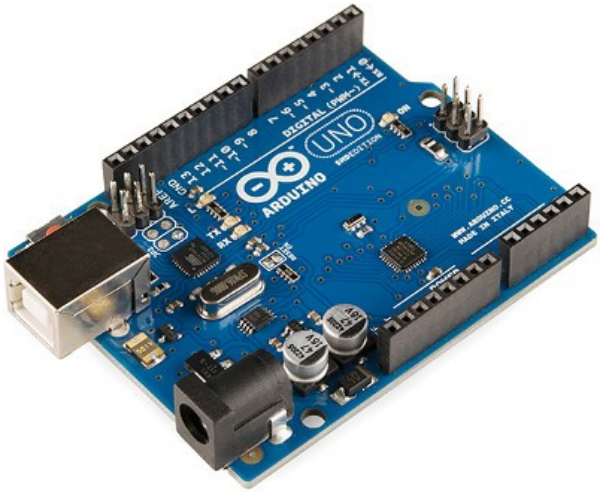
# What is an Arduino?




Short Answer:
This is an Arduino...

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# What is an Arduino?

- First we'll need to know what is a "micro-controller"


ATtiny 85

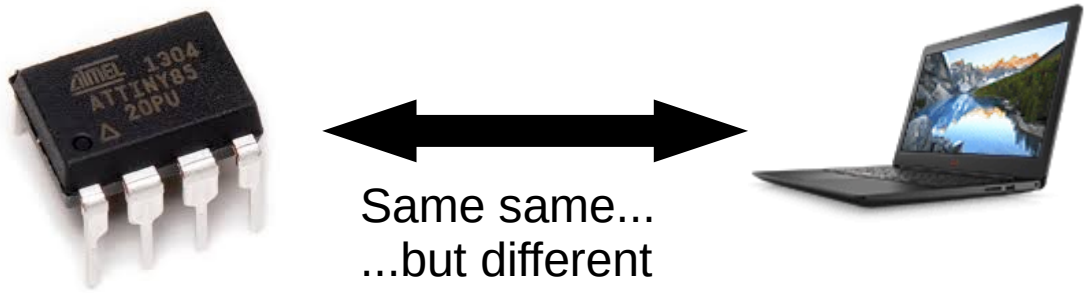
ATmega 328

# What is an Arduino?

**Micro-controllers are...**

Like a miniature computers...

- Contains processor, RAM, storage, and more
- Can be programmed like a computer




Same same...
...but different

Unlike a computer...

- Provides direct electrical connection to external devices
- Can’t run Minecraft or Fortnite...



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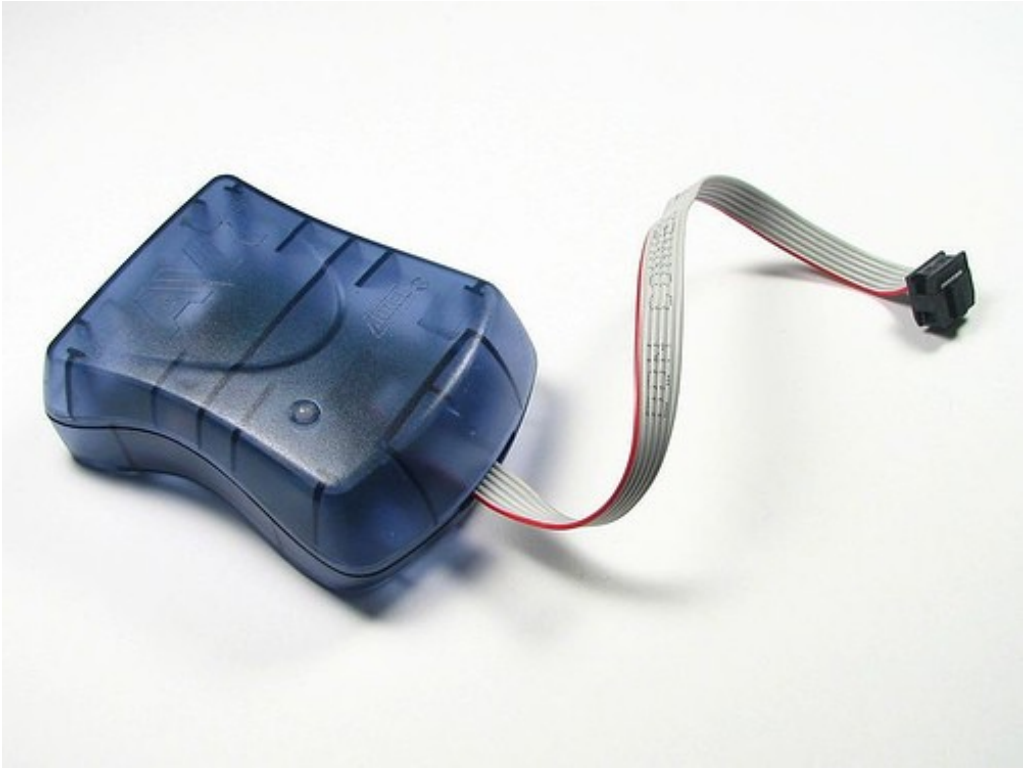
# What is an Arduino?

## Micro-controllers can be a pain…

- Require a special device to program...



AVRISP (In-System Programmer)



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# What is an Arduino?

## Micro-controllers can be a pain…

- Difficult to read code, that's different depending on the model...

```
// Enable ADC in single mode and slow clk pre-scaler.
ADMUX = _BV(REFS0) | _BV(MUX2) | _BV(ADLAR);
ADCSRA = _BV(ADEN) | _BV(ADPS2);

ADCSRA |= _BV(ADSC); // Trigger read

while (ADCSRA & _BV(ADSC))
  ; // Wait for completion

temperature = (float) ADCL / 256.0;
temperature += ADCH;
```

Code for ATmega8
(Doesn't work for all microcontrollers)

```
temperature = analogRead(sensorPin);
```

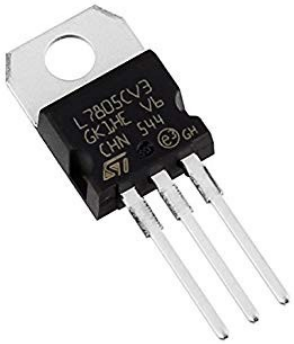
Code for Arduino
(Work on all Arduinos)

Both of these codes do the same thing!

