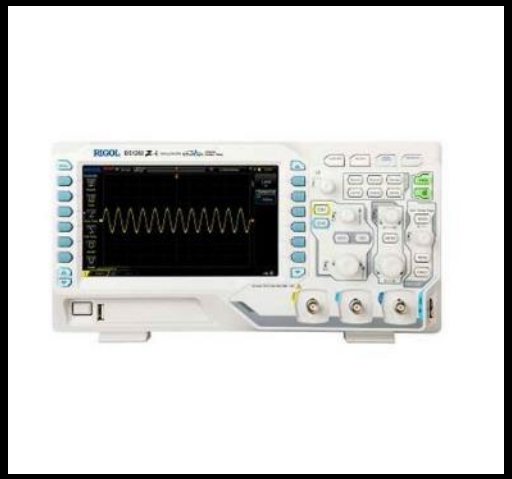
Desoldering Station

- for removing solder to make repairs to components
- makes fixing your mistakes a little easier

EQUIPMENT OVERVIEW

Coming Soon

Rigol DP-712 Single Channel DC Power Supply



Rigol DS1000Z-Eseries Digital Oscilloscope

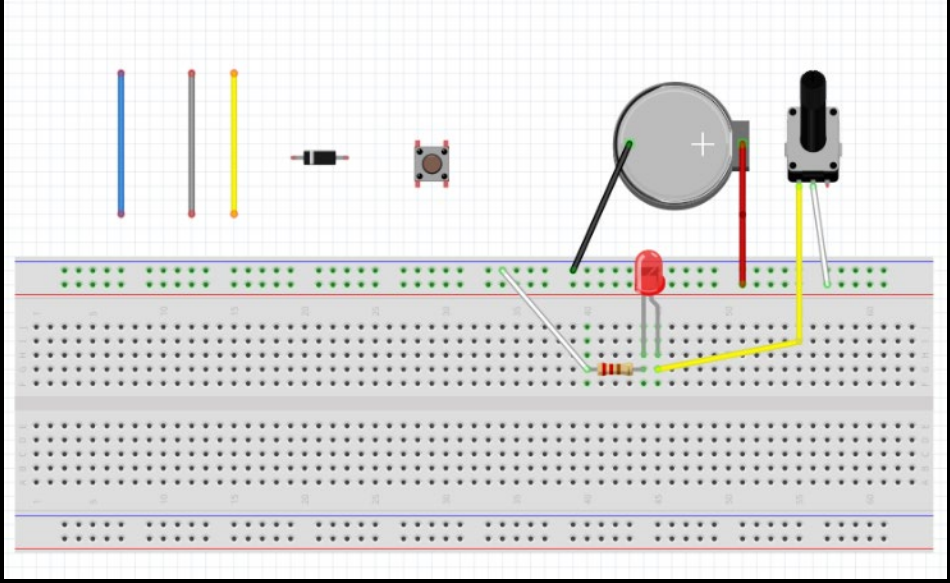
300W Hot Air SMD Rework Station

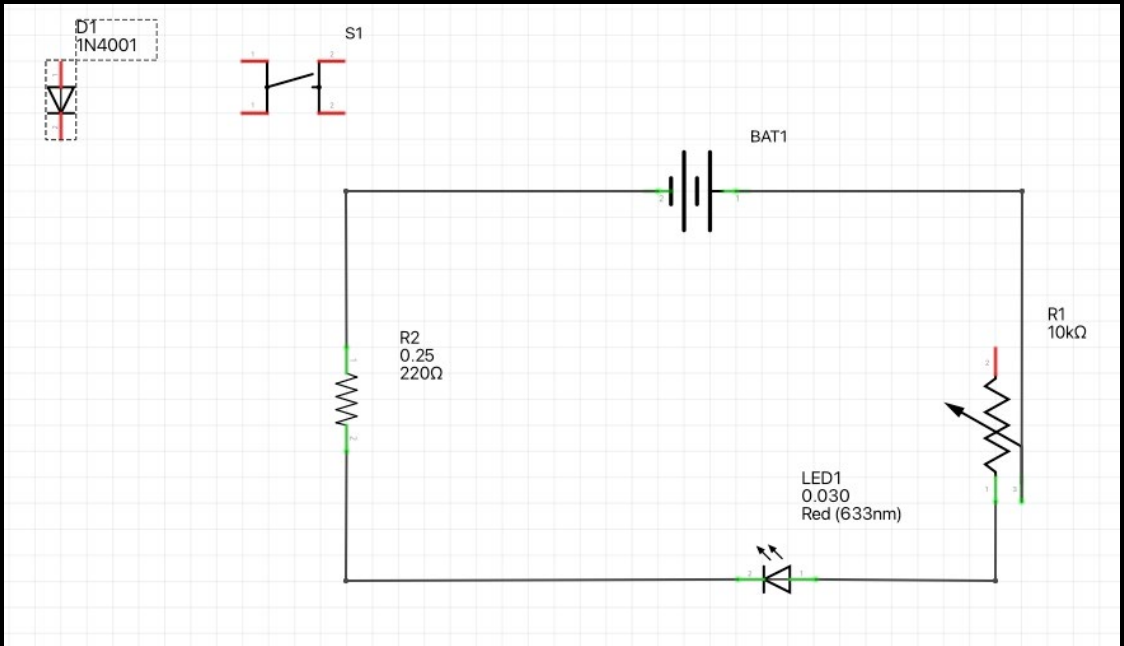
iFixit Repair Business Toolkit

SIMPLE CIRCUITS

How a circuit works

- Current Flow, Voltage & Resistance
- Basic components
- Use a multimeter
- Make a circuit with a breadboard





Switch

Mechanical break in a circuit that stops the flow of curr

Resistors

Inhibits the flow of current

Diodes (LED)

