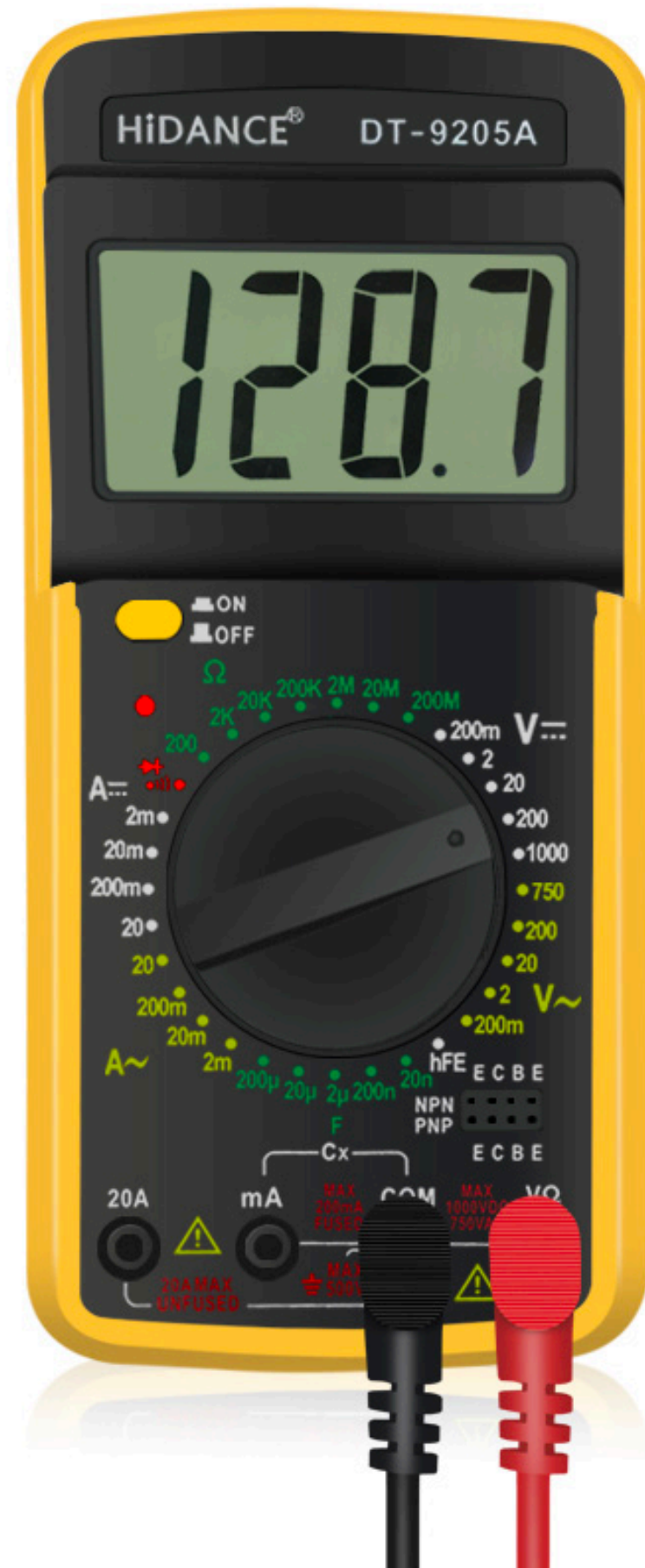
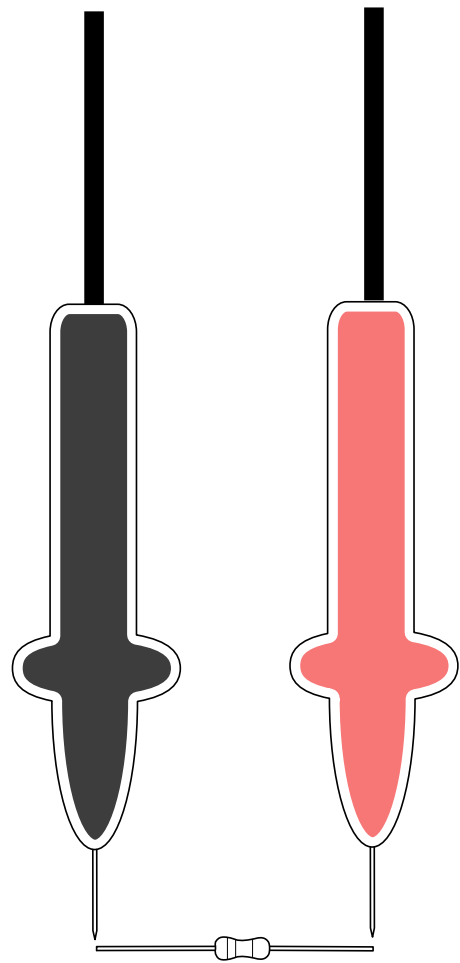


Physical Computing 2022

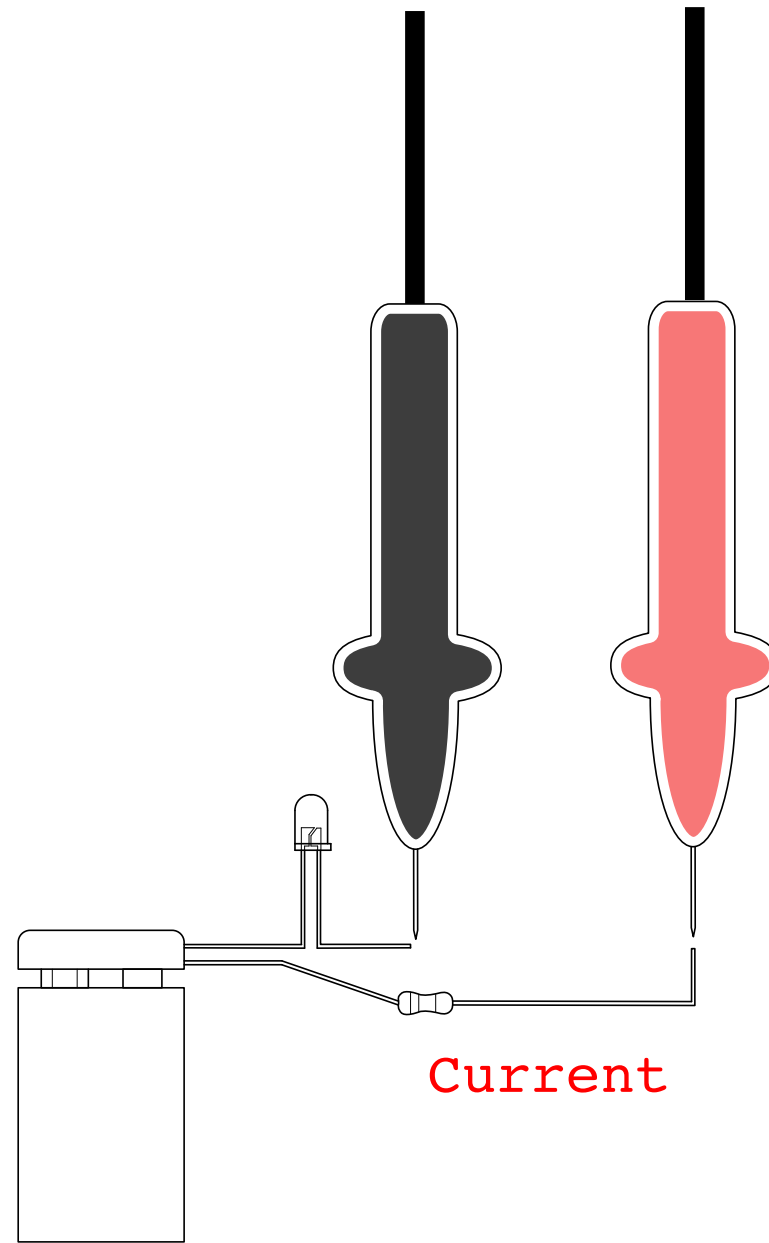
The multimeter is an essential tool for problem solving in electronics!