# What is an Arduino?

## Micro-controllers can be a pain…

- Require external parts to work (eg. voltage regulator, crystal oscillator, decoupling capacitors)




Voltage Regulator
(...this is the simple type)


Crystal Oscillator


Capacitor



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# What is an Arduino?

## So what is an Arduino?

- Combines a micro-controller with all the other components into a single device




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# Exercise 1a
# External LEDs

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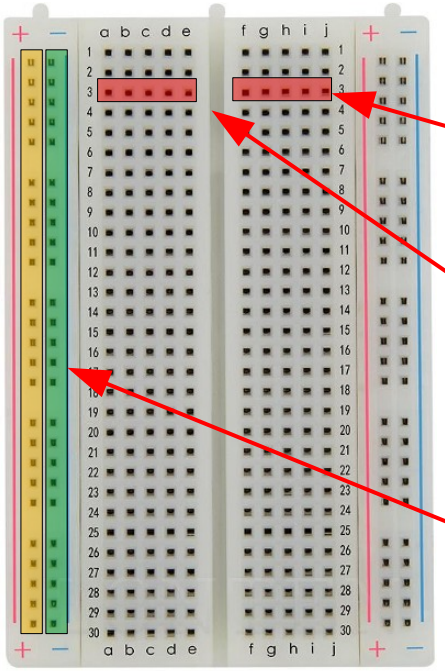
# Breadboard

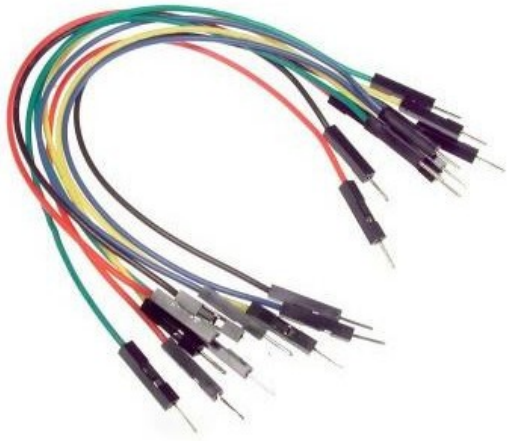
- Helps to make electrical connections
- Many components (eg. LEDs) can be plugged in directly
- Use dupont wires to make connections



**Holes in the same row are connected**

**No connection across center gap**

**Holes by the side are connected vertically across entire board**



**Dupont wires**
The colors doesn't matter; they all work the same



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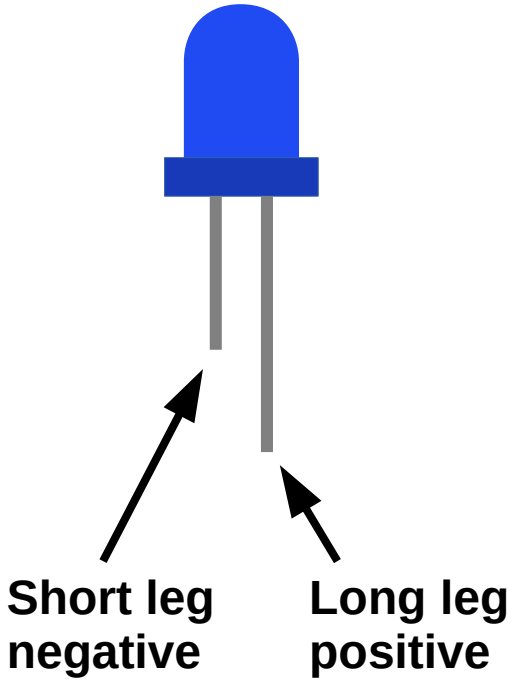
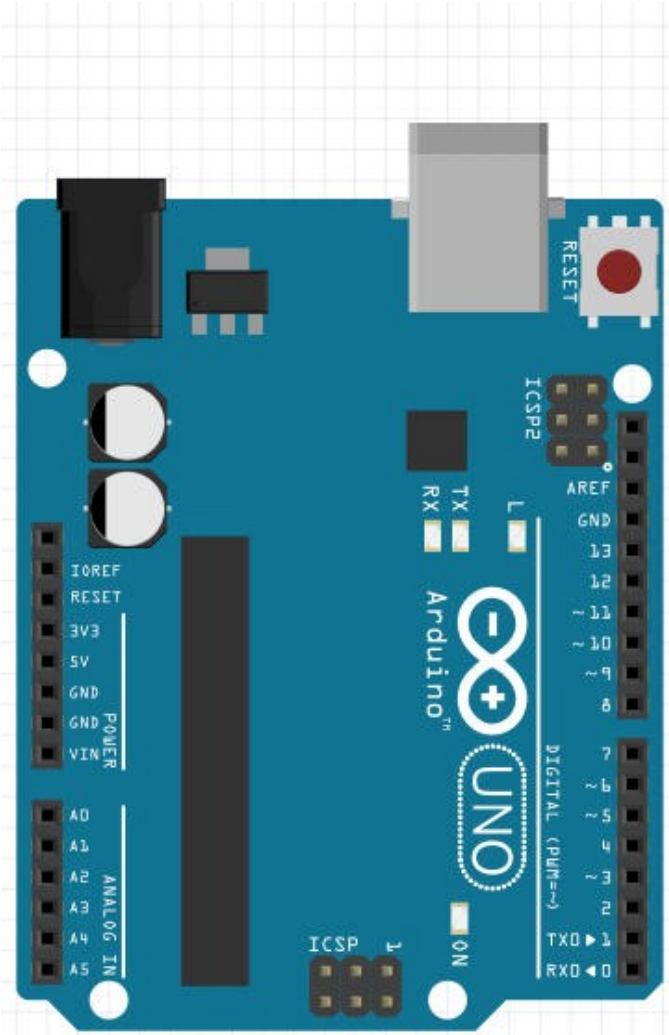
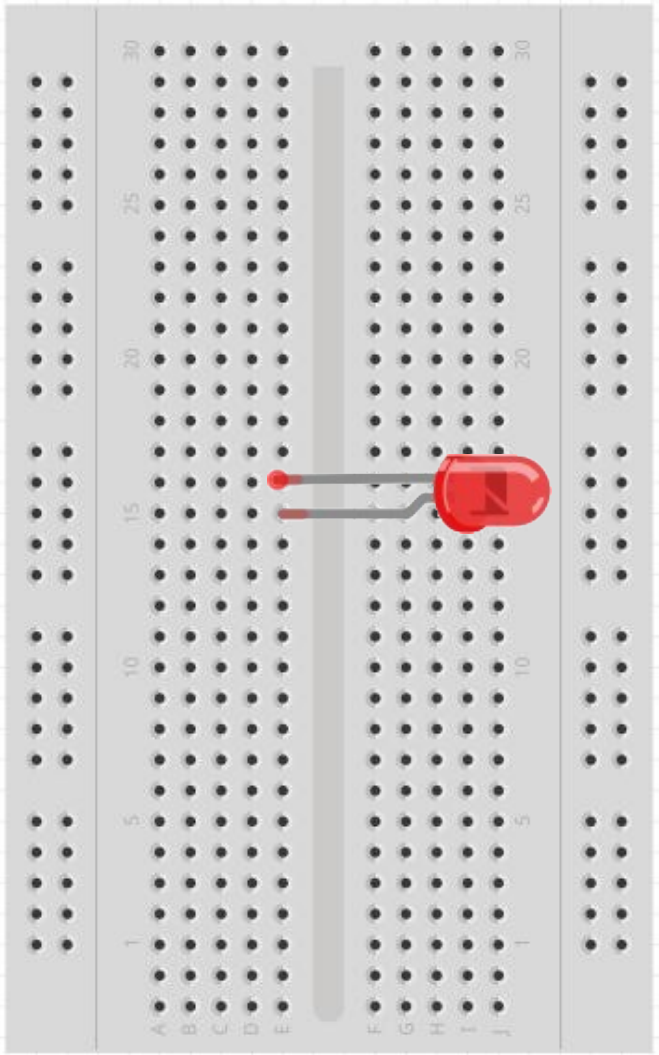
# LED

