Robogals Science Challenge

Minor Challenge Set #3
STEM Field: Electrical Engineering
Level: Junior
Challenge Name: Blinking an LED with Arduino
Project Cost: 0 USD
Materials Required:

- Laptop/ Computer with Internet access
- An account on TinkerCAD (a free software)
  - Registration for an account is necessary to save progress

Duration:

- The challenge takes approximately one to two hours to finish, however, the time guideline is an estimation only, and students and mentors can complete the tasks around their schedules

Introduction:

Arduino is a platform used to create interactive electronic projects. We can use Arduino boards to read an input, for example, light on a sensor, and turn it into an output, such as turning on an LED. If you want to tinker with a project that involves both software (coding) and hardware (building electrical circuits), Arduino is a great way to start.

To work on an Arduino project, you will need an Arduino board, wires, batteries, resistors, LEDs, and more components depending on the project you are working on. It may be difficult to gather all the required

components, therefore, in this activity, we will use TinkerCAD - a free software with tools to build electronic circuits and simulate them.

It may seem daunting as you attempt to build your first circuit, but fear not! Our activity is designed to help beginners navigate around TinkerCAD and build the first LED circuit.

Upon completion of this activity, you may like to build more difficult circuits and submit them as a Major Challenge.

Instructions:

Part 1: Setting Up

1. Navigate to the website: https://www.tinkercad.com. It is recommended that you open this website on a browser such as Chrome. This software is free-to-use, and creating an account is necessary to save the progress of your project.

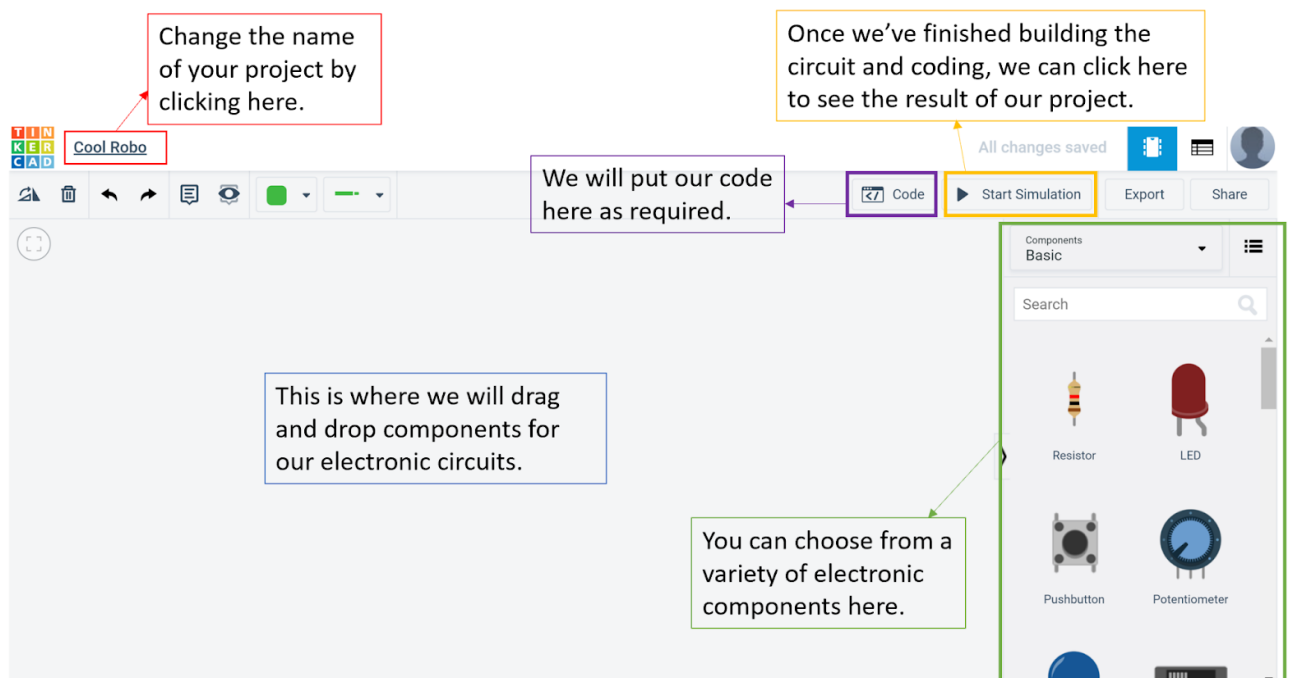   **Note:** Check with your parents or mentor before registering an account!

