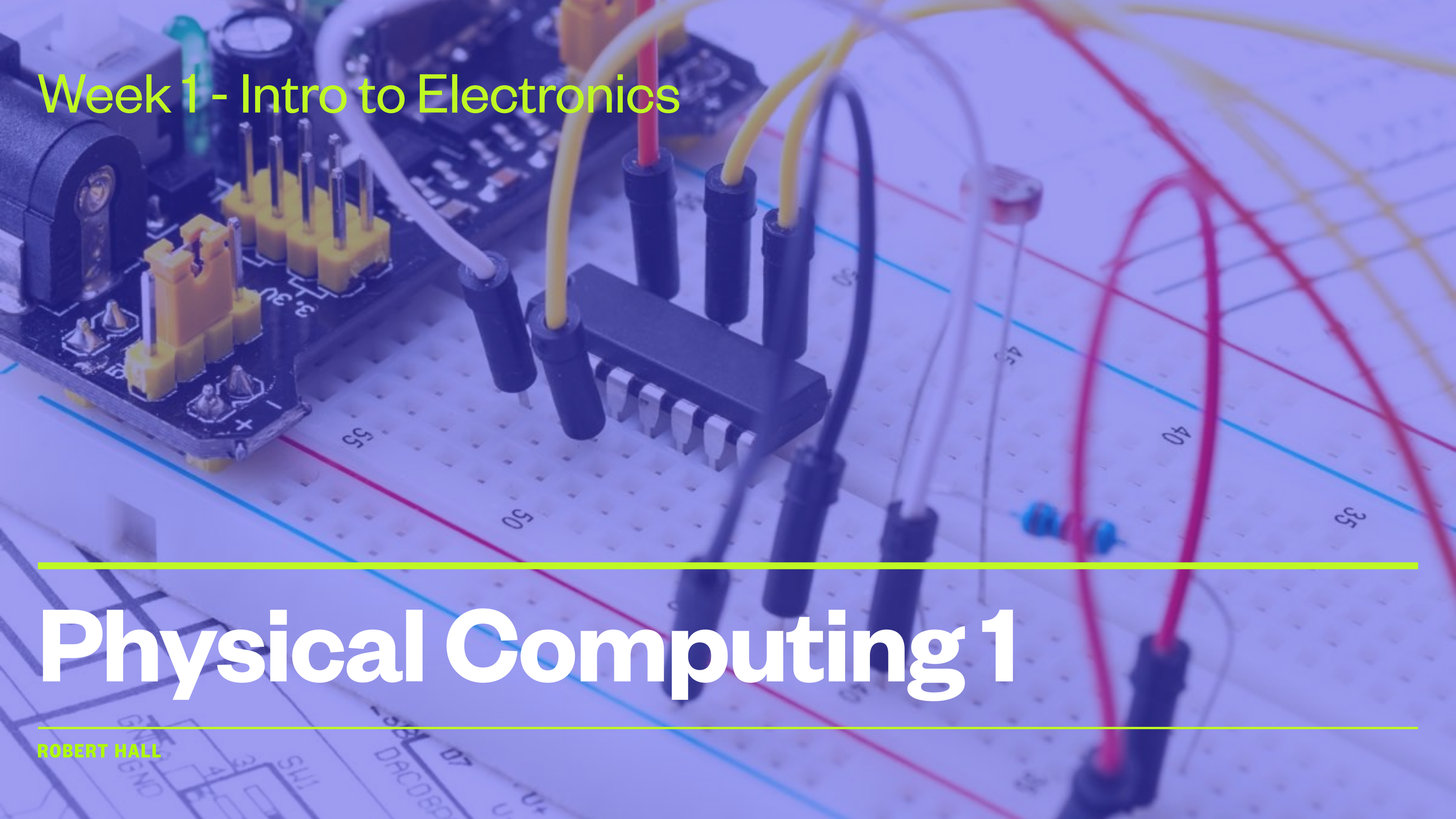
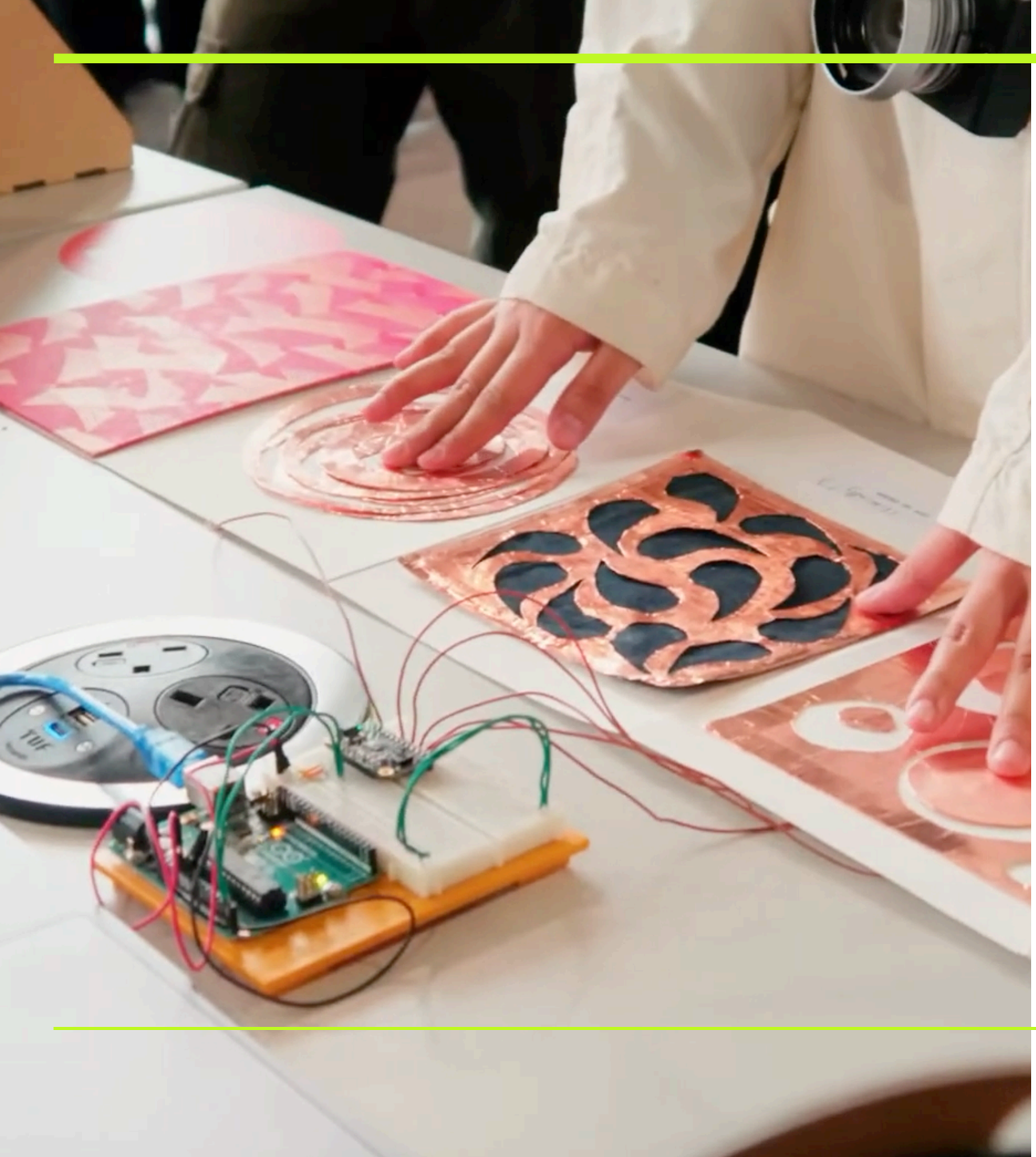


Week 1 - Intro to Electronics

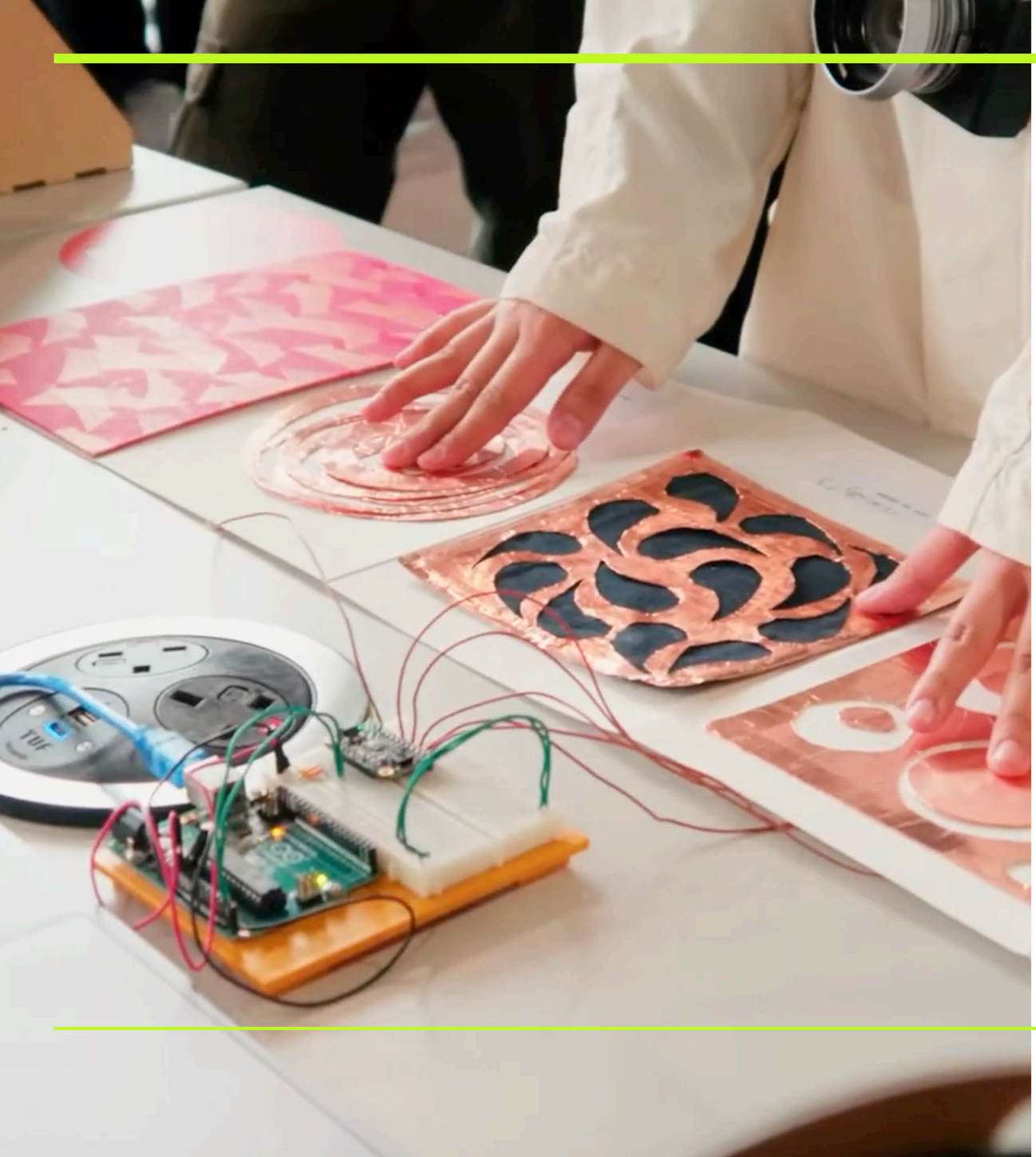
Physical Computing 1

ROBERT HALL



Welcome to Physical Computing!

- Module Overview
  - What to expect?
  - How will you be Assessed?
  - Intro to the Hatchlabs
- What is Physical Computing?
- Using a Breadboard
- Your First Circuit
- Soldering Demo



But First...
Admin time...

- Have you :-
  - Scanned the QR Code?
  - Enrolled on the VLE?
    - https://learn.gold.ac.uk/course/view.php?id=27909
  - Signed the Hatchlabs Code of Conduct?
    - https://www.doc.gold.ac.uk/hl-codeofconduct
  - Signed up for inductions in the Hatchlab?
    - https://learn.gold.ac.uk/course/view.php?id=6947
  - Bookmark the Hatchlab Website:
    - https://www.doc.gold.ac.uk/Hatchlabs/

Sign The Register!

- You must do this every week!
- Scan the QR code using the SEATS app.

Enrol on the VLE

- You only need to do this once
- https://learn.gold.ac.uk/course/view.php?id=24317

Sign the HatchLabs Code Of Conduct

- You only need to do this once
- This will make your card work on the HatchLabs Door
- https://www.doc.gold.ac.uk/hl-codeofconduct

Sign Up
HatchLab Inductions

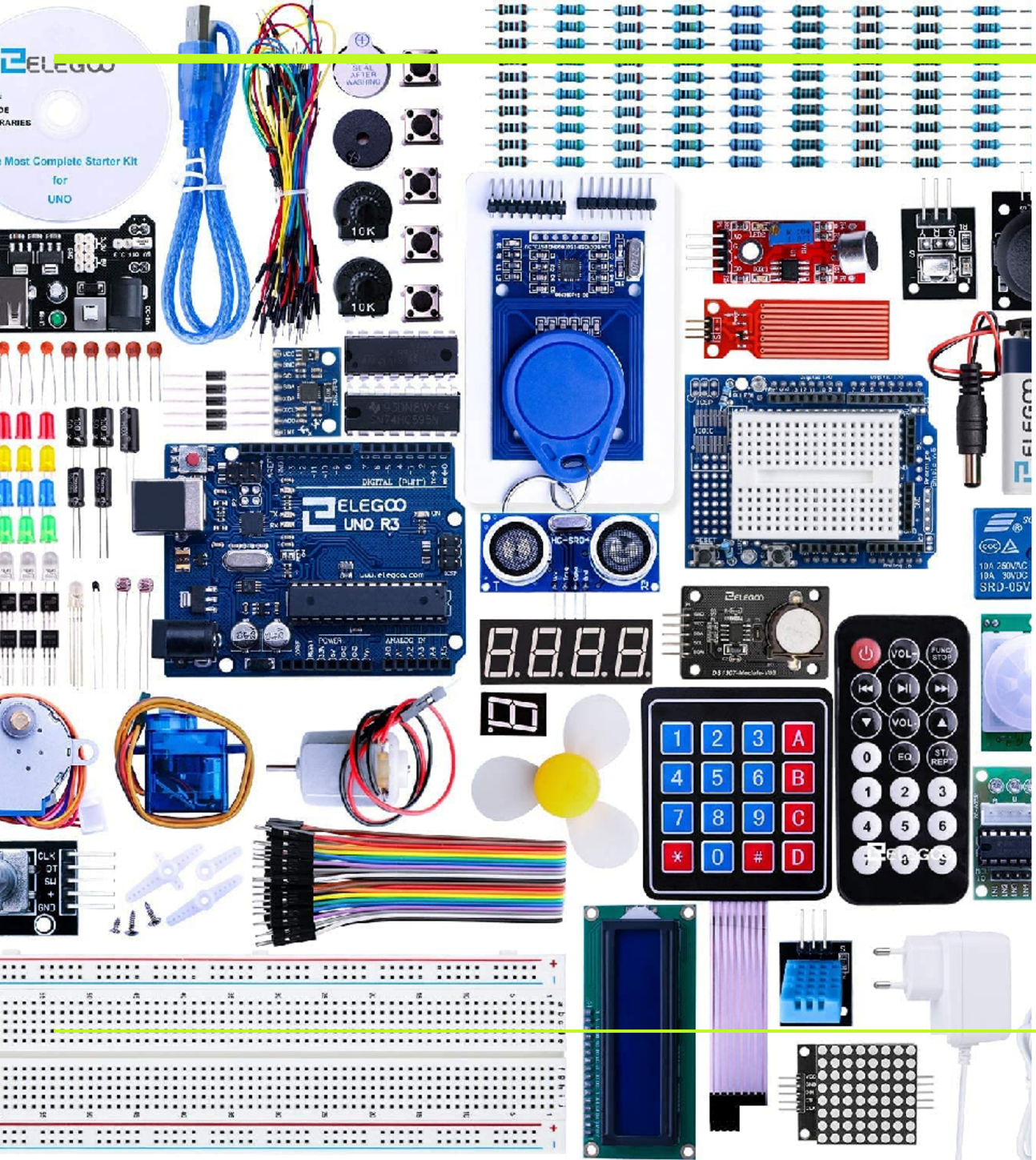
- https://learn.gold.ac.uk/course/view.php?id=6947
- You MUST Sign Up for Inductions if you want to use the exciting tools in the Hatchlab.
- You should also save our website! It's very useful and has information on all the tools in the lab :
  - https://www.doc.gold.ac.uk/Hatchlabs/

Safety Tips

- Don’t use more than 2 Amps or more than 24V without talking to us first.
  - Electricity below this level is the safest.
- Be careful to connect components with +/- , 5V/GND or Red/Black wires the correct way round.
- Stick to powering your circuits using the power cables and batteries in your kit.
- Watch out for your circuit getting hot, that might mean there is a short-circuit!

If you have an accident - Tell us!

We can always learn from accidents!



Time for Kits

- You must have a kit to do this module.
- This kit costs £45 and we will now come round so you can buy them.
- When you get yours write your NAME and USERNAME on the inside!

How will you be Assessed?

- 15% Ongoing Assessments (Fail-Outstanding for Idea and Execution) (2.5% Each)
  - 2 - Mini Projects
  - Project Proposal / MVP
  - 2 - 30 Second Check In Videos (You MUST show progress)
- 85% Final Project (Graded)

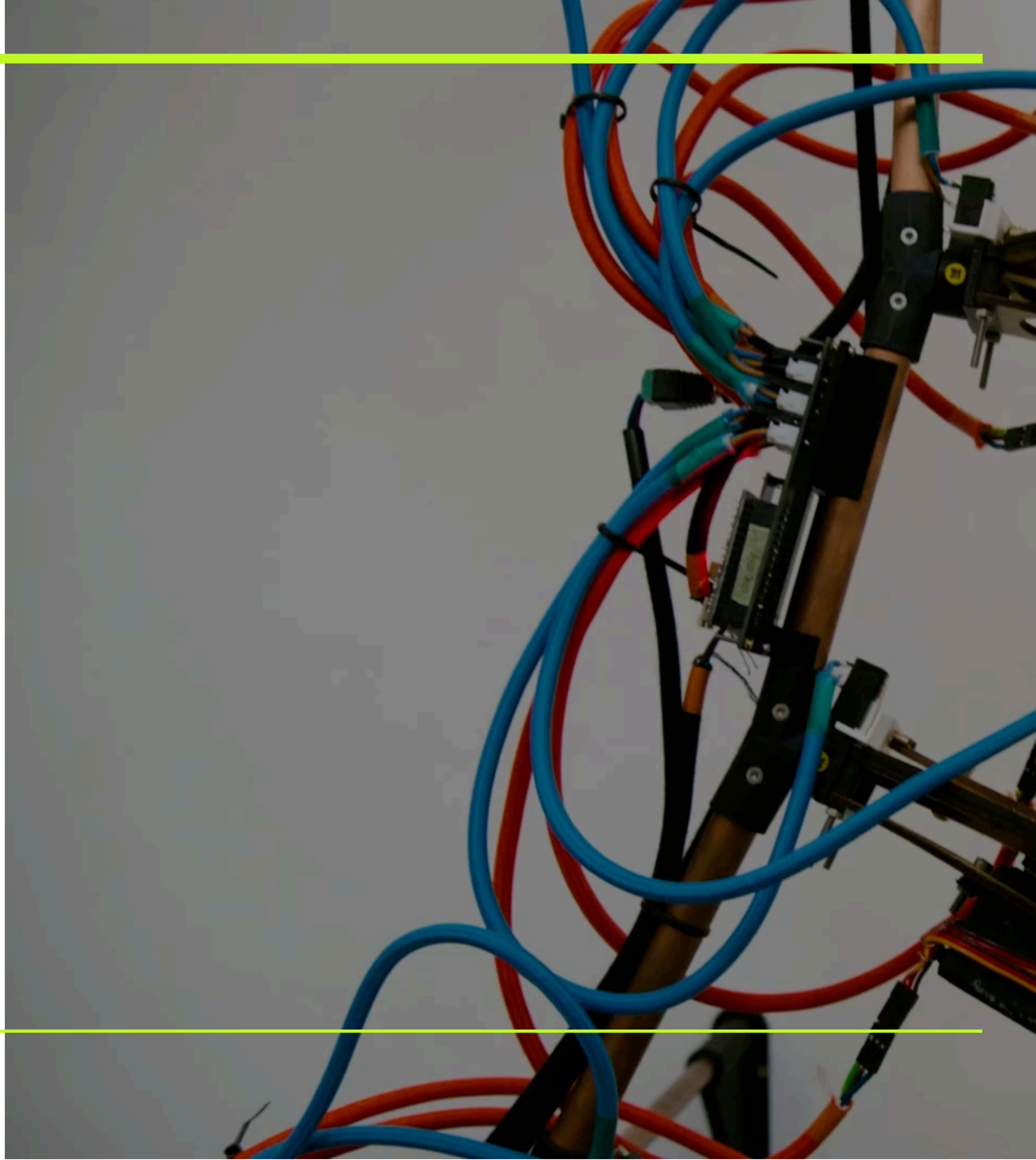
Get to know your Physical Computing Family!

Let's Go!

Tell us about :

- Your Name
- Your Preferred Pronouns (He/She/They)
- Your Art Practice
- The piece of Computational Art you have chosen!

What is Physical Computing?



What is Physical Computing?

