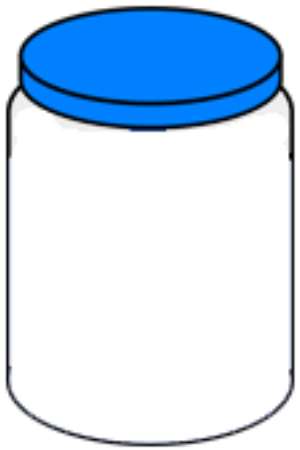
PORTO DESIGN FACTORY

öBot CERN

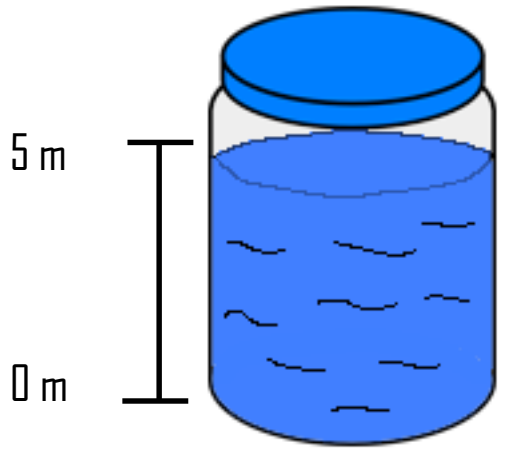
2018

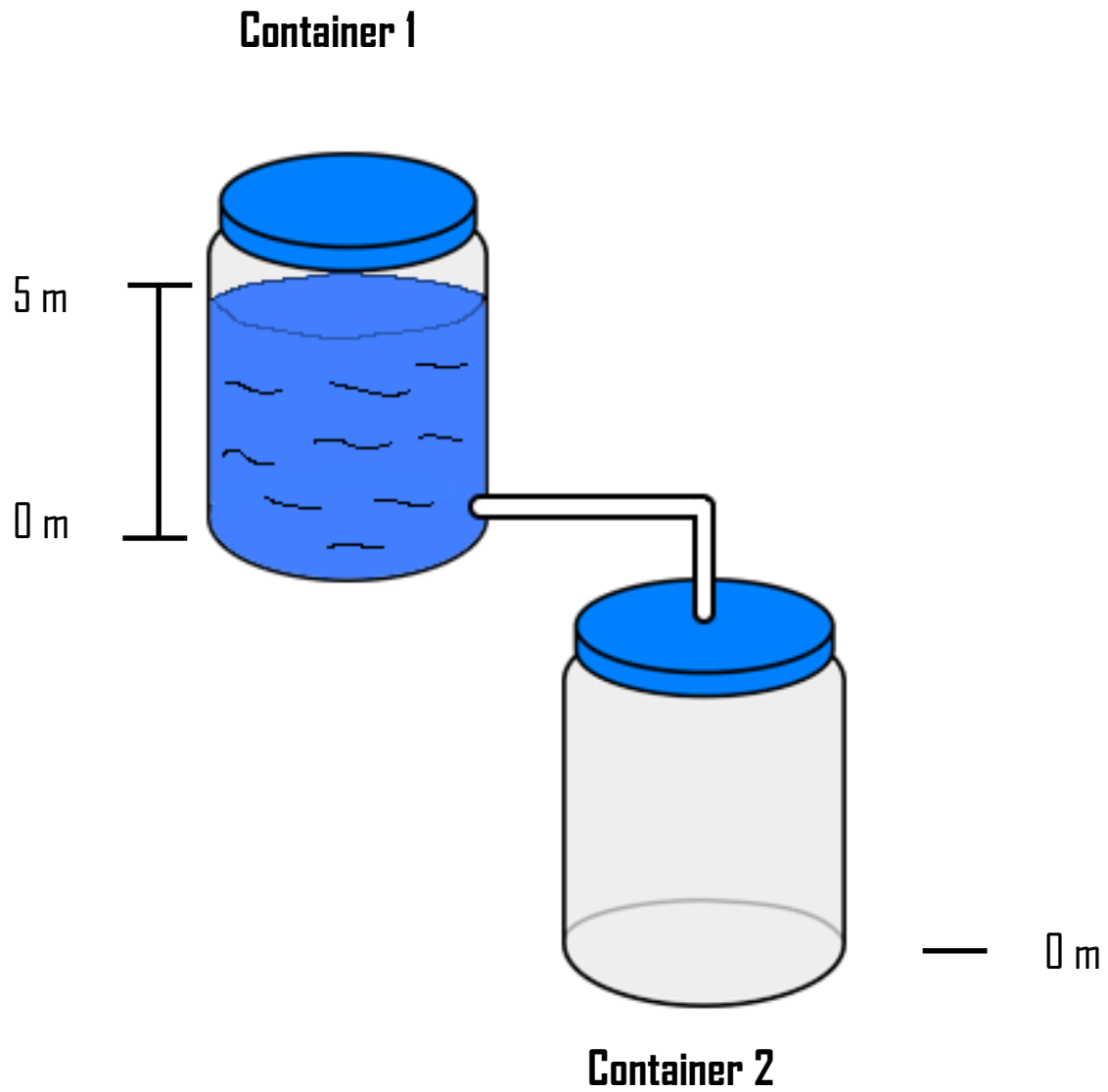
What is Voltage and Amperes??

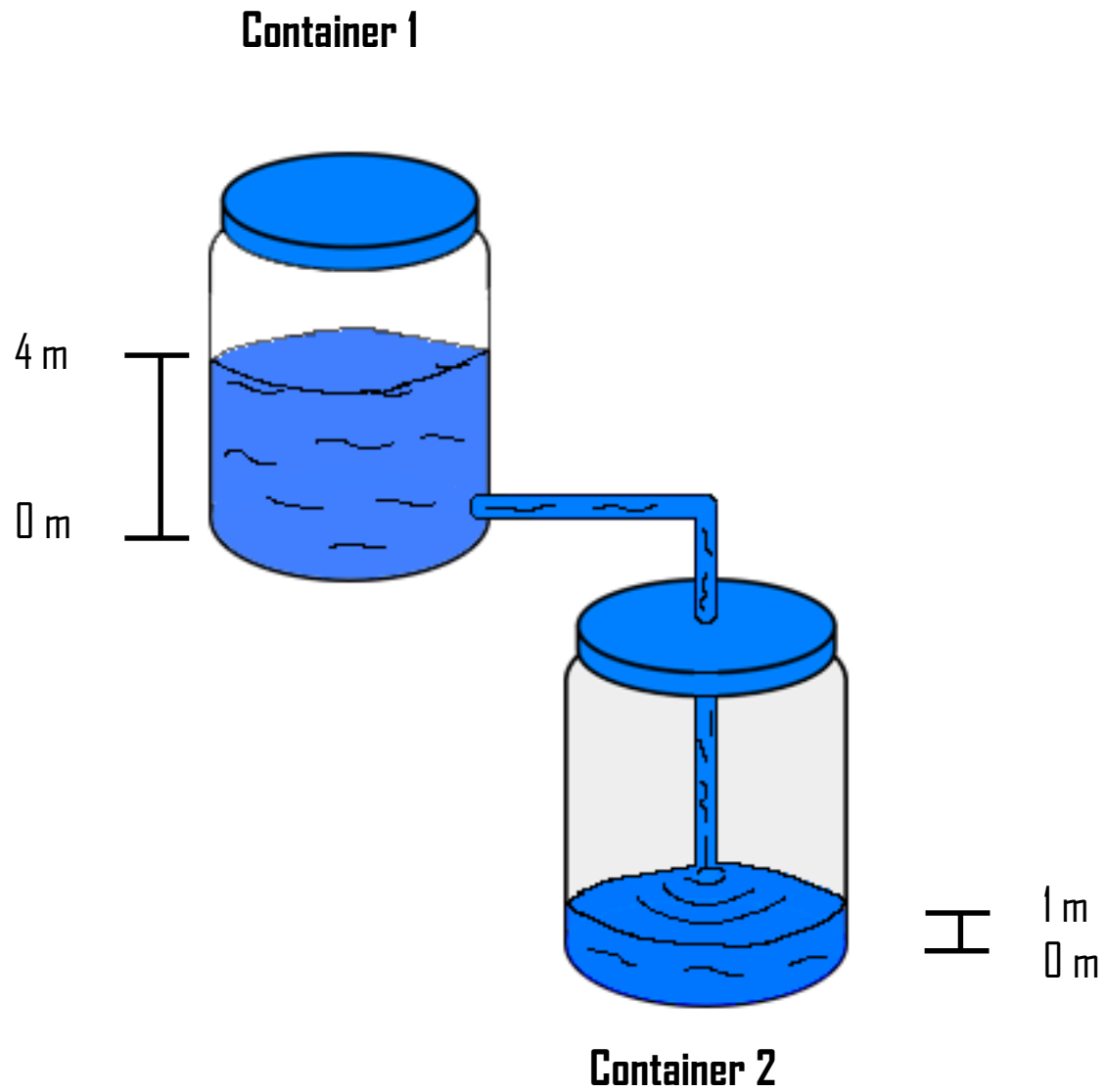
Container 1

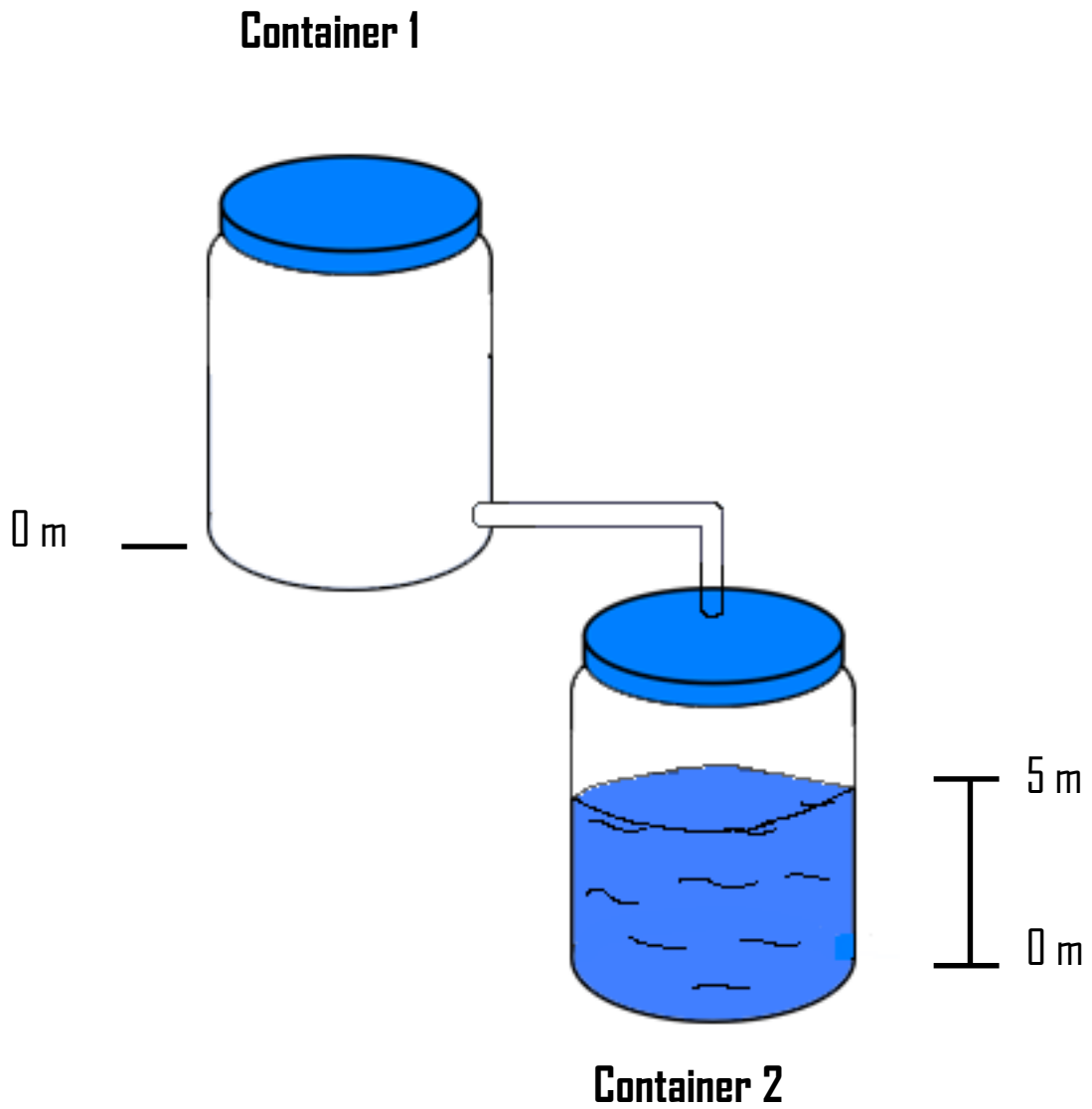


Container 1

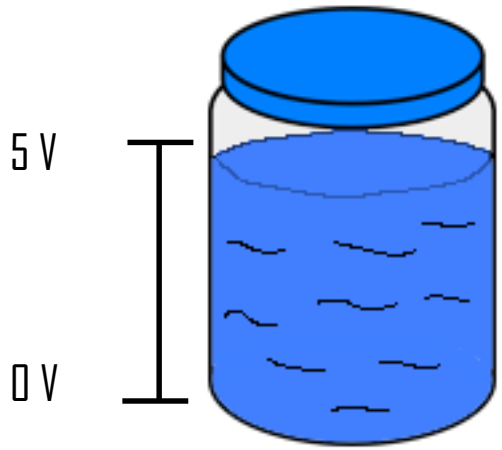


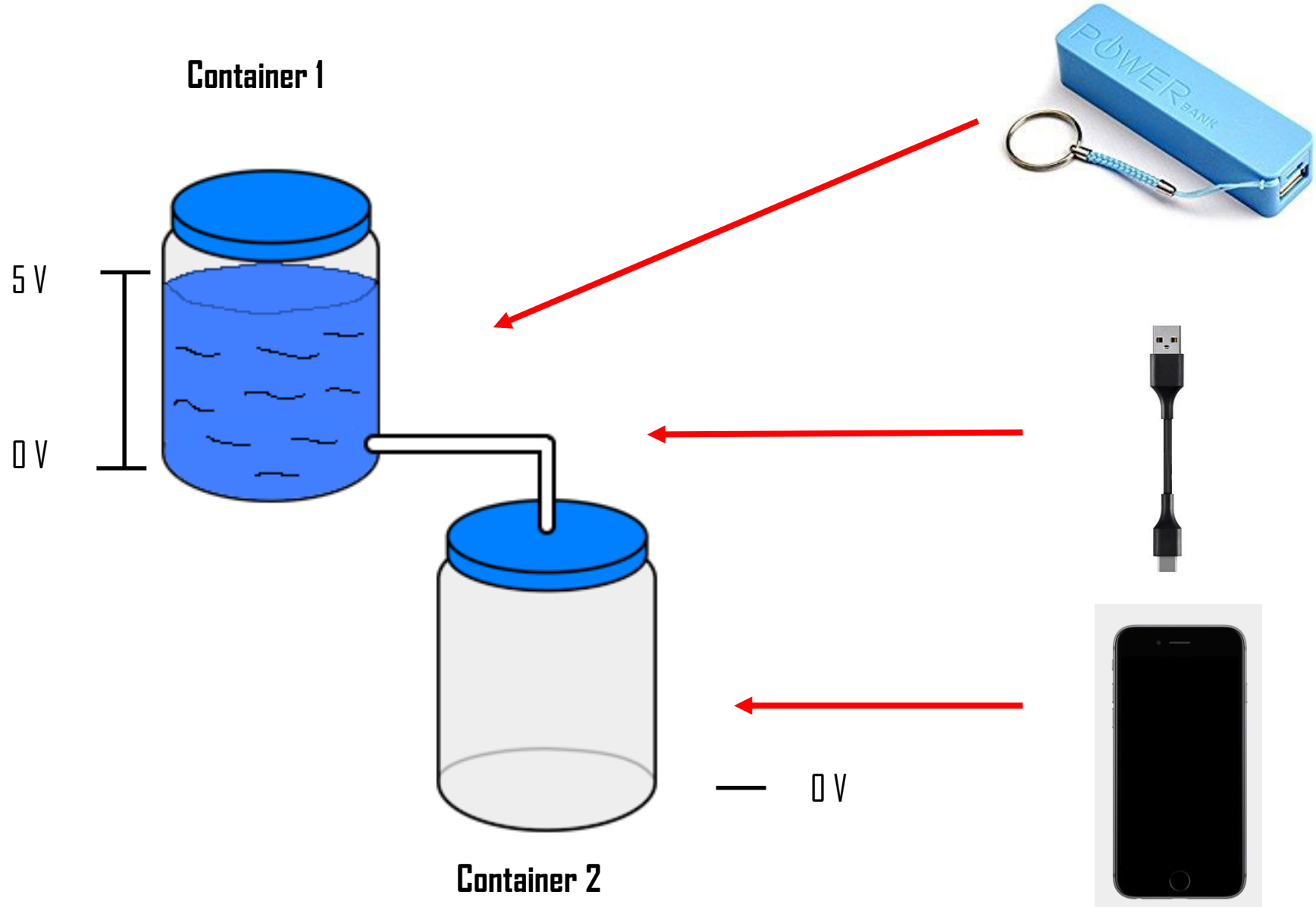

Container 1
5 m
0 m
0 m
Container 2

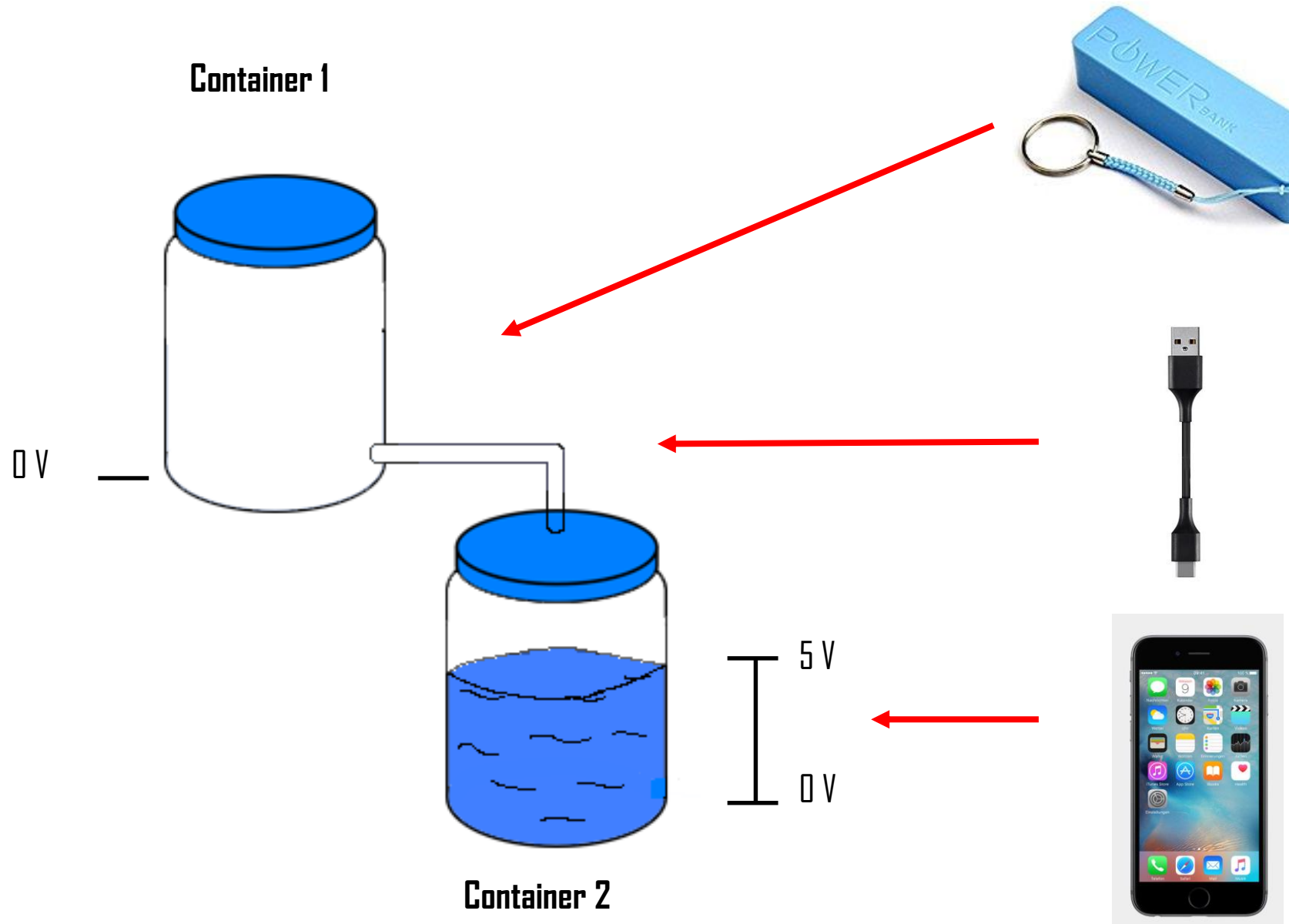

Container 1
4 m
0 m
1 m
0 m
Container 2


Container 1
0 m
5 m
0 m
Container 2

Container 1

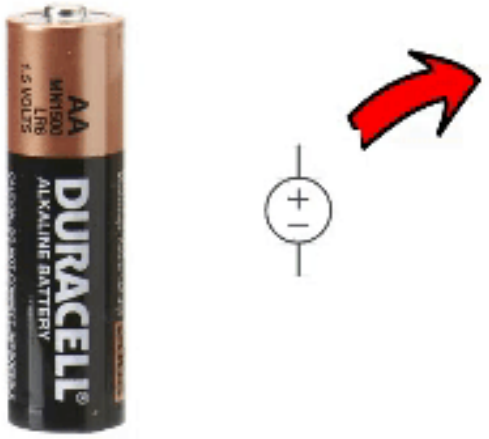



Container 1
5 V
0 V
0 V
Container 2


Container 1
0 V
5 V
0 V
Container 2

How to turn on an LED?

