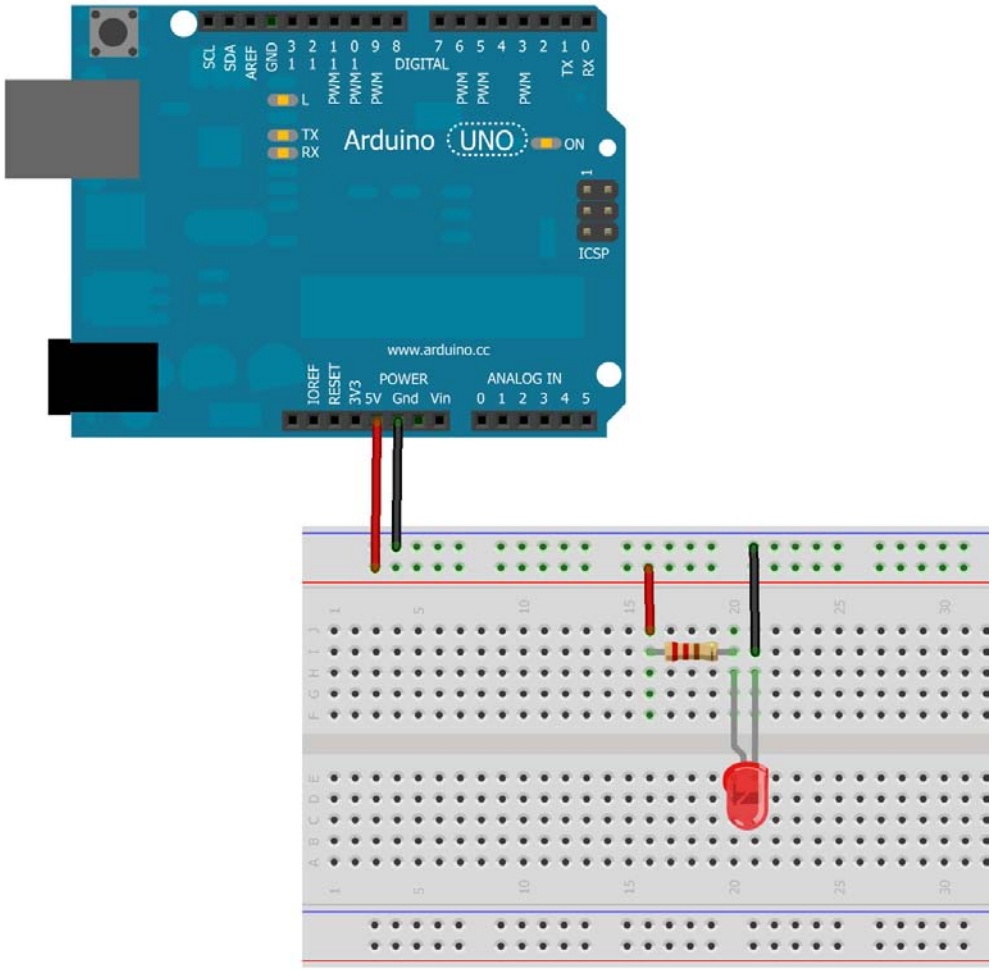
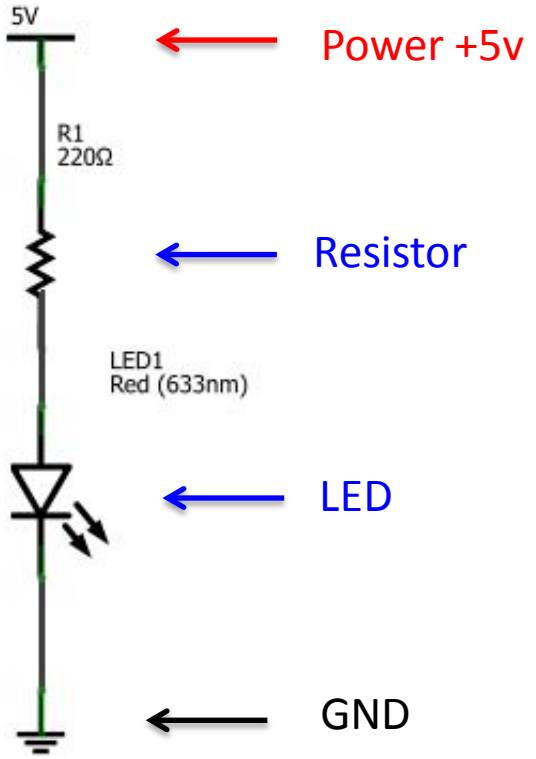
C0Ding Workshop Wk03:Yuta Nakayama

Quick Review:Week02

- **Introduction to Electronics/Arduino Programming**
  - Digital Input / Output
    digitalRead(); | digitalWrite();
  - **Analog Input / Output**
    analogRead(); | analogWrite();
  - Sensor Input
    map();
    Serial.begin();
    Serial.print();/ Serial.println();

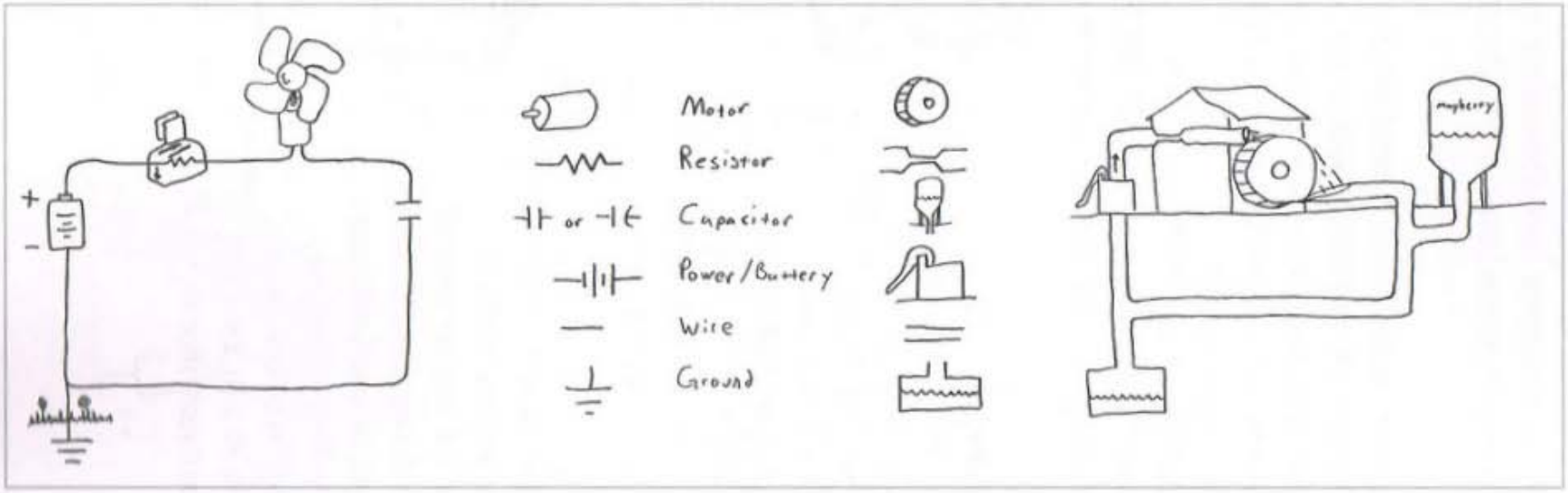
LED1:: My 1st LED Circuit





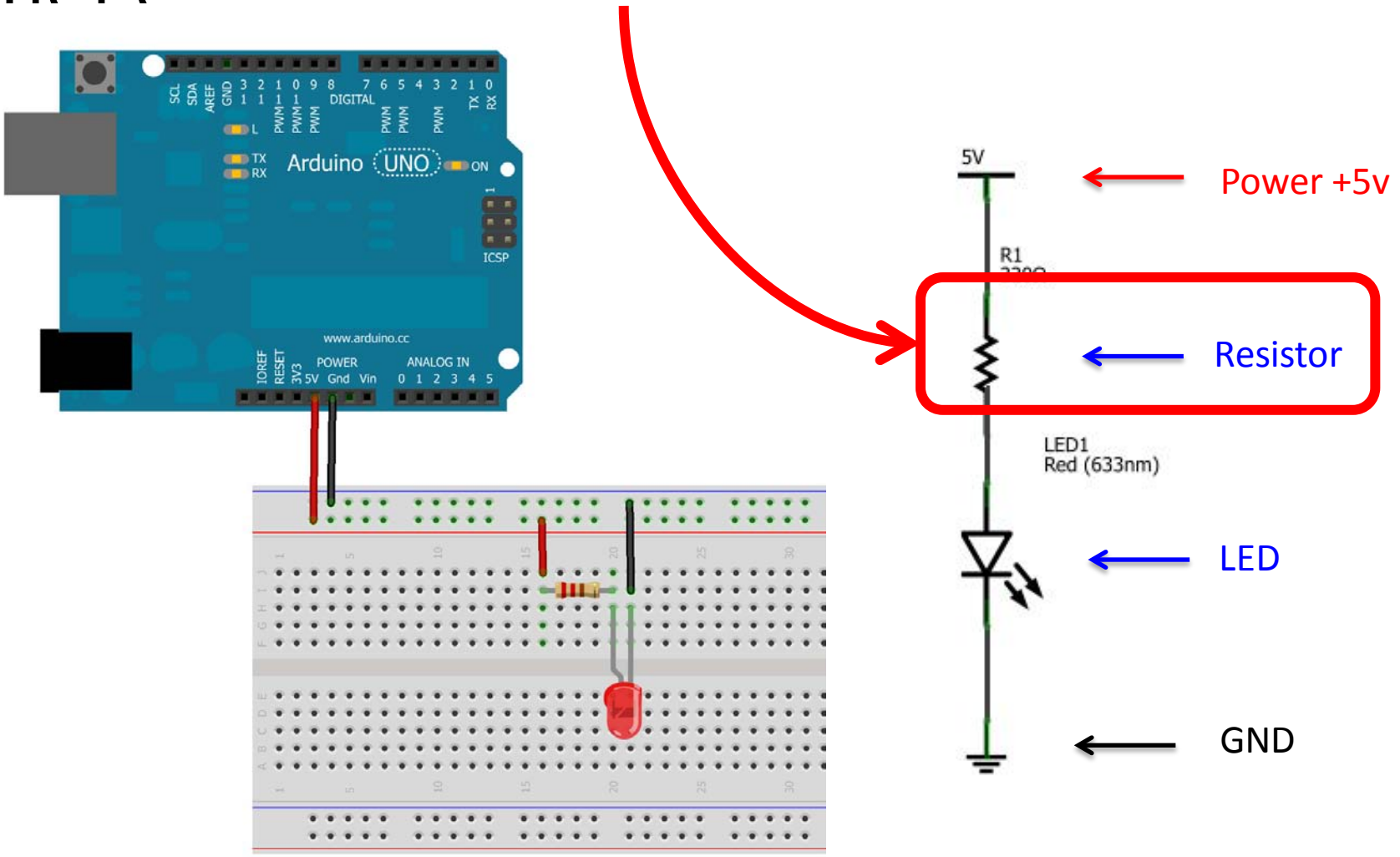
Water Analogy of Electrical Circuit

FIGURE 5-4 Water analogy ecosystem representing electricity flow through electronic components

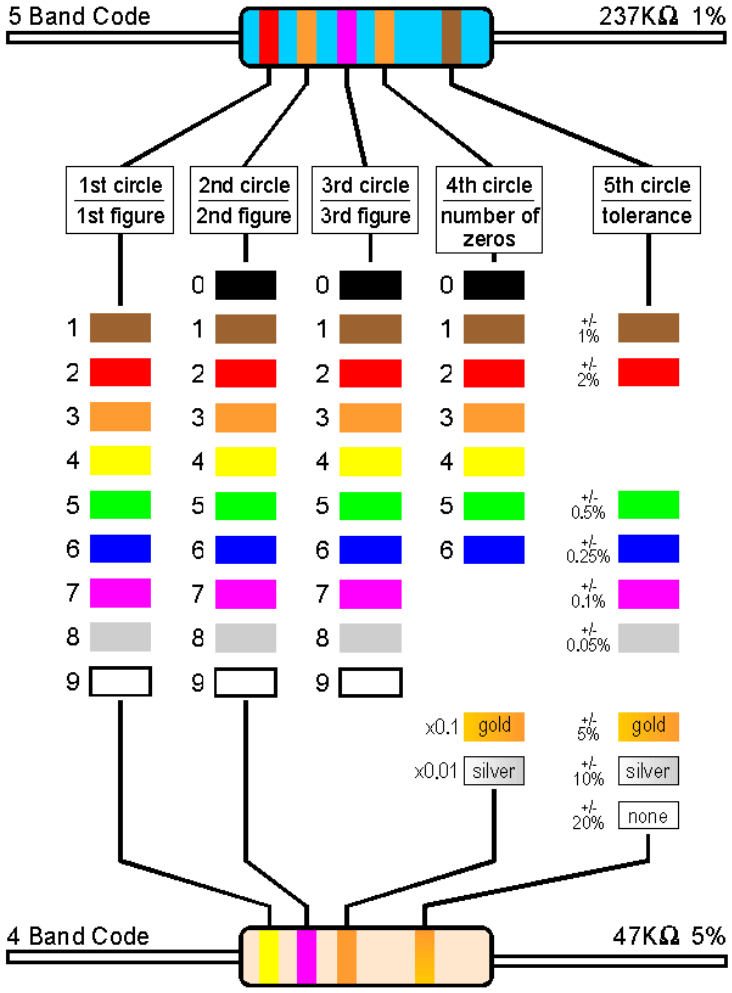


Making Things Move

Q1: Why do you need a resistor here?



Resistor ColorCode



1 : Brown

2 : Red

3 : Orange

4 : Yellow

5 : Green

6 : Blue

7 : Purple

8 : Gray

9 : White

0 : Black

Tolerance

+/- 5% : Gold

+/- 10% : Silver

Reading Resistor Color Code

Brown Black Red Gold

1 0 x 100 +/- 5% = 1000 = 1k Ohm

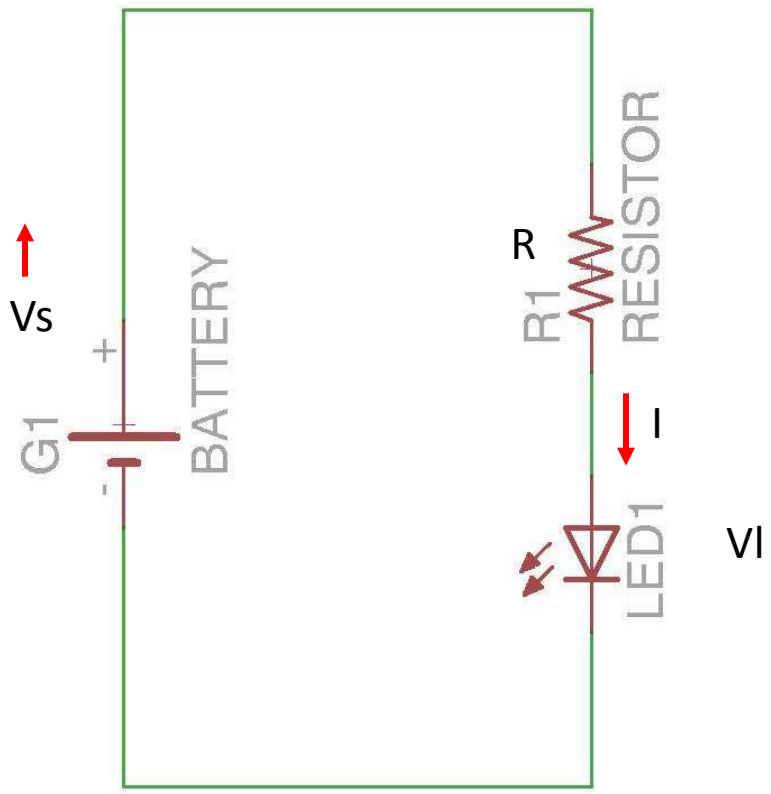
Yellow Purple Orange Gold

4 7 x 1000 +/- 5% = 47000 = 47k

Brown Black Orange Gold

? ? x 1? ? = ???