Computational Art

Design

Physics

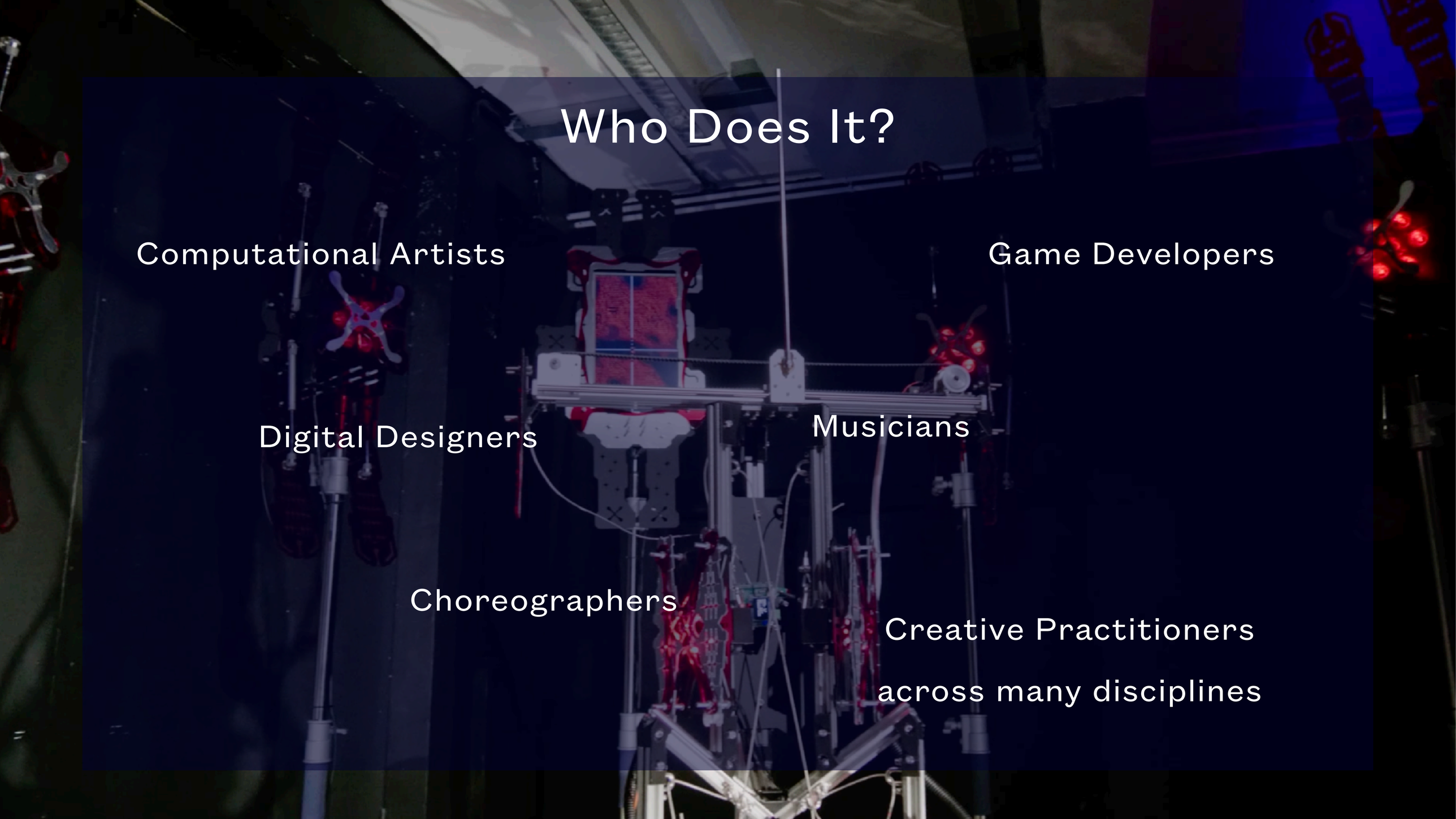
Conceptual Thinking

Engineering

Interaction Design

Programming

Physical Crafting



Who Does It?

Computational Artists

Game Developers

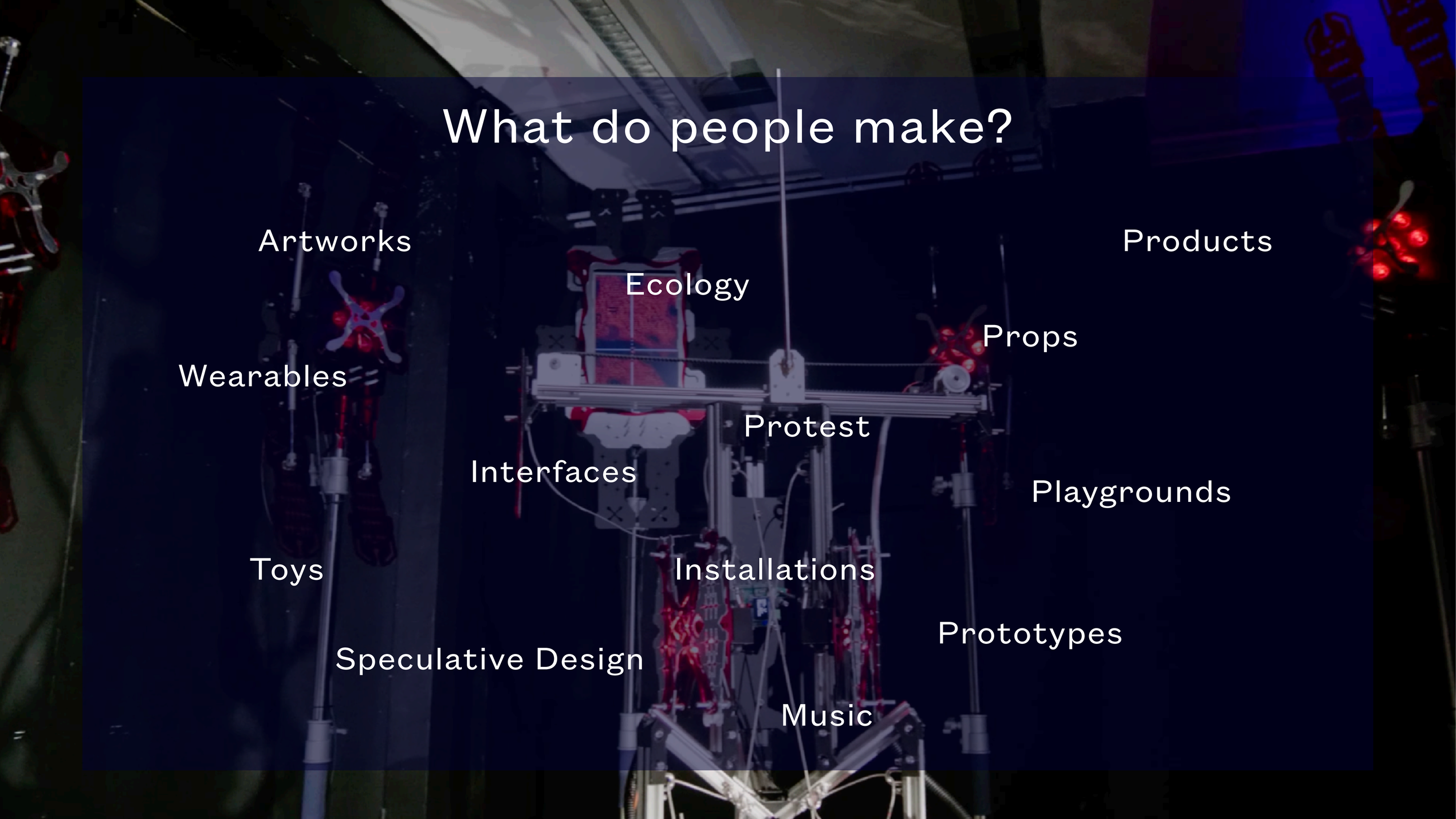
Digital Designers

Musicians

Choreographers

Creative Practitioners

across many disciplines


What do people make?
Artworks
Products
Ecology
Props
Wearables
Protest
Interfaces
Playgrounds
Toys
Installations
Prototypes
Speculative Design
Music

Do you have any Physical Computing Experience?

Inspiration Time!


Tap anywhere c
conti
14
Target: 1900
To create a special Striped Candy!
Tap anywhere on the screen to continue.
Skip
N SHAPPING
Def. The act of hiding an application from direct visibility.
Ex. "I'm always super embarassed about playing Candy Crush, so I shapped it."

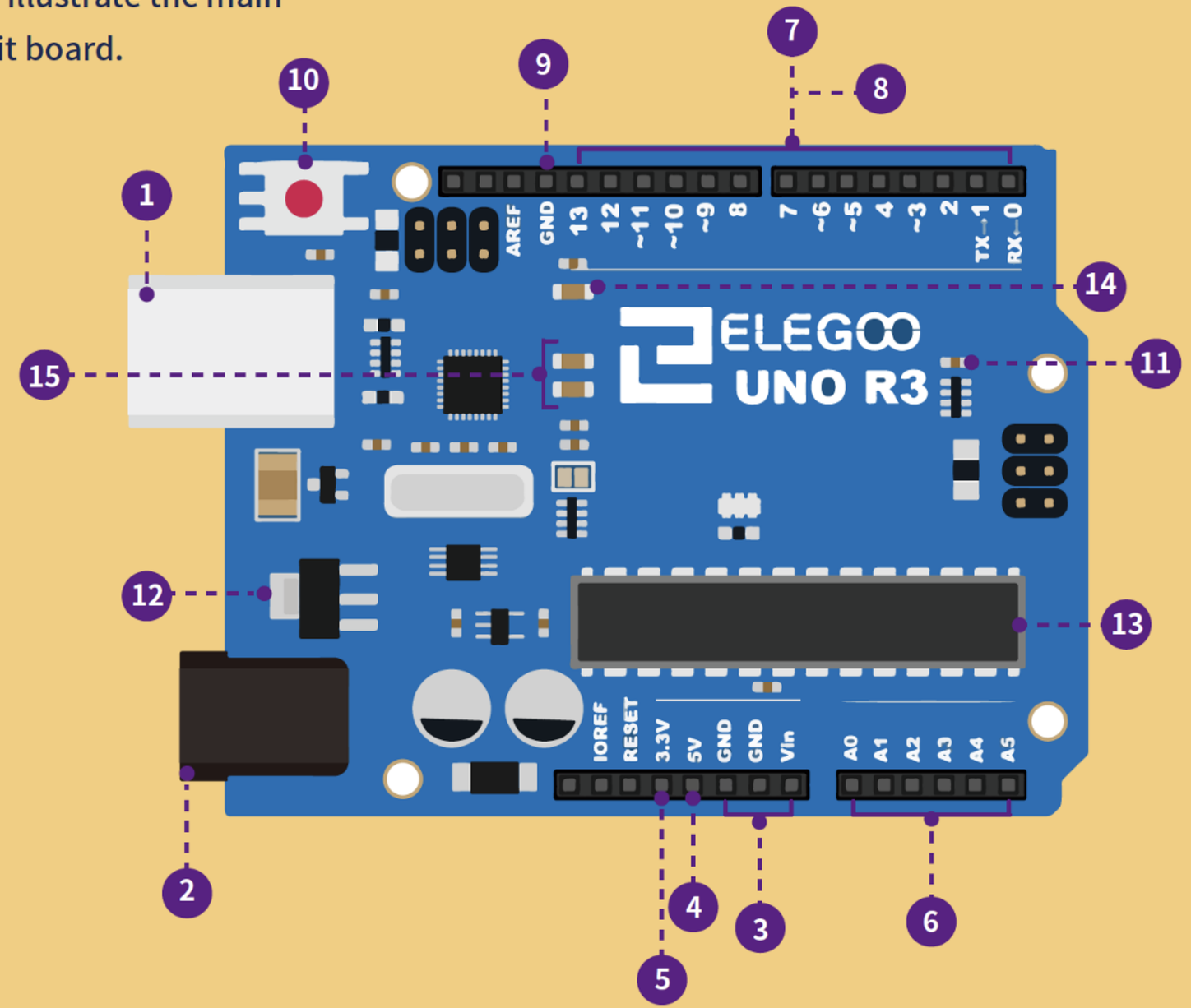
How was this done?

What are they trying to say?

3.Introduction of board

We use elegoo uno as an example to illustrate the main circuit components of Arduino circuit board.

① the USB connection
② the 6V~12V barrel jack
③ GND
④ 5V pin supplies
⑤ 3.3V pin supplies
⑥ analog pin
⑦ digital pin
⑧ (pwm~)
⑨ GND
⑩ Reset Button
⑪ Power LED Indicator
⑫ Voltage Regulator
⑬ Main IC
⑭ Pin D13 indicator LED
⑮ Serial communication indicator LEDs



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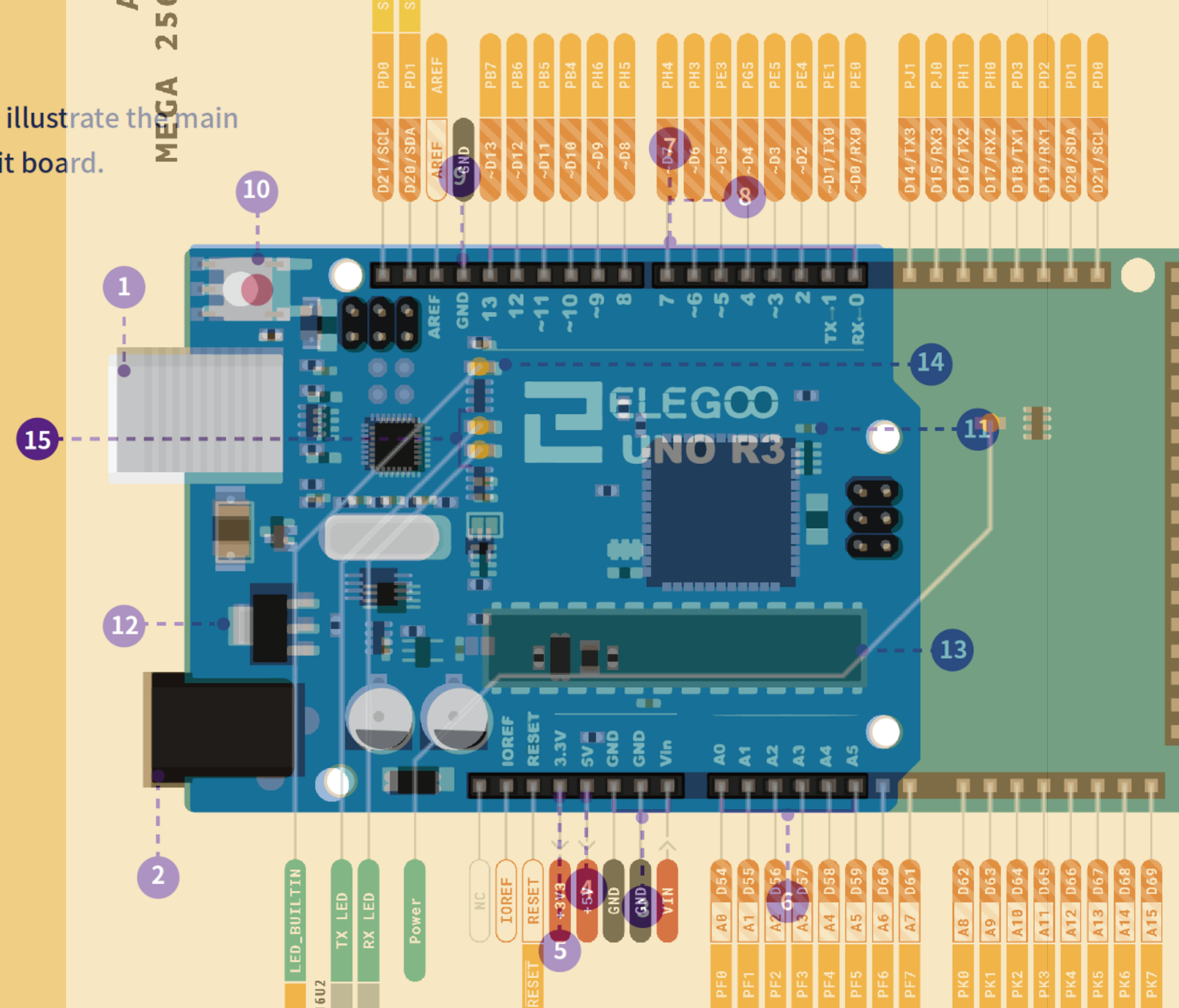

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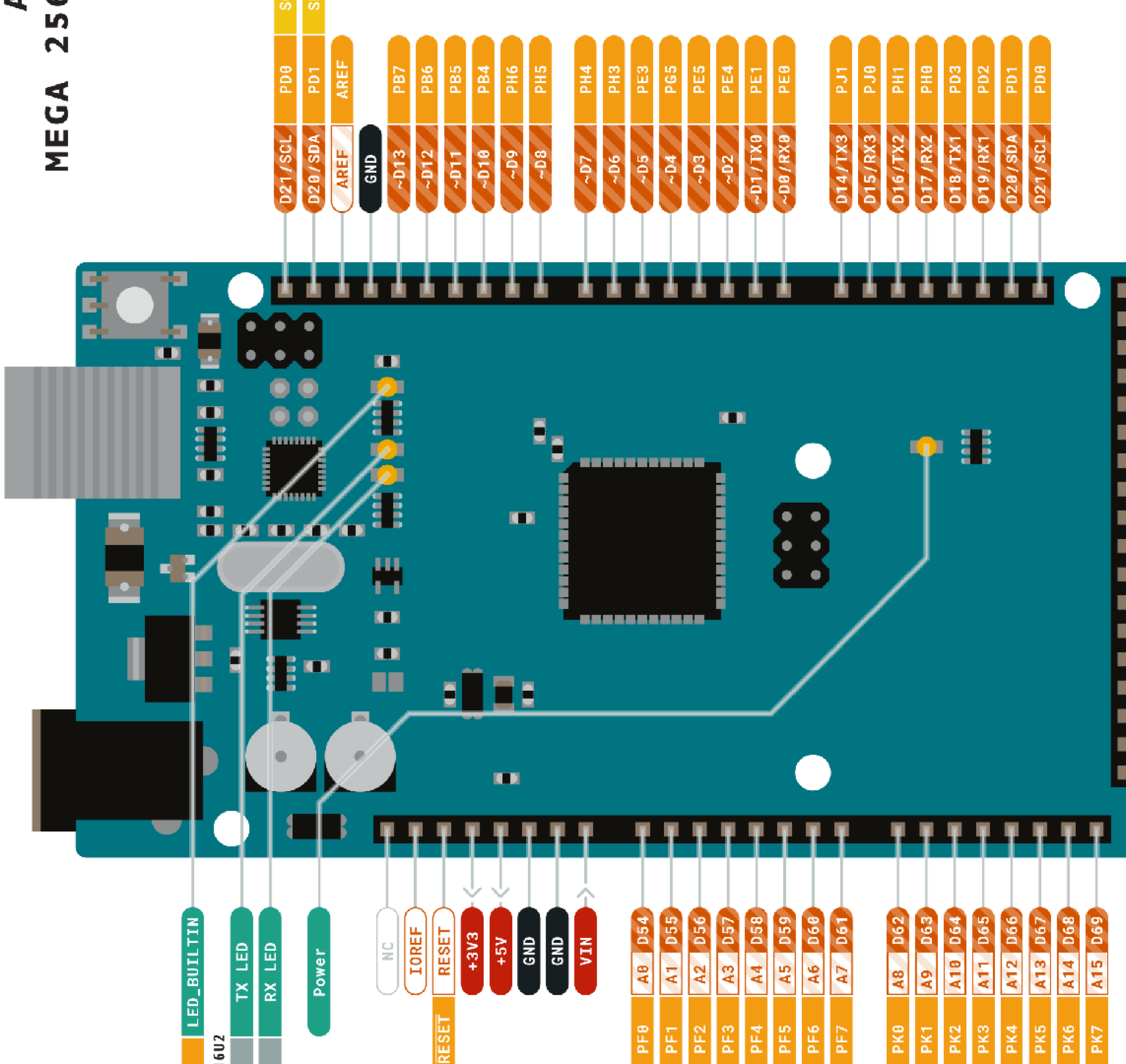
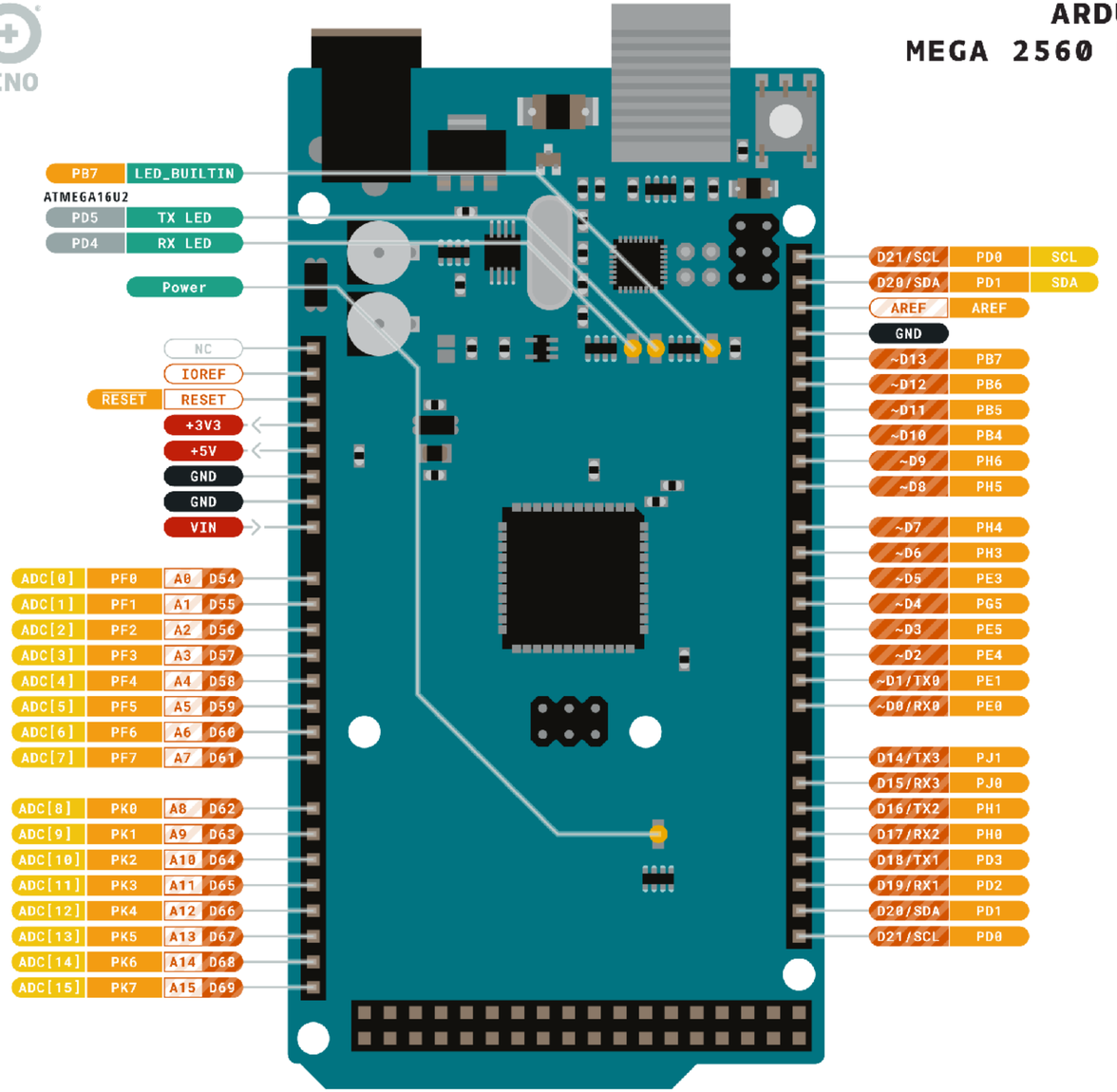