Current flows always from the positive pin to the negative

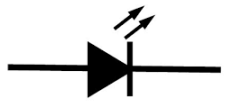


Components

Power supply

Resistance

LED



Jumpers

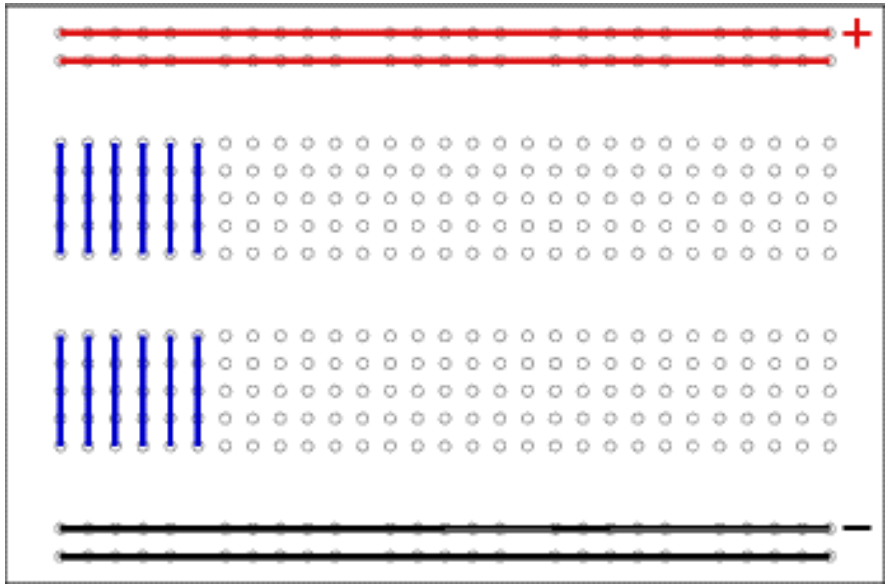
Breadboard

Perfect for prototyping

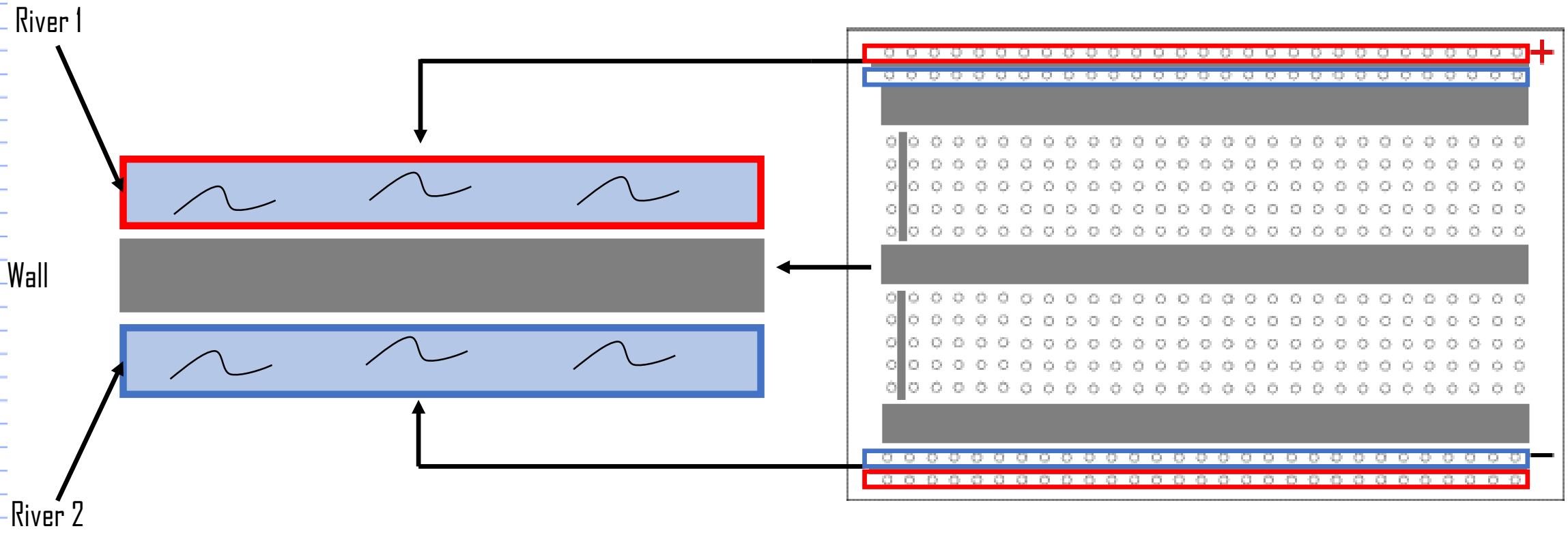
Fast connection, no need to solder every connection

Reusable

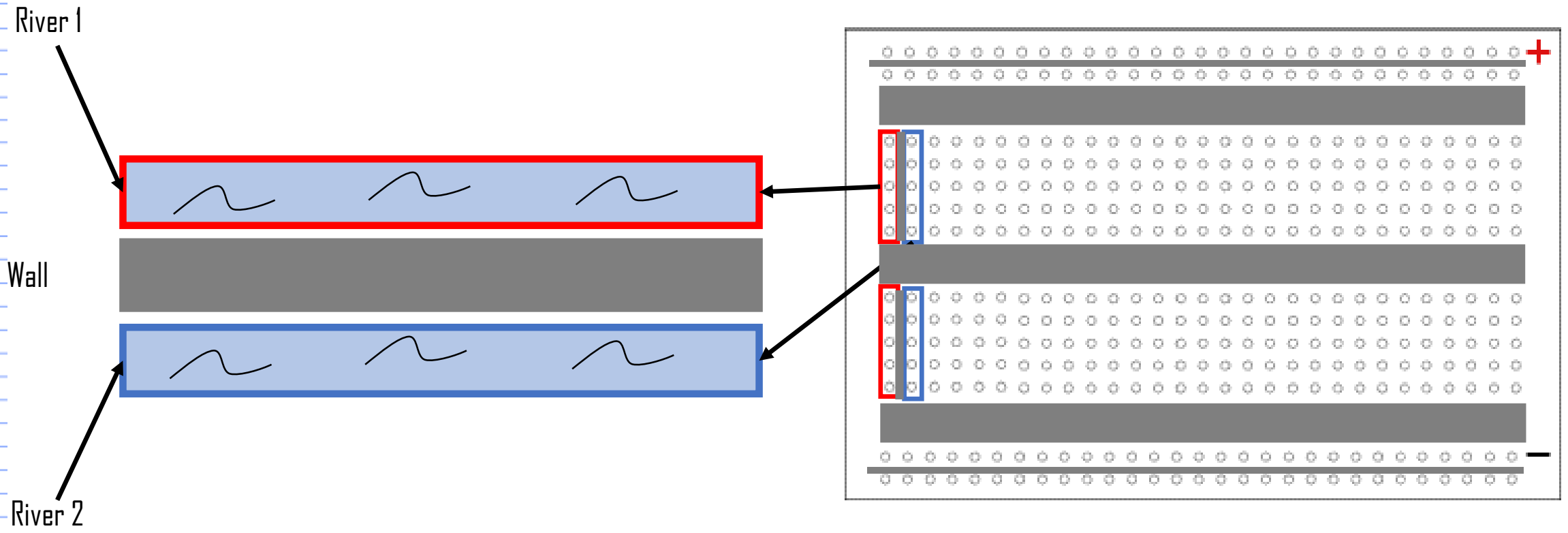
The lines that are shown in the image
are connected



