Arduino Workshop

Day 1

Electrical Concepts

Current

- Flow of electricity through a wire (Amperes/Amps)

Voltage

- Force that pushes electrons through the wire, generating a current
- Water example

Resistance

- Restricts flow of current

https://www.youtube.com/watch?v=BoRlclML3tE&ab_channel=EatonVideos

Until 3 minute mark

What is Arduino?

- Arduino is an open-source hardware and software company
    - Make boards such as the Arduino Uno, pictured below
- Arduino uses a microprocessor
    - Mini-Computer
- Arduino collects data from sensors and communicates with other devices
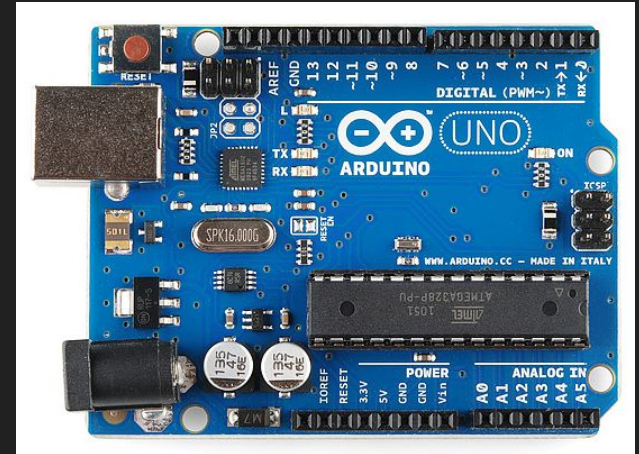
Why use Arduino?

- Arduino is very hands-on, which helps with understanding electronics
- You can build cool projects by controlling different sensors and devices
- Used in robotics!
- Companies use arduino for prototyping and testing devices
    - Apple
    - Amazon
    - Google

Arduino Cube Solver:

https://www.youtube.com/watch?v=awxGJ7aVk4g&ab_channel=MohammadMoaddi

Parts of the Arduino

USB Connector

- Transfer Power and data

Power Port

- For additional power

Voltage regulator

- Stabilizes voltage to prevent damage to board

Microcontroller

- Brain of the arduino
- Similar to CPU in a computer

USB Interface chip

- Translates usb signals into a form that arduino can understand

Crystal oscillator

- Generates clock at a frequency of 16 Mhz

Digital Pins

- Send or receive data and can send power as well

Analog Pins

- Read data from analog devices

Memory

- 32kB flash and 2kB SRAM

Arduino Safety

Safe Habits Around Electronics :

- - No water nearby
- - Don't connect electrical components randomly
- - Make sure all connections are secure
    - - No loose connections
- - Don't leave projects unattended
- - Disconnect when you are done with a project

First Project: Blink

- Connect the blue power cable from the Arduino to your computer
- Open Arduino IDE
- Go to File -> Examples -> 01.Basics -> Blink
- Make sure you selected your board (Arduino Uno)
- Run the program
- You should see a light blinking on the Arduino
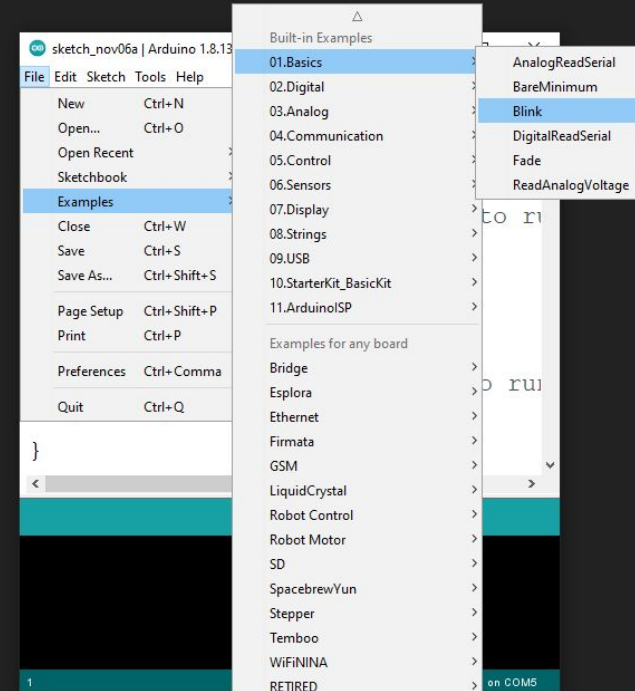
Code Walk Through

```
// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH);    // turn the LED on (HIGH is the voltage level)
  delay(1000);                        // wait for a second
  digitalWrite(LED_BUILTIN, LOW);     // turn the LED off by making the voltage LOW
  delay(1000);                        // wait for a second
}
```