How to lit a LED?



- Vs = Battery Voltage
- Vl = LED forward voltage
- R = Resistance
- I = LED Current

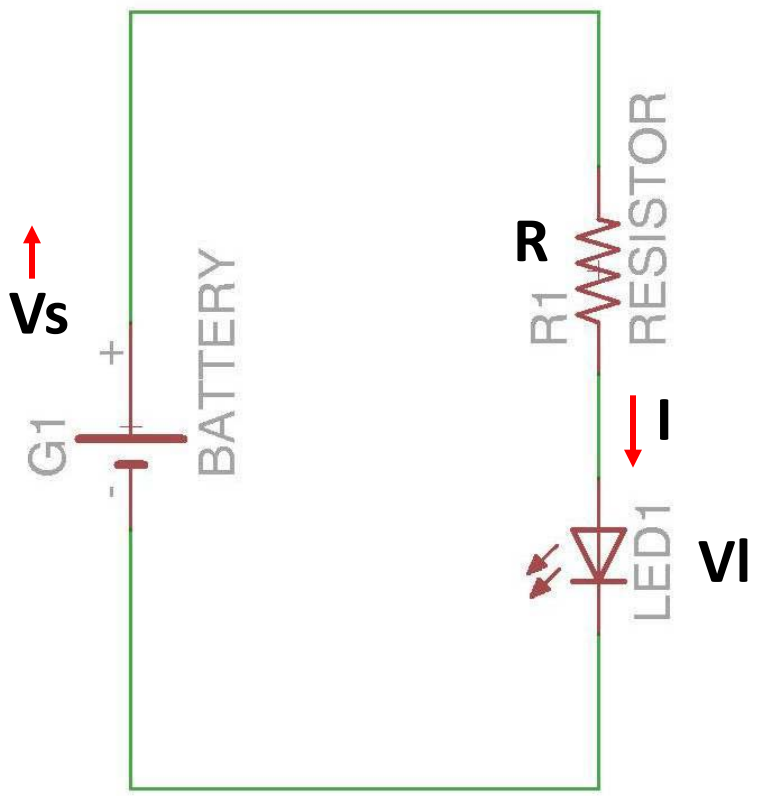
LED Brightness = I = LED current. Usually 10mA ~ 30mA

Ohm's Law

- V = IR :
  - Voltage = Current x Resistance
- I = V / R :
  - Current = Voltage / Resistance
- R = V / I :
  - Resistance = Voltage / Current

How to lit a LED?

= How to choose resistor value?



- R = (Vs - Vl) / I

Vs = 5v

Vl = 1.5

I = 20mA(0.02A)

R = (9 – 1.5) / 0.02

= **375 ohm**

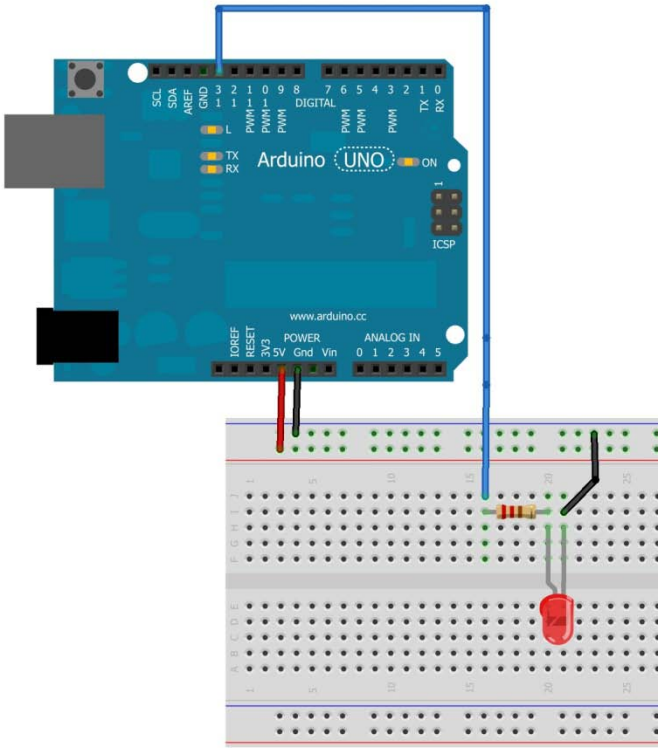
Cable Color Convention

Power Line = RED

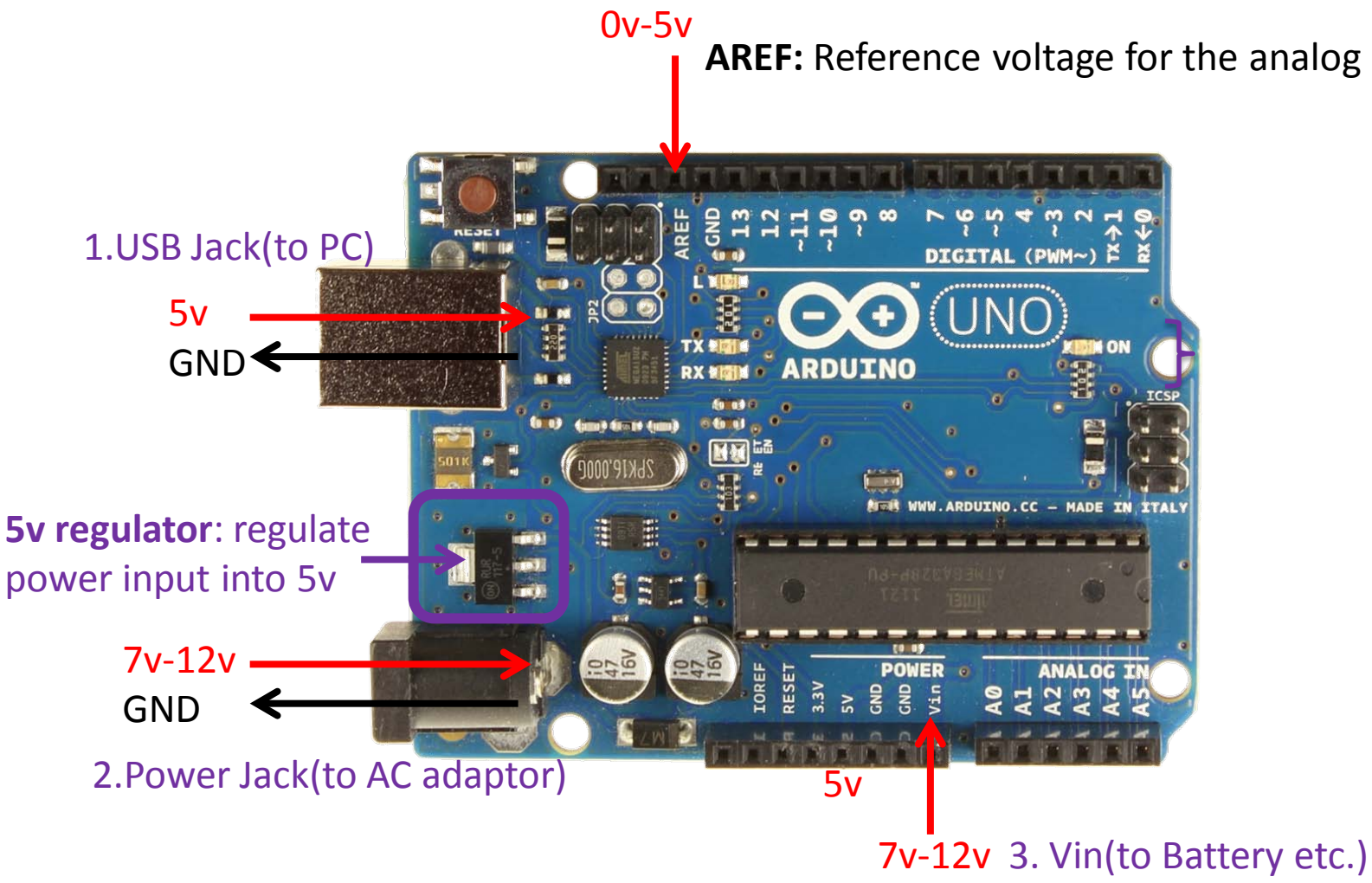
Ground Line = Black

Signal Line = Blue

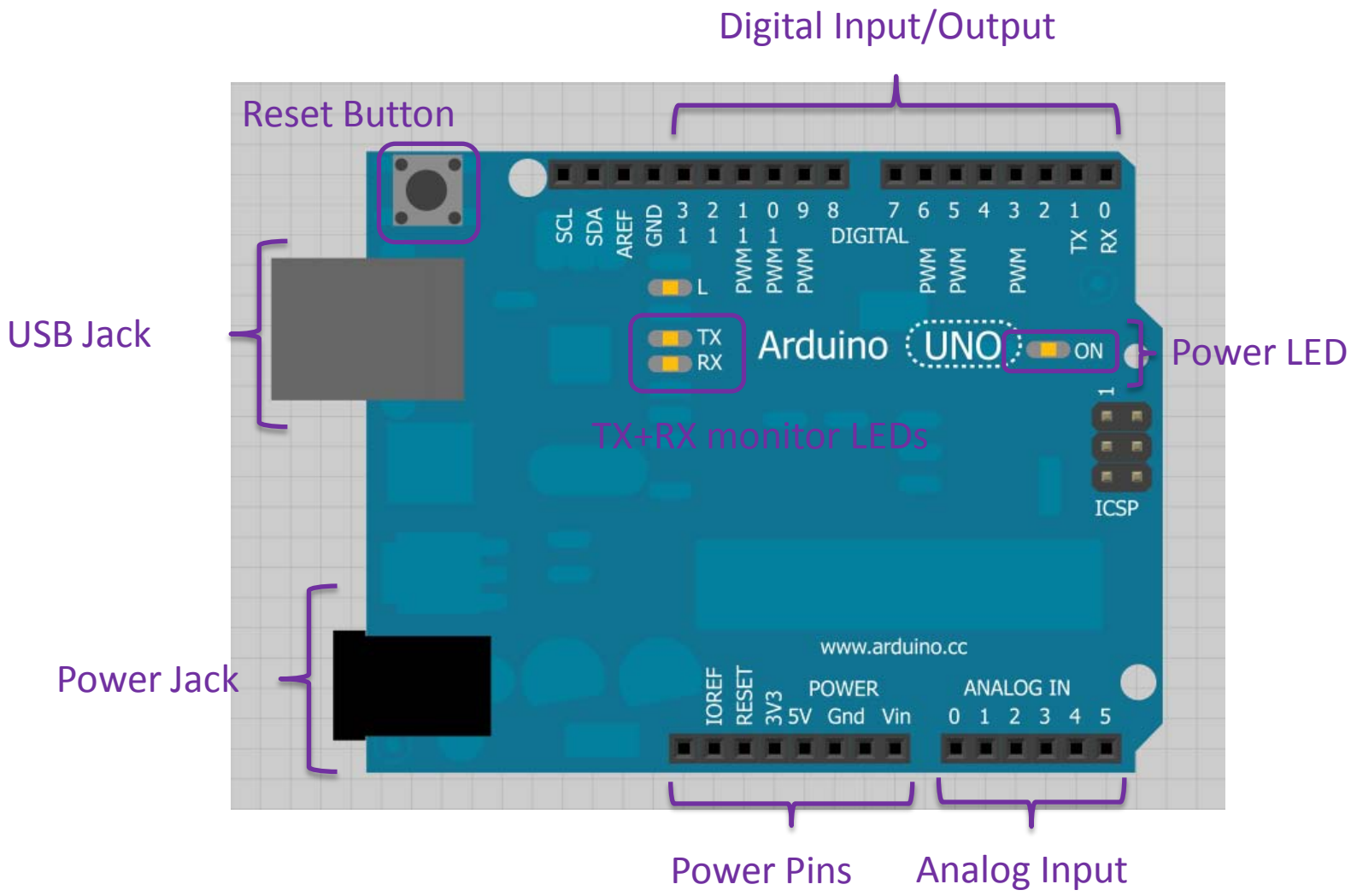
Helps you to find out
Short circuit/Power failure



Arduino Board(Power Signal)

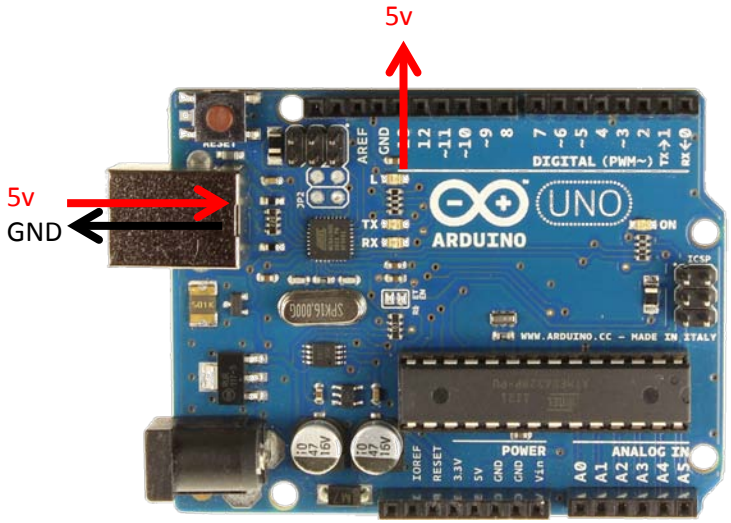


Arduino Board



digitalWrite(pin,value)

digitalWrite(11,HIGH);