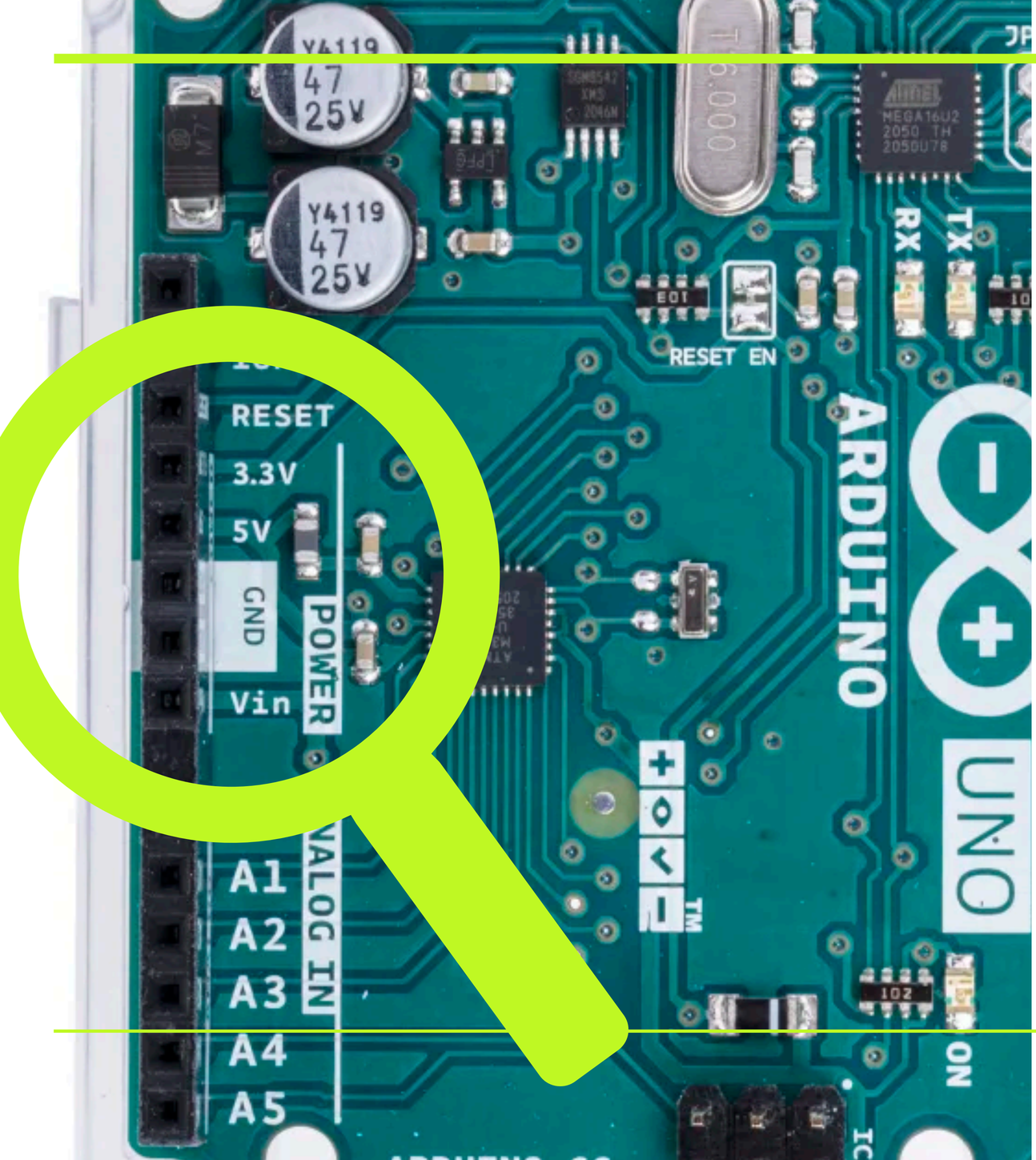
ARDUINO

ARDUINO
MEGA 2560 REV3



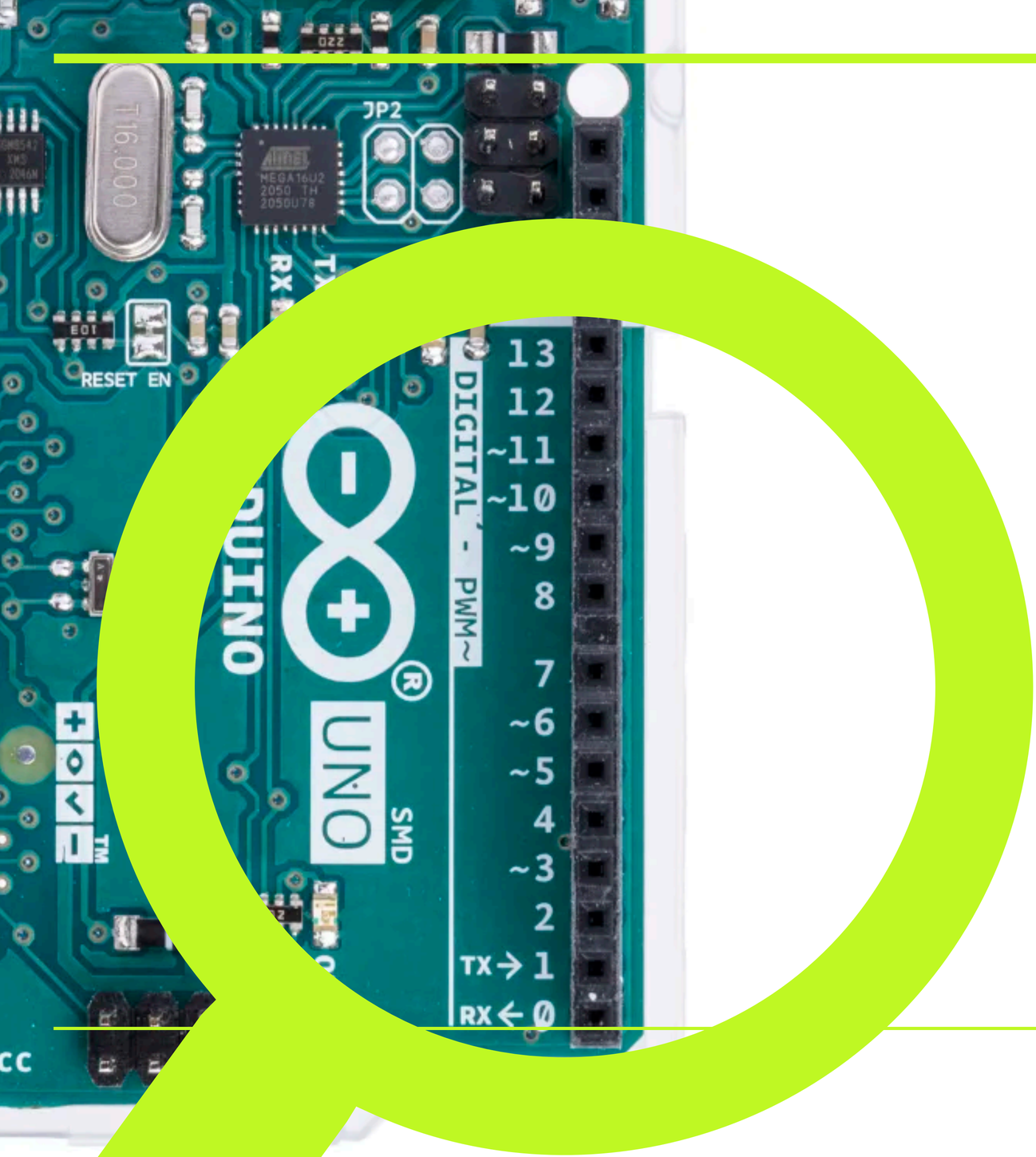
Ground
Power
LED
Internal Pin
SWD Pin
Other Pin
Digital Pin
Analog Pin
Default
Microcontroller's Port

ARDUINO.CC



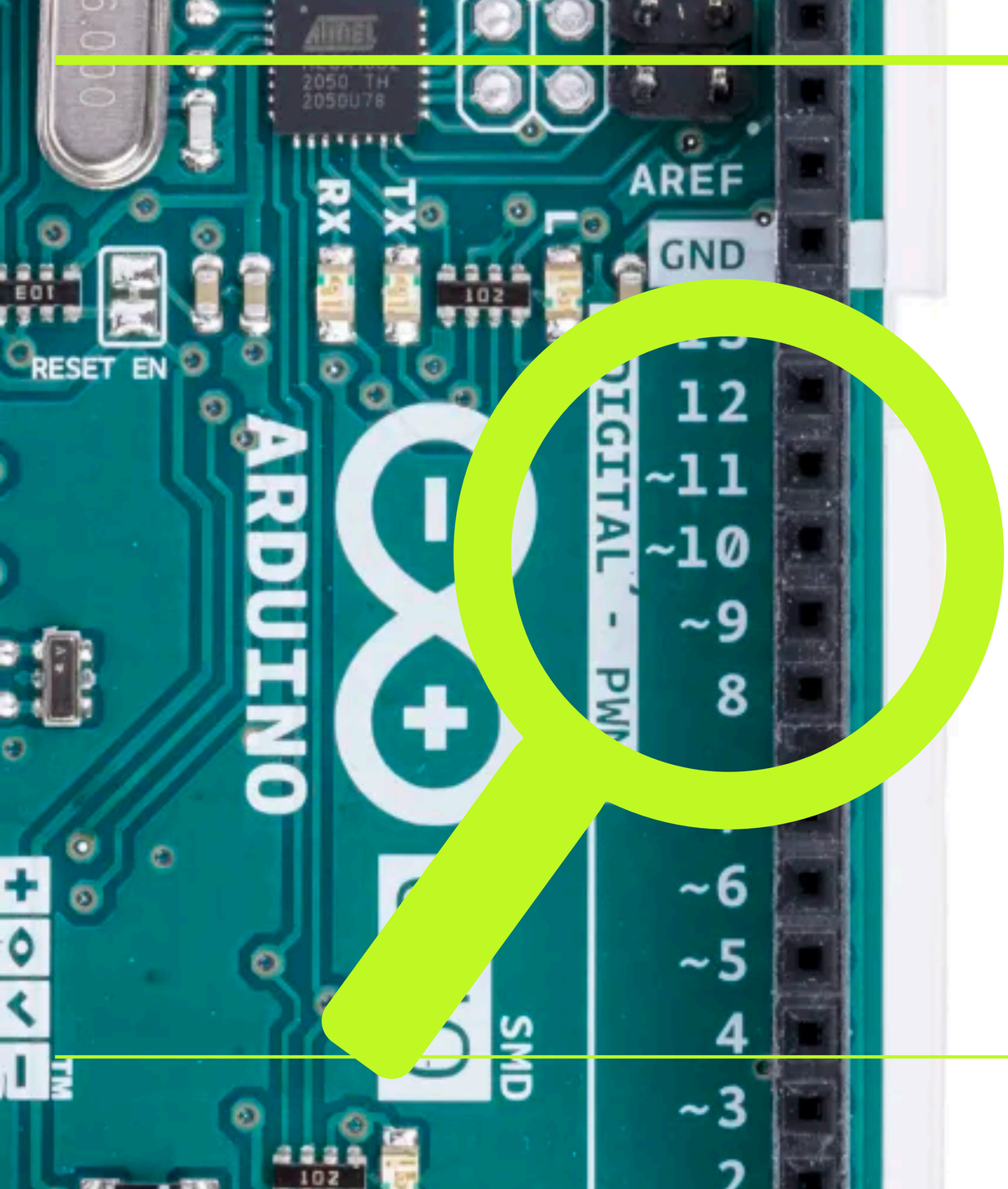
5V / GND (Ground) Pins

- These pins work together to create a circuit which includes your components, in order to give them power.
- You must always connect both 5V and GND to a component to power it.



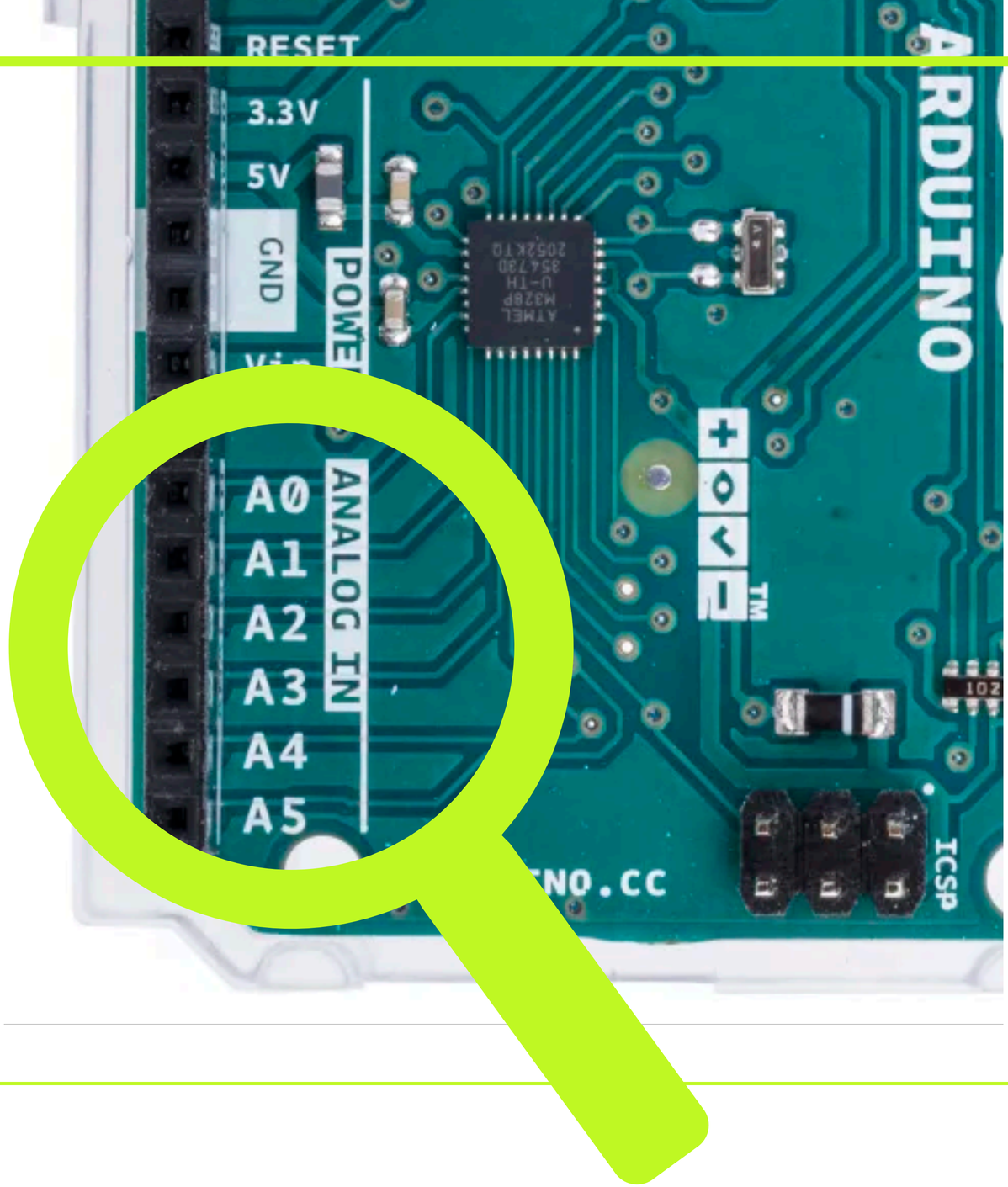
Digital Pins

- These pins can do two jobs on the Arduino.
- They can measure whether the wire connected to it is at 5V or 0V (Ground)
- 5V is also called HIGH and Ground is also called LOW.
- They can be set to output a voltage of 0V or 5V (LOW or HIGH)
- They can do this VERY fast!



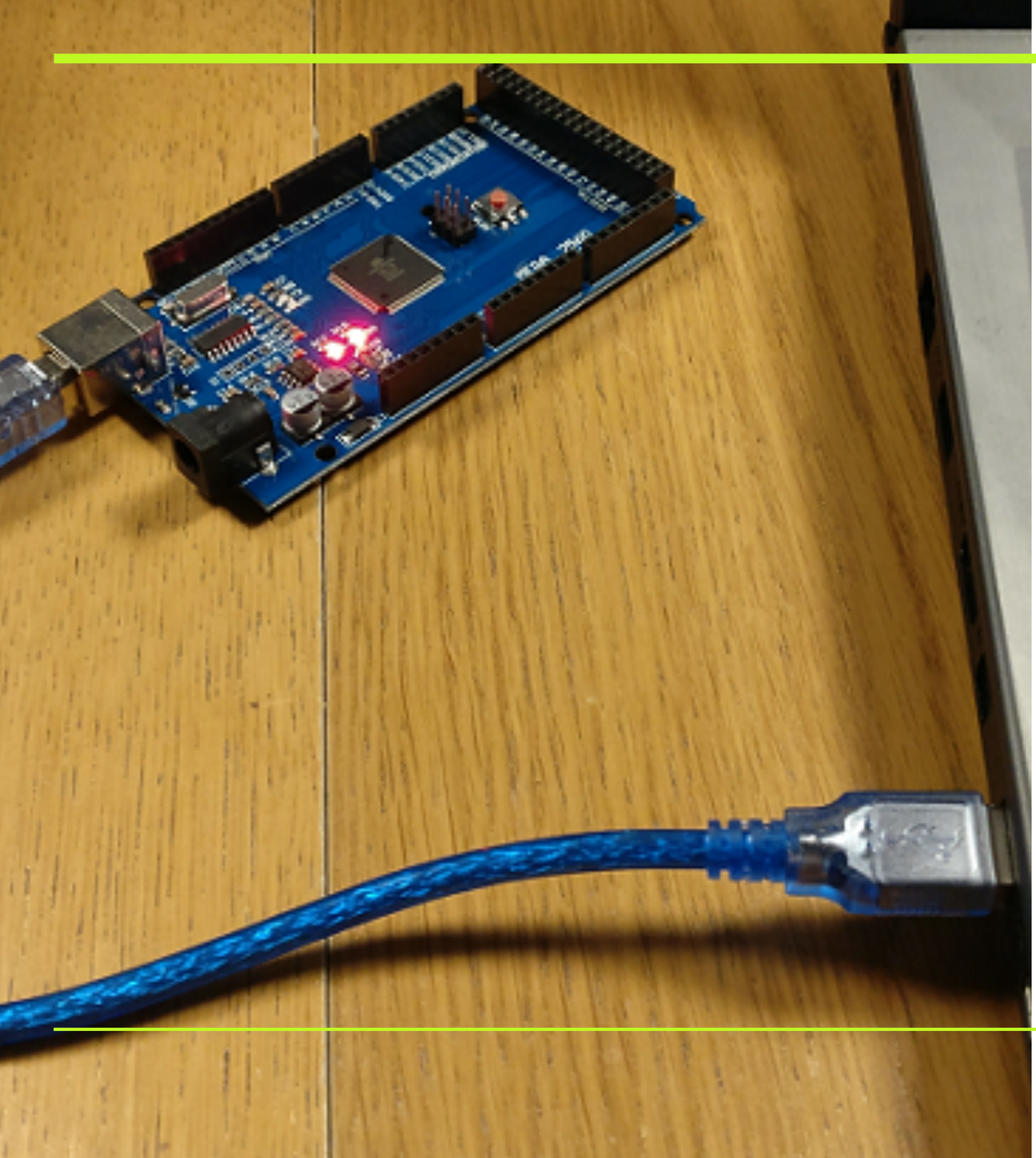
PWM (~) Pins

- These are special digital pins that can turn on and off even more quickly than the others.
- By turning them on and off at the right speed, we can make them output voltages other than 5V (HIGH) and 0V (LOW).
- We can use this to do things like dimming LEDs.



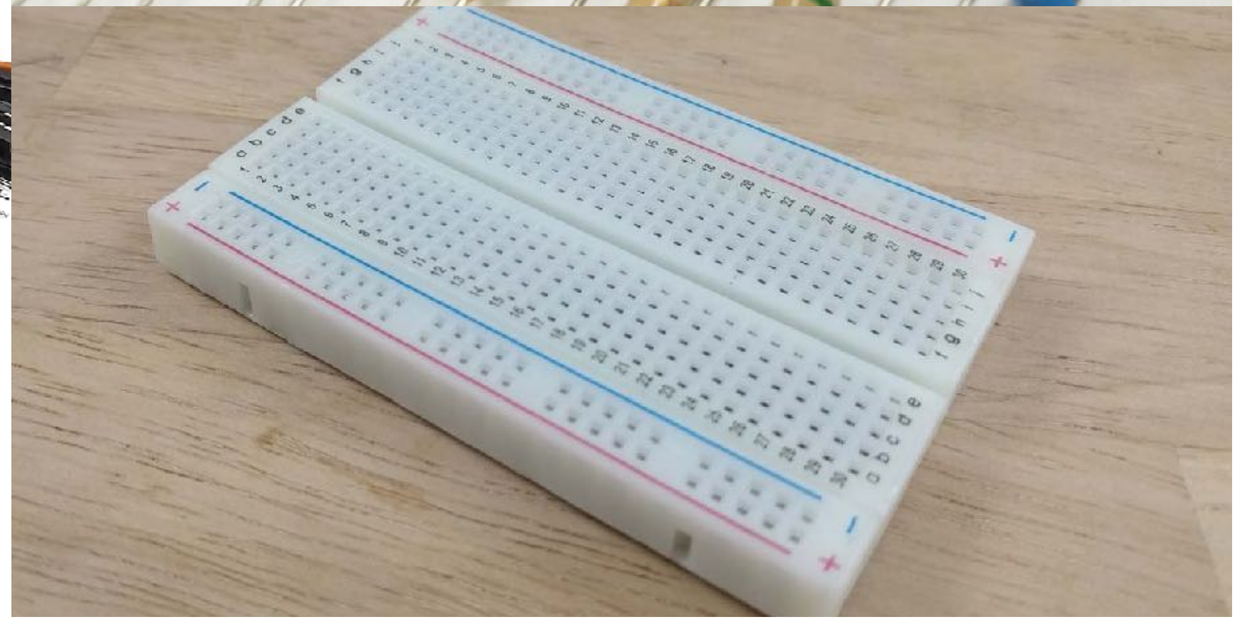
Analog Pins

- These special pins can measure voltages between 0V and 5V.
- In your code, the actual voltage will be converted to a number between 0 and 1024.
- They can also do this VERY fast!