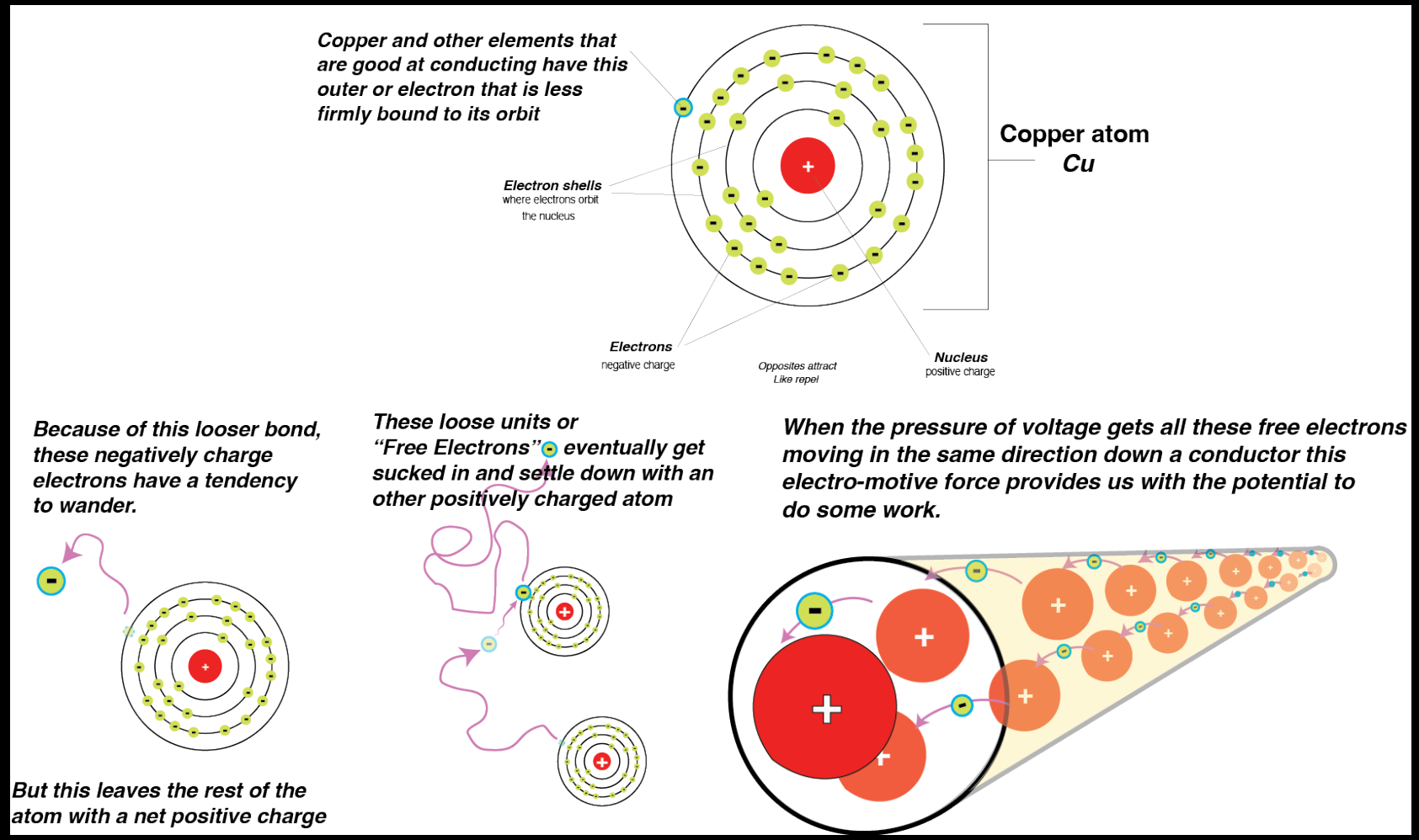
One-way gate

Common components

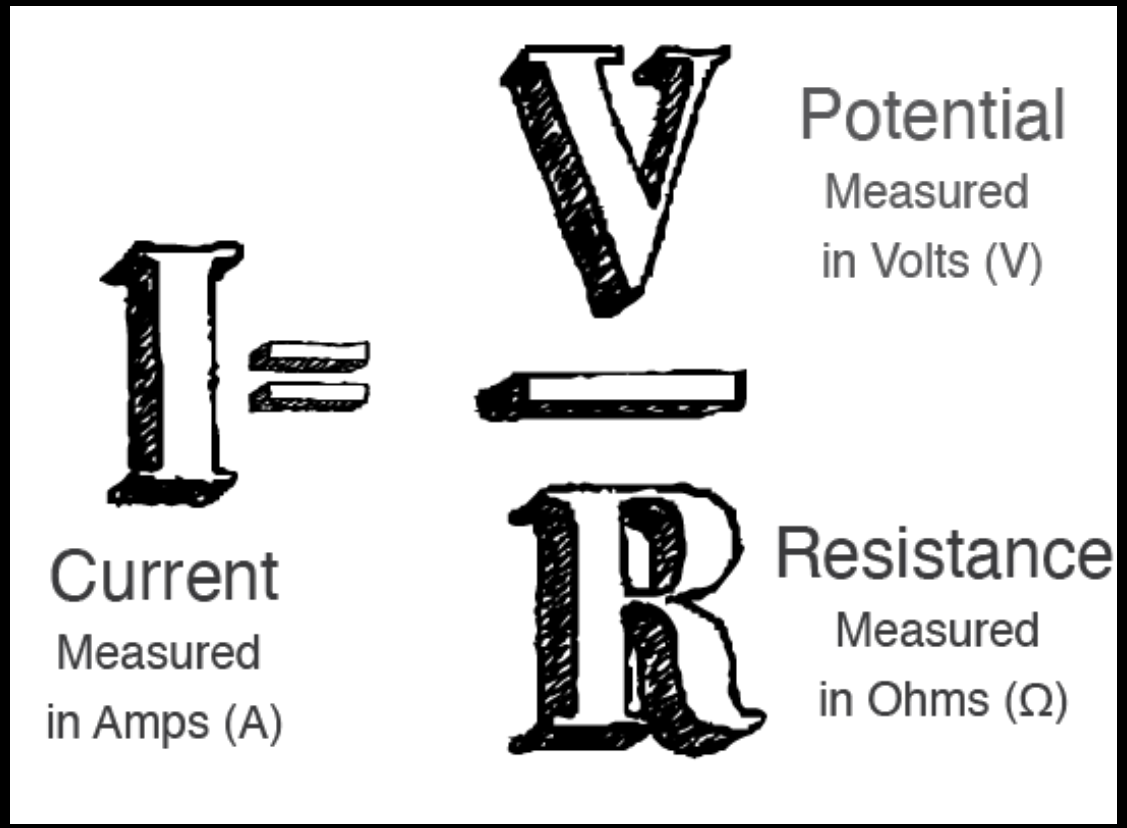
ELECTRIC CHARGE

Ohm's law states that the electric current through a conductor between two points is directly proportional to the voltage across the two points.

Ohm's Law Explained; youtube.com/@EngineeringMindset



OHM'S LAW



Ohm's Law Calculator. Below are three calculators used for Ohm's law to calculate the Current, Voltage and Resistance. There are basic examples below this for how to use the calculator.

Voltage	120
Resistance	5
	Calculate
Current	24

Resistance	5
Current	24
	Calculate
Voltage	120

Voltage	120
Current	24
	Calculate
Resistance	5

theengineeringmindset.com/ohms-law-calculator

COMMON COMPONENTS

Switch

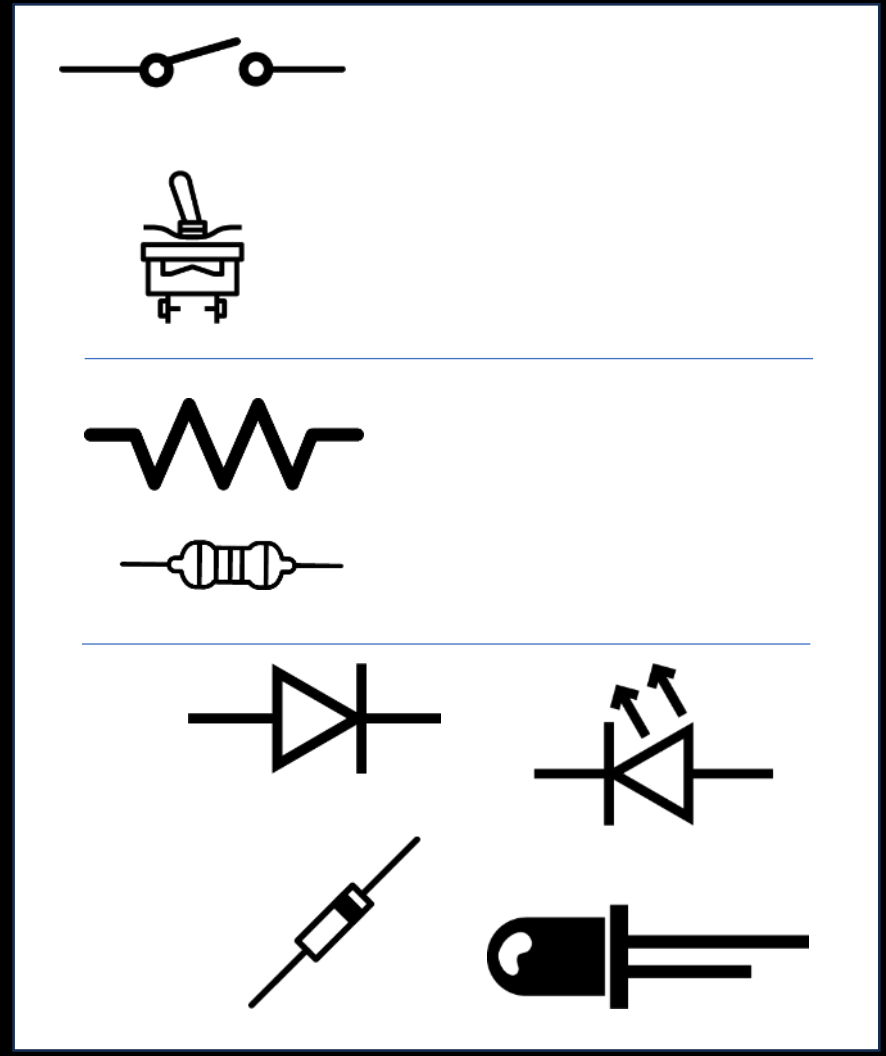
mechanical break in a circuit
that stops the flow of current.

