

# PHYSICAL COMPUTING WORKSHOP

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# Physical Computing

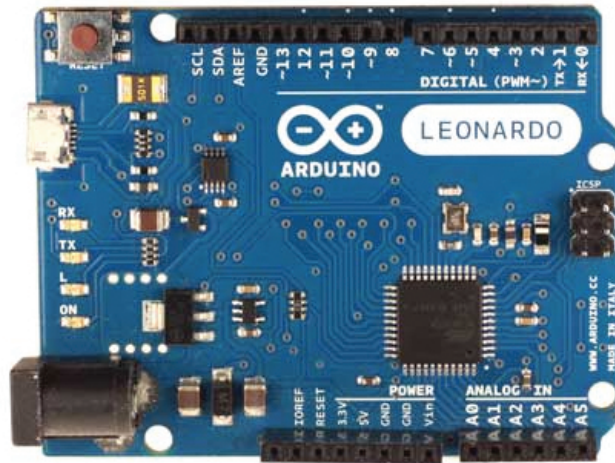
**Physical computing, in the broadest sense, means building interactive physical systems by the use of software and hardware that can sense and respond to the analog world.**

**Prototyping plays an important role in Physical Computing.**

# Arduino

**Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.**

**Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators.**



# Arduino Leonardo

<http://arduino.cc/en/Main/arduinoBoardLeonardo>

**ATmega 32U4 Chip**

**32KB Flash Memory (28KB Available)**

**USB**

**Serial Communication**

**External Power**

**9v**

**LEDs**

**ON / Power**

**L / LED – Pin 13**

**TX / Transmit**

**RX / Receive**

**Button**

**Reset**

**Pins**

**Power**

**3.2v**

**5v**

**GND**

**Analog**

**10-Bit ADC**

**Values 0 - 1023**

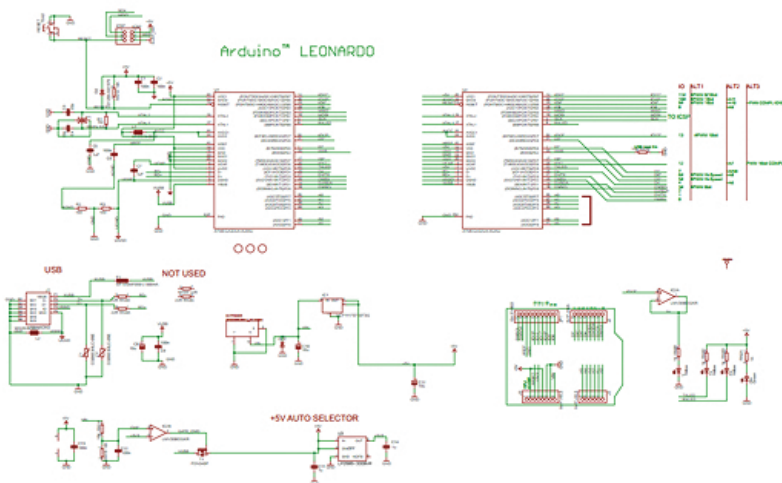