Challenge

How would you make it so the light blinks slower? faster?
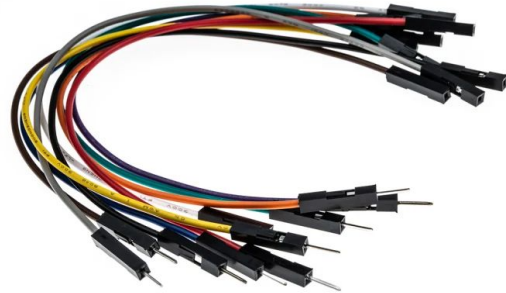
Arduino Workshop
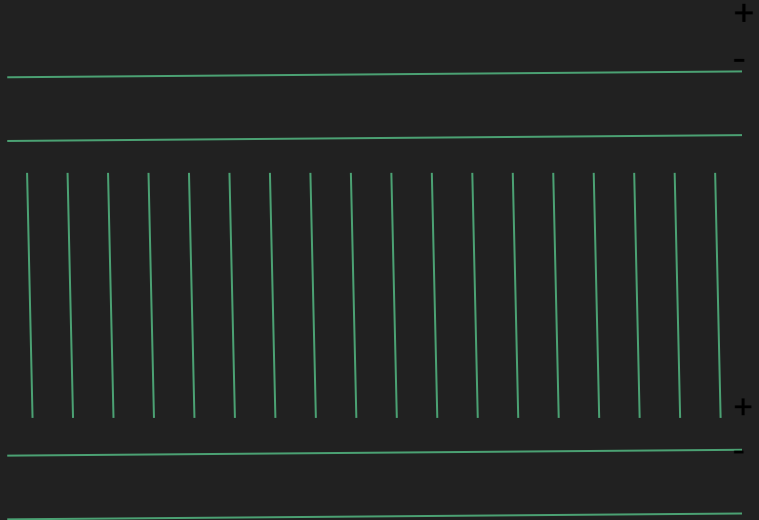
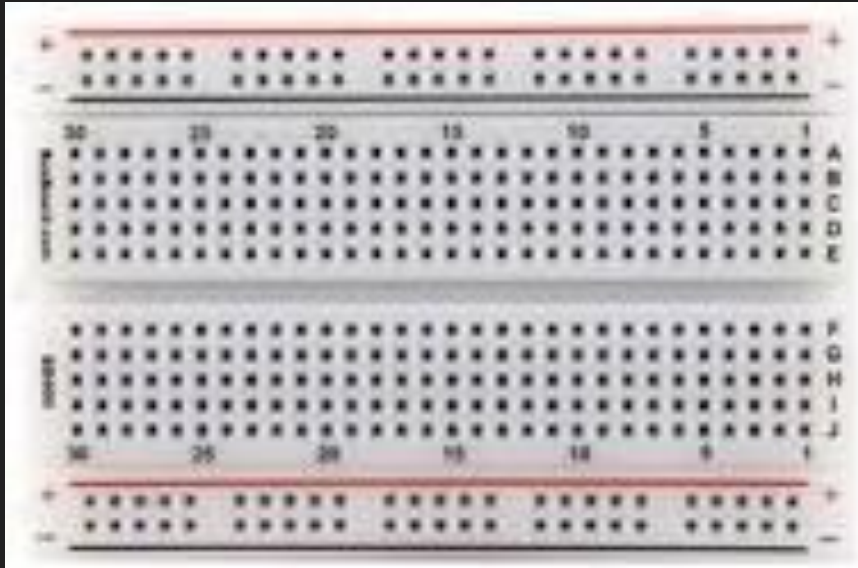Breadboards + Wiring