Resistors

Inhibits the flow of current

Diodes (LED)

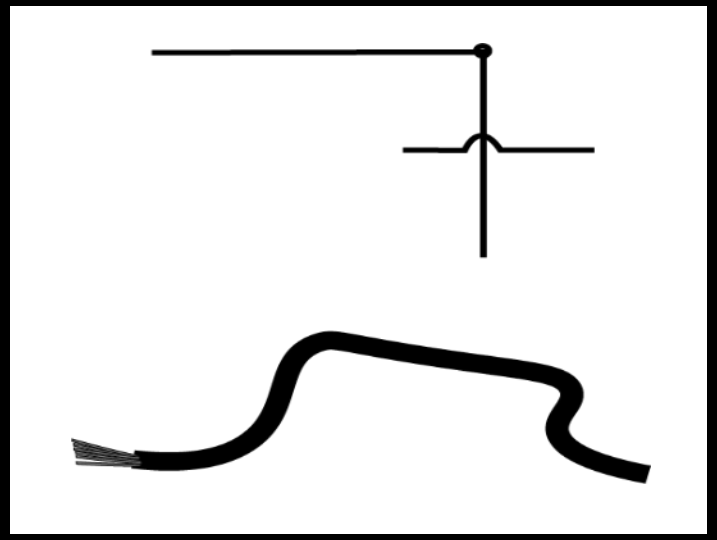
One-way gate



COMMON COMPONENTS

Conductors (wires)

These are wires or other strips of metal designed to carry current and are often surrounded by insulation

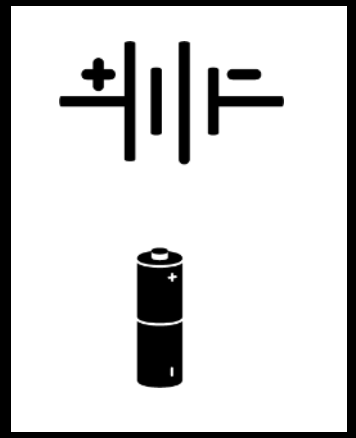


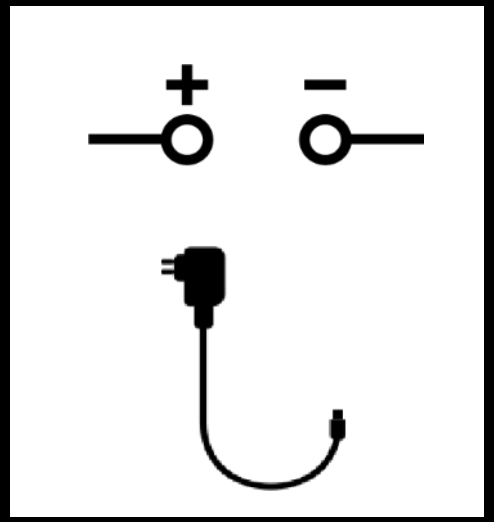
Supply Voltage

Usually a battery

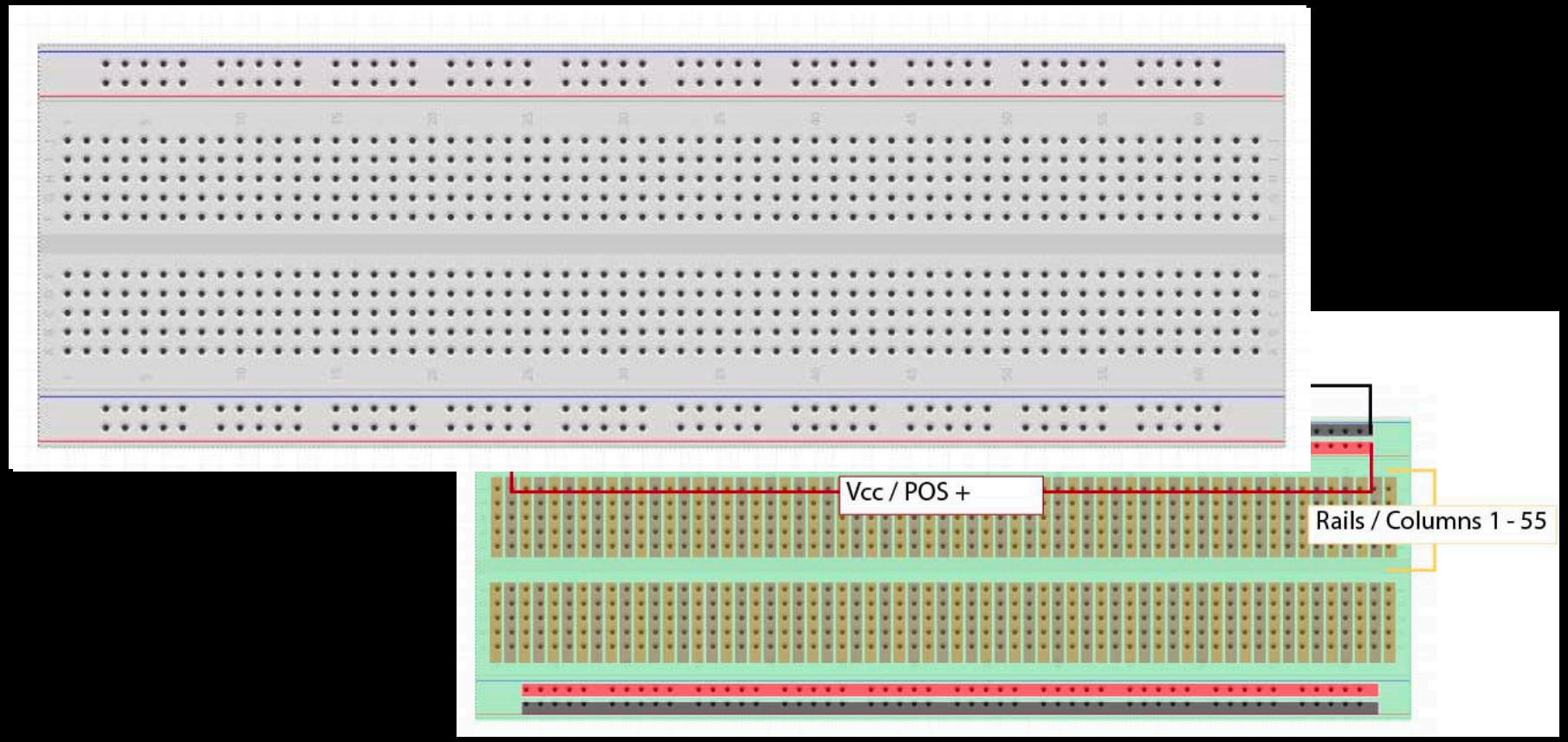
or

power supplies designed for powering DC circuits





BREADBOARDS



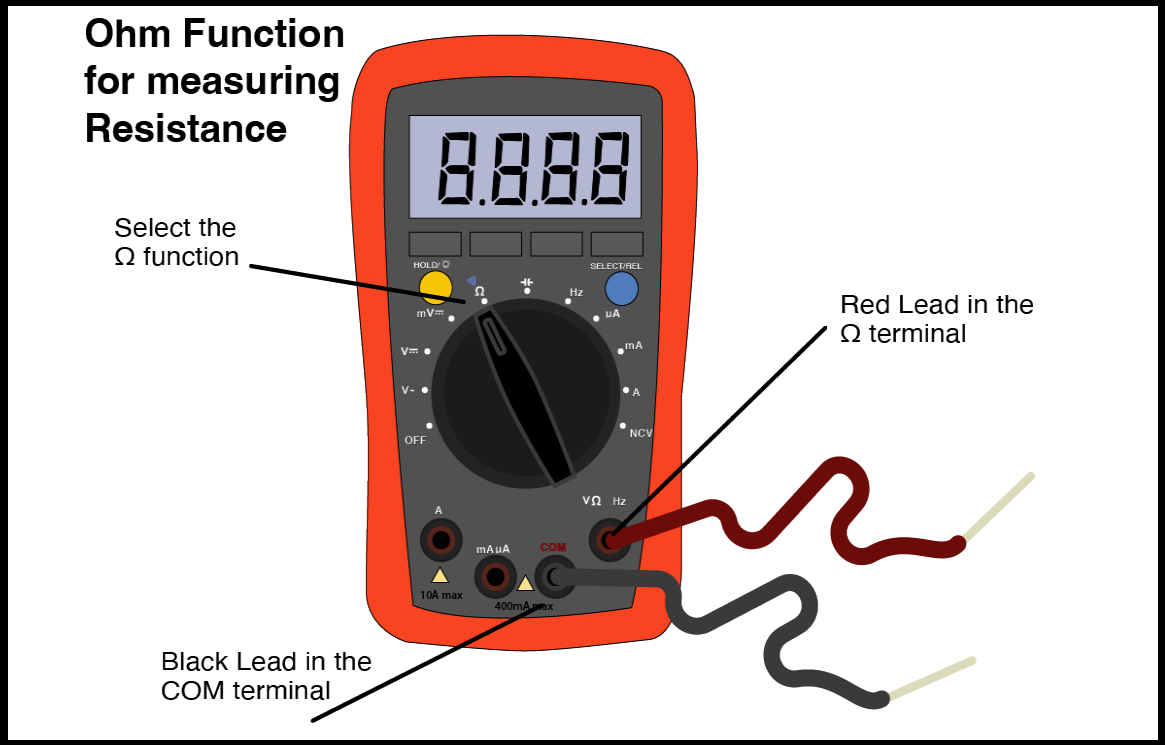
MULTIMETER

Multimeters are tools used for fault finding and checking things are working as you go.

