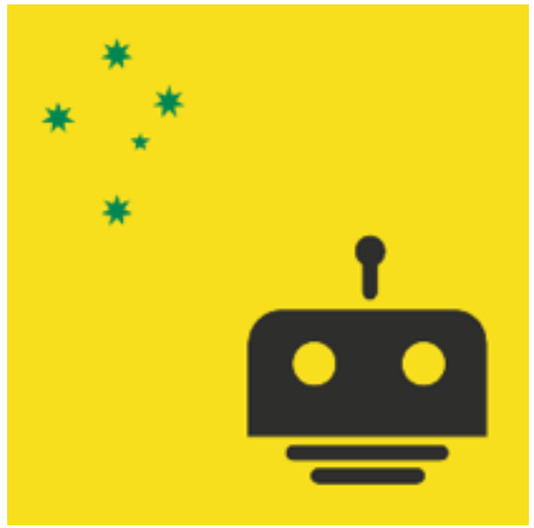


Nodebots - Electronics Primer

#nodebotsau #nbd14

$$V = I * R$$

VOLTAGE?
CURRENT?
RESISTANCE?
OHM'S LAW?

BEFORE WE PLUG IN THE ARDUINO, WE WILL REVIEW A FEW TERMS AND PRINCIPLES THAT HAVE TO DO WITH HOW ELECTRICITY (AND THEREFORE ELECTRONICS) WORKS.

VOLTAGE (V) IS A MEASURE OF ELECTRICAL POTENTIAL. IT IS MEASURED IN **VOLTS.**

CURRENT (I) IS THE AMOUNT OF FLOW THROUGH A CONDUCTIVE MATERIAL. IT IS MEASURED IN **AMPERES** OR **AMPS.**

RESISTANCE (R) IS A MATERIAL'S OPPOSITION TO THE FLOW OF ELECTRIC CURRENT. IT IS MEASURED IN **OHMS.**

ELECTRICITY IS THE FLOW OF ENERGY THROUGH A CONDUCTIVE MATERIAL.

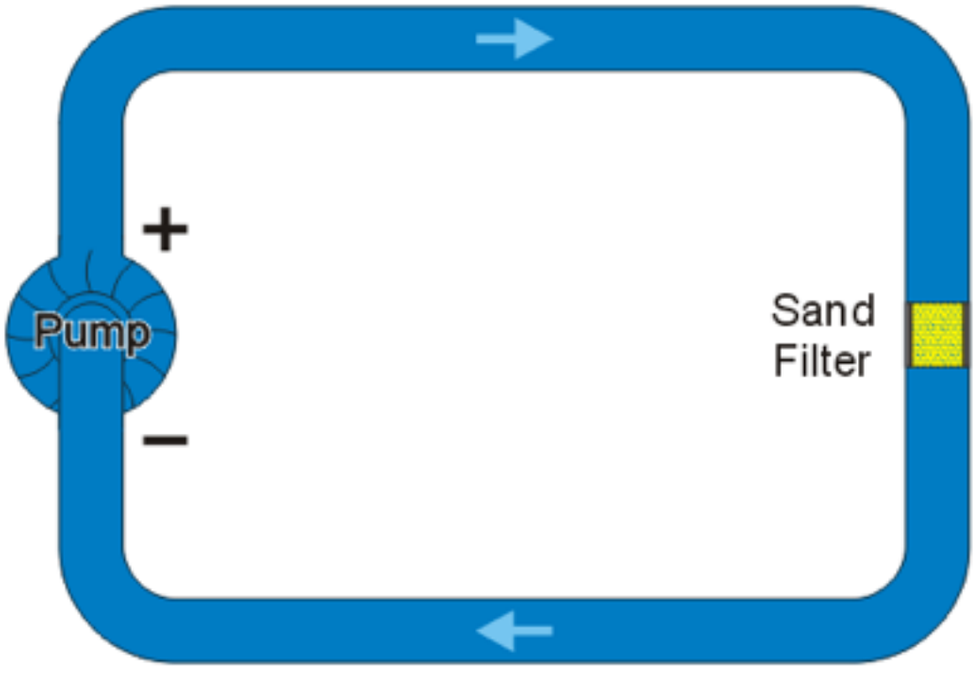
THE SPEED OF FLOW IS DETERMINED BY **VOLTAGE**