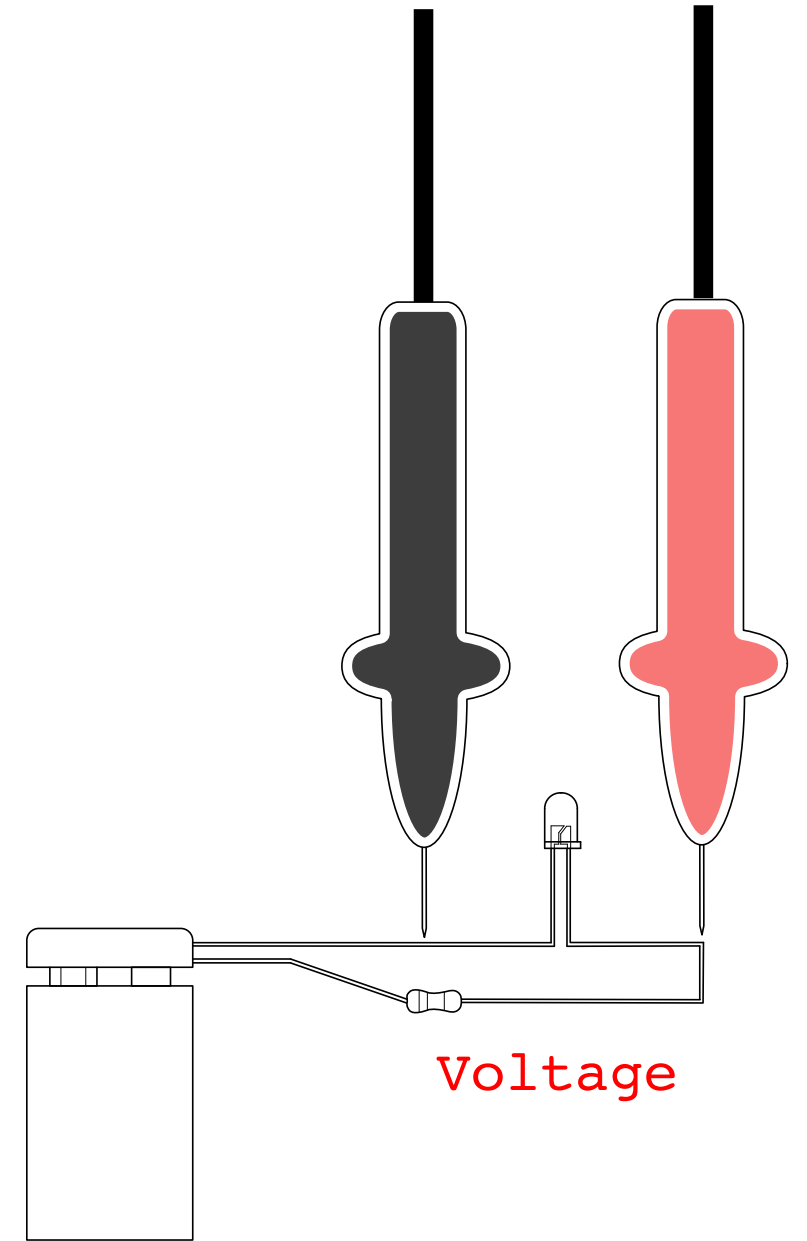
The Multimeter



Resistance



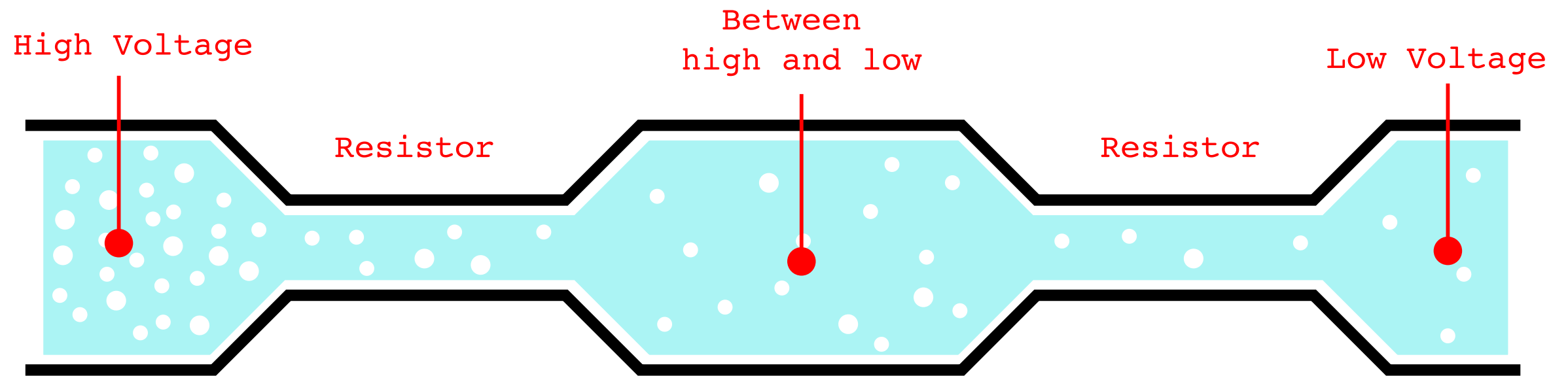
Current



Voltage

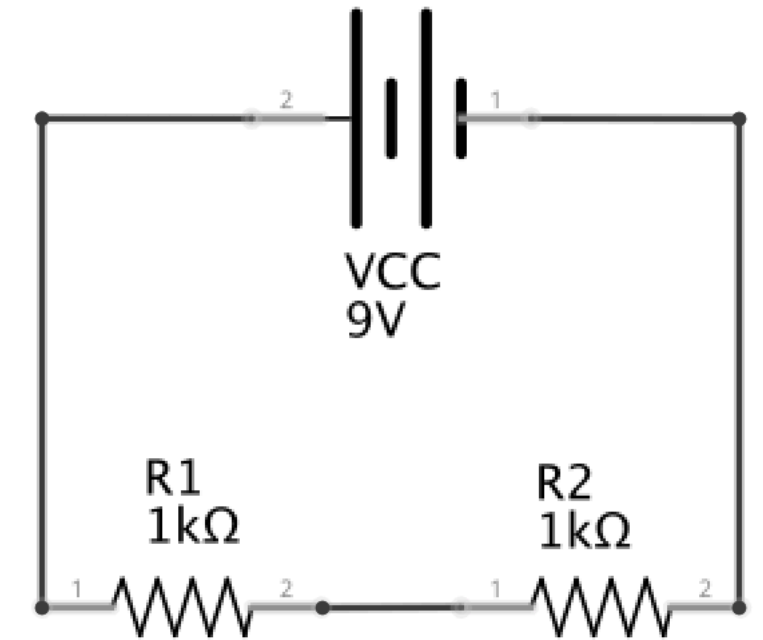
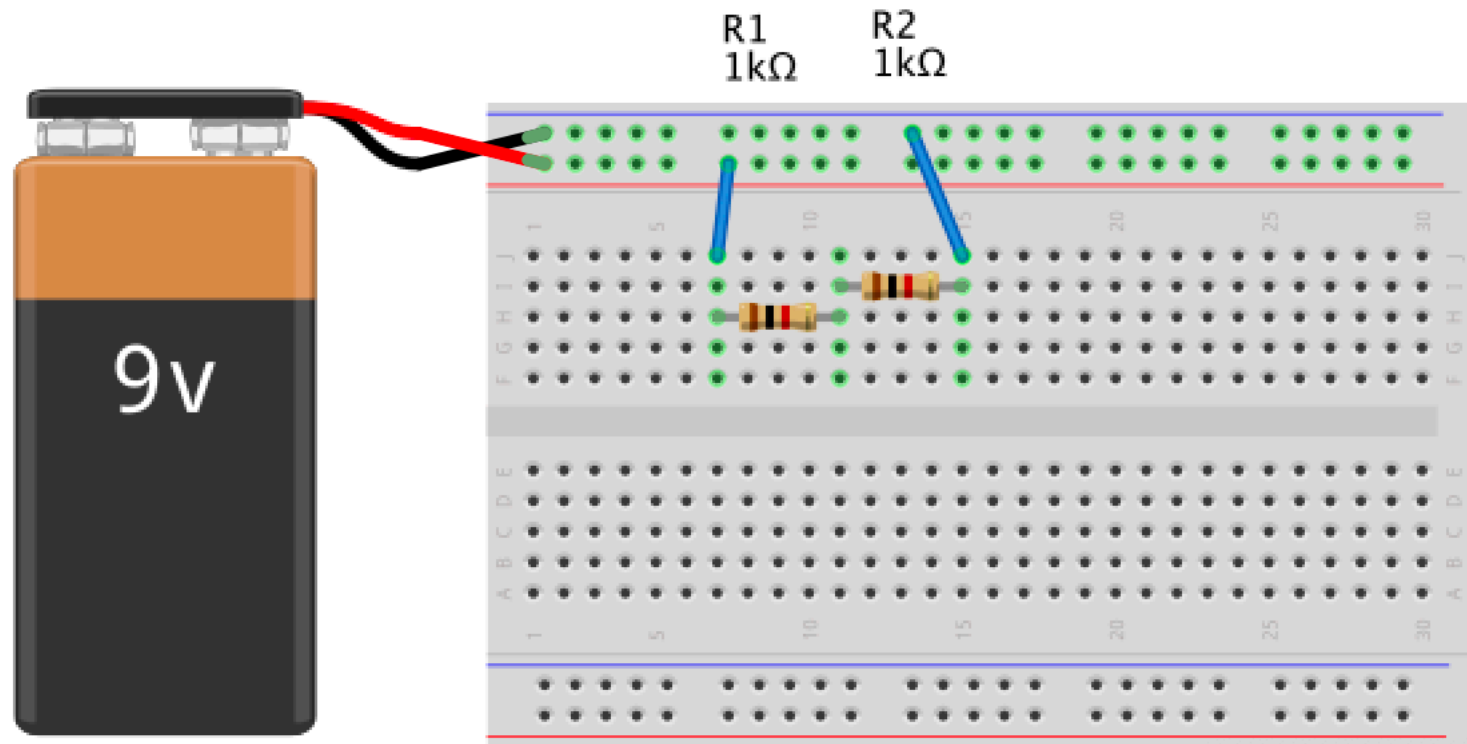
The way we use the probes on a multimeter depends on what we are testing! Resistance of components should (ideally) be tested outside its circuit. For current we have to break the circuit, and insert the probes to close it again. Voltage, however, can be measure between any two points.

The Multimeter



Voltage will drop when current flow through any component that converts electricity to some other form of energy.

