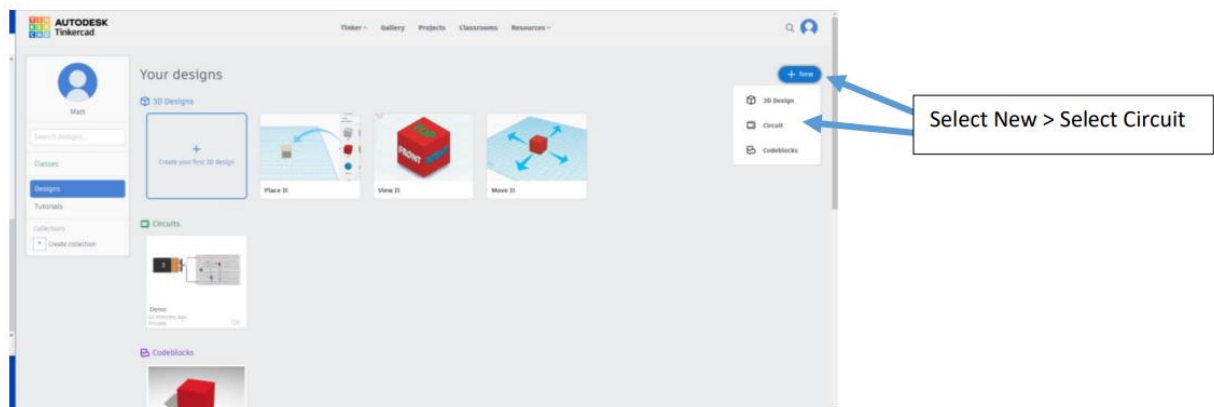


Electronic Circuit Basics with Tinker CAD.

Tinker CAD is a free online service for creating basic 3D shapes and developing digital prototypes of electronic components. These prototypes include basic circuits with LED lights, buzzers, switches, and even light sensors. These prototypes can include a microprocessor as part of the design. Microprocessors are the simplest form of computer that can be programmed. They can be programmed to manipulate electronic components like LED lights and buzzers. Microprocessors can be programmed to gather information from sensors and interpret that information. They are used in a variety of devices all around us. They are in microwaves, refrigerators, cars, computers and many other electronic devices.

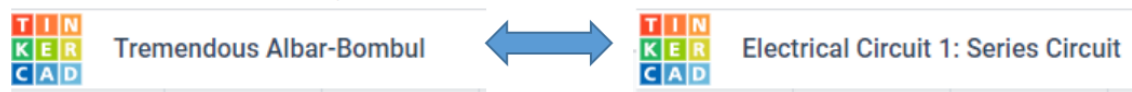
The process used in Tinker CAD is often used for rapid prototyping. Prototyping is a process where we can develop components in a flexible manner than can be quickly updated and modified to test a variety of options when developing a project or product.

1. Navigate to TinkerCAD.com > Click Sign In Icon (Top Left Side of Screen > Select Students, Join your Classroom > Classroom CODE: See Teacher for Code > Nickname: Student First Name (all lower case)
2. Select Circuits > Select Create New Circuit



3. Change Name of Circuit to Electrical Circuit 1: Series Circuit

Select Default File name in the Top Left Corner



4. Adding Electrical Components. TinkerCAD is a Drag and Drop interface
5. Rename File > TinkerCAD Electrical 3: Arduino 1

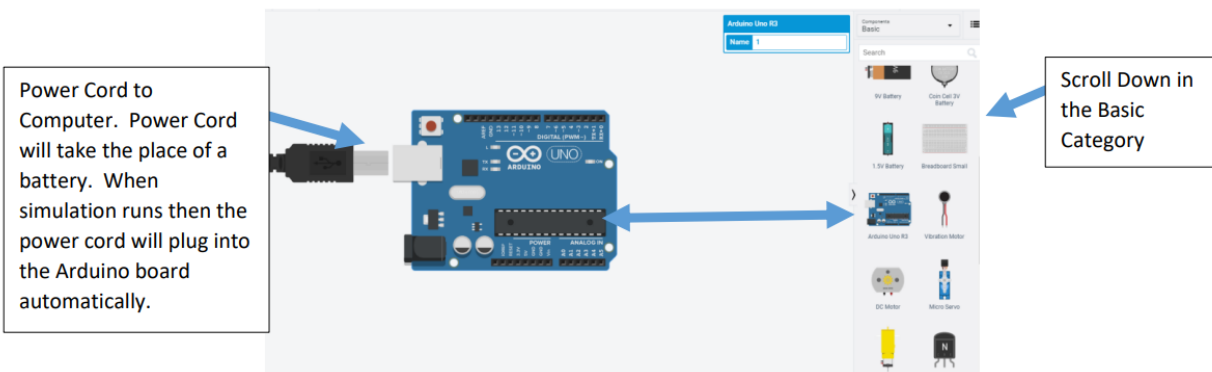
Arduino: is an open-source hardware and software that allows users to wire a circuit using resistors, buttons, sensors, etc. and write a program that can receive and transmit data to control the circuit.