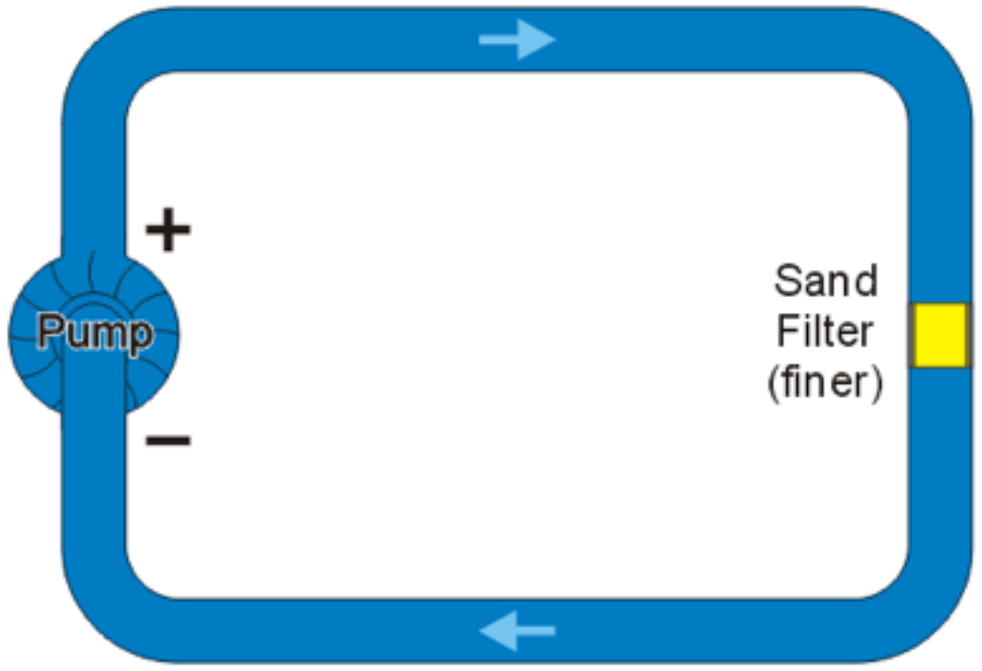
RESISTANCE INCREASES OR DECREASES FLOW

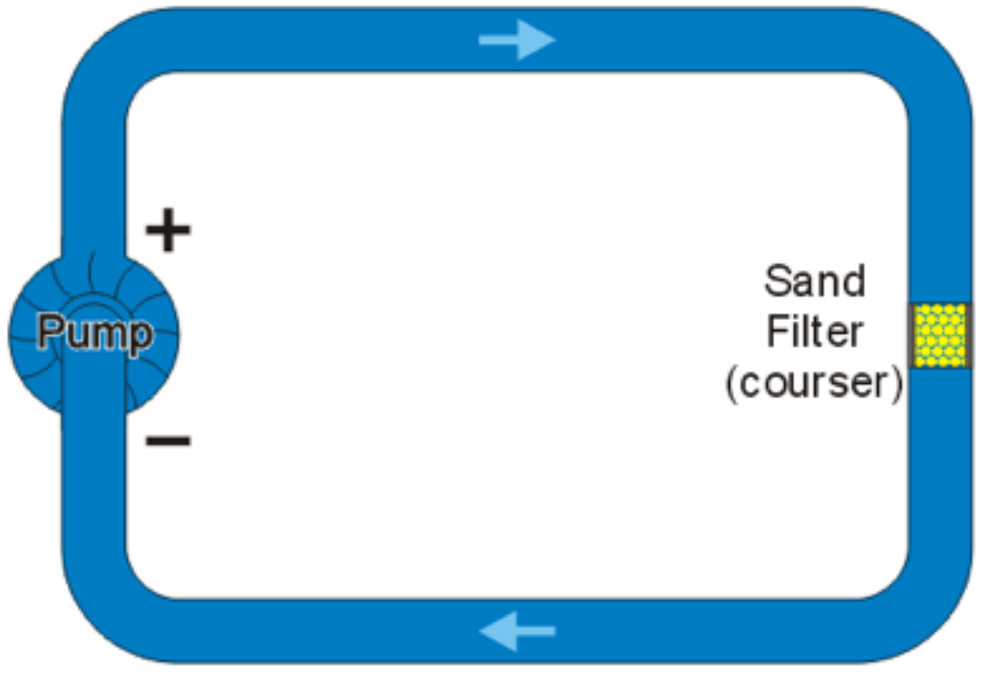
AMOUNT OF FLOW MOVING THROUGH PIPES IS **CURRENT**

THE WATER ANALOGY IS COMMONLY USED TO EXPLAIN THESE TERMS. HERE'S ONE MODEL.