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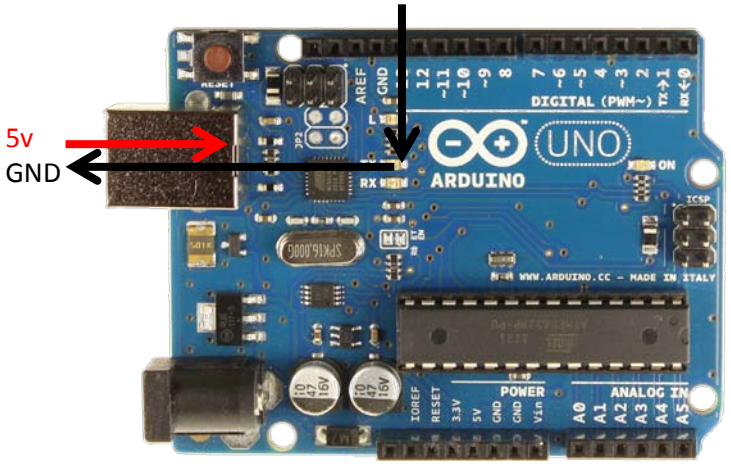
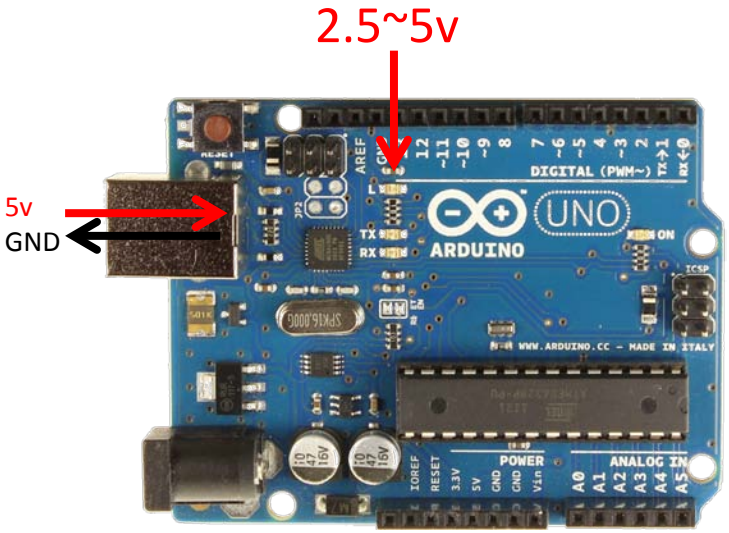
digitalWrite(11,LOW);

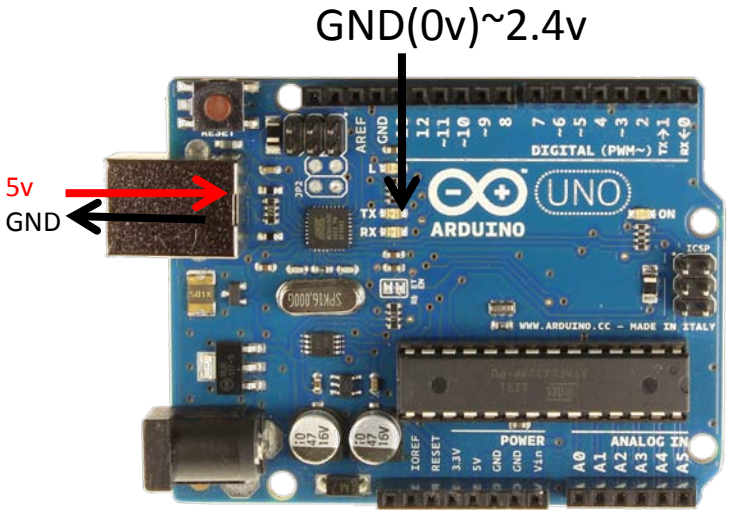


digitalRead(pin)

HIGH



LOW

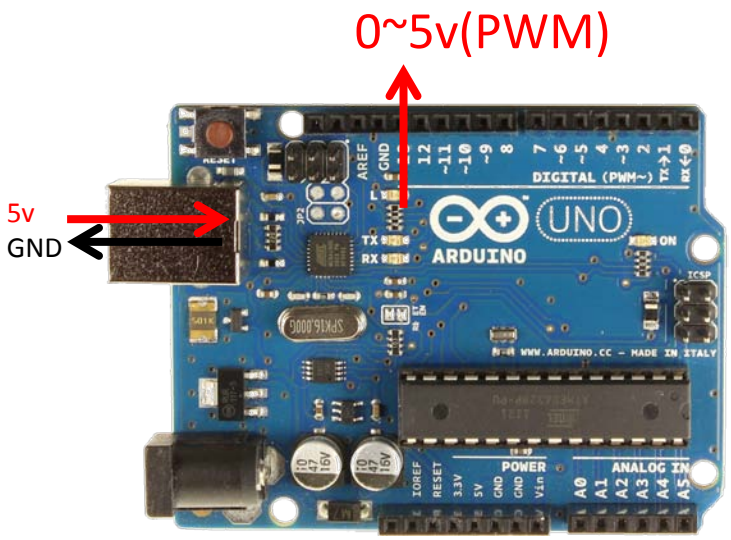


analogWrite(pin,val),/analogRead(pin)

Output analog-signal(PWM):

value : 0 ~ 255

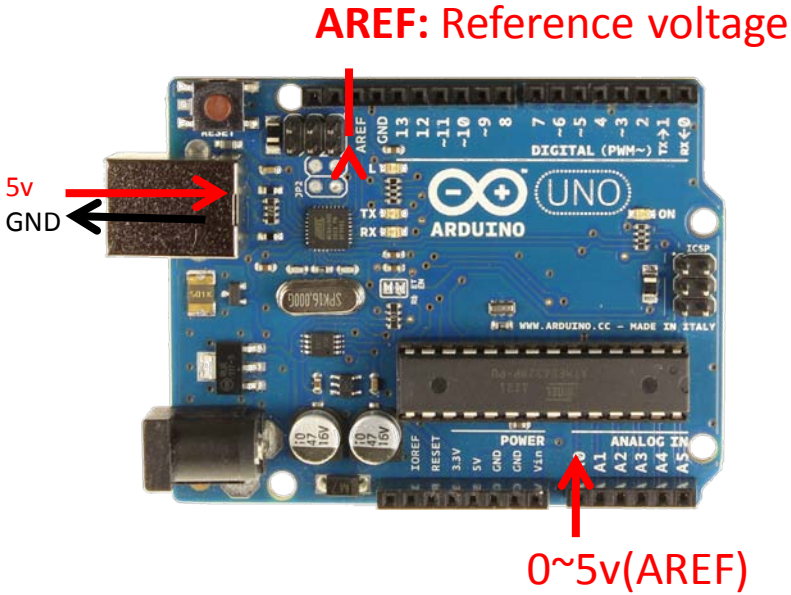
voltage: 0 ~ 5v



Read analog-signal:

voltage : 0 ~ 5v(AREF)

value: 0 ~ 1023



Power Sources

dry-cell battery
(1.2 ~ 1.5v)

Li-poly battery
(3v ~ 3.7v)

ACAdaptor
(5v ~ 24v)

Battery Types

Round
1.2v-1.5v
600-2800mAh

Lithium cells
3v
30-1000mAh

Lithium-polymer
3v~3.7
30-3000mAh

Battery Capacity

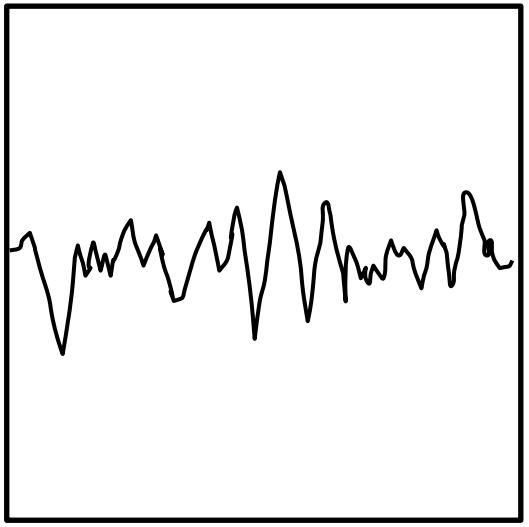
Lithium cell battery
1000mAh

+

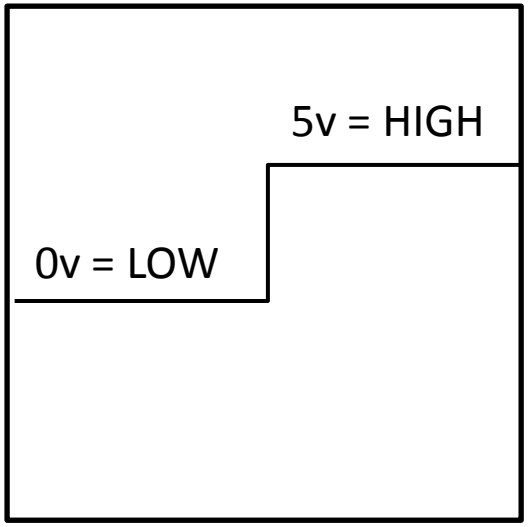
LED at 20mA

$$= \frac{1000\text{mAh}}{20\text{mA}} = 5\text{hr}$$

Electrical Signals

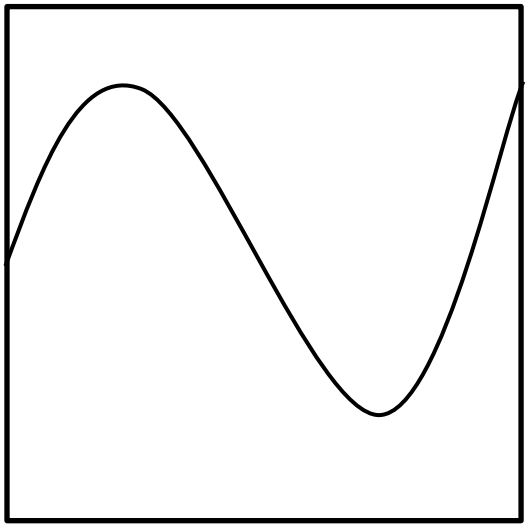


Analog



Digital Signal

TTL(5v)/LVTTL3.3



AC Power Signal

(245v 50hz)

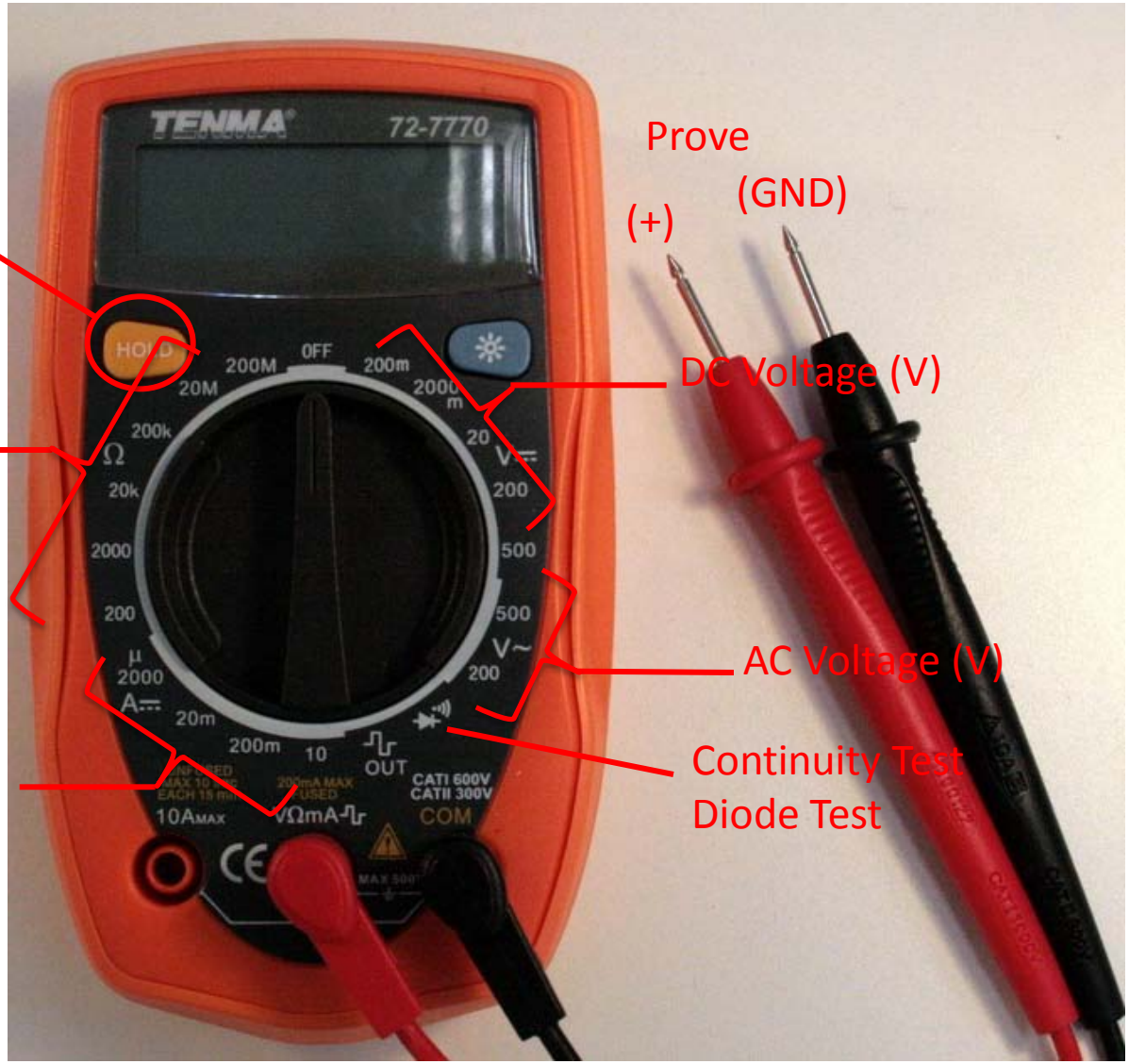
Quick Overview:Week03

- **Introduction to Sensor/Actuator Modules**
- ***3-1 Sensor modules (1hr)***
  - **Touch Sensor/ Sound Sensor/Pressure Sensor/**
- ***3-2 Actuators and* Basic Mechatronics *(1hr)***
  - **DC motor/Servo motor/Stepper motor/Solenoid**
  - ***Lever/Pulley/Gear***
- **Circuit Bending Exercise (2hr)**

Multimeter

- Resistance (Ω)
- DC Voltage (V)
- AC Voltage (V)
- DC Current (A)
- Continuity Test
- Diode Test