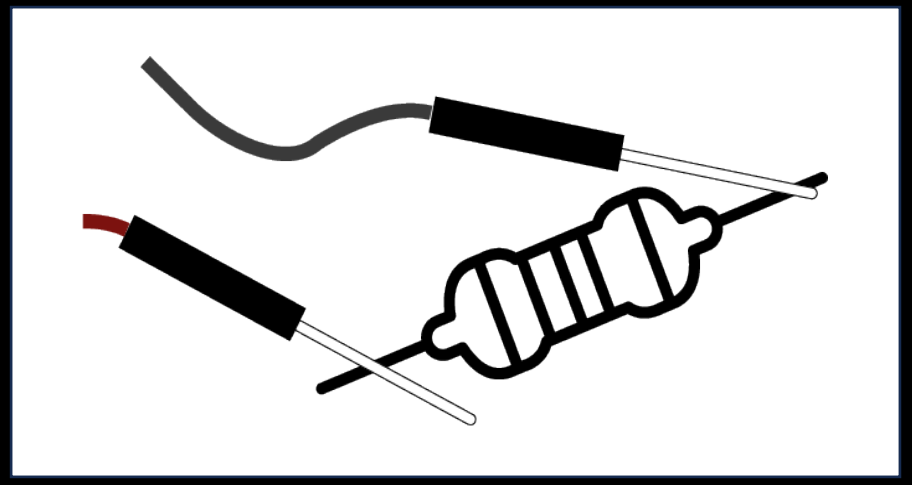
There are 2 main types, digital and analogue, and there are a variety of digital options.

The main thing to know is whether it's manual or auto ranging, the Edge multimeters are auto ranging .

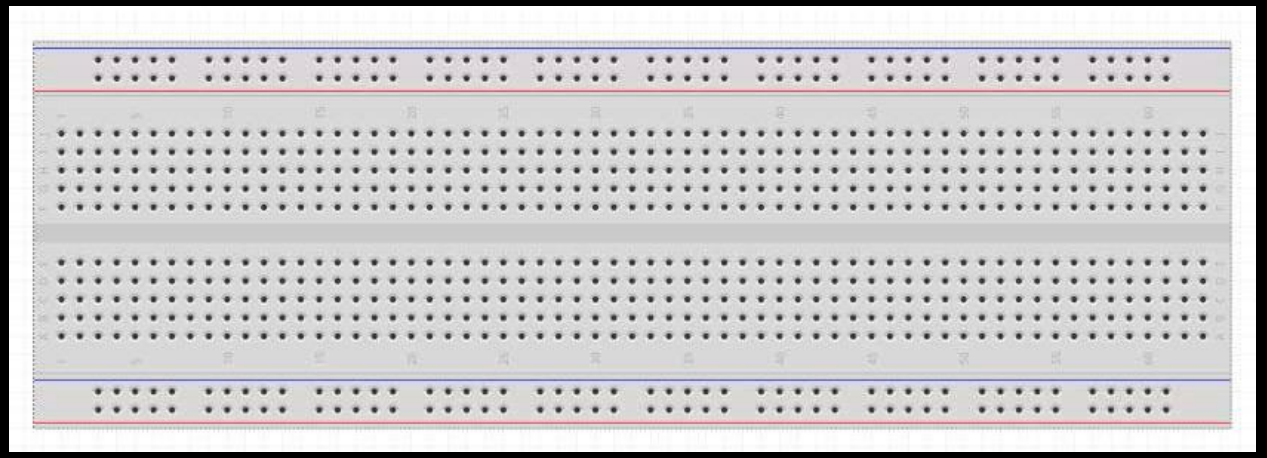
Although they measure all sort of things, the three we will focus on are Voltage, Resistance and Current.



Let's try the multimeter out on a couple of resistors.



We can also use the multimeter to work out which holes are connected on the breadboard.



Before you can measure anything, the first thing to work out is whether you're dealing with a Direct Current (DC) or Alternating Current (AC).

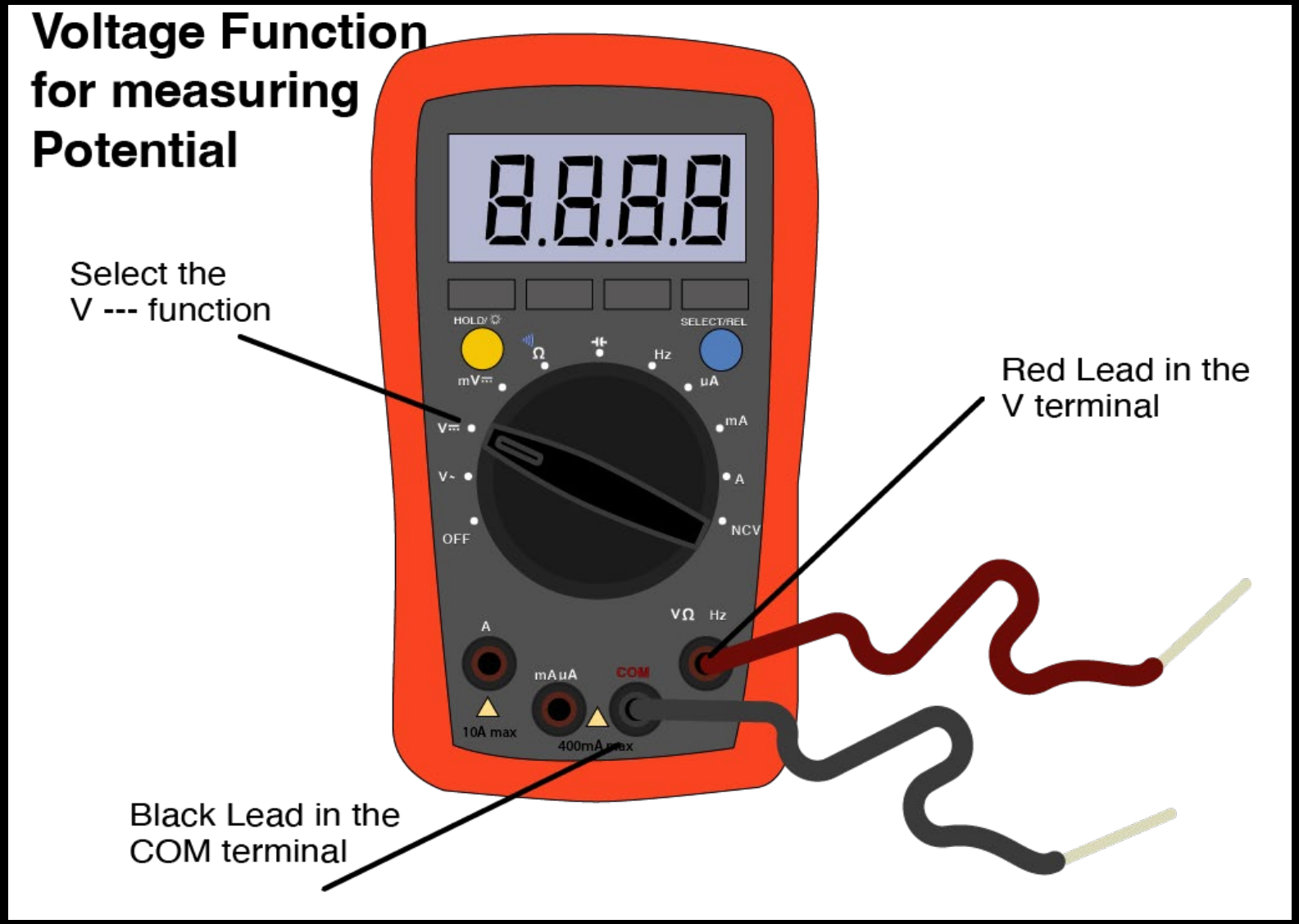
It should be DC because we generally **should not** be playing with AC.

We're luck cause these meters default to DC.

1. Place red cable in the V Ω -|)- Hz terminal and the black in the common.
2. Select V--- for DC Voltage.
3. Connect the red lead to the positive (+) and back lead to the negative (-) component or section of circuit you would like to measure.