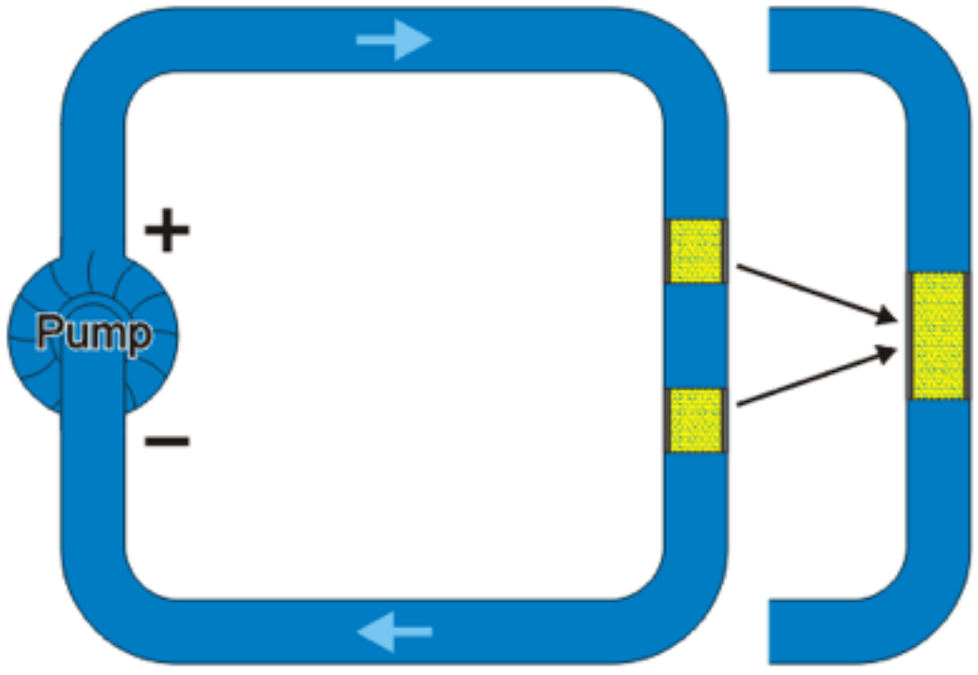
Resistors are like a sand filters

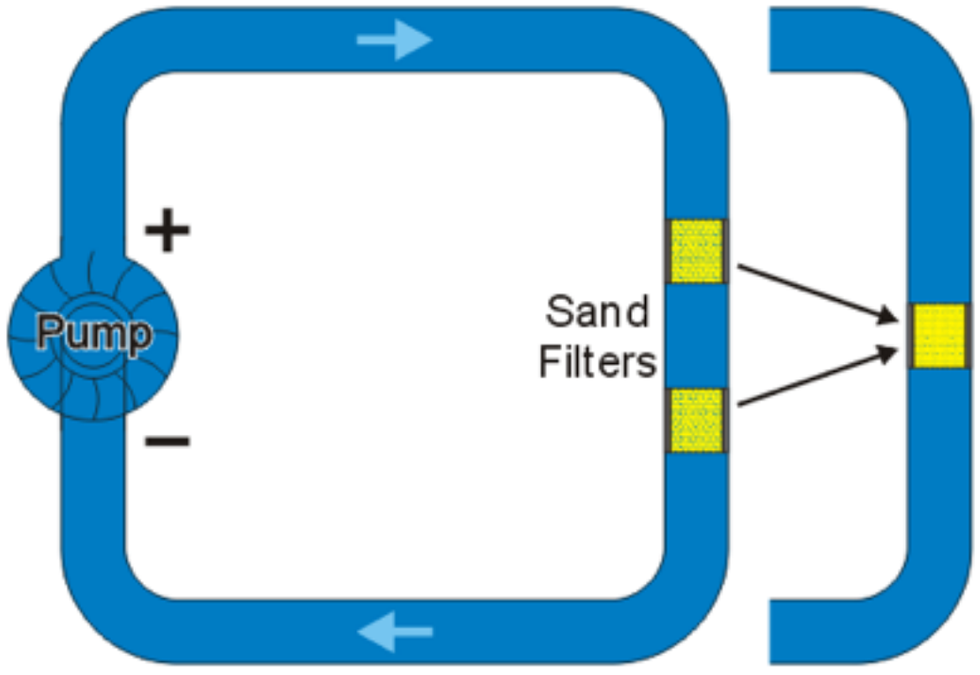




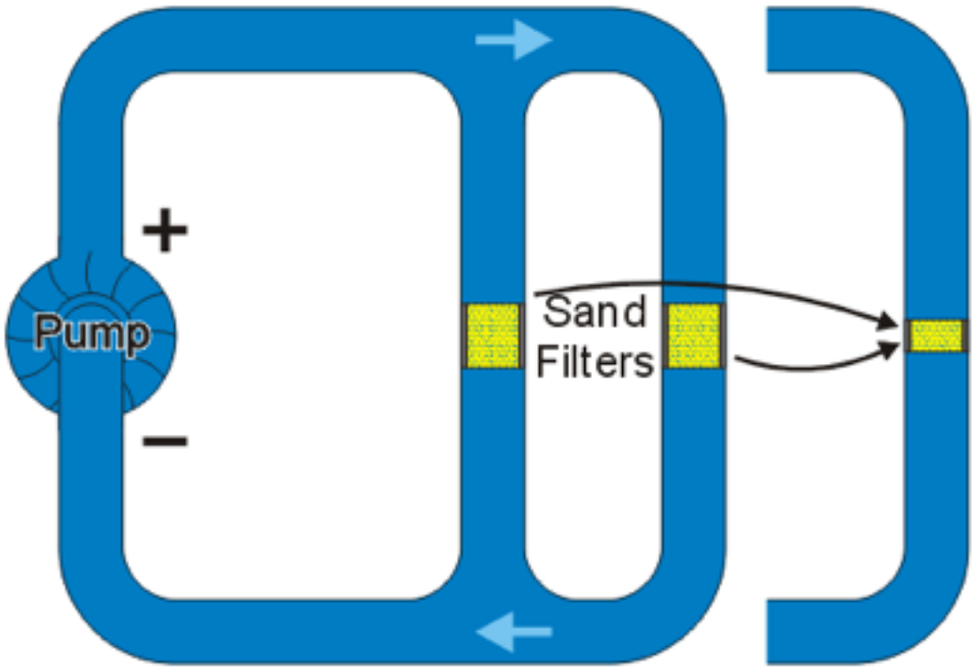


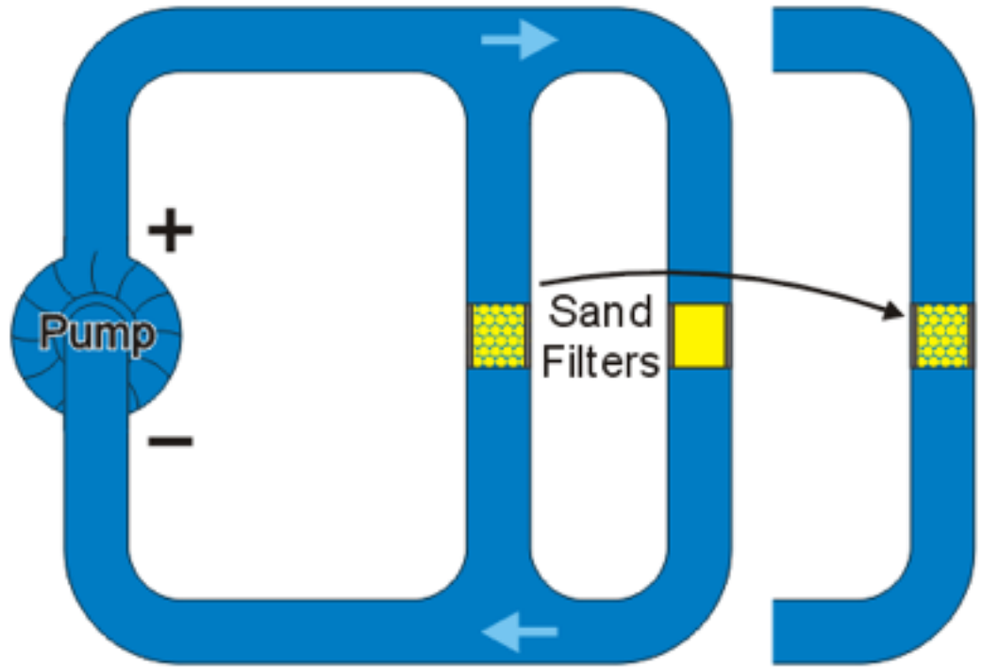
Resistors in series



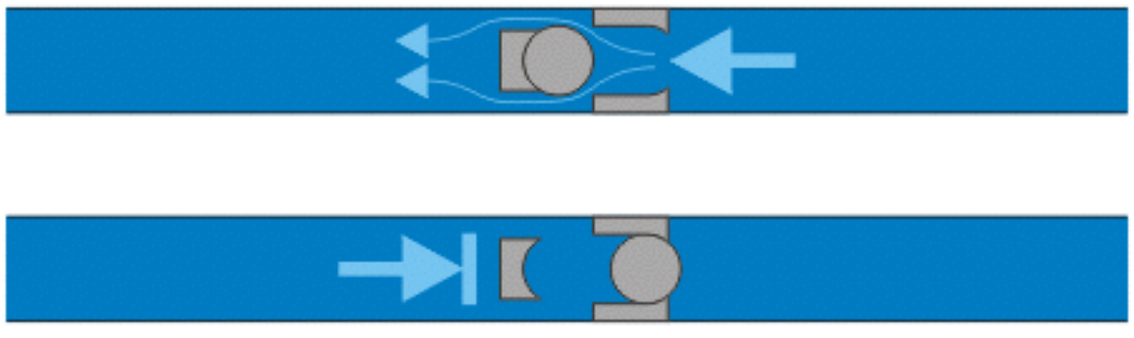


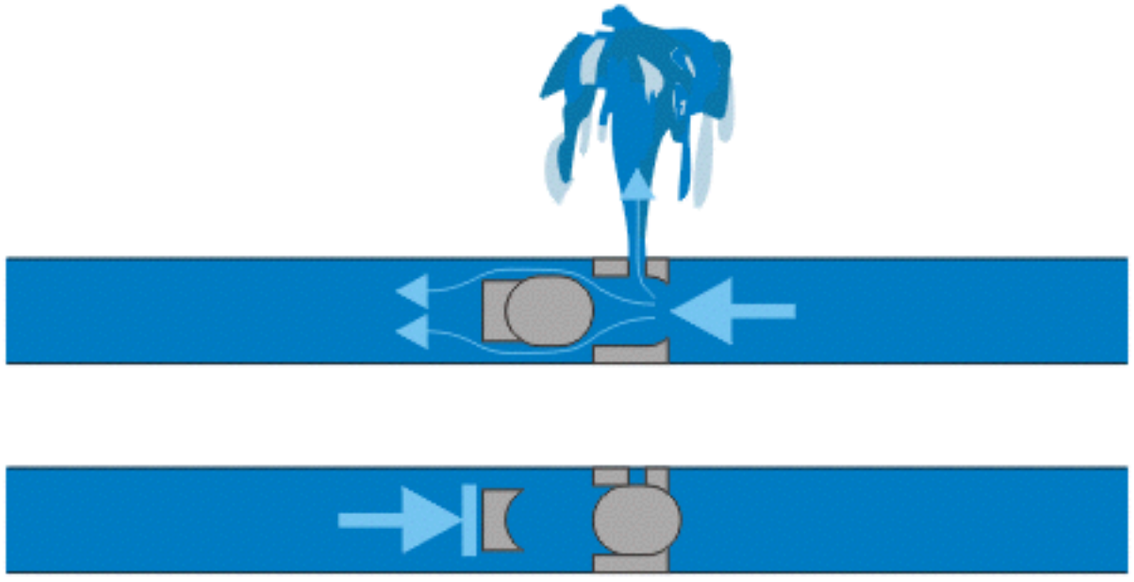
Resistors in parallel





Diodes and LEDs