Circuit Basics

- Positive and Negative sides
- Arduino
    - Positive is 5v or 3.3v (We will only be using 5v)
        - 5 Volts
    - Negative is Ground (Usually denoted as GND)
- Wiring
    - Conventional practices
        - Red for +
        - Black for -
    - Types of wires
        - Male to Male
        - Male to Female
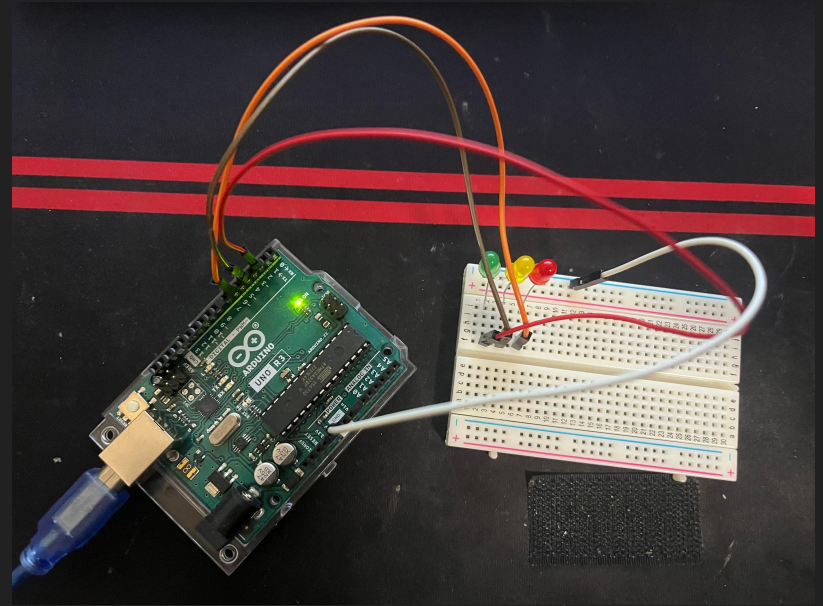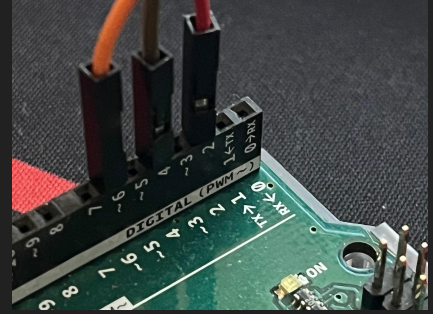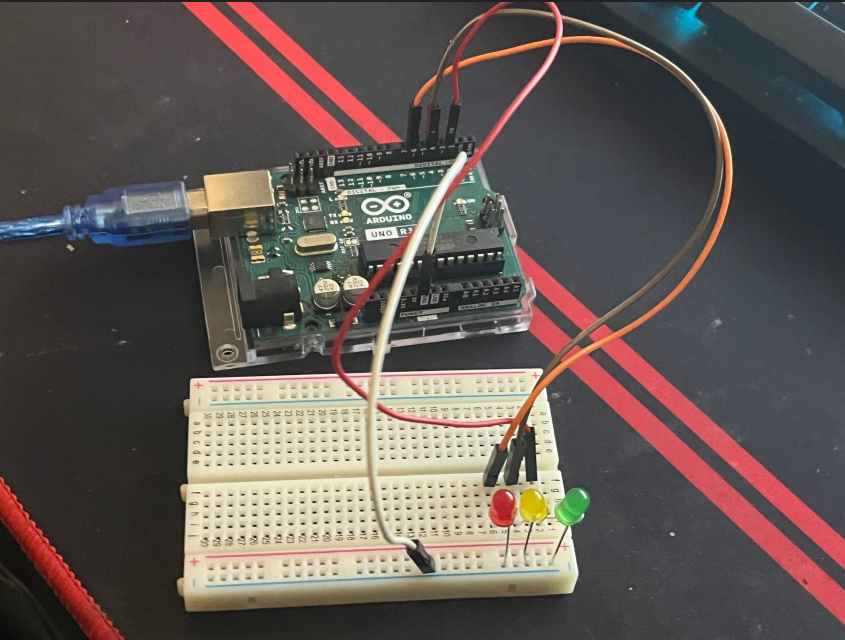   - Female to Female

Breadboards

Help connect multiple wires or devices to one port on the Arduino

LED Light Project

- Follow Along

Multiple Lights?!?!?!?!

```
// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(2, OUTPUT);
  pinMode(4, OUTPUT);
  pinMode(6, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(2, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);                       // wait for a second
  digitalWrite(2, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);
  digitalWrite(4, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);                       // wait for a second
  digitalWrite(4, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);
  digitalWrite(6, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);                       // wait for a second
  digitalWrite(6, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);
}
```

Kahoot Game!!!