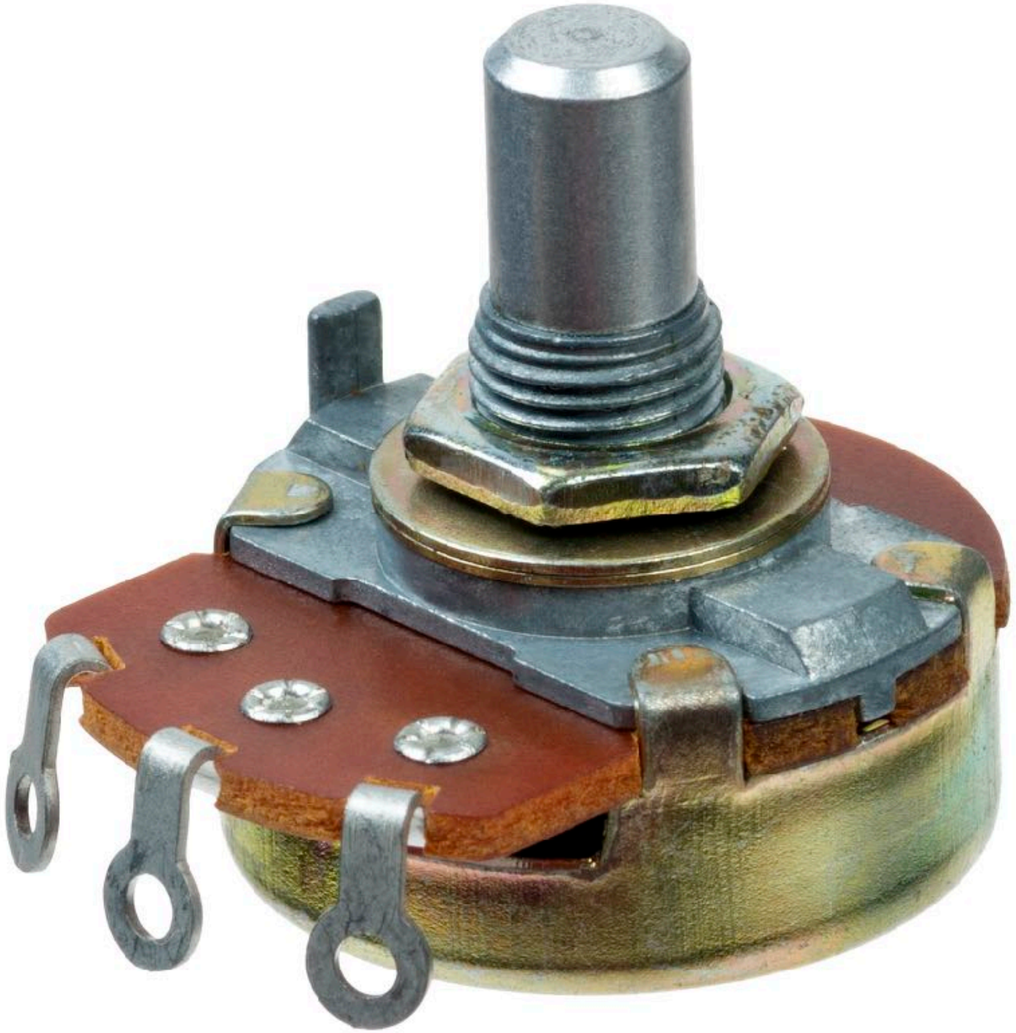


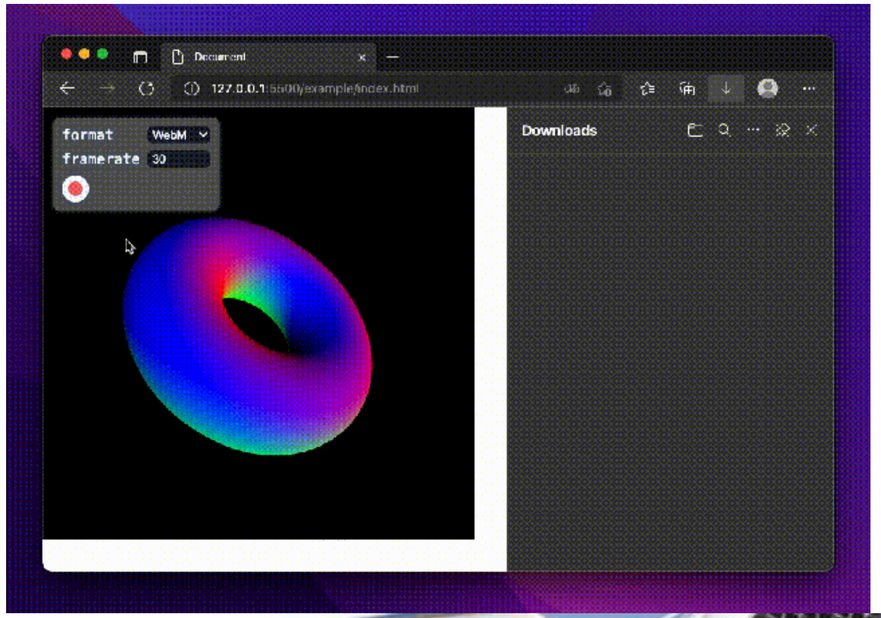
Arduino Remembers!

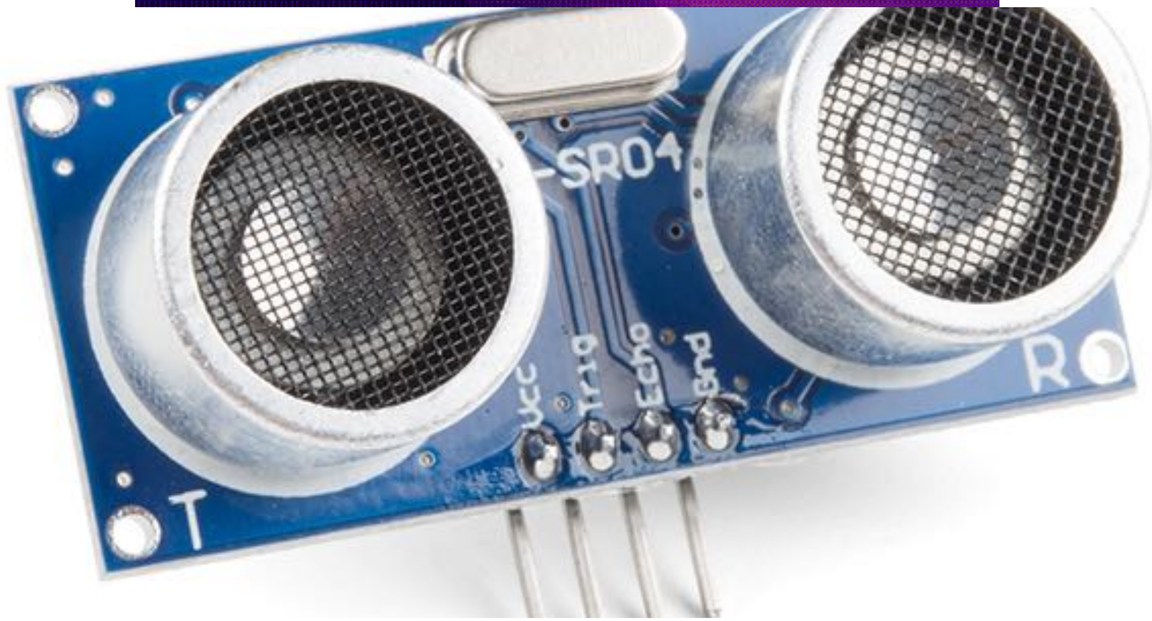
- Arduino can work on it’s own, once you have uploaded your code you can unplug it from your computer.
- Once it is connected to power it will run the code whether it is connected to the computer or not.



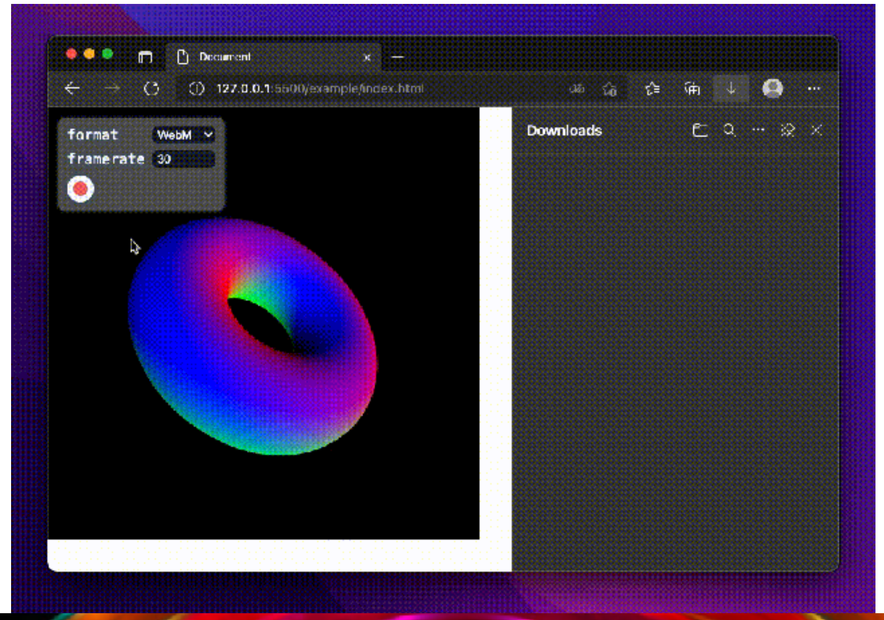
Components / Connections







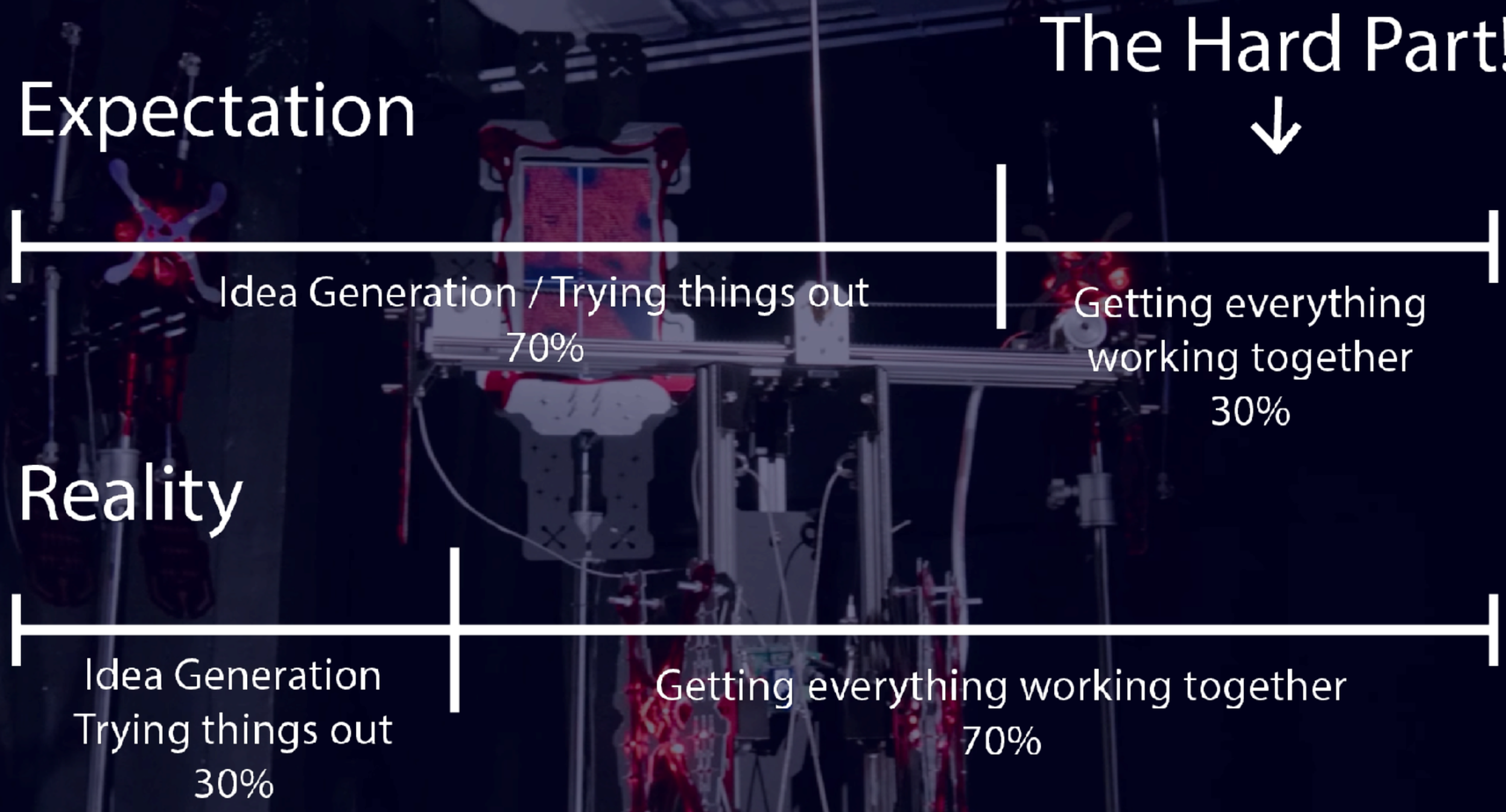
Sensors / Inputs



Actuators / Outputs

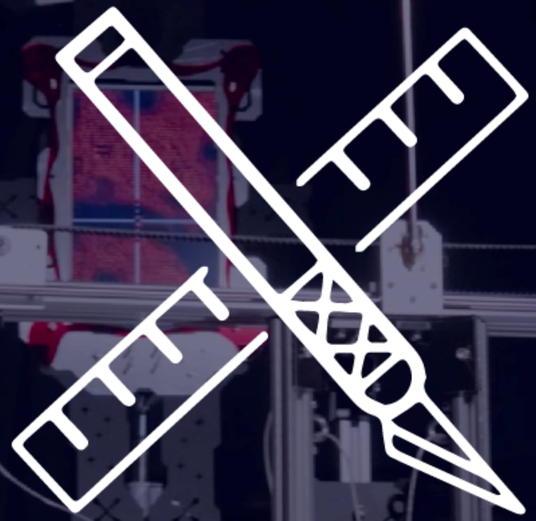
Any Questions so far?

Planning Projects

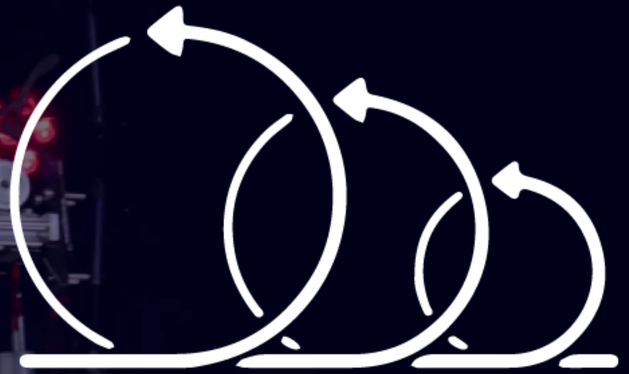


You will need to make many prototypes to make your idea better!

Ideate



Prototype



Iterate

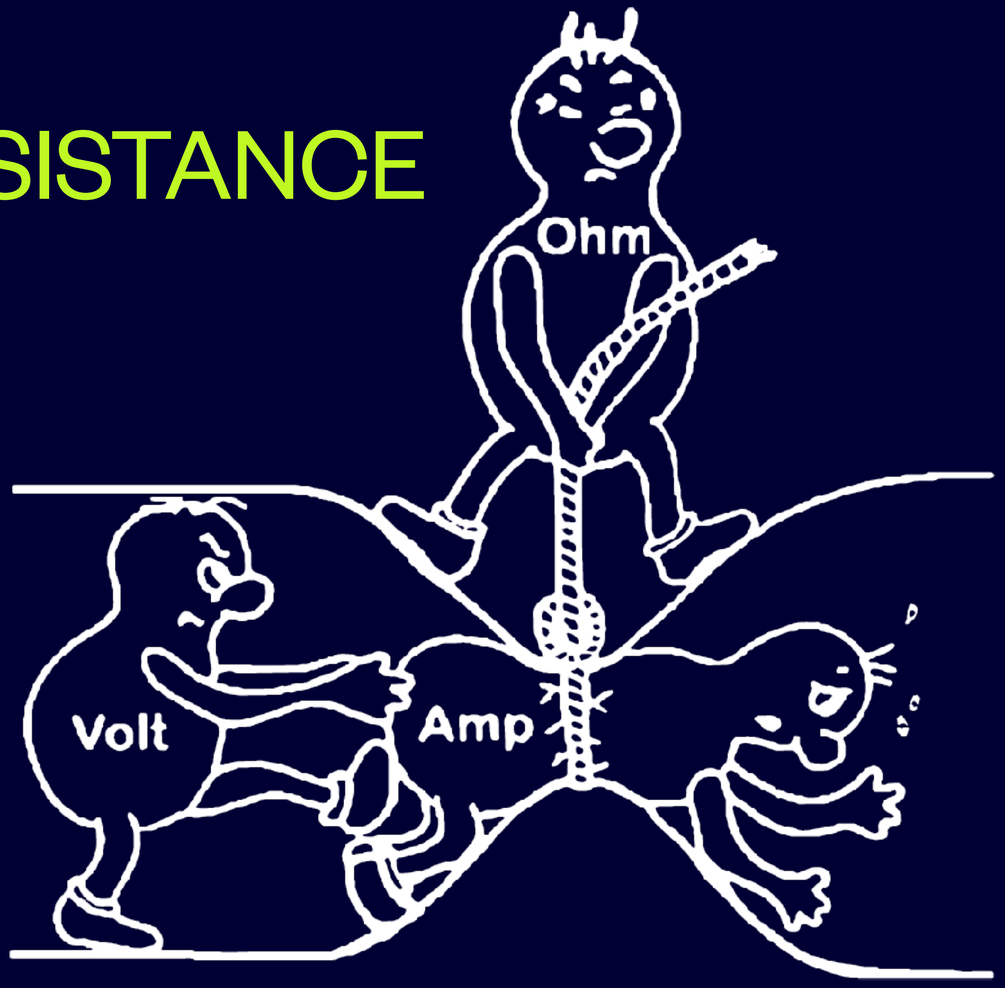
Electricity!

When we talk about electricity...

We will talk about VOLTS, AMPS and OHMS
These are the units for POTENTIAL DIFFERENCE (VOLTAGE), CURRENT and RESISTANCE.

Electricity!

RESISTANCE



VOLTAGE

CURRENT

Electricity!

VOLTAGE - VOLTS :
The potential of the power source to push energy through a circuit.

CURRENT - AMPS :
The amount of energy a circuit is using at any given moment.

RESISTANCE - OHMS :
The ‘squeezing’ force in wires, components, and resistors, that makes it more difficult for energy to pass through a circuit.

Electricity!

POWER - WATTS :

You may also see power supplies and various components rated in WATTS. This is a unit of power which is simply VOLTAGE x CURRENT

Equations!