   If you have not registered, click "JOIN NOW", then select "Create a personal account".

   Alternatively, click "Sign In" to log into your TinkerCAD account.

2. After you have logged in, you will see a dashboard with projects you are working on. TinkerCAD can be used to create 3D models or other software projects. In this activity, we will build our electronic circuit, so select "Circuits", then "Create new Circuit". (See the figure below)

Step annotations:
- 1) Click "Circuits"
- 2) Click "Create new Circuit"
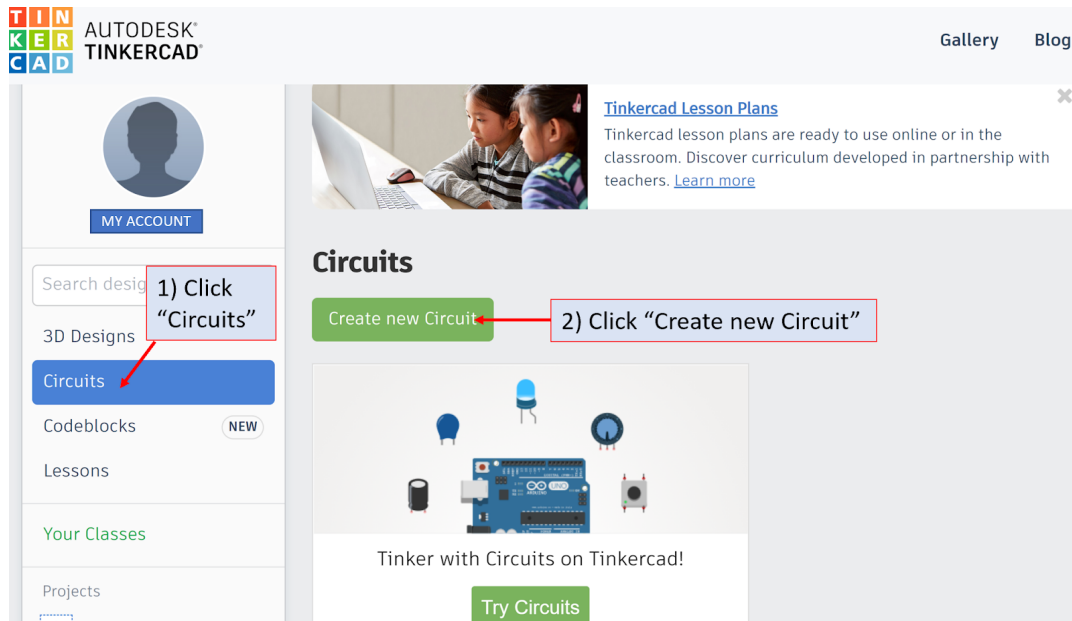
3. This is what your project dashboard will look like. The figure below shows the main functions you should be aware of before building your project.

Annotations:
- Change the name of your project by clicking here.
- Once we've finished building the circuit and coding, we can click here to see the result of our project.
- We will put our code here as required.
- This is where we will drag and drop components for our electronic circuits.
- You can choose from a variety of electronic components here.

4. In this project, you will need 1x Arduino Uno board, 1x LED and 1x resistor. Drag and drop the components to the space provided.

5. Click on the resistor and change the resistance to 220 Ω (as highlighted in the red box below). The symbol "Ω" is read as "ohms", which is a unit used to measure the resistance of an electrical device. Resistance is a property that reduces the current flow in a circuit.