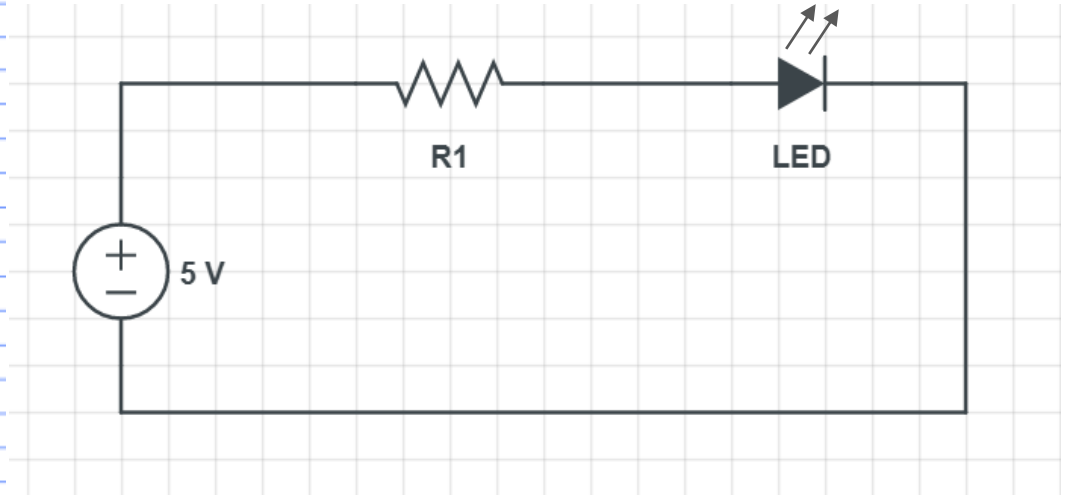
Breadboard

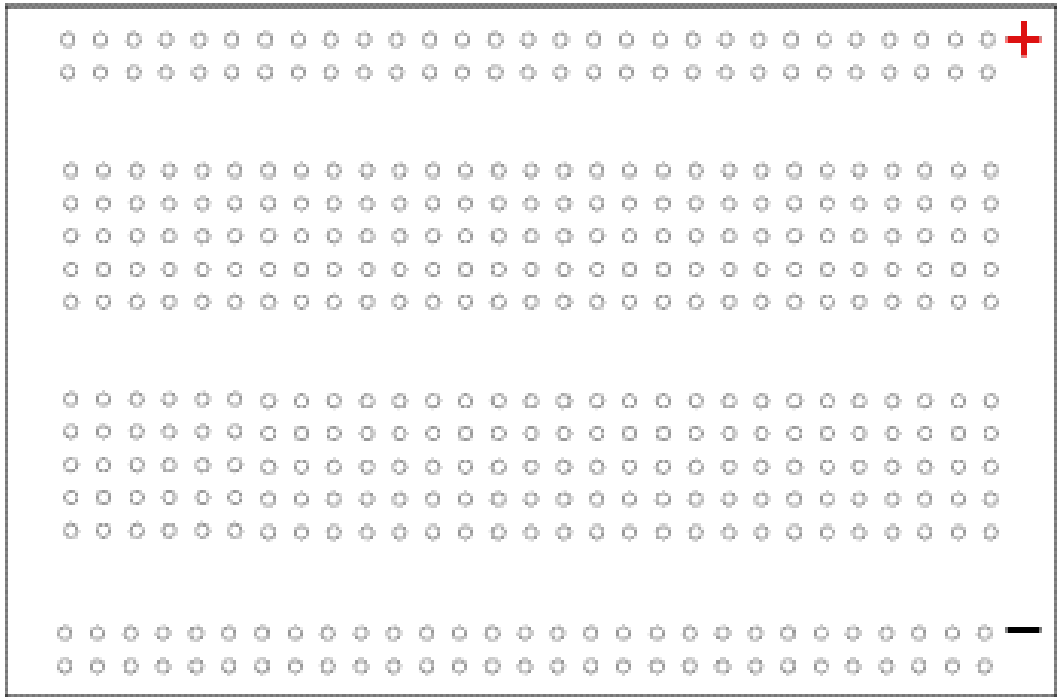


Breadboard

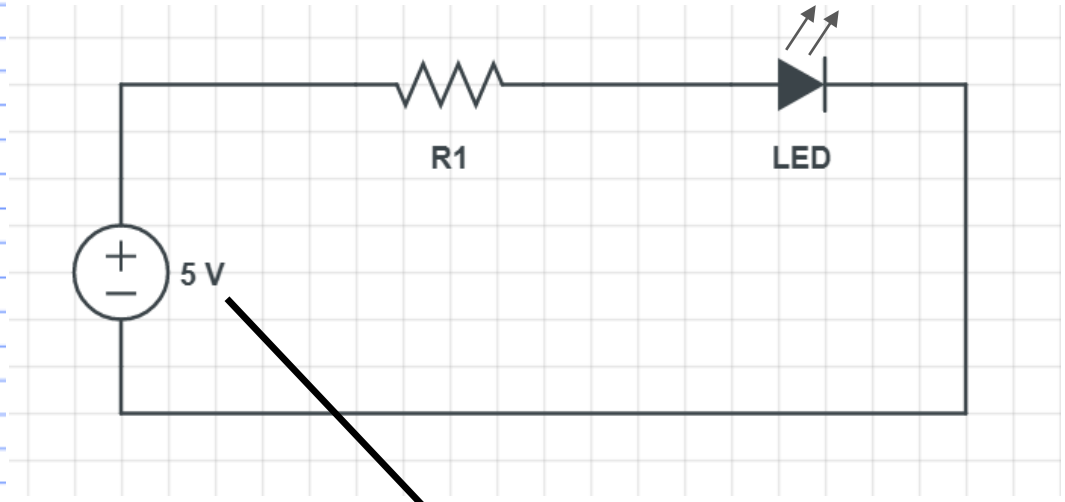


Assemble our first circuit

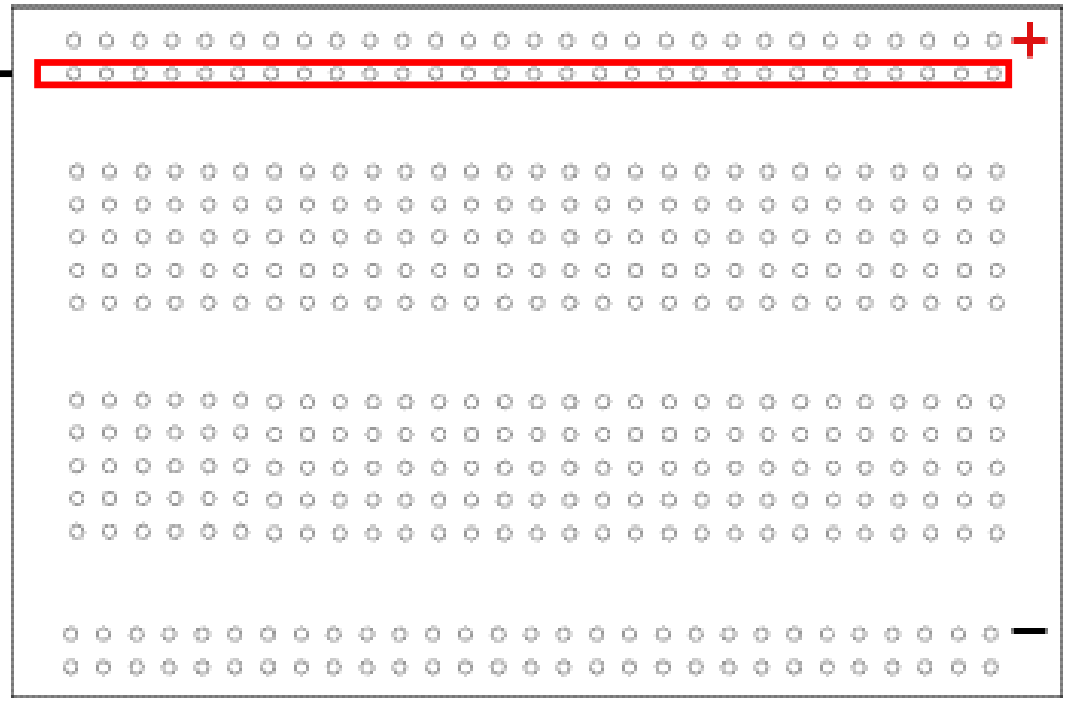




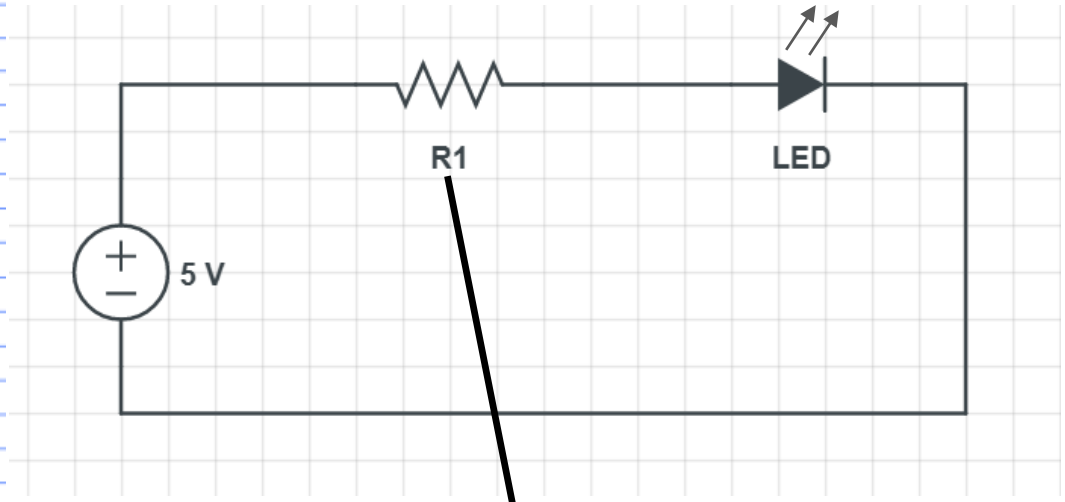
Assemble our first circuit

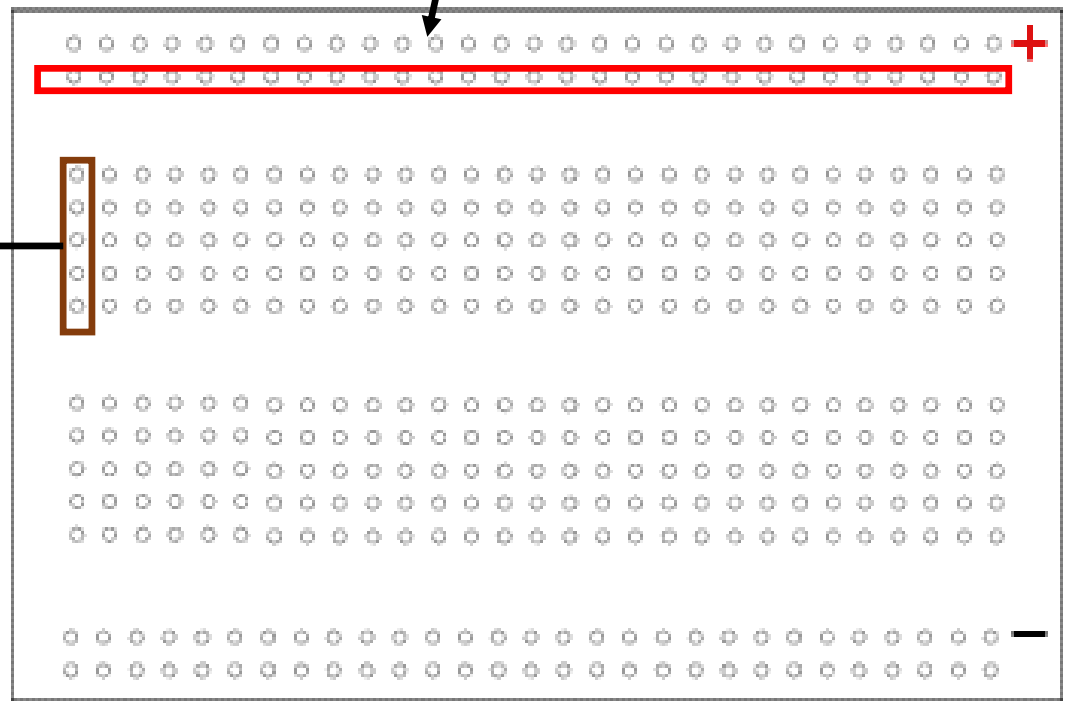


5V River



Assemble our first circuit





Resistance River

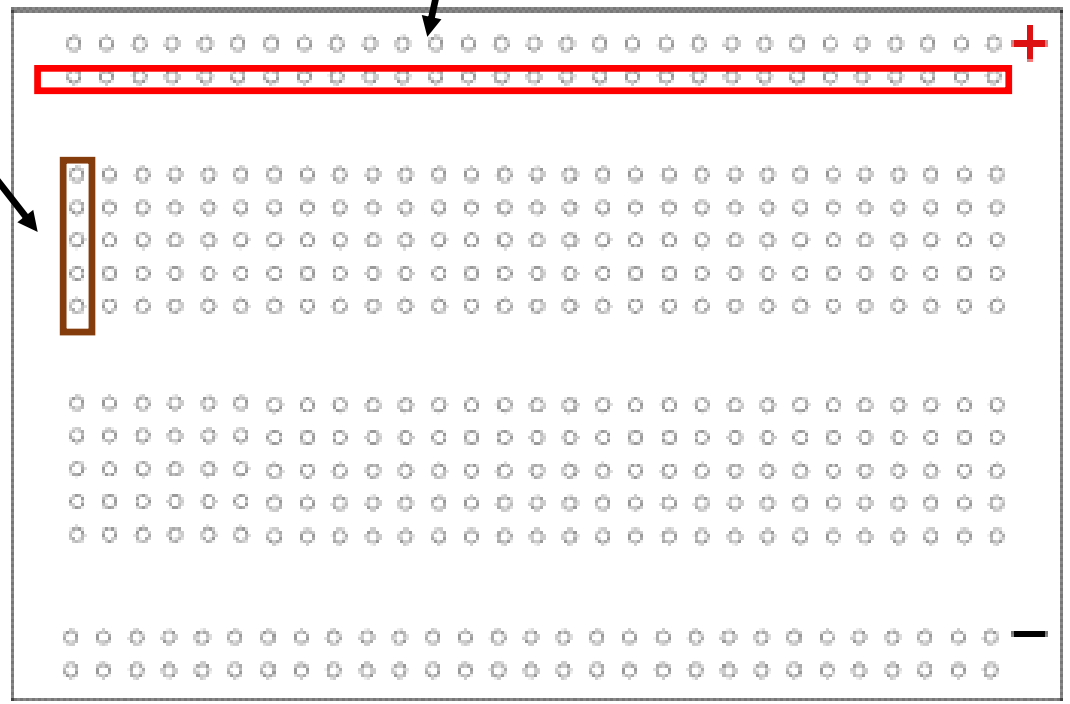
Assemble our first circuit

Leg 1

Leg 2

5V River

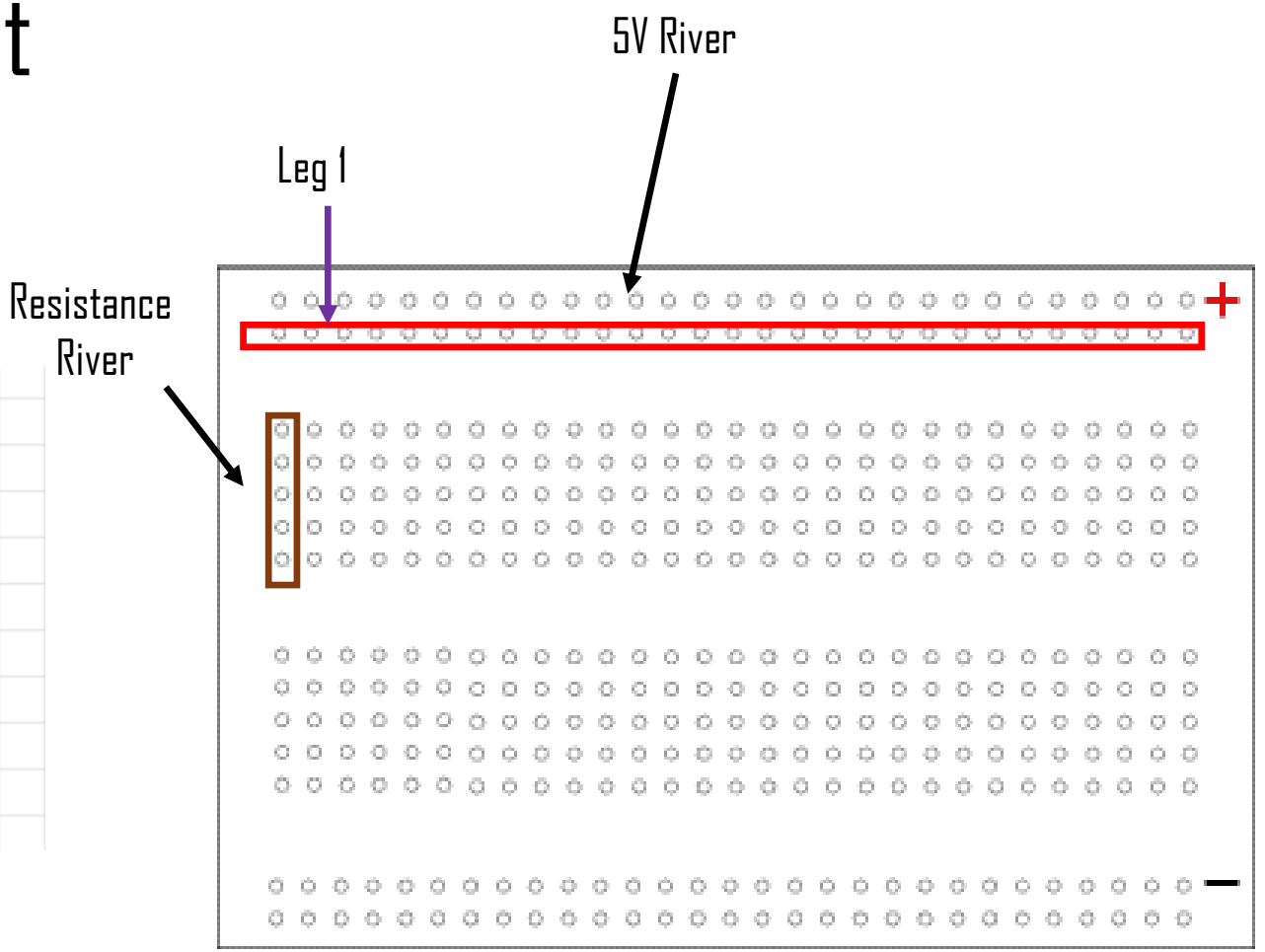
Resistance River



Assemble our first circuit

Leg 1

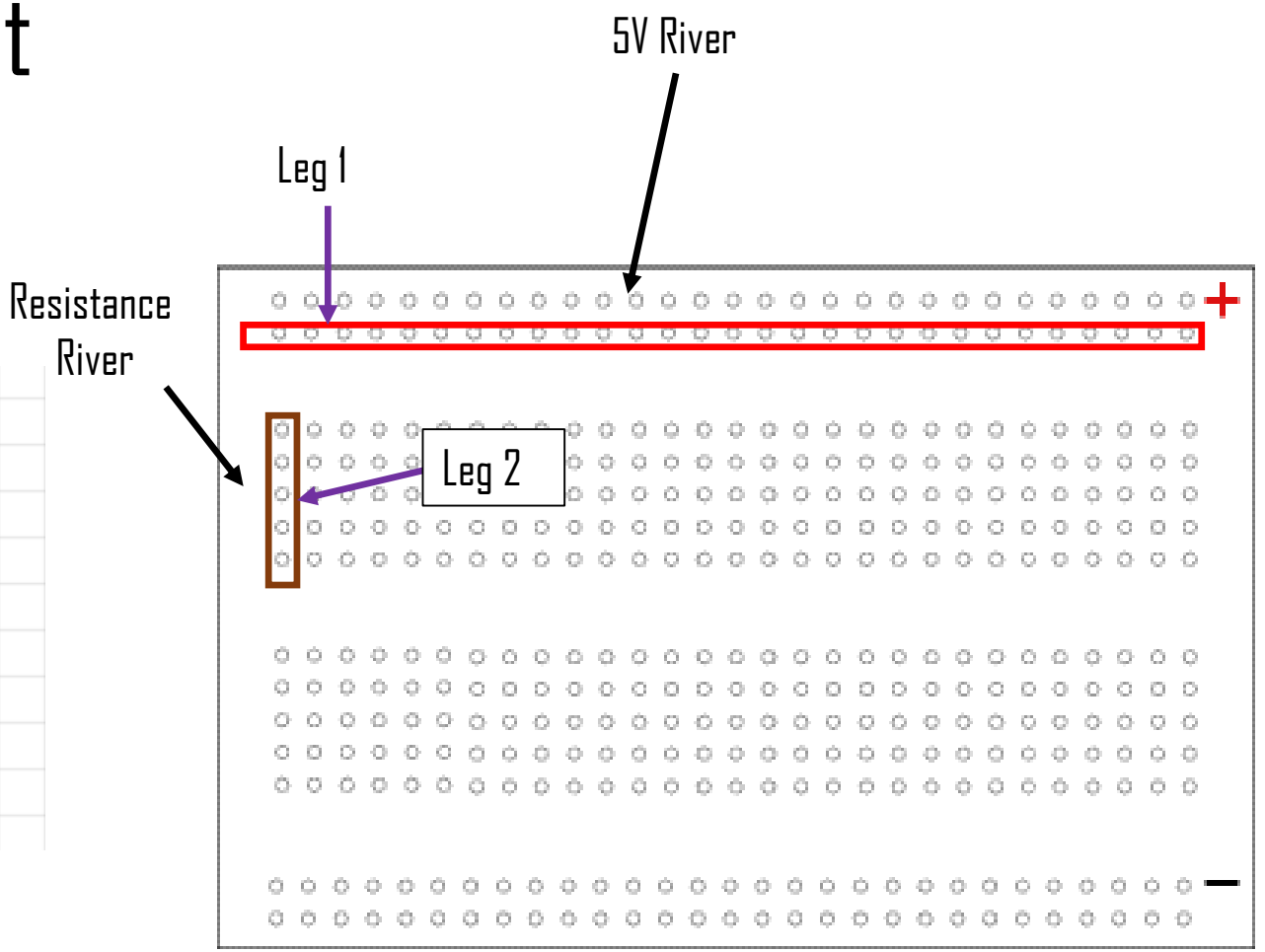
Leg 2



Assemble our first circuit

Leg 1

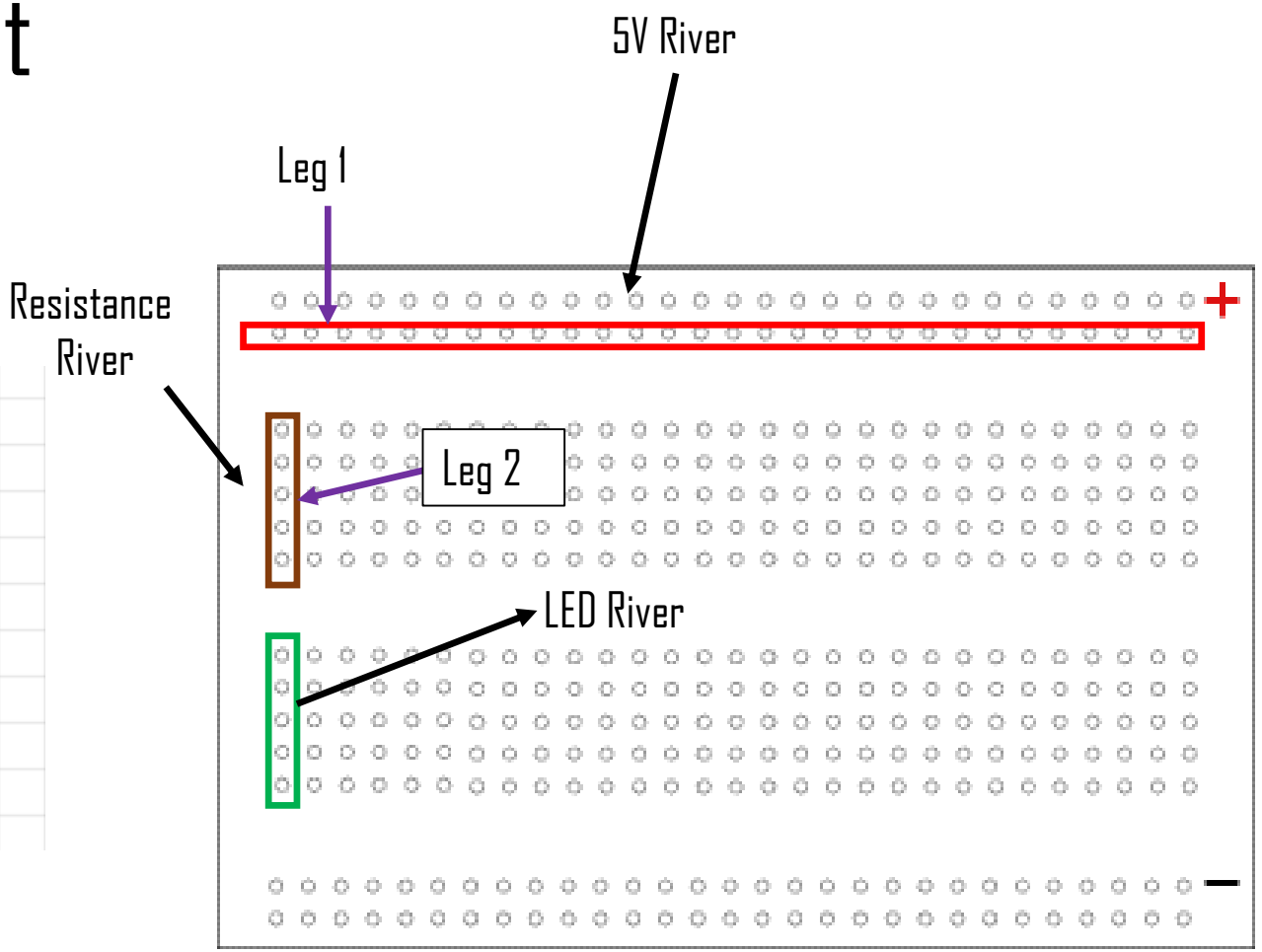
Leg 2



Assemble our first circuit

Leg 1

Leg 2

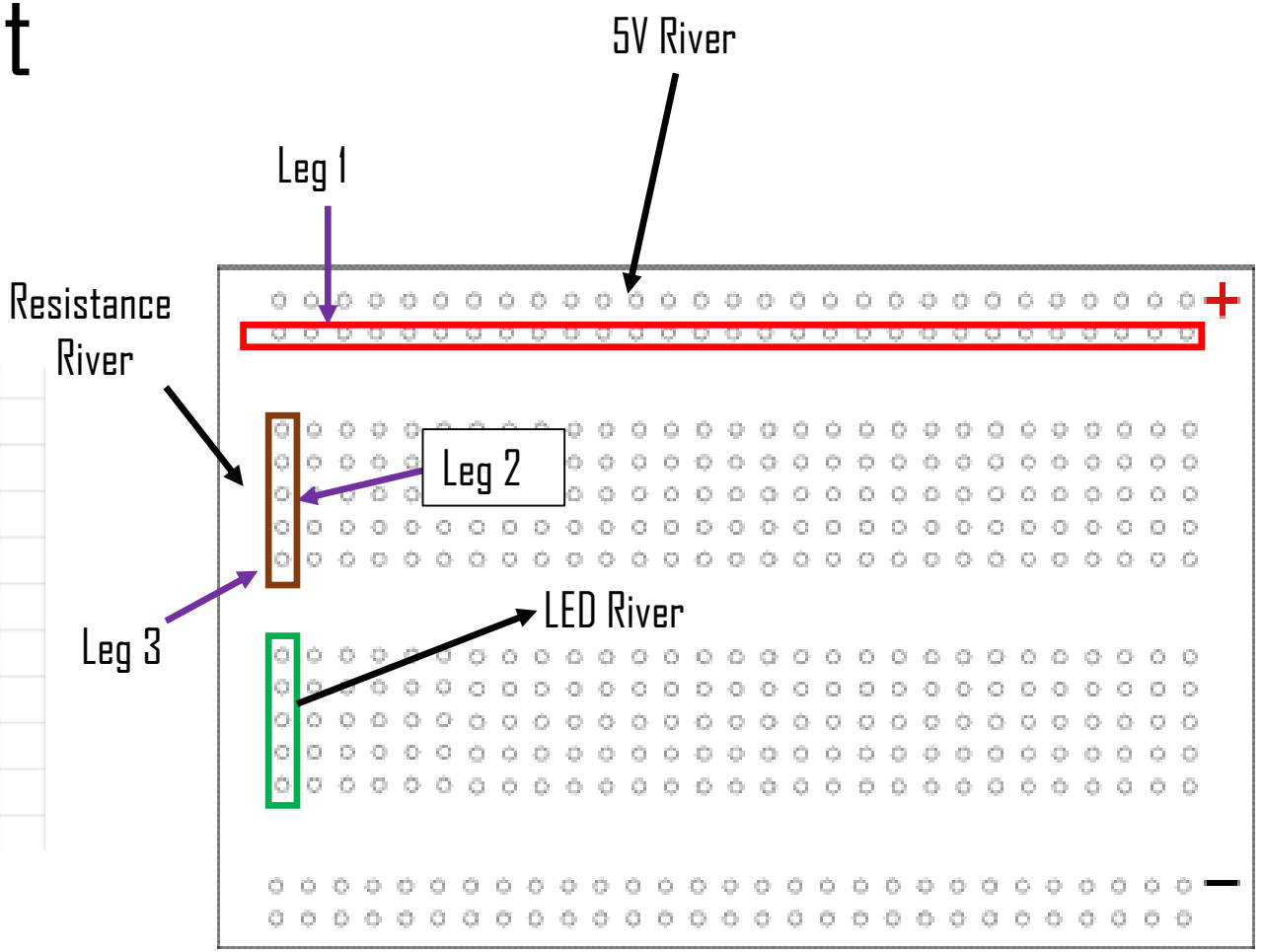


Assemble our first circuit

Leg 1

Leg 2

Leg 3



Assemble our first circuit