**Digital**

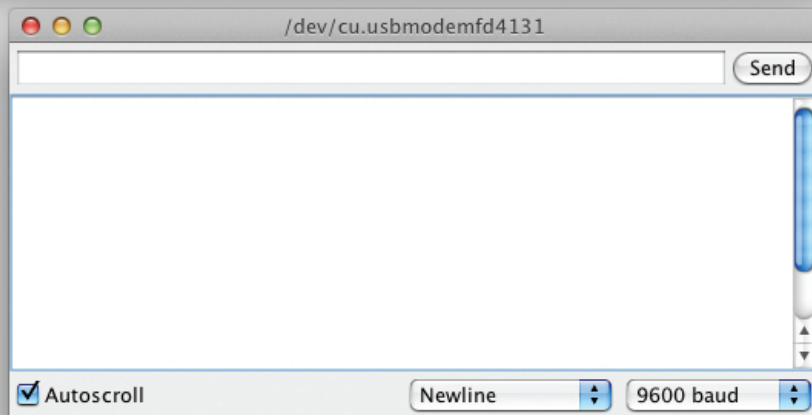
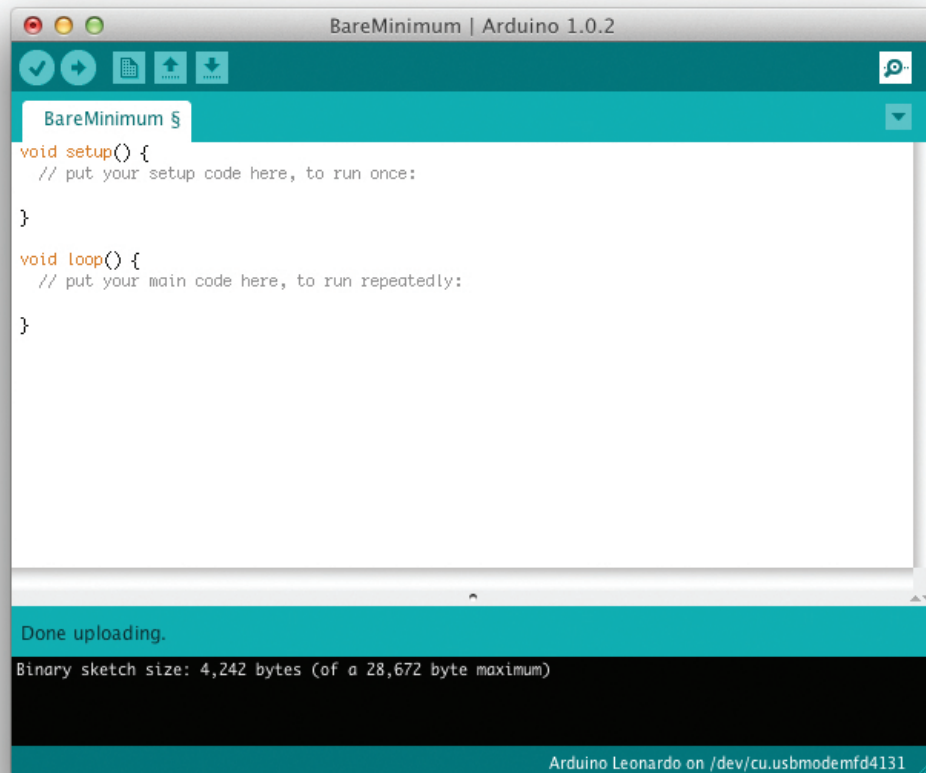
**HIGH**

**LOW**

**PWM**

**Pulse Width Modulation**





# Arduino Environment

<http://arduino.cc/en/Guide/Environment>

## Sketch

**Examples**

**Library location**

**Code Editor**

**Verify**

**Upload**

**Serial Monitor**

**Tools**

**Board**

**Arduino Leonardo**

**Serial Port**

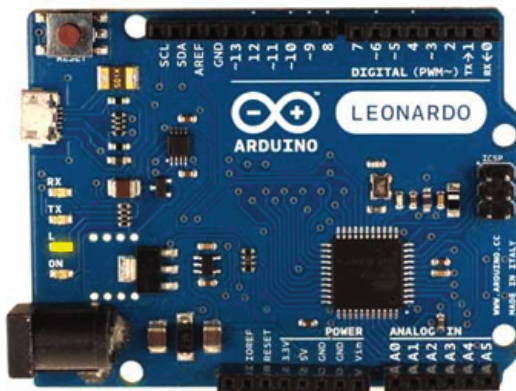
**C/C++**

**Wiring**

<http://wiring.org.co/>

**Arduino**

<http://arduino.cc/en/Reference/HomePage>



# Blink

## Multimeter

Measures Voltage (and many other things)

Sketch: Examples > Basics > Blink

Define an Output Pin

Pin 13

Built-in LED

setup()

Runs once at program start

loop()

Runs indefinitely

digitalWrite()