Arduino has its own IDE Software where the user programs then downloads to the Arduino Board. TinkerCAD offers a simulation, that allows the user to create a simulated Arduino board and its circuit and then the user can write a program to receive and/or transmit data to control said circuit.

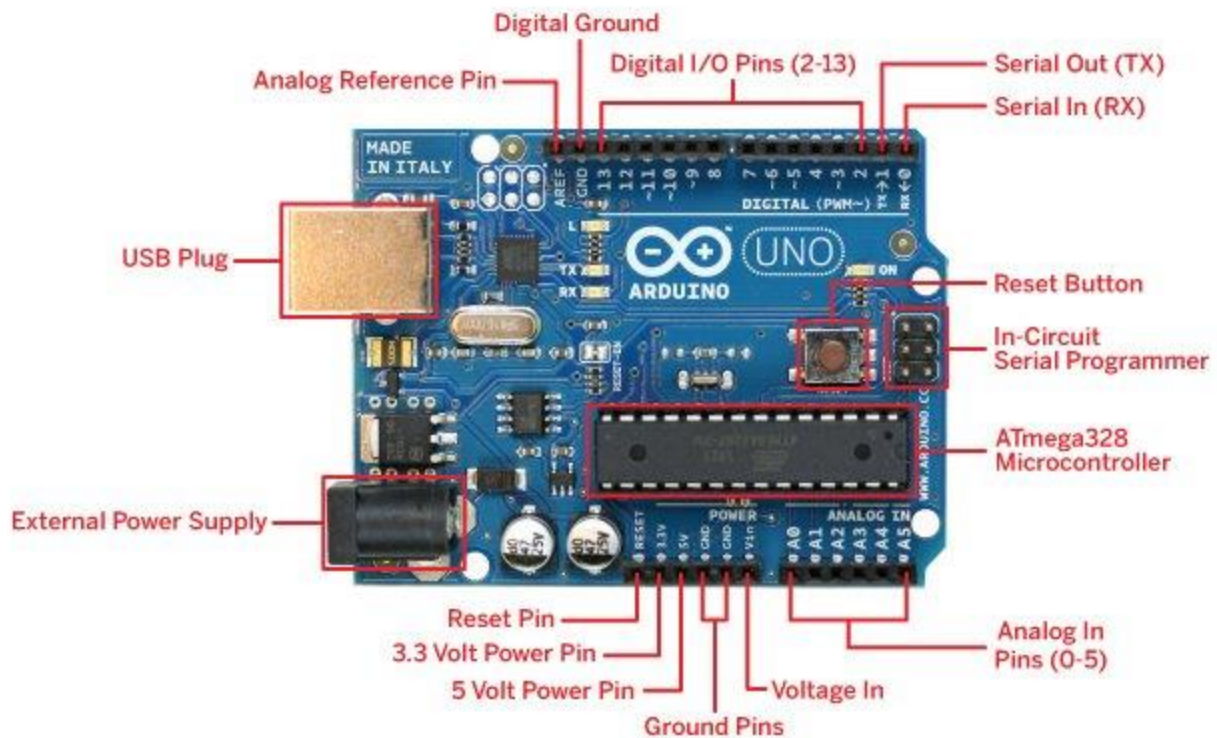
Arduino uses a C++ based programming language. Arduino Programming Syntax is very similar to C++, so things like comparison (IF/THEN Statement), Mathematical Computations, Loops (FOR, DO, DO/WHILE), Ending of Line Statements (;), etc. are written the same. What differs is how to INPUT/OUTPUT data varies. See Reference Document: Arduino Common Syntax on the class website for common coding commands.

Objective: First Tutorial is designed to simply wire a single LED and then Program its use.

1. Electrical Component Toolbox > Find Arduino Uno > Drag and Drop Arduino Uno onto screen



2. Arduino Board Overview



Arduino Uno Board Description

The Arduino Uno board is the most popular board and mostly referred for the beginners as they are super easy to begin with, it does not requires any specific arduino uno software instead of that all you need is to select the arduino uno in the device option before uploading your program. There are plenty of arduino uno boards look different from the one as shown. But they all have plenty of the same components given below.

Voltage Regulator

The Arduino Uno can be powered by USB cable or directly supplying 9-12v from the barrel jack. The circuitry operates at 5v dc which in case input more than that is regulated with the help of 7805 voltage regulator. The 7805 voltage regulator ic is used regulate the voltage supplied to the arduino board and manage it through processor and other elements.