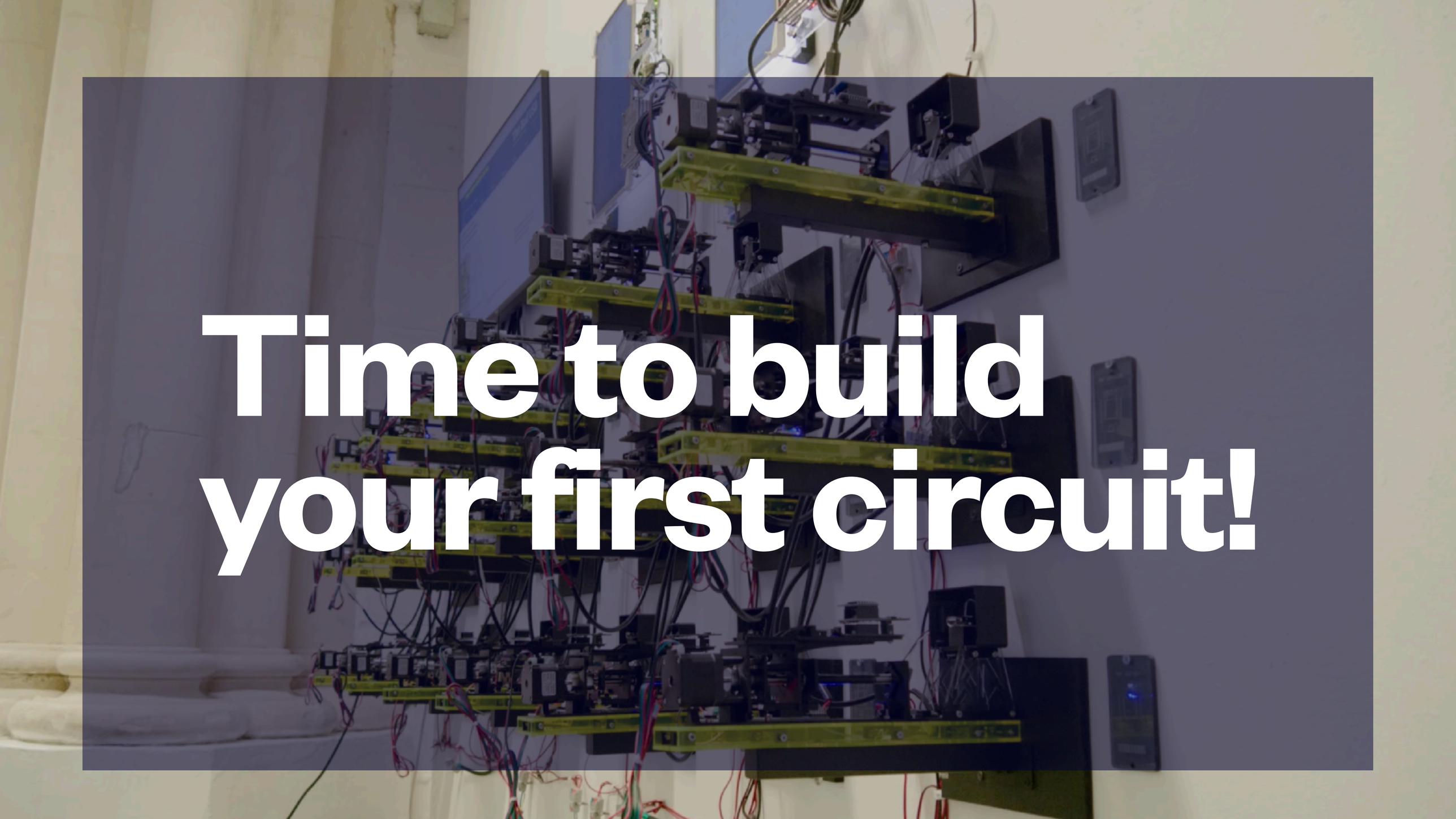
POWER (P) = CURRENT (I) * VOLTAGE (V)

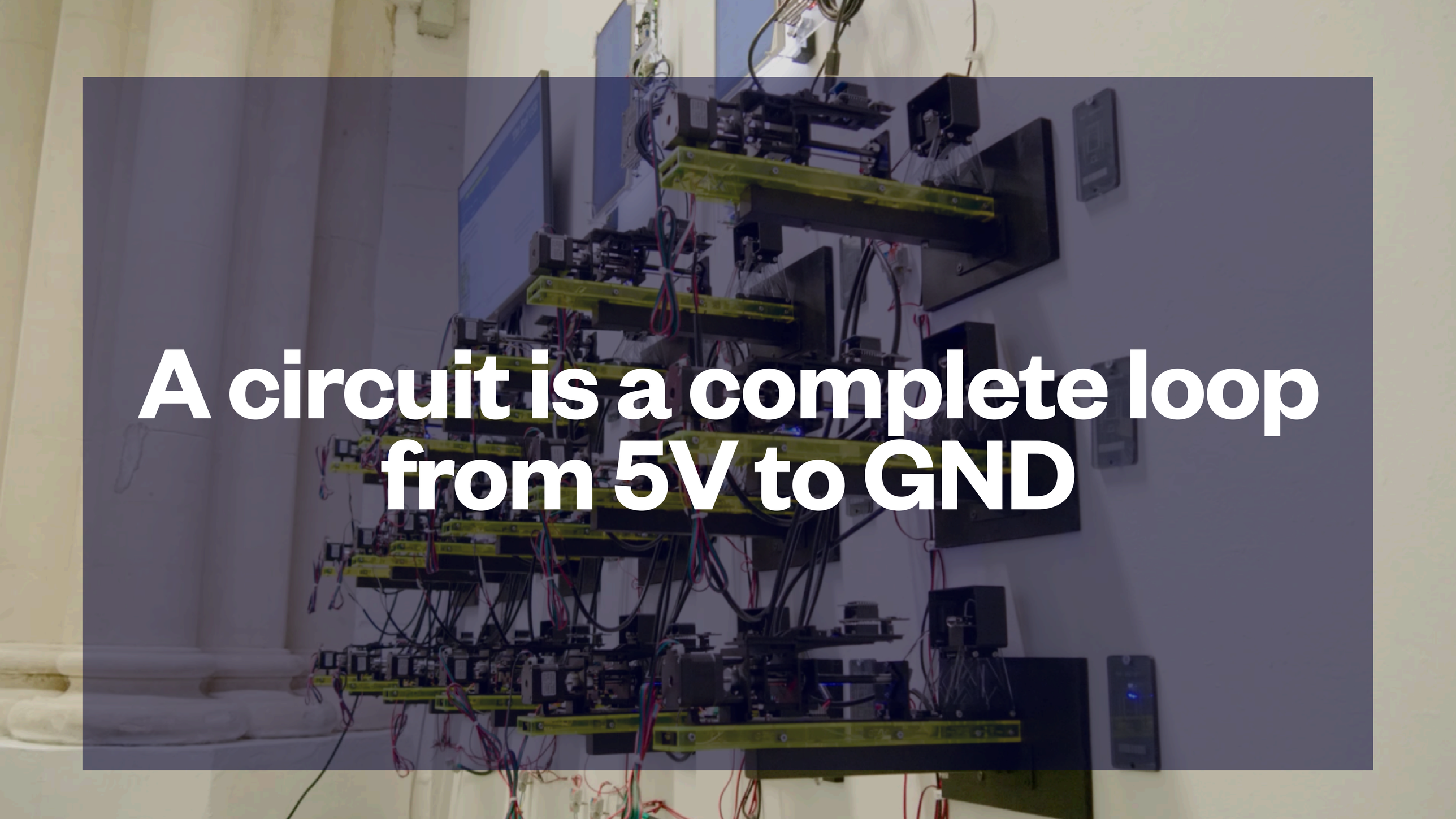
VOLTAGE (V) = CURRENT (I) * RESISTANCE (R)

We can use P = I*V to work out how many WATTS we need our power supply to be.

We can use V = I*R to work out which resistor we need to use for a specific LED.

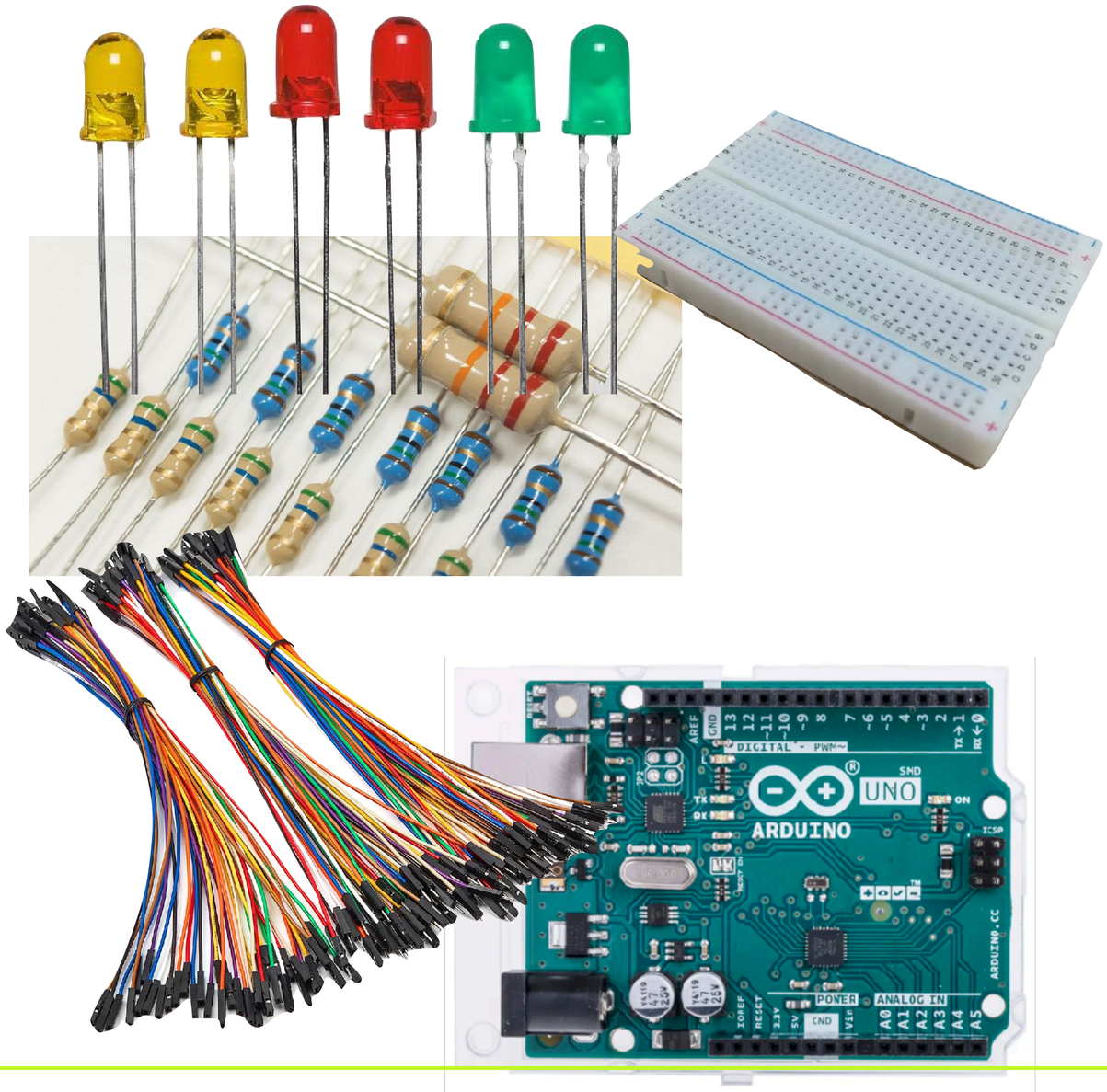
Any Questions so far?


Time to build
your first circuit!

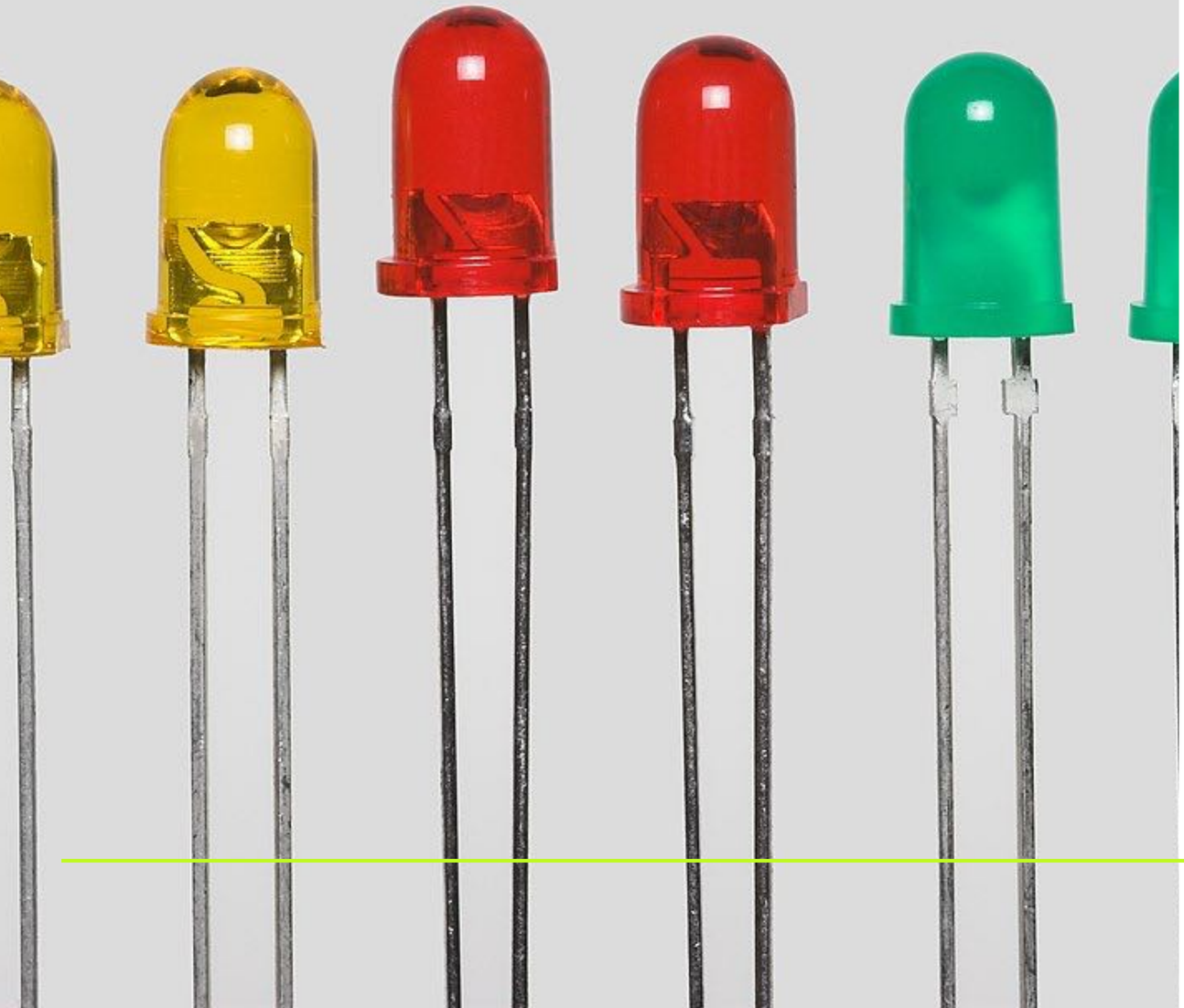


A circuit is a complete loop from 5V to GND

Components you'll need

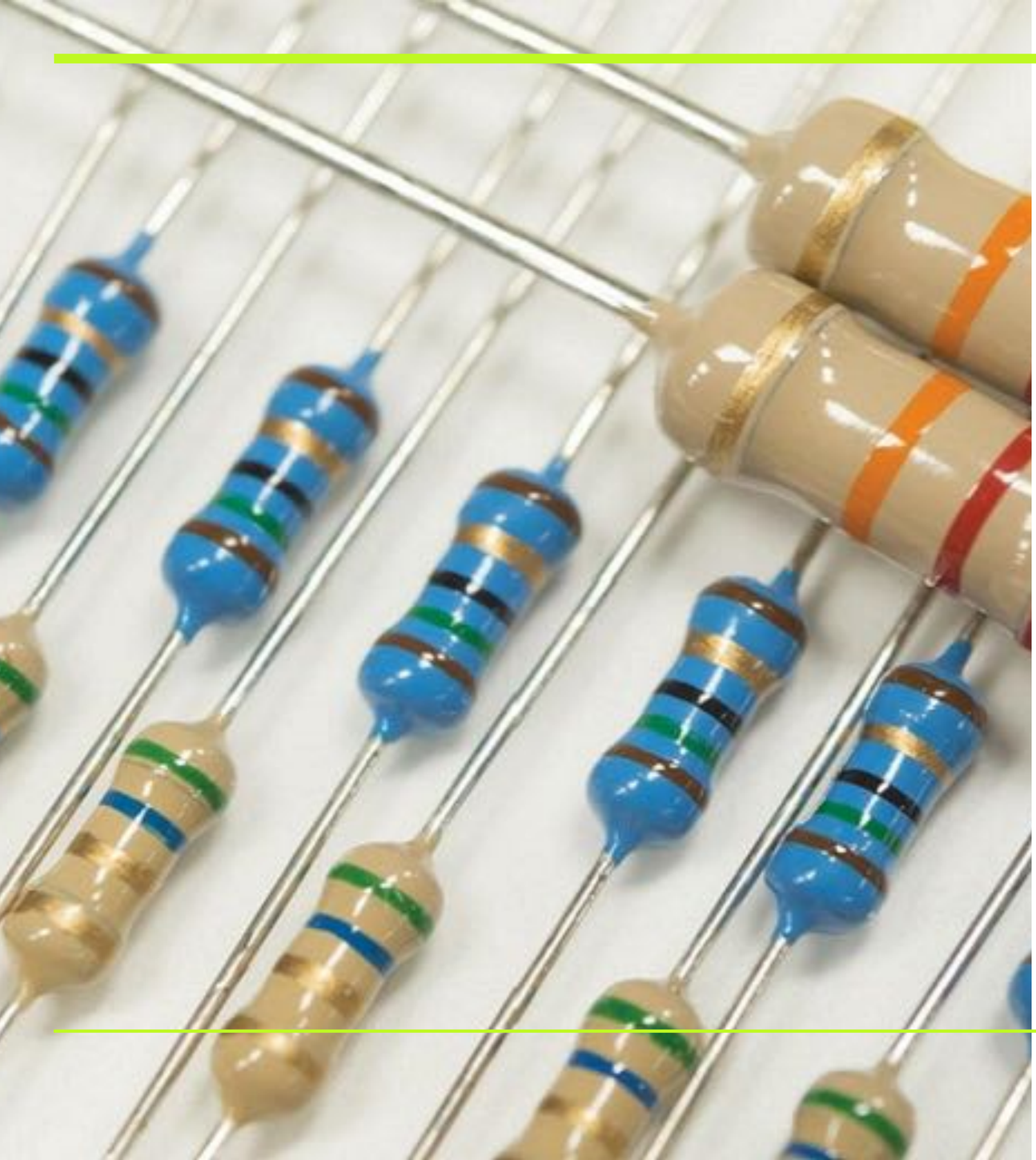


- LED
- 200-400 Ohm Resistor
- Jumper Wires
- Breadboard
- Arduino



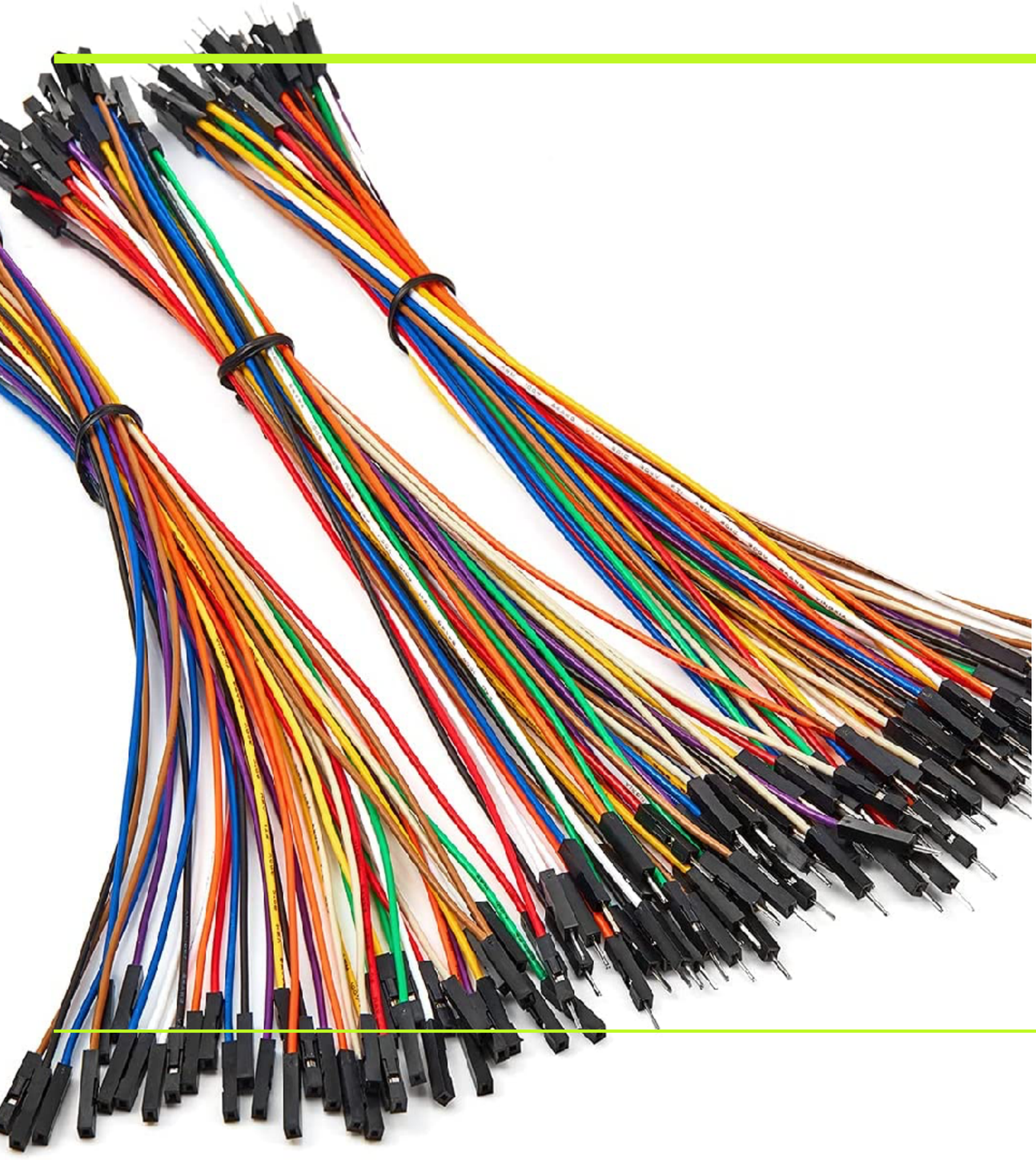
Light Emitting Diode (LED)

- Produces light when a current is passed through it.
- It is a Diode so it blocks current flowing in the wrong direction.
- Has one leg longer than the other.
- The Long Leg is + and the Short Leg is -
- The + connects to 5V and the - to GND
- Will break if too much current goes through it.
- +/5V side is also called ANODE
- -/0V side is also called CATHODE



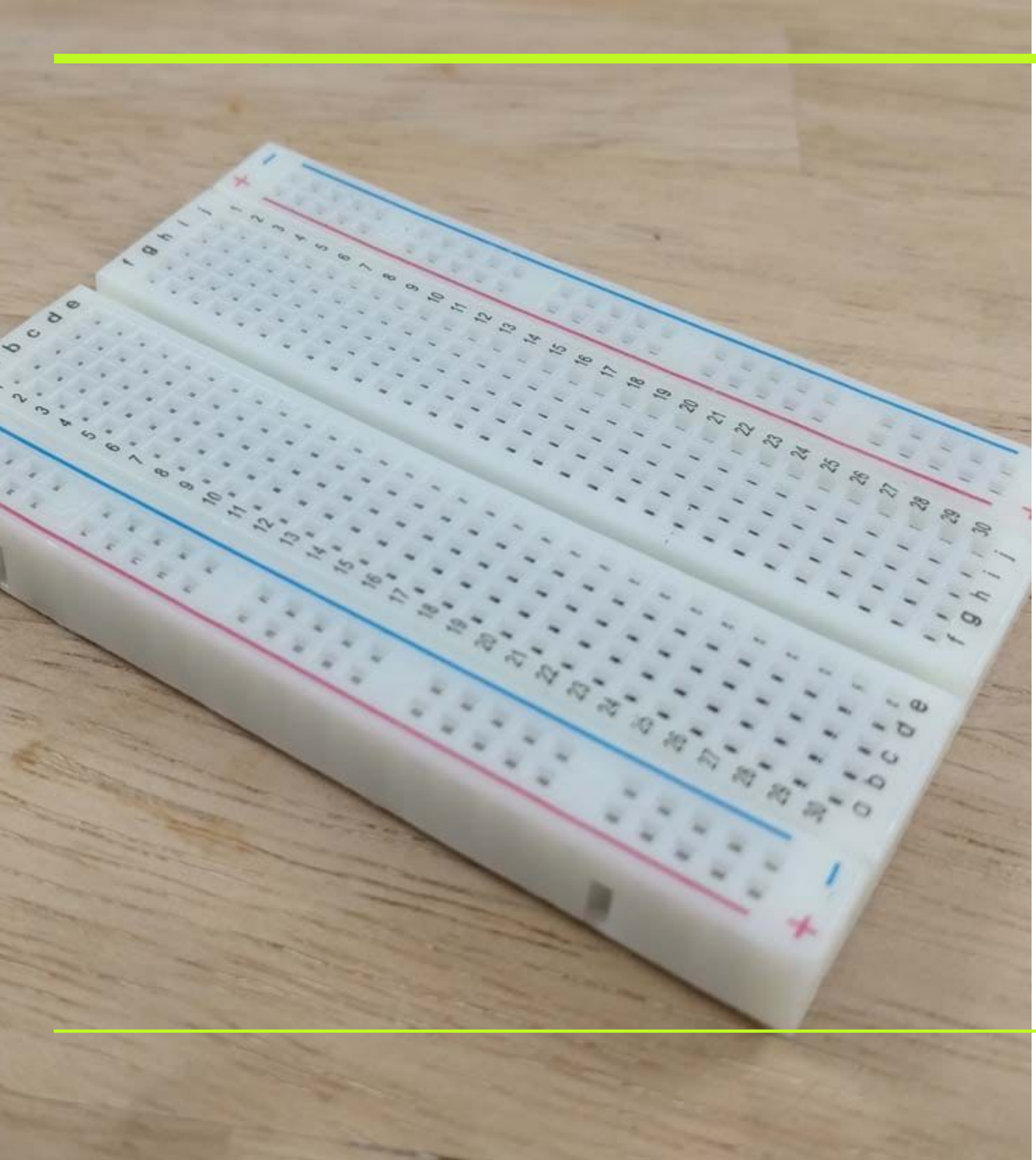
Resistor

- Makes it harder for current to pass through a circuit.
- Can protect an LED from breaking from too much current.
- Have two legs the same length.
- Can be used either way round.
- Come in many different values and can be used for different uses.