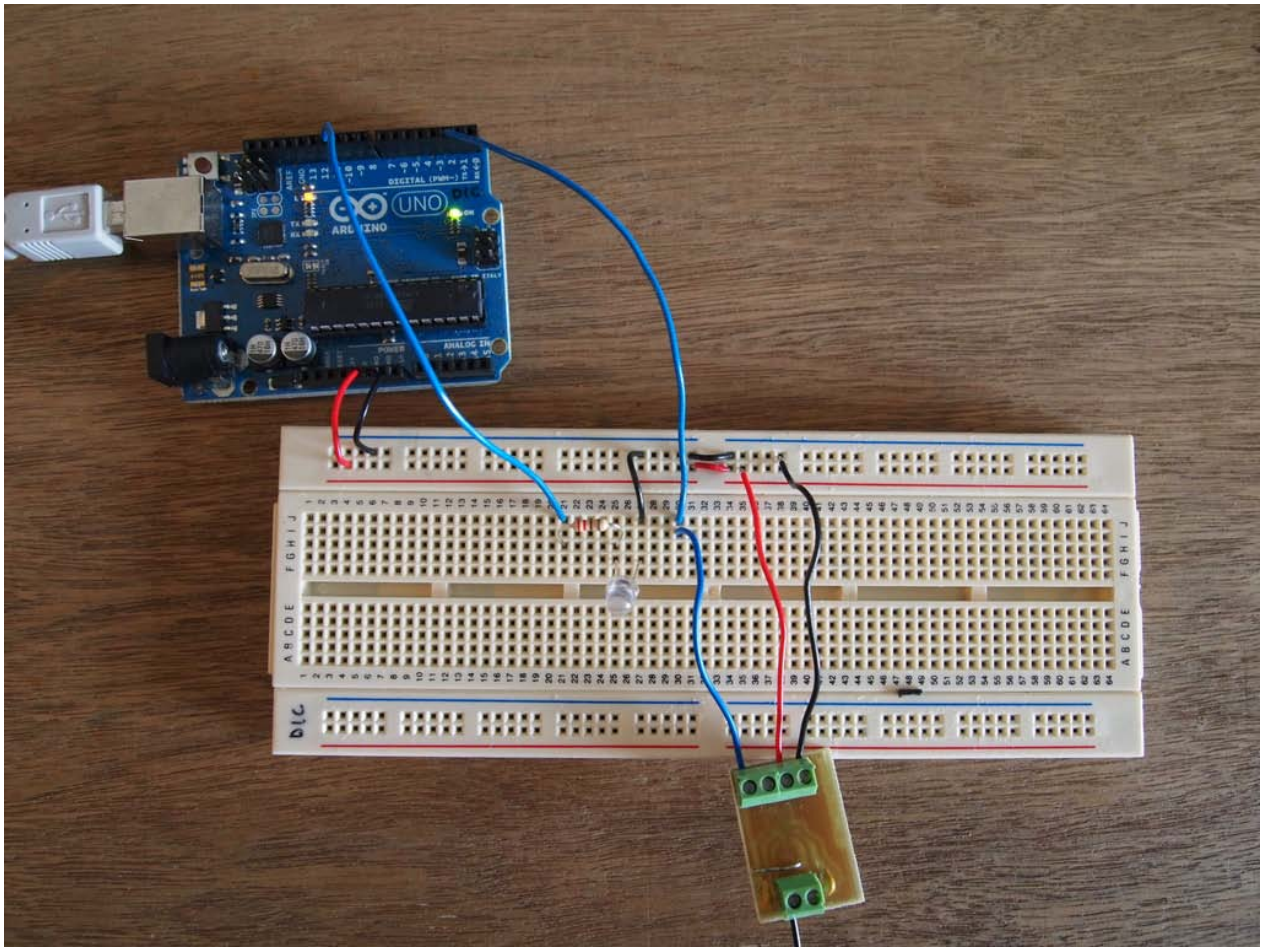
Multimeter


Hold Button
Resistance (Ω)
DC Current Test
Prove
(+)
(GND)
DC Voltage (V)
AC Voltage (V)
Continuity Test
Diode Test
TENMA
72-7770
OFF
200M
200m
20M
2000
m
200k
20
Ω
20k
200
2000
500
200
500
μ
2000
V~
200
A⎓
20m
200m
10
OUT
CATI 600V
CATII 300V
10AMAX
VΩmA
COM

3-1 Sensor modules (1hr)

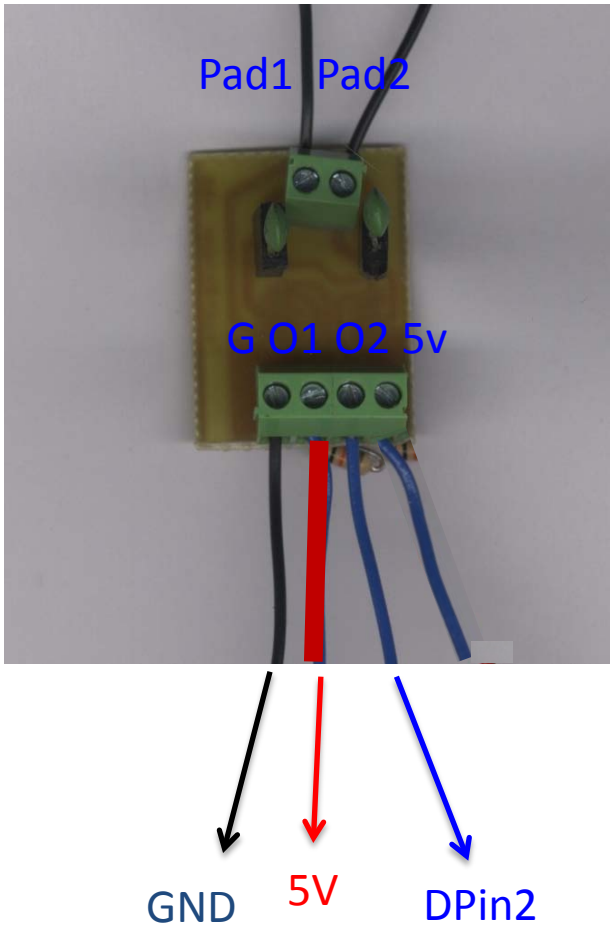
- Light Sensor
- Touch sensor
- Sound sensor
- Pressure Sensor