Note

- Remember you are measuring the difference in voltage (potential, pressure) so measuring at the same point you get zero (no difference in voltage).
- If you get a negative Voltage – you have the leads around the wrong way.



CURRENT CAN DAMAGE YOUR METER!!

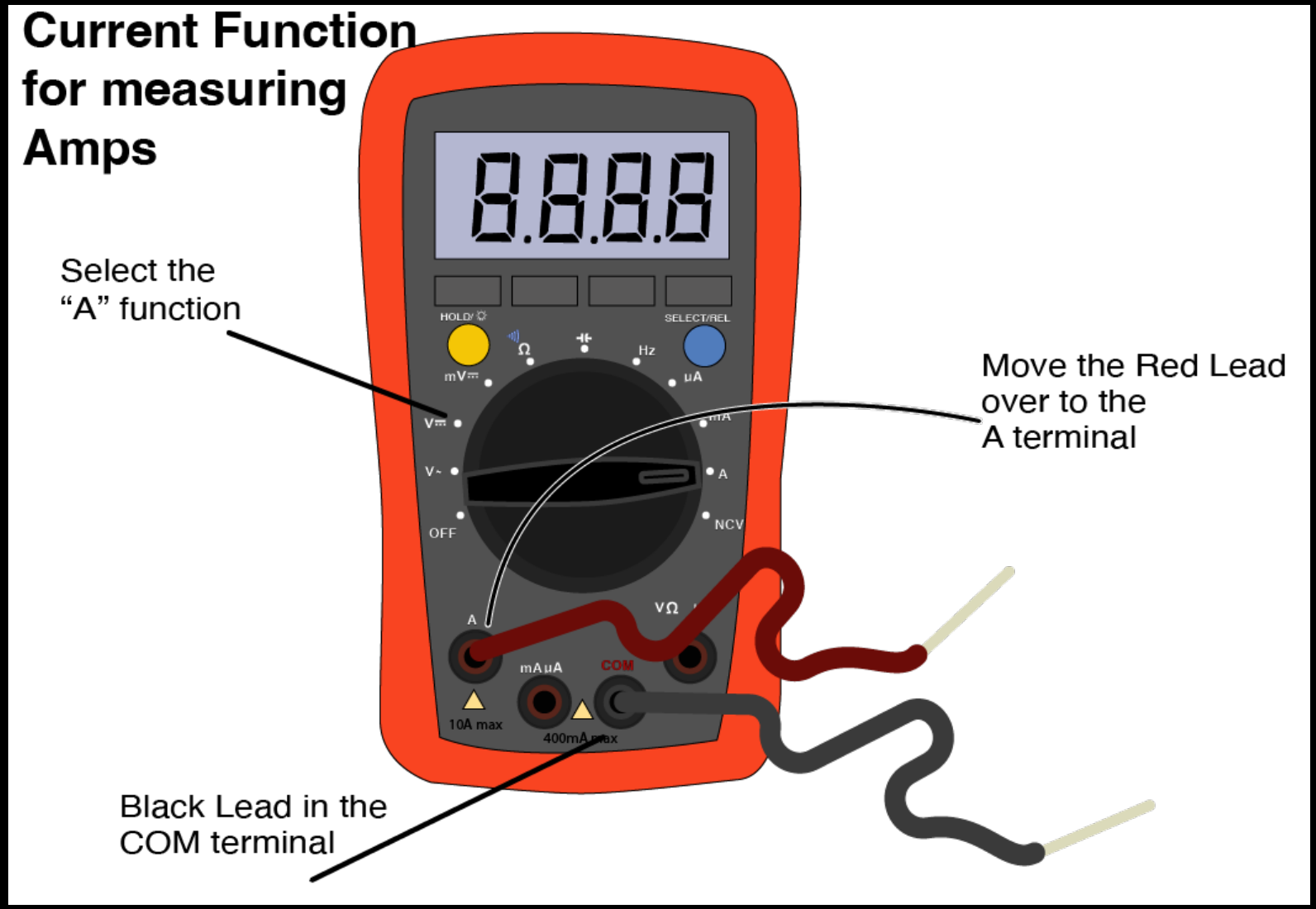
The mA (milliAmp) µA (microamp) terminal is only designed to measure up to a maximum value of 400mA. Try to measure anything over this and you'll blow the fuse.

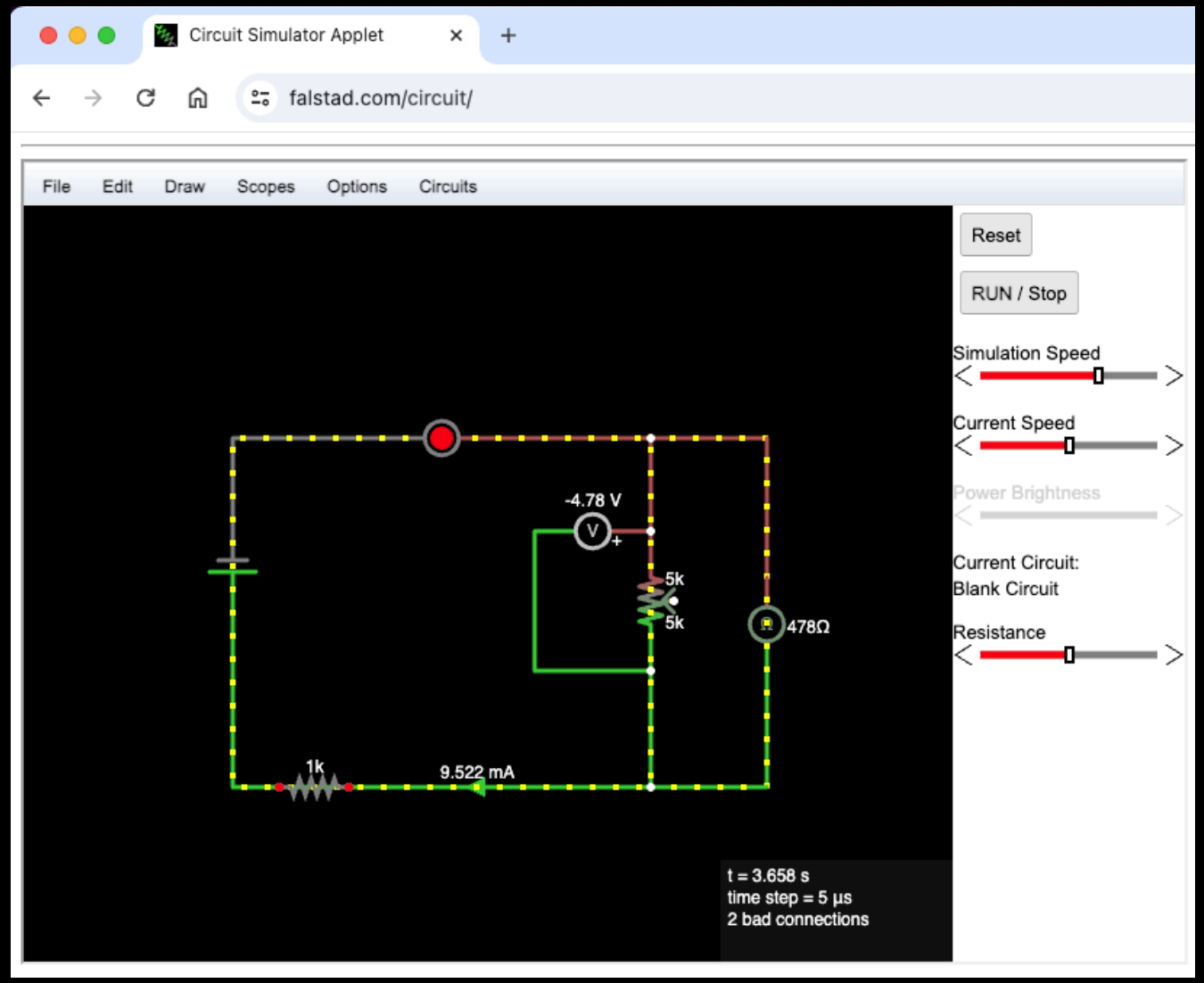
If you don't know what amperage reading you are likely to get, select the **"A" setting** and work your way back if need be.

If you don't know the Amperage range

1. Place the black in the common and the red cable in the **A** or **mA µA** terminal.
2. Select for A---, mA---, or µA---
3. **Amperage readings need to always taken in series. Taking a reading in parallel to the load provides a shorter path for the current to to flow and will give you a false reading and could damage your meter.**

1. Remember you are measuring the difference in voltage (potential, pressure) so measuring at the same point you get zero (no difference in voltage) .