Voltage Divider

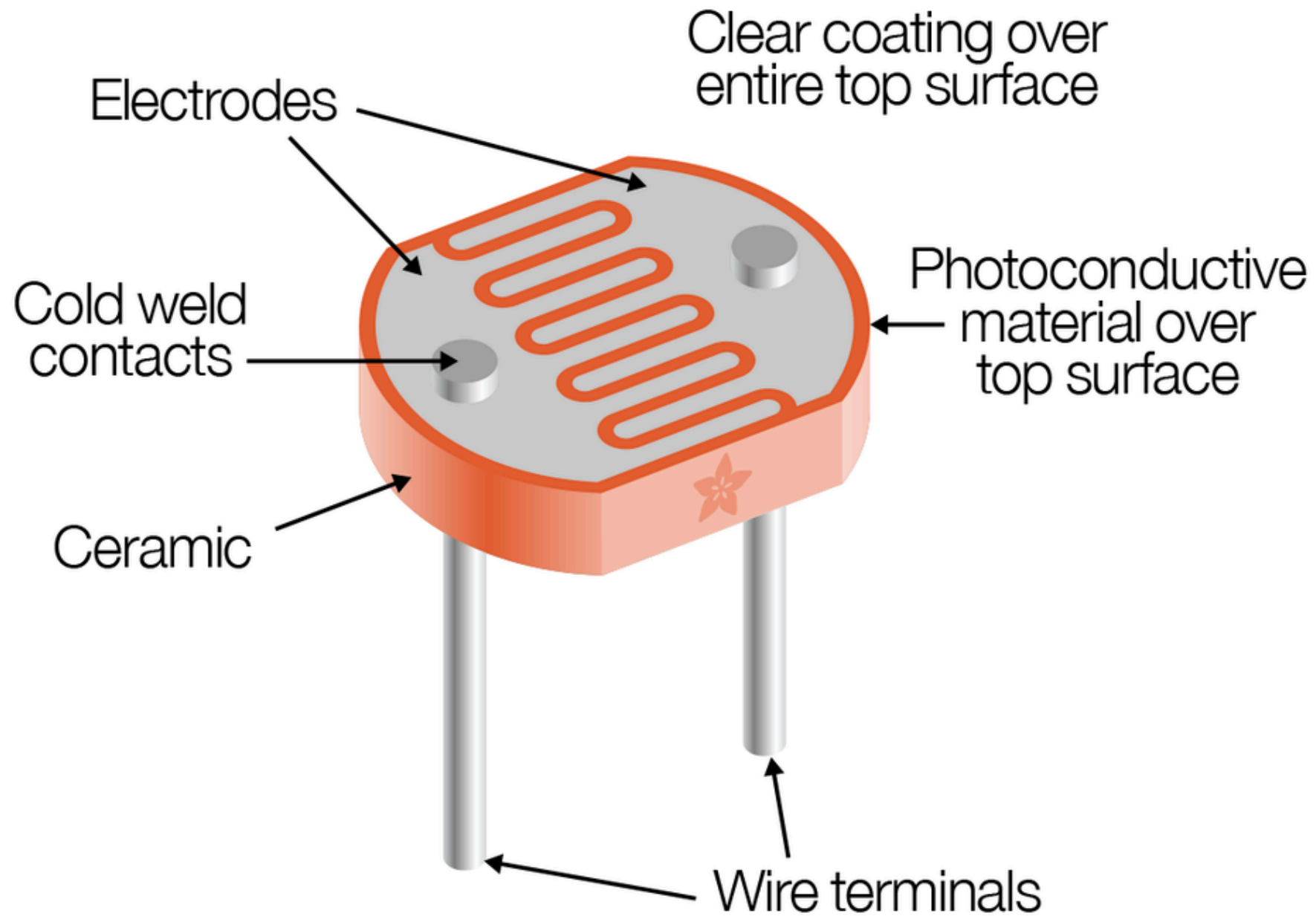


Exercise PC1.1: Voltage Divider

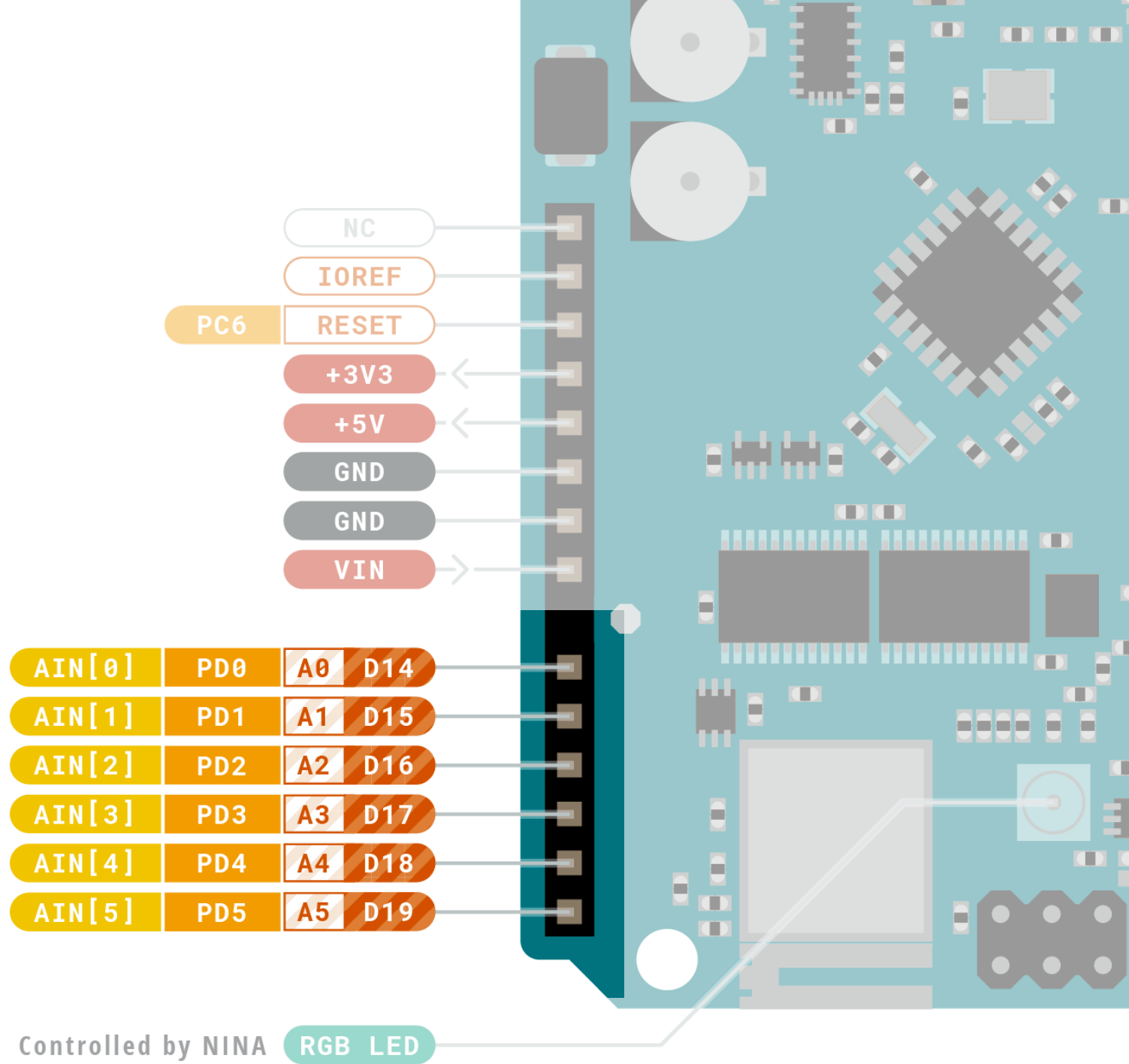
Assembly the circuit with resistors of two different values. Try calculating the voltage between your resistors, and check with the multimeter if it's correct.