- Light Emitting Diode
- Longer leg connects to positive
- Shorter leg connects to ground (0V)
- **Doesn’t work if connected in reverse**



# Connecting an LED



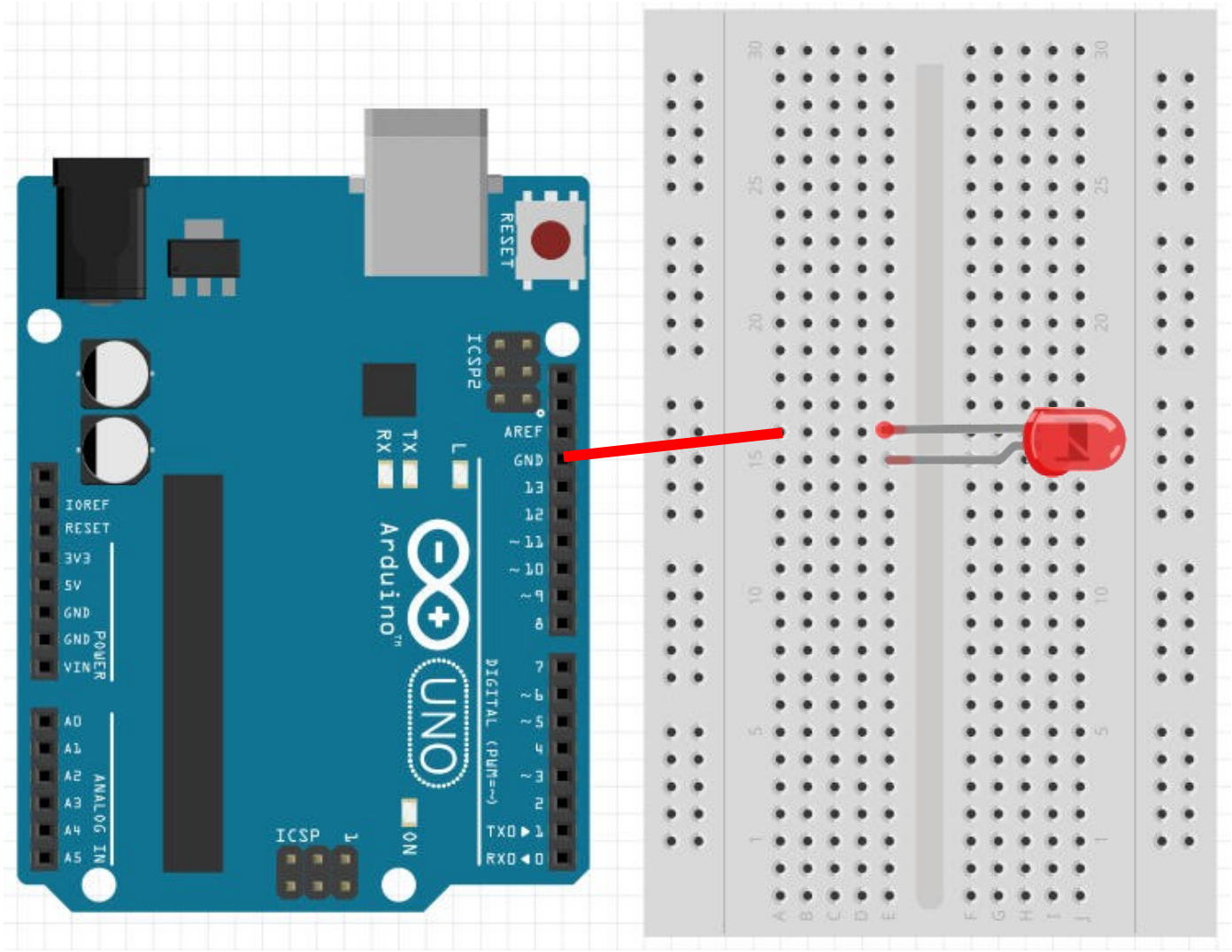



**Important!!!**
**Take note of which leg of the LED is longer**

**In this example, the bottom leg is longer.**

**Long leg : Positive**
**Short leg : Gnd**

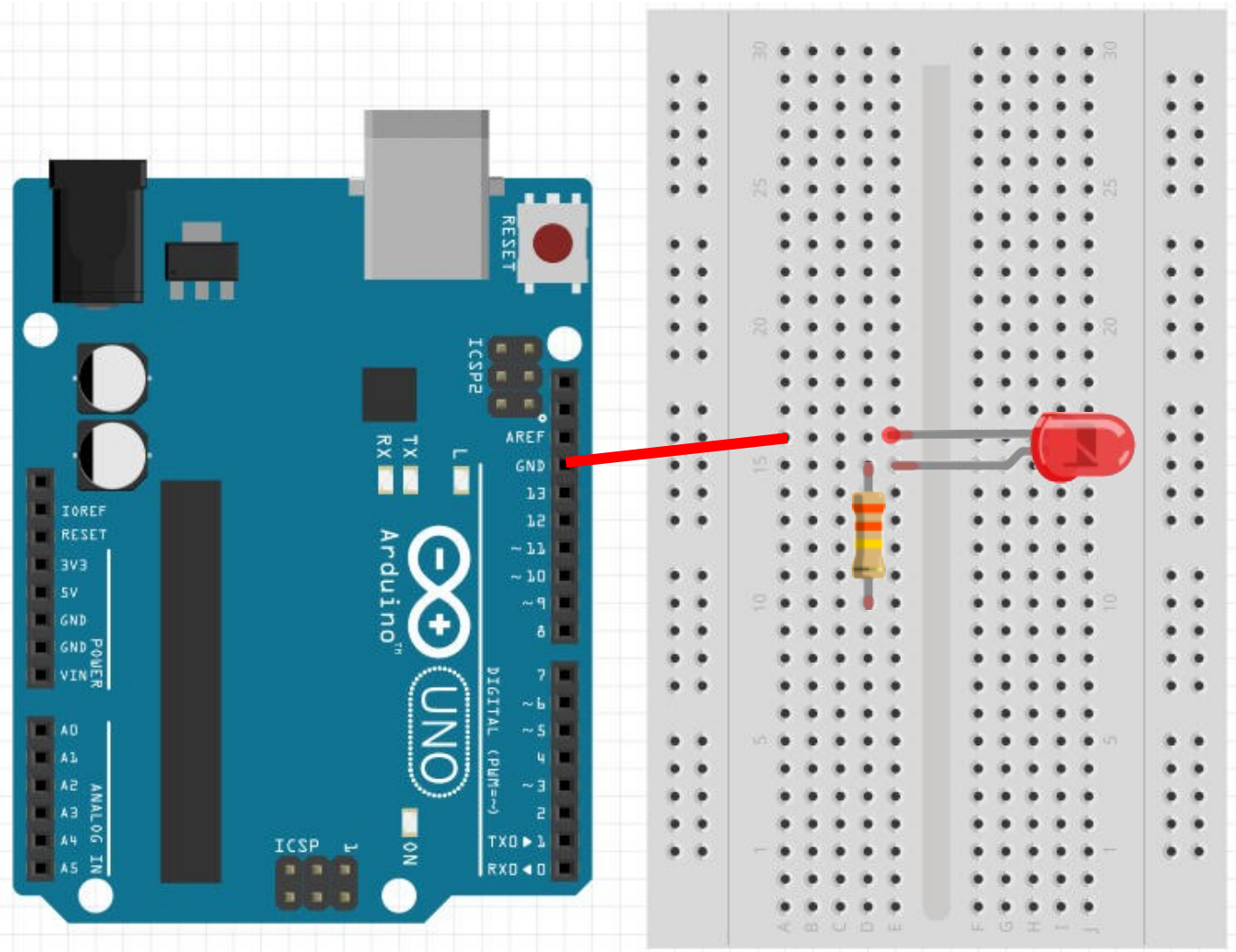