Leg 1

Leg 2

Leg 3

Leg 4

5V River

Leg 1

Resistance River

Leg 2

Leg 3

LED River

Leg 4

Assemble our first circuit

Leg 1

Leg 2

Leg 3

Leg 4

5V River

Leg 1

Resistance River

Leg 2

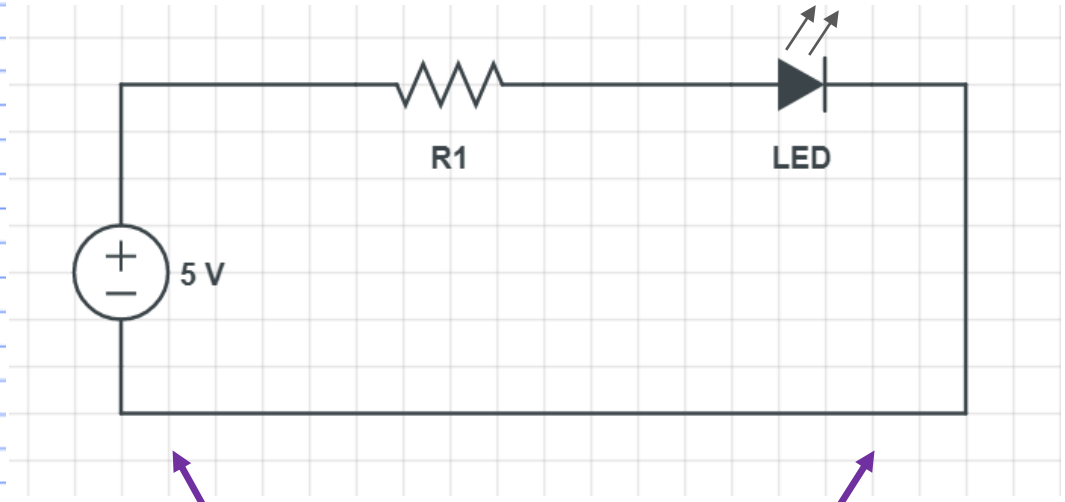
Leg 3

LED River

Leg 4

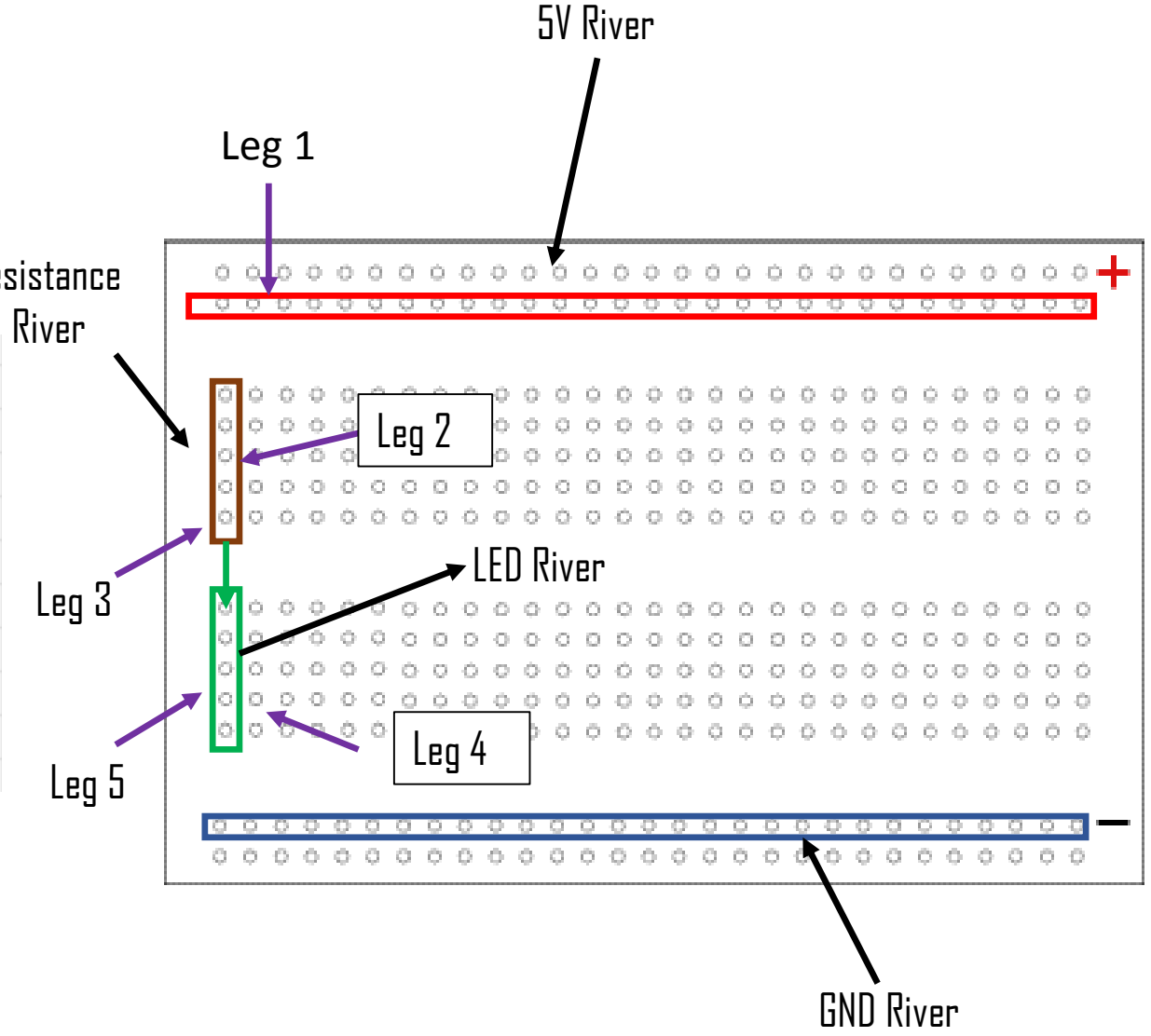
GND River

Assemble our first circuit

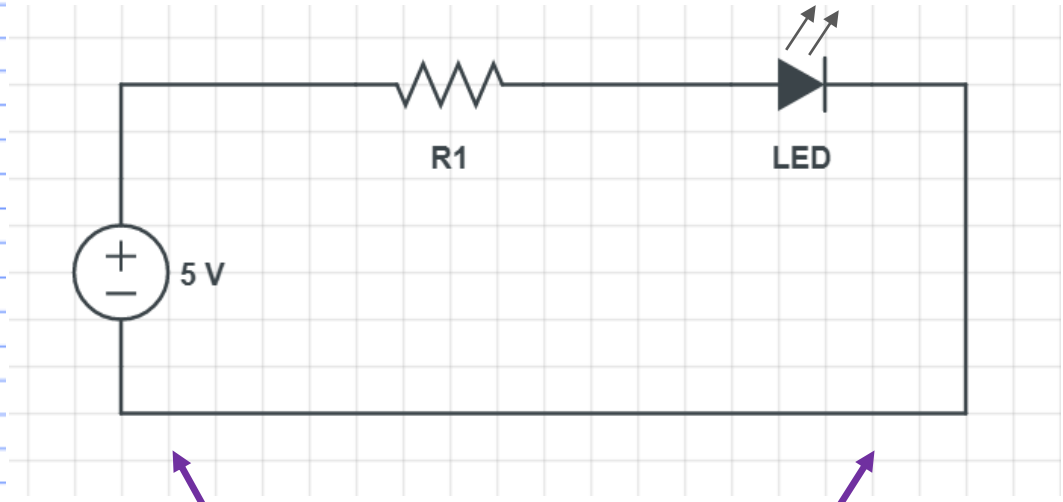


Leg 6

Leg 5

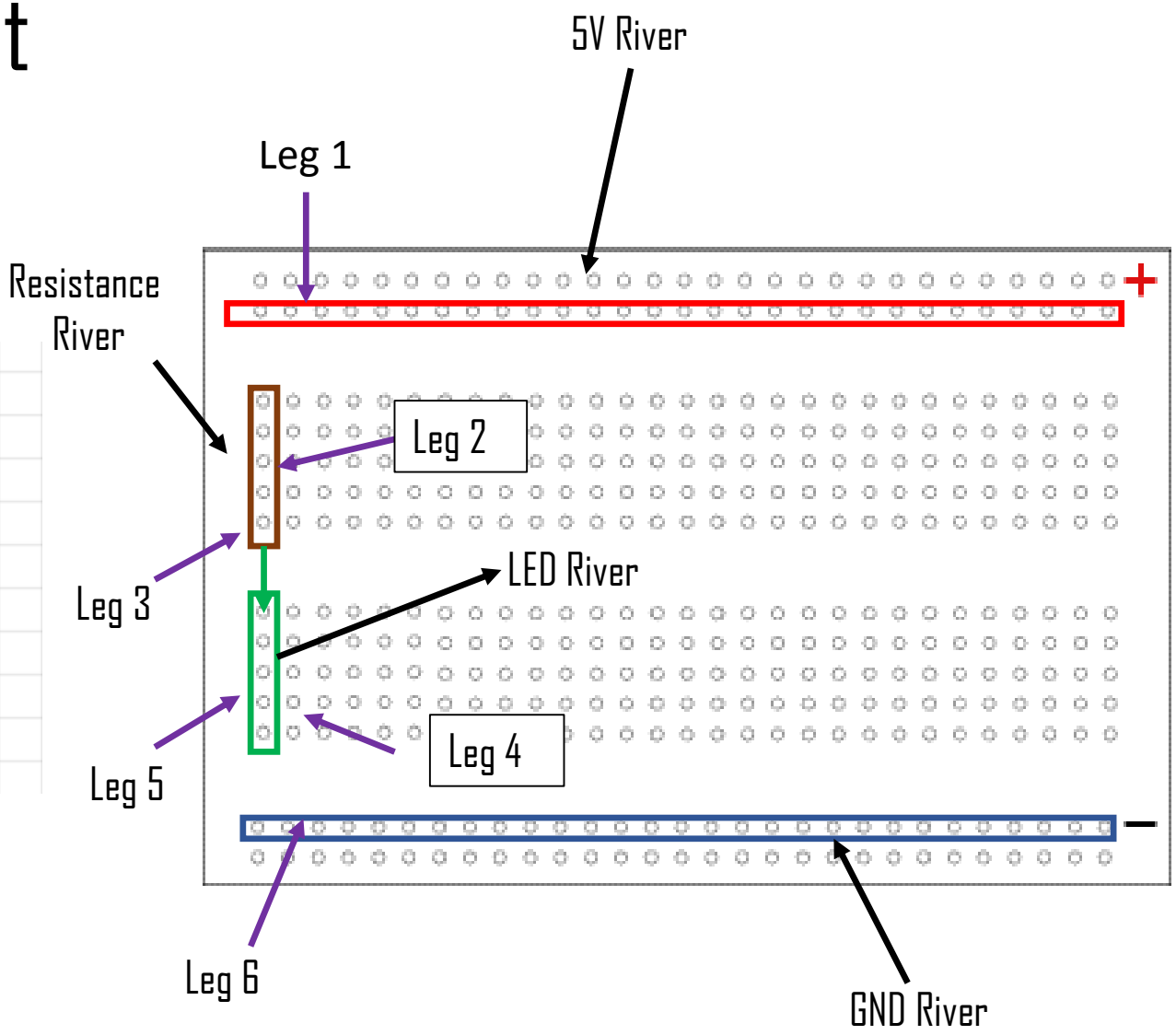


Assemble our first circuit



Leg 6

Leg 5

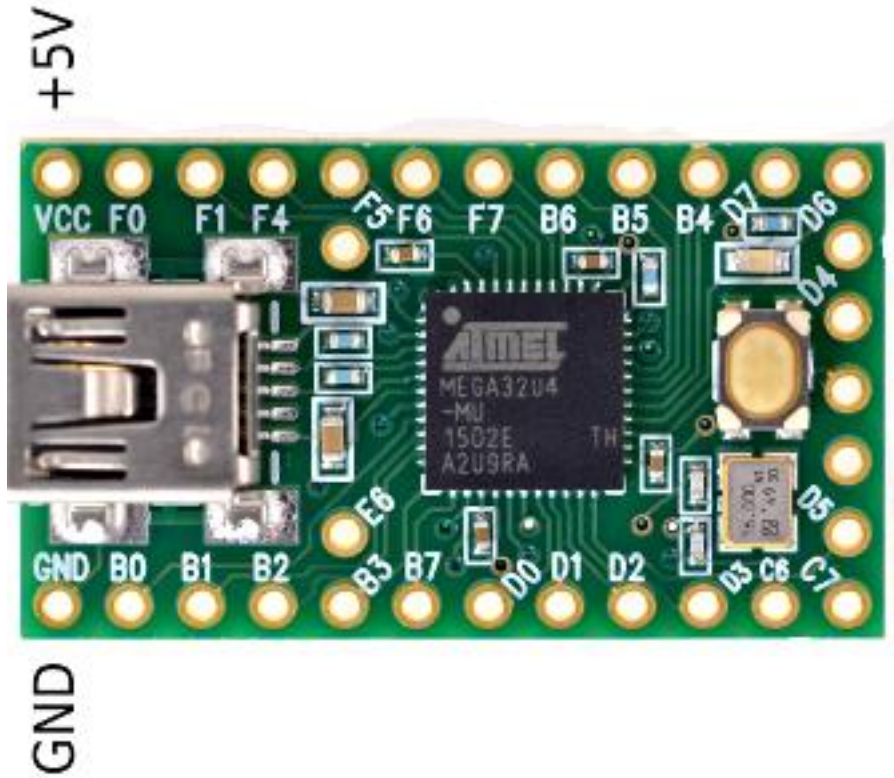


Where is the power supply?

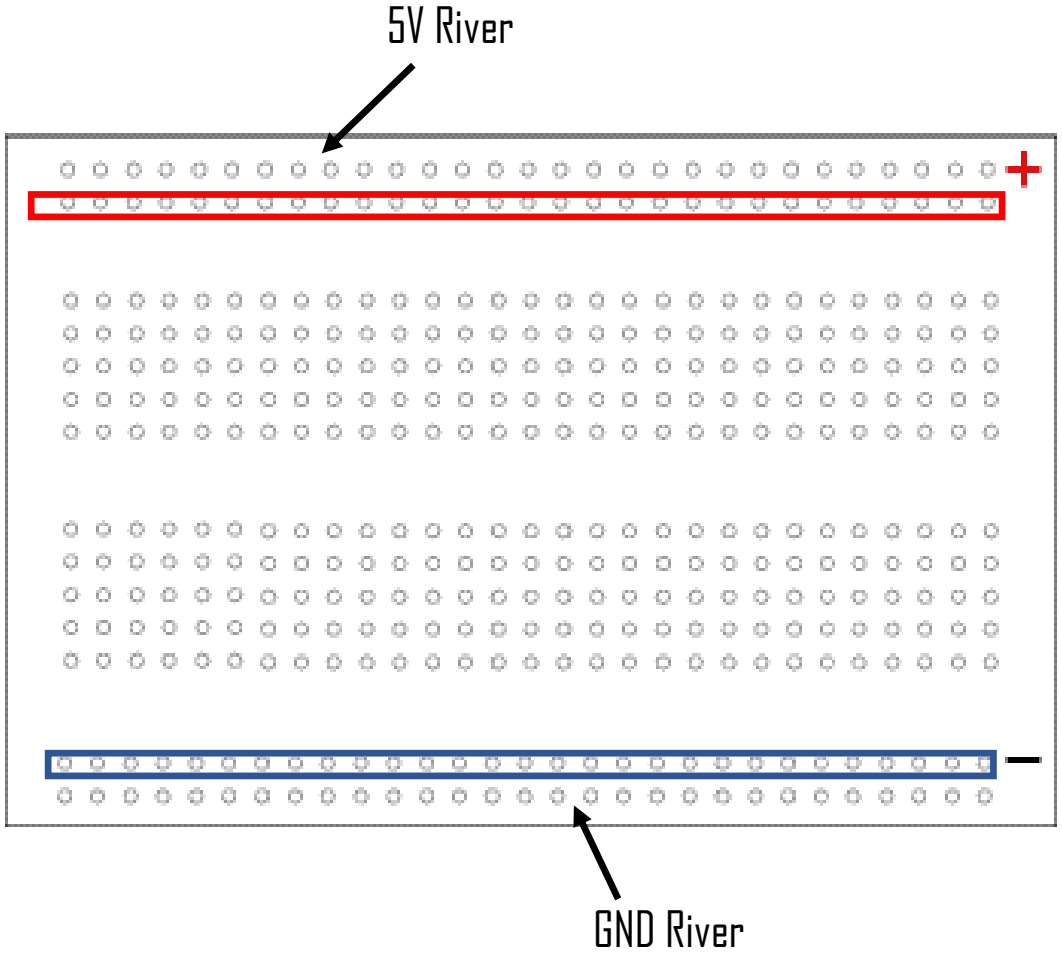
To power up the teensy just connect it to your laptop using USB port

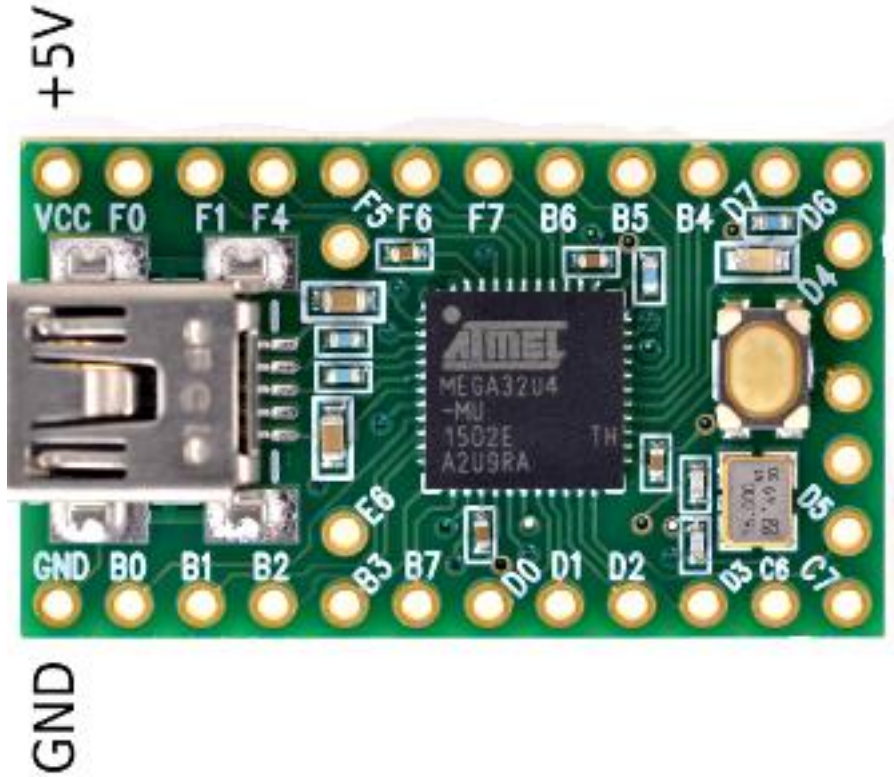
Very important:

DOUBLE CHECK your circuit before connecting the teensy to your laptop. Invalid connection may damage the microcontroller or your USB port.

