

Halsey Street - Arduino Circuits and Robotics Course Detailed – Course Activity Schedule

Lesson – Changing Colors using a RGB LED

In this lab, students must write a C++ program that powers a Cathode Red, Green and Blue LED at varying intensities. **Bonus:** Students must write a C++ program which allows the user to type in a value (e.g., red, green or blue) which will determine the color that will be displayed by the RGB LED.

Lesson – Using a Potentiometer to Measure Analog Outputs

In this lab, students must write a C++ program that changes the LED's brightness as the dial of the potentiometer is turned up or down. **Bonus:** Students must write a C++ program that uses the serial monitor to view changes in analog voltage as the potentiometer knob is turned.

Lesson – Using a Piezo Buzzer and a Photo Resistor to make Music

In this lab, students must write a C++ program that uses the light sensor in the photo resistor to turn on the buzzer and LED when the room gets dark. **Bonus:** Students must write a C++ program that plays the musical notes (a, b, c, d, e, f and g) using a buzzer, based on the frequency for each musical note.

Lesson – Using an Ultrasonic Motion Sensor to turn on a Buzzer and LED

In this lab, the students must create a C++ Program that uses an Ultrasonic Motion Sensor to turn on a buzzer and a blue LED when an object comes within the sensor's range of detection. **Bonus:** In addition, when an object comes close to the motion sensor the buzzer's sound should alternate between 400, 800 and 1,100 Hz, while the LED should flash rapidly. Finally, the message, "Motion Sensor Activated" should be displayed if an object comes too close to the motion sensor and "Motion Sensor Deactivated" should be displayed if no object is within the motion sensor's range of detection.

Lesson – Making a DC Motor Spin Counterclockwise at 255 RPMs

In this lab, students must write a C++ program that will enable a DC motor to spin counterclockwise (backward) at 255 RPMs. **Bonus:** This lab will require that students write a C++ program that will enable a DC motor to spin clockwise (forward) and alternate between a speed of 255 RPMs and 100 RPMs. In addition, participants must program the IDE serial monitor to show the motor's speed and direction.

Introduction to the mBot Makeblock Robot.

Lesson – Building a mBot Arduino Robot

The next step in our building block process is to create projects that enable students to combine all their circuit building skills, **and transition seamlessly from the Arduino circuit to a mBot MakeBlock Arduino Robot.** Hence, building and programming the mBot Robot would be the perfect project. It requires a circuit that uses DC motors for directional control, a motion sensor for collision avoidance, light sensors for navigating a black line circle 8 map and LEDs and buzzers as warning signals.

Halsey Street - Arduino Circuits and Robotics Course Detailed – Course Activity Schedule

Lesson – Programming a MakeBlock mBot Arduino Robot

In this lab, coders will learn which is which and what goes where in relation to navigating and placing drag and drop graphical block commands in the mBlock5 Coding Editor. Specifically, the goals are to: (1) make the mBot Robot's two RGB LEDs alternate between red, green and blue light; (2) make the buzzer play musical notes; and (3) make a motion sensor avoid obstacles. **Bonus:** In this lab, coders must make the mBot Robot travel in a square via a loop procedure. In addition, the mBot's two LEDs must display a different color at the beginning of each leg in the square, while the buzzer must play musical notes at the end of the routine.

Lesson – Advanced Programming a MakeBlock mBot Arduino Robot

The final step in our building block process is to give students an opportunity to complete two coding assignments using the commands that make up the mBlock Drag-and-drop Graphical Blocks Coding Editor (e.g., Show, Action, Sensing, Events, Control, and Operations).

In the first lab assignment, coders will be taught to make the mBot perform a forever loop based on an object's relationship to the motion sensor. If you place your hand less than 10 cm from the sensor's range of detection it should move backward 10 cm and then stop, turn the two LEDs to red for one second and have the buzzer, buzz for three notes. If you move your hand away from the sensor's range of detection, move the mBot forward 10 cm and then stop, and then turn the two LEDs to green for one second.

Bonus: In this lab, coders will distribute three bottles, cans, blocks (obstacles) along the circle 8 map and have the mBot use its motion sensor to navigate around the obstacle and the line follower sensor to keep the mBot on the circle 8 map.