Touch Sensor/

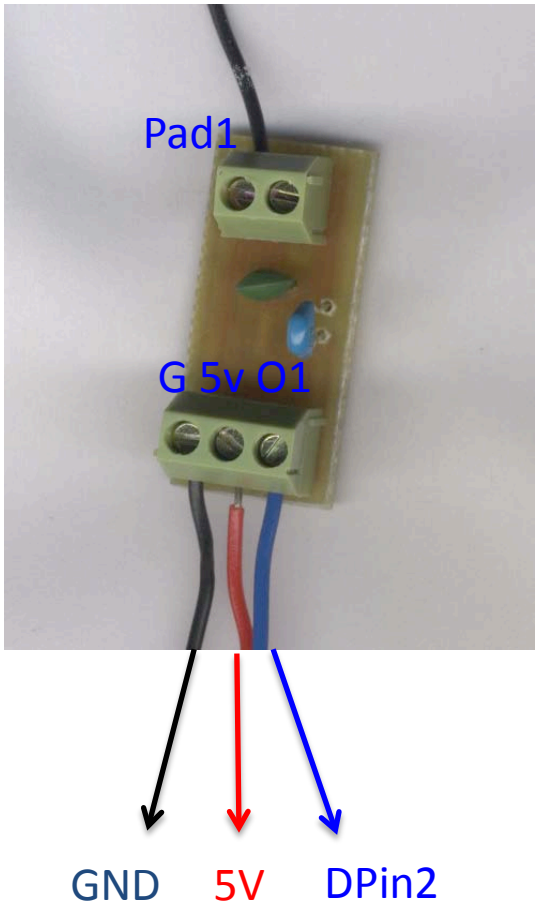


Touch Sensor

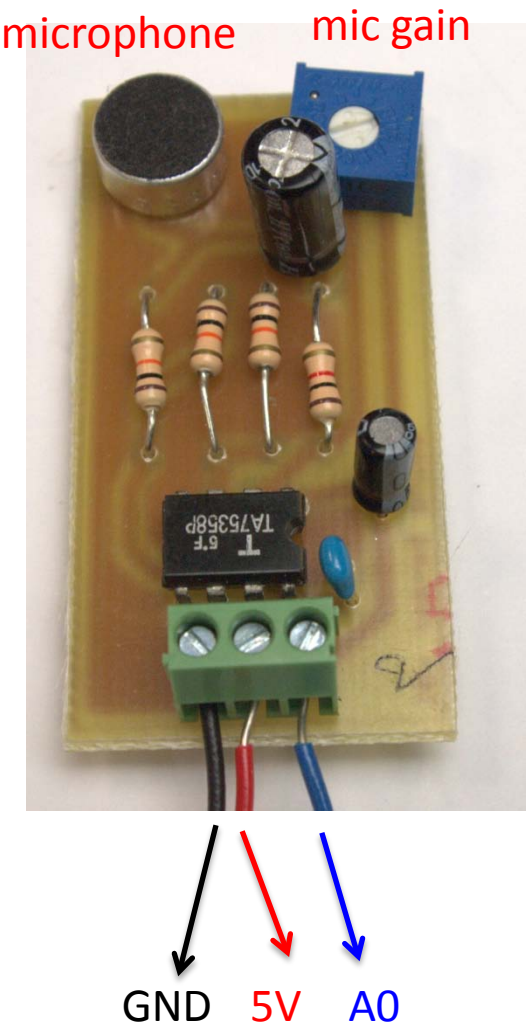
2ch Touch Sensor Module

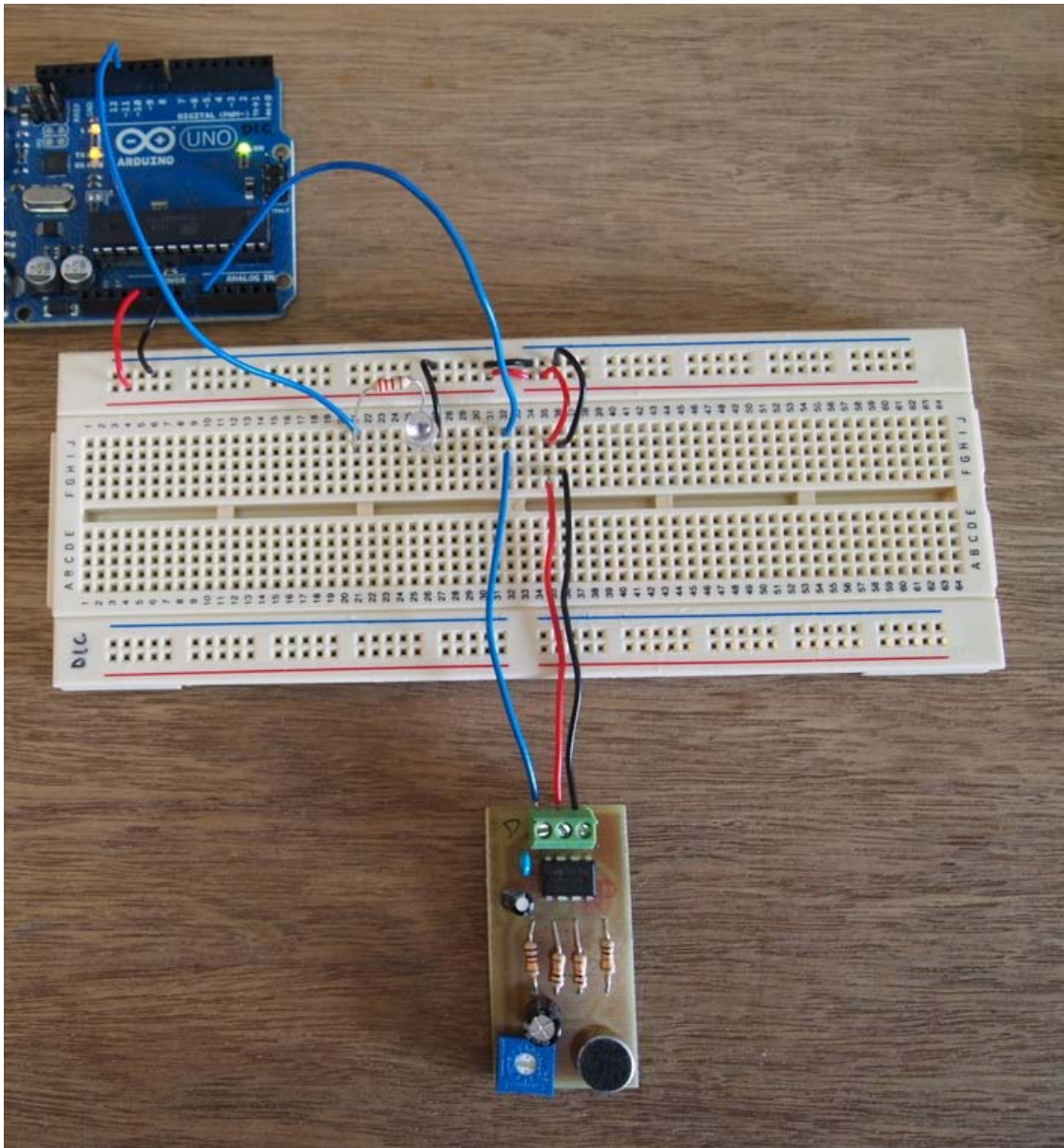


1ch Touch Sensor Module

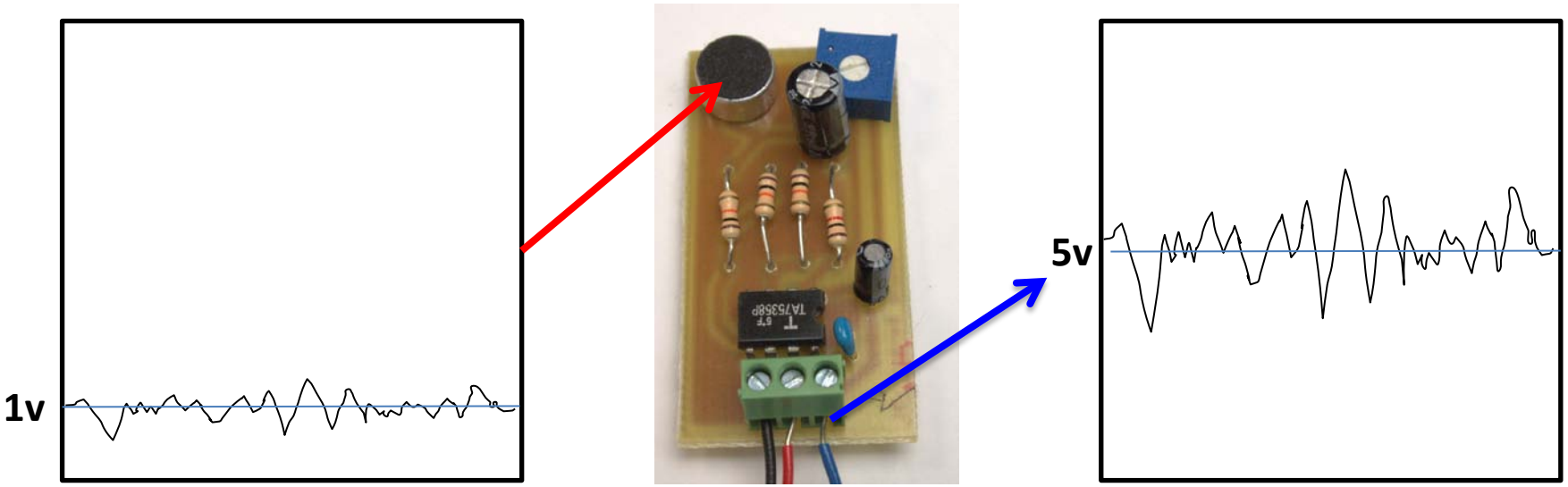


Sound Sensor/

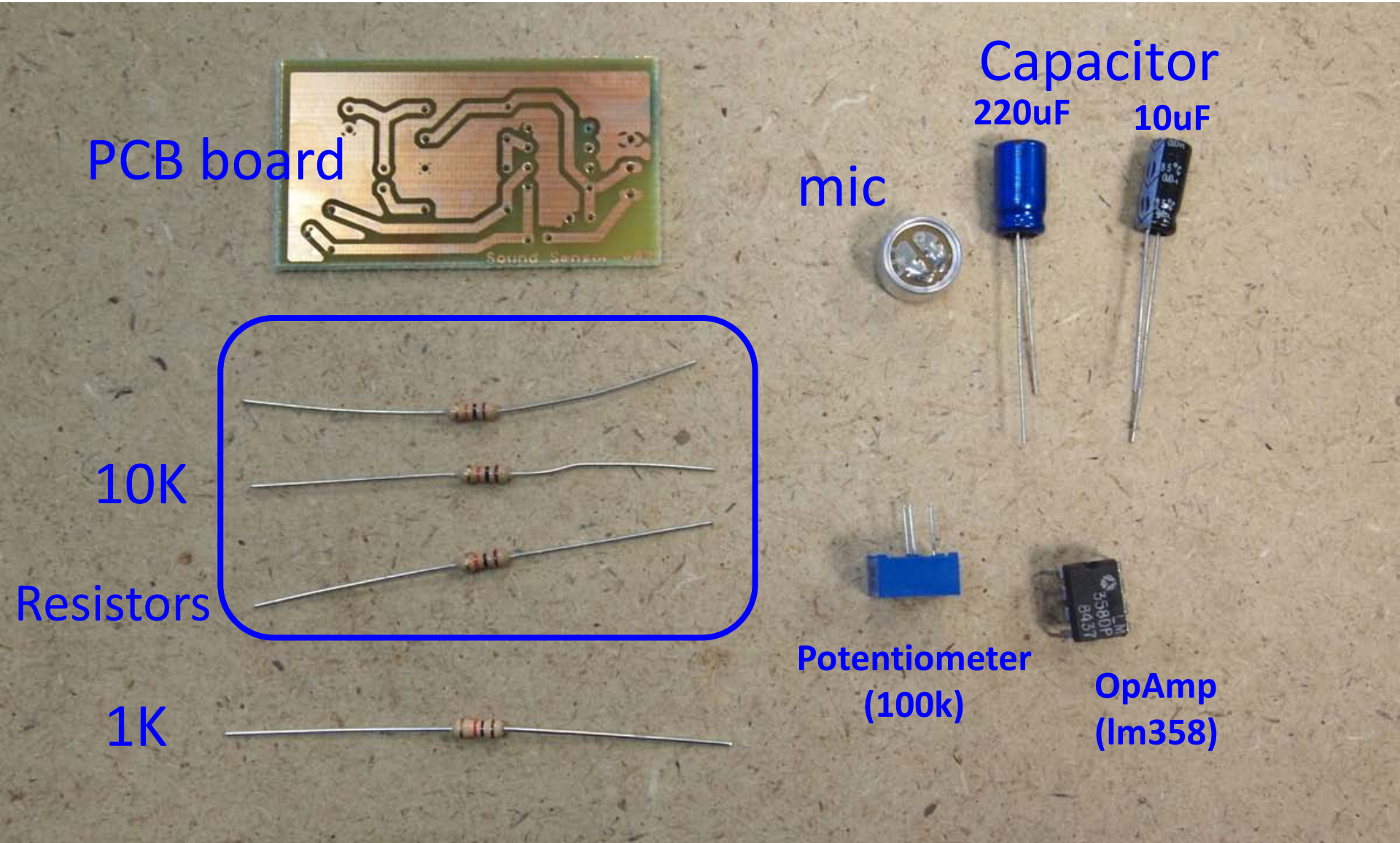




SoundSensor/ microphone amplifier



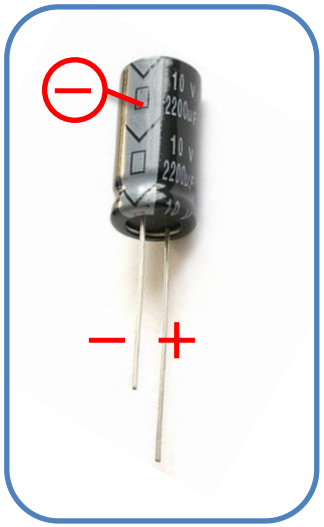
Sound Sensor Components List

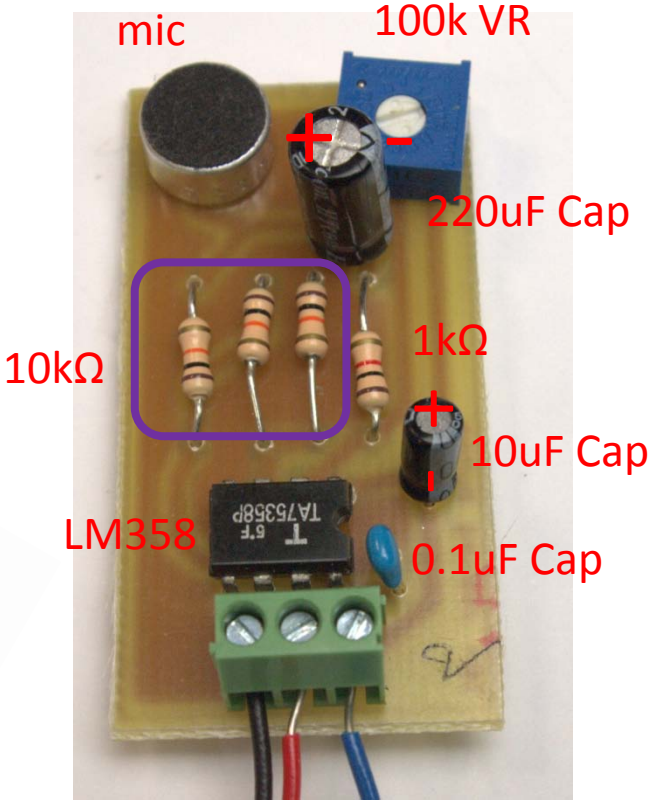


Sound Sensor ASSY

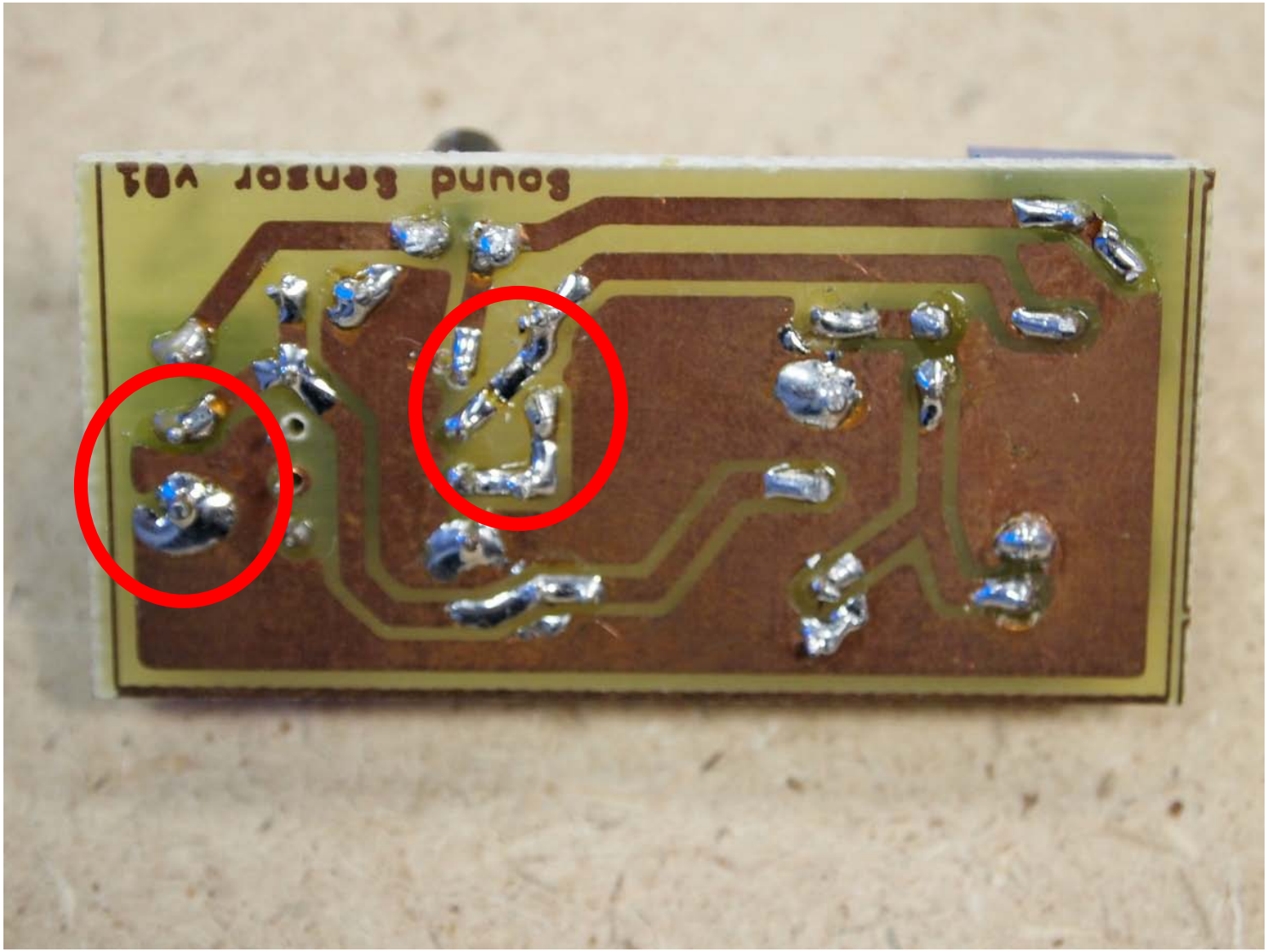
Order of Soldering
(shorter profile first)

1. Resistors(10kΩ x3 1kΩ x1)
2. LM358
3. 0.1uF Capacitor
4. mic and 100kVP
5. 220uF & 10uF
6. 3pin Connector



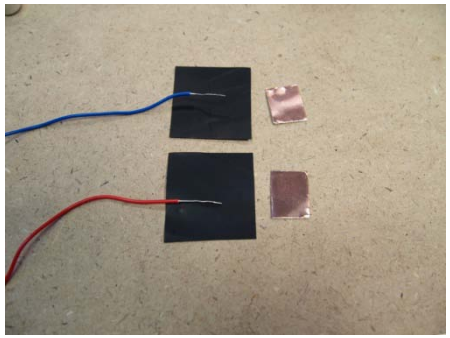
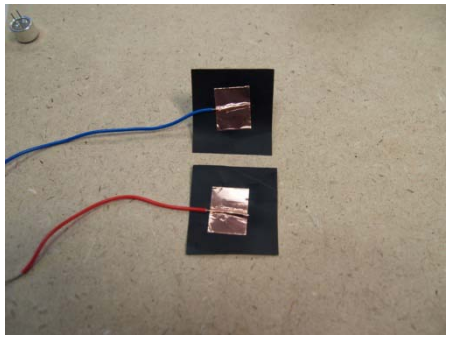
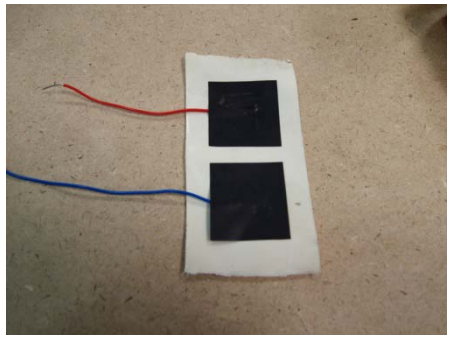
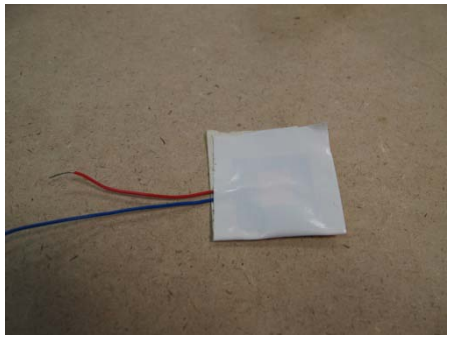


Do Check All connections
before plug into Arduino

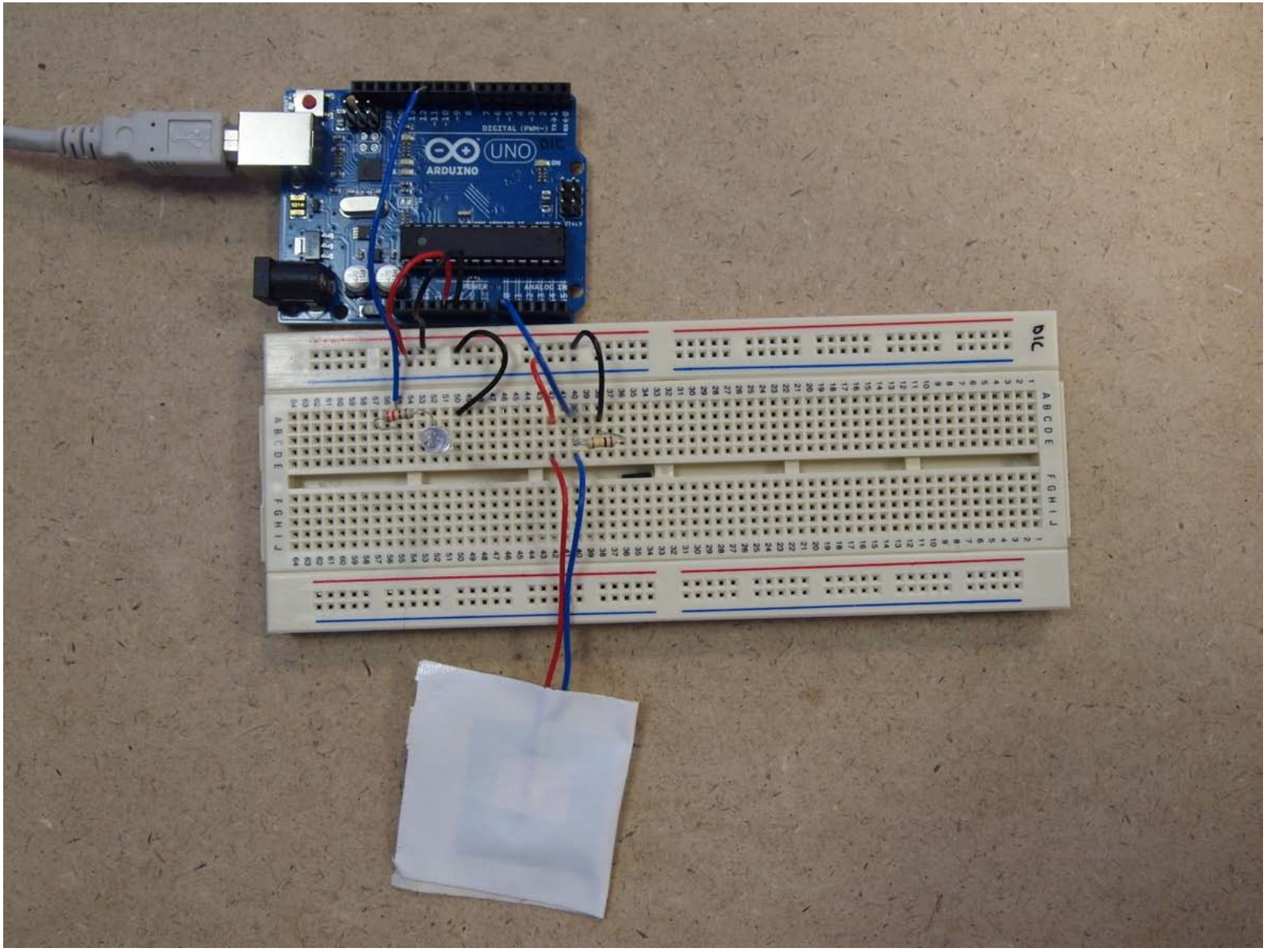


Making a Pressure Sensor

- **Stickytape Bend Sensor in less than 4 minutes** http://www.youtube.com/watch?feature=player_embedded&v=FEPgLbPv6NM
- Material: 1. Conductive PlasticBag 2. Copper Tape