Sends a value to the defined Pin

HIGH

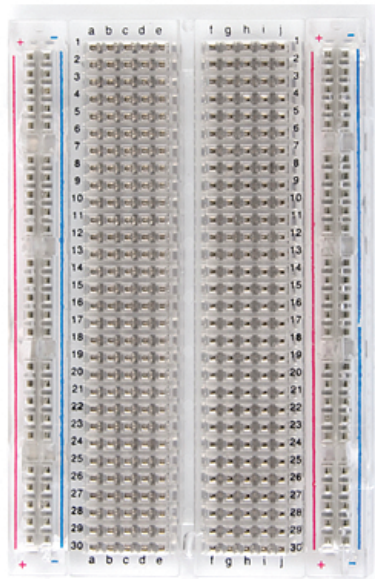
5v DC

LOW

0v DC

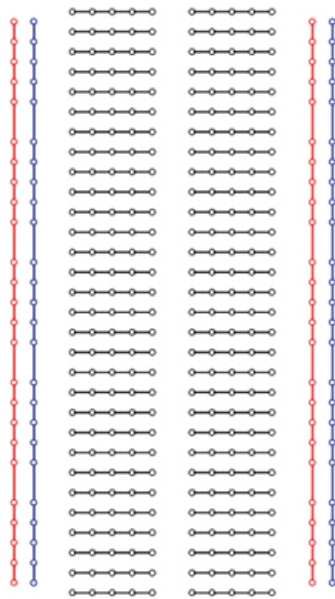
delay()

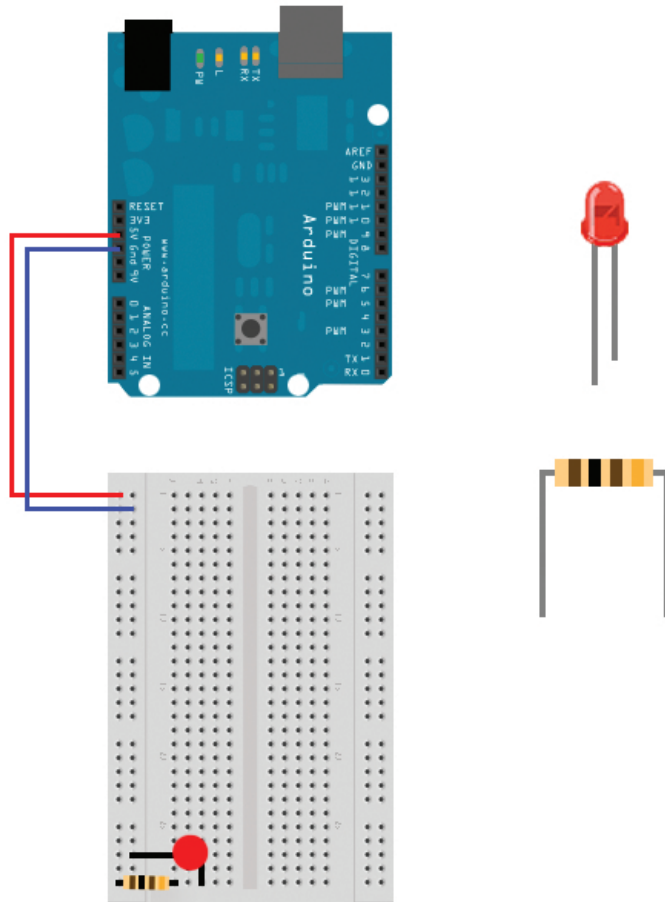
Number of milliseconds to pause



# Breadboard

**Bus strip**  
**Red & Blue / Positive & Negative**  
**Terminal strips**  
**Numbered**





# Power an LED

## Power the breadboard

Arduino 5v to Breadboard + / Red strip

Arduino GND to Breadboard - / Blue strip

## LED

Light Emitting Diode

Positive – Long “Leg”

Negative – Short “Leg”

## 5v is too strong for our 2v LEDs

Calculating the appropriate resistor

Voltage (Arduino Pin 5v)

Voltage Drop (LED 2-2.4v)

Current (Arduino Pin 40mA)

Online calculator

<http://led.linear1.org/1led.wiz>

## Resistor

Provides electrical resistance

Color bands indicate resistance

Online calculator

[www.diyalarmforum.com/4-band-resistor-calc/](http://www.diyalarmforum.com/4-band-resistor-calc/)

