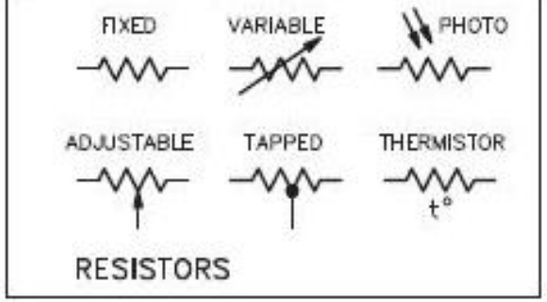
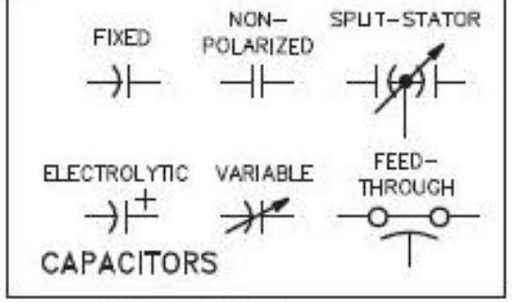
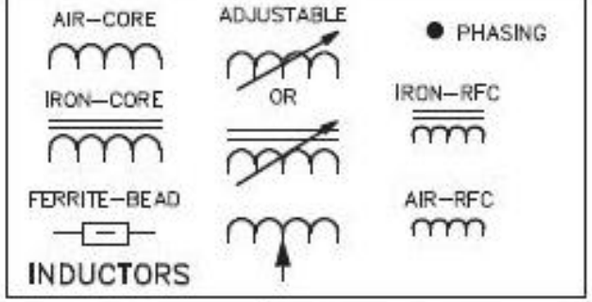
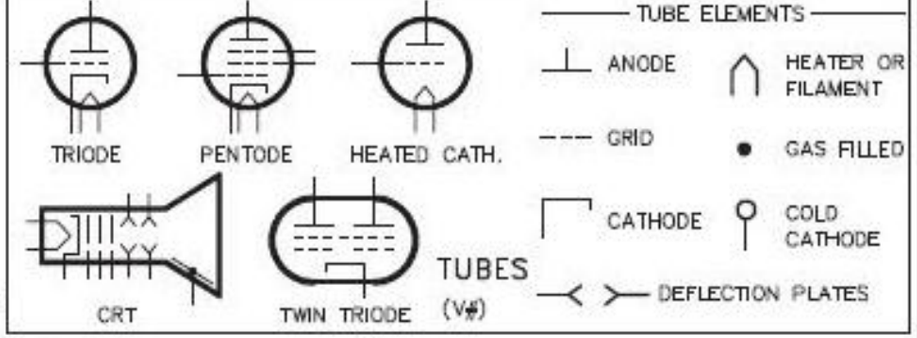
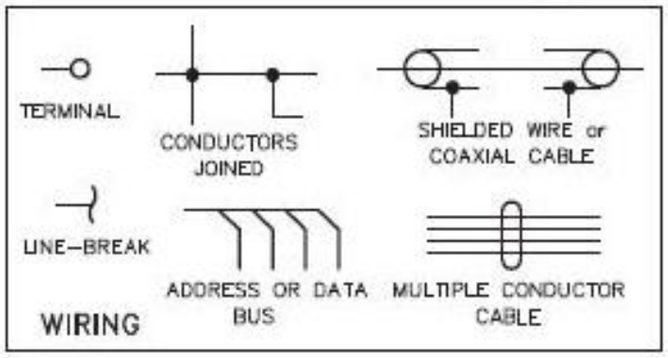
Sensing & Acting