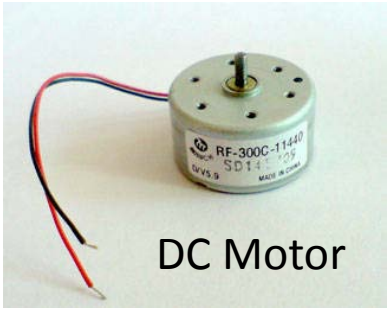
Pressure Sensor Circuit



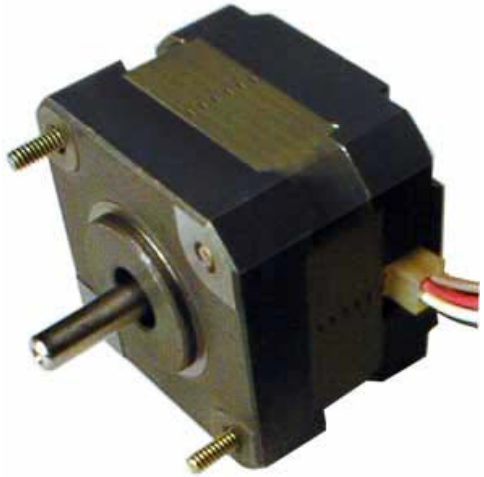
List of Actuators

Servo

DC Geared Motor

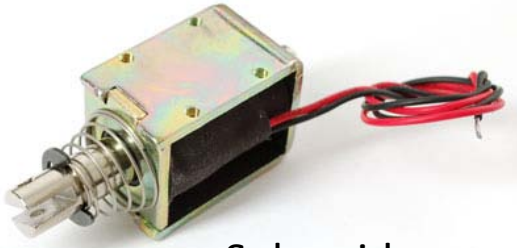


DC Motor



Stepper Motor

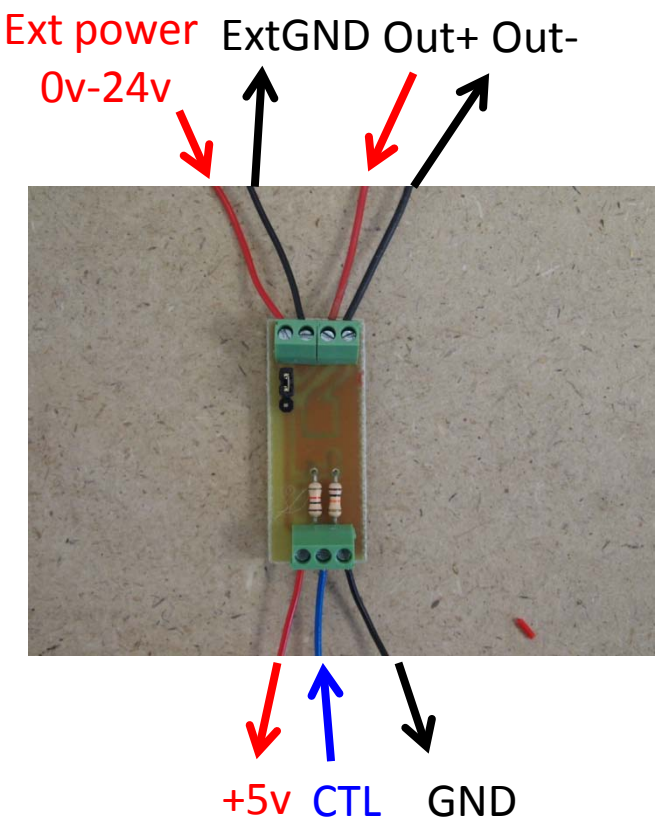
Linear Servo

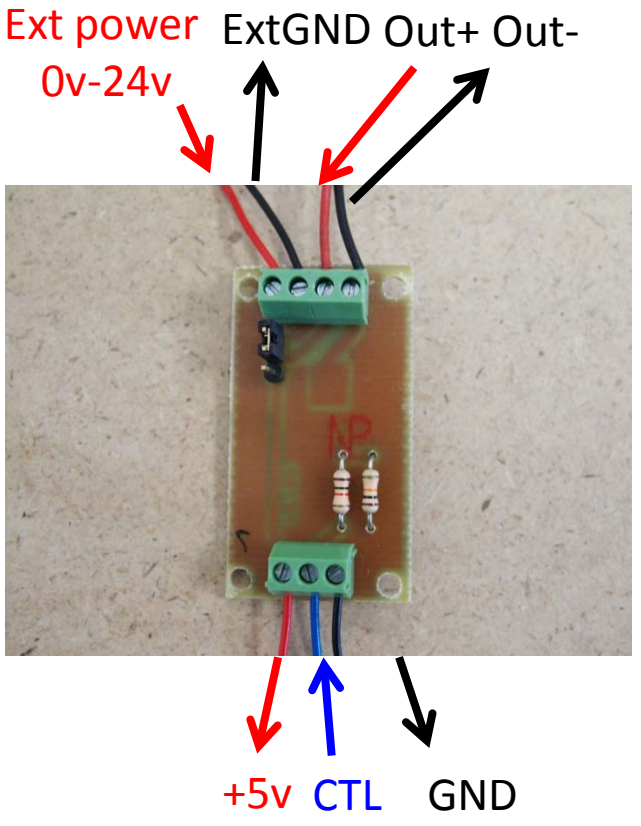


Solenoid

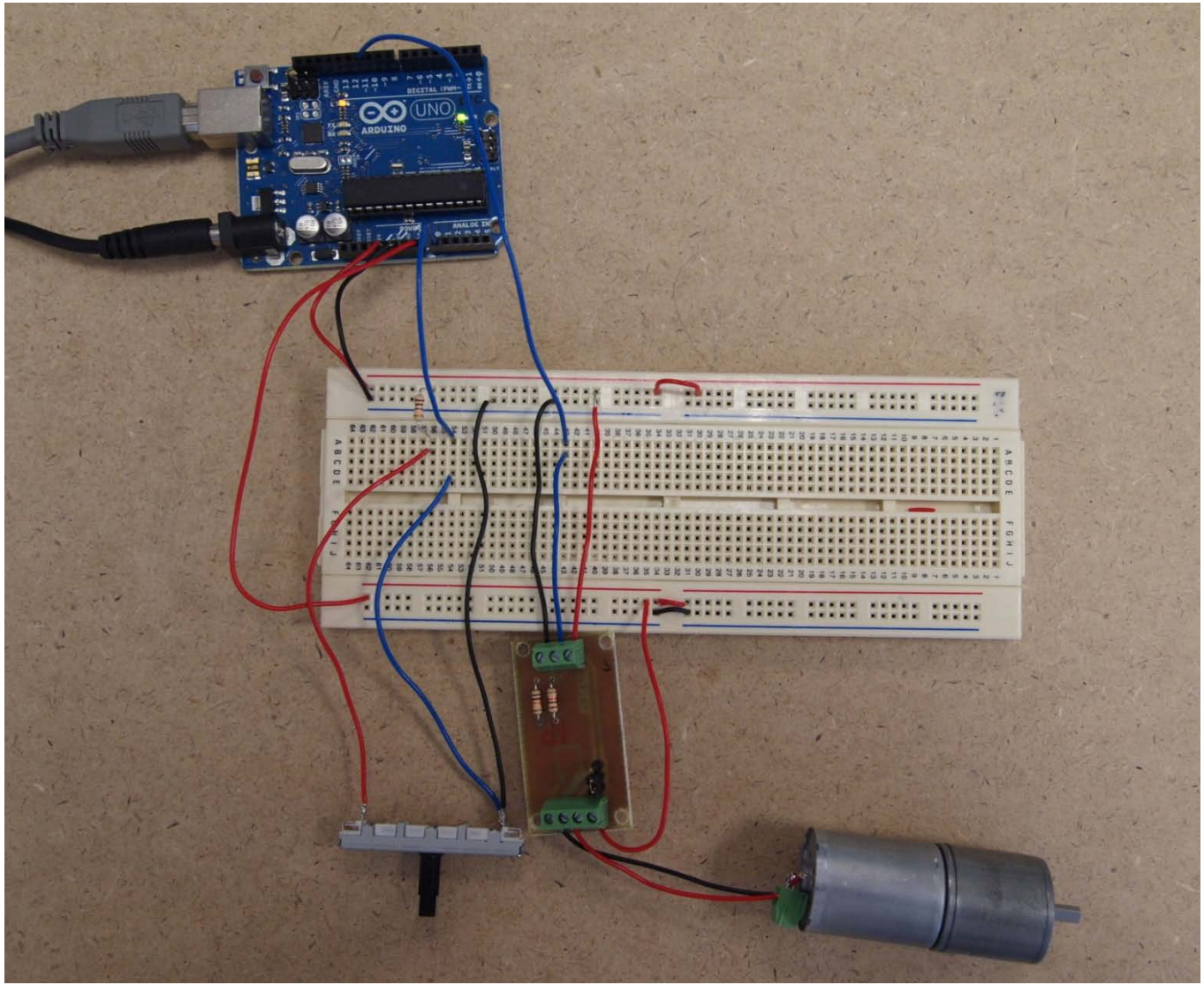
DC Geared motor

FET module

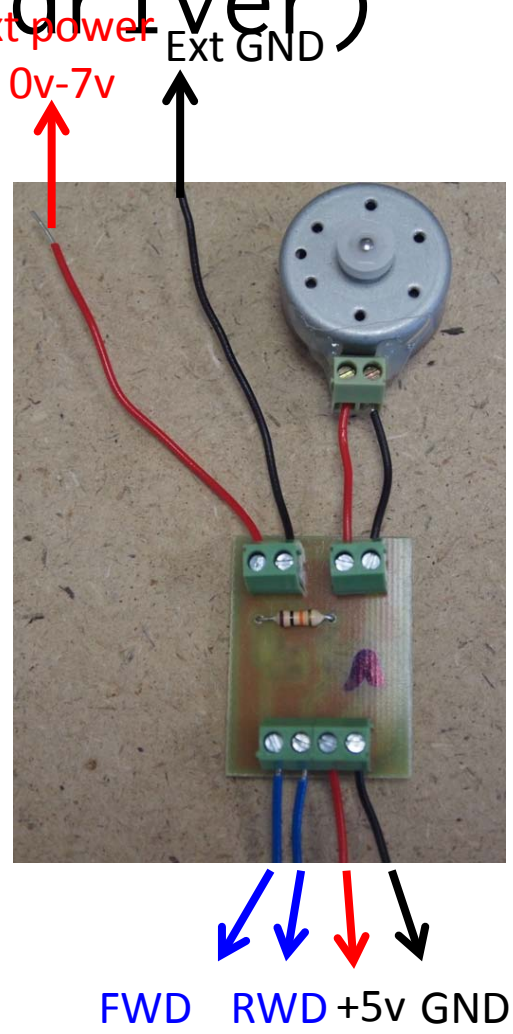

Ext power
0v-24v
ExtGND Out+ Out-
+5v CTL GND

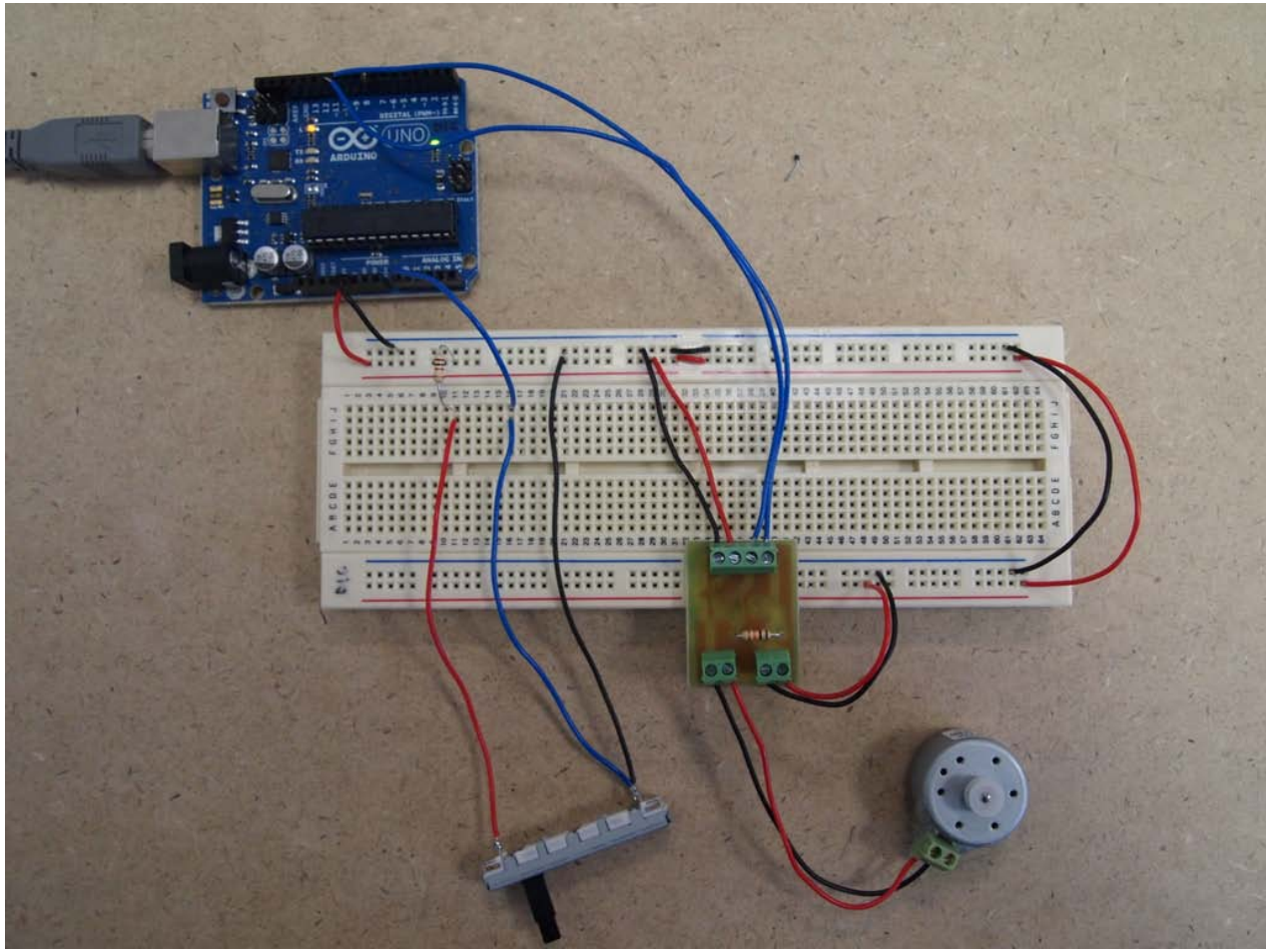

Ext power
0v-24v
ExtGND Out+ Out-
+5v CTL GND

DC Geared Motor Control (FET driver)