## 100ohm Resistor

Positive / Red Strip

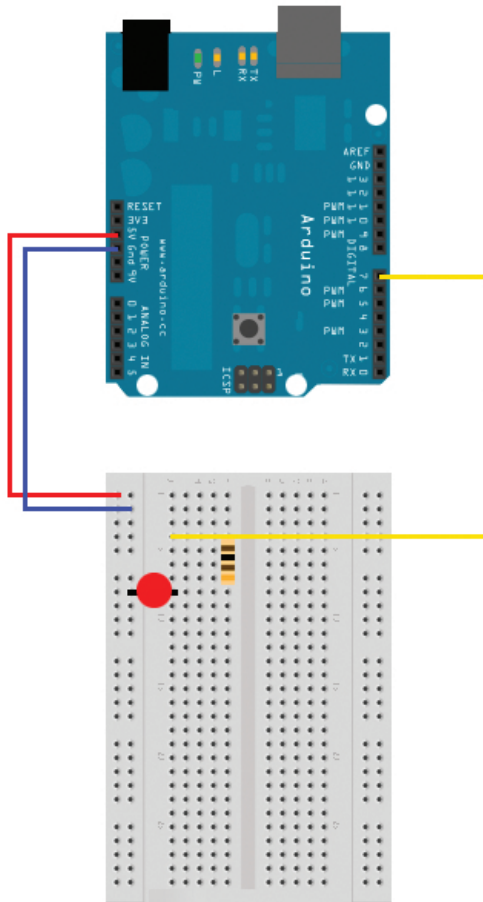
Bus 30, Row A

## LED

Negative / Blue Strip

Positive / Bus 30, Row C





## Blink – Extended

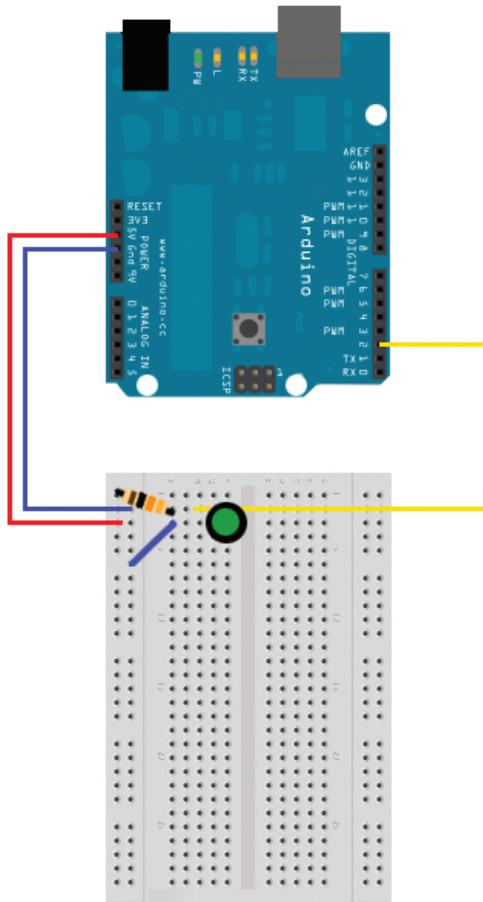
Sketch: Examples > Basics > Blink

100ohm Resistor  
Bus 10, Row E  
Bus 7, Row E

LED  
Negative – Blue Strip  
Positive – Bus 10, Row A

Modify Blink Code  
`int led = 7;`

Add a Second LED & Alternate Flashing



# Button – Pulled Up

Sketch: Examples > Digital > Button

`digitalRead()`

Reads the value of a defined Pin

HIGH

5v DC

LOW

0v DC

10k Resistor

Positive – Red Strip

Bus 2, Row A

Pin 2

Bus 2, Row B