Lesson – Advanced Programming a MakeBlock mBot Arduino Robot

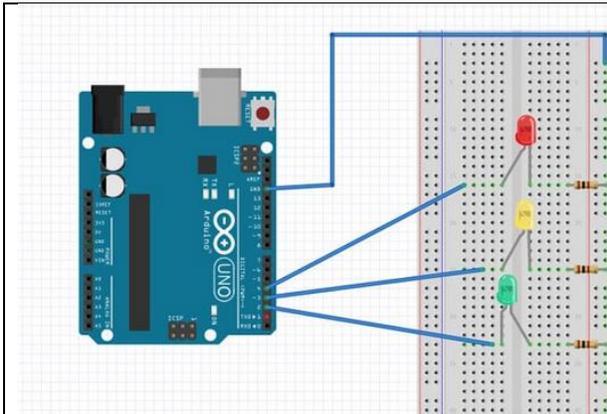
Coding Assignment: In this lab, coders must write a program that makes the mBot Robot travel in a circle with a circumference based on calculations from this project's math section. Thus, your program should make the mBot move in a circle that has a diameter, which is one-and-one-half times the 12-inch diameter of Circle (B). In addition, the radius, diameter, circumference, and area of circle (A), must be calculated in inches and centimeters and documented in the table provided in the math section of the lab activity workbook.

Finally, a calibration experiment and confirmation test must be conducted to confirm the speed (e.g., inches/second, cm/second) that the robot travels at.

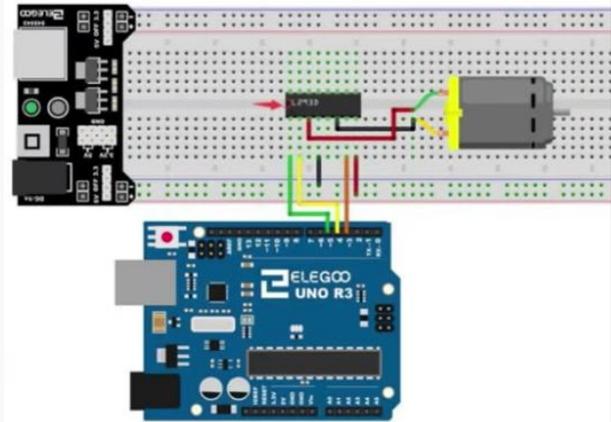
In addition, the six steps in each Arduino circuit building and robotics lab activity includes the following:

1. Step One: Explore keywords and Draw a schematic diagram of the project's circuit;
2. Step Two: Perform the project related math computations;
3. Step Three: Build a TinkerCad circuit simulation and the actual circuit;
4. Step Four: Write the initial C++ coding or mBlock 5 coding assignment;
5. Step Five: Points to Ponder – Answer What If and Why Not? Reflective Questions; and
6. Step Six: Write the **bonus** C++ coding or mBlock coding assignment.

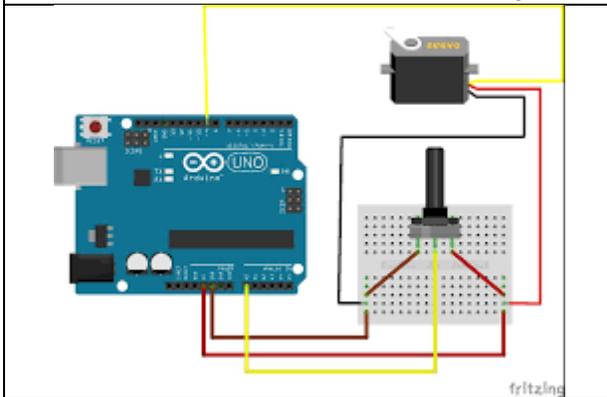
Pictures of the Course Kits and Robot



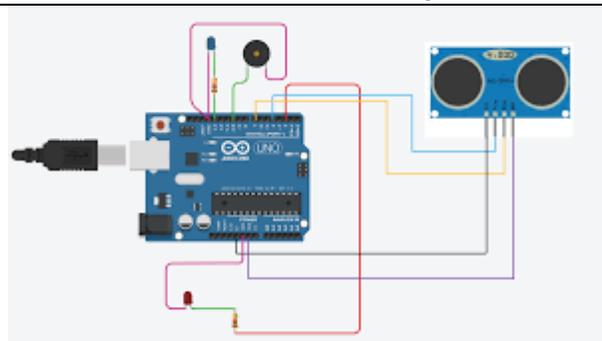
Arduino Red, Yellow, Green LED Project



Arduino DC Motor Project



Arduino Servo Motor, Potentiometer Project



Arduino, Motion Sensor, Alarm, LED Project



Miniature Solar Panel Kit



Arduino MakeBlock mBot Robot