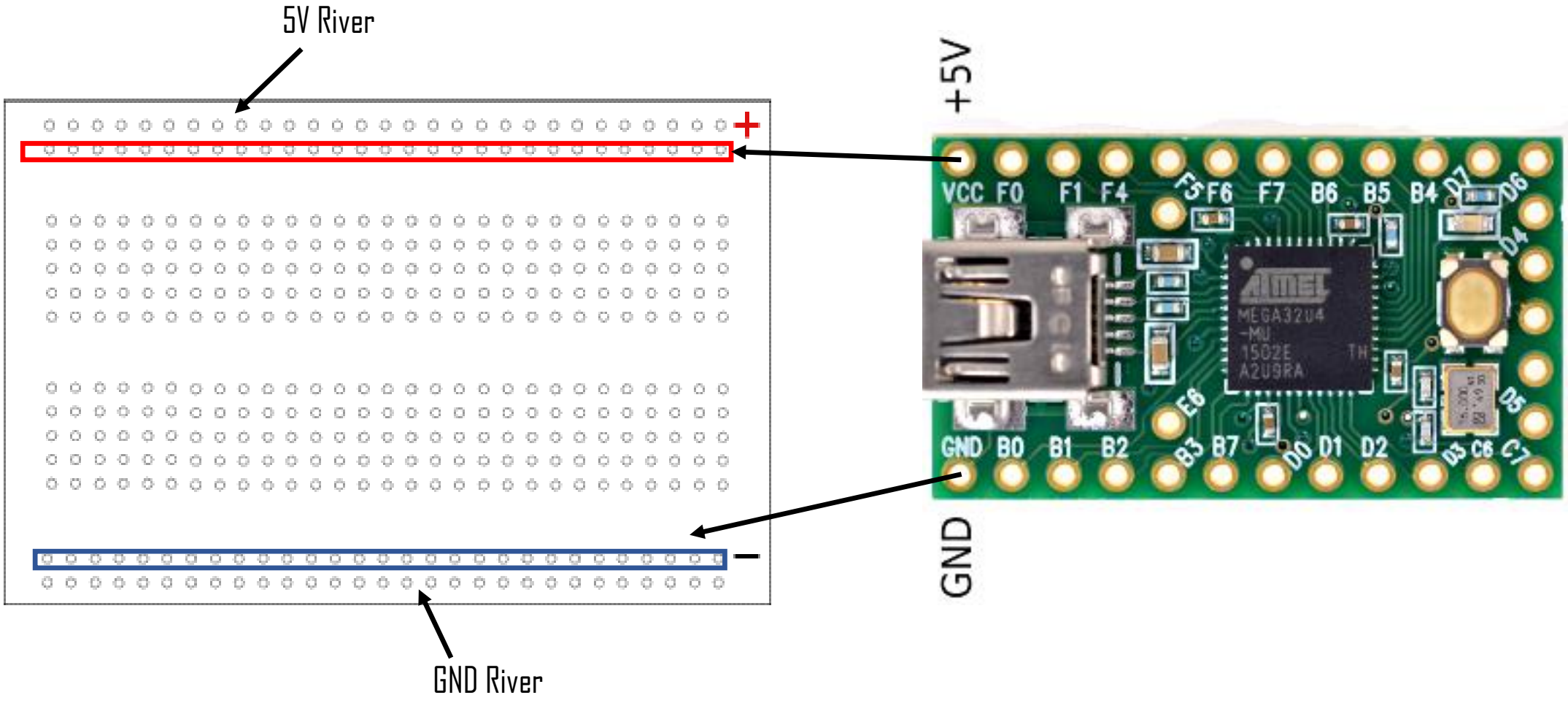


Where is the power supply?

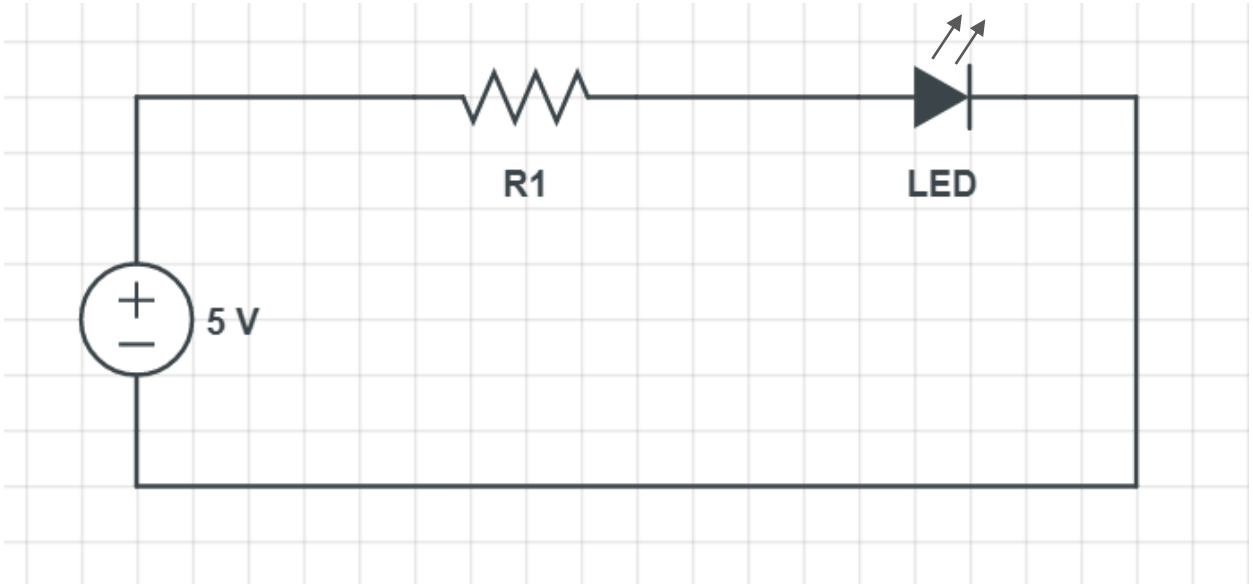


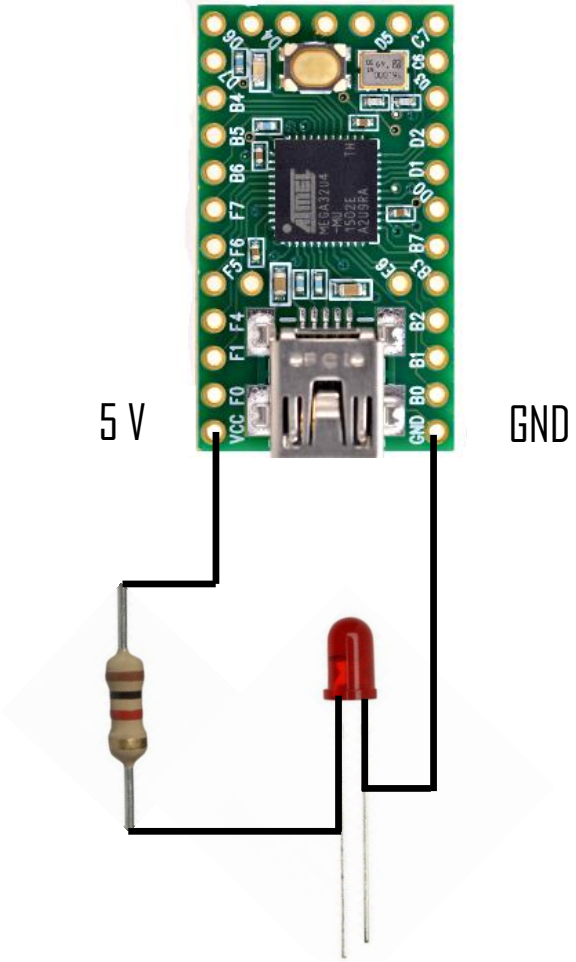


Where is the power supply?



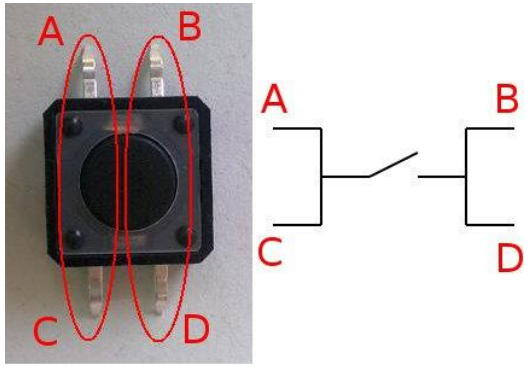
Challenge nº1

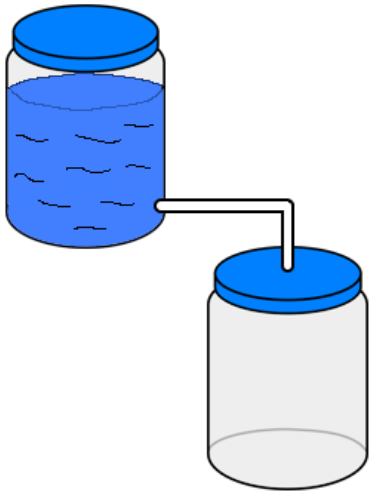


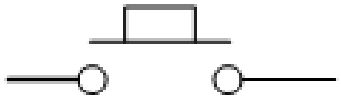


You have 15 min!!

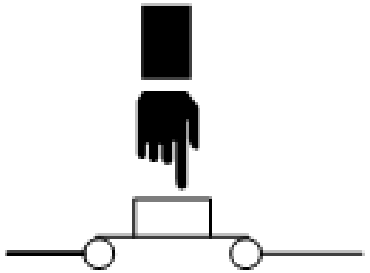
Button



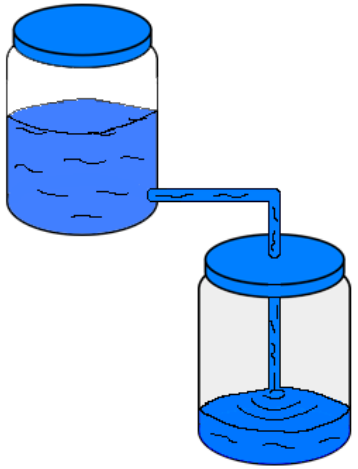




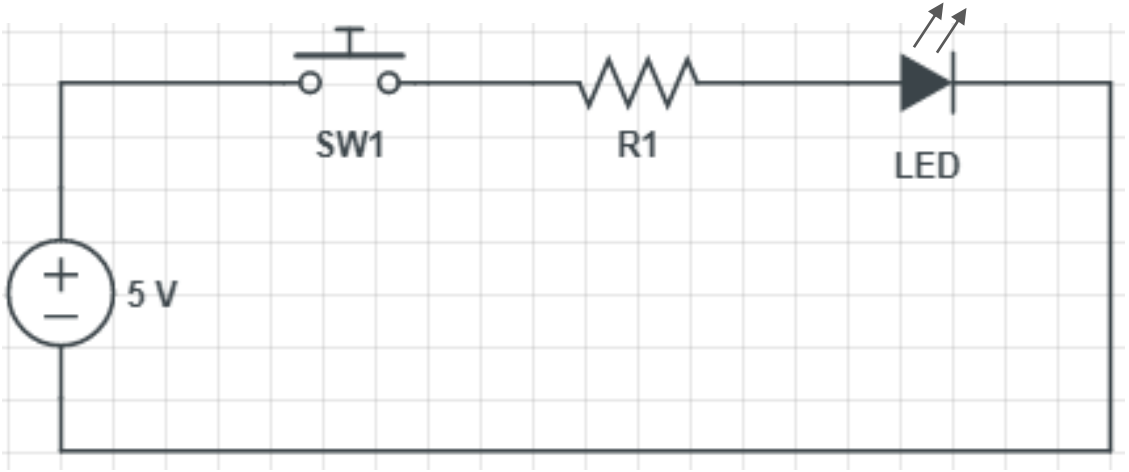
Normally Open
When not pressed

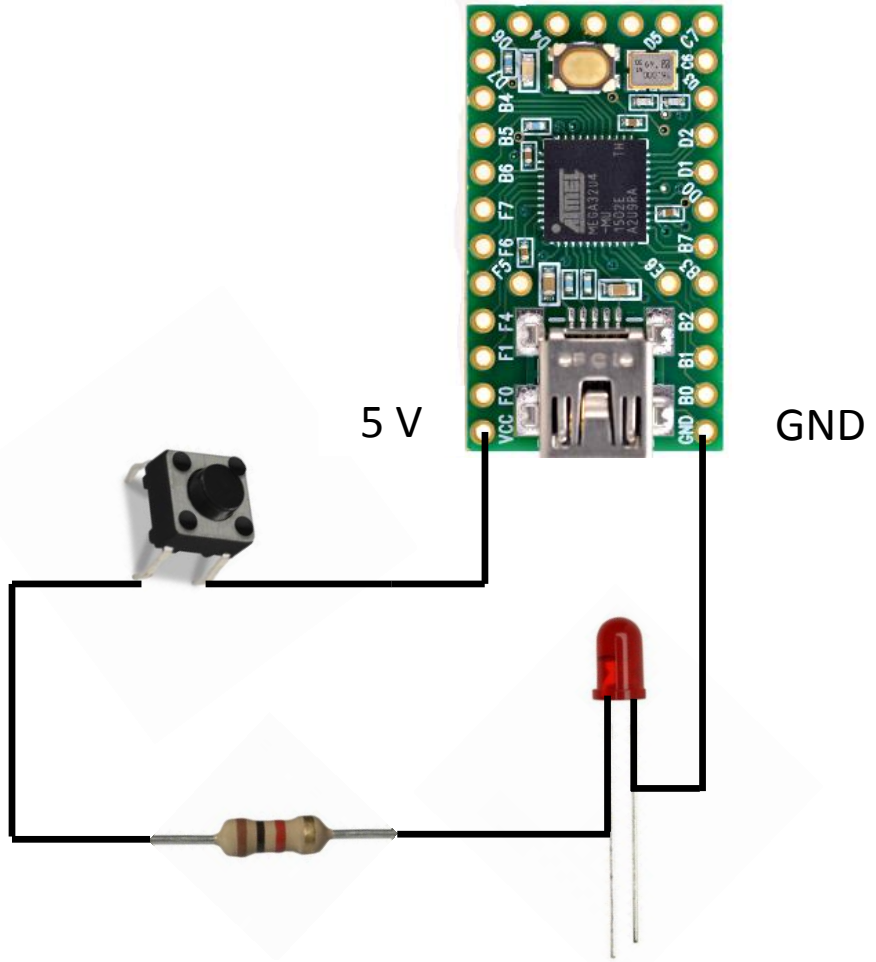


Closed
When pressed



Challenge nº2





You have 5 min!!

What is a microcontroller?

Small computer

Able to do tasks like turn on/off a LED, rotate a motor, read values from different sensors, etc...

It's the brain off the project

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Small computer

Able to do tasks like turn on/off a LED, rotate a motor, read values from different sensors, etc...

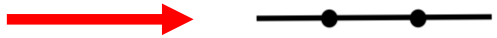
It's the brain off the project

What is a microcontroller?

The teensy 2.0 has 11 digital pins, and they can be used to send or read signals

They only have 2 states:

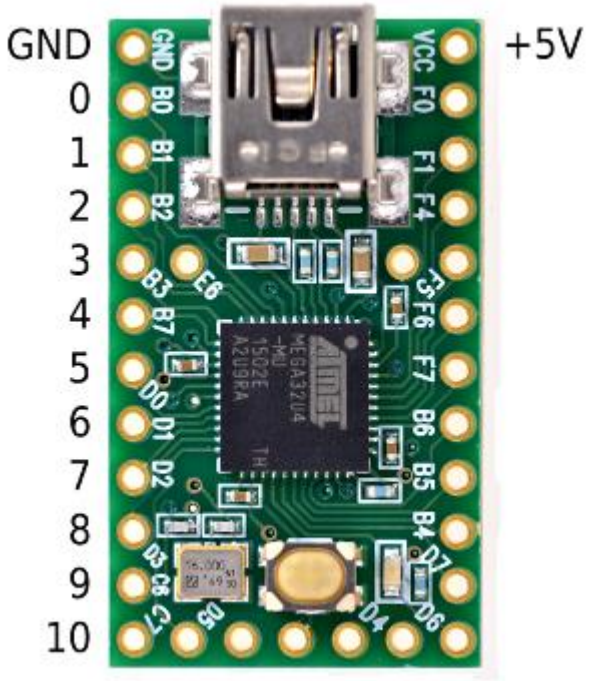
- 1 (High state)



- 0 (Low state)

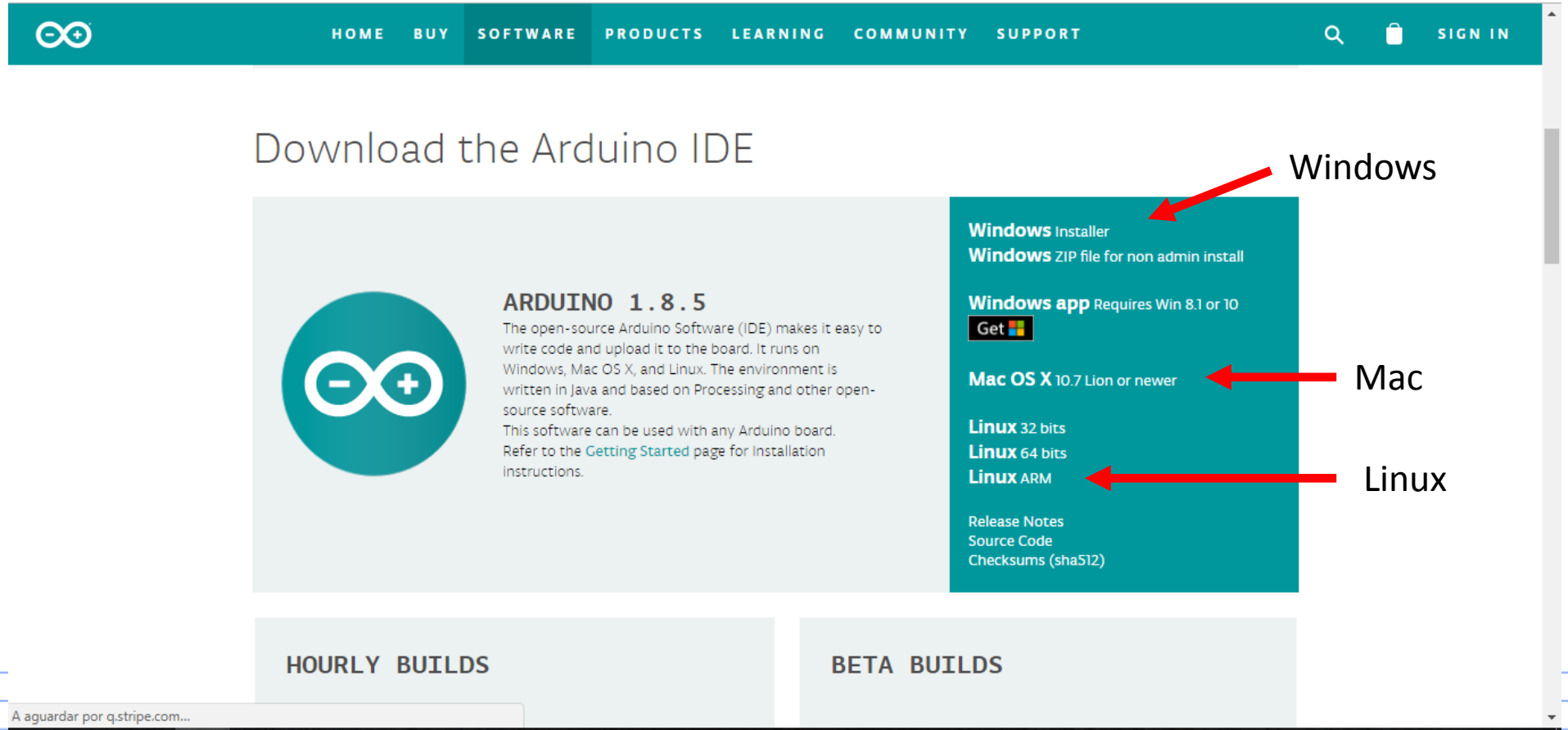
Like the push button, when it's activated the current will flow from the pin to the component that is connected to it