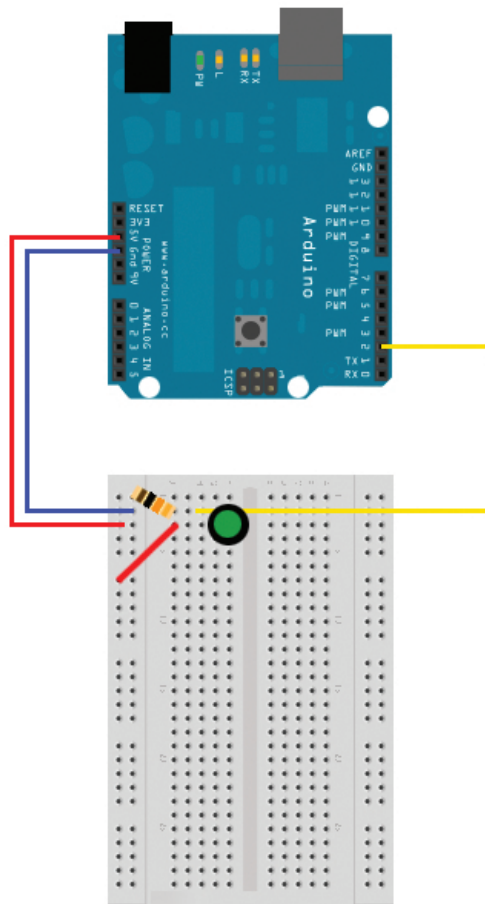
Negative – Blue Strip

Bus 3, Row A

Button

Bus 2, Row E

Bus 3, Row D



# Button – Pulled Down

Sketch: Examples > Digital > Button

`digitalRead()`

Reads the value of a defined Pin

HIGH

5v DC

LOW

0v DC

10k Resistor

Negative – Blue Strip

Bus 2, Row A

Pin 2

Bus 2, Row B

Positive – Red Strip

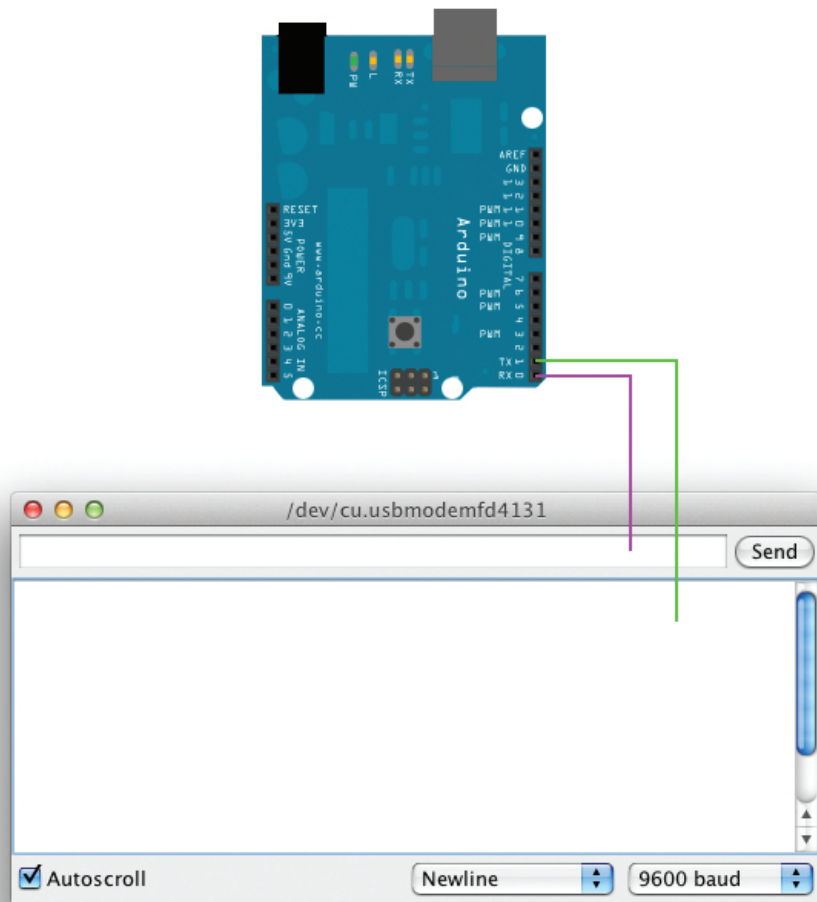
Bus 3, Row A

Button

Bus 2, Row E

Bus 3, Row D

Add an external LED



# Serial

**Sketch: Serial**

**Serial.begin(9600);**  
Enables a Serial connection  
Sets the Serial connection speed

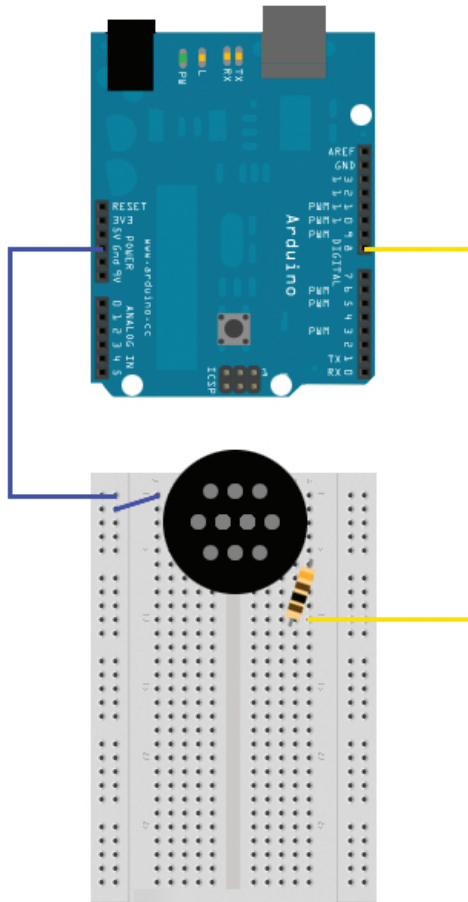
**Serial.print();**  
Outputs Serial data