Crystal Oscillator

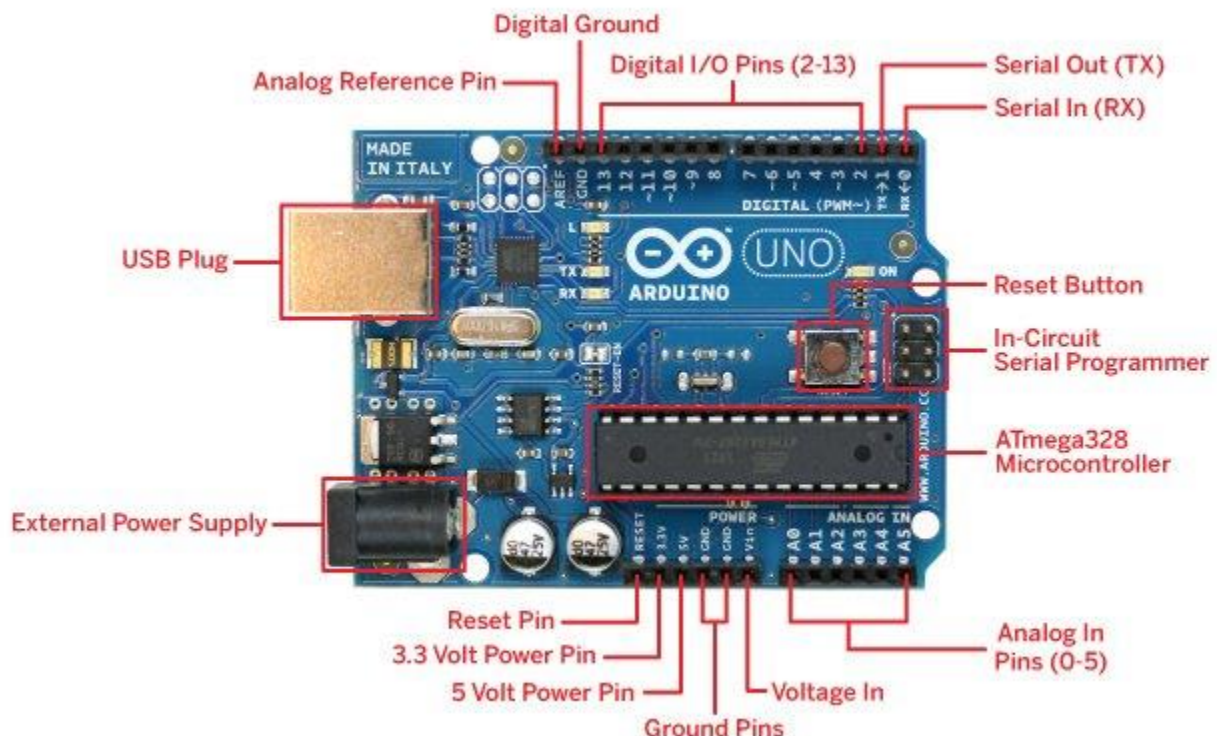
There are certain case when the processor has to deal with time-signal issues, in order to balance it the crystal oscillator is used. The crystal oscillator is the only way the arduino is able to calculate the time.

There is a number printed on the top of the crystal. The number indicates the frequency of the crystal, in most of them the frequency is 16 MHZ or 16,000,000 hertz.

Reset Button

There is a reset button given which is used to restart the program running in the Arduino uno. There are two ways to restart the whole program.

- You can use the default reset button.
- You can connect your own reset button at the pin labeled as Reset.



Arduino Uno Board General Voltage Pins

There are following output voltage pins.

- 3v output pin
- 5v output pin
- GND (ground)

Most of the arduino components operate at 5v or 3.3v and so can be powered with these pins. There are several ground ports which can be used to give ground to your circuit and components. There is a Vin pin which can be used to power the arduino uno from an external source.

Note: The voltage must be 5v DC in case the arduino board is powered using external source.

Analog I/O Pins

The Arduino uno board has 6 analog input and output pins from A0 to A5. The pins are best used in case of the analog sensors. The analog pins can read the analog signals from them like temperature, proximity, humidity etc and converts them into digital values that can be read and processed by the microcontroller.



Microcontroller In Arduino Uno Board

Different Arduino boards have different microcontrollers. It can be said that is the main component in the overall Arduino board. The main IC is a bit different in different arduino uno boards. The microcontrollers used basically are of ATMEL Company and it is necessary for you to know what IC you are using in order to load your program in it. You can easily read the information on the top of the IC and select the corresponding from the option given in the arduino software. For more information about the ic you can refer to the corresponding datasheet.

SPI Ports

The SPI (Serial Peripheral Interface) is considered for an expansion of the output. In most of the cases the ICSP Pin as an small programming header in Arduino Uno consist of RESET, SCK, MOSI, MISO, VCC and GND.

Power Indicator LED

When you power up the Arduino uno board, there must be an LED light up which will indicate the board is powered up correctly. In case you don't see the glowing light, there must be something wrong with the connection you've made.

TX And RX Pins

In the Arduino Uno board there are two LED's labeled as TX (transmitter) and RX (Receiver), Same are labeled on the pin 0 and 1 respectively. These pins are used for serial communication and the corresponding LED glowing indicated if the data is being sent by TX and if the data is being received by RX. The TX LED flashes at the different frequency which depends on the baud rate being used by the arduino board to transmit.