# Connecting an LED




**Connect a wire from “GND” to the shorter LED leg.**

*** My shorter leg is on top.**

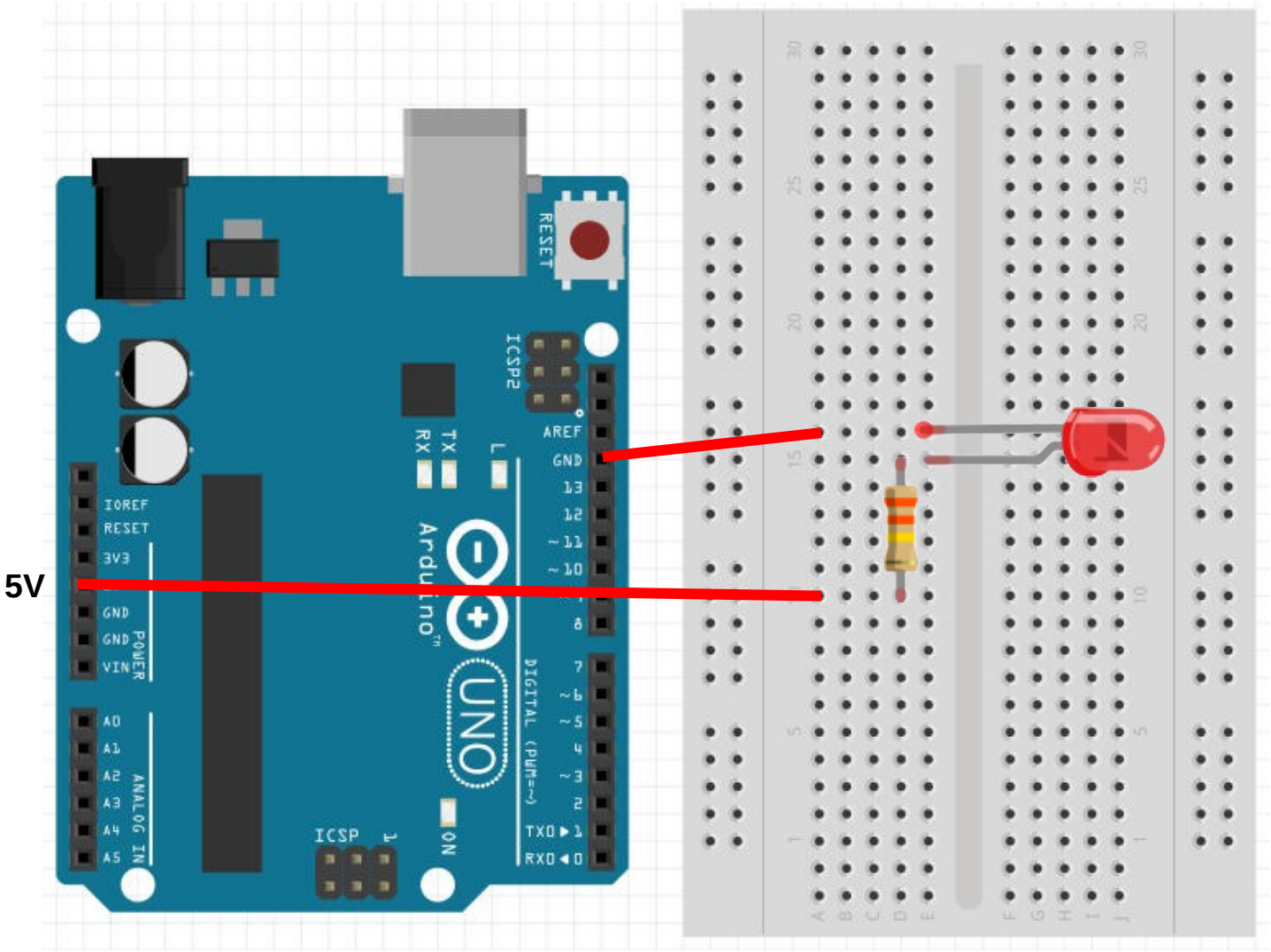
# Connecting an LED




**Add a resistor.**

**Connect one end to the long LED leg, and the other end to an empty row.**

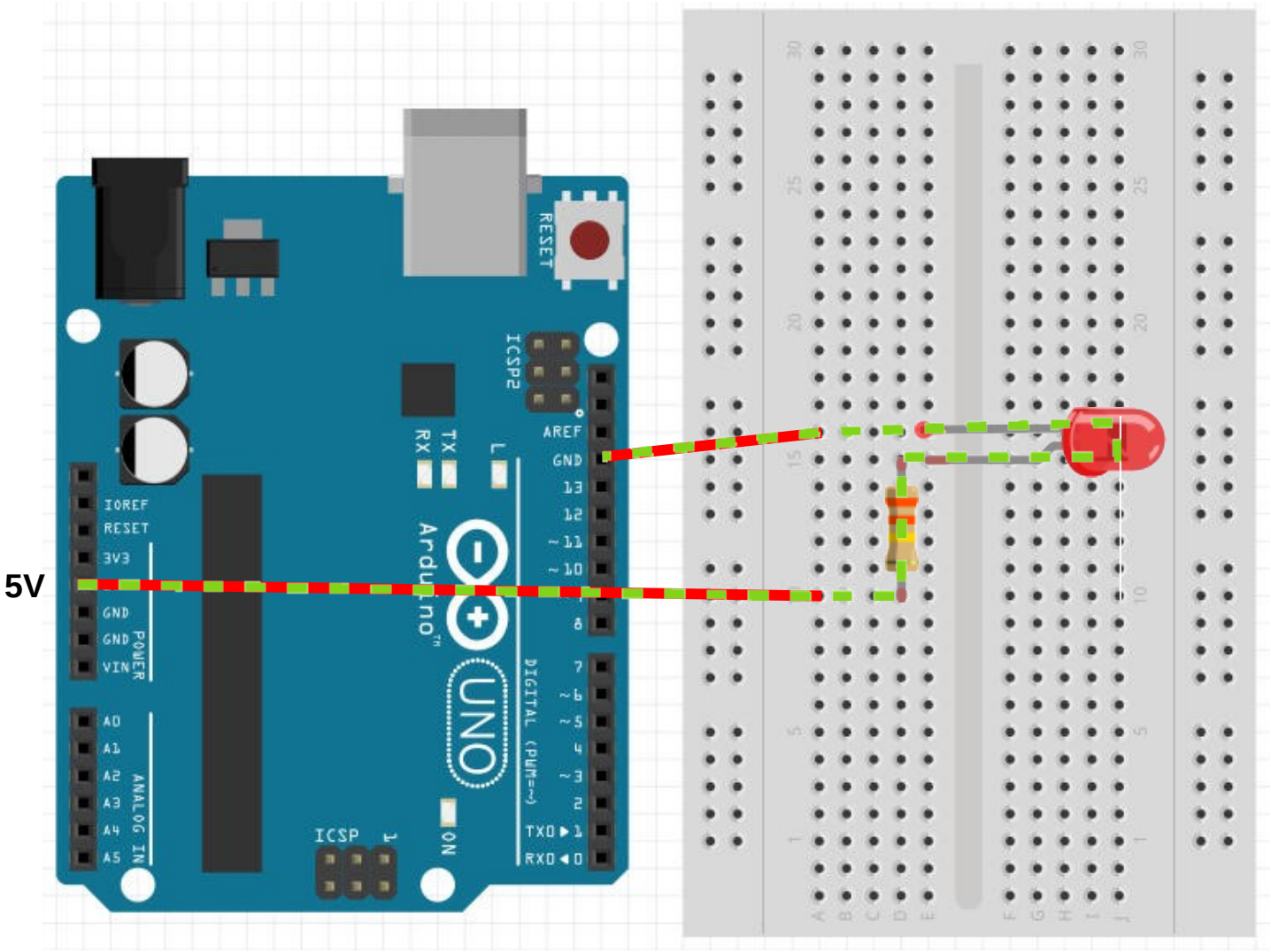