**Serial.println();**  
Outputs Serial data and New Line character

**count++;**  
Increase the count by one

**Decrease the count by one**

**Incorporate the count into the Button sketch**  
**Button\_Count Sketch**



# Tone Melody

Sketch: Examples > Digital > toneMelody

## Speaker

Negative to Bus 1, Row E

Positive to Bus 6, Row F

## Negative

Bus 1, Row A

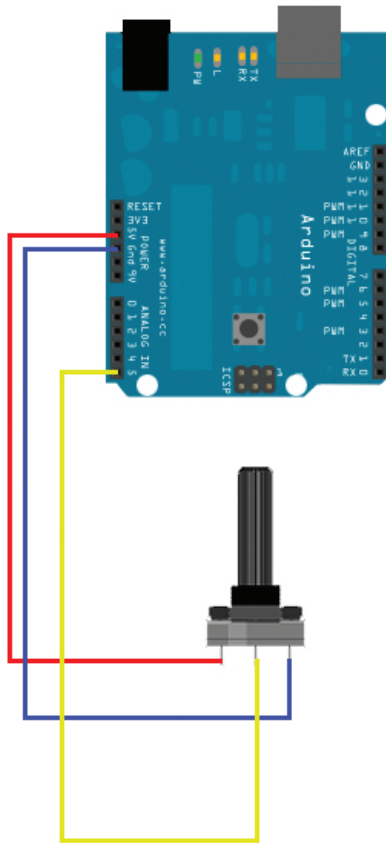
## 100ohm Resistor

Bus 6, Row J

Bus 10, Row J

## Pin 8

Bus 10, Row H



# Analog Read

Sketch: Analog\_Read

`analogRead()`

Reads the voltage

10bit ADC

Analog to Digital Conversion

Value Range

0 - 1023

**Potentiometer**

A potentiometer informally a pot, is a three-terminal resistor with a sliding contact that forms an adjustable voltage divider