Digital I/O Pins

Arduino uno board does have 14 digital i/o pins (input/output pins) out of which contains 6 PWM output (Pulse width modulation). The digital pins can be configured to read logic values such as 0 and 1 or can give logic (0 and 1) output for different modules such as LEDs, Relays, etc. there is a symbol “~” corresponding to the PWM pins.

Additionally, there is AREF which is used to set an external reference voltage as the upper limit to the analog input pins. The external reference voltage is usually in between 0 to 5 volts.

Tinker CAD Electrical Component Toolbox:

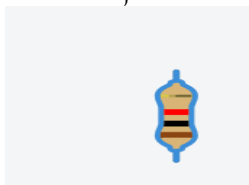
Power Sources:

- ✓ **Battery:** Represents a DC power source. In embedded systems, batteries are often used to provide portable and independent power to electronic devices.

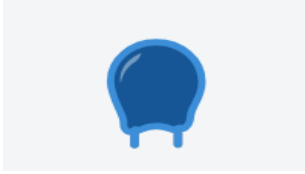


Passive Components:

- ✓ **Resistor:** A fundamental component that limits the flow of electric current. Resistor values can be adjusted to control voltage and current in a circuit.



- ✓ **Capacitor:** Stores electrical energy and releases it when needed. In embedded systems, capacitors are used for smoothing power supplies and filtering signals.



Semiconductors:

- ✓ **LED (Light-Emitting Diode):** Emits light when current passes through it. LEDs are commonly used in embedded systems for status indicators.

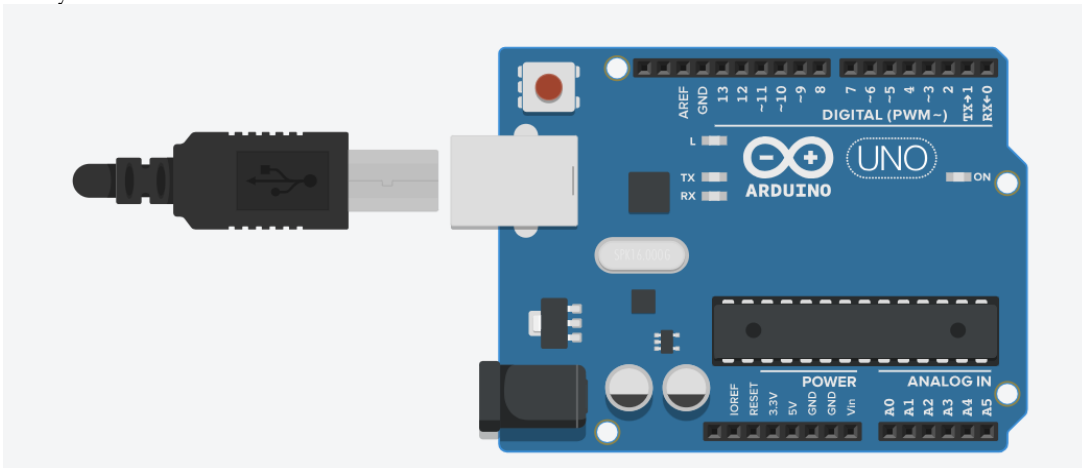


- ✓ **Transistor:** Acts as a switch or amplifier in electronic circuits. In embedded systems, transistors are crucial for controlling higher-power devices using low-power signals.



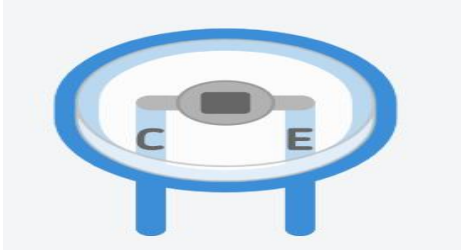
Microcontrollers:

- ✓ **Arduino:** Represents a microcontroller board widely used in embedded systems. It can be programmed to control various components within a circuit, making it a central element in many electronic devices.



Sensors:

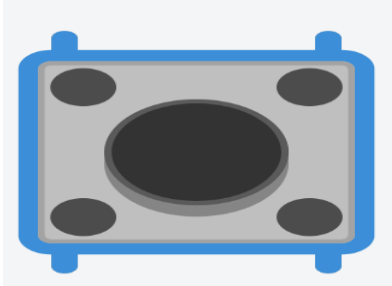
- ✓ **Photocell (Light Sensor):** Changes resistance based on light intensity. In embedded systems, light sensors are employed for automatic lighting control and other applications.



- ✓ **Temperature Sensor:** Measures temperature variations. Embedded systems often use temperature sensors for climate control and monitoring.

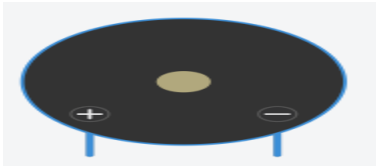
Switches:

- ✓ **Push Button:** A momentary switch that completes a circuit when pressed. Embedded systems frequently use push buttons for user input and control.