DC Motor Control (H-Bridge driver)





Servo Motor (Geared motor + angle senso

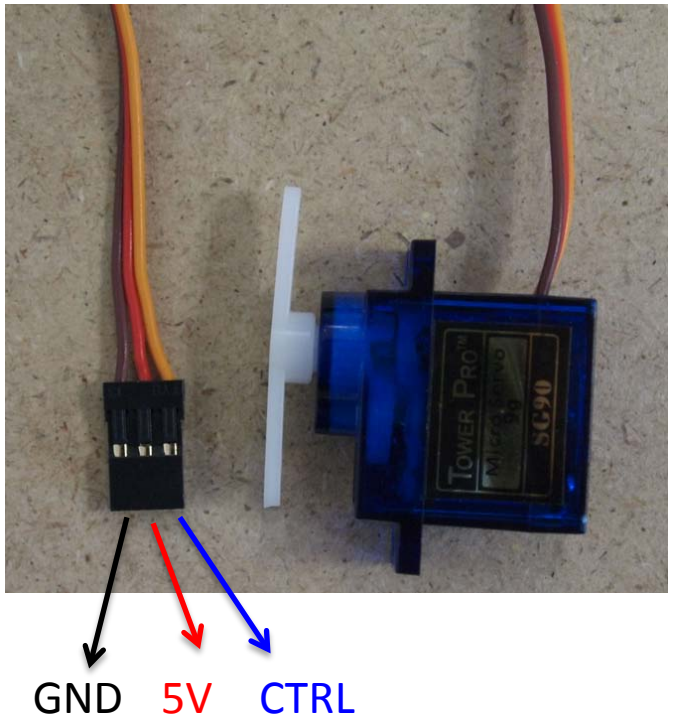
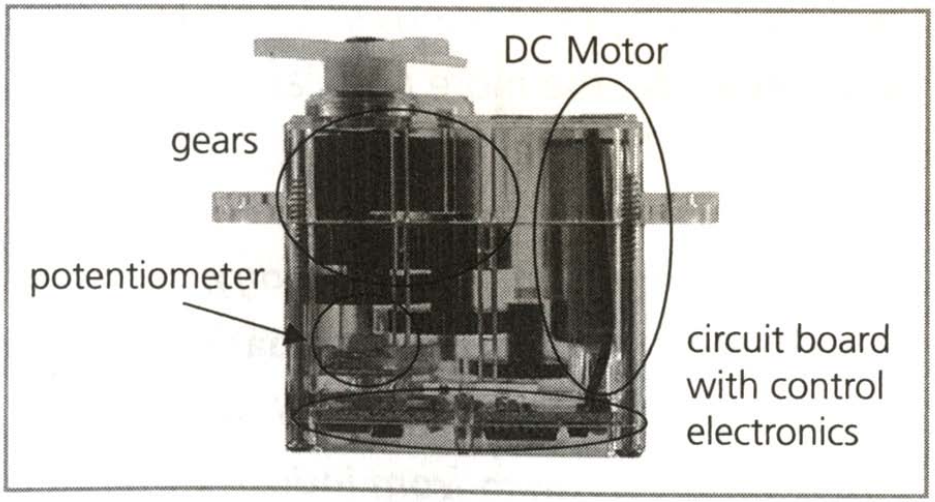
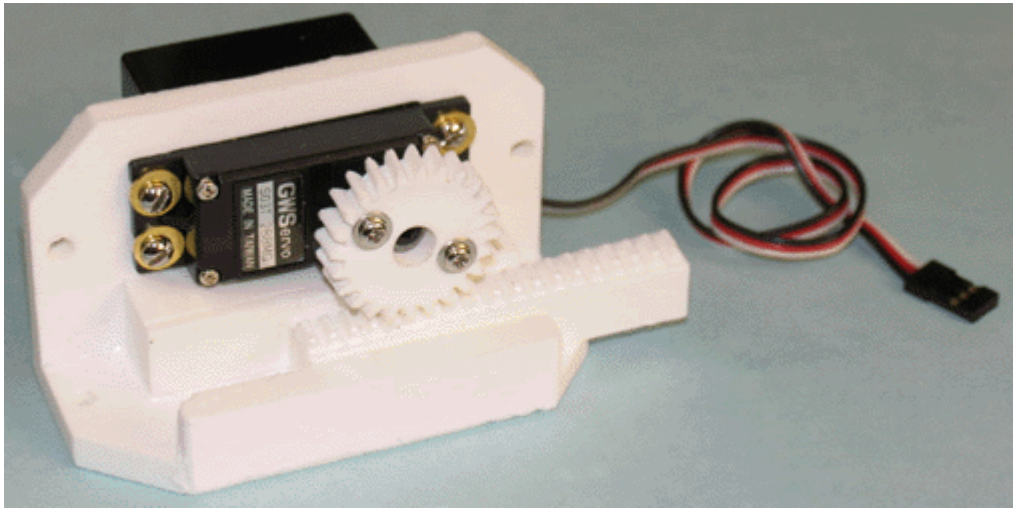


FIGURE 6-9 Anatomy of a hobby servo motor (image used with permission from ServoCity)

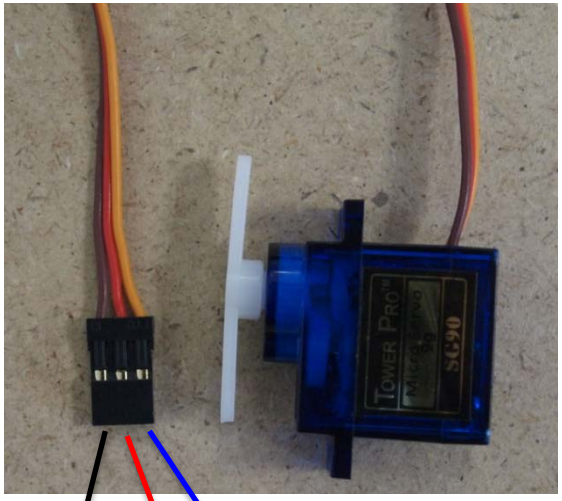


Linear Servo

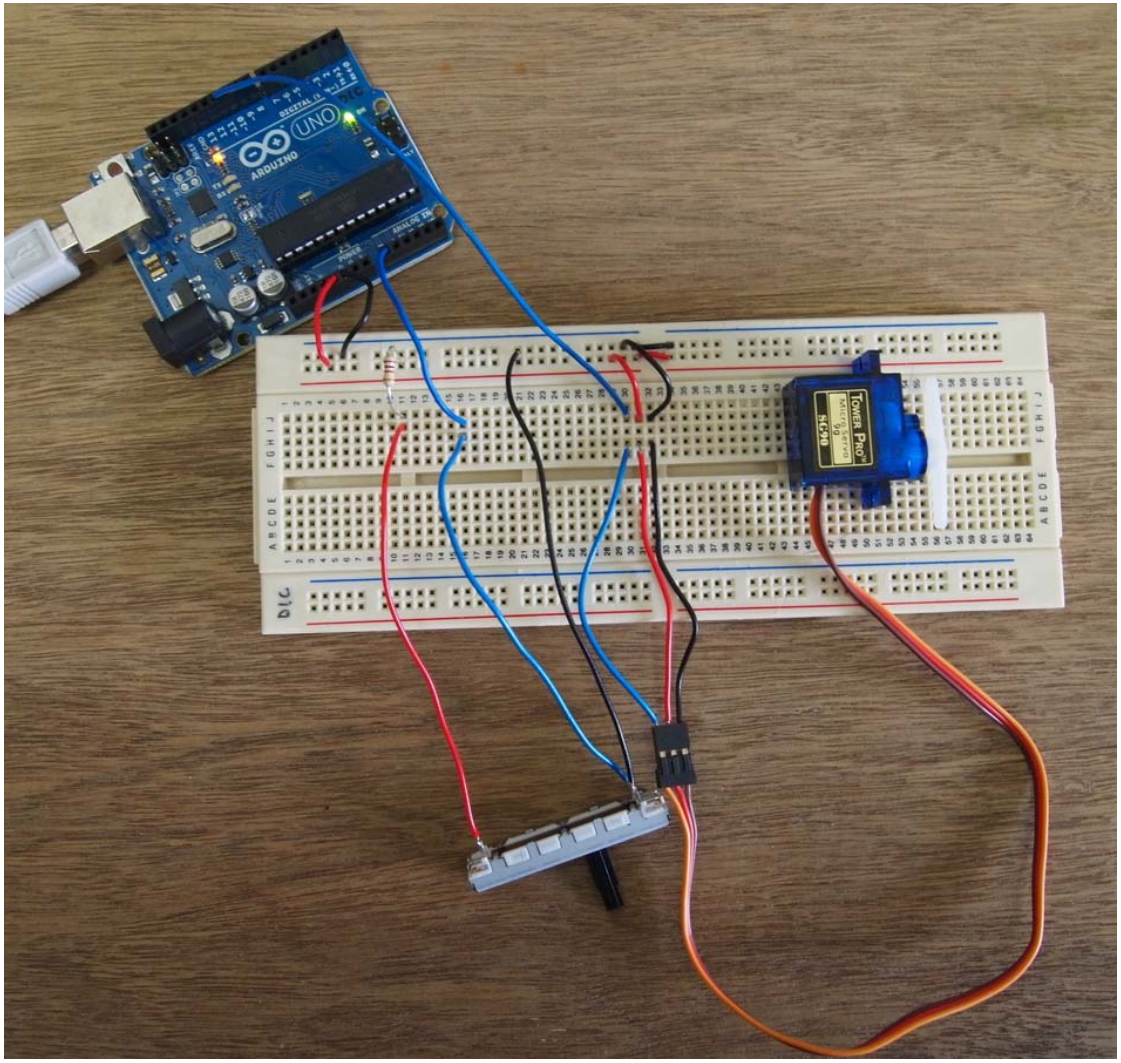


http://www.youtube.com/watch?v=fq5u7jFQFCg&feature=relmfu

Servo Control



GND 5V D11



What do we do with Sensors/Actuators?

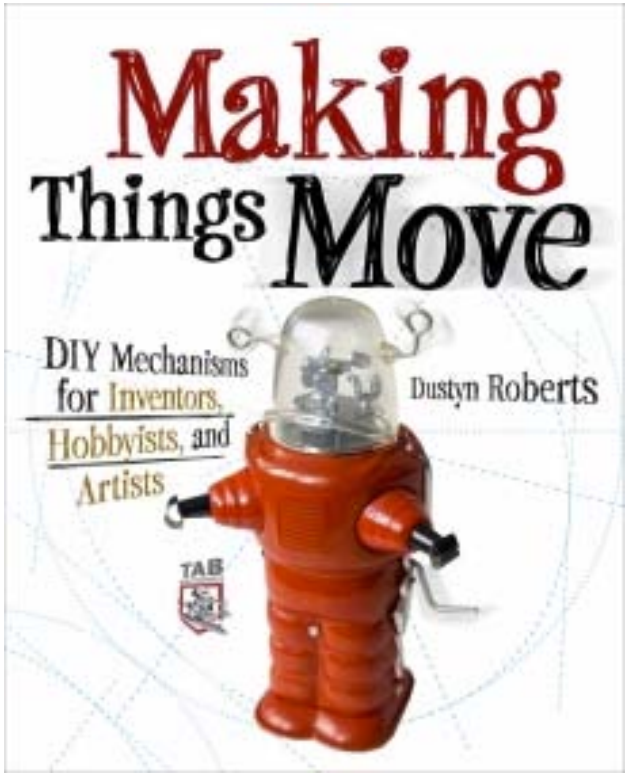
- http://www.youtube.com/watch?v=DIGTD1WGFdM