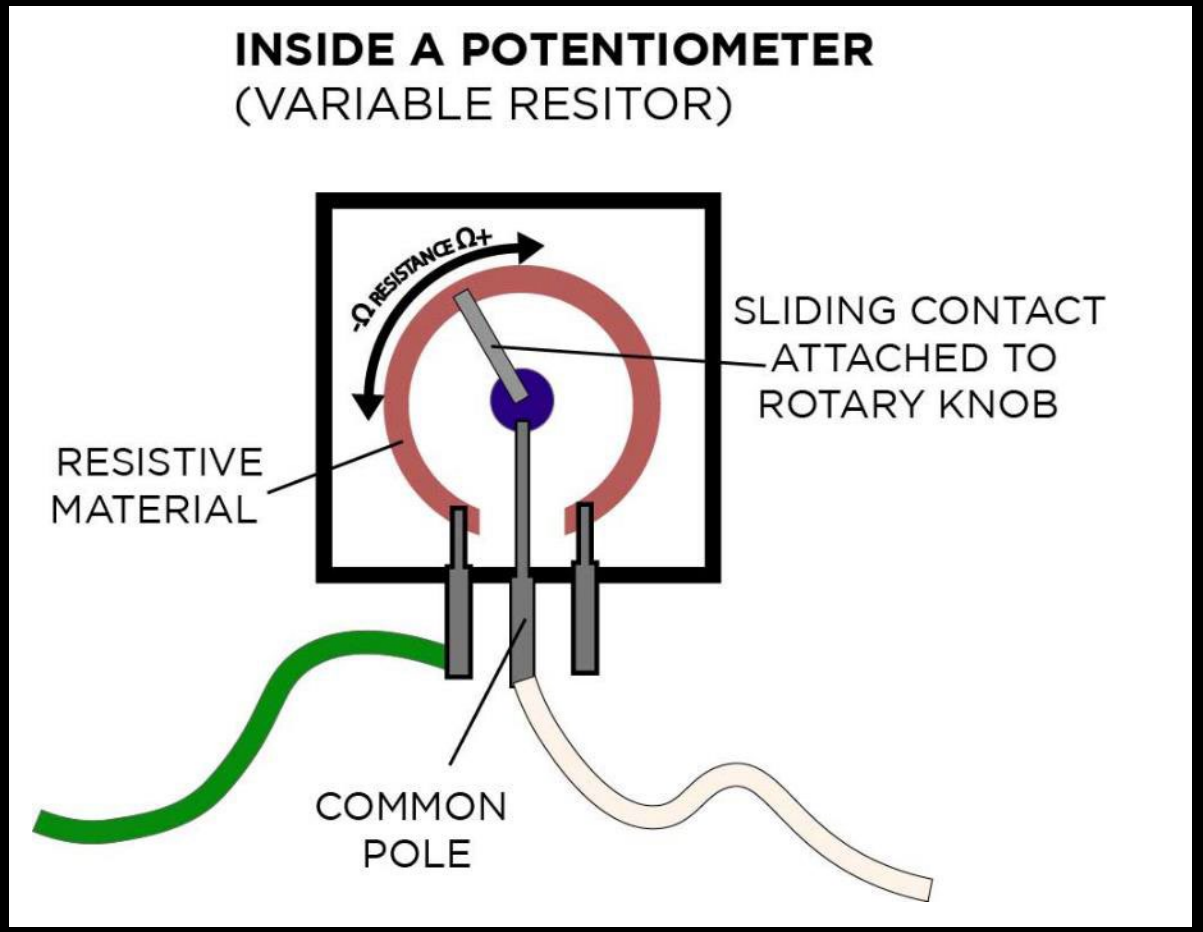


A good way to see how components and a meter behave is using a circuit simulator.

Try falstad.com/circuit/ it is free and pretty powerful.

POTENTIOMETERS

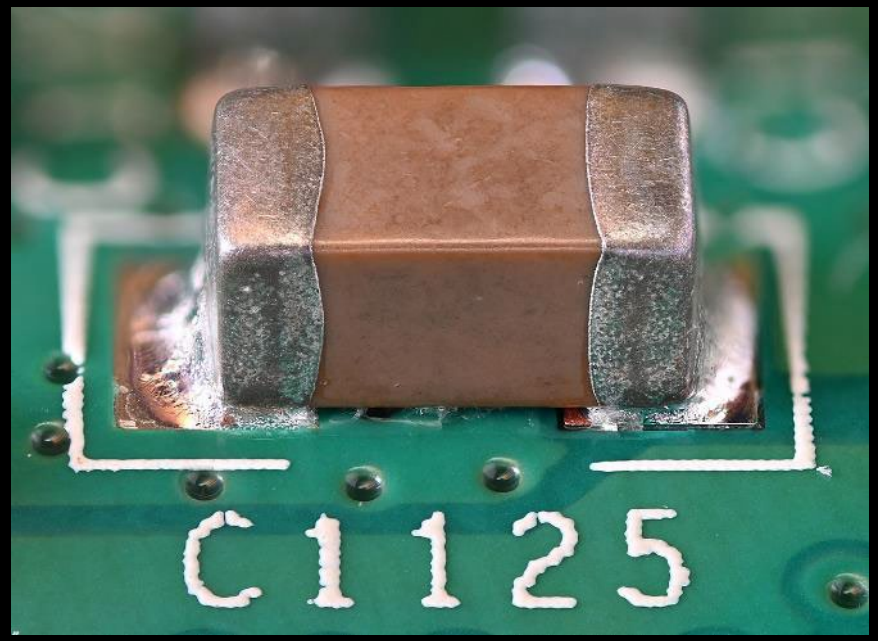
Potentiometer is essentially an adjustable resistor that are commonly used to control electrical devices such dimmers or volume controls on audio equipment.



SOLDERING

Types of Solder joints

Surface mount



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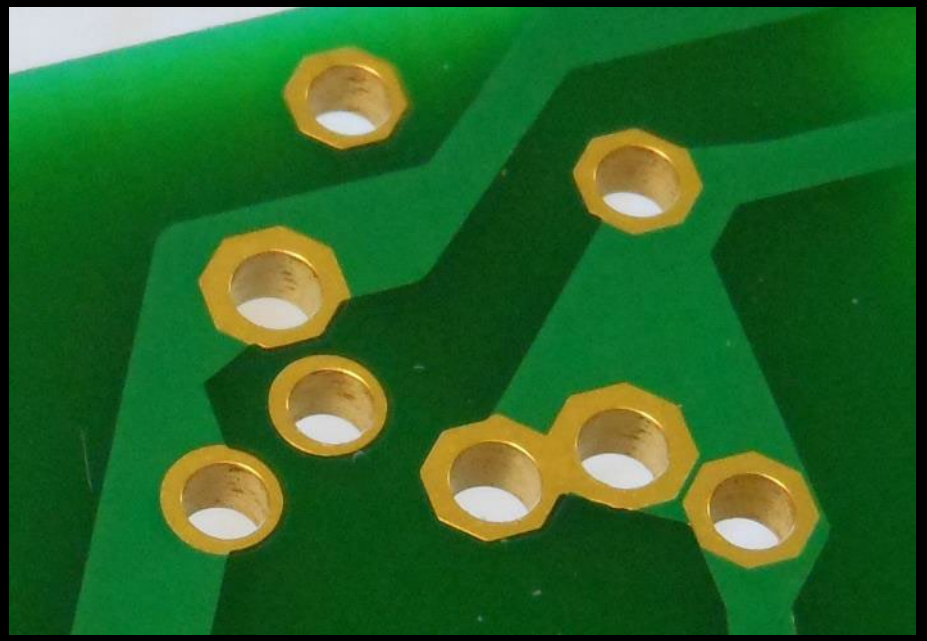
Through hole



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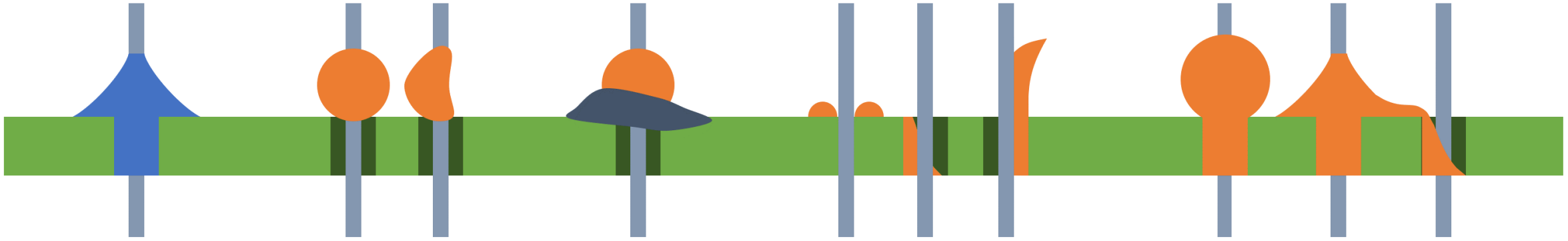
Soldering practice

What's a good solder joint look like?