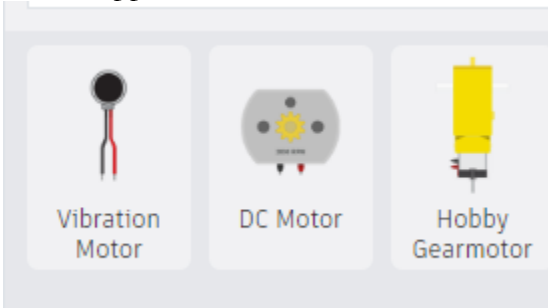


Active Components:

- ✓ **Buzzer:** Produces sound when a current is applied. In embedded systems, buzzers are used for alarms, notifications, and feedback.



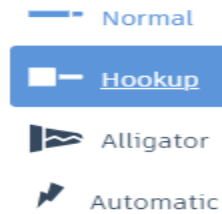
- ✓ **Motor:** Represents an electric motor. Embedded systems often involve motor control for various applications, such as robotics.



✚ Connectors and Wires:

- ✓ **Jumper Wire:** Used to connect different components on the breadboard. Wires are essential for creating electrical connections between components in embedded systems.

WIRE TYPE



- ❖ **Normal wires:** These are the default wire type in Tinkercad. They are simple, colored lines that connect components without any additional detail.
- ❖ **Hookup wires:** These wires resemble the jumper wires that you would use on a breadboard. They have a single solid color and come in various lengths.
- ❖ **Alligator clip wires:** These wires have alligator clips on the ends, which is how they connect to components in real life. They are also available in various lengths and colors.
- ❖ **Automatic wires:** These wires automatically adjust their length and shape to connect components in the most efficient way possible. They can be helpful for creating complex circuits, but they may not be as visually clear as other wire types.

✚ Integrated Circuits (ICs):

- ✓ **555 Timer IC:** An integrated circuit used as a timer or oscillator. It finds applications in embedded systems for generating precise time delays.



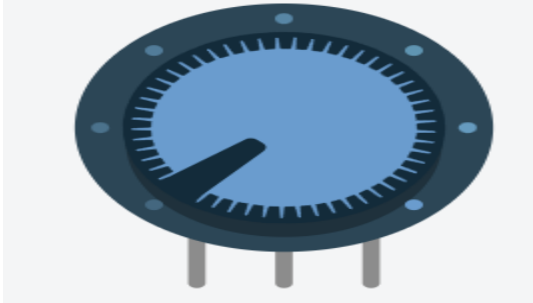
✚ Displays:

- ✓ **7-Segment Display:** A component that can display numerical digits. Embedded systems use displays for presenting information to users.



Miscellaneous:

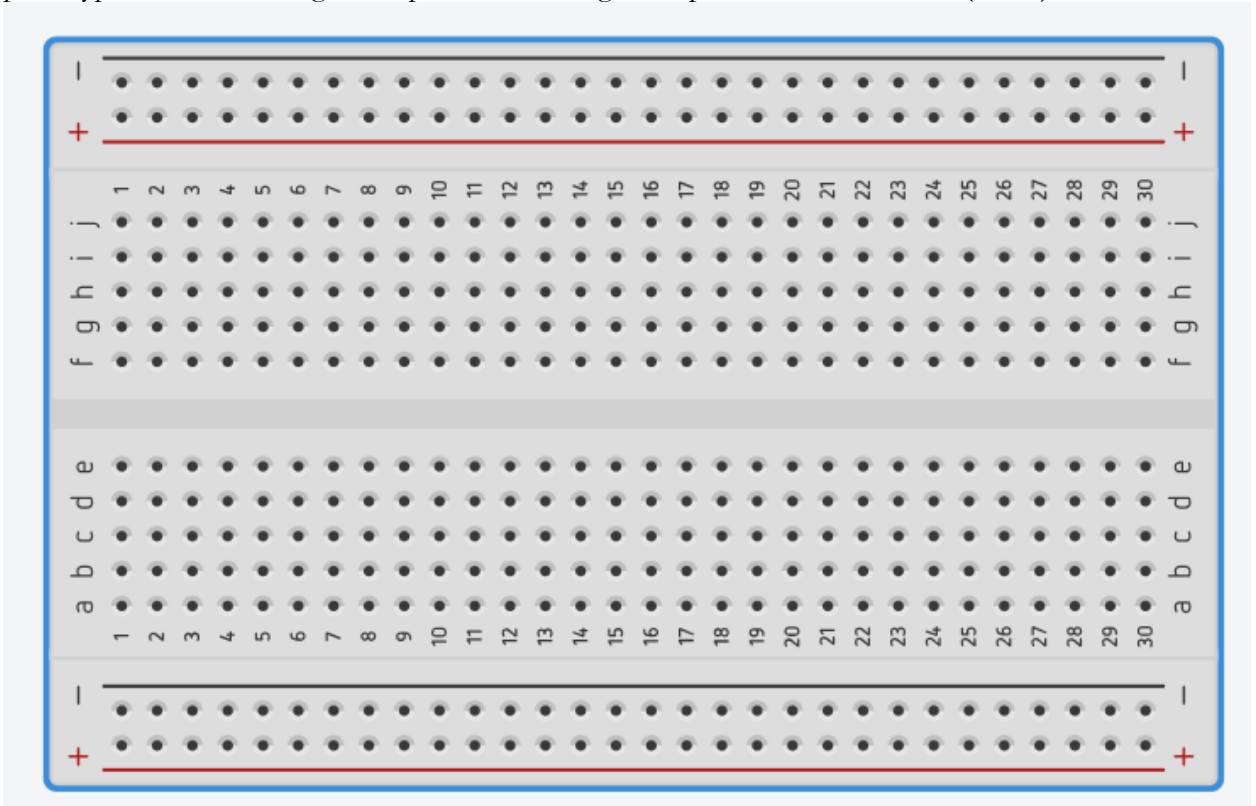
- ✓ **Potentiometer:** Variable resistor used to control voltage or current. In embedded systems, potentiometers are used for analog input adjustment.