Digital Pins

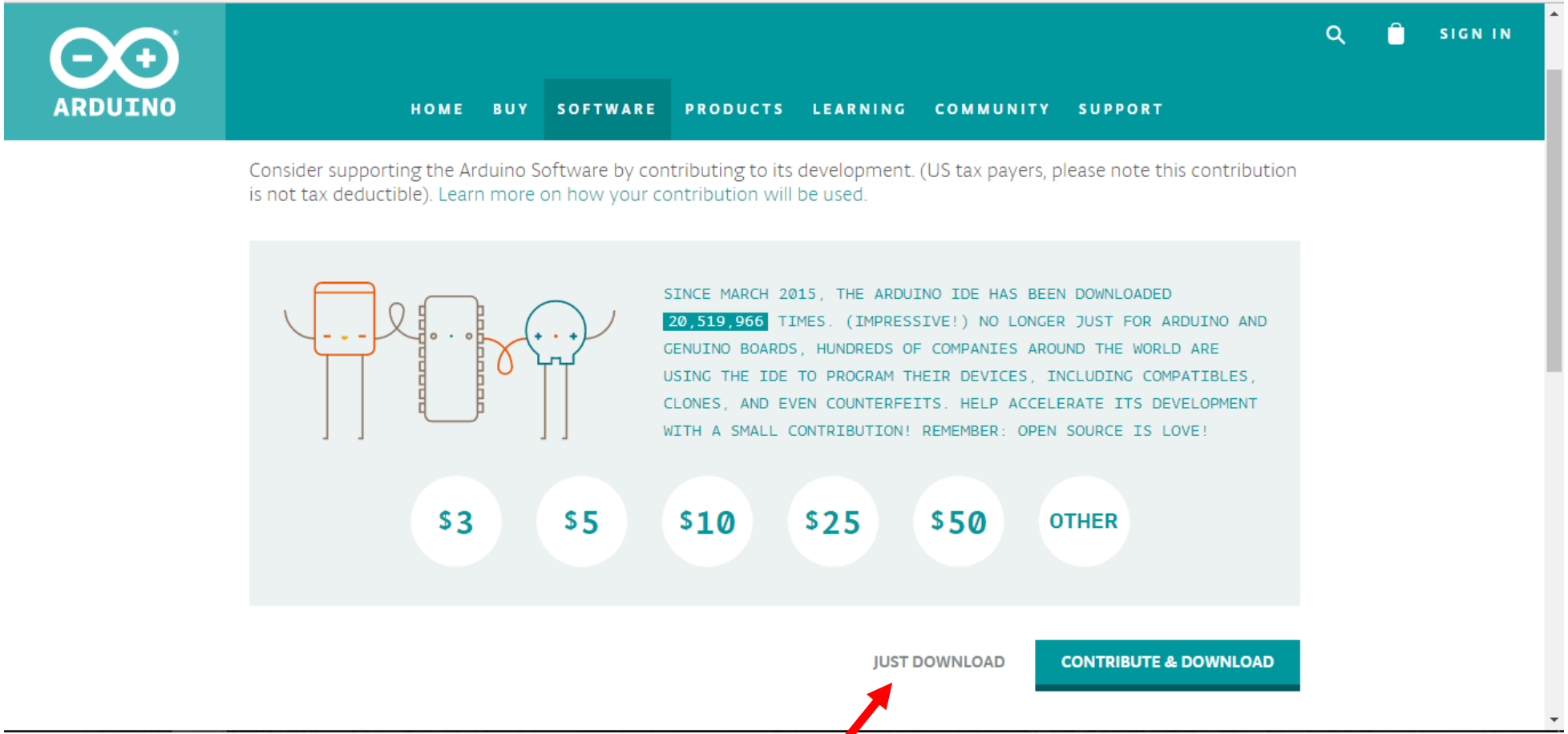


Install the software

Go to this link : https://www.arduino.cc/en/main/software



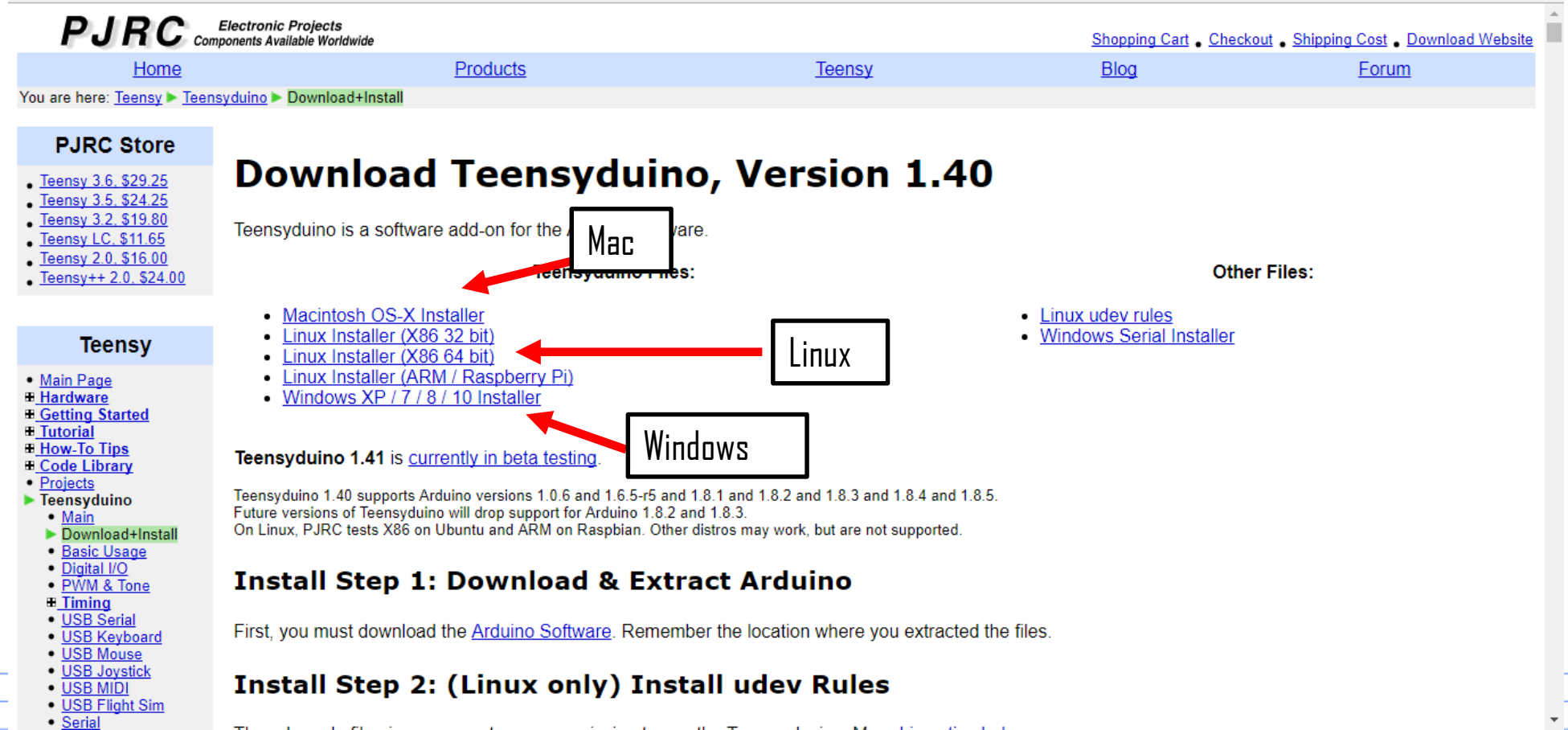
Install the software



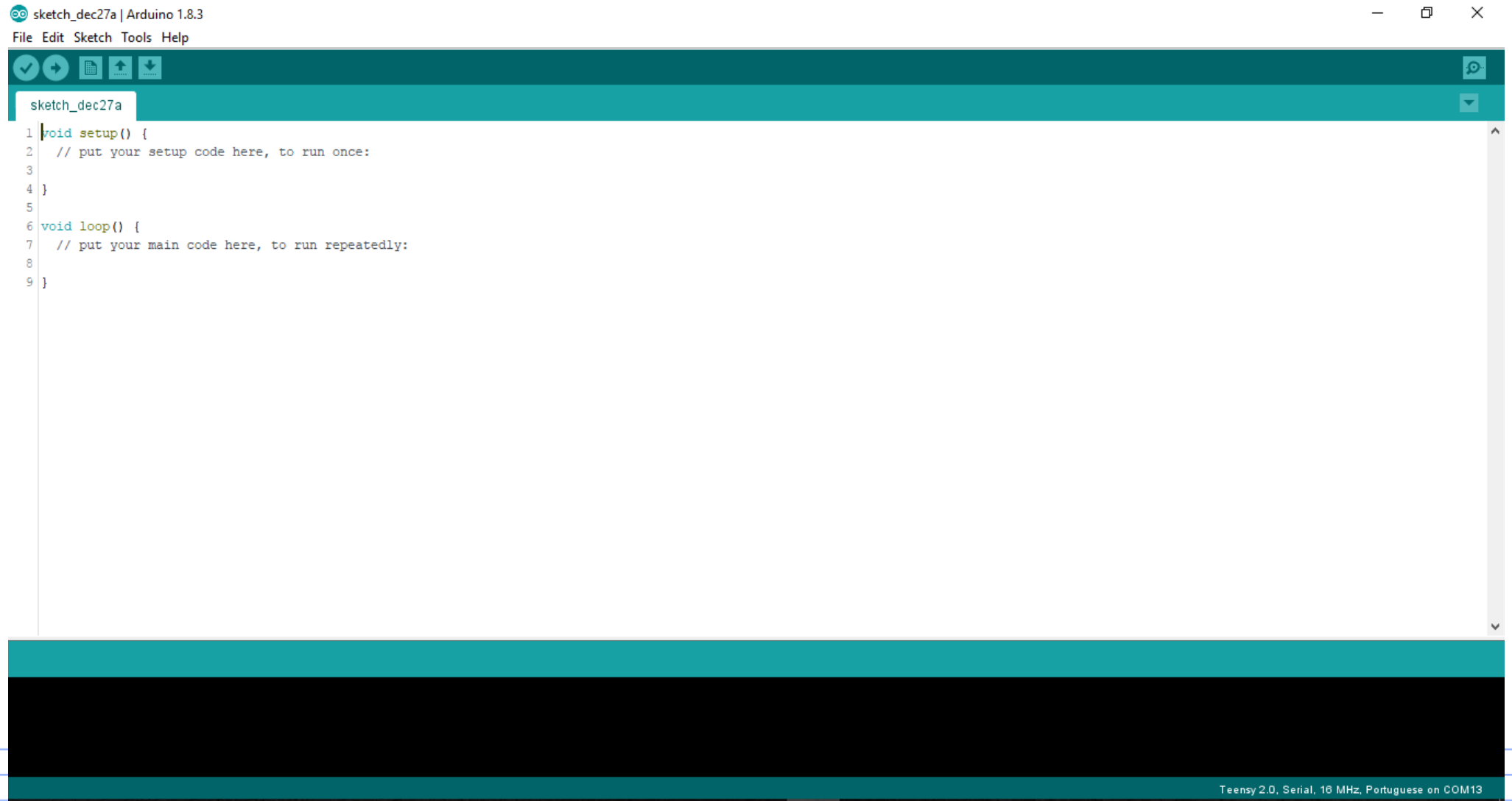
Download it

Install teensy driver

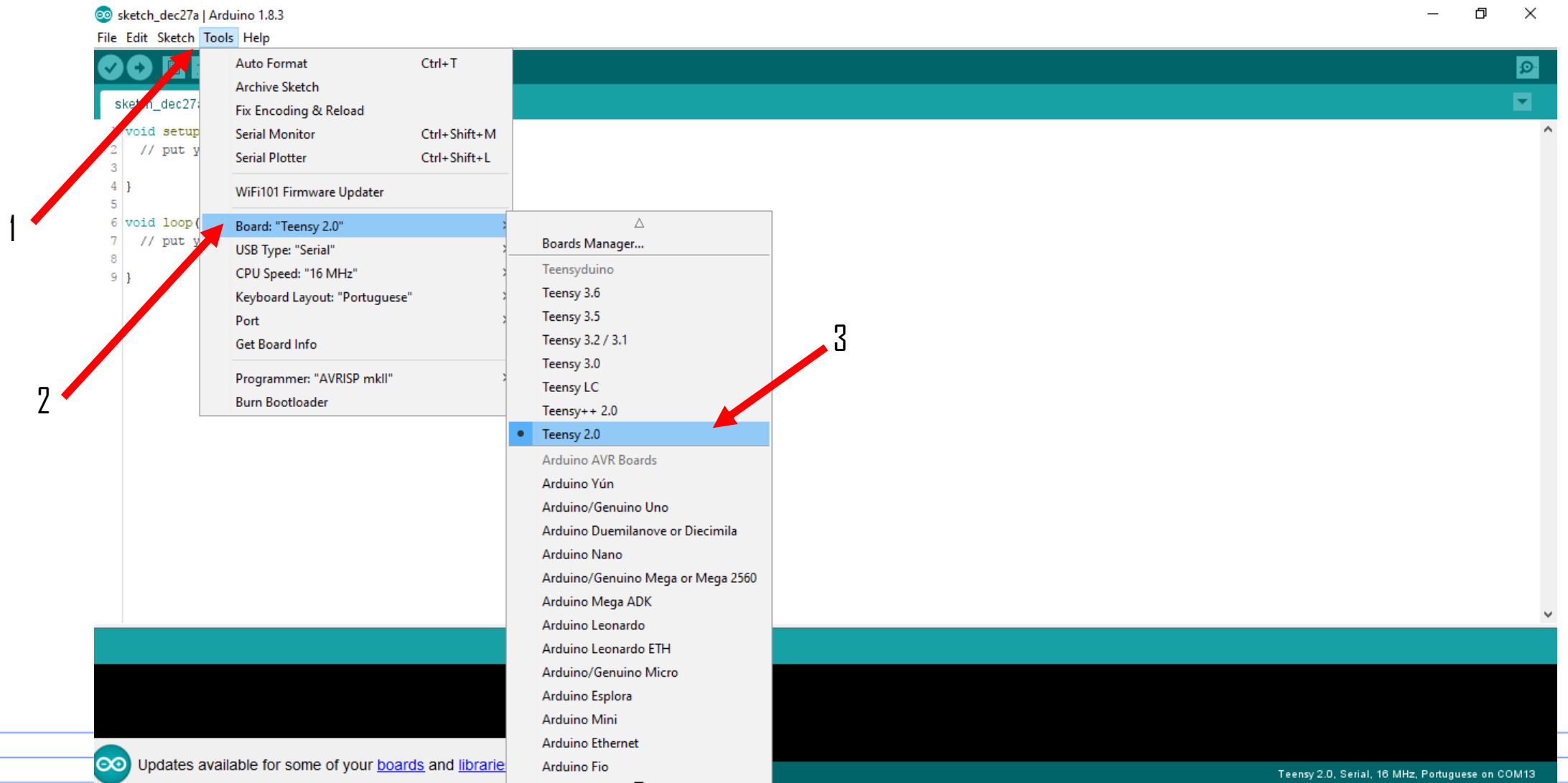
Go to this link : https://www.pjrc.com/teensy/td_download.html



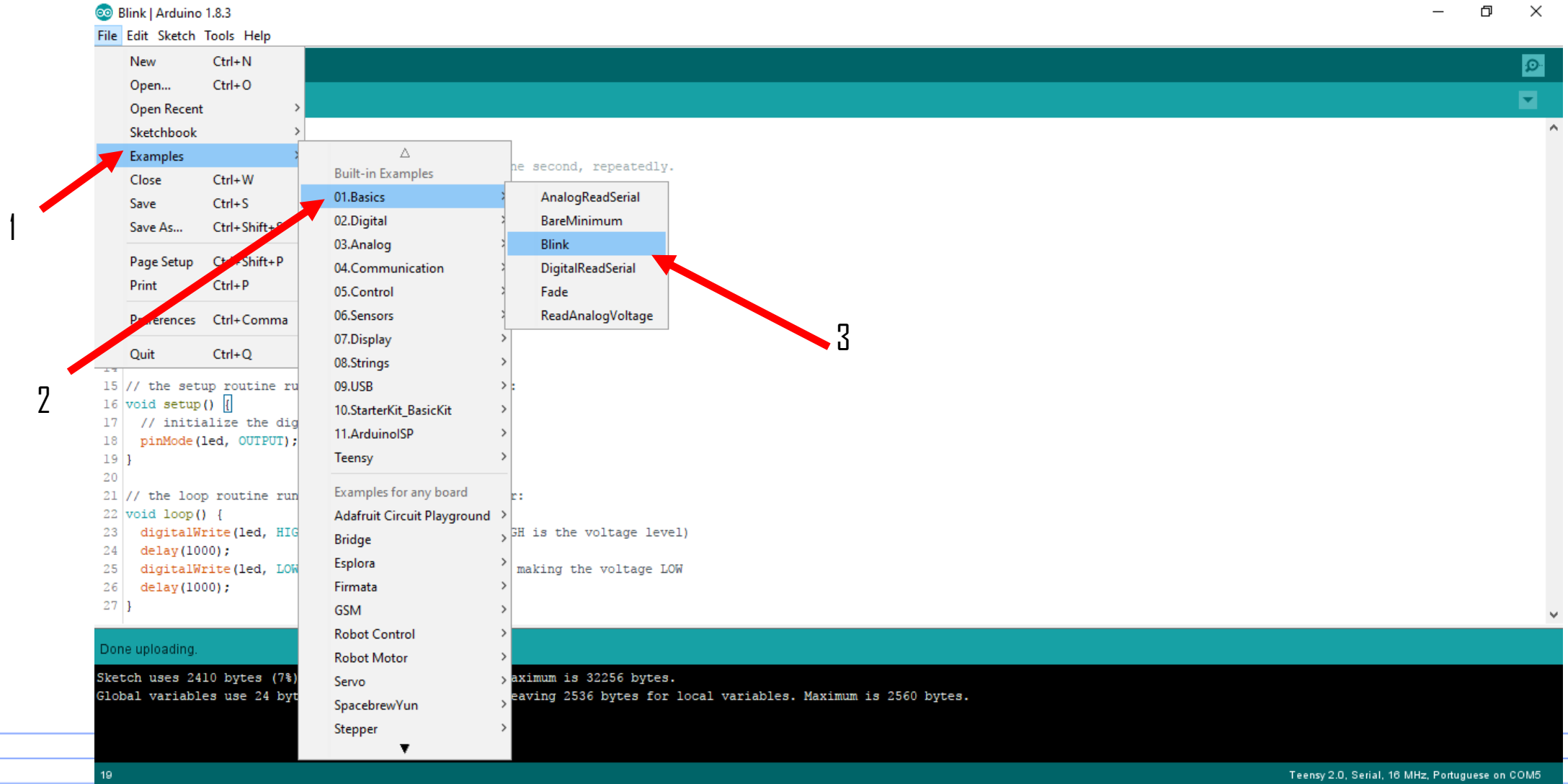
Arduino IDE


sketch_dec27a | Arduino 1.8.3
File Edit Sketch Tools Help
sketch_dec27a
void setup() {
// put your setup code here, to run once:
}
void loop() {
// put your main code here, to run repeatedly:
}
Teensy 2.0, Serial, 16 MHz, Portuguese on COM13

Arduino IDE


sketch_dec27a | Arduino 1.8.3
File Edit Sketch Tools Help
Auto Format Ctrl+T
Archive Sketch
Fix Encoding & Reload
Serial Monitor Ctrl+Shift+M
Serial Plotter Ctrl+Shift+L
WiFi101 Firmware Updater
Board: "Teensy 2.0"
USB Type: "Serial"
CPU Speed: "16 MHz"
Keyboard Layout: "Portuguese"
Port
Get Board Info
Programmer: "AVRISP mkII"
Burn Bootloader
Boards Manager...
Teensyduino
Teensy 3.6
Teensy 3.5
Teensy 3.2 / 3.1
Teensy 3.0
Teensy LC
Teensy++ 2.0
Teensy 2.0
Arduino AVR Boards
Arduino Yún
Arduino/Genuino Uno
Arduino Duemilanove or Diecimila
Arduino Nano
Arduino/Genuino Mega or Mega 2560
Arduino Mega ADK
Arduino Leonardo
Arduino Leonardo ETH
Arduino/Genuino Micro
Arduino Esplora
Arduino Mini
Arduino Ethernet
Arduino Fio
Updates available for some of your boards and librarie
Teensy 2.0, Serial, 16 MHz, Portuguese on COM13
1
2
3