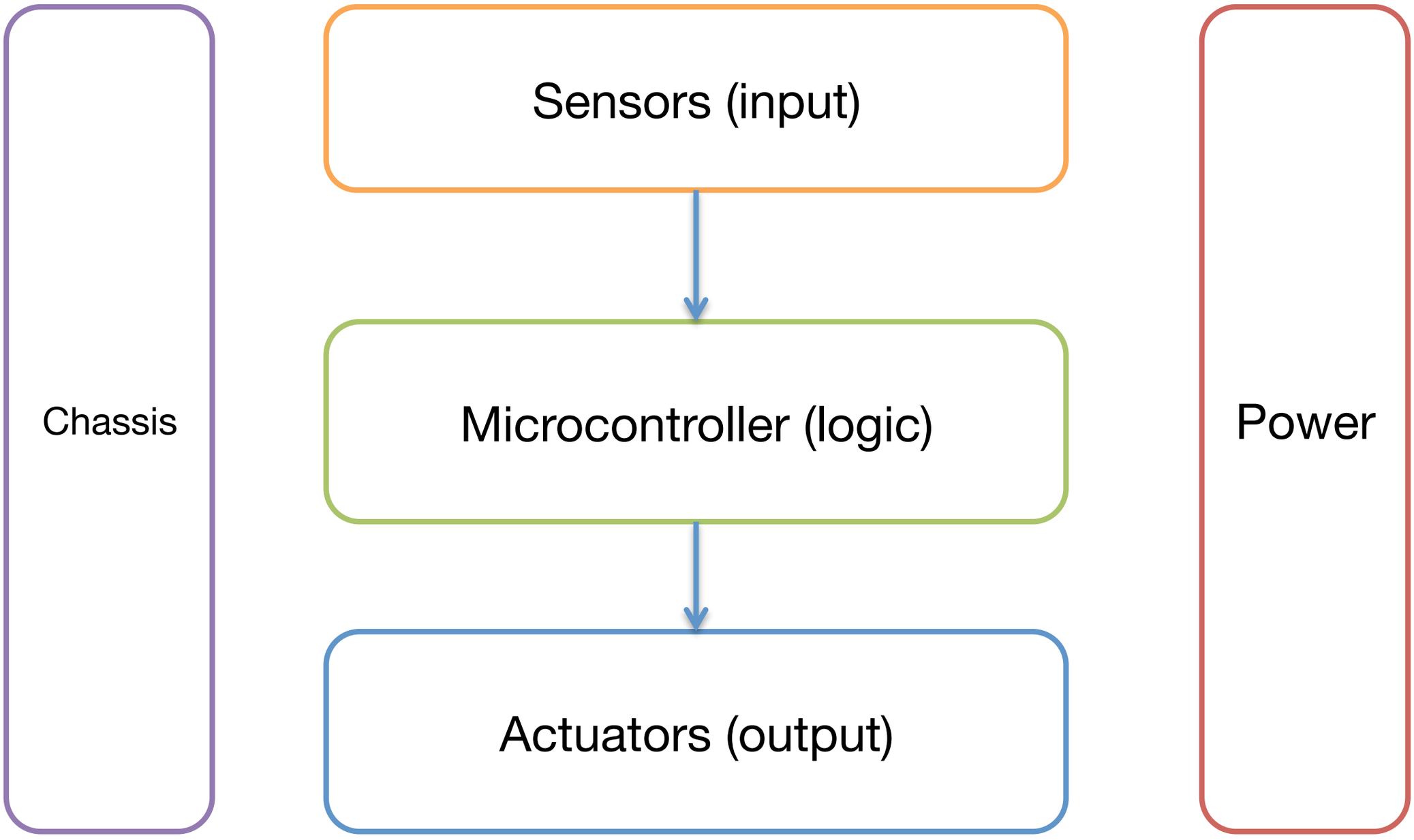
$$V = I * R$$

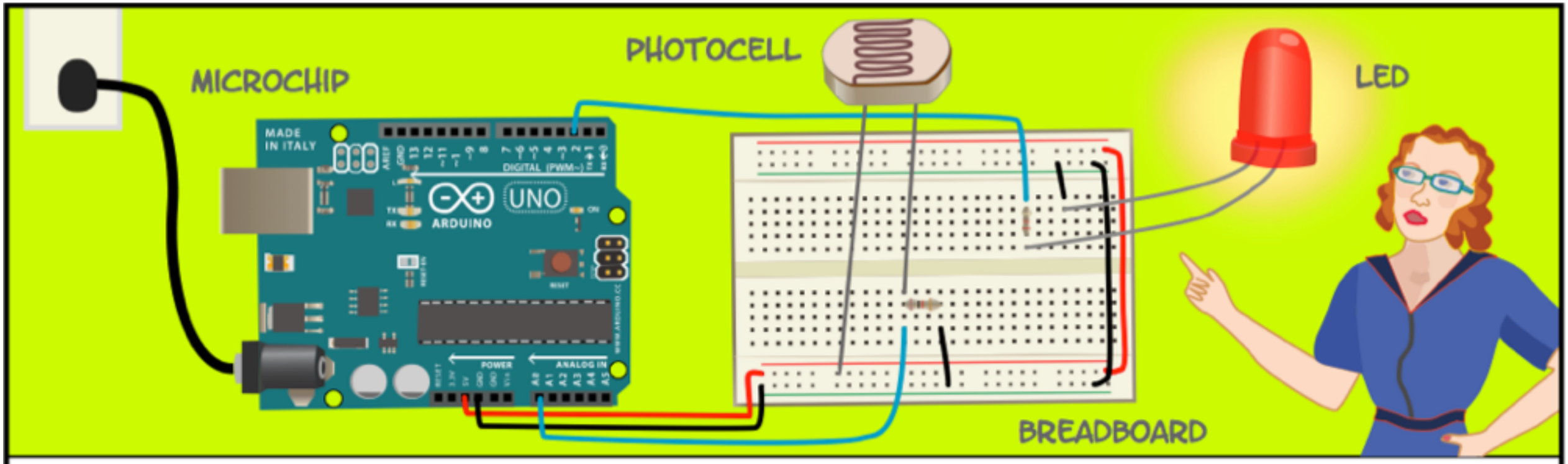
More info:

https://github.com/AnnaGerber/bits-n-bots (general intro material)
https://ece.uwaterloo.ca/~dwharder/Analogy/ (more water analogies)
https://www.khanacademy.org/science/physics/electricity-and-magnetism/v/circuits--part-1 (course on circuits)