Breadboard:

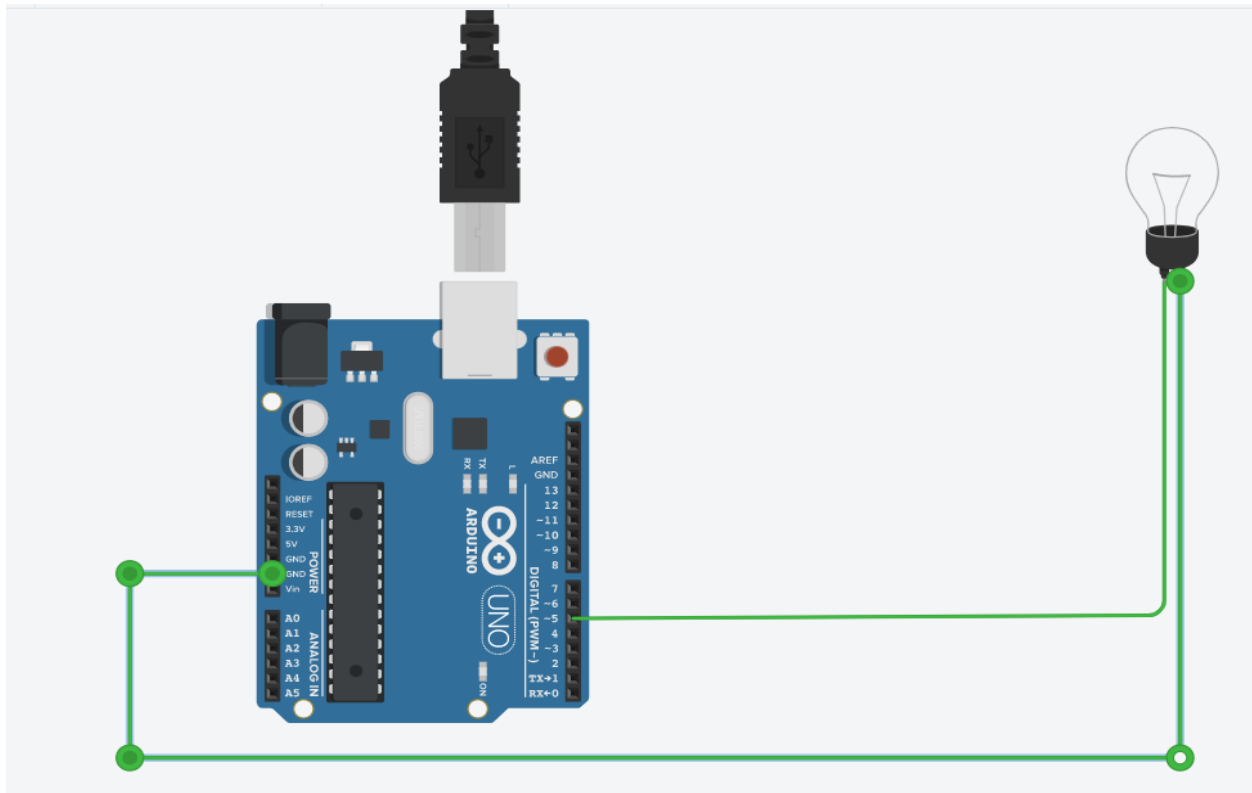
Function: Provides a temporary and reusable platform for prototyping circuits by connecting components without soldering.

Embedded Systems & Design: Breadboards are commonly used in the early stages of development for testing concepts, experimenting with circuit designs, and debugging simple prototypes before moving on to permanent designs on printed circuit boards (PCBs).



Conclusion:

- ✓ Understanding and utilizing the components in the TinkerCAD Electrical Component Toolbox provides valuable hands-on experience for individuals involved in embedded systems and design. The ability to design and simulate circuits with these components is fundamental for prototyping and testing electronic systems before physical implementation, contributing to the iterative and efficient development of embedded systems.