# Connecting an LED




**Connect the other end of the resistor to the “5V” pin**

**The LED should light up immediately!**

# Connecting an LED

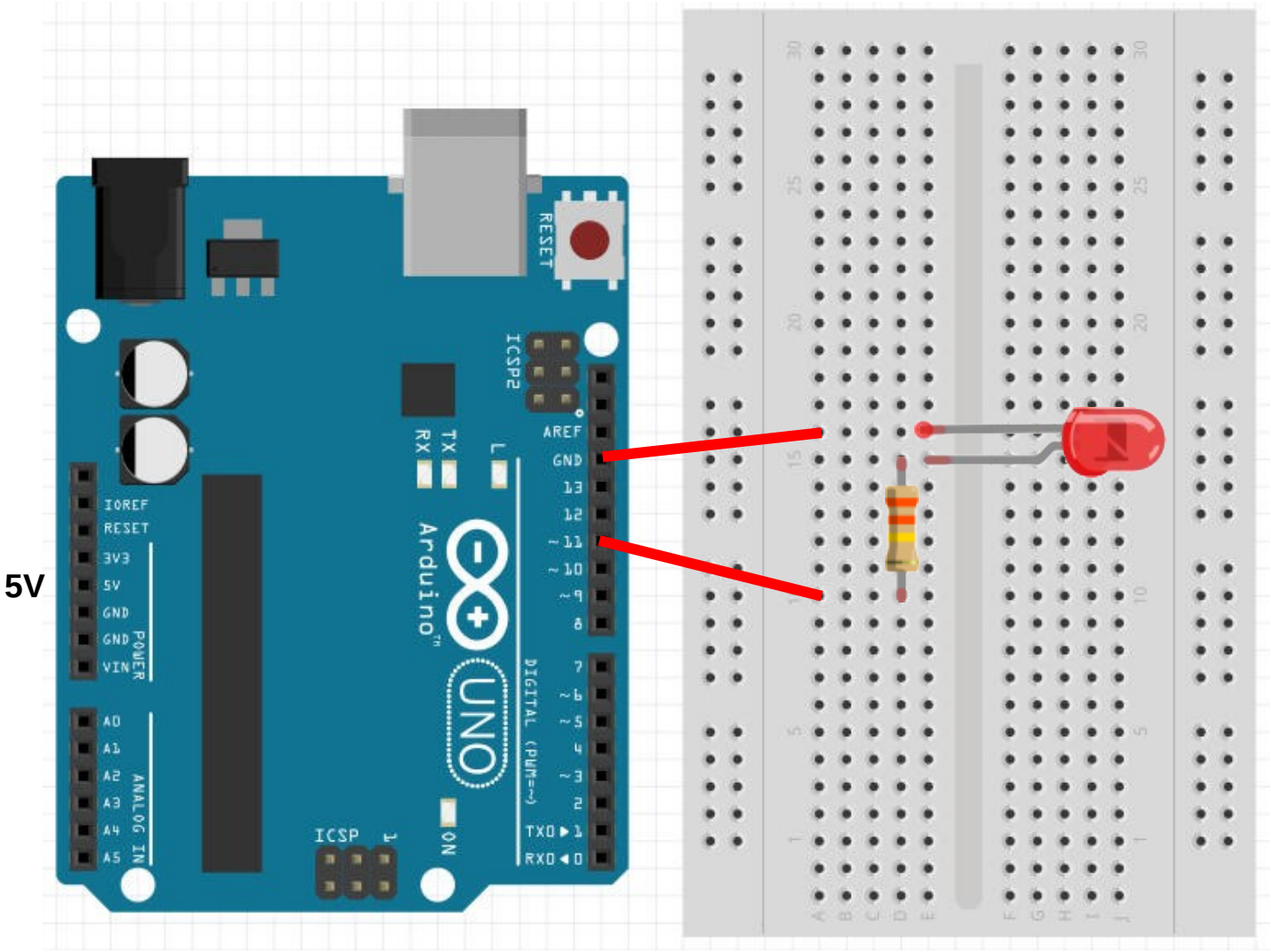



**This is how the electricity is flowing**

**From…**

- **5V to…**
- **Resistor to…**
- **LED to…**
- **GND**

# Connecting an LED




**<u>Controlling the LED</u>**

**To control the LED, we need to connect it to an output pin instead of 5V.**

- **Disconnect it from 5V.**
- **Connect it to Pin 11.**

# Why the resistor?

- Arduino pins provide **5V**
- Different color LEDs require different voltages
  - Red, Yellow, Infra-red: **1.8V**
  - Blue, White, UV: **3.3V**
  - Green: Depends. Try **1.8V** first.
- **Resistor helps to reduce the voltage**
- What happens when you connect 5V to a Red LED without a resistor?