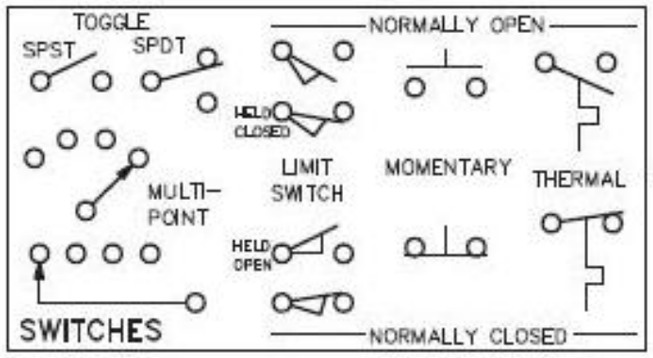


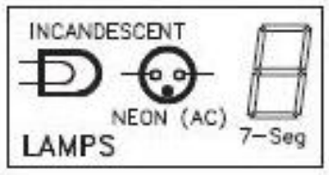


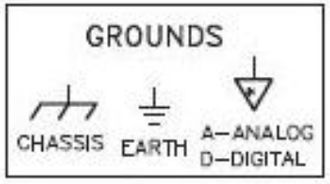


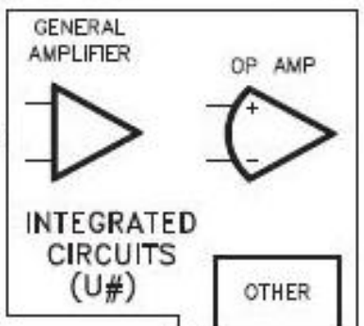


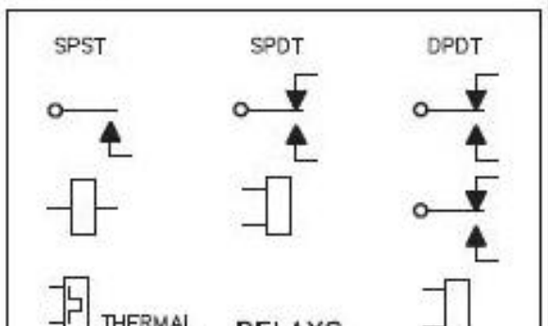


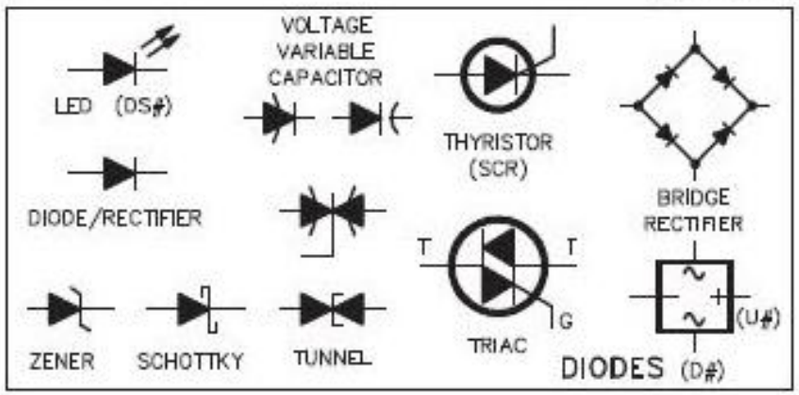


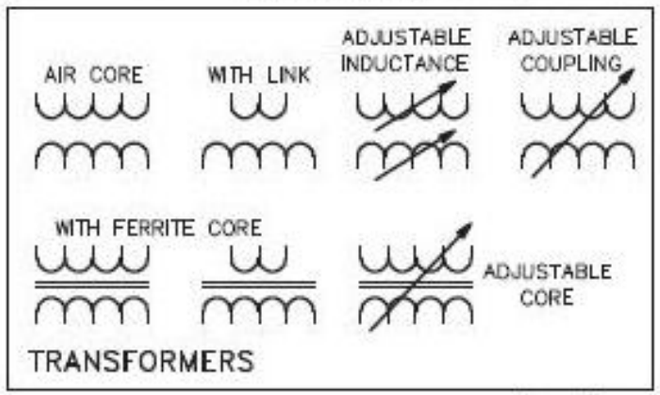


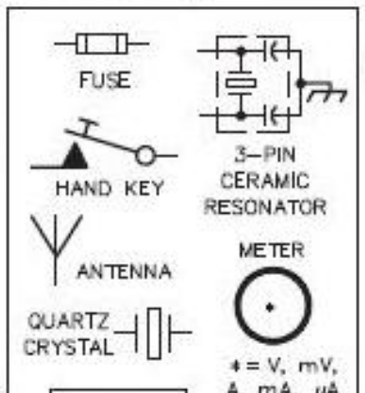


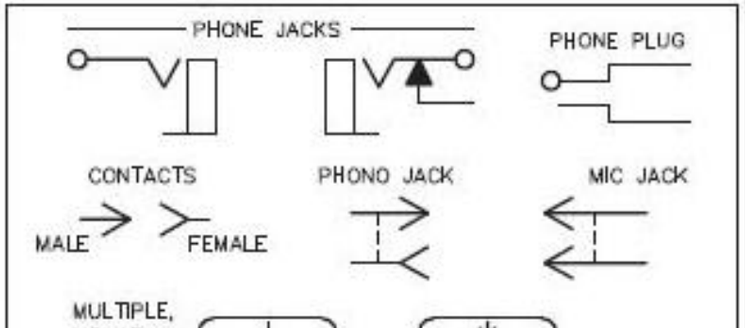


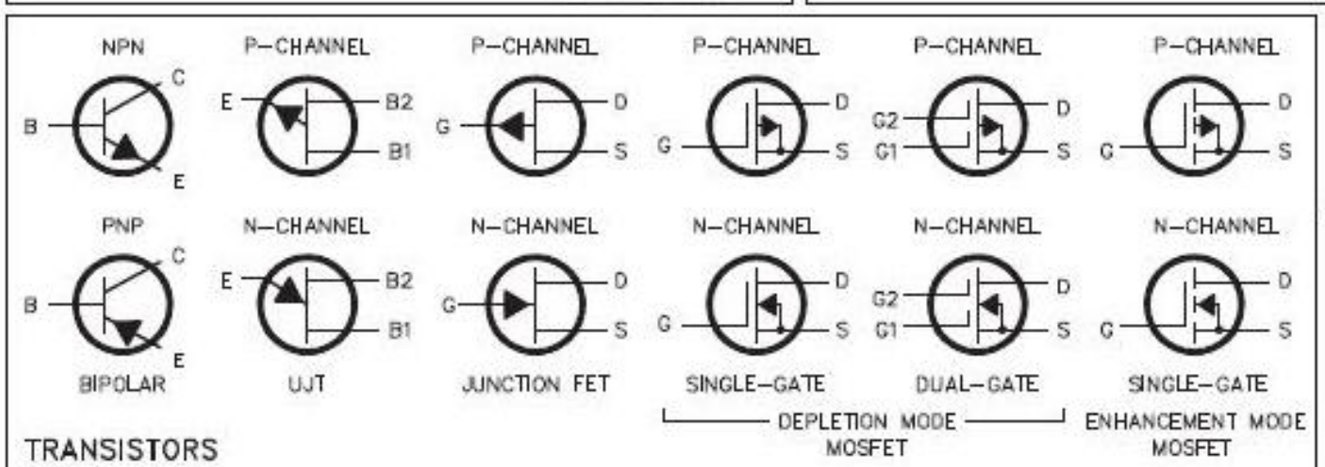


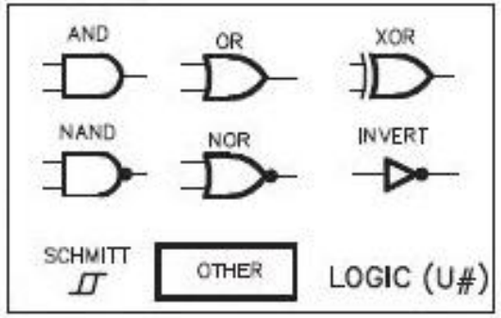




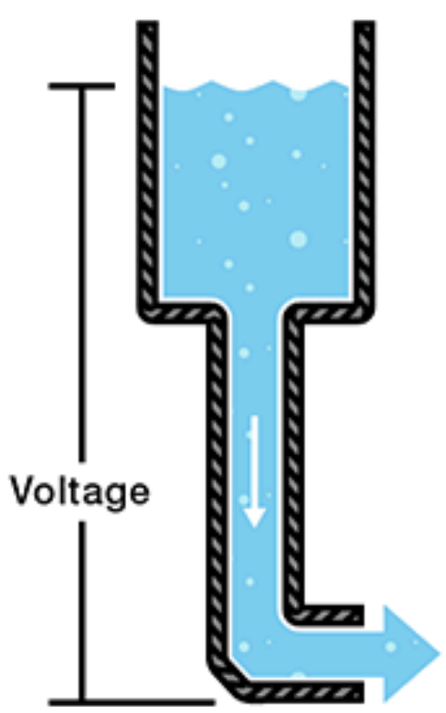


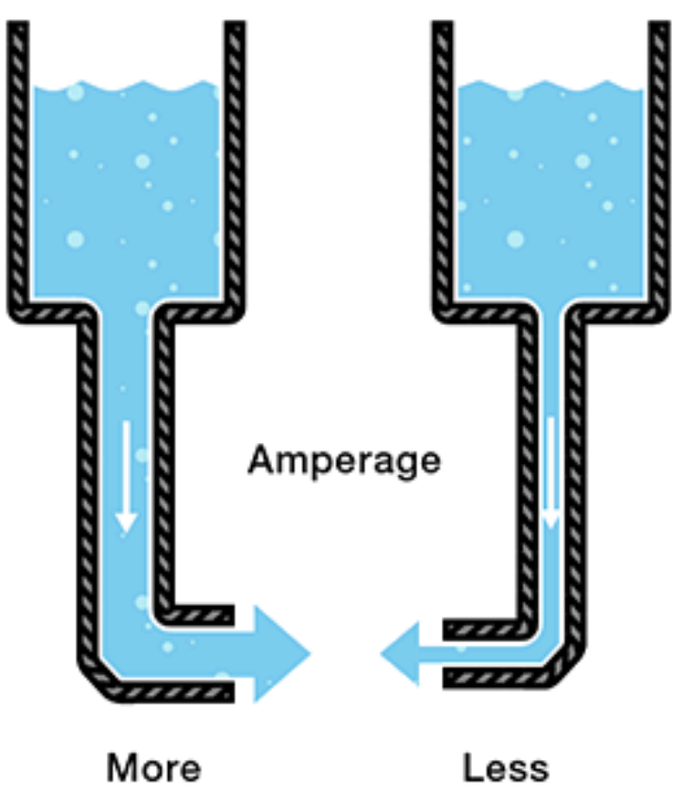


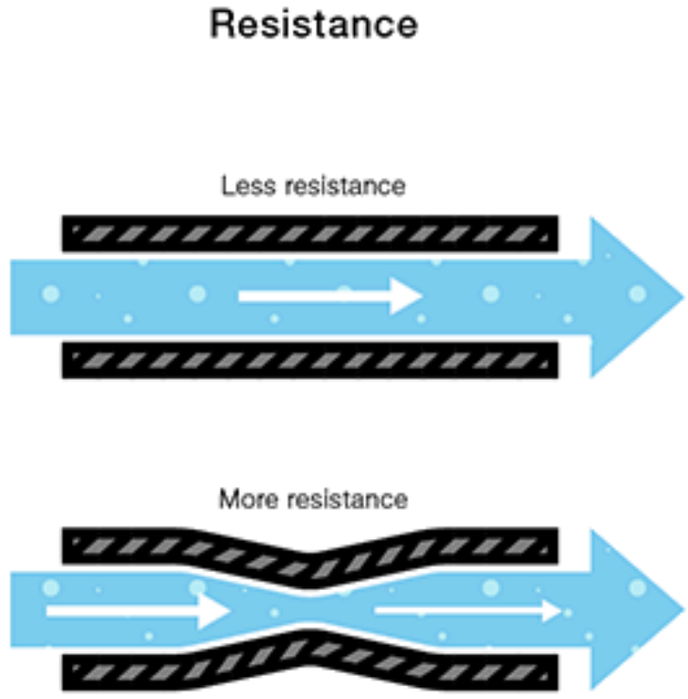