Arduino IDE

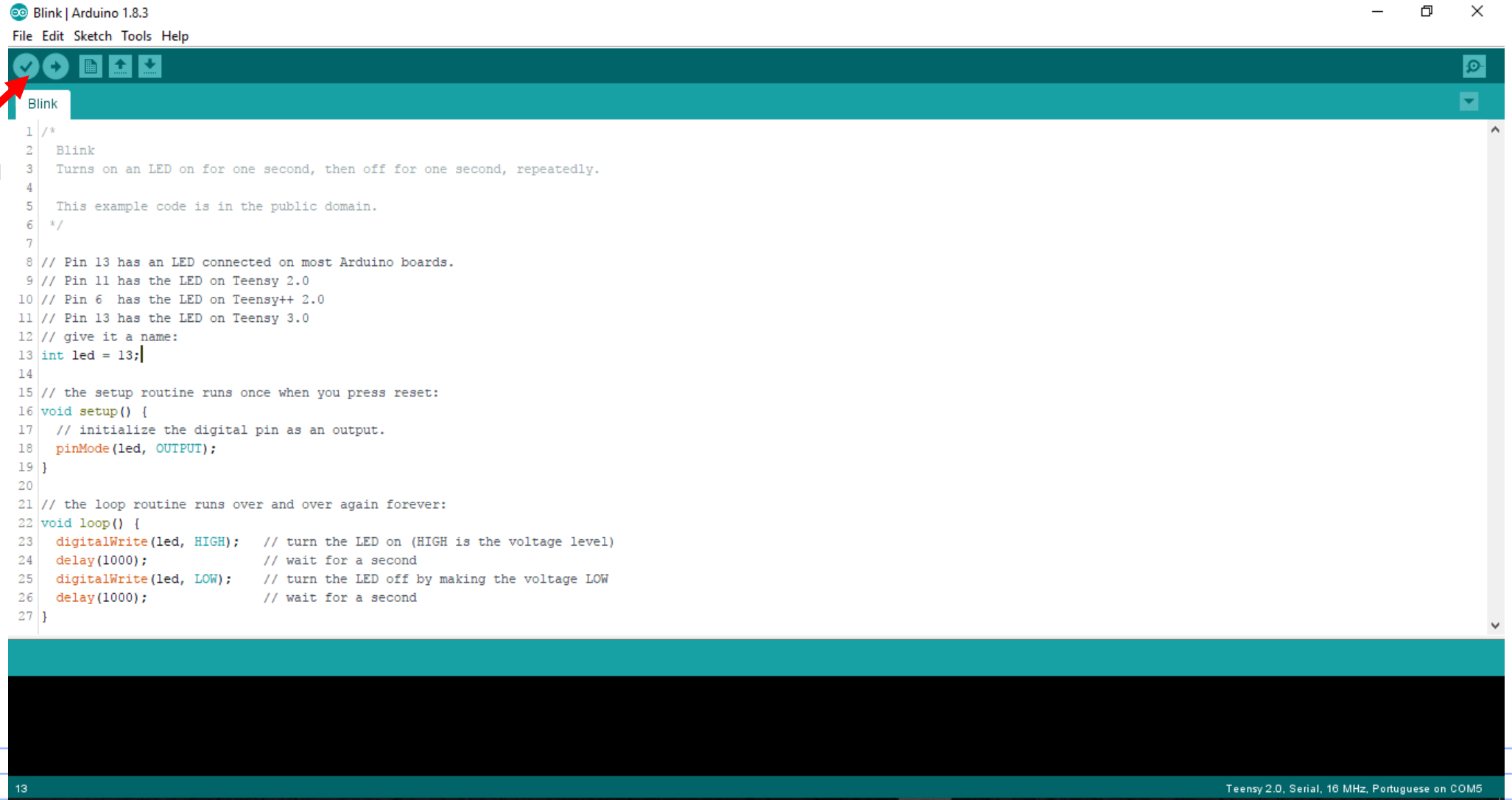

Blink | Arduino 1.8.3
File Edit Sketch Tools Help
New Ctrl+N
Open... Ctrl+O
Open Recent
Sketchbook
Examples
Close Ctrl+W
Save Ctrl+S
Save As... Ctrl+Shift+S
Page Setup Ctrl+Shift+P
Print Ctrl+P
Preferences Ctrl+Comma
Quit Ctrl+Q
Built-in Examples
01.Basics
02.Digital
03.Analog
04.Communication
05.Control
06.Sensors
07.Display
08.Strings
09.USB
10.StarterKit_BasicKit
11.ArduinoISP
Teensy
Examples for any board
Adafruit Circuit Playground
Bridge
Esplora
Firmata
GSM
Robot Control
Robot Motor
Servo
SpacebrewYun
Stepper
AnalogReadSerial
BareMinimum
Blink
DigitalReadSerial
Fade
ReadAnalogVoltage
1
2
3
Done uploading.
Teensy 2.0, Serial, 16 MHz, Portuguese on COM5

Arduino IDE

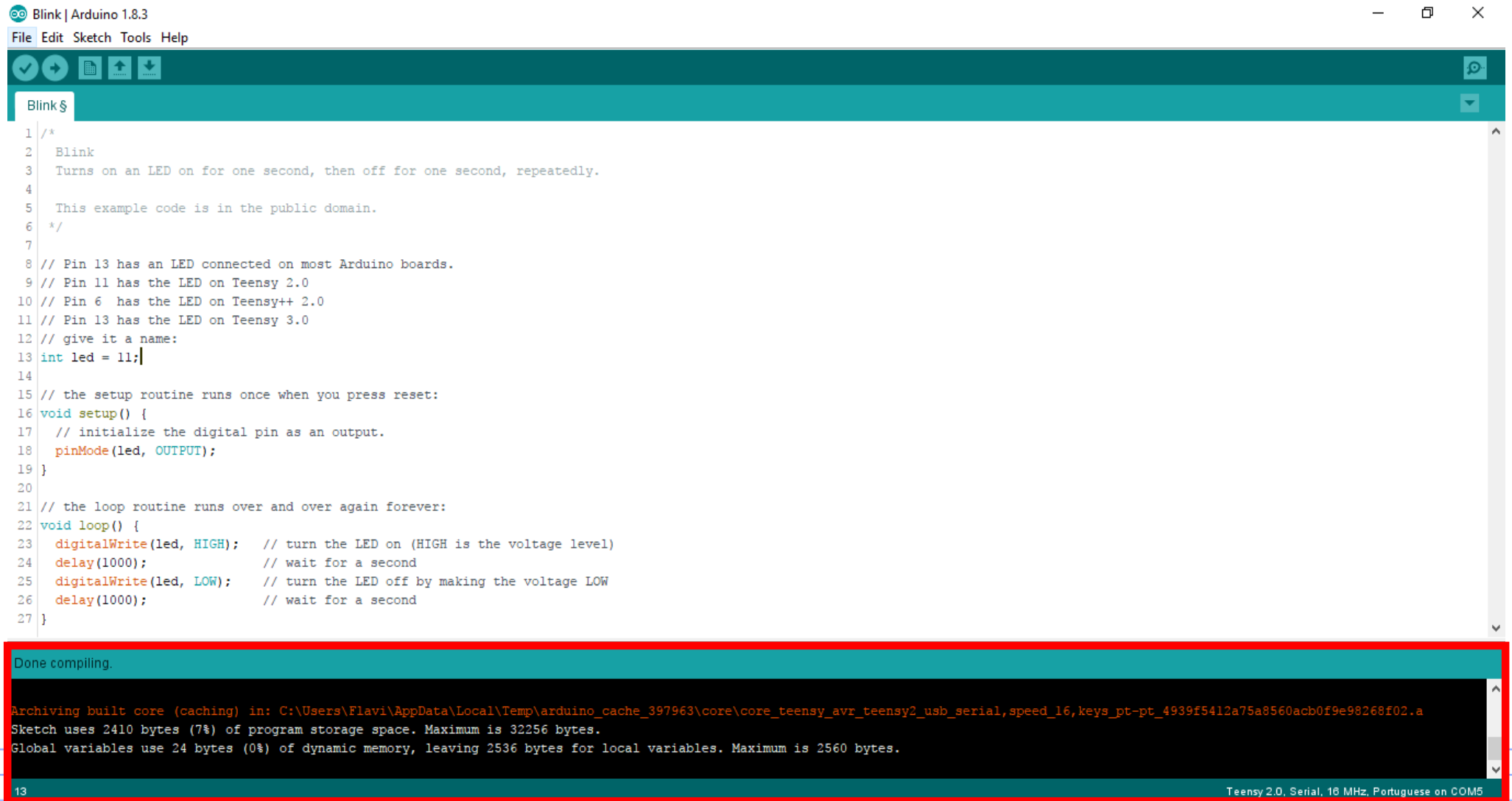

Blink | Arduino 1.8.3
File Edit Sketch Tools Help
Blink
/*
Blink
Turns on an LED on for one second, then off for one second, repeatedly.
This example code is in the public domain.
*/
// Pin 13 has an LED connected on most Arduino boards.
// Pin 11 has the LED on Teensy 2.0
// Pin 6 has the LED on Teensy++ 2.0
// Pin 13 has the LED on Teensy 3.0
// give it a name:
int led = 13;
Change 13 to 11
// the setup routine runs once when you press reset:
void setup() {
// initialize the digital pin as an output.
pinMode(led, OUTPUT);
}
// the loop routine runs over and over again forever:
void loop() {
digitalWrite(led, HIGH); // turn the LED on (HIGH is the voltage level)
delay(1000); // wait for a second
digitalWrite(led, LOW); // turn the LED off by making the voltage LOW
delay(1000); // wait for a second
}
13
Teensy 2.0, Serial, 16 MHz, Portuguese on COM5

Arduino IDE

Click on Verify

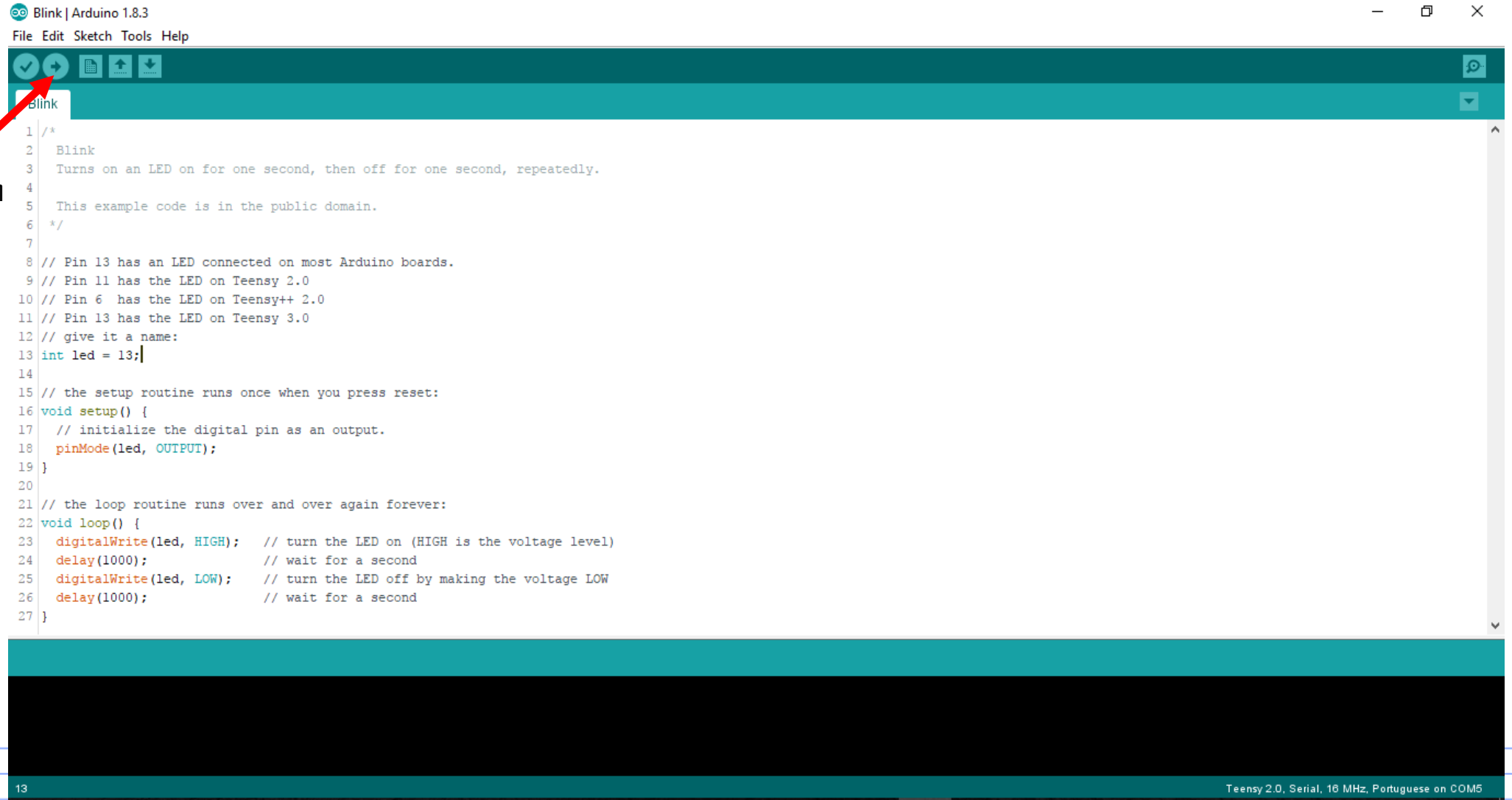


Arduino IDE

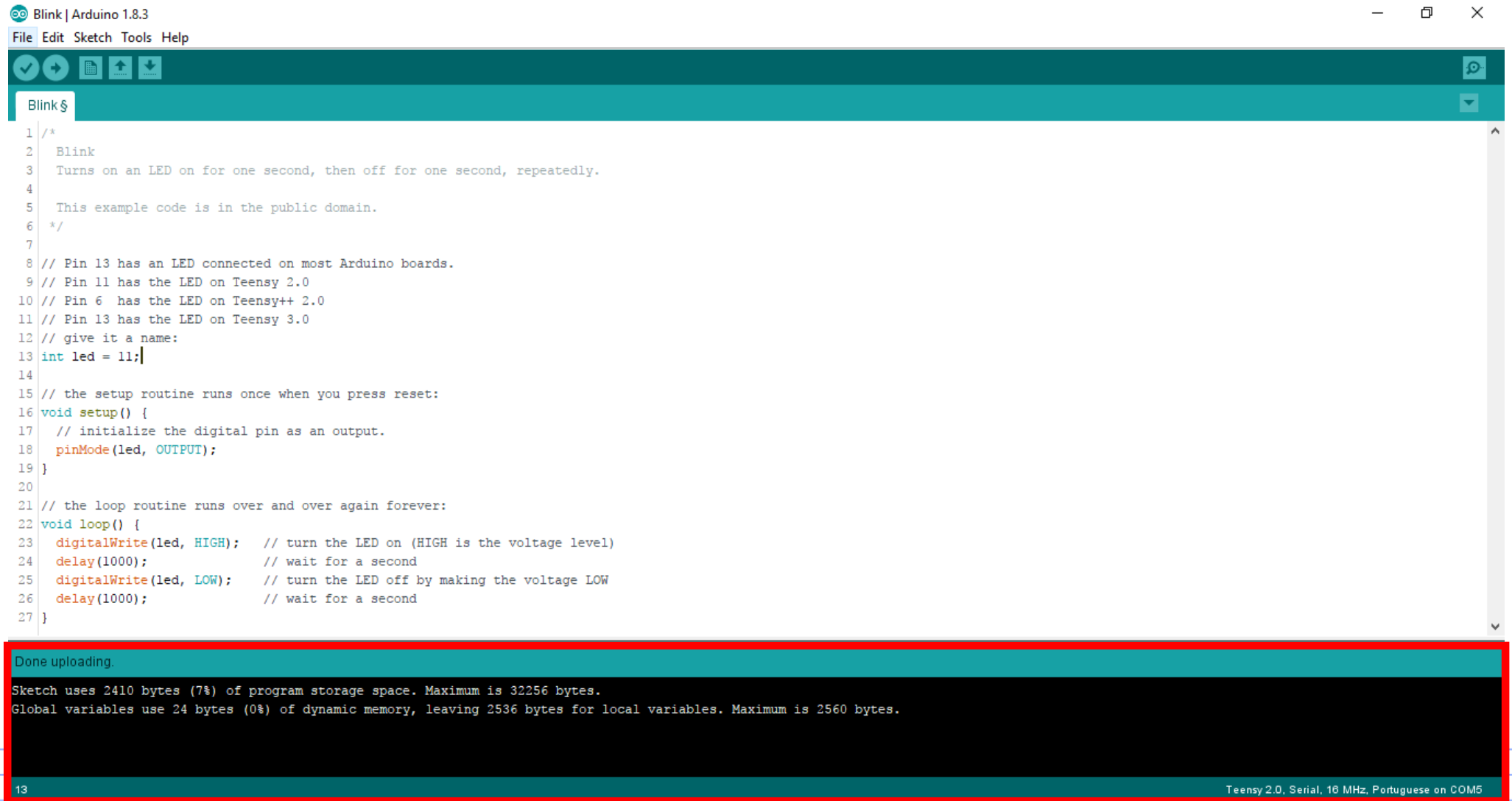

Blink | Arduino 1.8.3
File Edit Sketch Tools Help
Blink §
/*
Blink
Turns on an LED on for one second, then off for one second, repeatedly.
This example code is in the public domain.
*/
// Pin 13 has an LED connected on most Arduino boards.
// Pin 11 has the LED on Teensy 2.0
// Pin 6 has the LED on Teensy++ 2.0
// Pin 13 has the LED on Teensy 3.0
// give it a name:
int led = 11;
// the setup routine runs once when you press reset:
void setup() {
// initialize the digital pin as an output.
pinMode(led, OUTPUT);
}
// the loop routine runs over and over again forever:
void loop() {
digitalWrite(led, HIGH); // turn the LED on (HIGH is the voltage level)
delay(1000); // wait for a second
digitalWrite(led, LOW); // turn the LED off by making the voltage LOW
delay(1000); // wait for a second
}
Done compiling.
Archiving built core (caching) in: C:\Users\Flavi\AppData\Local\Temp\arduino_cache_397963\core\core_teensy_avr_teensy2_usb_serial,speed_16,keys_pt-pt_4939f5412a75a8560acb0f9e98268f02.a
Sketch uses 2410 bytes (7%) of program storage space. Maximum is 32256 bytes.
Global variables use 24 bytes (0%) of dynamic memory, leaving 2536 bytes for local variables. Maximum is 2560 bytes.
13
Teensy 2.0, Serial, 16 MHz, Portuguese on COM5

Arduino IDE

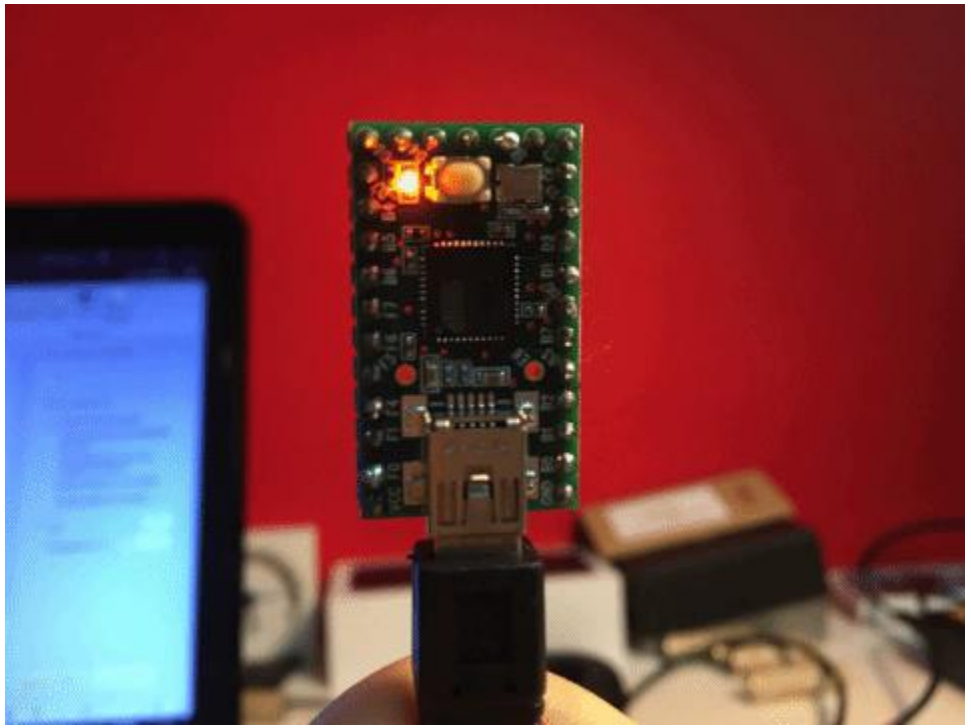
Click on upload



Arduino IDE


Blink | Arduino 1.8.3
File Edit Sketch Tools Help
Blink §
/*
Blink
Turns on an LED on for one second, then off for one second, repeatedly.
This example code is in the public domain.
*/
// Pin 13 has an LED connected on most Arduino boards.
// Pin 11 has the LED on Teensy 2.0
// Pin 6 has the LED on Teensy++ 2.0
// Pin 13 has the LED on Teensy 3.0
// give it a name:
int led = 11;
// the setup routine runs once when you press reset:
void setup() {
// initialize the digital pin as an output.
pinMode(led, OUTPUT);
}
// the loop routine runs over and over again forever:
void loop() {
digitalWrite(led, HIGH); // turn the LED on (HIGH is the voltage level)
delay(1000); // wait for a second
digitalWrite(led, LOW); // turn the LED off by making the voltage LOW
delay(1000); // wait for a second
}
Done uploading.
Sketch uses 2410 bytes (7%) of program storage space. Maximum is 32256 bytes.
Global variables use 24 bytes (0%) of dynamic memory, leaving 2536 bytes for local variables. Maximum is 2560 bytes.
13
Teensy 2.0, Serial, 16 MHz, Portuguese on COM5