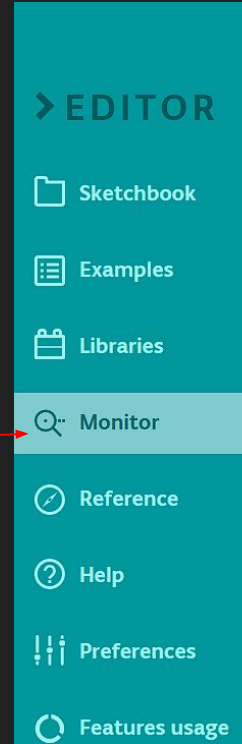- Search up Kahoot.it

- Wait for the code to appear on my screen
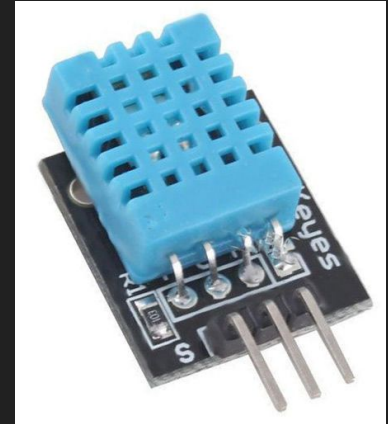
Arduino Workshop

Intro to Sensors

Sensors

- Sensors pass in some form of input data to the Arduino
- Examples
    - DHT11 Temperature and Humidity Sensor
    - Proximity Sensor
    - Ultrasonic Sensor
    - Air Quality Sensor
- Serial Monitor
    - Helps view data readings
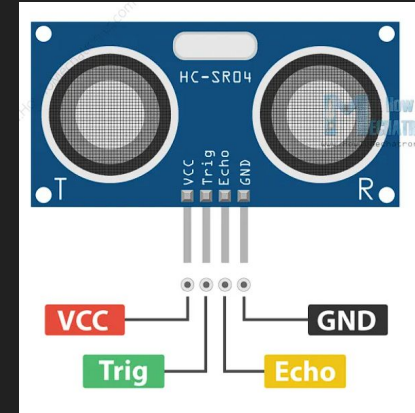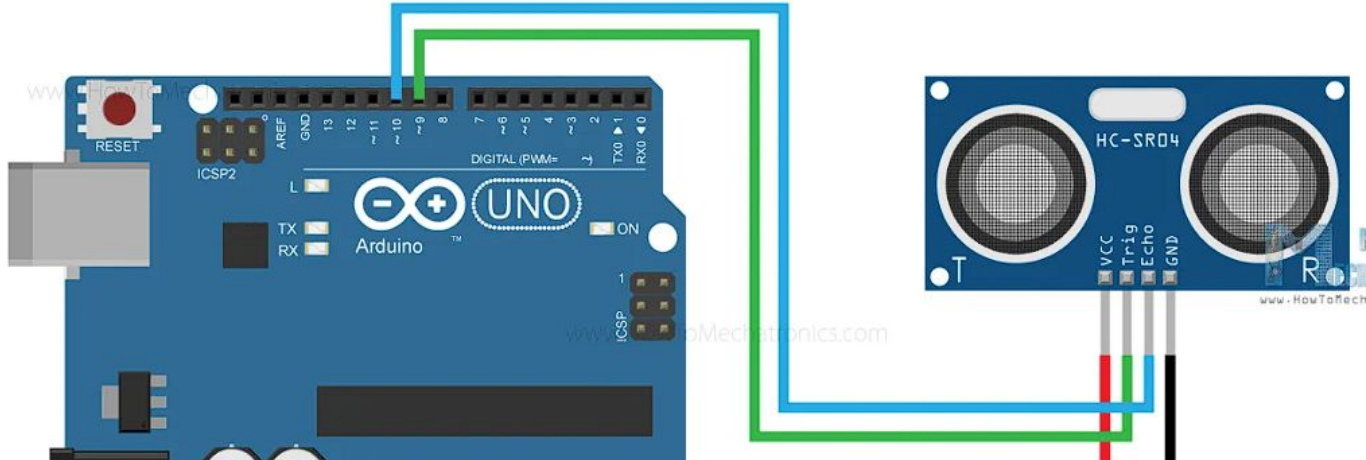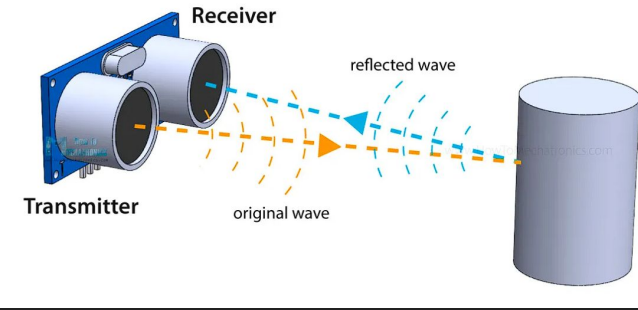   - Open the Monitor button on the left side