// C++ code

//

void setup()

{

pinMode(5, OUTPUT);

}

void loop()

{

digitalWrite(5, HIGH);

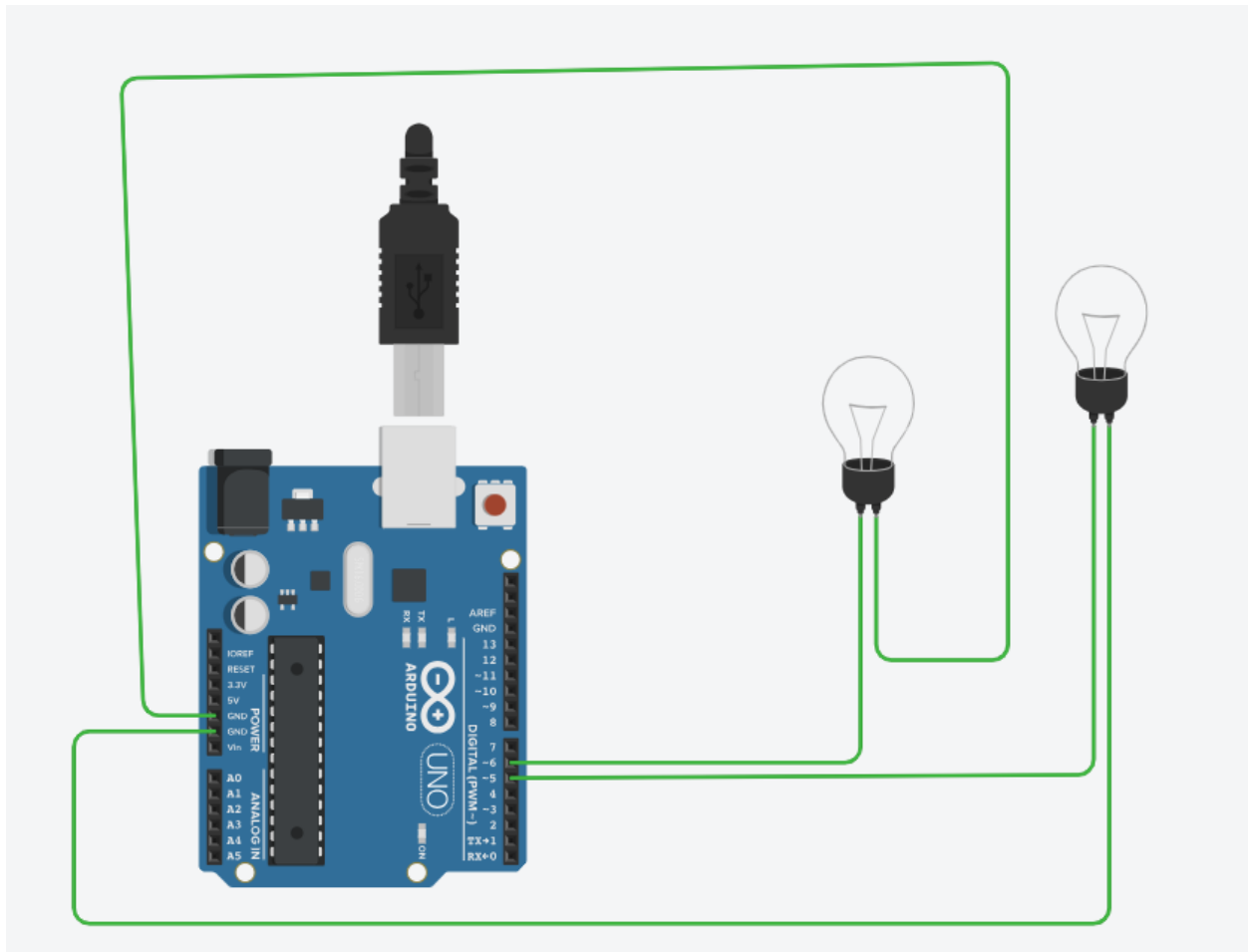
delay(1000); // Wait for 1000 millisecond(s)

digitalWrite(5, LOW);

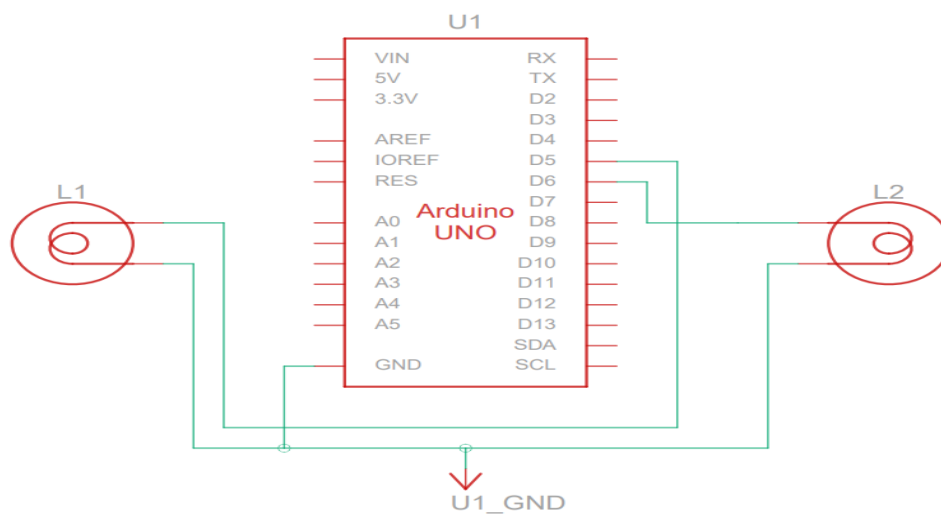
delay(1000); // Wait for 1000 millisecond(s)