1. Transform Energy
2. Transfer Energy
3. Multiply / Change direction of force
4. Multply Speed

Making Things Move

Dustin Roberts

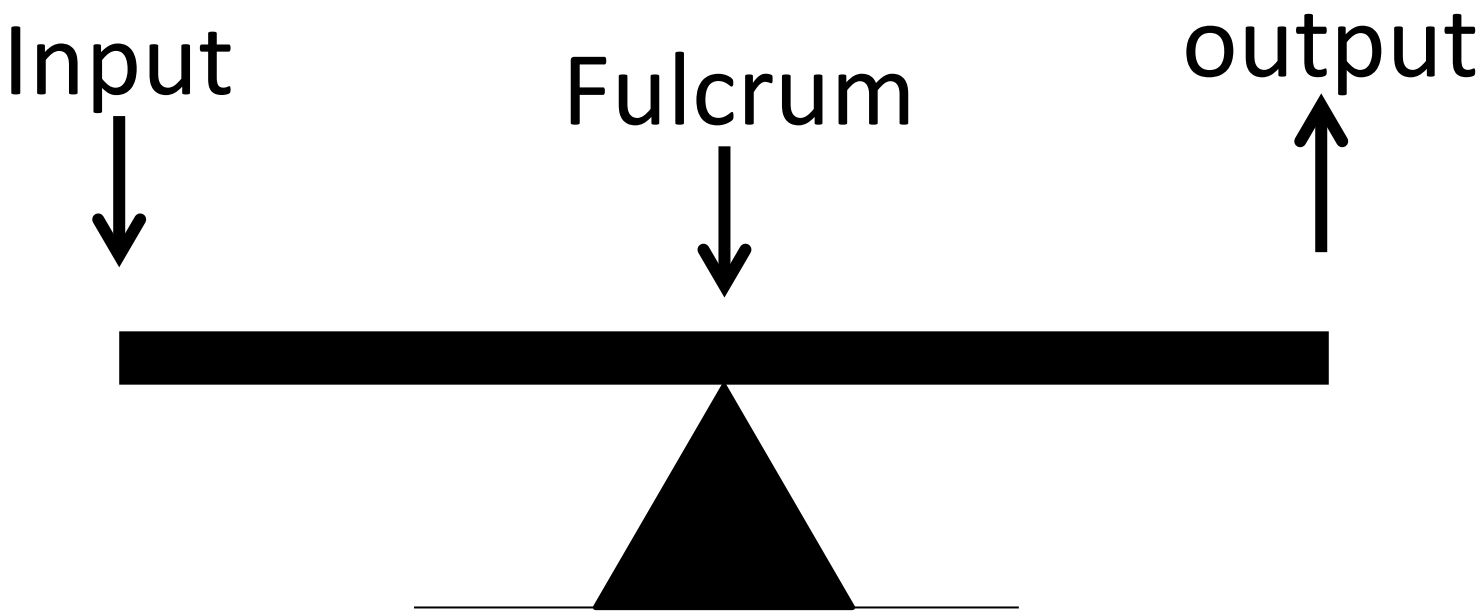
- http://www.makingthingsmove.com/



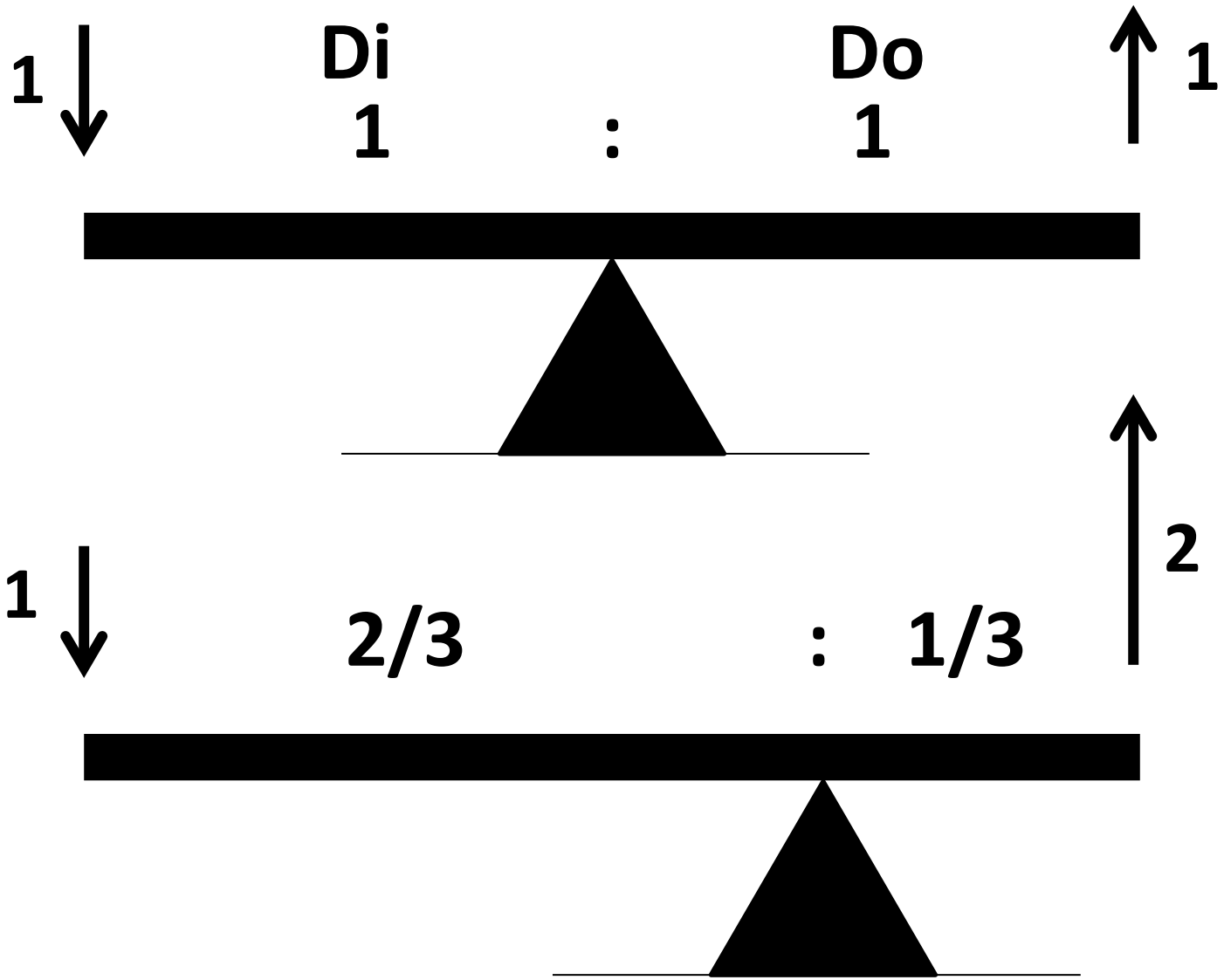
Basic Mechatronics

1. Lever
2. Pulleys
3. Gears
4. Wheel

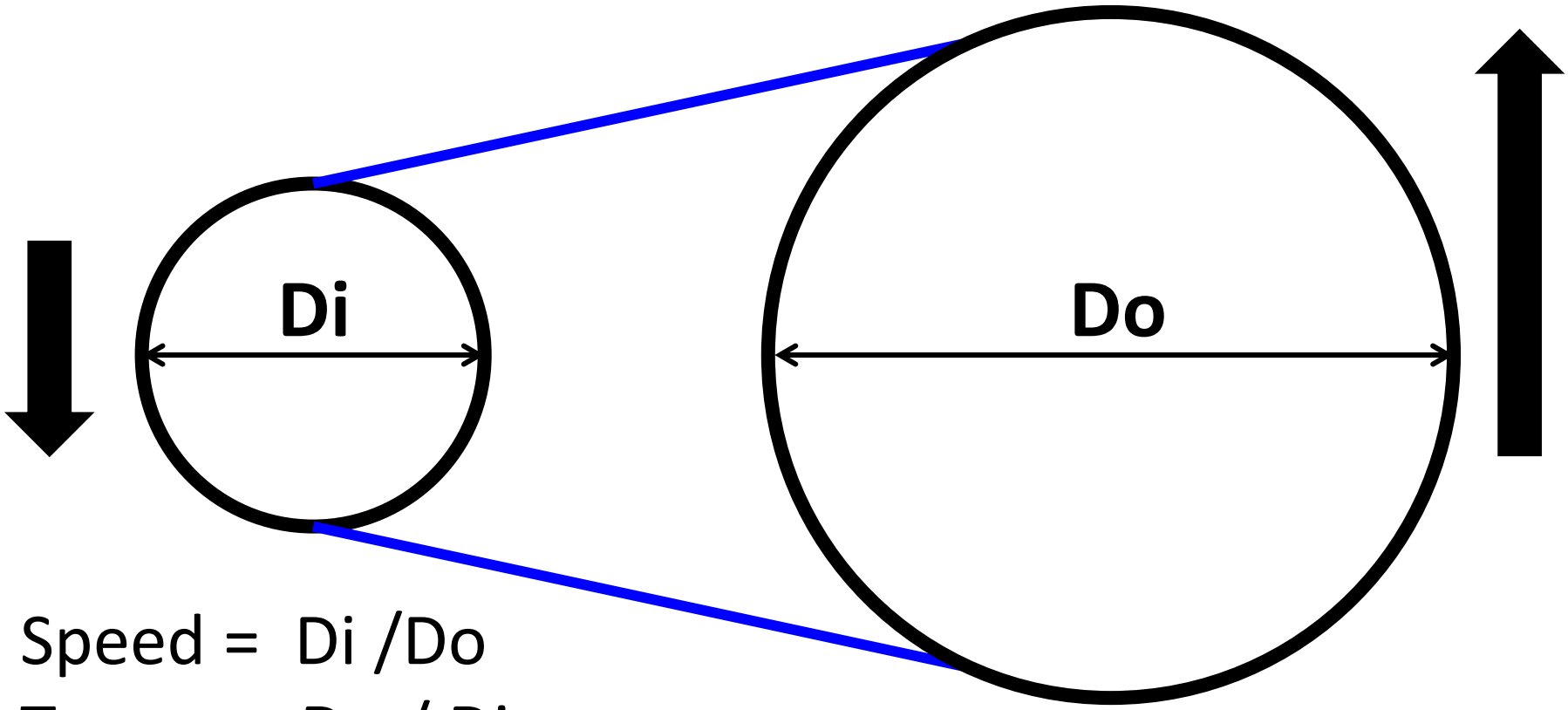
Lever



Output = Di/Do



Pulley:

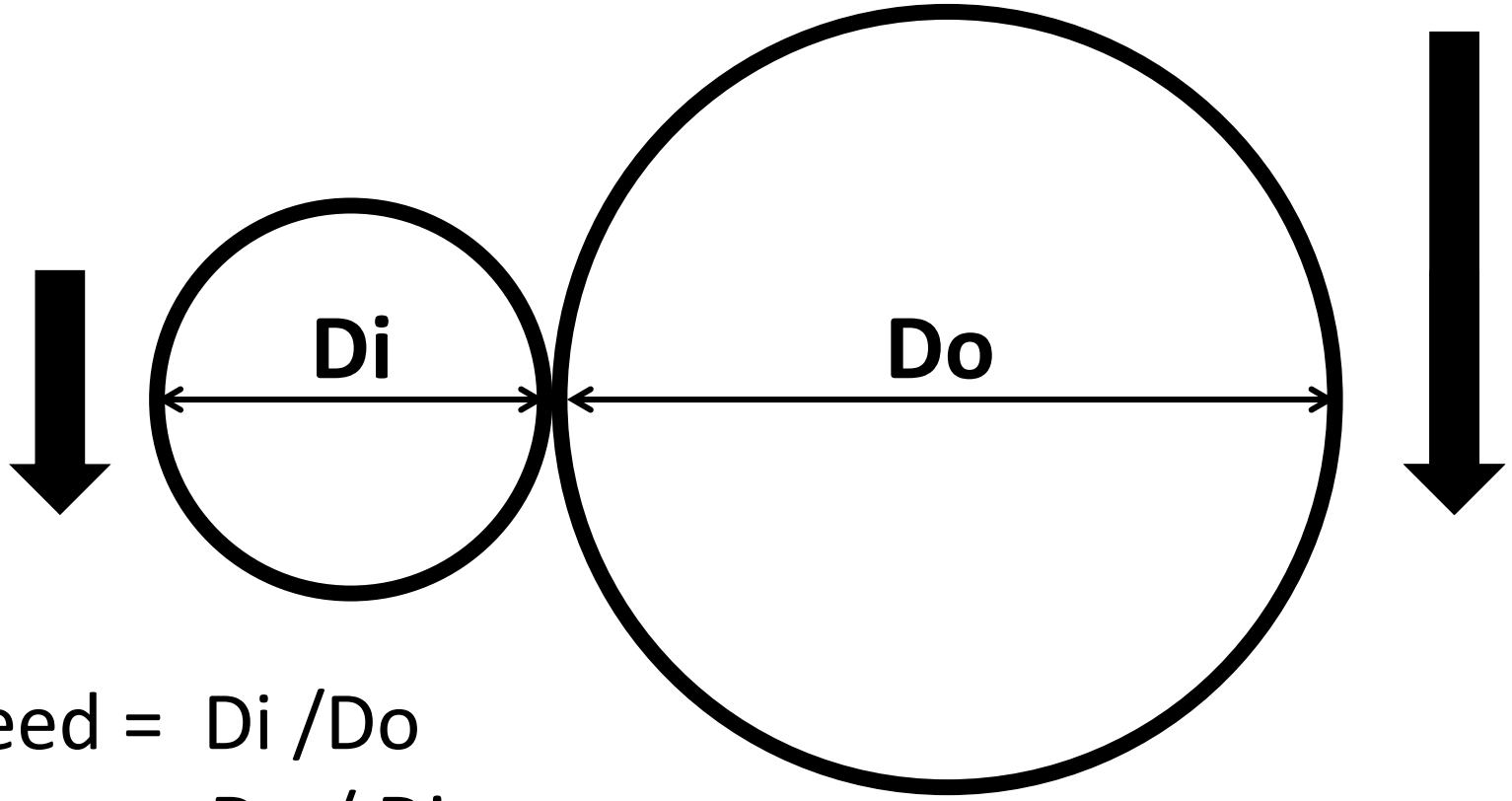


Speed = Di /Do

Torque = Do / Di

Rotate Same the Direction

Gear



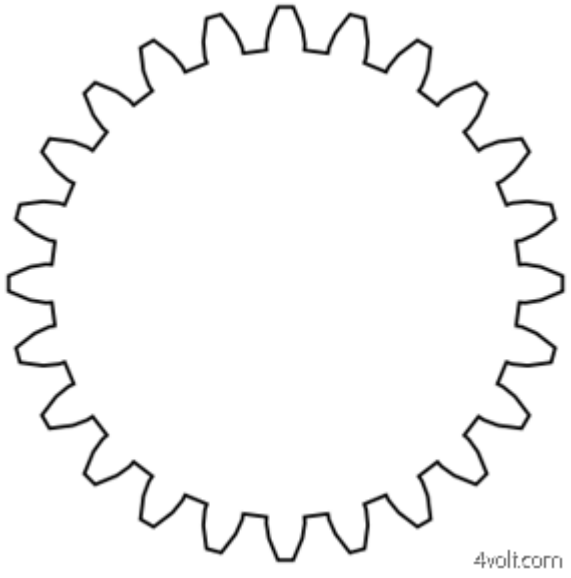
Speed = Di /Do

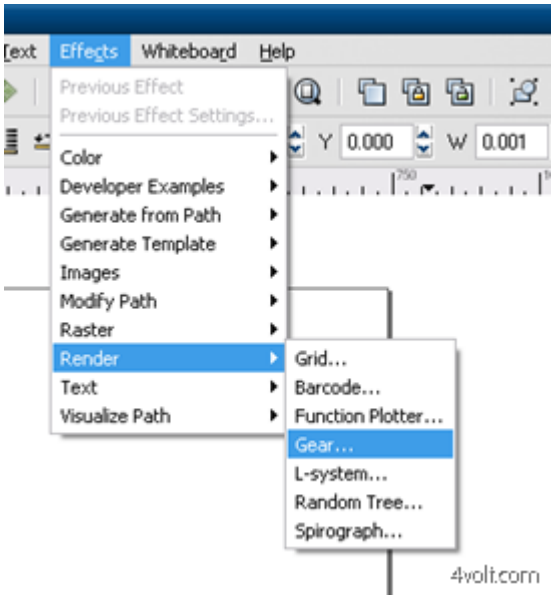
Torque = Do / Di

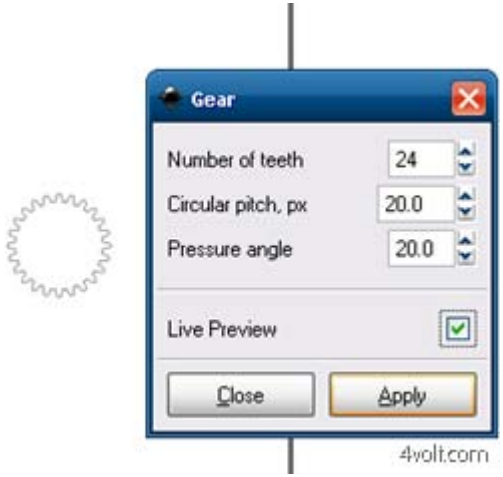
Rotate Opposite Directions

Making Laser Cut Gears with InkScape Tutorial

- http://4volt.com/Blog/archive/2009/01/05/laser-cut-gears-and-inkscape.aspx







Assignment1: Rolling Ball machine

Design a rolling ball machine

- ***Size within w:42cm h: 30cm d:30cm (A4 paper)***
- **A mechanism to lift up balls**
- **Minimum 3 Gimmicks using switches or sensors**
  http://www.oobject.com/category/15-videos-of-amazing-rolling-ball-machines/
-

List of Shops for materials/components.

- Sim-lim tower
  - B1 Continental Electronic
  - 4F Kaichin/SunLight
- Sgbotic:
  - *www.sgbotic.com*
- Sparkfun products
  - http://www.sparkfun.com/
- Element14
  - http://sg.element14.com/
- RS-components
  - http://singapore.rs-online.com
- RotorHobby
  - http://rotor.com.sg/
- McMasterCarr
  - http://www.mcmaster.com/#
- *ServoCity*
  - *http://www.servocity.com*