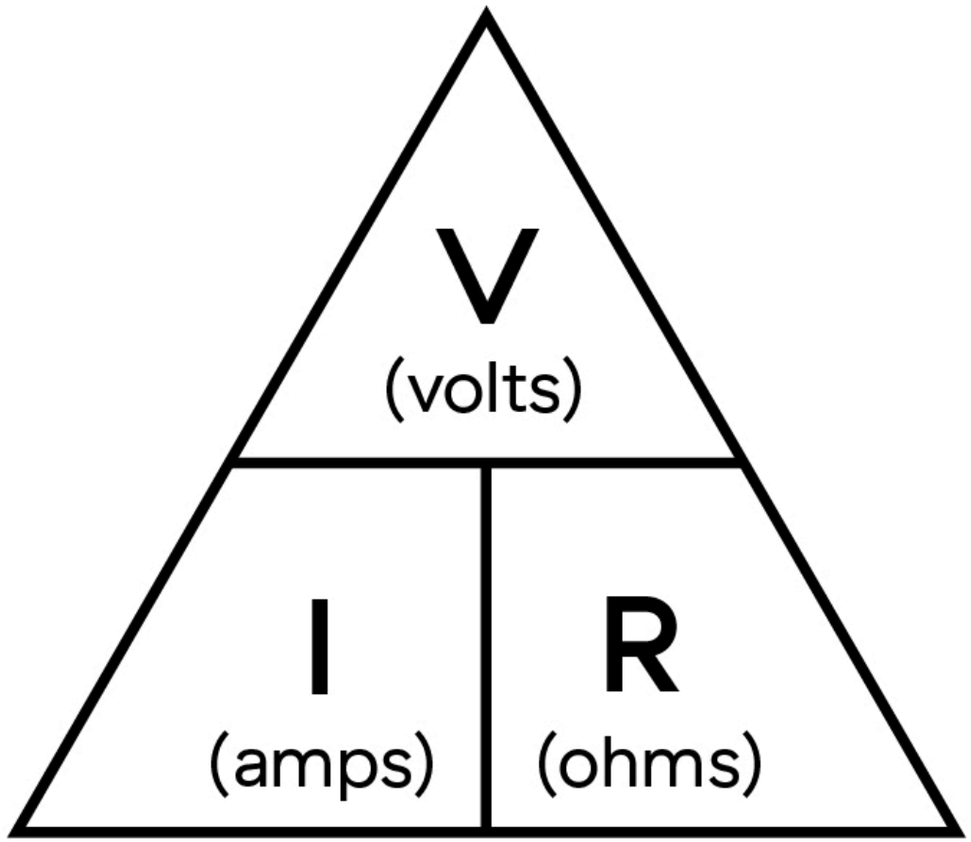
Recap







Measures of Electricity



$$V = I \times R$$

$$I = \frac{V}{R}$$

$$R = \frac{V}{I}$$

Ohms LAW

Bluetooth headphones
0.03 W

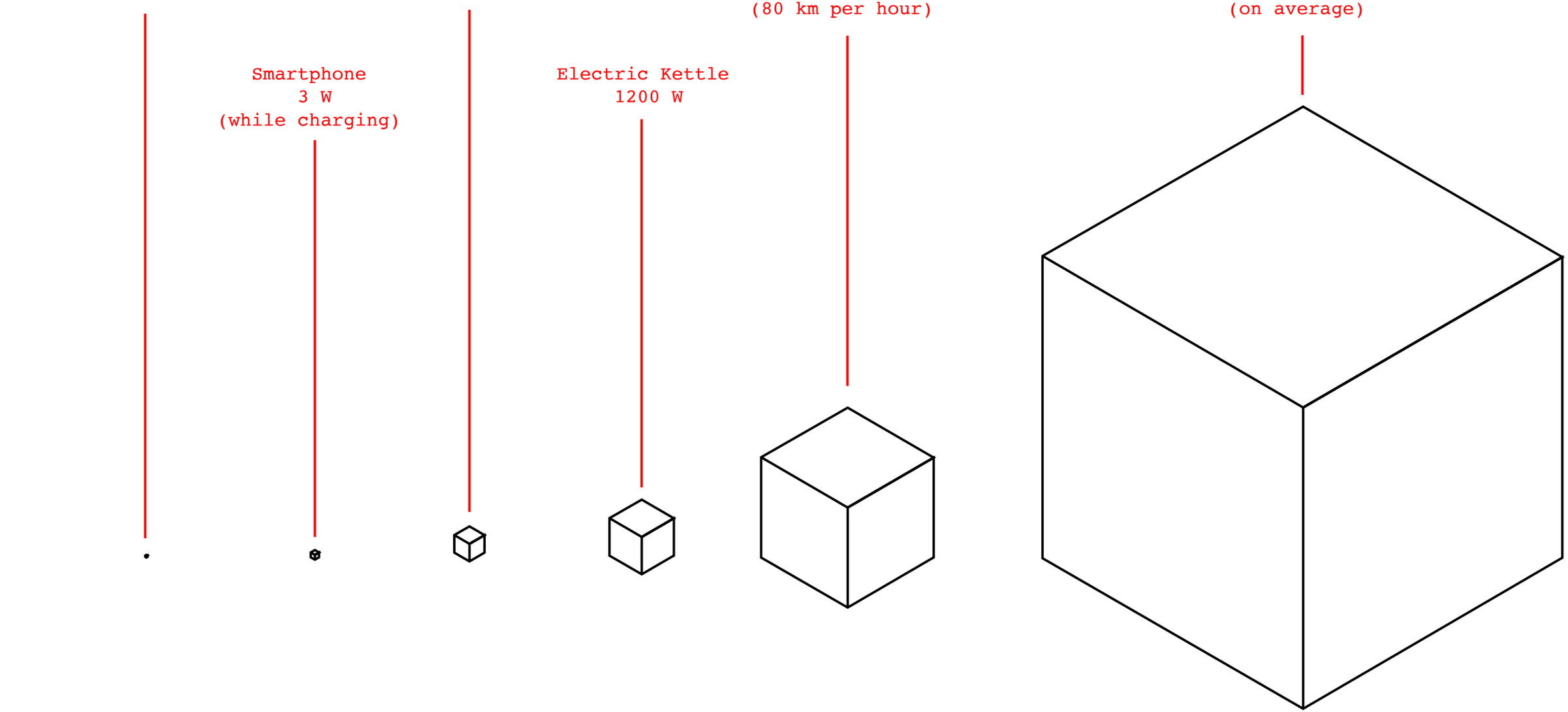
Smartphone
3 W
(while charging)

Home Refrigerator
150 W

Electric Kettle
1200 W

Tesla model S
30’000 W
(80 km per hour)

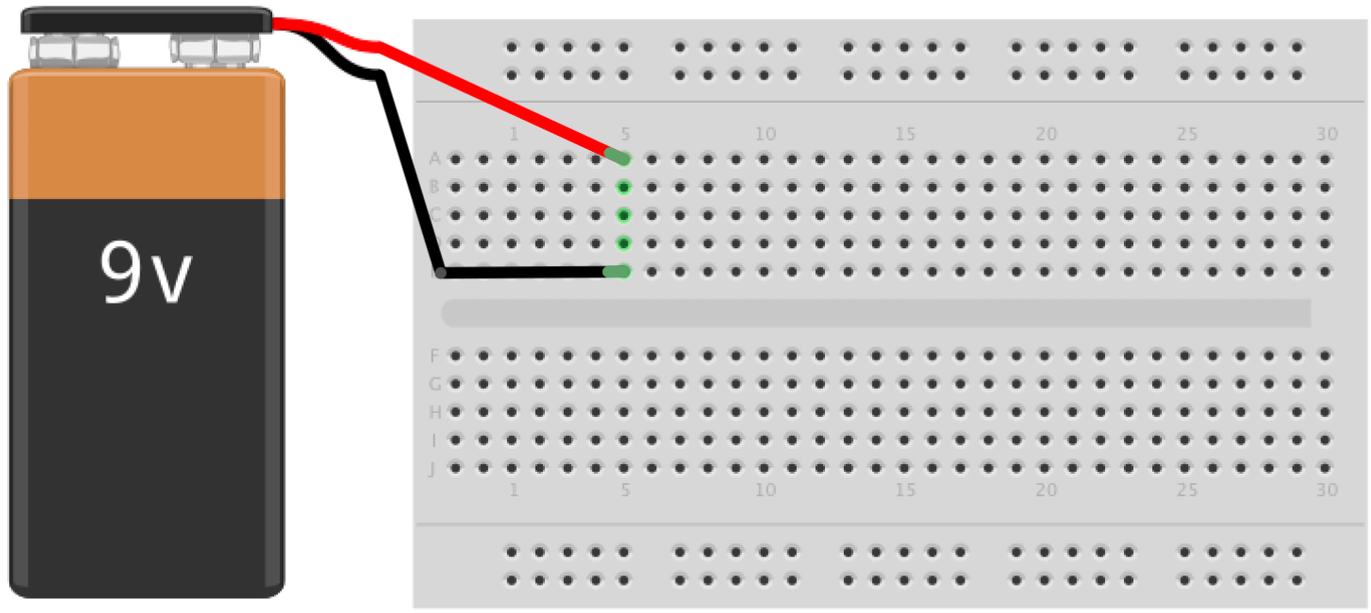
Toni Areal
744’292 W
(on average)

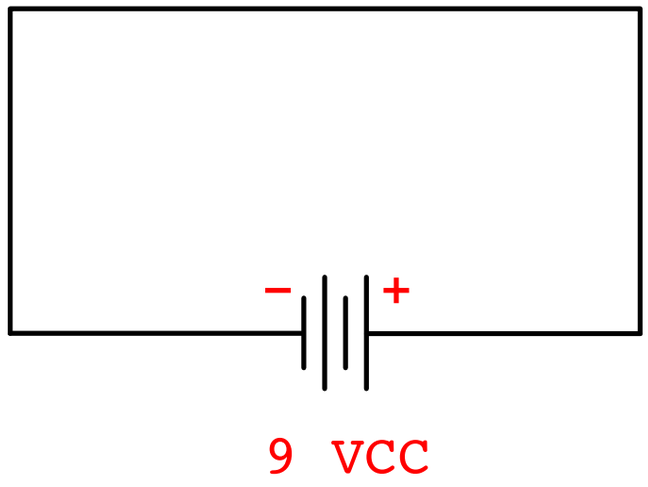


Energy (watts)

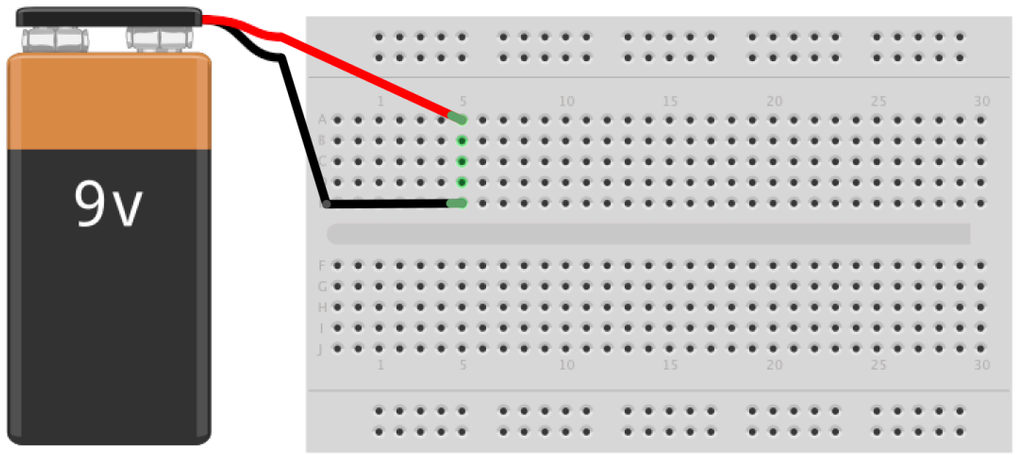
Watt Hours = W (Watts) x H (hours in use)