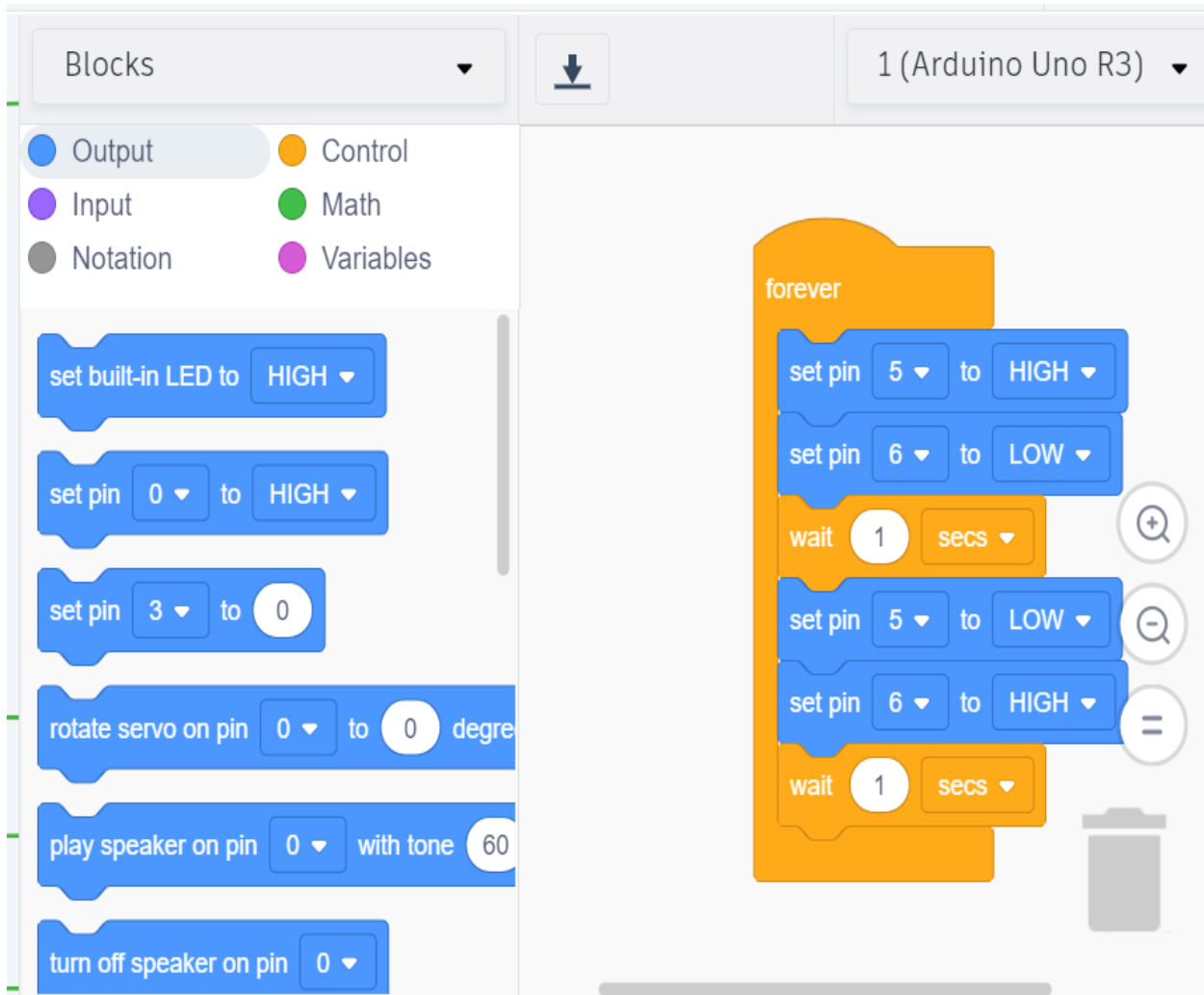
}

Using TWO Bulbs:



Schematic View:





```
// C++ code
//
void setup()
{
  pinMode(5, OUTPUT);
  pinMode(6, OUTPUT);
}
void loop()
{
  digitalWrite(5, HIGH);
  digitalWrite(6, LOW);
  delay(1000); // Wait for 1000 millisecond(s)
  digitalWrite(5, LOW);
  digitalWrite(6, HIGH);
  delay(1000); // Wait for 1000 millisecond(s)
}
```