$$V_{res} = V_{cc} \times \frac{R_2}{(R_1 + R_2)}$$

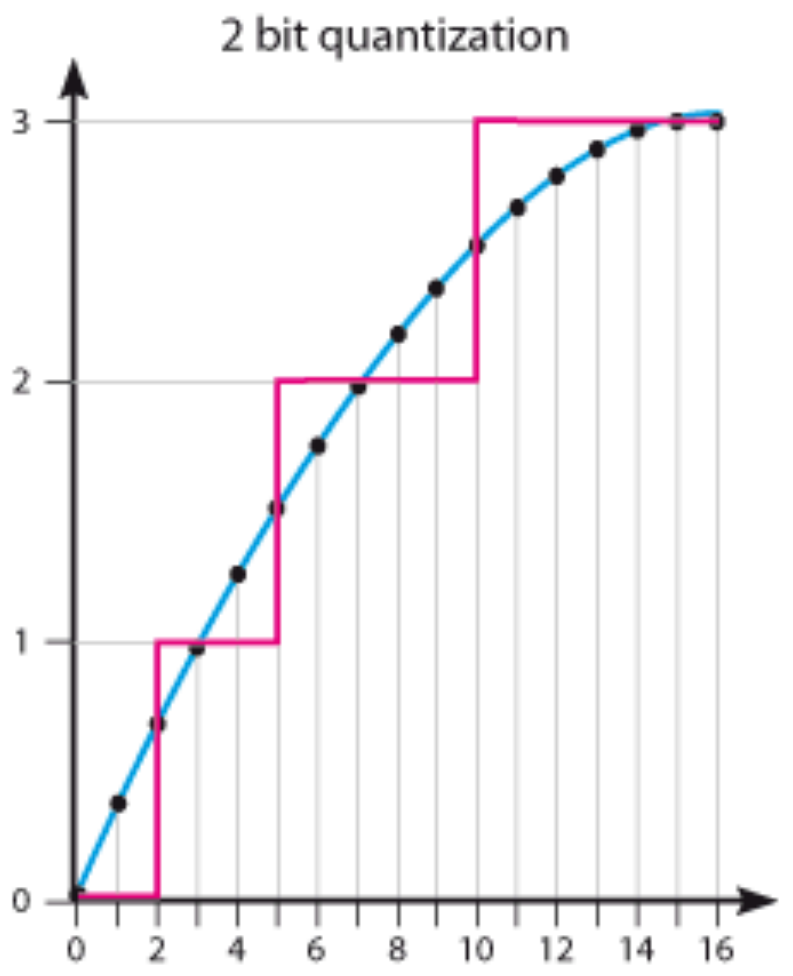
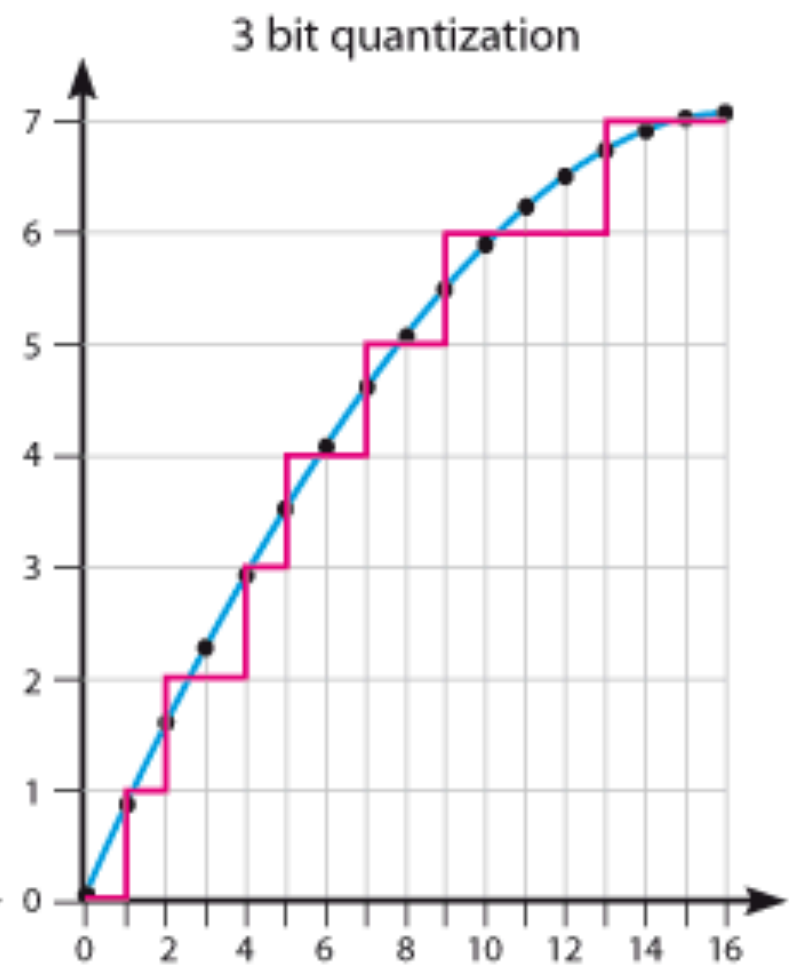
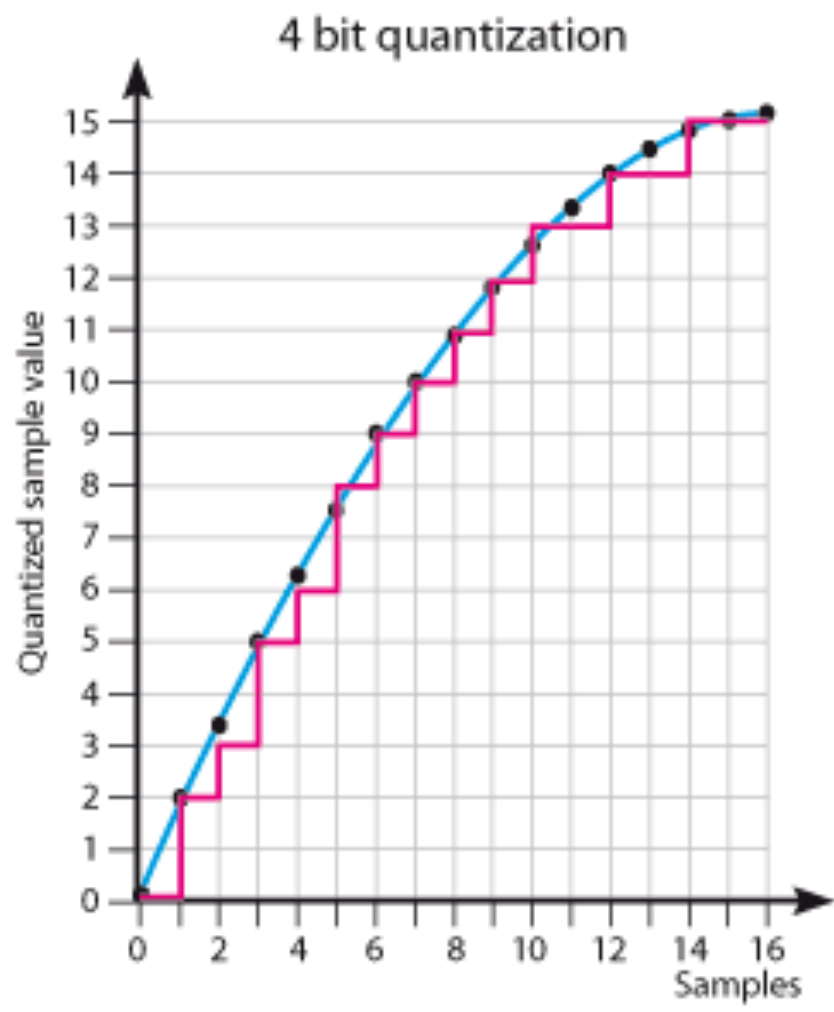
- Vres = resulting voltage
- Vcc = applied voltage (9V)
- R1 = first resistor (1000 ohm)
- R2 = second resistor (1000 ohm)