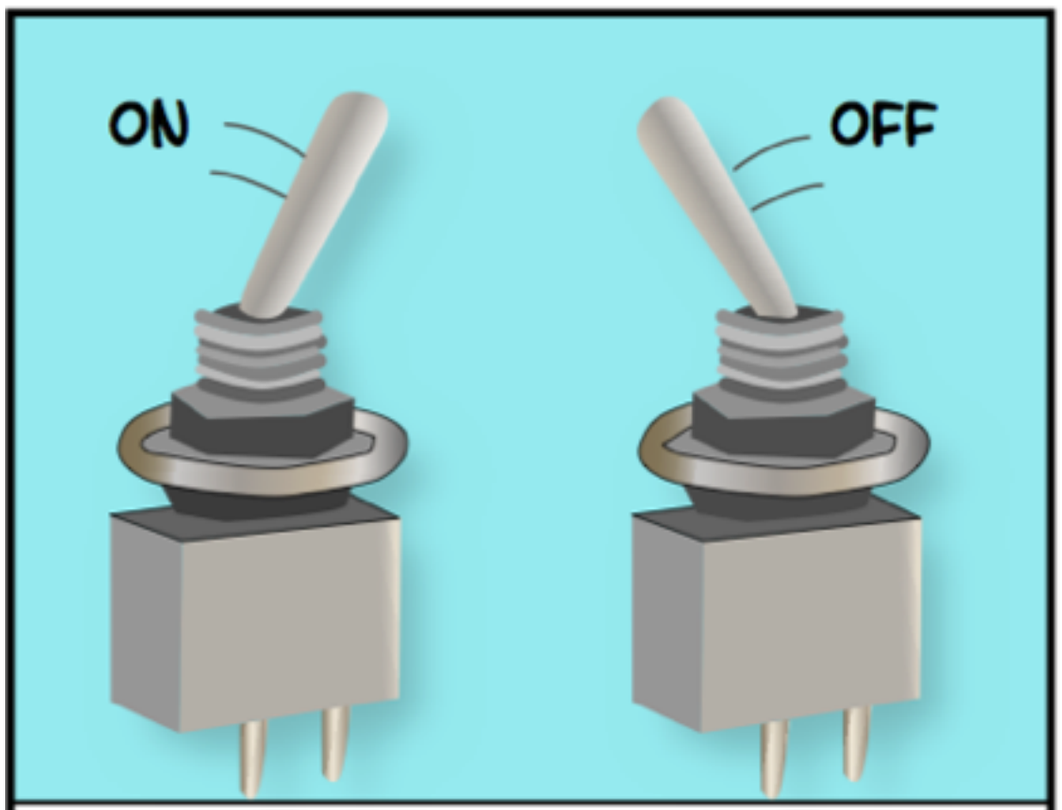
Physical computing is building interactive systems, using hardware and software, to sense and respond to the physical world.

Our nodebots will have sensors and actuators, and they will use a microcontroller for decision making…