DHT 11

> EDITOR

📁 Sketchbook

📋 Examples

🔋 Libraries

🔍 Monitor

🧭 Reference

❓ Help

🎚 Preferences

🔄 Features usage

Ultrasonic Sensor

Trigger and Echo Pins

```
const int trigPin = 9;
const int echoPin = 10;
//defines variables
long duration;
int distance;
void setup() {
  pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
  pinMode(echoPin, INPUT); // Sets the echoPin as an Input
  Serial.begin(9600); // Starts the serial communication
}
void loop() {
  // Clears the trigPin
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  // Sets the trigPin on HIGH state for 10 micro seconds
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  // Reads the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin, HIGH);
  // Calculating the distance
  distance = duration * 0.034 / 2;
  // Prints the distance on the Serial Monitor
  Serial.print("Distance: ");
  Serial.println(distance);
  delay(1000);
}
```

Arduino Workshop

Final Project

Some Coding Tips

Variables

- Help store specific values, either set by the coder or collected from a sensor

If statements

- Let you choose between different conditions
- "If ___ then ____ else ____"

We've already seen variables!

```
const int trigPin = 9;
const int echoPin = 10;
//defines variables
long duration;
int distance;
void setup() {
  pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
  pinMode(echoPin, INPUT); // Sets the echoPin as an Input
  Serial.begin(9600); // Starts the serial communication
}
void loop() {
  // Clears the trigPin
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  // Sets the trigPin on HIGH state for 10 micro seconds
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  // Reads the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin, HIGH);
  // Calculating the distance
  distance = duration * 0.034 / 2;
  // Prints the distance on the Serial Monitor
  Serial.print("Distance: ");
  Serial.println(distance);
  delay(1000);
}
```

These are all variables!

The ones shown here all hold numeric values (int and long)

Some other types of variables can hold words, decimal numbers, or even True False values

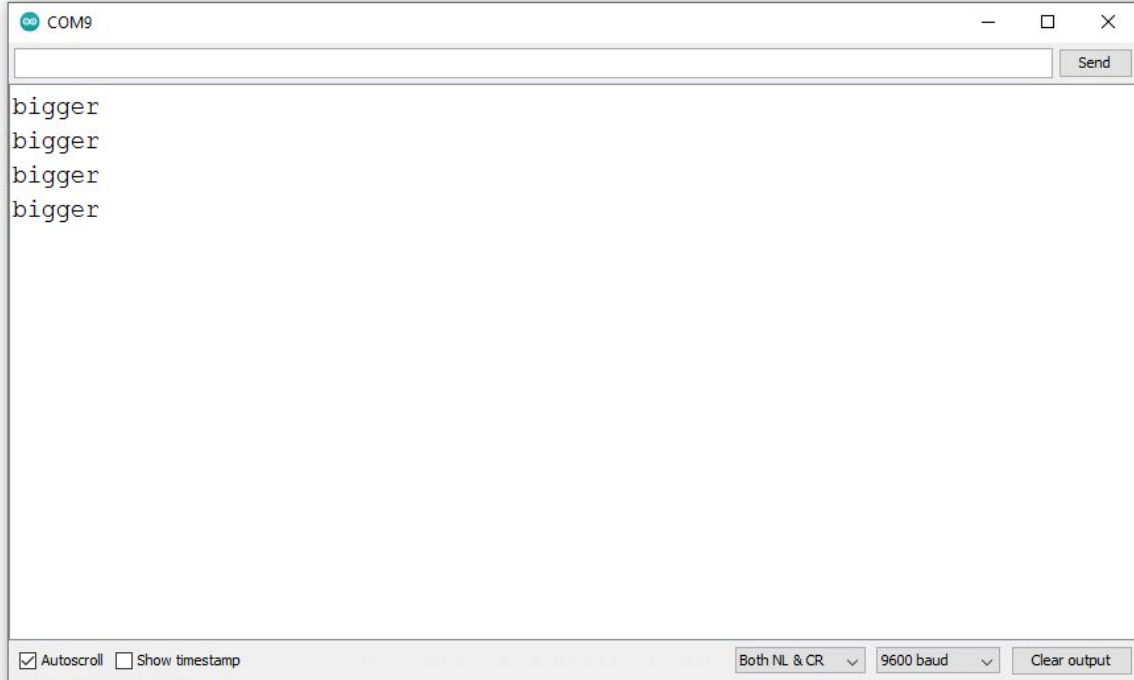# Example of an If Statement

```
sketch_feb23a | Arduino 1.8.13
File Edit Sketch Tools Help

sketch_feb23a

int value1 = 1;
int value2 = 7;
void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
}

void loop() {
  // put your main code here, to run repeatedly:
  if (value2 > value1){
    Serial.println("bigger");
    delay(1000);
  }
}
```

```
COM9                                            —  □  ×

[                                            ]  Send

bigger
bigger
bigger
bigger




☑ Autoscroll ☐ Show timestamp    Both NL & CR    9600 baud    Clear output
```