# Challenges

1) Program the connected LED blink continuously

2) Program the connected LED to blink at a varying rate (slow-fast-slow)

# Exercise 1b
# External Inputs

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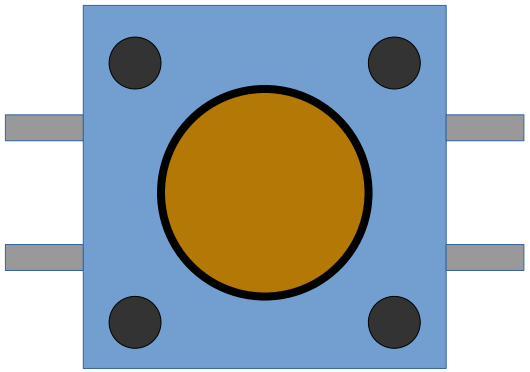
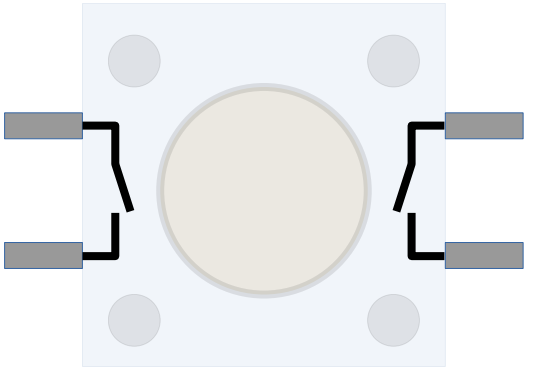
# Push Button Switch



**External View**



**Internal View**



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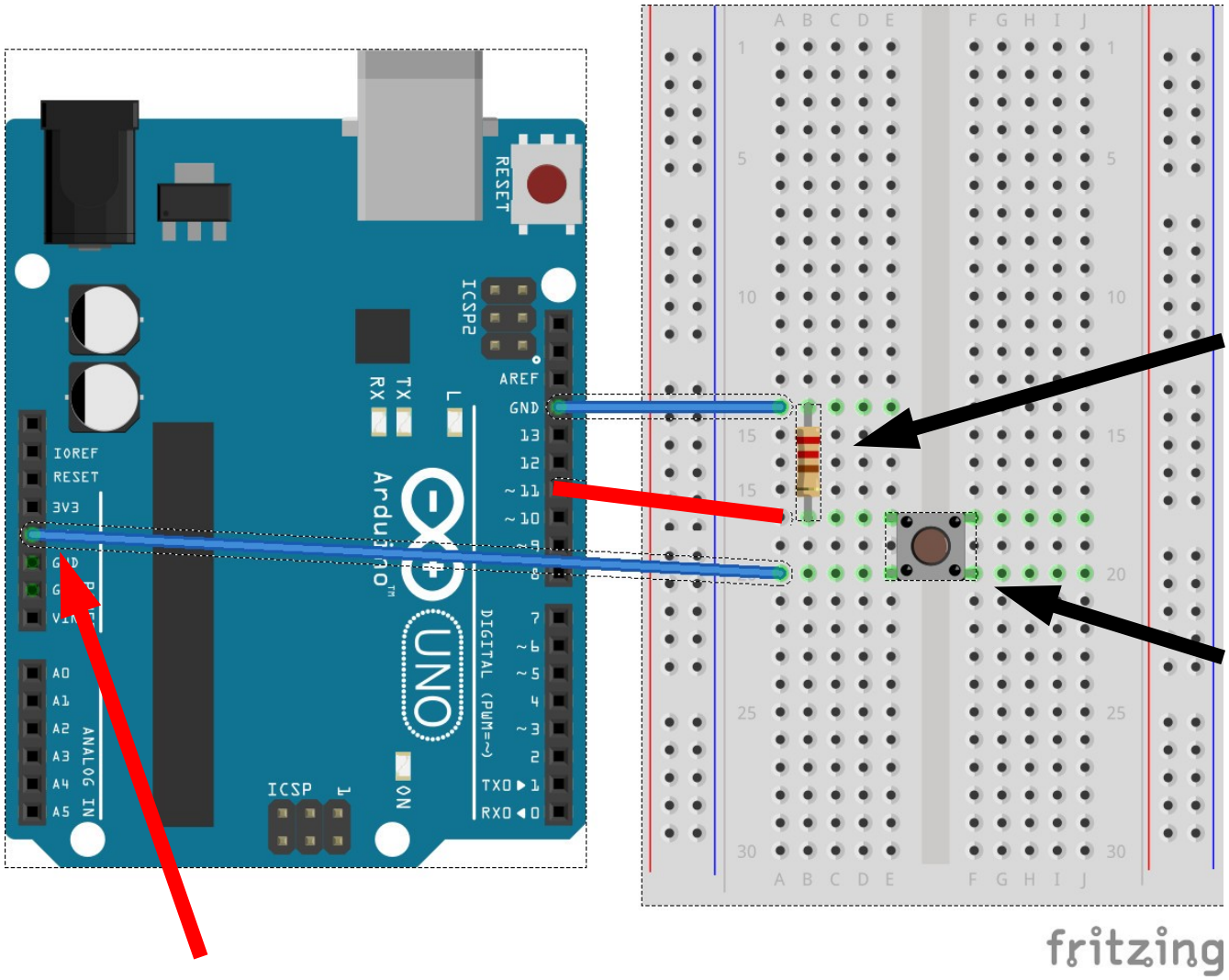
# Connecting a Switch