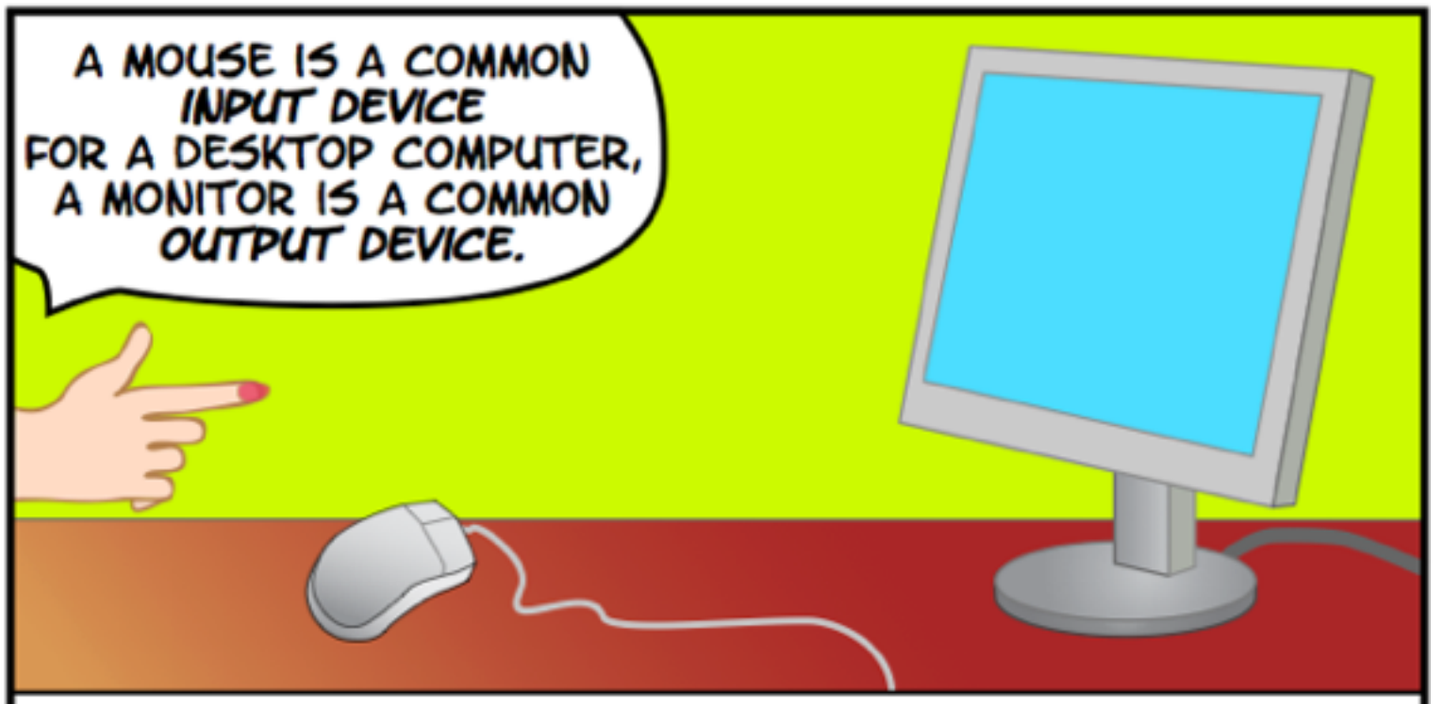




AN ARDUINO CONTAINS A ***MICROCHIP***, WHICH IS A VERY SMALL COMPUTER THAT YOU CAN PROGRAM. YOU CAN ATTACH SENSORS TO IT THAT CAN MEASURE CONDITIONS (LIKE HOW MUCH LIGHT THERE IS IN THE ROOM). IT CAN CONTROL HOW OTHER OBJECTS REACT TO THOSE CONDITIONS (ROOM GETS DARK, LED TURNS ON).



OR IT CAN RESPOND TO SOMETHING AS SIMPLE AS THE PRESS OF A SWITCH.



MICROCONTROLLERS USE ***INPUTS*** AND ***OUTPUTS*** LIKE ANY COMPUTER. INPUTS CAPTURE INFORMATION FROM THE USER OR THE ENVIRONMENT WHILE OUTPUTS DO SOMETHING WITH THE INFORMATION THAT HAS BEEN CAPTURED.

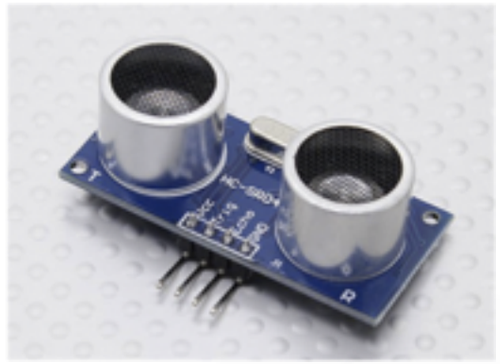
Types of sensors

- **Acoustic, sound, vibration:** microphone, lace sensor (guitar pickup)
- **Chemical:** CO2, CO, pH, smoke detector, breathalyser
- **Electric current, electric potential, magnetic, radio:** magnetometer, hall-effect sensor, electron multipliers
- **Environment, weather, moisture, humidity:** soil moisture, water sensor
- **Flow, fluid velocity:** flow meter
- **Ionizing radiation, subatomic particles:** geiger counter, particle detector
- **Position, angle, displacement, distance, speed, acceleration:** capacitive sensing, gyroscope, accelerometer, LIDAR, tachometer, tilt
- **Optical, light, imaging, photon:** infra-red, LED as light sensor, photo-resistor, camera
- **Pressure:** barometer, tactile sensor, piezometer
- **Thermal, heat, temperature:** thermistor
- **Proximity, presence:** ultra-sonic sensor

http://en.wikipedia.org/wiki/List_of_sensors

Examples of sensors and input devices

- **Ultrasonic sensor:** used to detect distance from objects.



- **Photo resistor:** used to detect light.

- **Push button:** used to capture discrete input or collision

- **Camera:** used to capture visual information

Types and examples of actuators

- **Light and display:** LED, LCD
- **Sound:** piezo buzzer

- **Motion and switching:** DC motor, servo motor, solenoid relay

- Others, such as: hydraulic, pneumatic, mechanical

Digital vs Analog signals

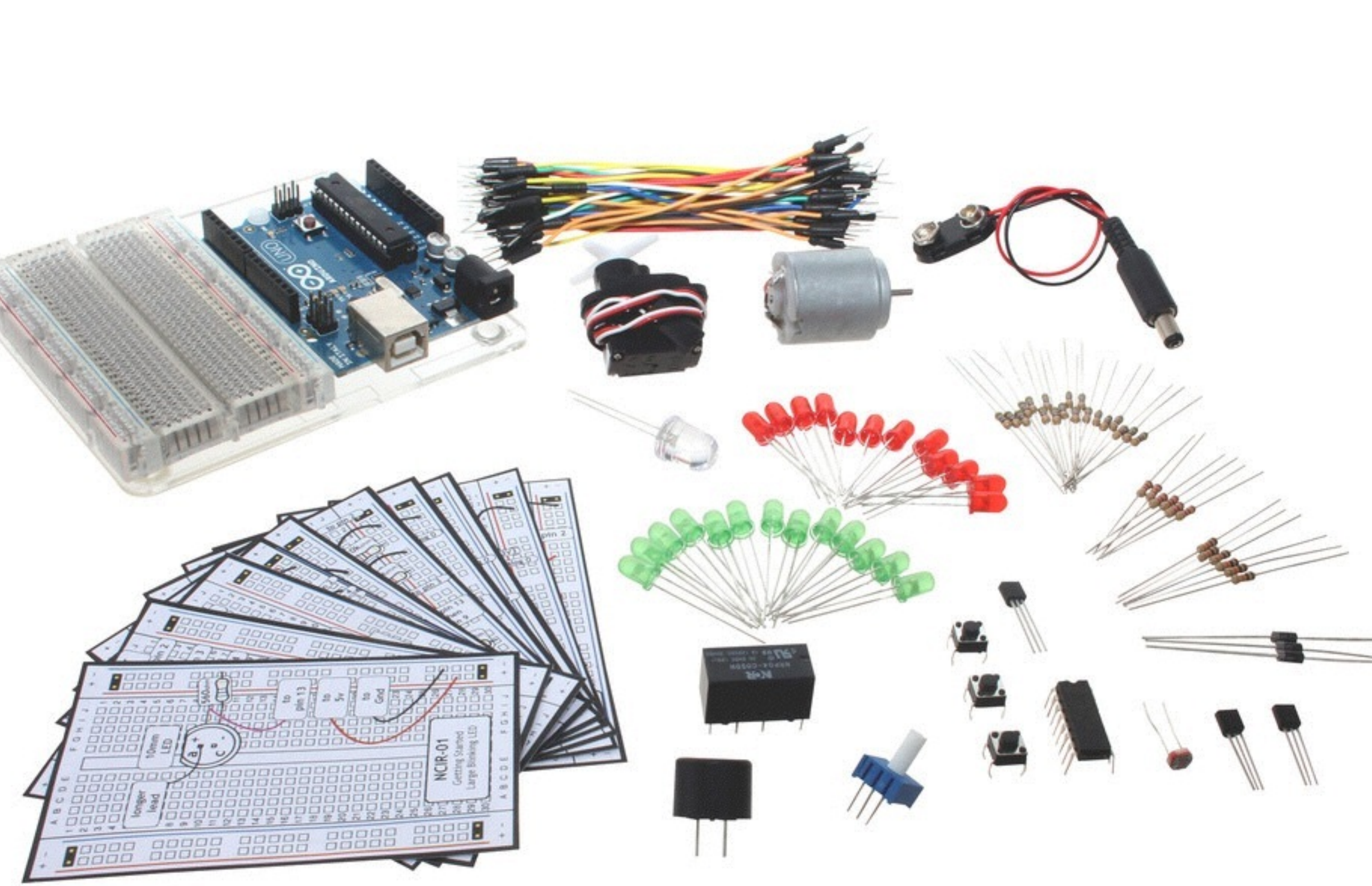
Digital components rely on discrete values, typically indicated by high and low voltages