   Explanation: We need to use a resistor for our LED circuit. If there is too much current flowing through the LED, it may burn the LED out. A resistor is a component used to limit the current flow, and helps prevent the LED from burning.
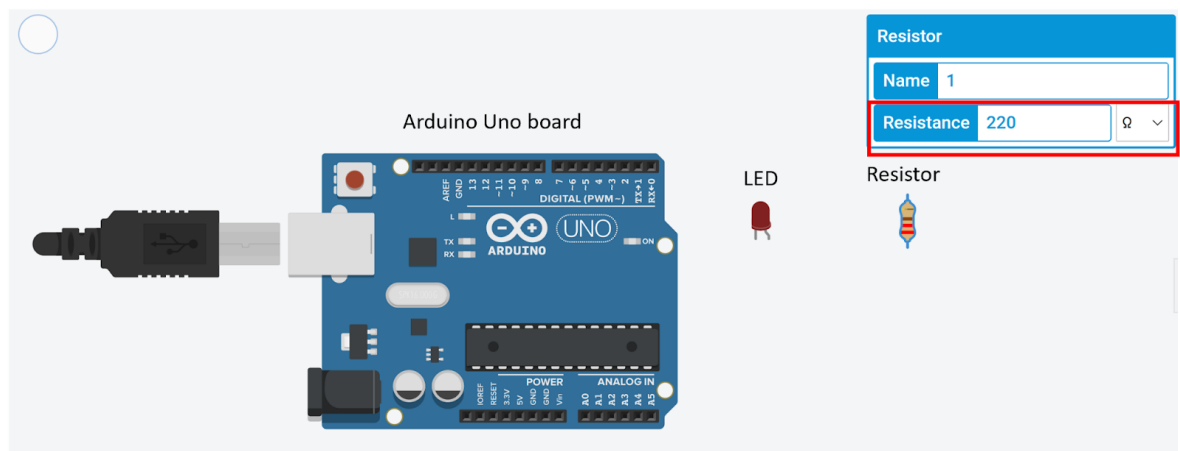

Part 2: Building the Circuit

6. We will now connect the circuit as shown below. We will connect the negative leg (or the shorter, straight leg) of the LED to one side of the resistor.

   Explanation: By clicking and joining the components together, you are adding wires to build an electrical connection between them.

7. Click on the other side of the resistor and connect it to the GND (Ground) port.

8. Click on the positive leg (longer, bent leg) of the LED to the output 13 port. The figure below shows what your final electrical circuit should look like.

   Explanation: The LED only works when we connect it in a certain way. The negative leg (shorter, straight leg) of the LED is always connected to GND (Ground). The positive leg (longer, bent leg) of the LED is always connected to an output port (in this case, we have chosen port numbered 13).
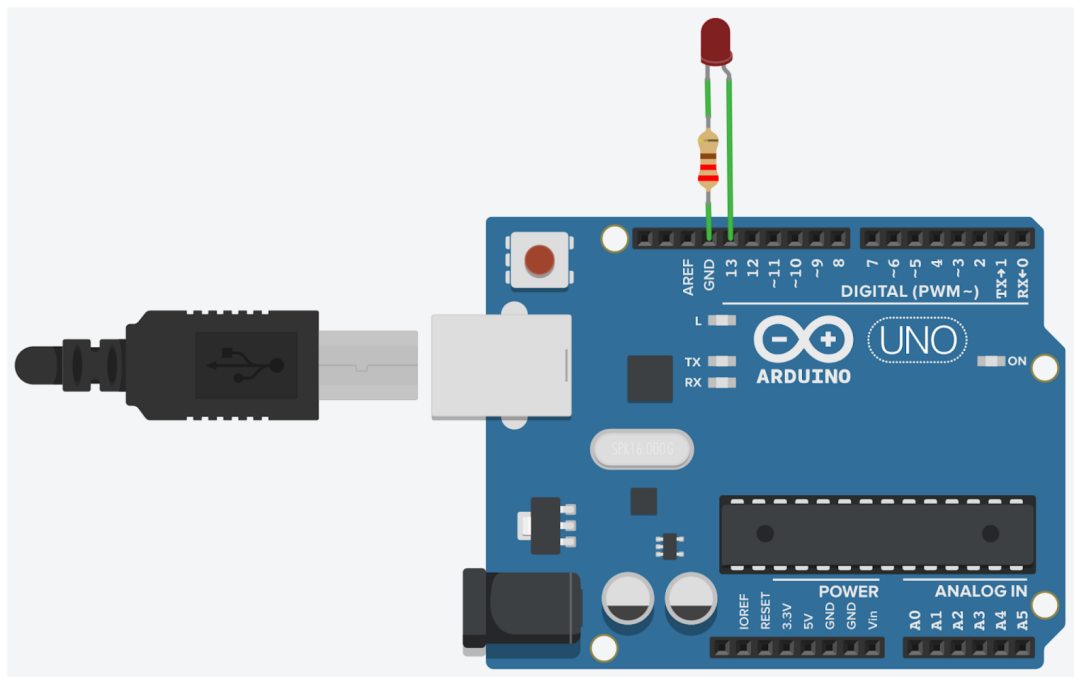