Analog Sensors

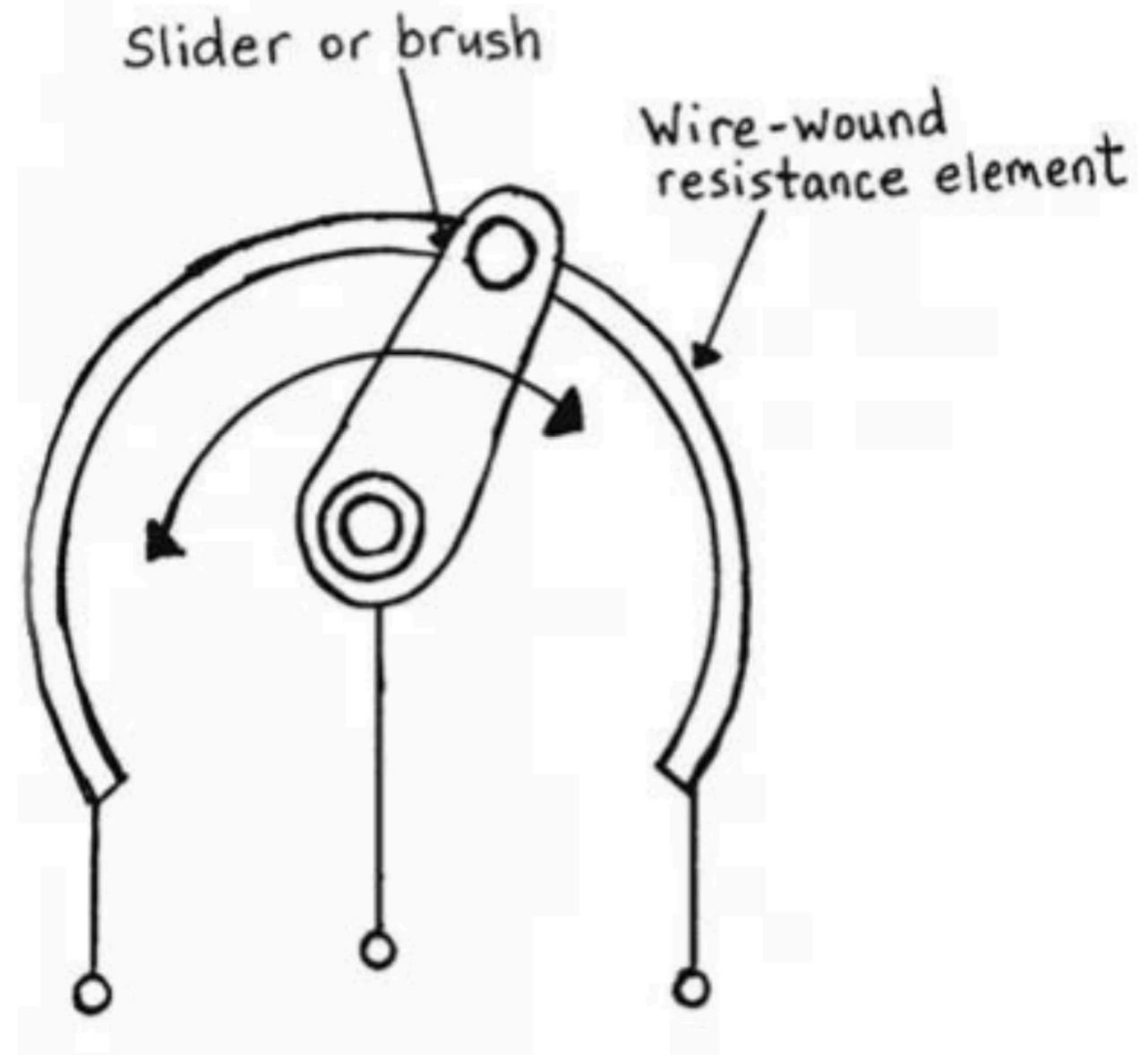


Analog Pins



Analog to Digital Conversion

A Potentiometer
is also a voltage
divider!

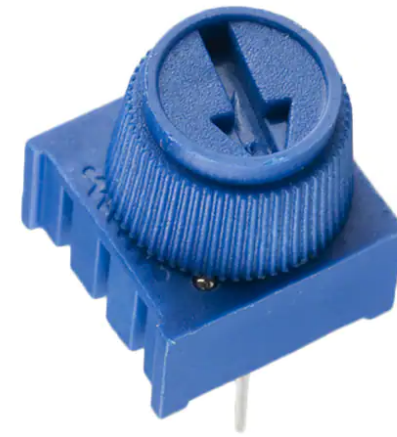


Potentiometer

Exercise: Potentiometer

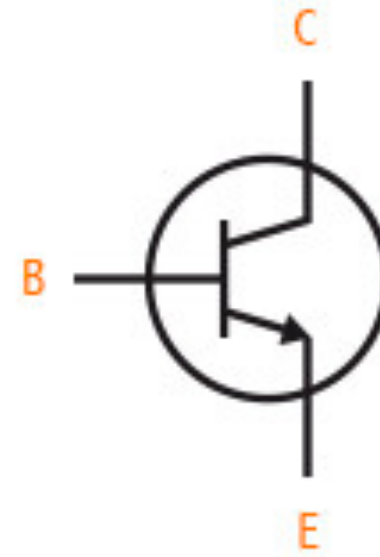
Build a circuit with your Arduino, a potentiometer and several LEDs.

Write your code so that the potentiometer controls the some form of output. Is it an animated sequence, light intensity or both?