- 5V (or 3.3V) => high => 1 => ON
- 0V => low => 0 => OFF
  - Examples of digital sensors: tilt sensor, push button
  - Examples of digital actuators: relay, LCD display, servo motor

Analog components use continuous values, produced as a signal over time

- Values are usually constrained, e.g. 0-100mA or 0-100k
  - Examples of analog sensors: accelerometer, thermistor, photo-resistor
  - Examples of analog actuators: DC motor

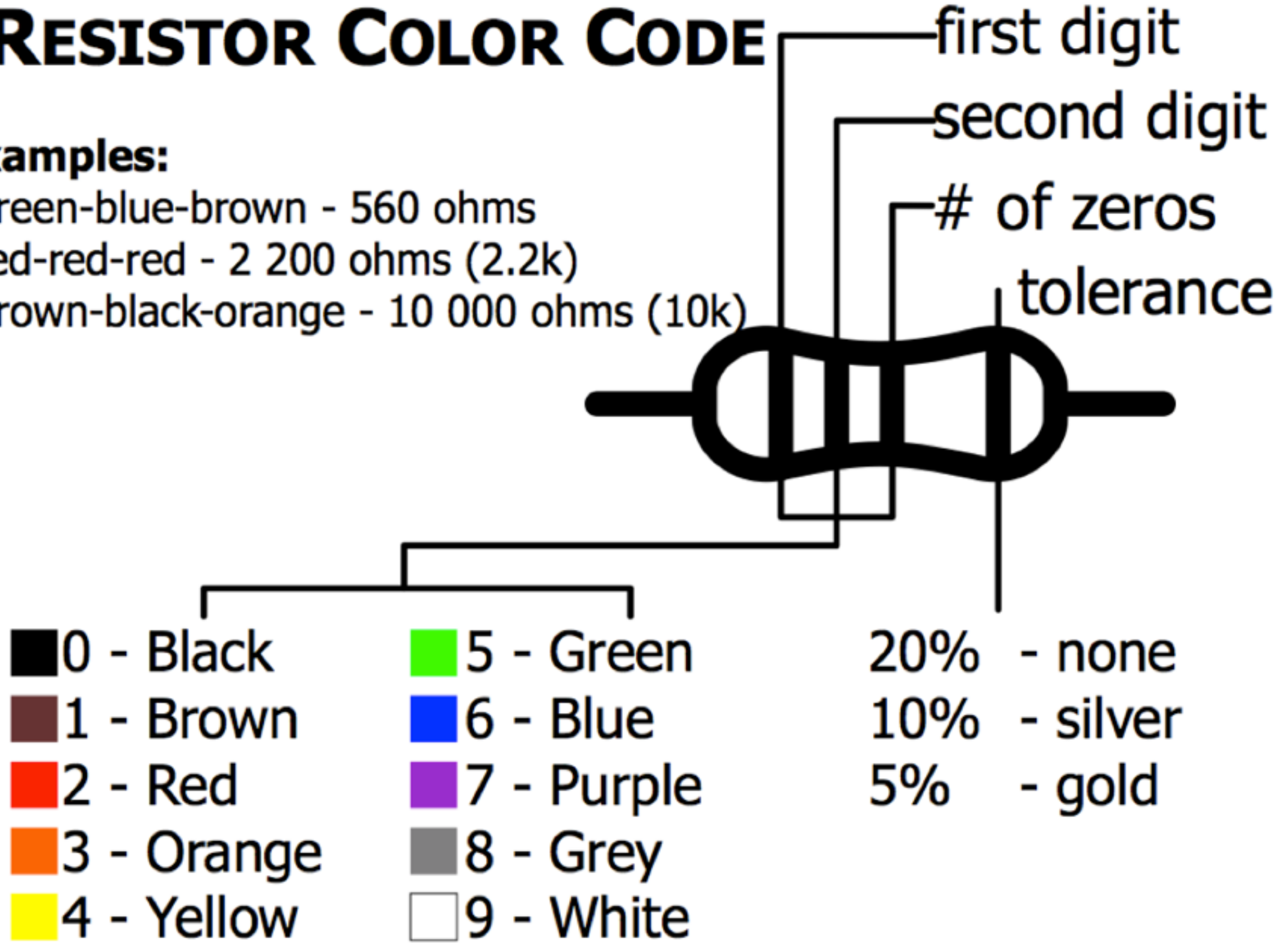
Note: Some sensors support both Analog and Digital outputs.


UNO
NCIR-01
Getting Started
Large Blinking LED
10mm
LED
longer
lead
pin 13
5v
Gnd