PERFECT!
Neat volcano shape,
good contact

TOO COLD
Add flux
& iron

TOO HOT
Lower
temp/time

NOT ENOUGH SOLDER
Add flux, more solder,
& iron

TOO MUCH SOLDER
Add flux, re-heat and
wick/suck away excess

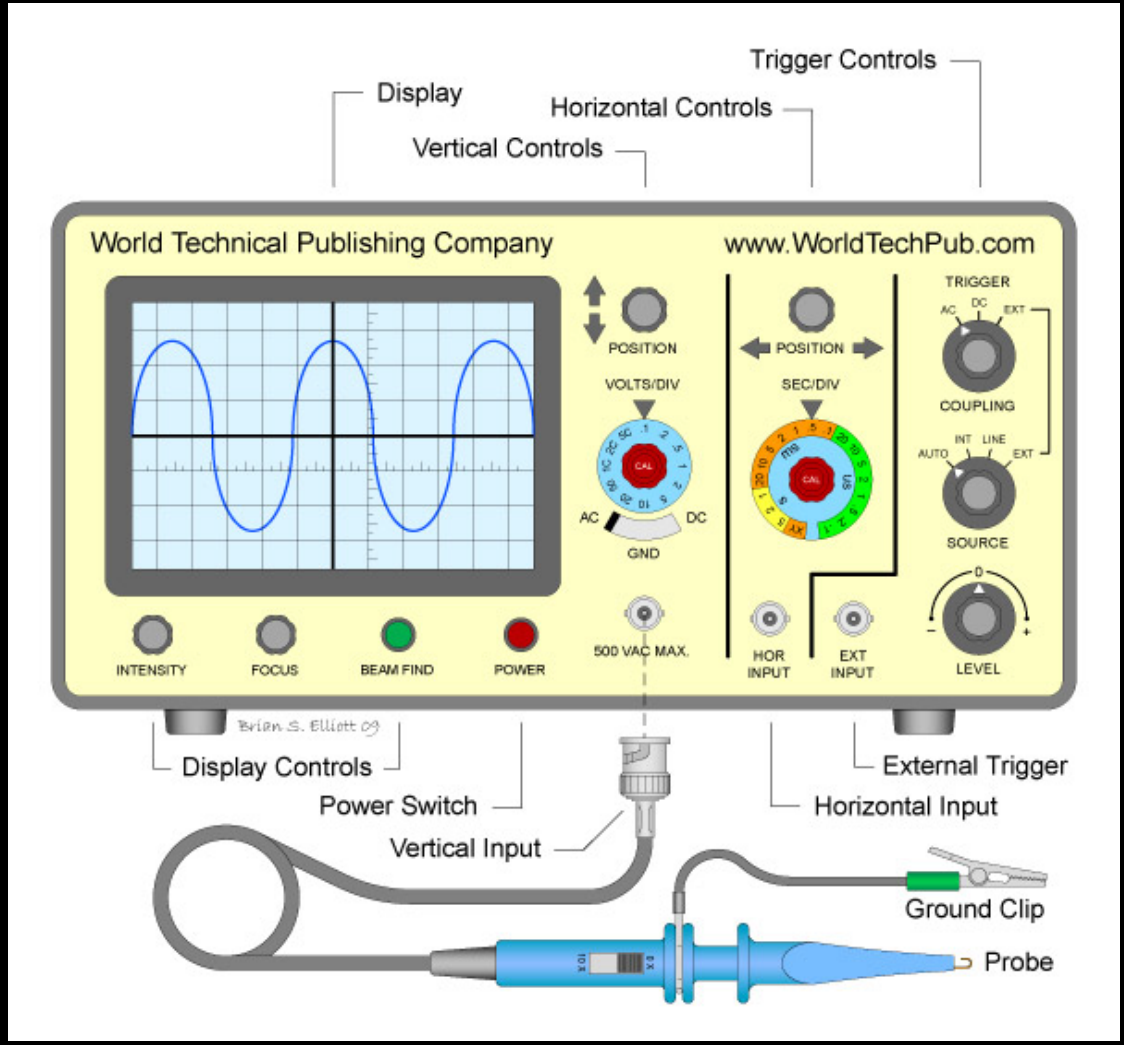
DIAGNOSTICS

Diagnostic tools
- Bench Power Supply (including safe use)
- Oscilloscope basics (including safe use)

Resources
EEVblog #279 - How NOT To Blow Up Your Oscilloscope!
https://www.youtube.com/watch?v=xaELqAo4kkQ

The oscilloscope usage example | Rigol DS1054Z basics
https://www.youtube.com/watch?v=hIz6rD4TVBA

Oscilloscopes Made Easy #1 - Introduction to Oscilloscopes (Rigol DS1104Z)
https://www.youtube.com/watch?v=uU3FhH7_Mwo



HAND TOOLS

The hand tools available to use during Open lab include;

- side cutters
- hot air
- glue gun
- screwdrivers
- utility knife

GETTING STARTED

- Let an Open lab staff member know that you have a booking.
- Ask for support to access any equipment that's not available in the lab.
- Open lab staff members can assist with basic support.

ACTIVITY

LED and a pair of batteries that produce 3V

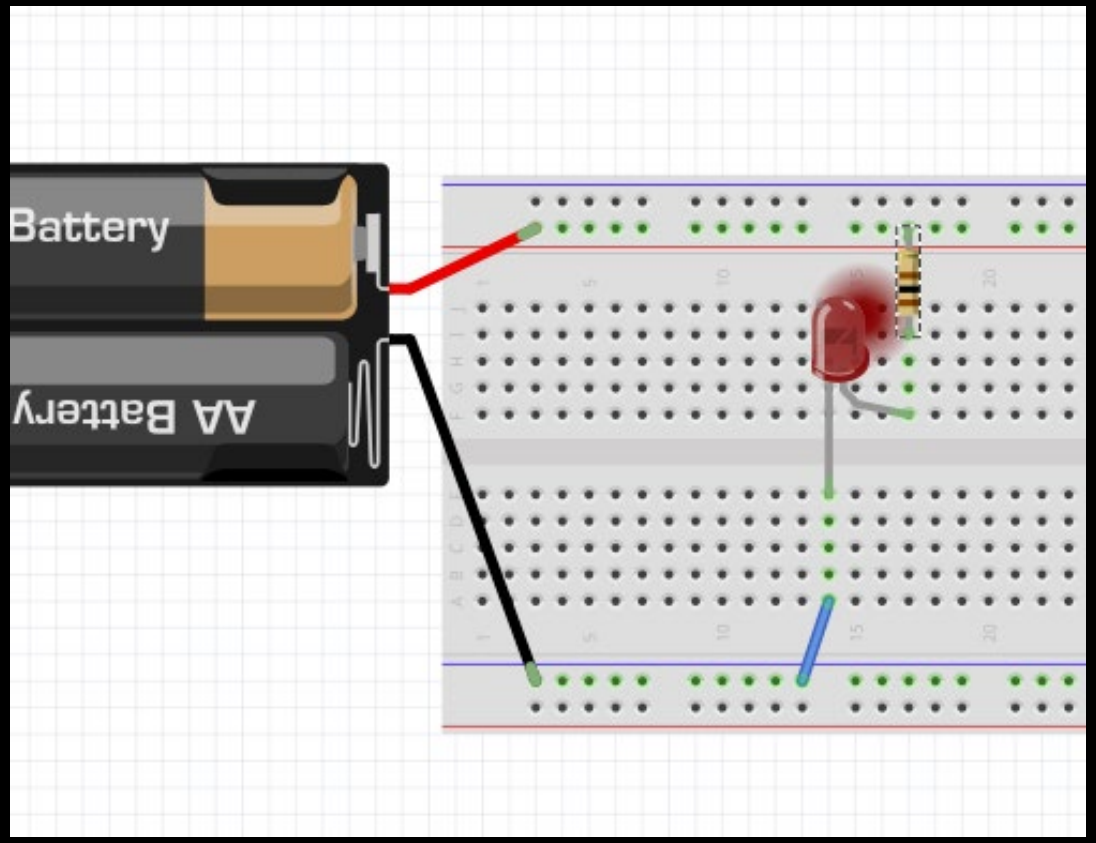
Using a breadboard, AA batteries, LED, resistor and jumper wires we will power the light.