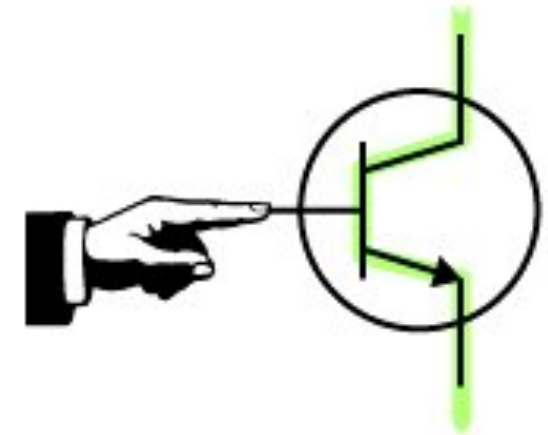
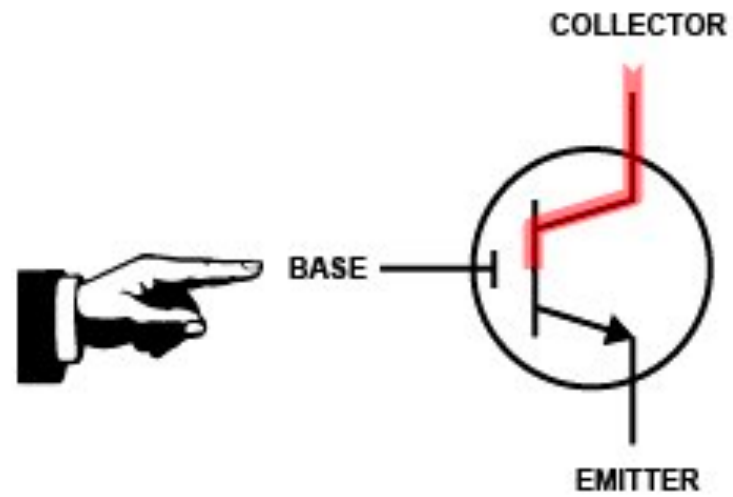


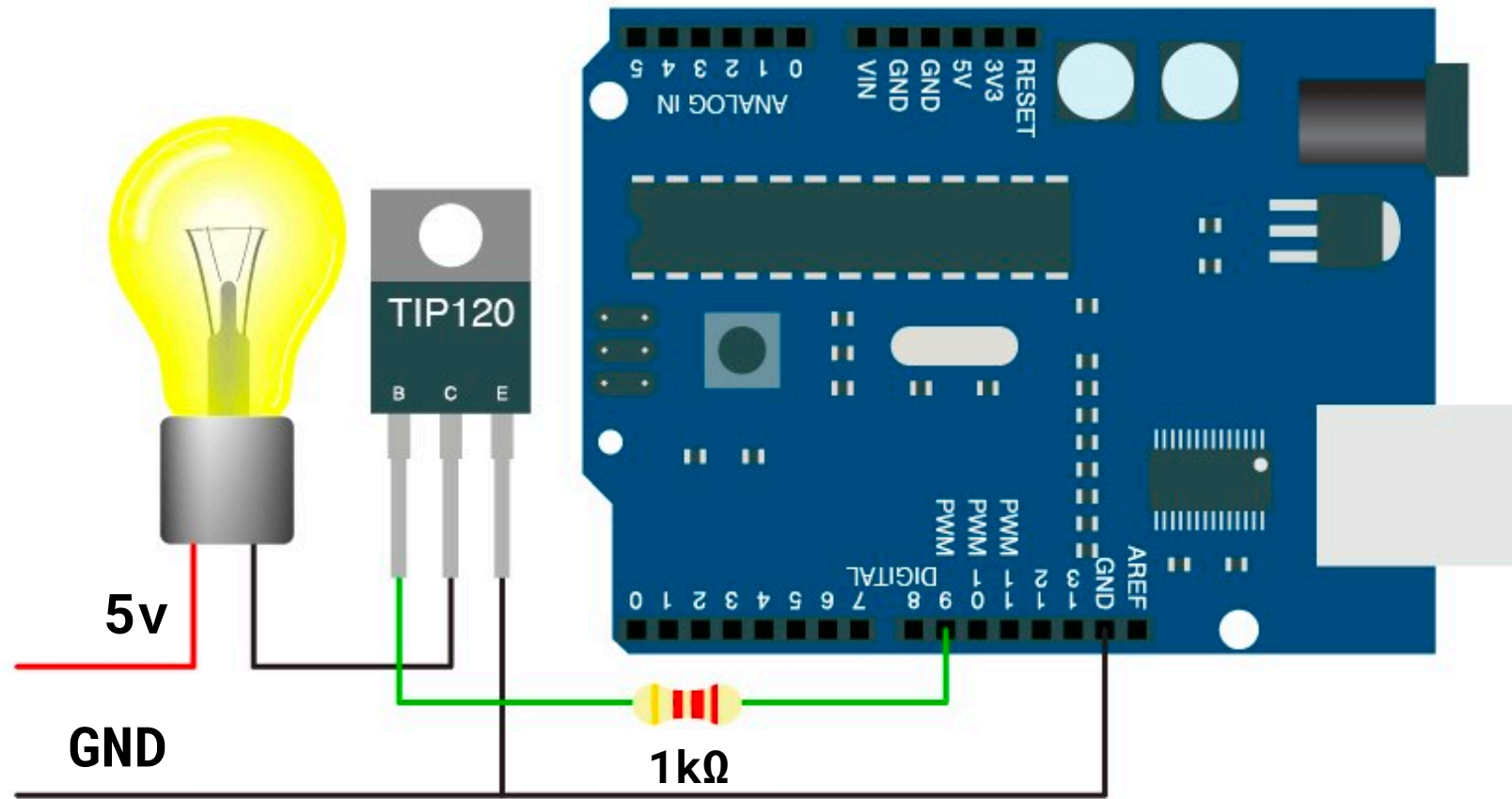
Potentiometer

To power loads greater than the 40mA our Arduino digital pins can provide, we need to use a transistor.



Transistors work like buttons, with a very small current on the base pin, allowing a larger current to flow between collector and emitter.