Final Project

Description:

Let's say you are on a team designing a car and you're a part of the safety department. Your task is to create a early crash detection safety system using an ultrasonic sensor. When an something gets too close to the sensor, a bright red light is supposed to turn on, alerting the driver to brake. Your job is to use what we have learned so far to create this detection system.

Materials: Arduino, Wires, Breadboard, Ultrasonic Sensor, red LED

Work in **Groups of 3** and make sure to brainstorm ideas with each other. You guys can designate jobs, such as the Design Lead, the Hardware Lead and the Software lead.

Code

```cpp
const int trigPin = 9;
const int echoPin = 10;
// defines variables
long duration;
int distance;
void setup() {
  pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
  pinMode(echoPin, INPUT); // Sets the echoPin as an Input
  pinMode(6, OUTPUT);// For the Light
  Serial.begin(9600); // Starts the serial communication
}
void loop() {
  // Clears the trigPin
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  // Sets the trigPin on HIGH state for 10 micro seconds
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  // Reads the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin, HIGH);
  // Calculating the distance
  distance = duration * 0.034 / 2;
  // Prints the distance on the Serial Monitor
  delay(1000);
  Serial.println(distance);
  if (distance <= 50){
    digitalWrite(6, HIGH);
  }
  if (distance> 50){
    digitalWrite(6, LOW);
  }
}
```