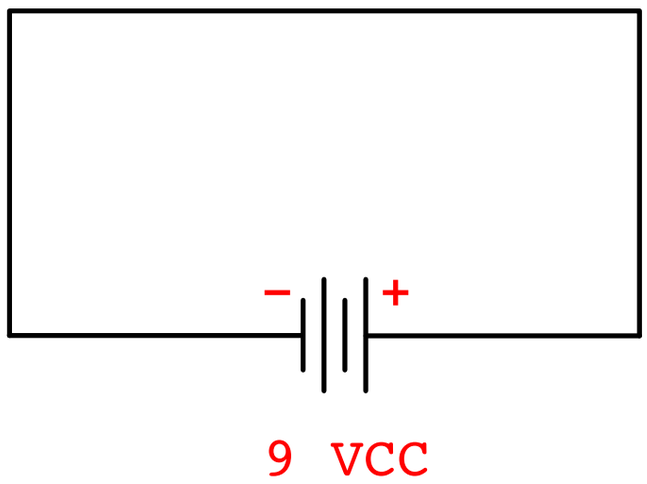
Watt hours

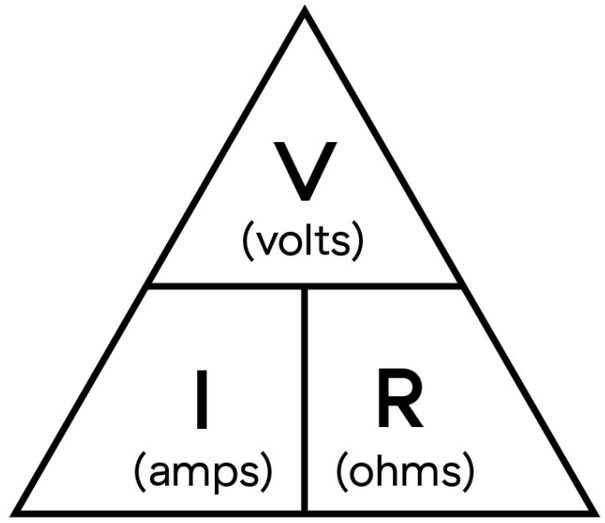




Short Circuits and Joule heating





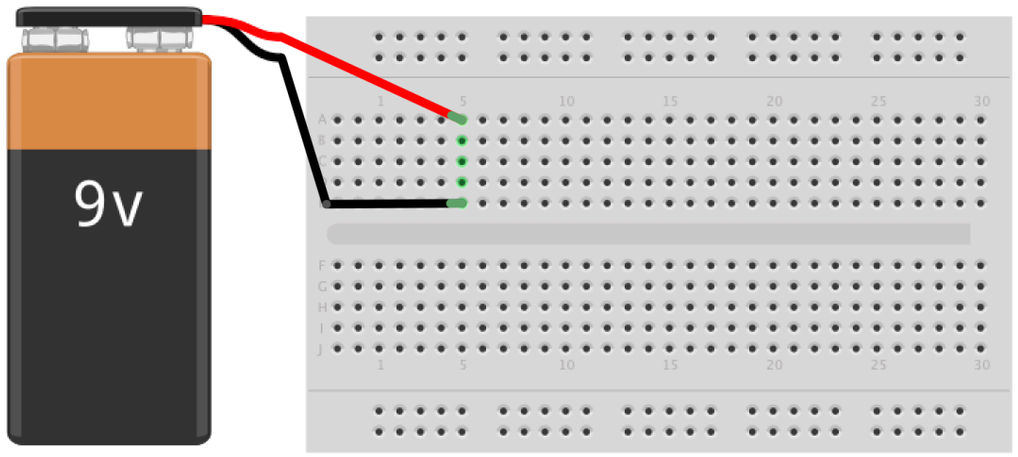


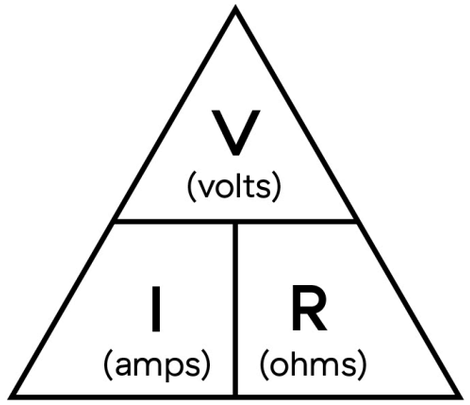
$$V = I \times R$$

$$I = \frac{V}{R}$$

$$R = \frac{V}{I}$$

Short Circuits and Joule heating

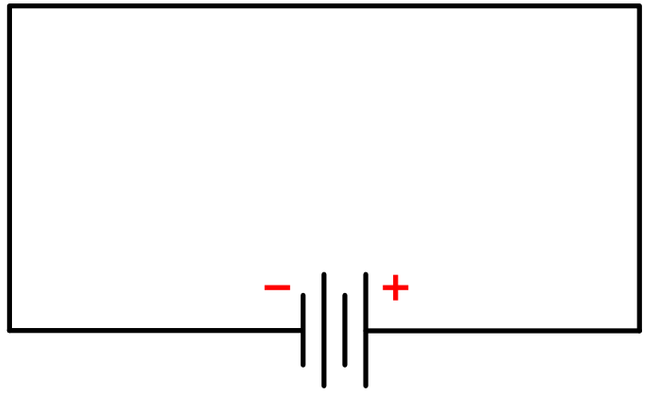




$$V = I \times R$$

$$I = \frac{V}{R}$$

$$R = \frac{V}{I}$$



$$\frac{9\ v}{0.0000001\ ohm} = 90\ 000\ 000\ amps$$

or

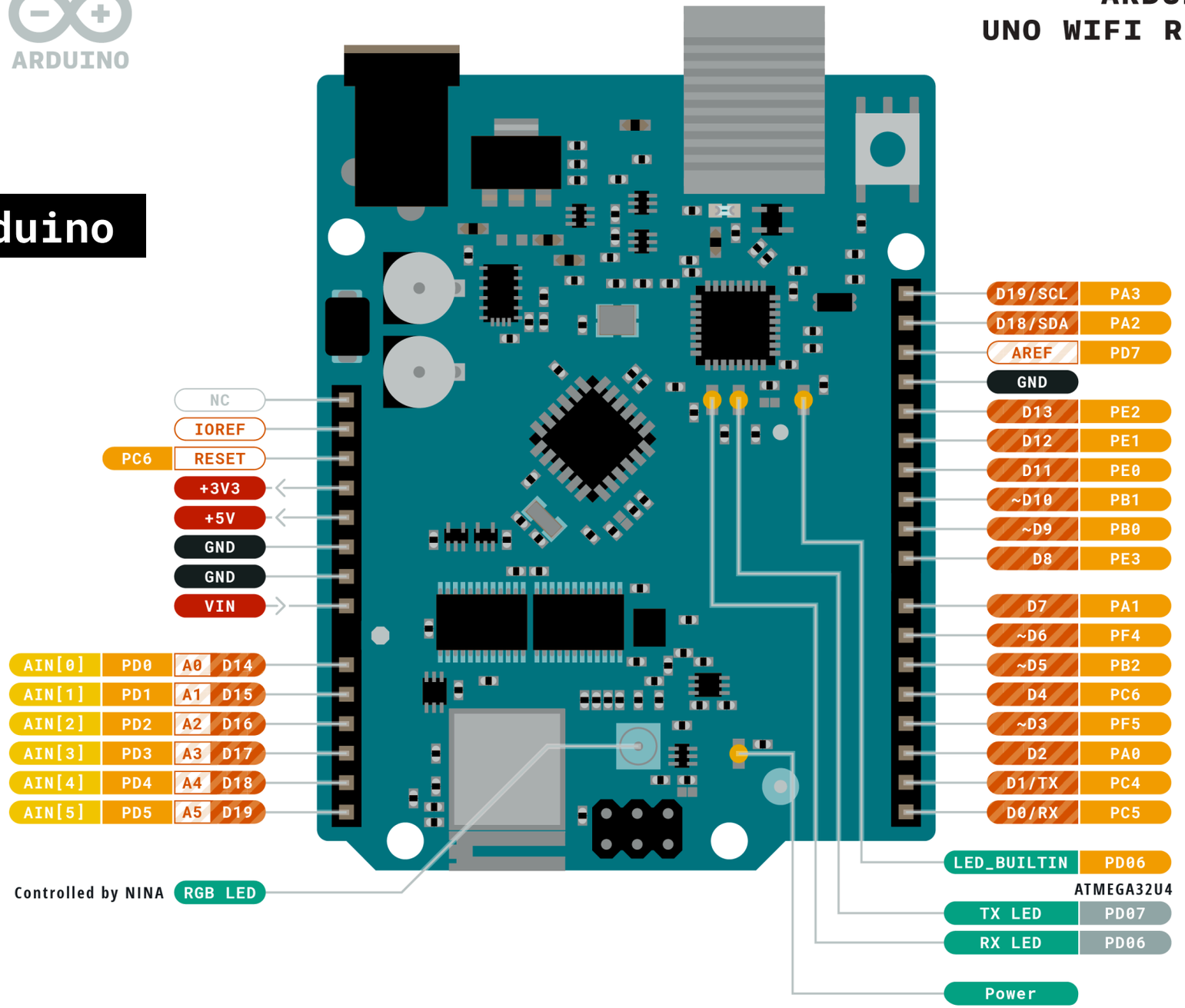
81 000 0000 watts!