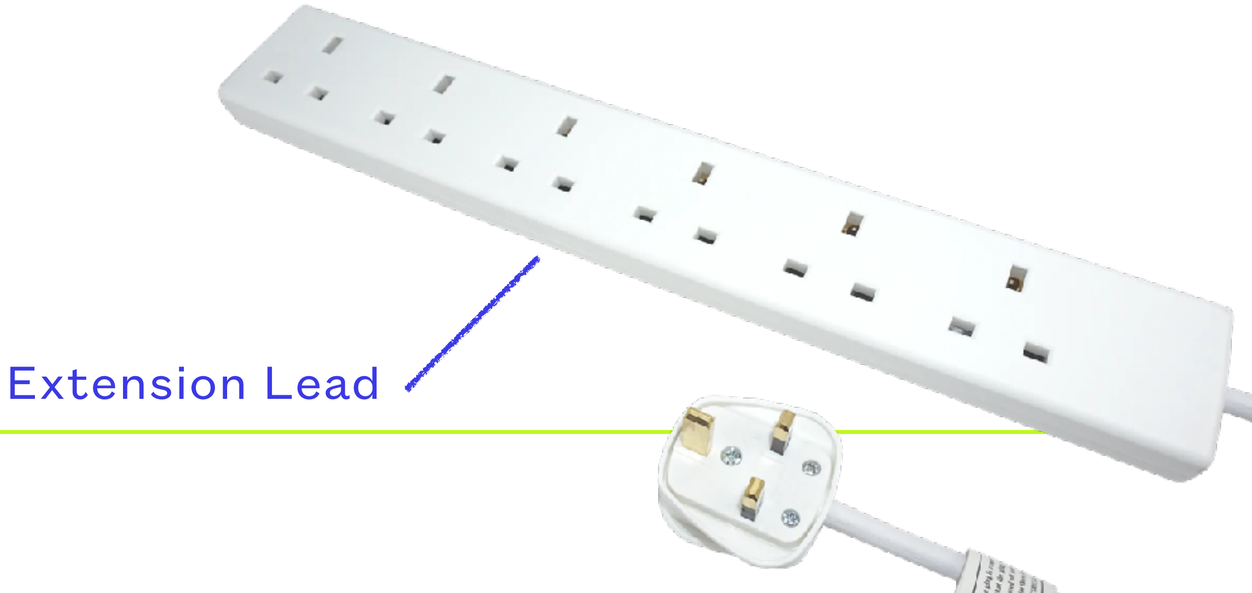
Jumper Wires

- The wires in your kit are all the same inside.
- Use colours to help us remember what we are using the wires for.
- Commonly used colours :
  - RED -> 5V
  - BLACK -> Ground
  - OTHER COLOURS -> Data/Signal

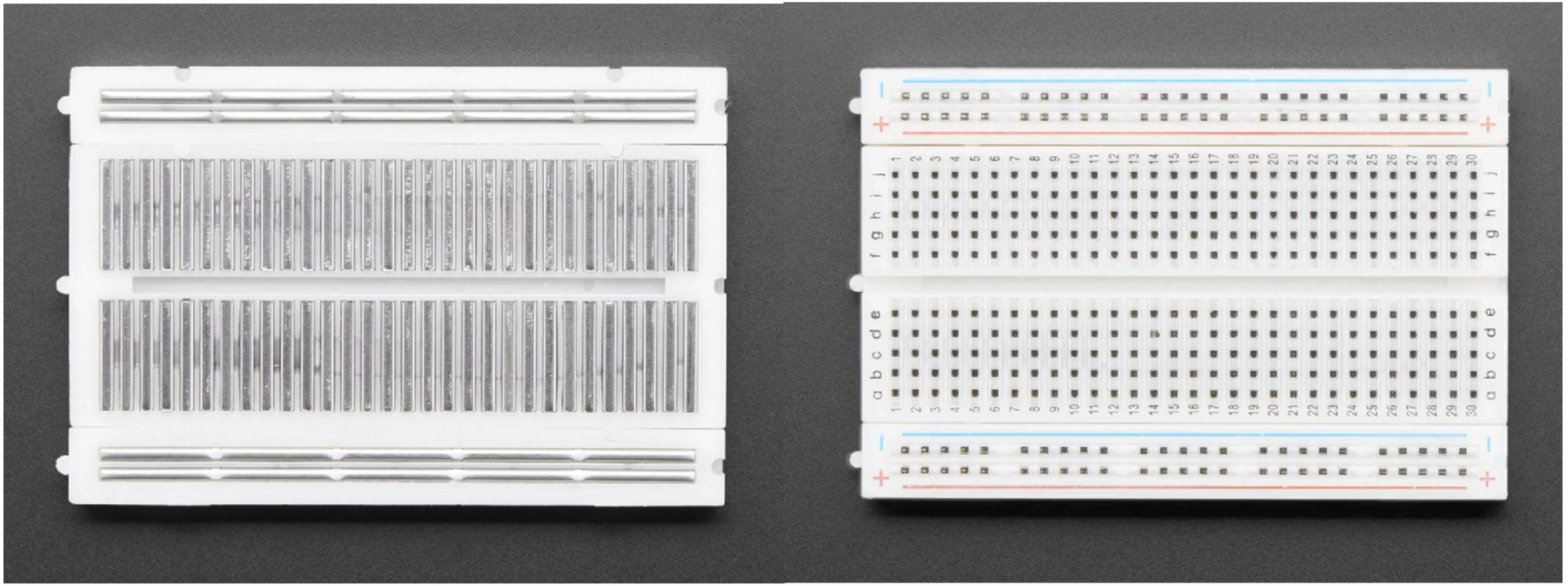


Breadboard

- Works like an extension lead.
- Connects wires together.
- Has different zones that can be used for different things.

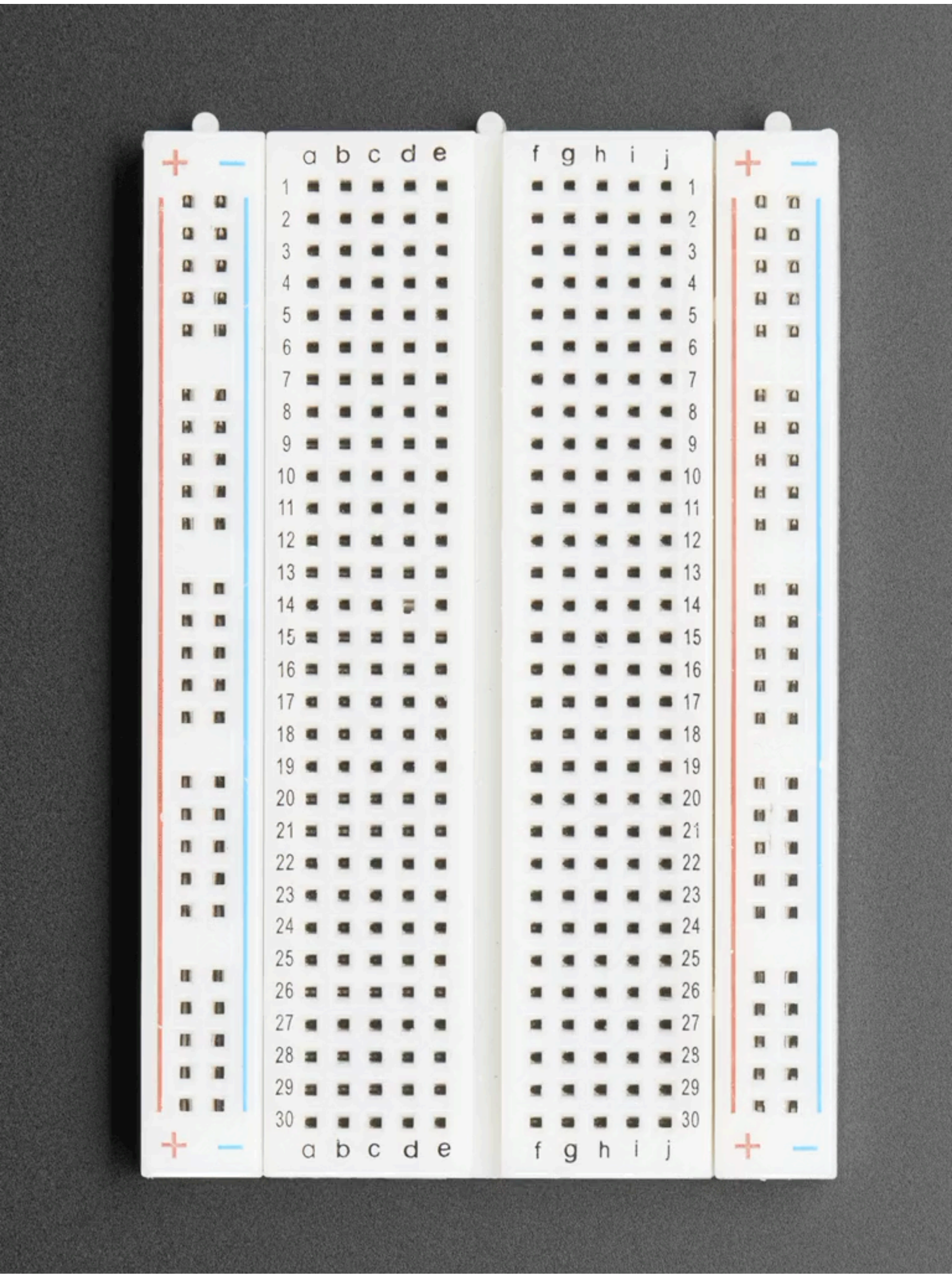


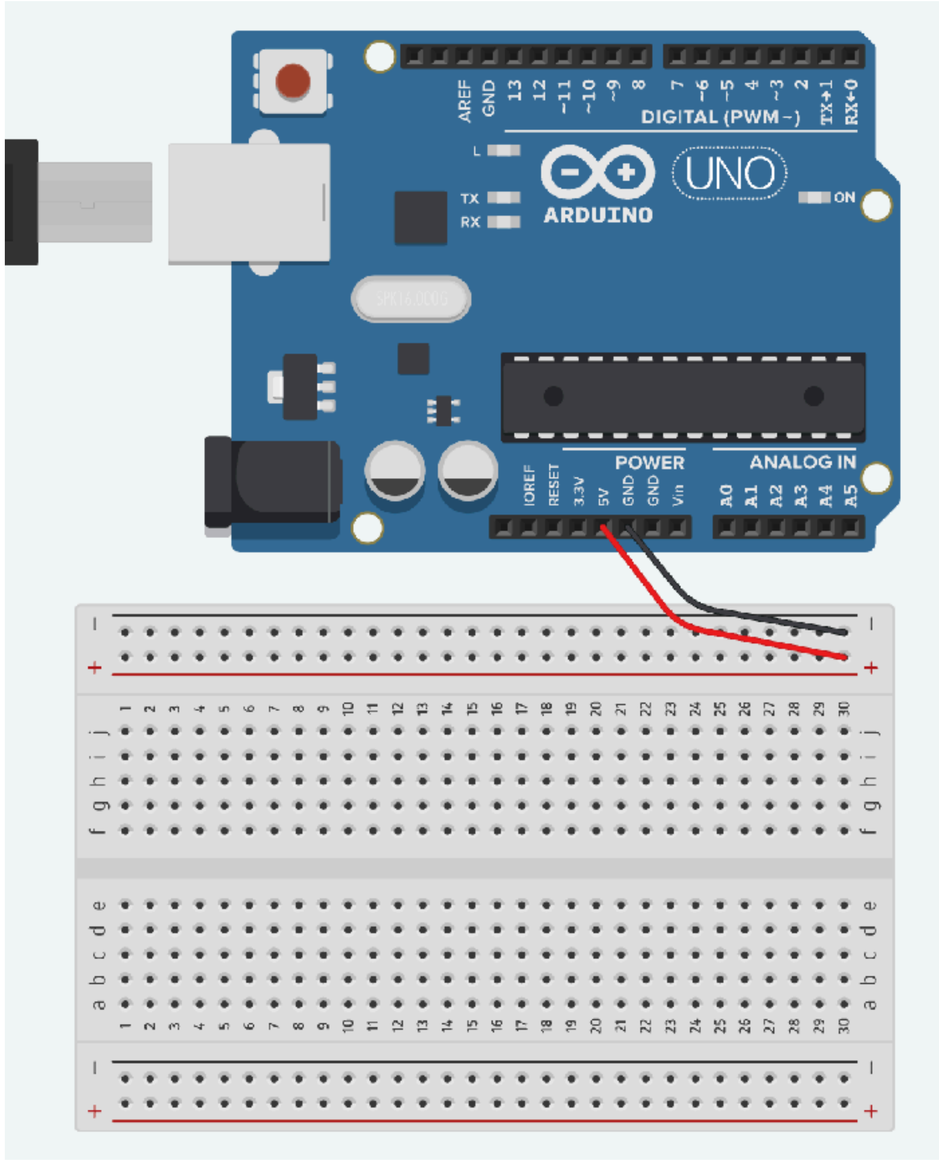
Breadboard



Inside

Outside

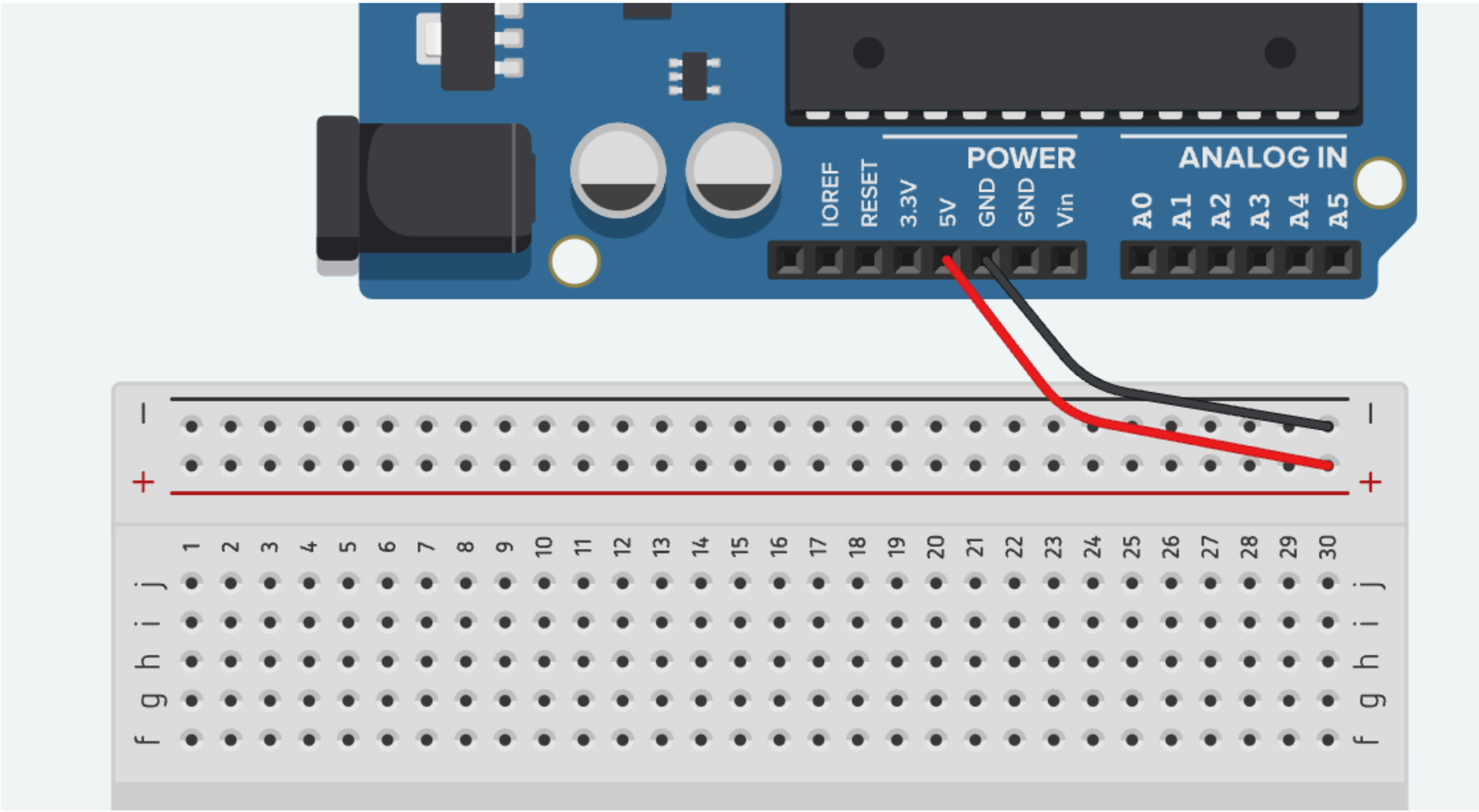

a b c d e
f g h i j
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

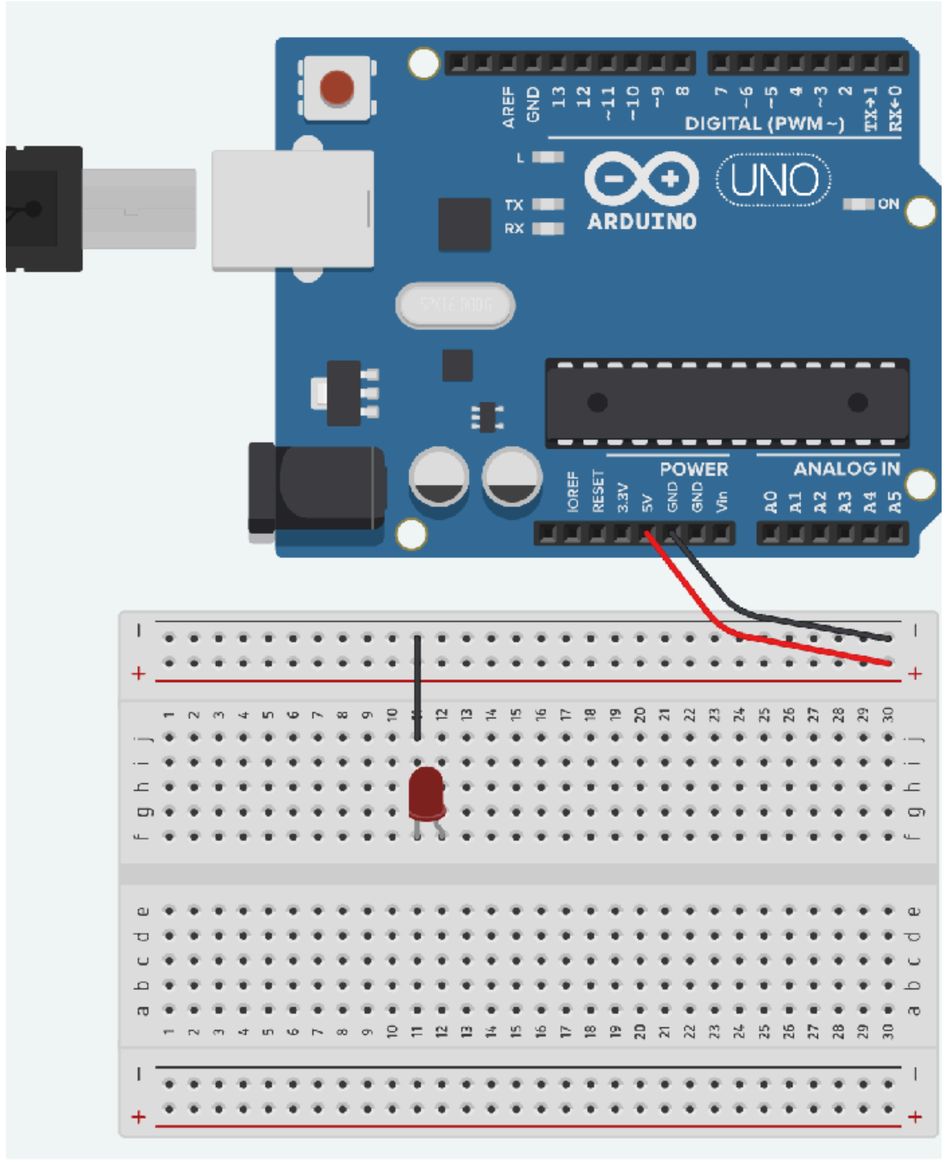


First Circuit

- Start by connecting the power cables to the breadboard.
- We can now access 5V and GND on any of the holes in the strips at the top.