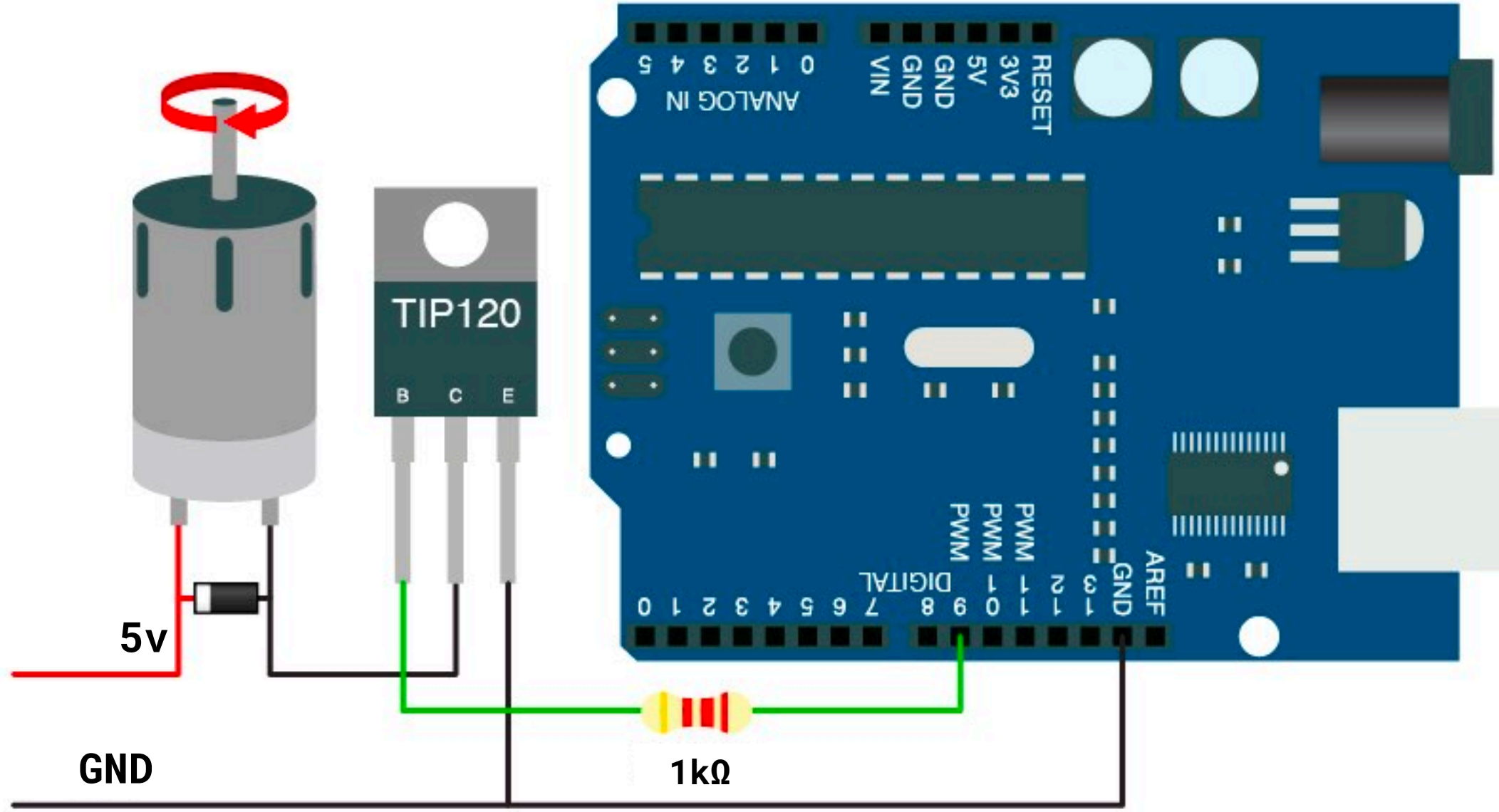


Exercise: Transistor with Lightbulb

Control an incandescent lightbulb using a transistor.

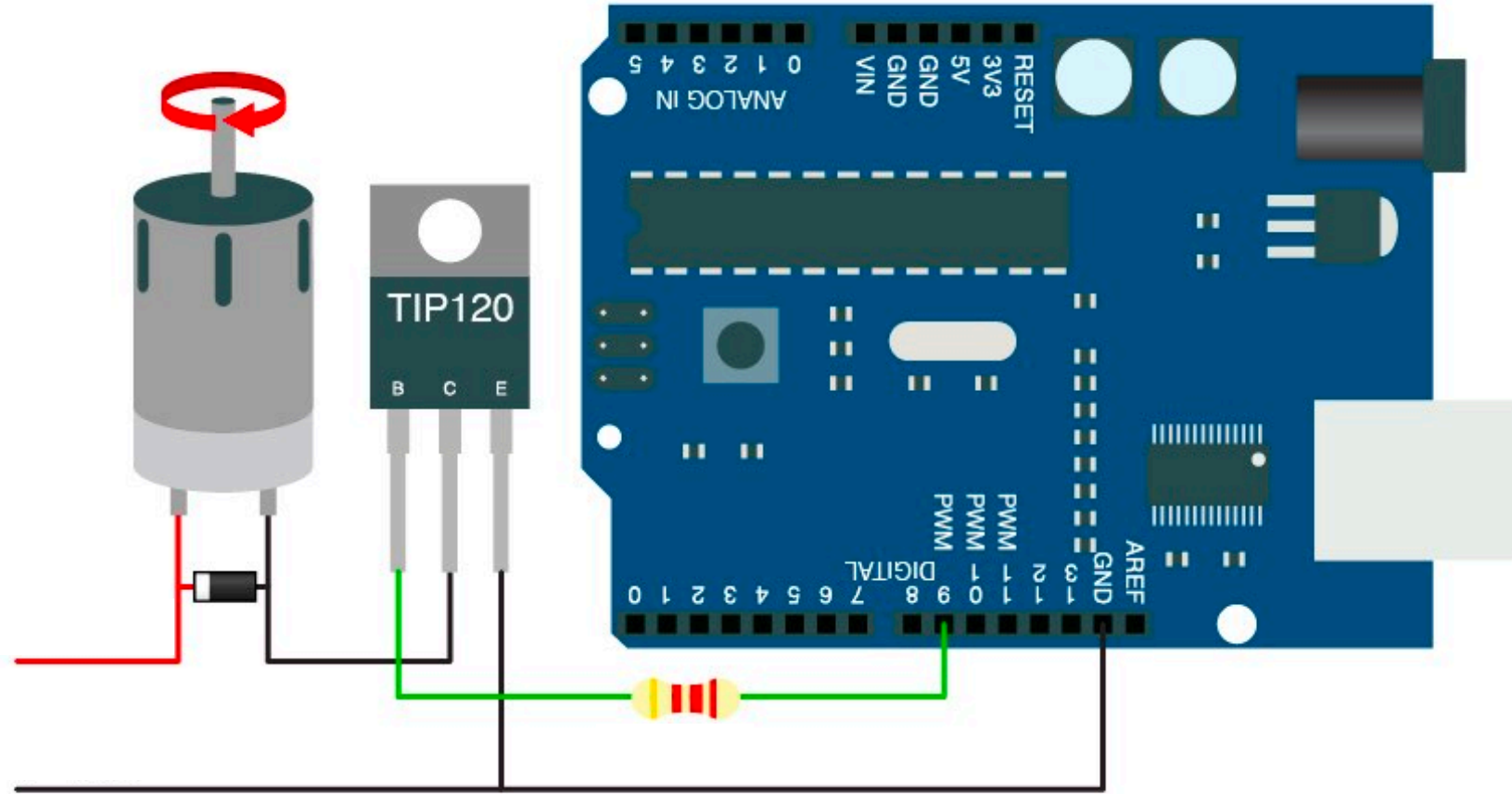
Can you also use PWM to dim it?

Adding diode is important for inductive loads (motors for example)



Transistors

Adding diode is important for inductive loads!



Exercise: Transistor with Motor

Hook up a motor in place of your lightbulb. Add in a potentiometer and write new code to control the motor speed by rotating a potentiometer.