Short Circuits and Joule heating

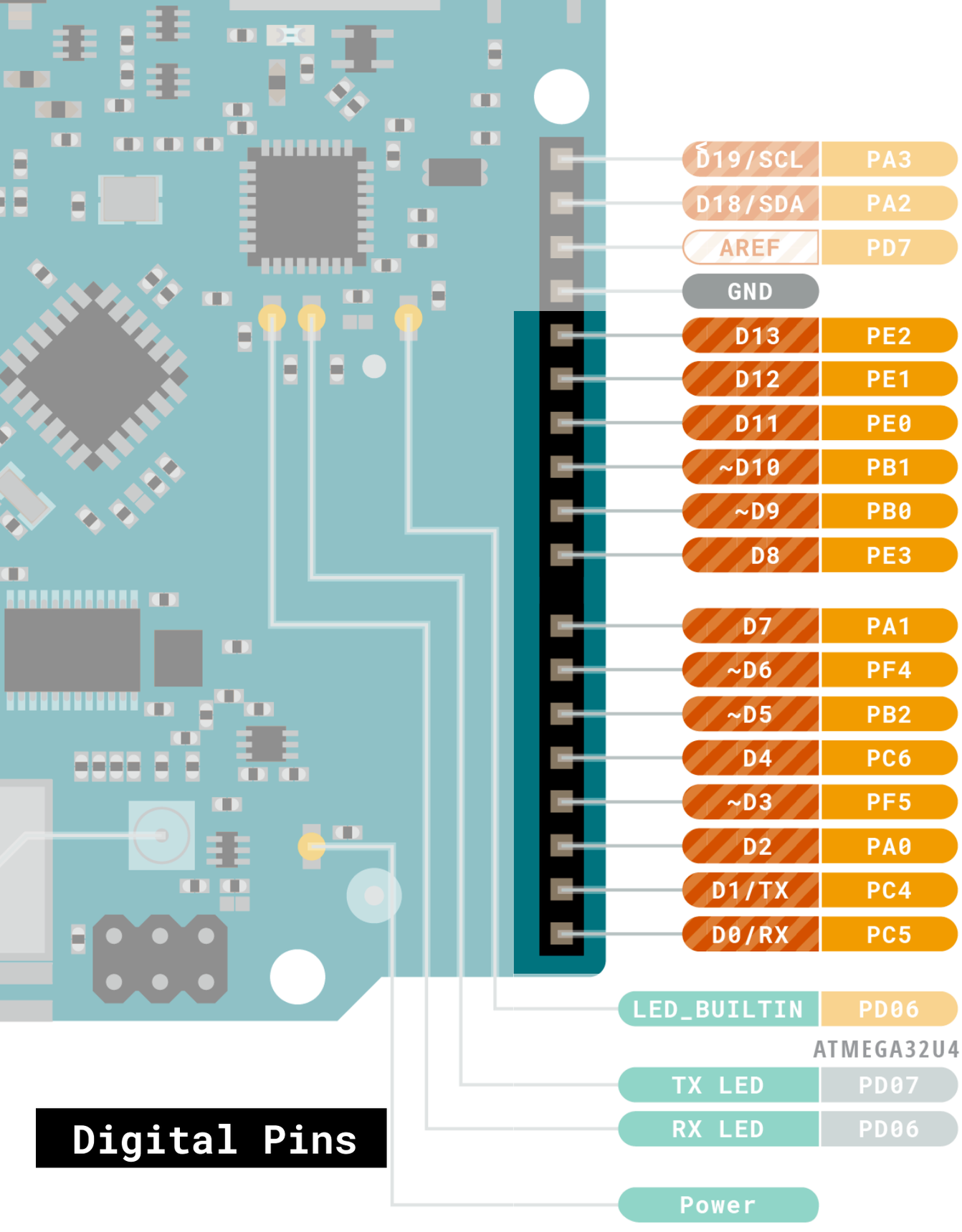
ARDUINO

ARDUINO
UNO WIFI REV2

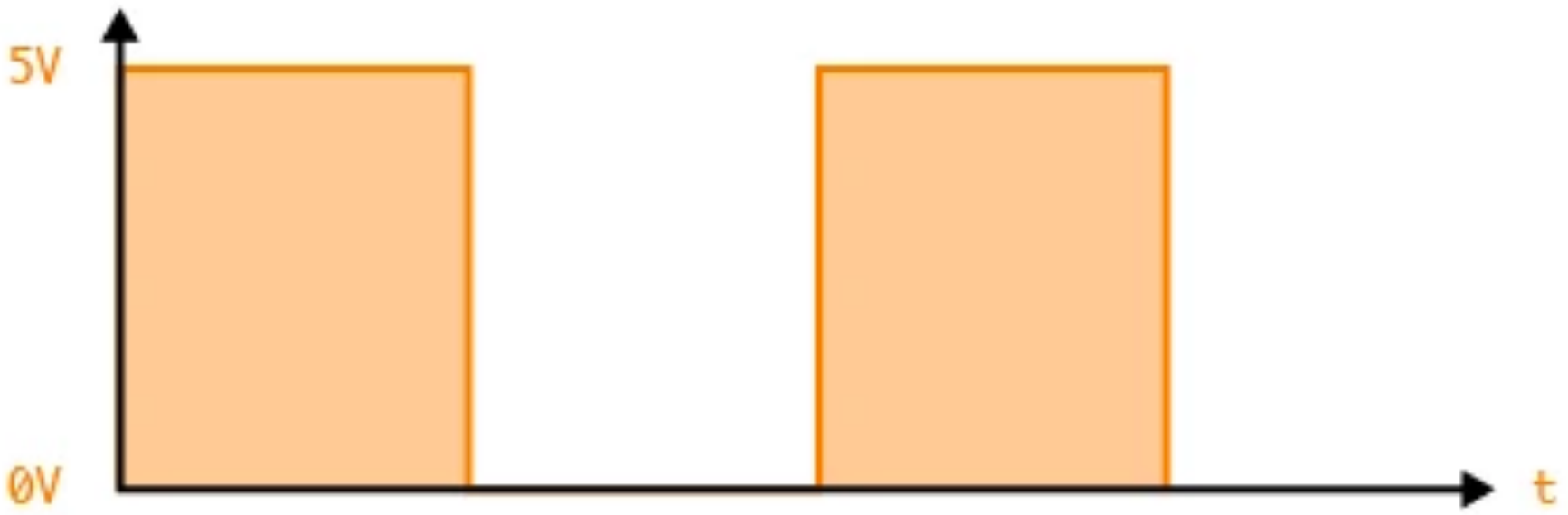
Getting Started with Arduino



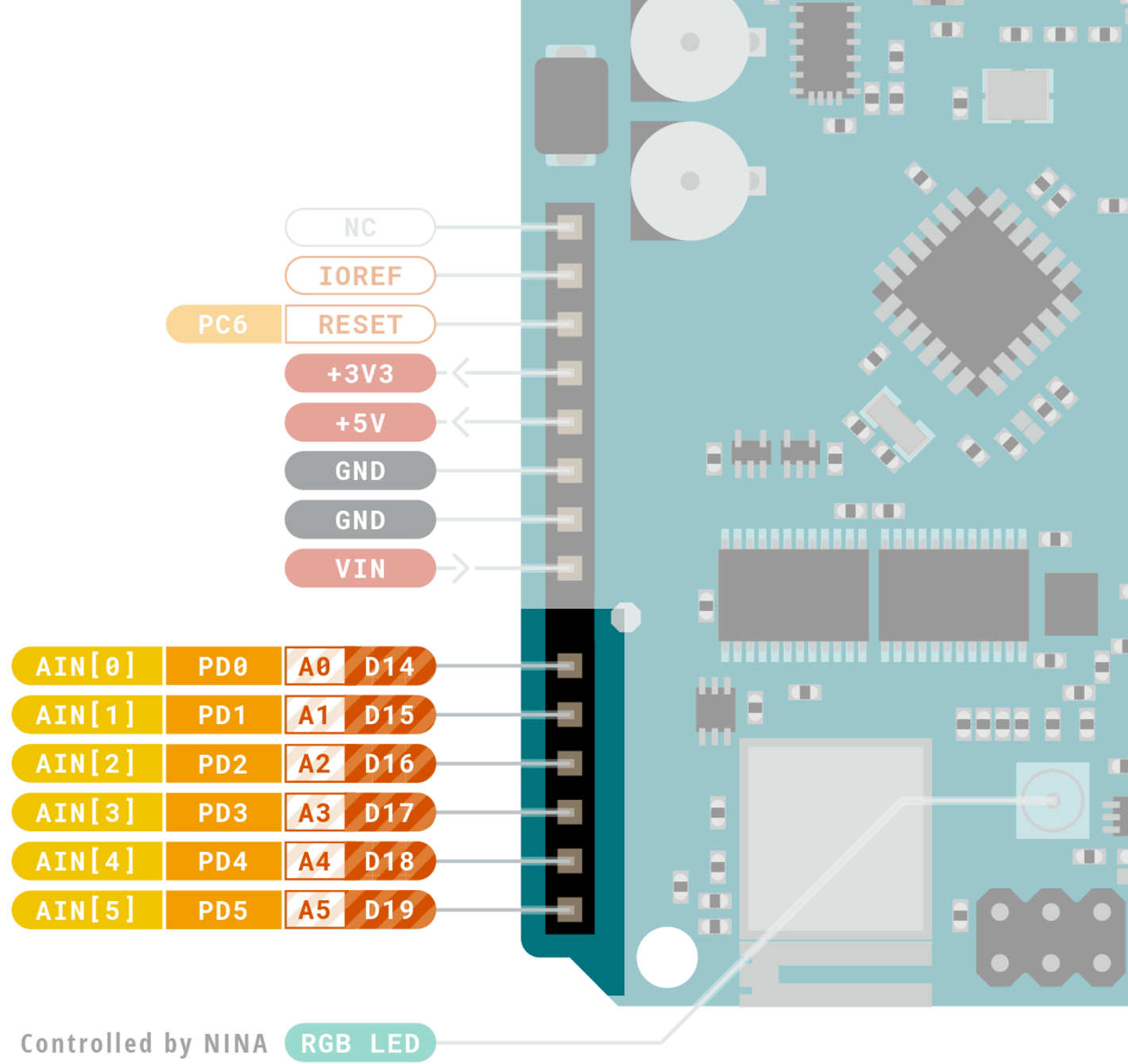
Ground
Power
LED
Internal Pin
SWD Pin
Other Pin
Digital Pin
Analog Pin
Default
Microcontroller's Port