Closeup

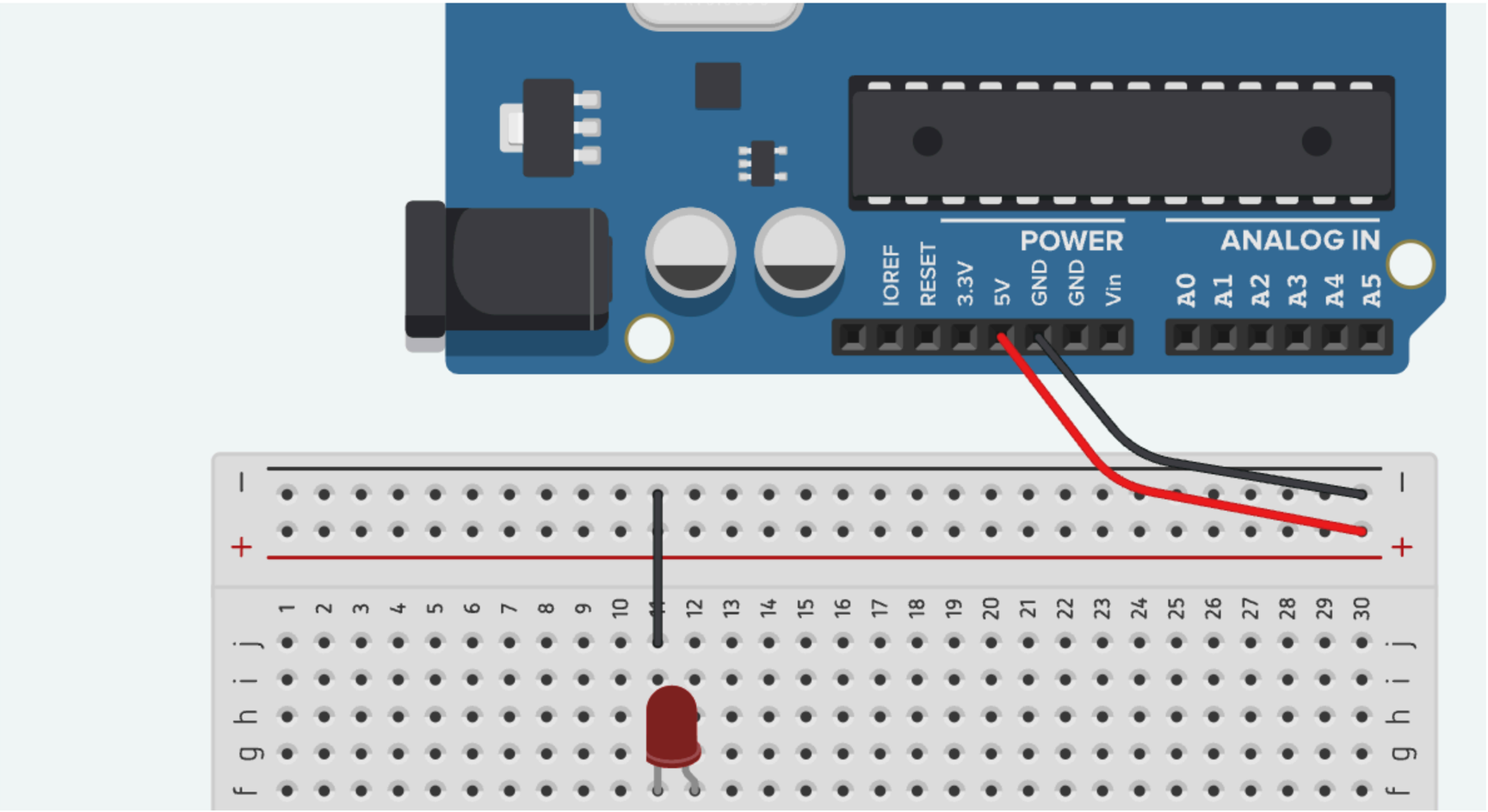

POWER
ANALOG IN
IOREF
RESET
3.3V
5V
GND
GND
Vin
A0
A1
A2
A3
A4
A5
f g h i j
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

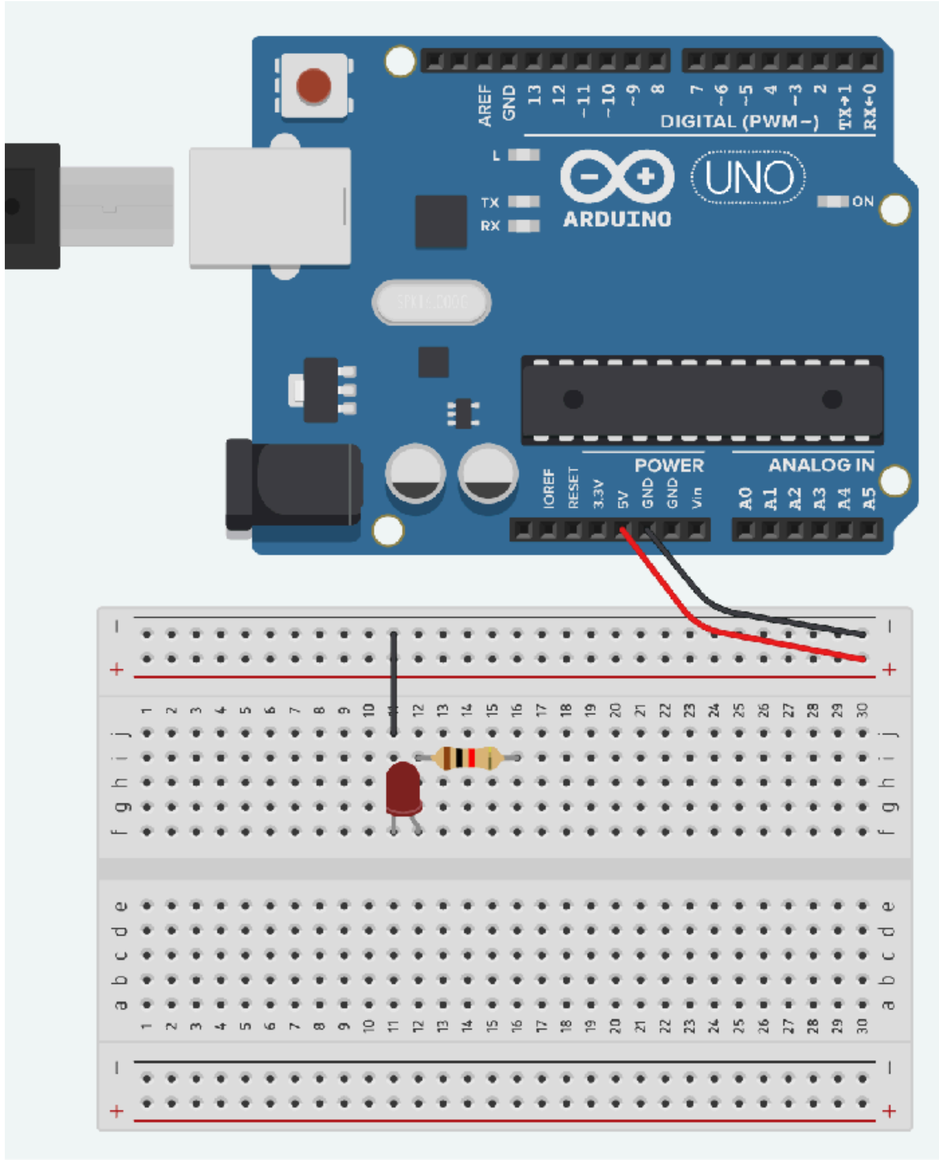


First Circuit

- Now we can insert our first jumper wire and LED.
- This is not enough to make our LED switch on, as we have not yet completed the circuit.
- It doesn’t matter where on the breadboard you build your circuit, only that everything is aligned with each other.

Closeup

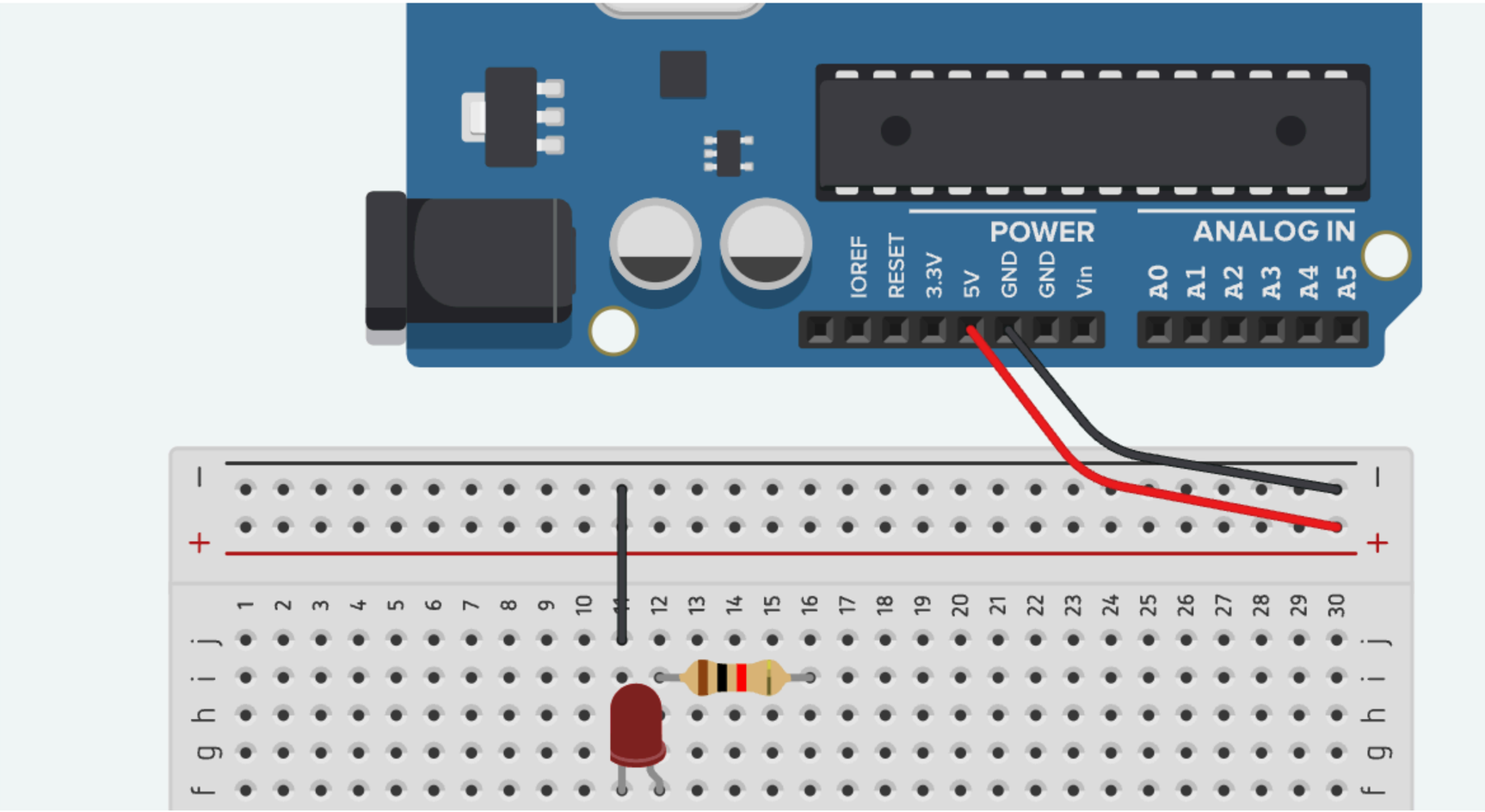

IOREF
RESET
3.3V
5V
GND
GND
Vin
POWER
A0
A1
A2
A3
A4
A5
ANALOG IN
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
f g h i j

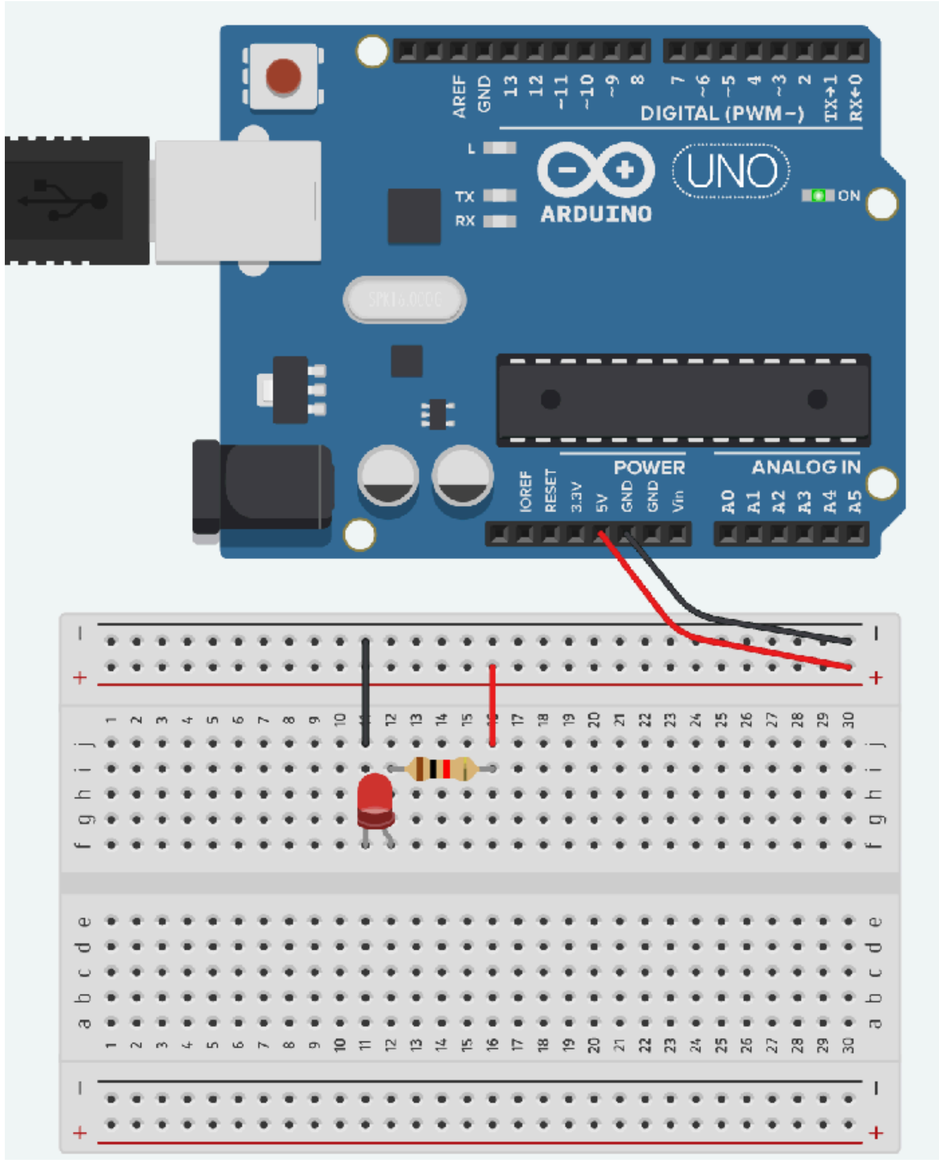


First Circuit

- Now we add our resistor, it doesn't matter which way round we place it.
- In your pack the resistors should be labelled with how much resistance they have.
- It doesn't matter whether it goes before or after the LED in the circuit.

Closeup

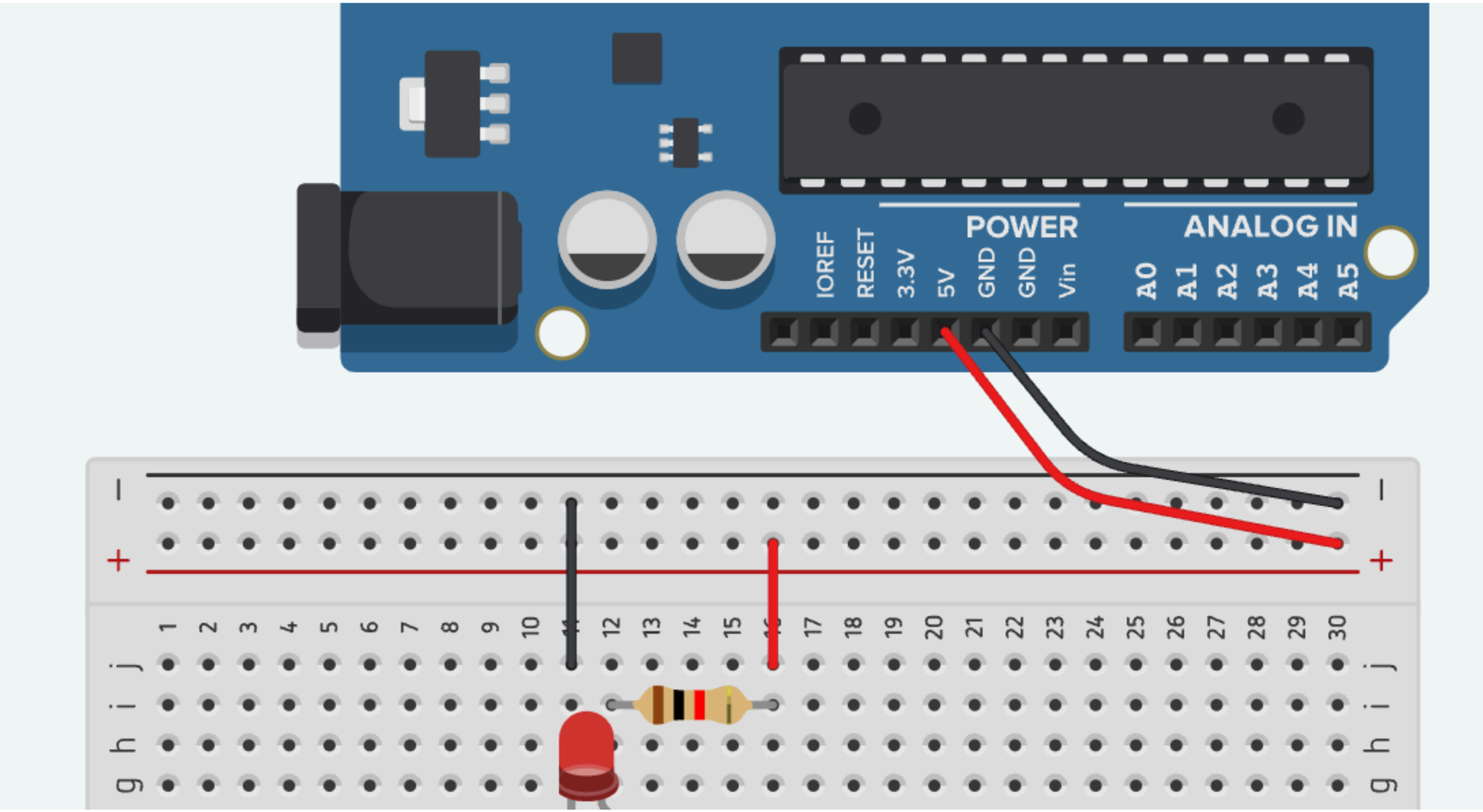

IOREF
RESET
3.3V
5V
GND
GND
Vin
POWER
A0
A1
A2
A3
A4
A5
ANALOG IN
f g h i j
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

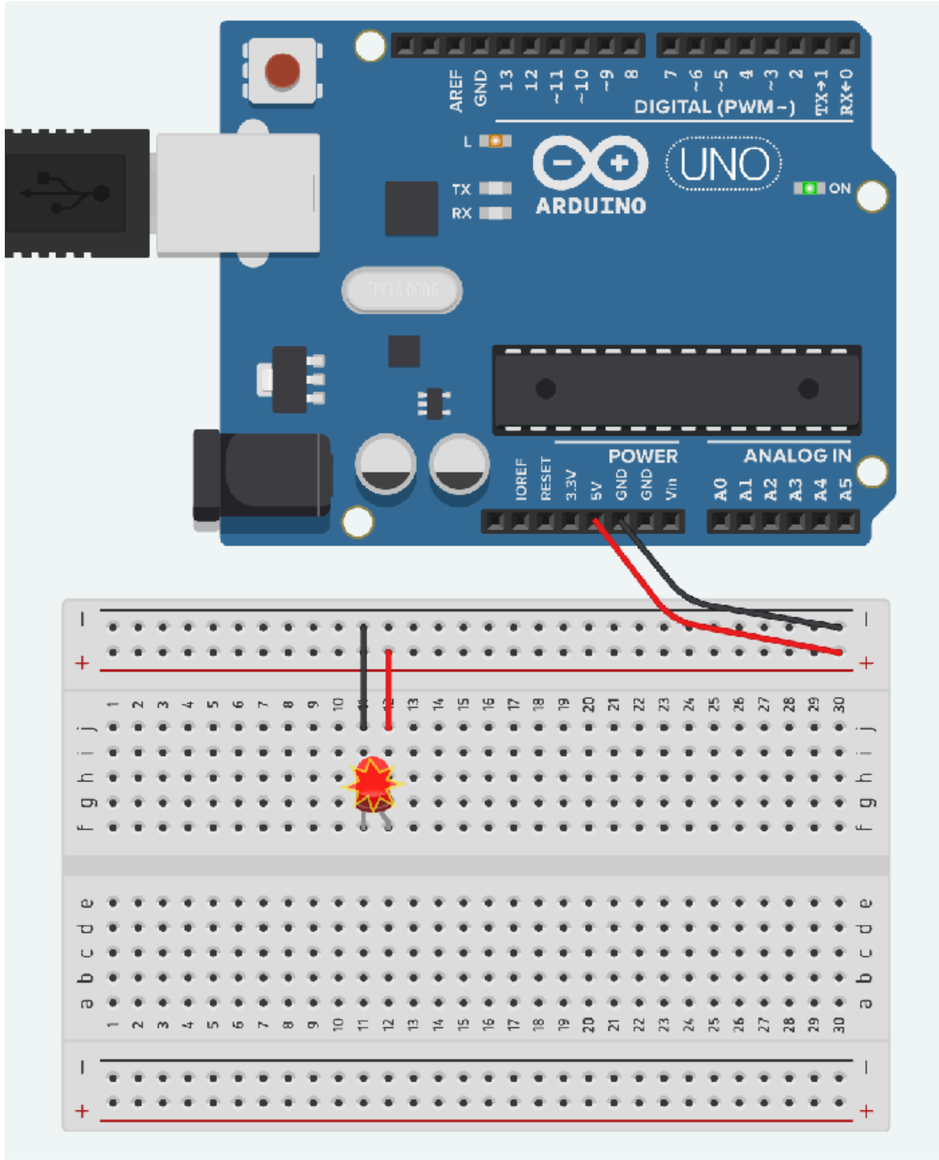


First Circuit

- Now we can add our final wire.
- As soon as we do this the LED should light up!
- If you like you can try out a couple of resistors and see if the brightness changes (Don’t use any less than 200 Ohms)