**Connected to 5V**

**Make these connections**

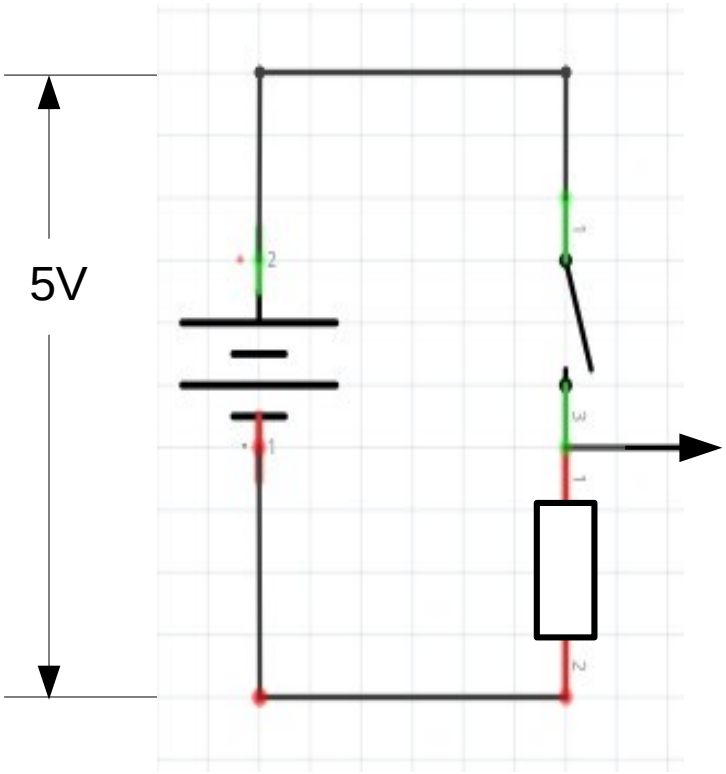
**Resistor**
Value isn't as important as before. Recommend to pick 1000 ohm, but most other values will do as well.

**Push button switch**
Connects the adjacent pins. Only need to use one side...

# Connecting a Switch

- When switch is open…
- Pin 11 is connected to 0V via the resistor
- Pin 11 not connected to 5V

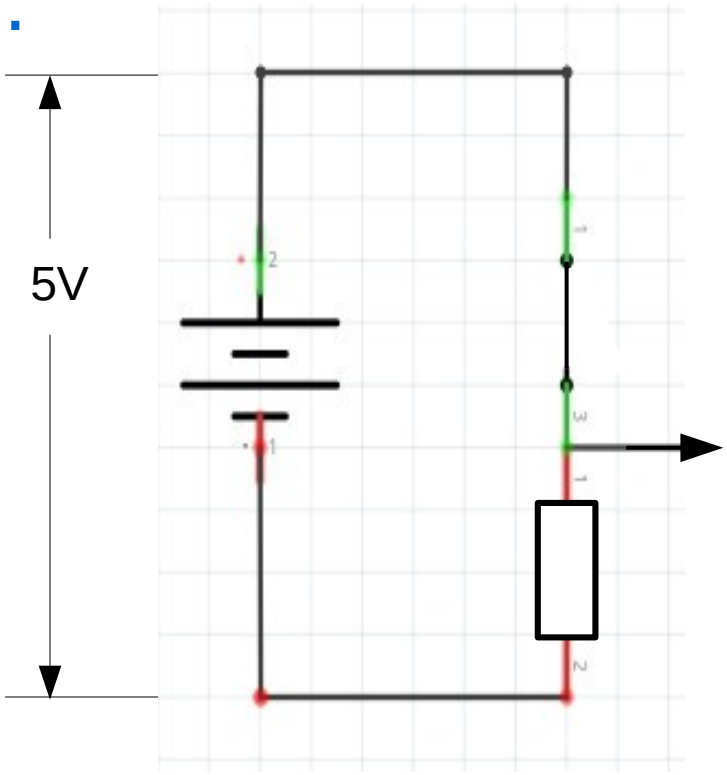
**Voltage of pin 11**
**= 0 V**
**= False**
**= Low**



# Connecting a Switch

- When switch is closed…
- Pin 11 is connected to 0V via the resistor
- Pin 11 is connected to 5V **directly**

**Voltage of pin 11**
**= 5 V**
**= True**
**= High**



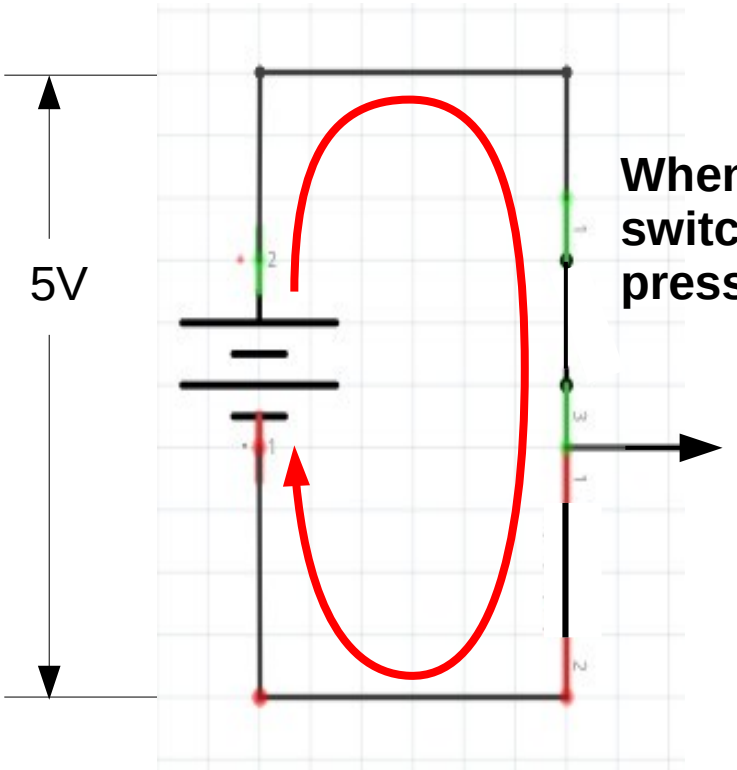
# Connecting a Switch

- This resistor is call a **pull-down resistor**, because it pulls the voltage down to 0V when the switch is open

- We can also connect the resistor to 5V and the switch to Gnd. This is call a **pull-up resistor**.

# Connecting a Switch

- Can we connect the switch to Gnd without a resistor?
  - NO! Without the resistor, we will have a short circuit when the switch is pressed




**Positive connected directly to negative.**
**Short circuit!**



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# Challenges

1) Make an LED blink rapidly for 2 seconds when the button is pressed

2) Make an LED toggle between on and off when the button is pressed

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