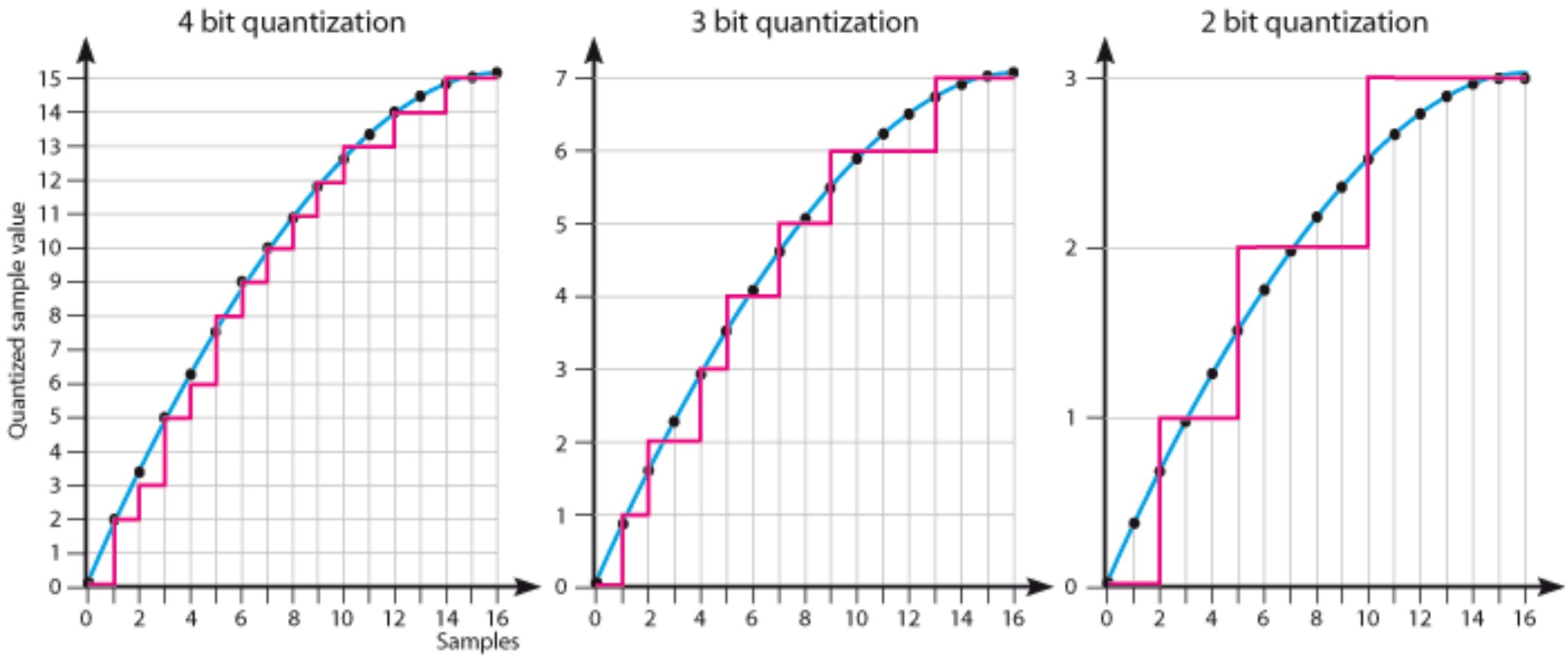
GPIO pins (General Purpose Input and Outputs)



Digital Pins

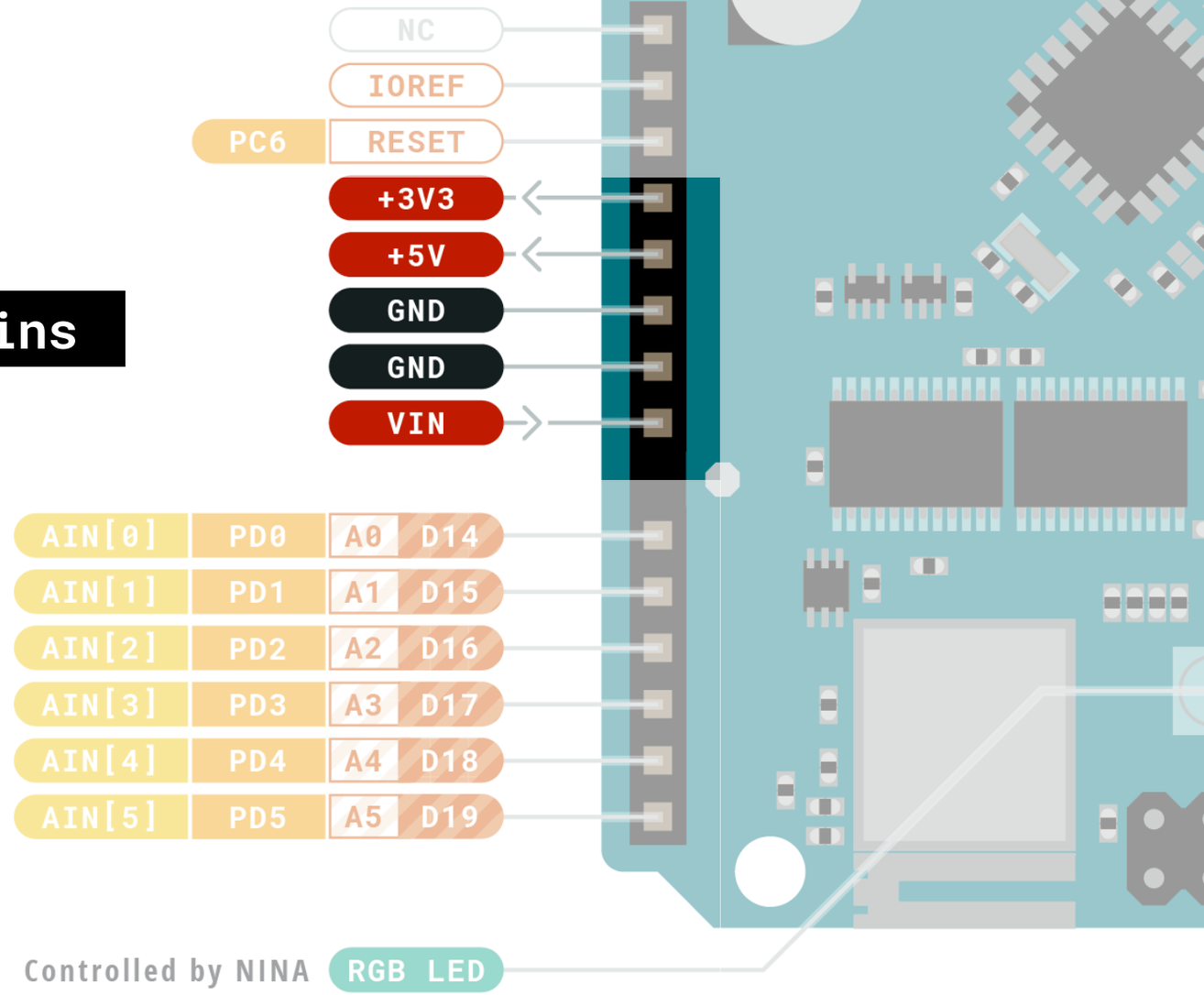

NC
IOREF
PC6
RESET
+3V3
+5V
GND
GND
VIN
AIN[0] PD0 A0 D14
AIN[1] PD1 A1 D15
AIN[2] PD2 A2 D16
AIN[3] PD3 A3 D17
AIN[4] PD4 A4 D18
AIN[5] PD5 A5 D19
Controlled by NINA RGB LED