Closeup

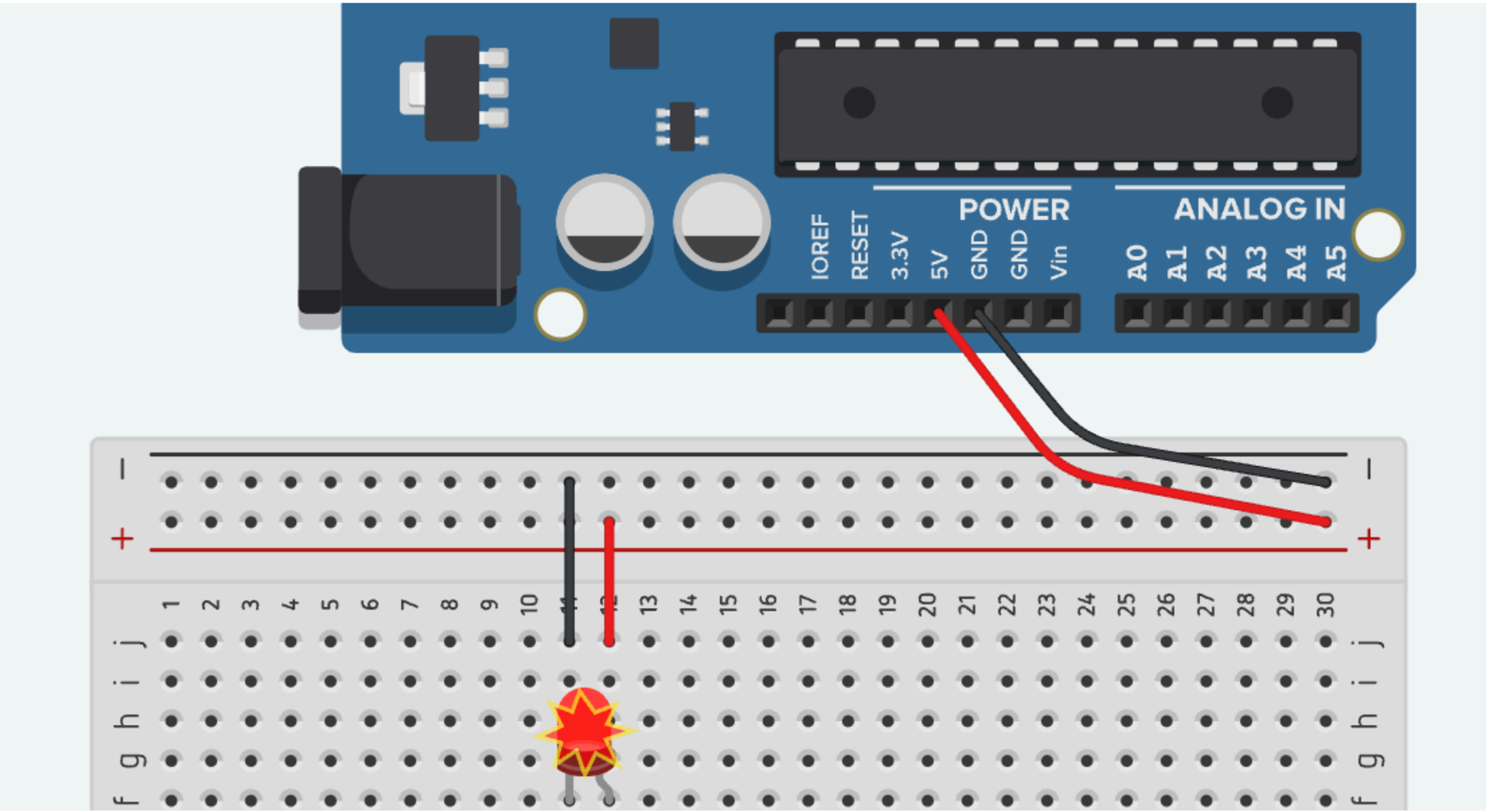




First Circuit

- It is important that we have the resistor in place so that we don’t break the LED!

Closeup



How could you add a physical computing element to something you have made in the past?

Get into groups of 3 people

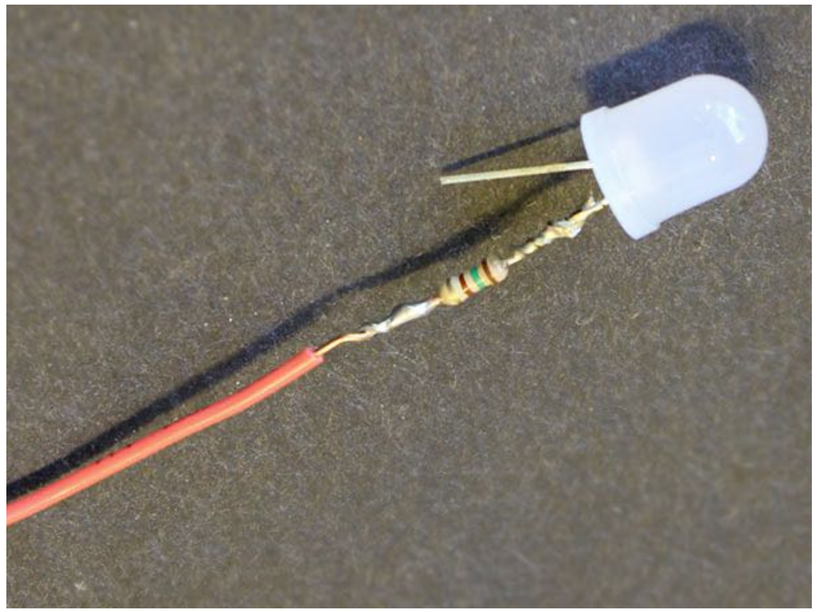
- Discuss the things you have made
- How might you include a new digital element (sensors & actuators)?
- Would the addition improve the piece? how? why not?

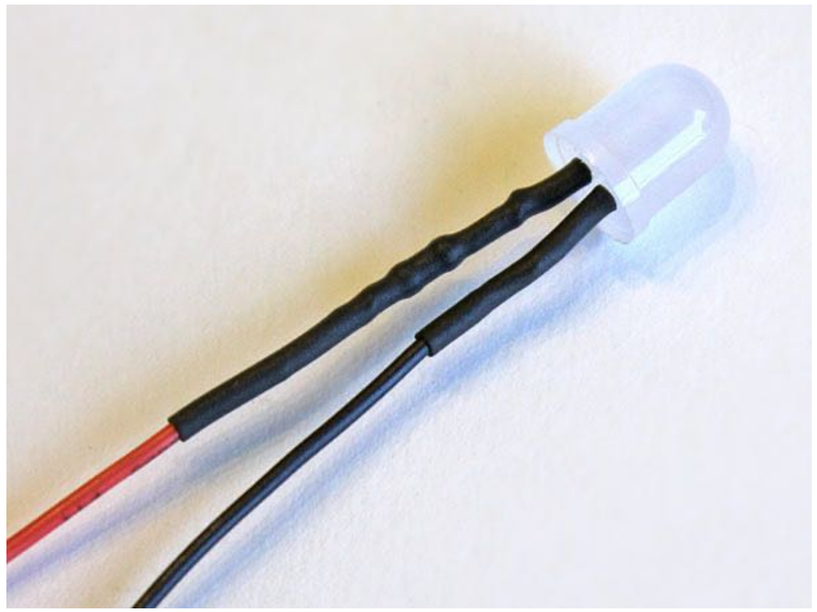
That’s Great!

But this isn’t very useful...

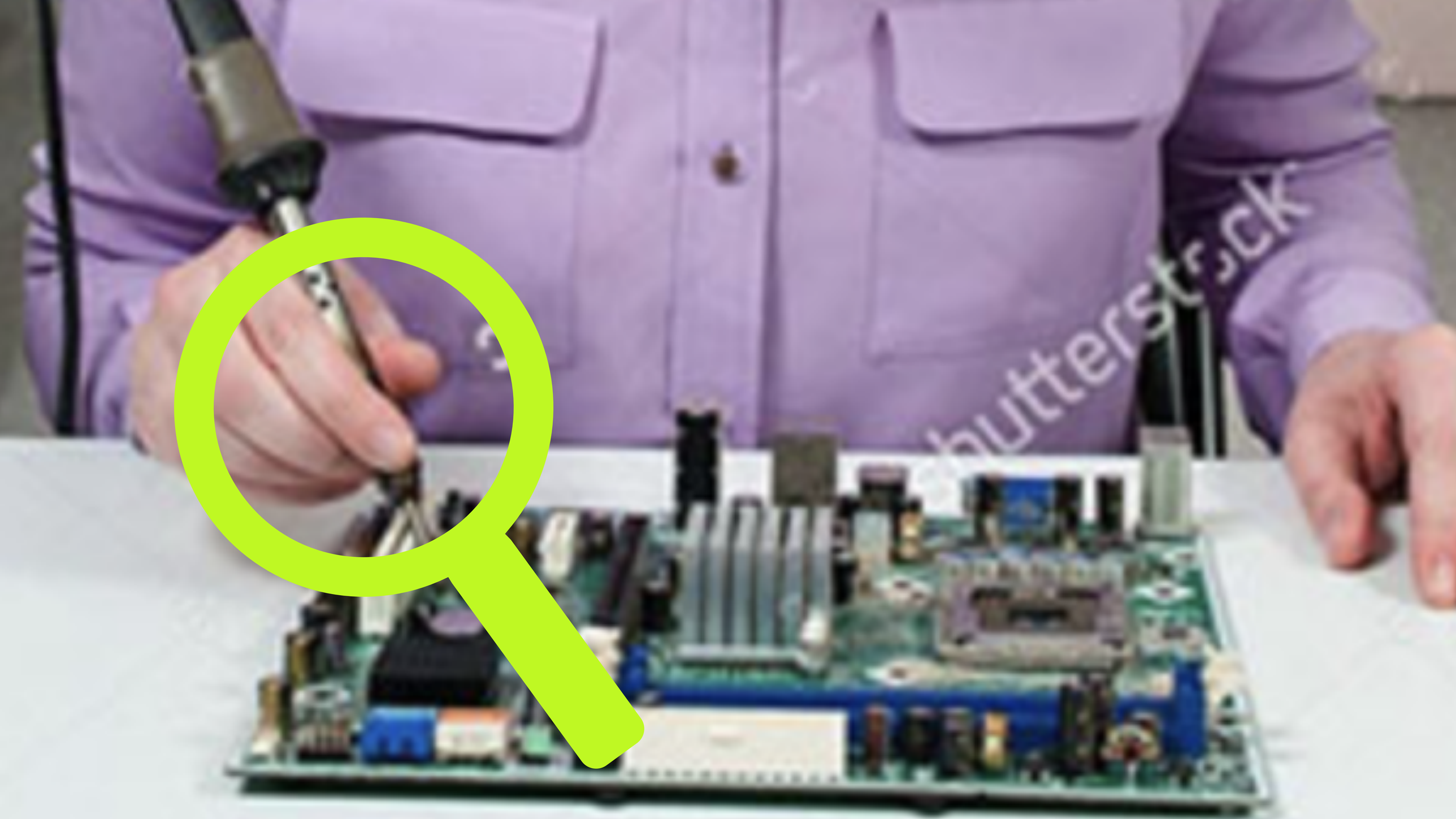
- Having our LED stuck in our board isn’t very useful.
- To make any sensor useful in projects, we need to add cables...

Soldering!



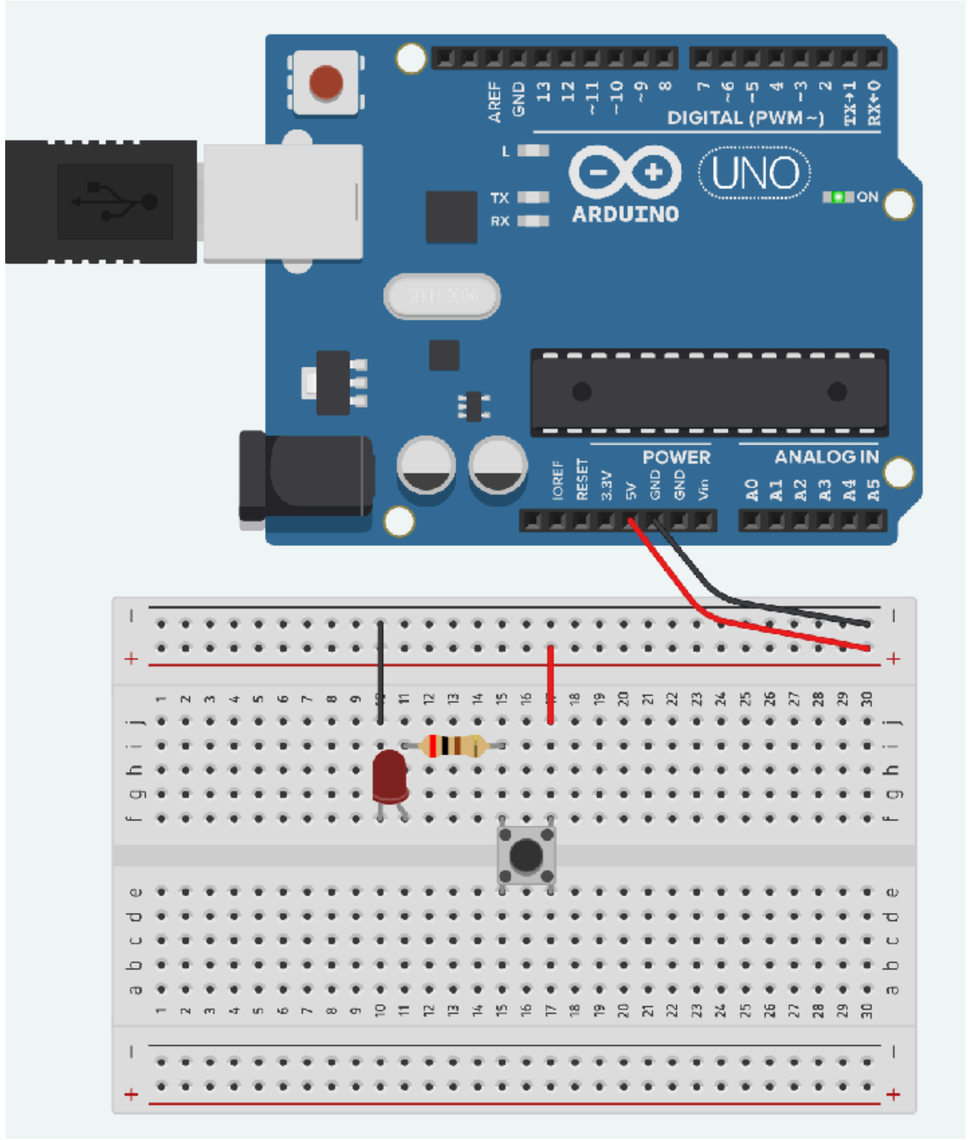


What is wrong here !?


shutterstock

Demo

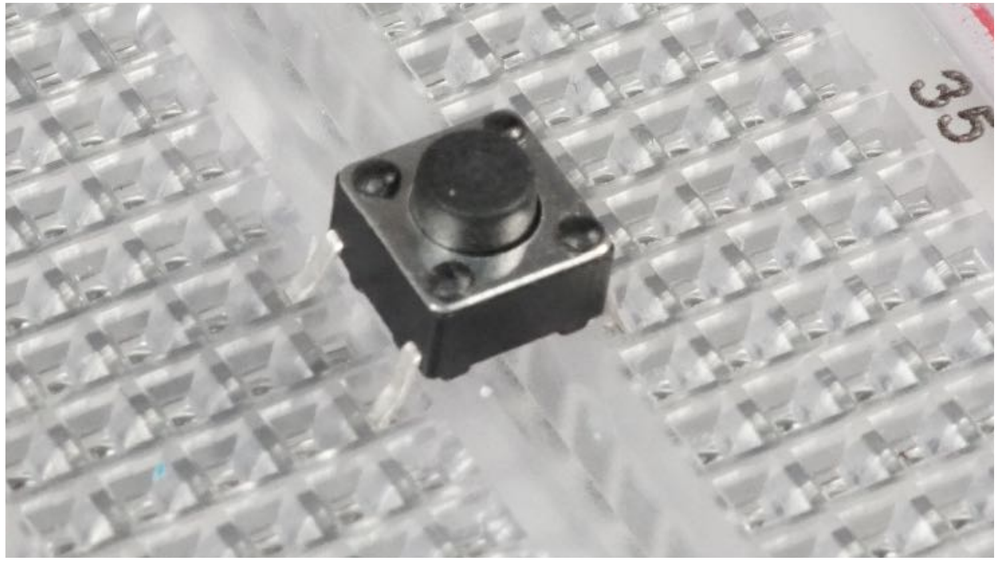
Any Questions so far?



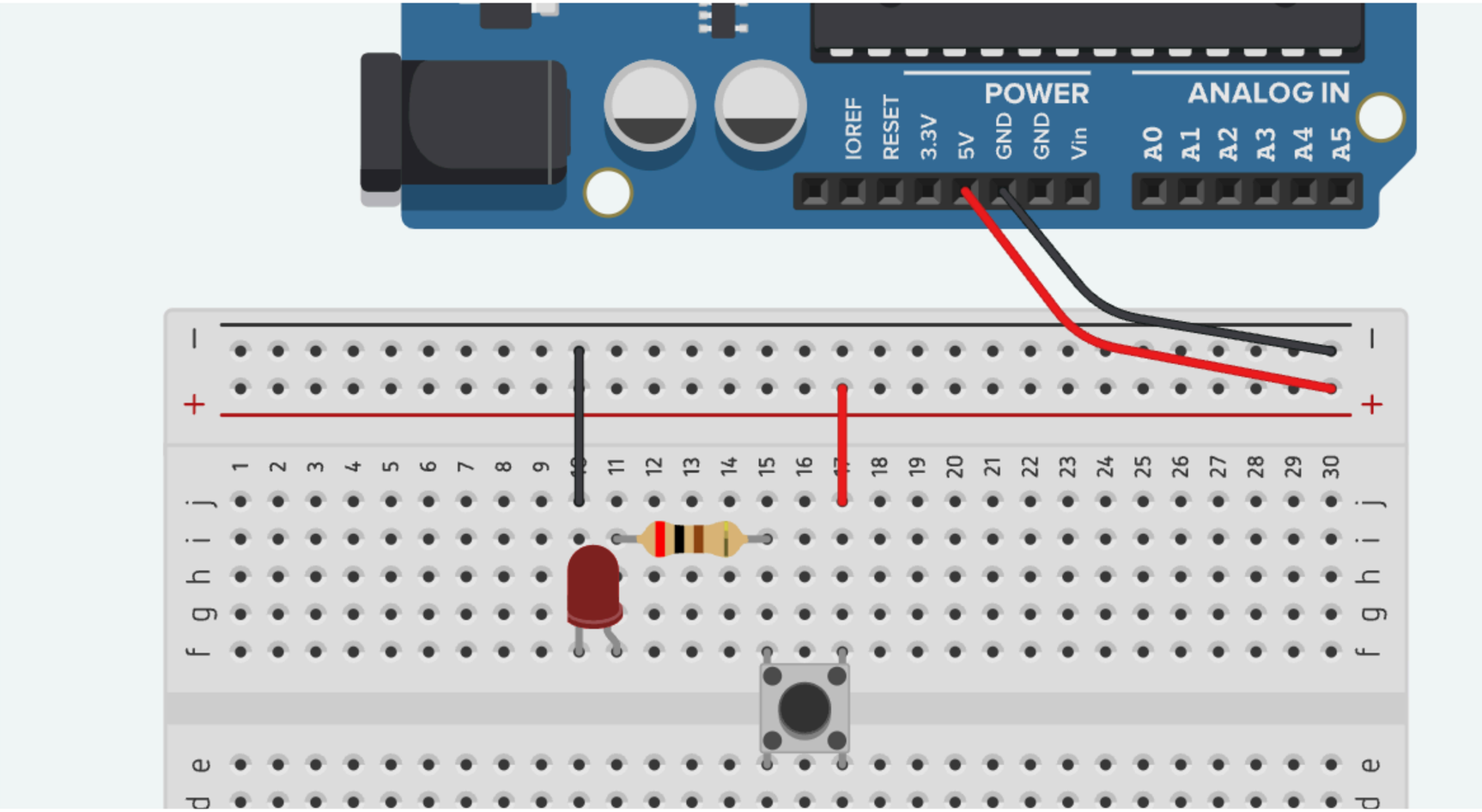
Still not very useful...

Let's add a button!

- Only when the button is pressed, will the LED light up.



Closeup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A3
A4
A5
ANALOG IN
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
f g h i j
d e

It’s not easy...

- Hardware - electronics, circuits, sensors, actuators
- Software - programming microcontroller
- Fabrication - Using the hatch lab tools to rapidly make and iterate on prototypes

At the end of the day, Physical Computing is about :

THE IDEA!

THE IDEA!

THE INTERACTION DESIGN!

THE MEANING!

Legacy IDE (1.8.X)

Before Next Week

- Download Arduino IDE
- https://www.arduino.cc/en/software
- Install version 1.8.19
- Solder Up 2 More LEDs

Where can you get help?

- Ask on the class forum first!
- When posting questions please give as much detail as possible
- Google it!
- Ask on online Arduino/electronics forum
- Check the Arduino reference guide

See you next week!