`map(value, from low, from high, to low, to high)`

<http://arduino.cc/en/Reference/Map>

Map the range from 1 - 10

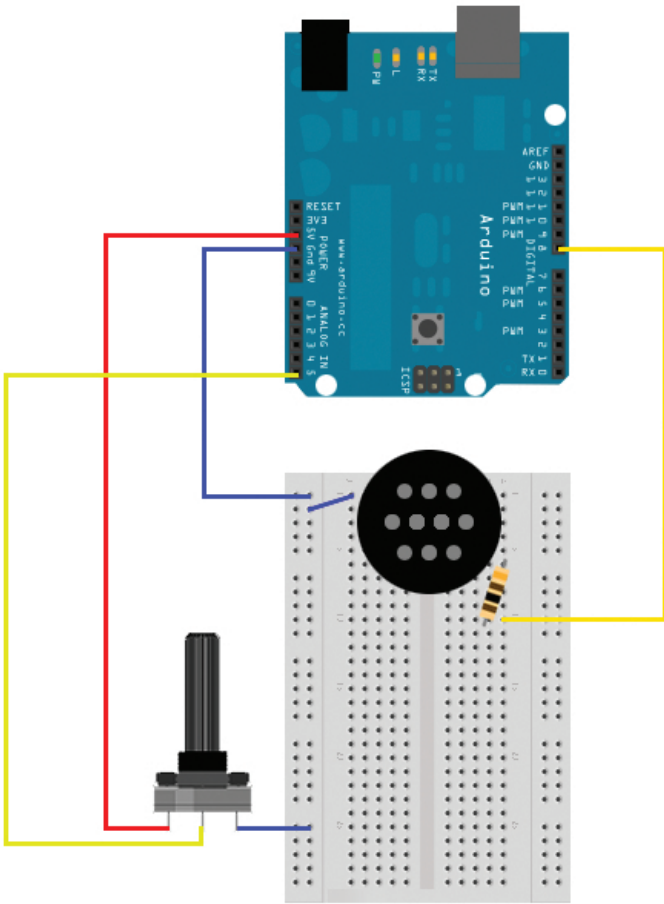
Map the range from 1 - 11

# Analog Read – Extended

Sketch: `Analog_Read_Extended`

`tone(pin, frequency, duration)`  
<http://arduino.cc/en/Reference/Tone>

`notone(pin)`  
<http://arduino.cc/en/Reference/NoTone>



# Capacitive Sensor

Sketch: `Capacitive_Sensor`

Sketch > Import Library > `CapacitiveSensor`  
<http://playground.arduino.cc/Main/CapacitiveSensor>

Pin 7  
Bus 7, Row E

Pin 3  
Bus 3, Row E

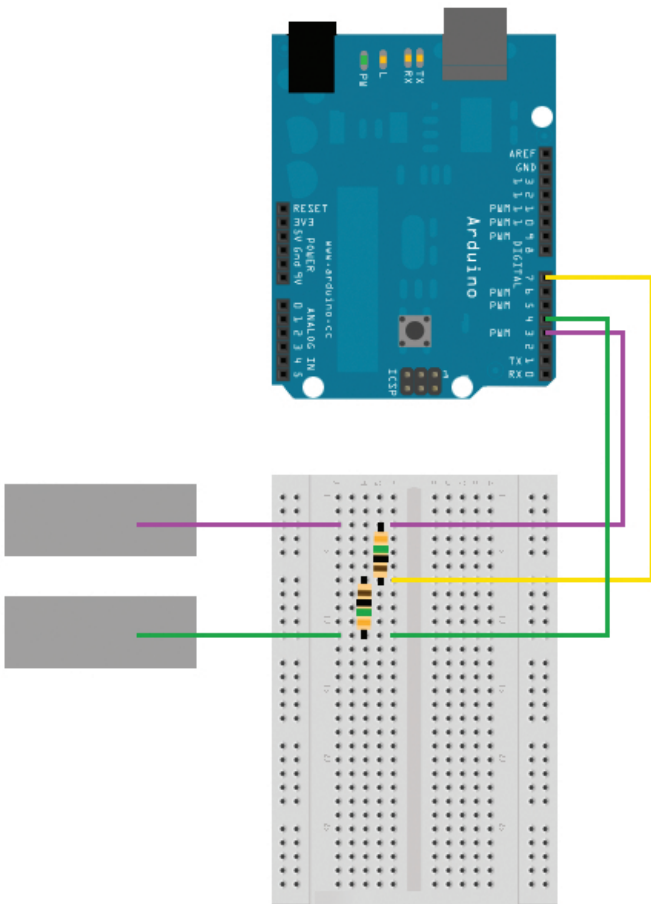
1M Resistor  
Bus 7, Row D  
Bus 3, Row D

Wire to Foil  
Bus 3, Row A

Pin 4  
Bus 11, Row E

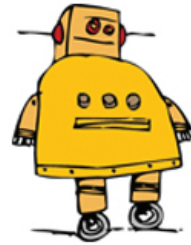
1M Resistor  
Bus 7, Row C  
Bus 11, Row C

Wire to Foil  
Bus 11, Row A









**instructables**



**Inspiration:**

**MAKE Magazine**  
[www.makezine.com](http://www.makezine.com)  
[blog.makezine.com](http://blog.makezine.com)  
[www.makerfaire.com](http://www.makerfaire.com)

**Instructables**  
[www.instructables.com](http://www.instructables.com)

**Supplies:**

**Sparkfun**  
[www.sparkfun.com](http://www.sparkfun.com)

**All Electronics**  
[www.allelectronics.com](http://www.allelectronics.com)

**Code Examples & References:**

**Arduino**  
[www.arduino.cc](http://www.arduino.cc)

**Imagery:**

[www.arduino.cc](http://www.arduino.cc)  
[www.sparkfun.com](http://www.sparkfun.com)  
[www.harbordreight.com](http://www.harbordreight.com)

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[www.fritzing.org](http://www.fritzing.org)