Analog Pins

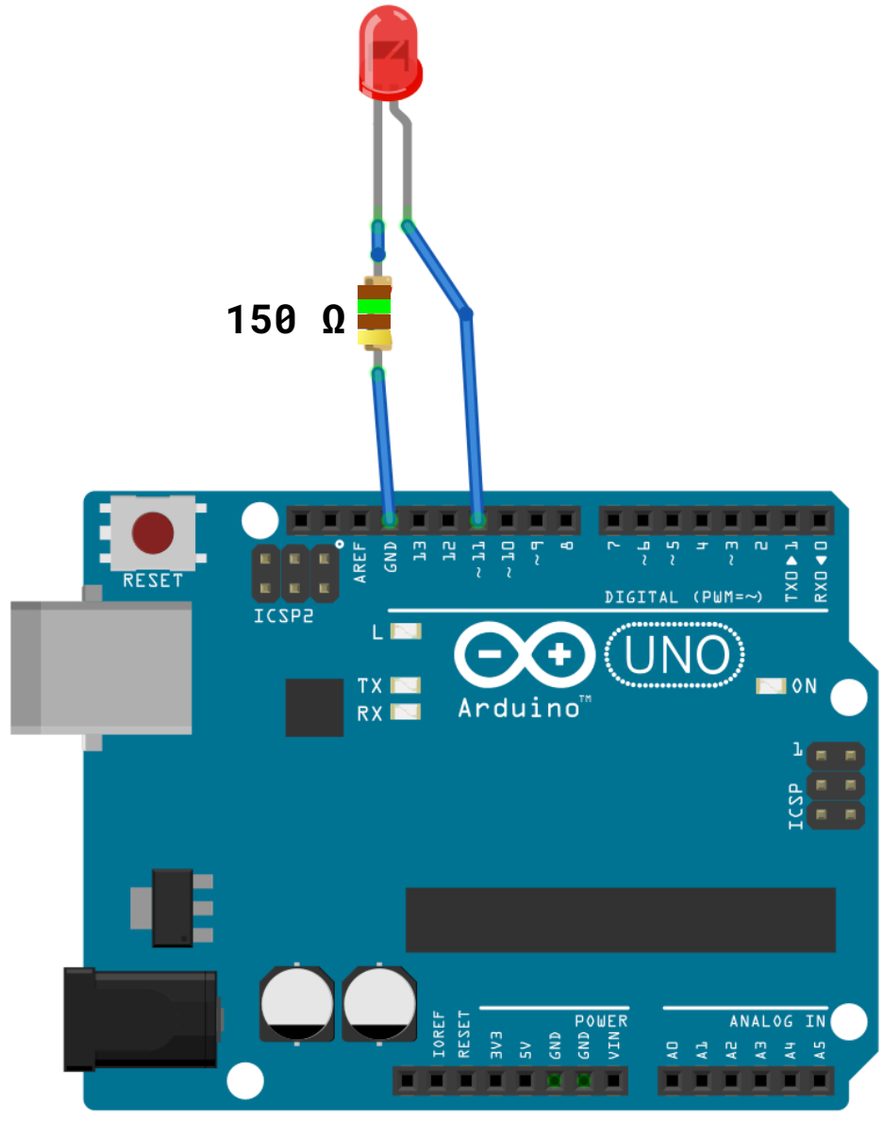


Analog to Digital Conversion

Power Pins



Getting Started with Arduino

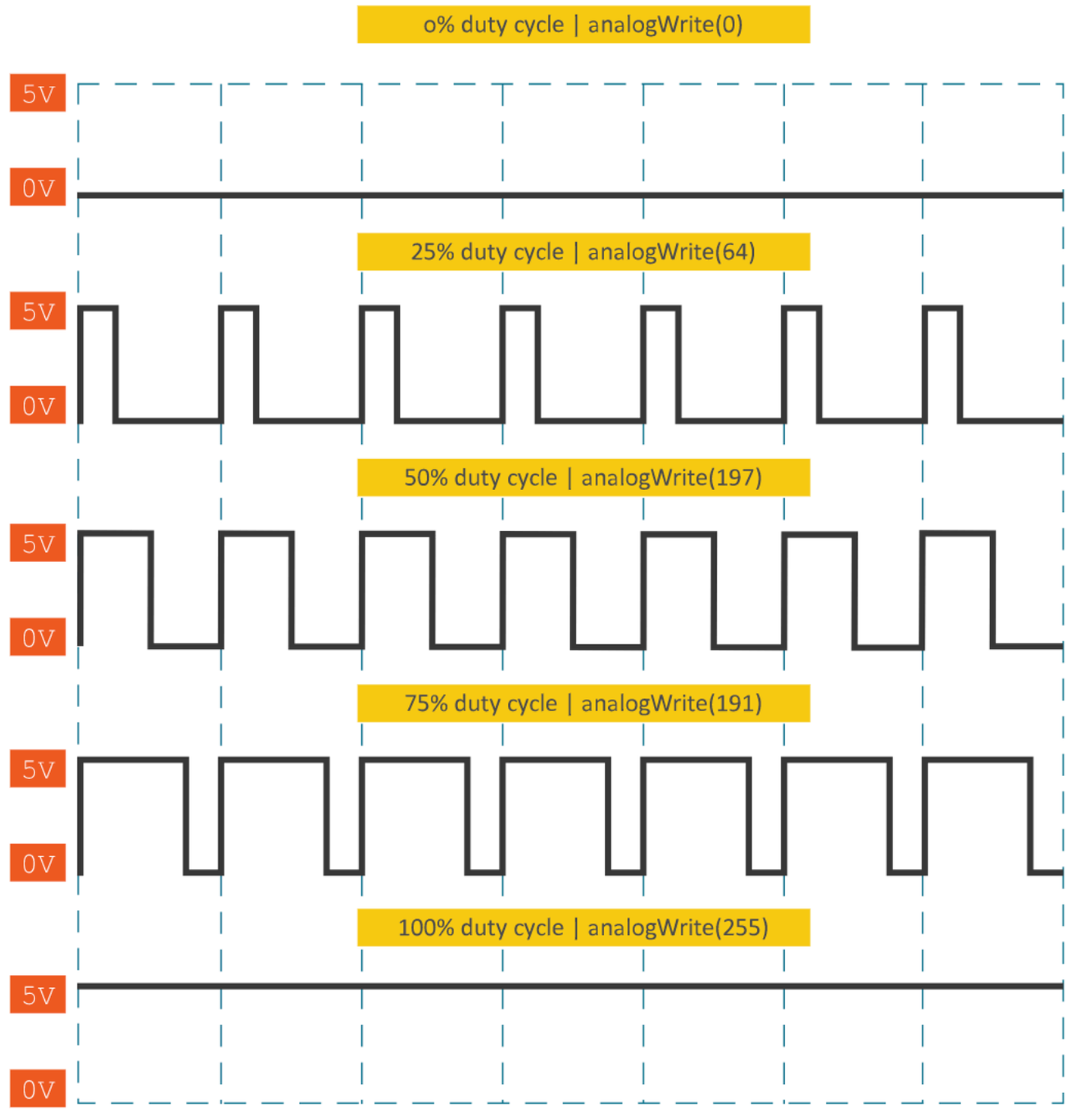


Exercise 1.3: Arduino Blinky

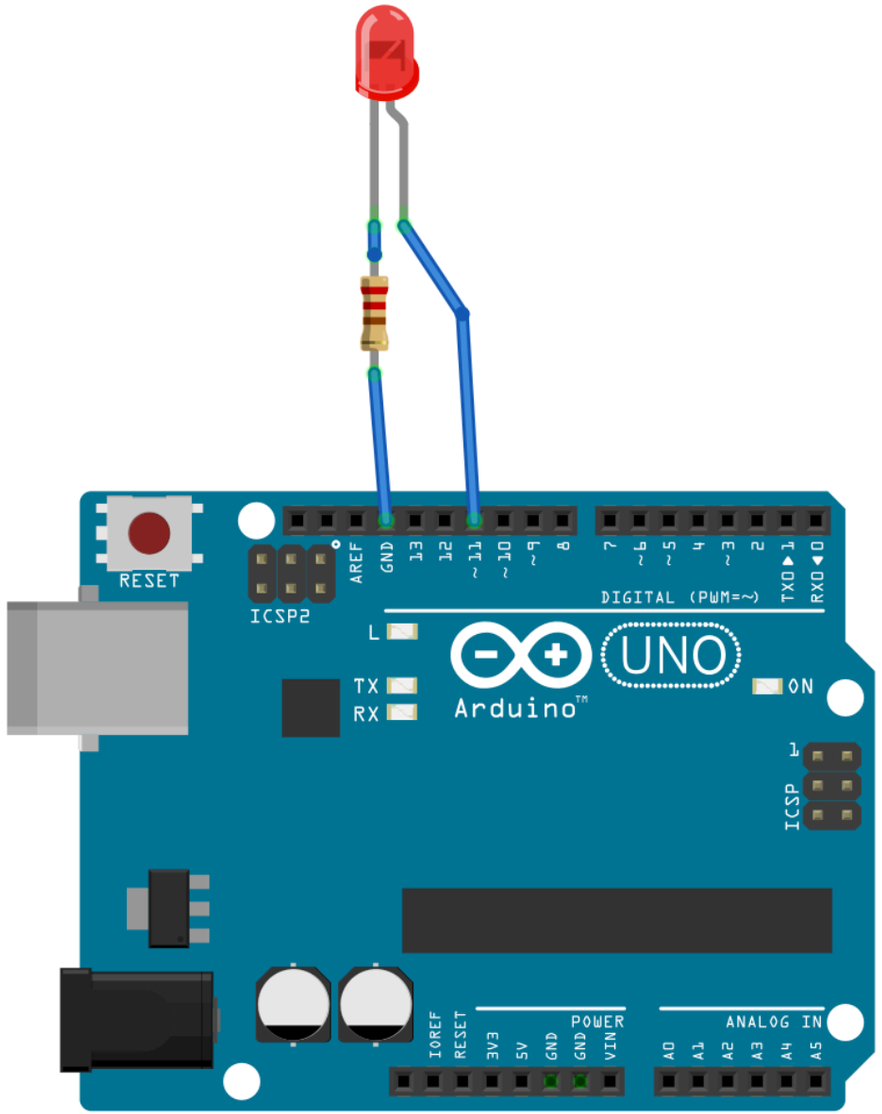
Connect an LED and Resistor to your Arduino to GND and Pin 11 using your breadboard. Code it to blink SOS in morse code: . . . _ _ _ . . .