- Battery has a Pos and Neg side
- LED is a Diode – one way gate has a pos and neg

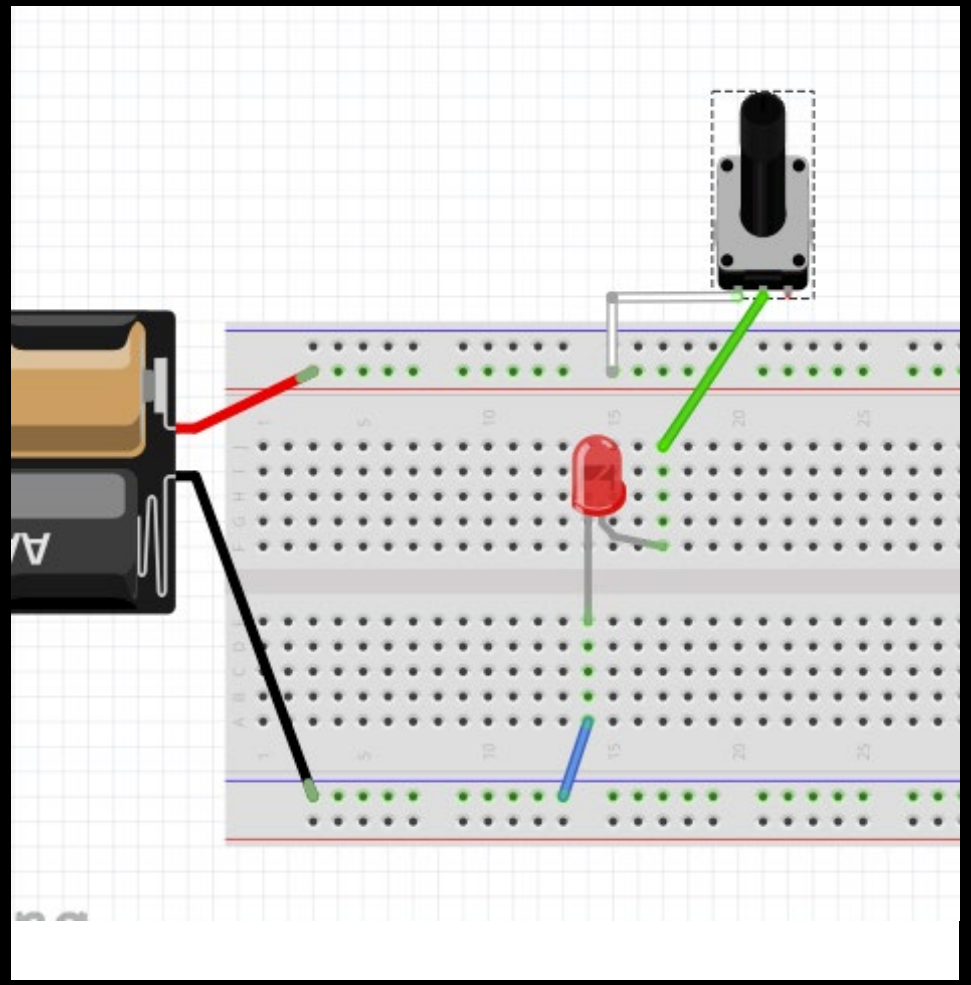
When positioned the right way around the voltage pushes electrons down the LED which activate the semi-conductor which emits photons and then continue around to complete the circuit.

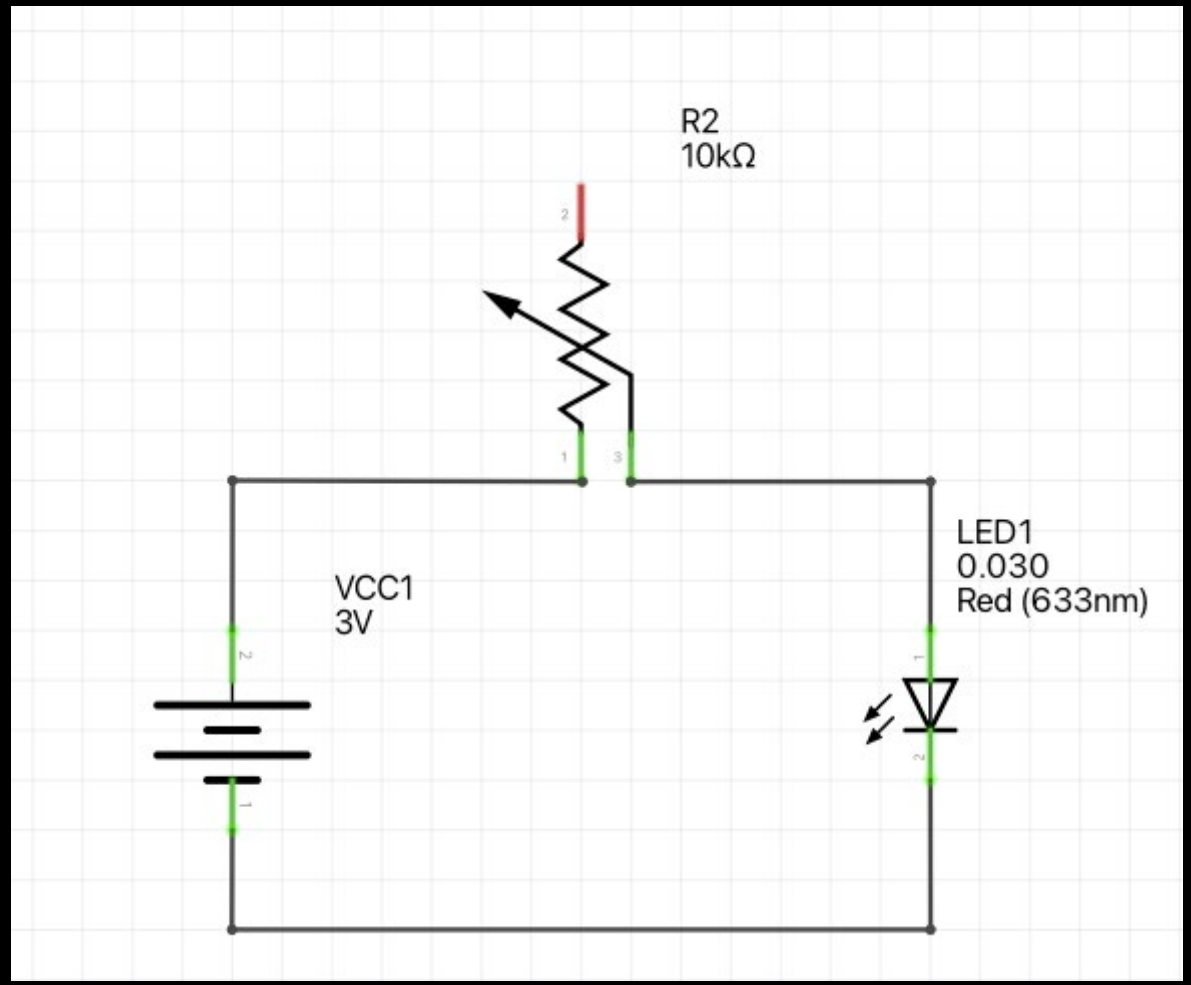
If there is a break in the circuit the electrons – current cannot flow.

If the LED is around the wrong way the electrons get caught at the led and the circuit wont flow.



Let's swap the normal resistor for a potentiometer





ACTIVITY

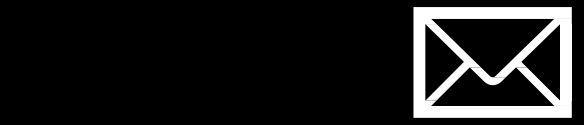
Practical demonstration of soldering

For this activity we will share the soldering irons and work with our neighbours to do some solder joints.

THANKS FOR ATTENDING

Please complete our survey that will be sent out via Eventbrite.

Contact us on appliedcreativity@slq.qld.gov.au



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