Servo Motor
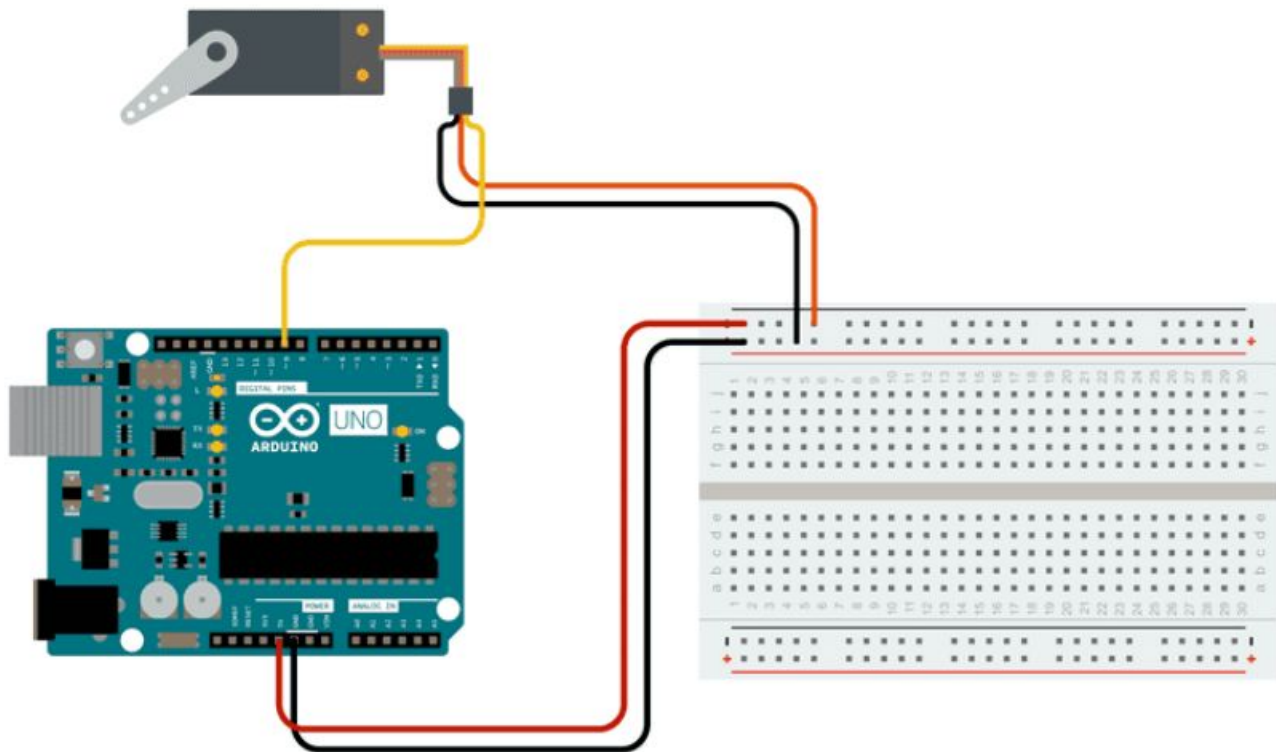
Code

```
1   #include <Servo.h>
2
3   Servo myservo;  // create servo object to control a servo
4   // twelve servo objects can be created on most boards
5
6   int pos = 0;    // variable to store the servo position
7
8   void setup() {
9     myservo.attach(9);  // attaches the servo on pin 9 to the servo object
10  }
11
12  void loop() {
13    for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
14      // in steps of 1 degree
15      myservo.write(pos);                 // tell servo to go to position in varia
16      delay(15);                          // waits 15ms for the servo to reach the
17    }
18    for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
19      myservo.write(pos);                 // tell servo to go to position in varia
20      delay(15);                          // waits 15ms for the servo to reach the
21    }
22  }
```
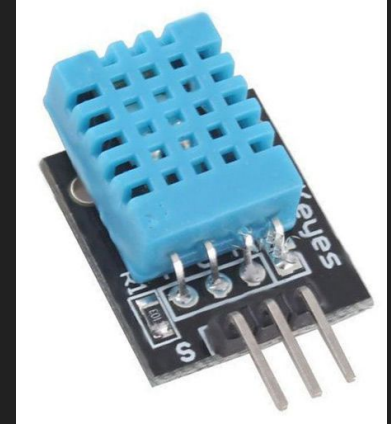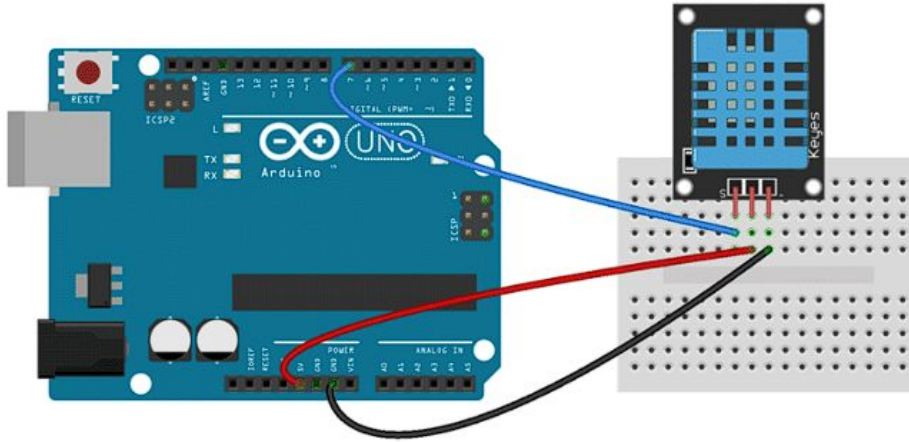
THANK YOU ALL!!!