PWM pins on the Arduino Uno:

11, 10, 9, 6, 5, 3



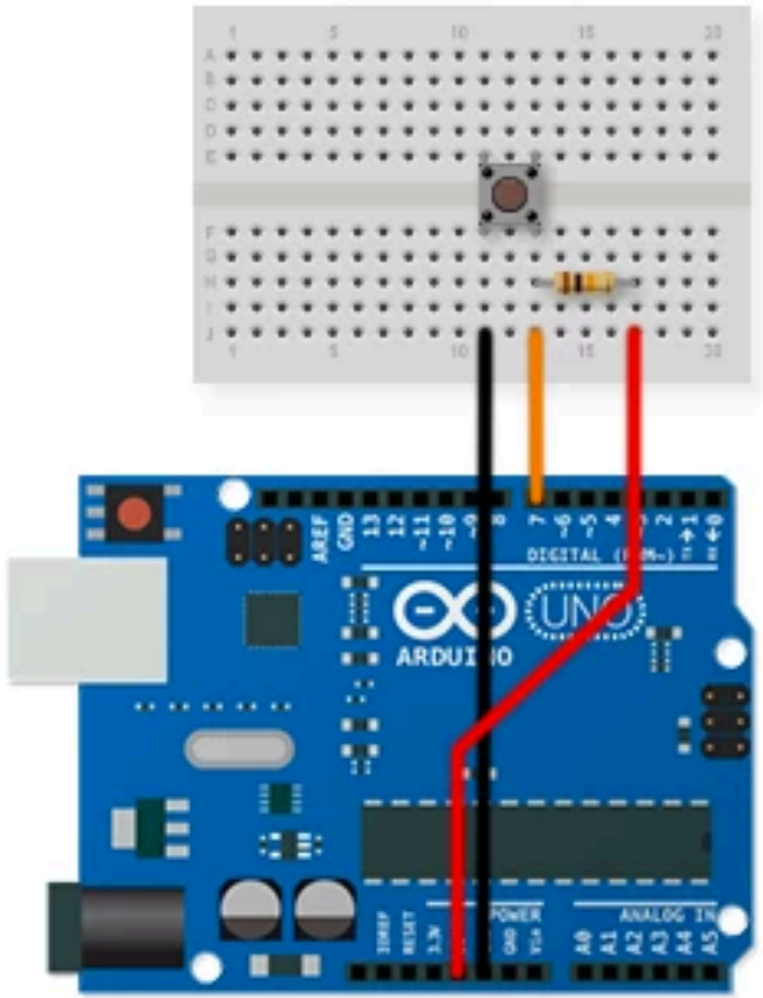
Pulse Width Modulation



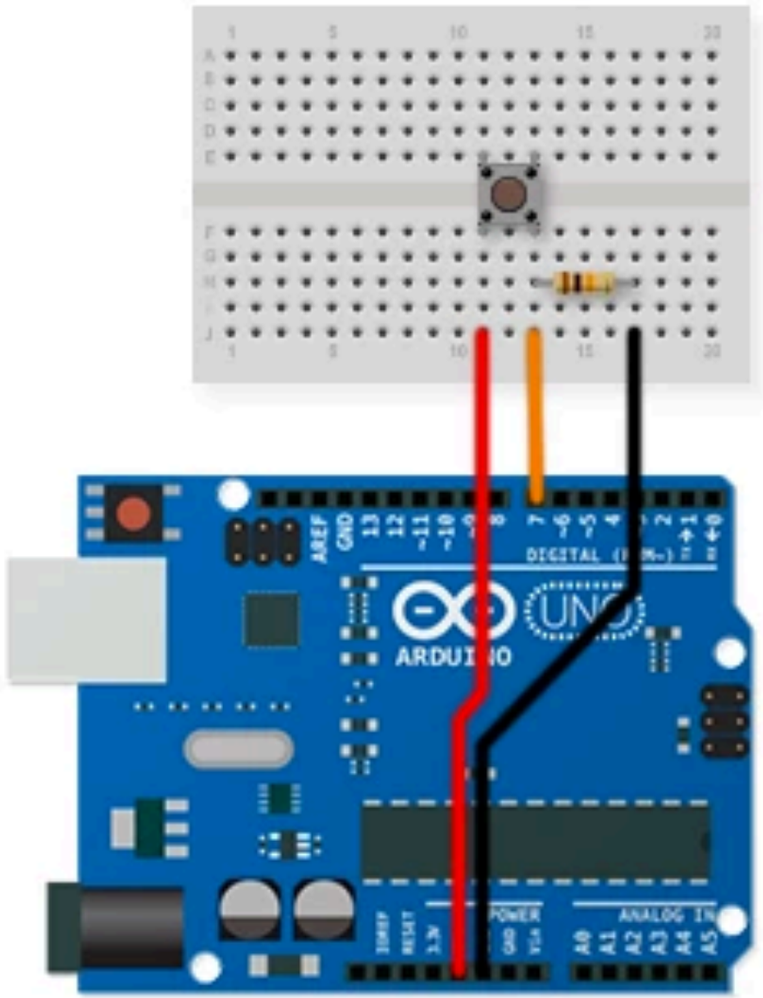
Exercise 1.4: PWM

Take your existing circuit and code it to fade in and out.

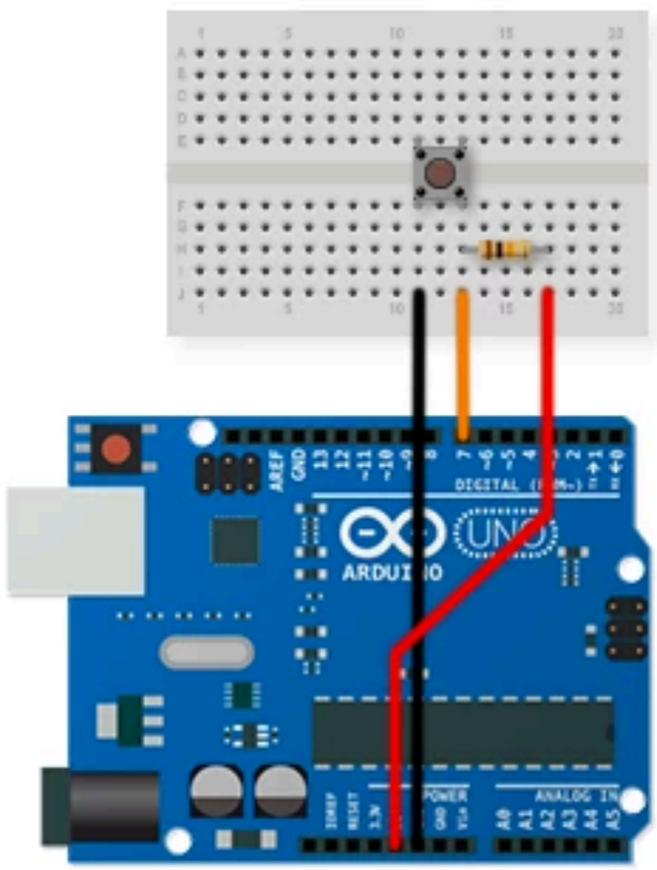
Negative Logik

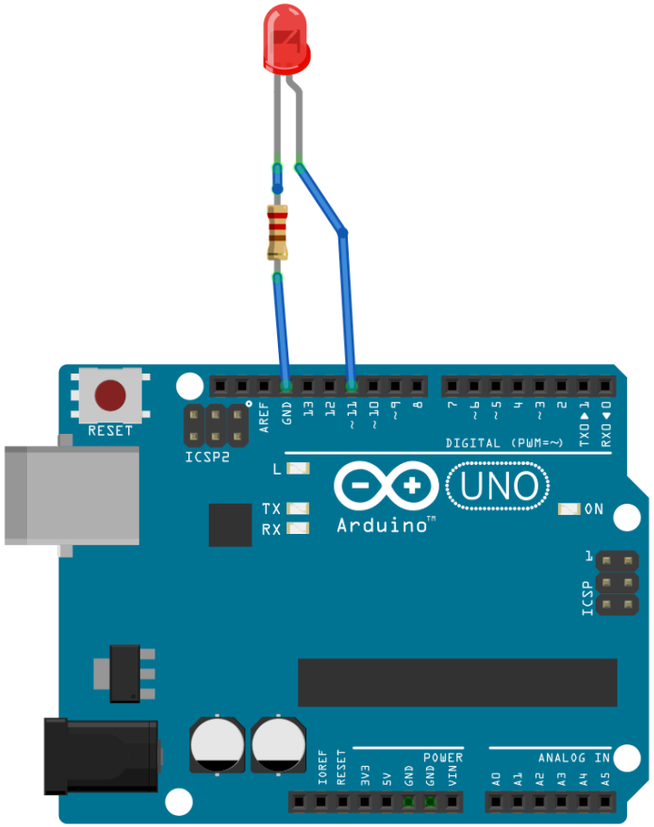


Positive Logik



Digital Input





Exercise 1.5: Digital Input

Combine the two circuits to create an LED that can be controlled with a switch and some programmed logic

Sensing & Acting