Challenge nº3



MAGIC

Arduino Code

The code is always written and read from the top to bottom, and left to right

A command as always to end with a " ; " except when it's a function or a condiction

```
digitalWrite(led, HIGH);
delay(1000);
```

It's good practice to comment our code, to do that just type " // " and the rest of the text after is just comments

Arduino Code

Variables are used to store information to be used in a computer program

They also provide a way of labeling data with a descriptive name

Variables are containers that hold information

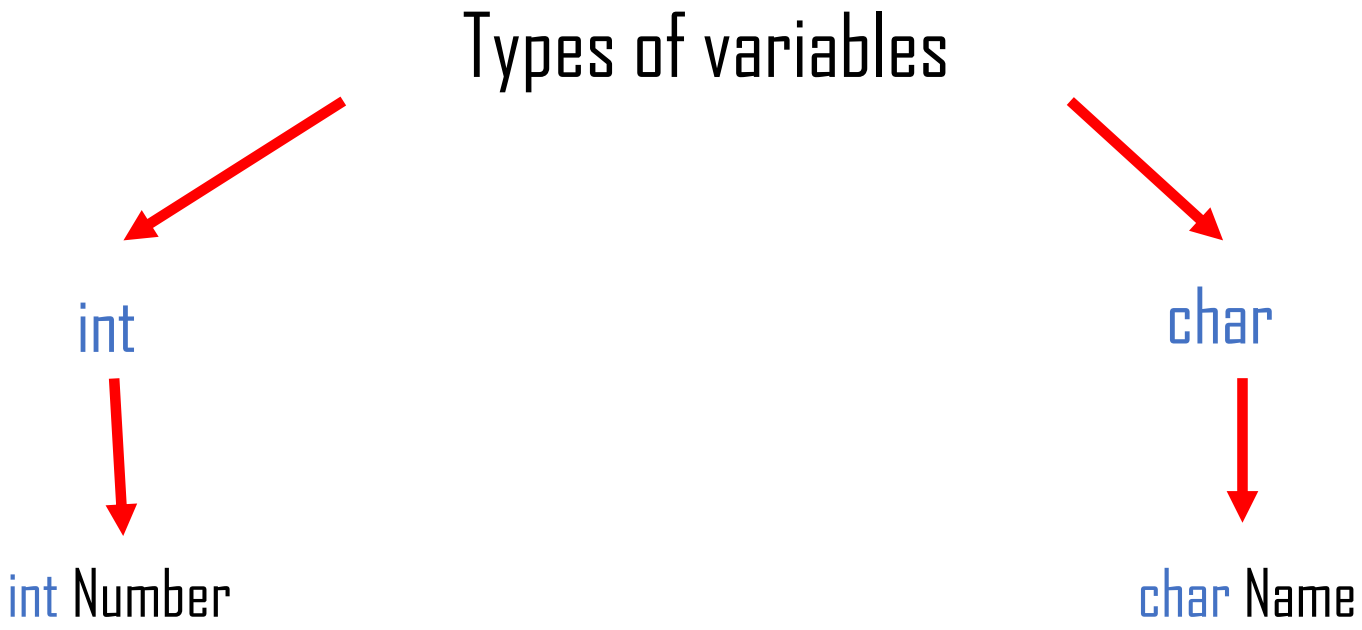
Arduino Code

Types of variables

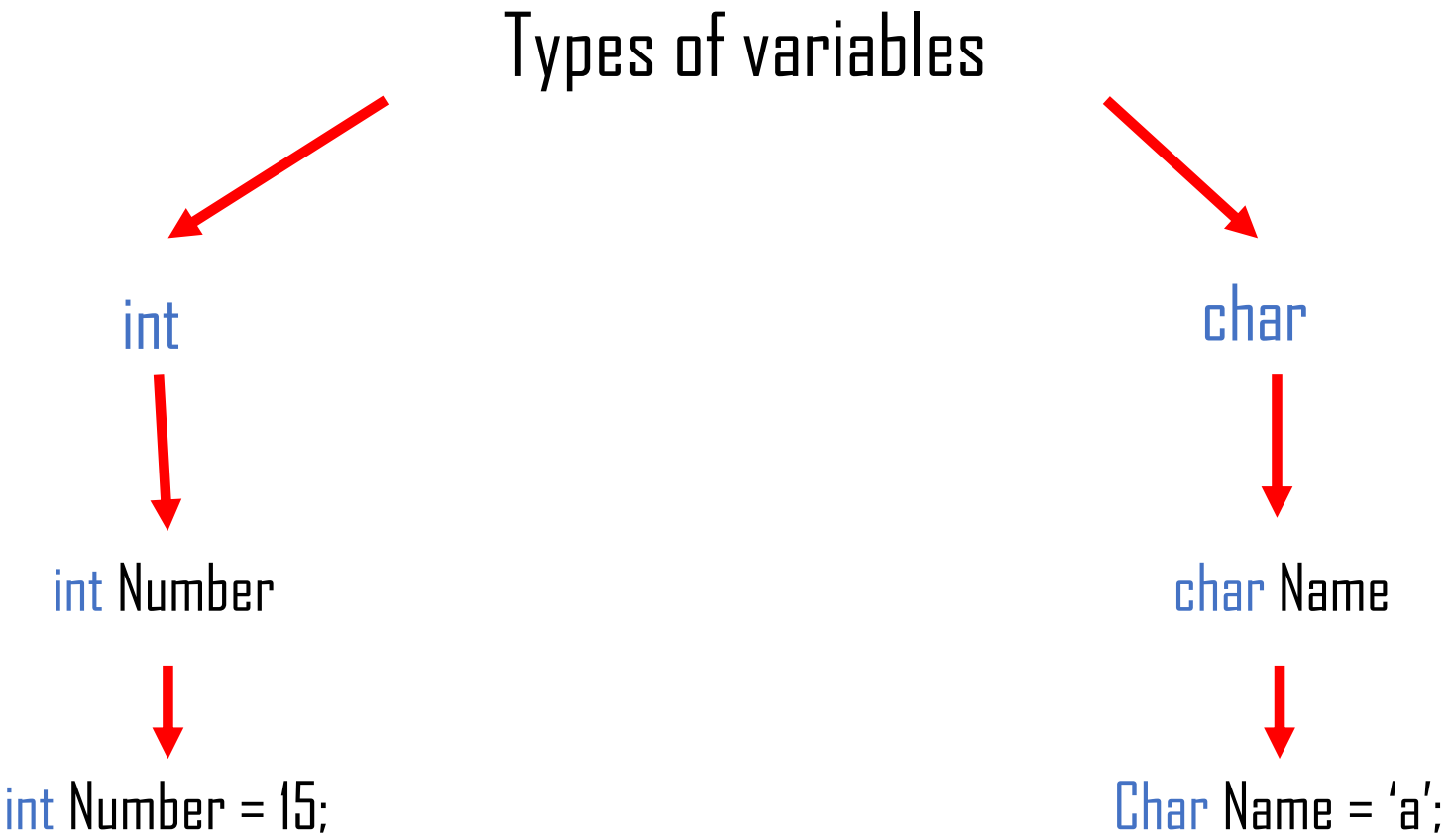
int

char

Arduino Code



Arduino Code



Arduino Code

Functions allows a programmer to create modular pieces of code

```
void name_of_the_function
{



}
```

Arduino Code

Functions allows a programmer to create modular pieces of code

```
void name_of_the_function
{

}
```

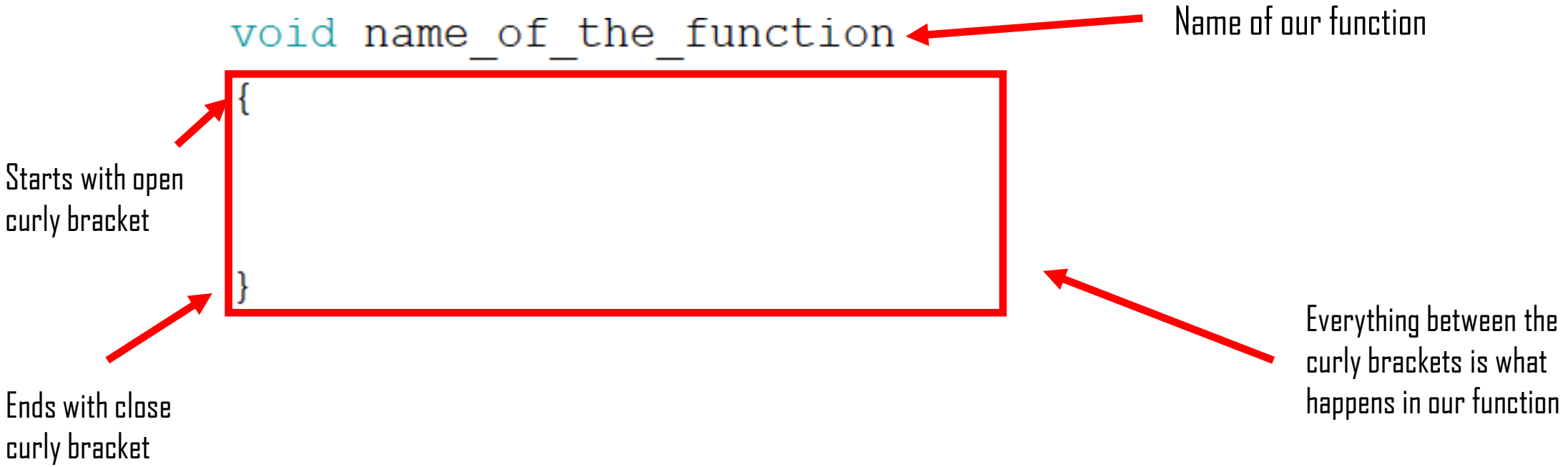
Name of our function

Starts with open curly bracket

Ends with close curly bracket

Arduino Code

Functions allows a programmer to create modular pieces of code



Arduino Code

Functions allows a programmer to create modular pieces of code

```
void setup()
{


}
```

- Used to state what we will be using in our project
- Number of LED, sensors, etc…

Arduino Code

Functions allows a programmer to create modular pieces of code

```
void setup()
{

}

void loop()
{

}
```

- Used to state what we will be using in our project
- Number of LED, sensors, etc…

- Where the action begins
- Happens in a infinit loop

Arduino Code

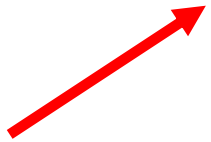
Arduino has built-in functions that can be use for different situations

Arduino Code

Arduino has built-in functions that can be use for different situations

When we want to use a LED:

```
pinMode( 13 , OUTPUT);
```



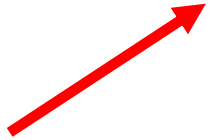
Function to configures the specified pin to behave either as an input or an output

Arduino Code

Arduino has built-in functions that can be use for different situations

When we want to use a LED:

```
pinMode( 13 , OUTPUT);
```



Function to configures the specified pin to behave either as an input or an output

Number of the pin

Arduino Code

Arduino has built-in functions that can be use for different situations

When we want to use a LED:

```
pinMode( 13 , OUTPUT);
```

Function to configures the specified pin to behave either as an input or an output

Number of the pin

Direction of the signal

Arduino Code

Arduino has built-in functions that can be use for different situations

When we want to use a LED:

```
digitalWrite( 13 , HIGH);
```

Arduino Code

```
int led = 11 ;

// the setup routine runs once when you press reset:
void setup()
{
  pinMode(led, OUTPUT);
}

// the loop routine runs over and over again forever:
void loop()
{
  digitalWrite(led, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);               // wait for a second
  digitalWrite(led, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);               // wait for a second
}
```

Arduino Code

```
// the setup routine runs once when you press reset:
void setup()
{
  int led = 11 ;
  pinMode(led, OUTPUT);
}

// the loop routine runs over and over again forever:
void loop()
{
  digitalWrite(led, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);               // wait for a second
  digitalWrite(led, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);               // wait for a second
}
```

Arduino Code

'led' was not declared in this scope

```
Blink: In function 'void loop()':
Blink:13: error: 'led' was not declared in this scope
   digitalWrite(led, HIGH);   // turn the LED on (HIGH is the voltage level)
                ^
```

13

Arduino Code

Global variable

When a variable it's declare outside of the functions it can be used by any of them

```
int led = 13;

// the setup routine runs once
void setup()
{
  pinMode(led, OUTPUT);
}
```

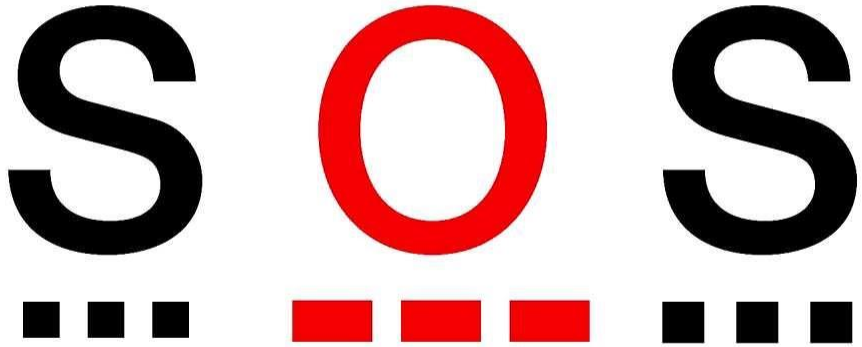
Local variable

When a variable it's define in a function, it can only be used inside the function

```
void setup()
{
  int led = 13;
  pinMode(led, OUTPUT);
}
```

Challenge nº 4

Send a S.O.S. signal from arduino with the built-in LED



You have 15 minutes!!

Using teensy to read a signal

Now you learn how to use the teensy to read a signal

To do that, we will be using a push botton to send the signal to the teensy

Depending on the state off the pin that we will read, the LED should be on or off

Using teensy

Use the PIN 0 of teensy to read a signal

```
pinMode( 0 ,  INPUT );
```

Function to configures the specified pin to behave either as an input or an output

Number of the pin

Direction of the signal

```
digitalRead(0)
```

Function that returns the state of the pin

PIN to read

Using teensy

If condition is used to compare values and take action according to the result

```
if (digitalRead(0) == HIGH)
{
  digitalWrite(led,HIGH);
} else
{

  digitalWrite(led,LOW);
}
```

Our condition

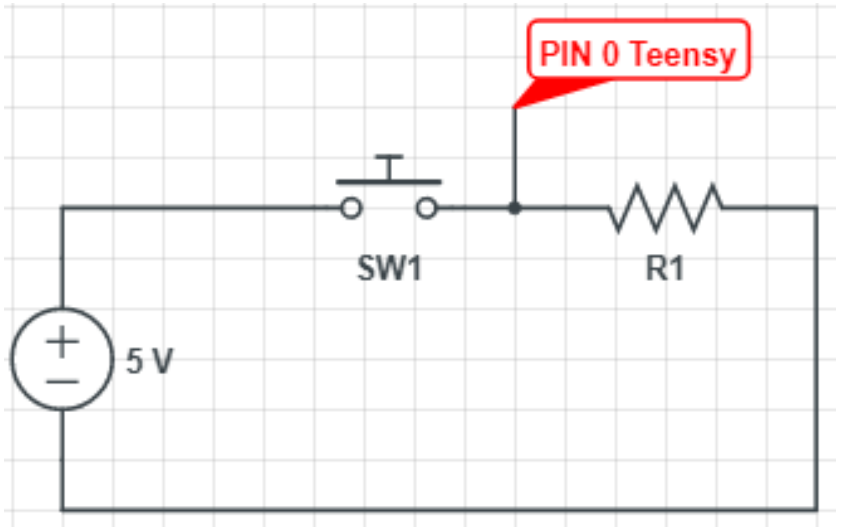
True

False

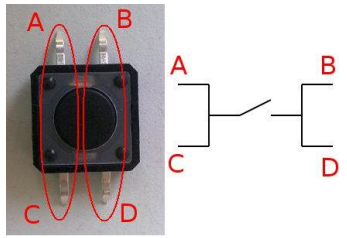
= to assign values

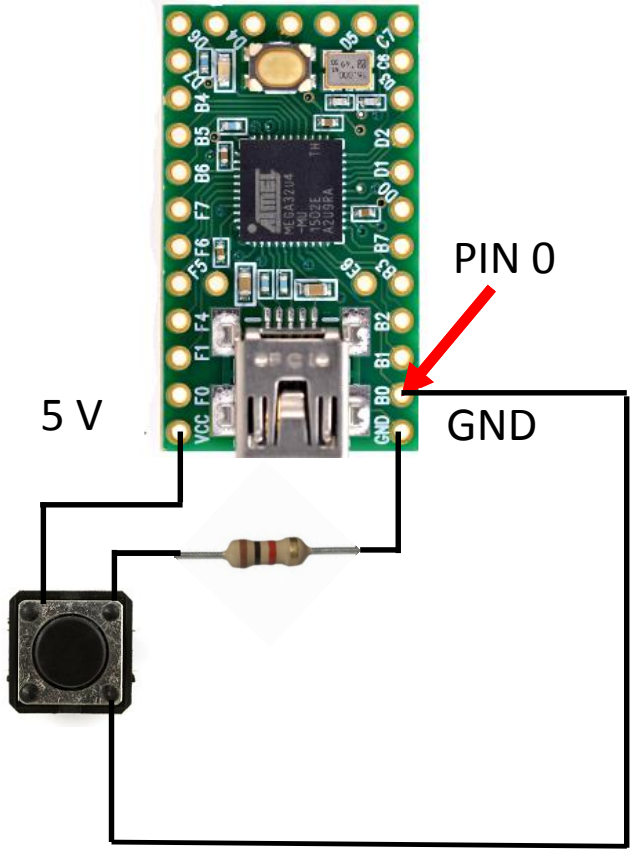
== to compare values

Challenge nº 5



Send the S.O.S. only when you press the push button

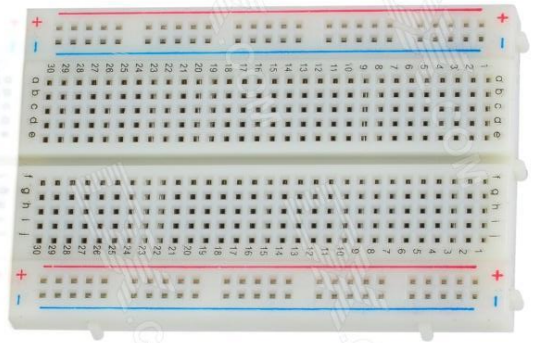




You have 10 minutes!!

The Big Challenge

Create a game of your own using:



You have 90 minutes!!