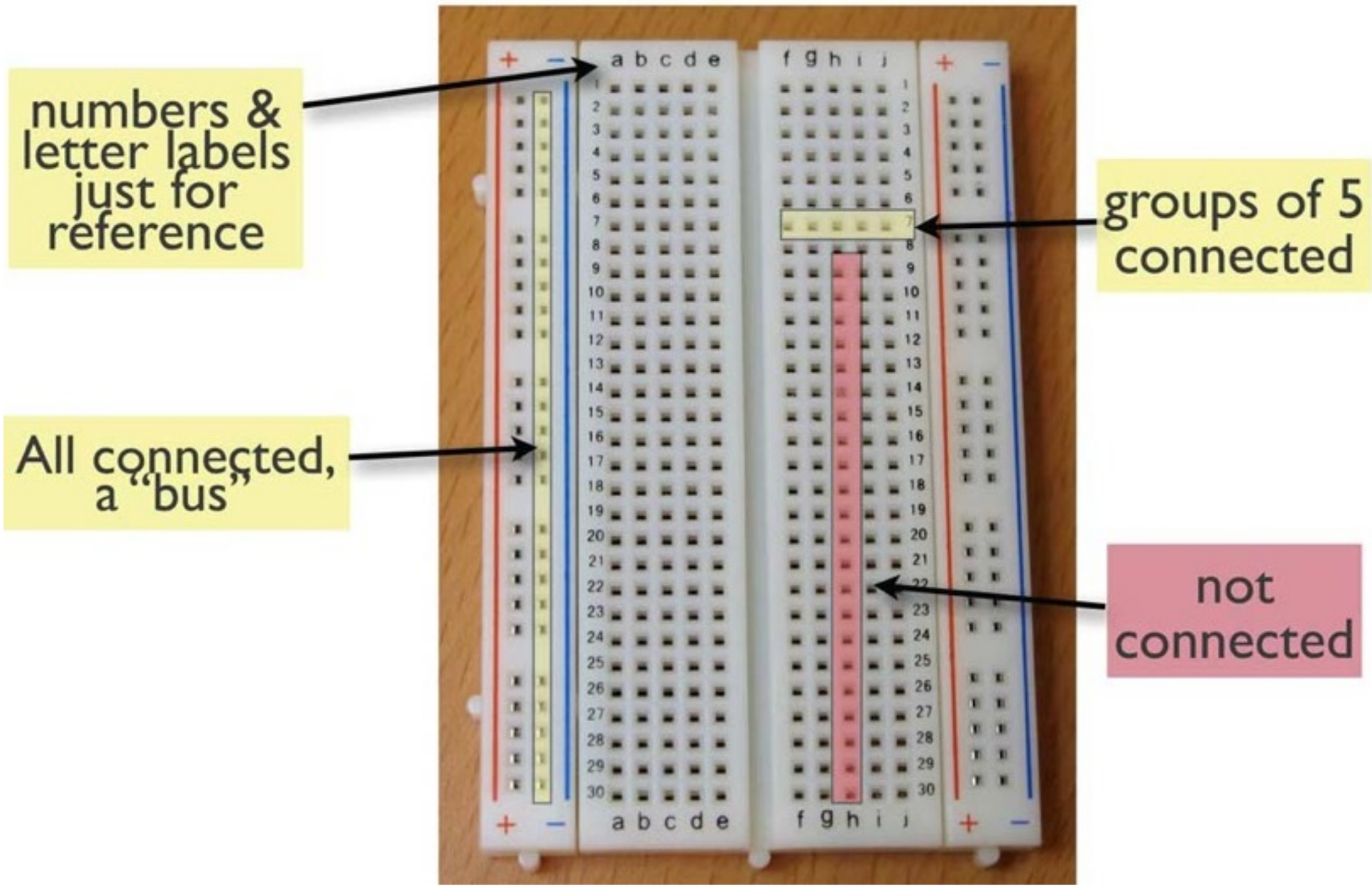
Resistor Color Code

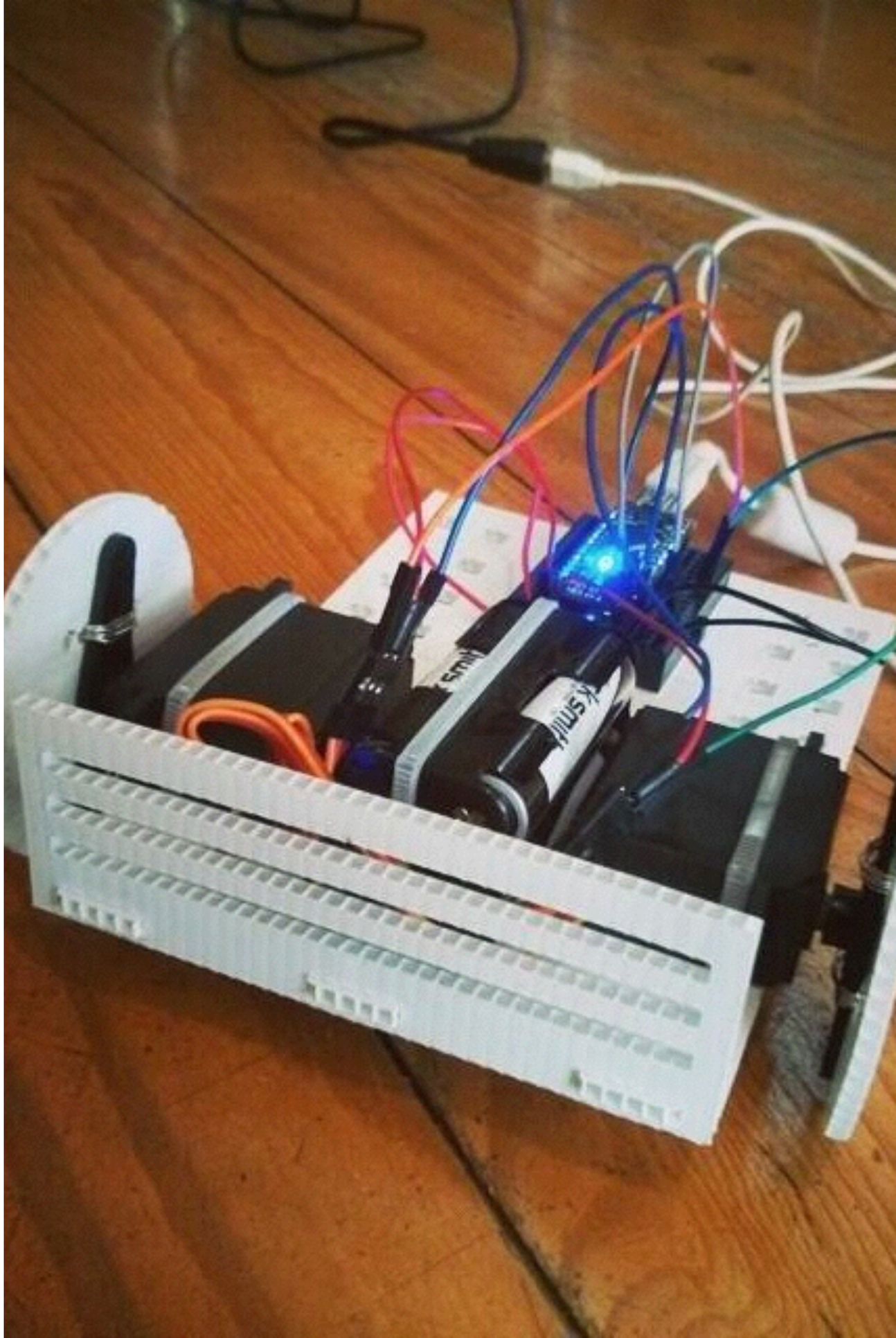
Examples:

green-blue-brown - 560 ohms
red-red-red - 2 200 ohms (2.2k)
brown-black-orange - 10 000 ohms (10k)



Breadboard


numbers & letter labels just for reference
All connected, a "bus"
groups of 5 connected
not connected
a b c d e
f g h i j

Good luck!

#nodebotsau