Extension

Try adding a motor to the Final Project

Make it so the motor spins until the light turns on

Temperature and Humidity Sensor

DHT 11

CONNECTING A THREE PIN DHT11:

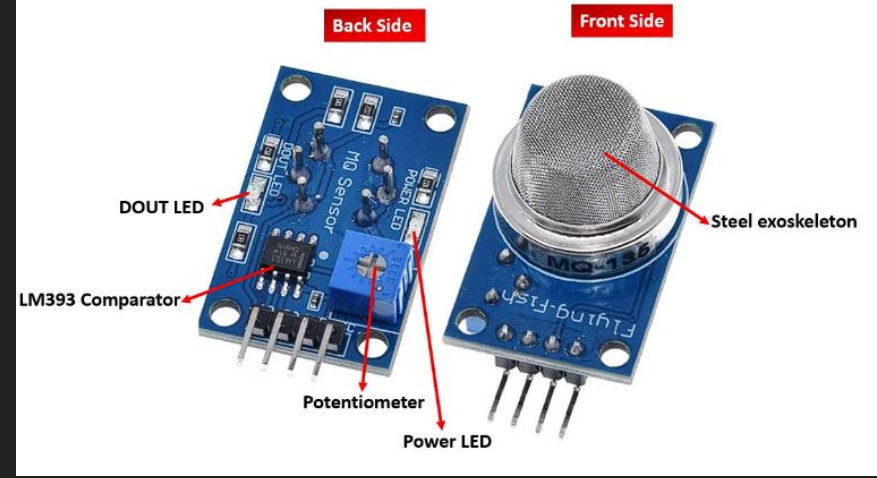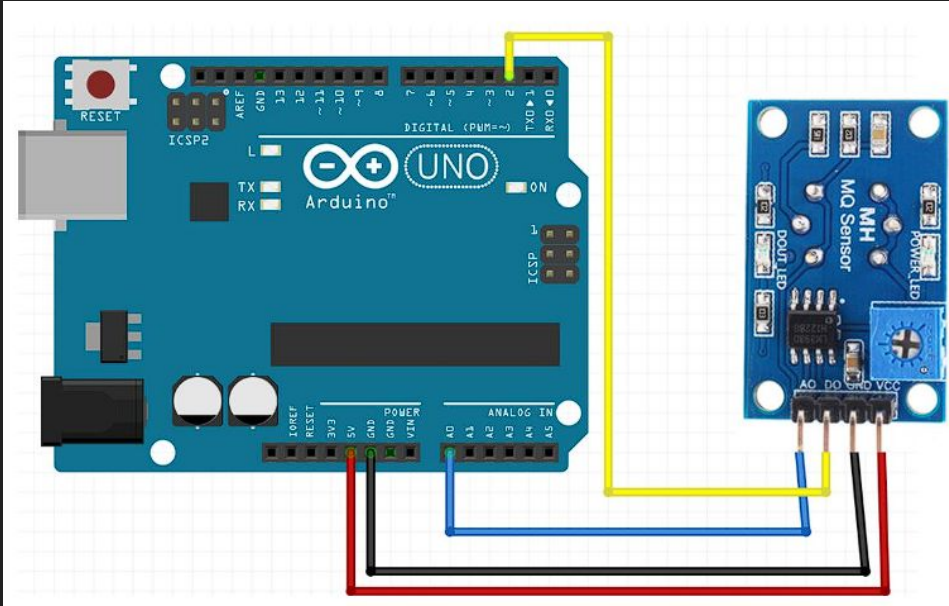# DHT11 Code

```
#include <dht.h>

dht DHT;

#define DHT11_PIN 7

void setup(){
  Serial.begin(9600);
}

void loop(){
  int chk = DHT.read11(DHT11_PIN);
  Serial.print("Temperature = ");
  Serial.println(DHT.temperature);
  Serial.print("Humidity = ");
  Serial.println(DHT.humidity);
  delay(1000);
}
```

Air Quality Sensor

AQI Code

```cpp
int sensorValue;
int digitalValue;

void setup()
{
  Serial.begin(9600); // sets the serial port to 9600
  pinMode(13, OUTPUT);
  pinMode(2, INPUT);
}


void loop()
{
  sensorValue = analogRead(0); // read analog input pin 0
  digitalValue = digitalRead(2);
  if (sensorValue > 400)
  {
    digitalWrite(13, HIGH);
  }
  else
    digitalWrite(13, LOW);
  Serial.println(sensorValue, DEC); // prints the value read
  Serial.println(digitalValue, DEC);
  delay(1000); // wait 100ms for next reading
}
```