Part 3: Adding Code

9. We will now add code to our electrical circuit by clicking on the **Code** symbol.

10.   We want to turn on the LED (connected to pin 13 in the figure above) by setting it to HIGH for one second. Then, we want to turn off the LED by setting it to LOW for one second. You can replicate the below code to achieve this. The blue code blocks can be found in the "Output" section, and the yellow code blocks in the "Control" section.
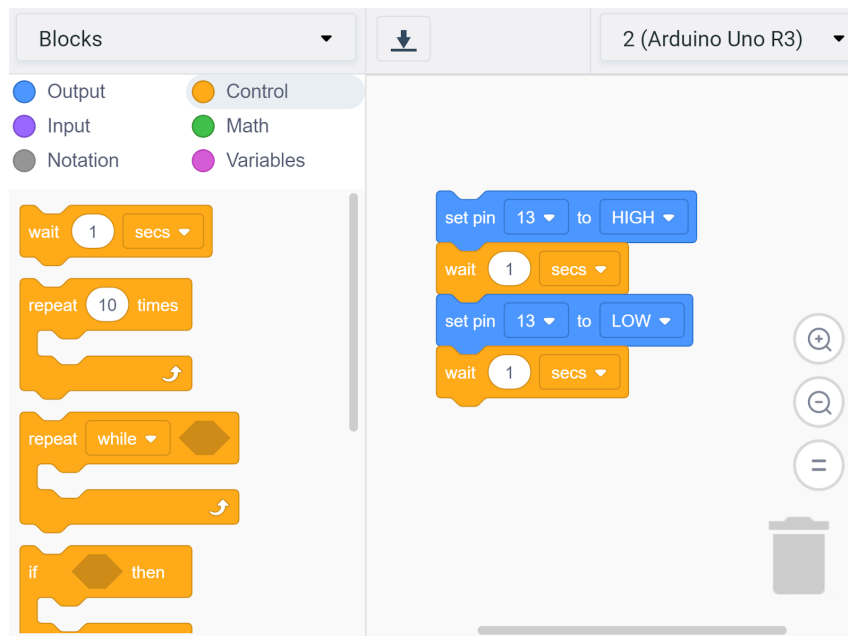
11. You can now click on "Start Simulation" and see how your circuit behaves.

12. You can modify the code to have the LED being turned ON, then OFF repeatedly. This can be achieved by adding a "Repeat" code block around your previous codes. For example, the below code specifies the LED is turned ON and OFF repeatedly three times.

13. You can add in more LEDs to the circuit by dragging and dropping LEDs and resistors. You can connect the negative leg of these LEDs to the same GND (ground) port, and connect the

positive leg to different numbered ports (for example, port 12, or 11). Then, add in more code blocks to set turn LEDs ON, or OFF at different times.

Extension - Make your own blinking LED circuit

Let's build your own LED circuit! You can connect multiple LEDs with different colours, and set different blinking times and patterns. Be creative!

You may also like to check out the Intermediate or Senior projects for more electronic projects using Arduino!

Reflection Questions:

- Are there any improvements you would make to this challenge?
- What real world application/s can you apply this challenge to?
- What are the key science and engineering concepts that relate to this challenge?

- How would you change the time between when the LED is turned on and off?
- How would you change the colour of the LED? How would you change the colour of the wire?
- Remove the resistor from the circuit. Then connect the negative leg of the LED to GND (Ground). Did you get a notification as you simulate your circuit? In your own words, why do we need a resistor for this LED circuit?
- What other circuits would you like to make and why?

Submission Guidelines:

- Submit photos of your code and circuit, including any code or circuit you build for the Extension task. Include a short summary that addresses the reflection questions.

> Note: Remember, if you want to upload pictures of your Minor Challenge that also include you, please check if it is OK with your parent or guardian first.

- The submission form is on the Minor Challenges page: https://sciencechallenge.org.au/index.php/minor-challenges/ Fill out the details and make sure you upload your submission.

Learn More! Resources:

- This website has lots of projects and lessons for beginners - https://www.tinkercad.com/learn/circuits/learning
- If you want to see what other people are building or tinkering with, have a look at the Gallery section of TinkerCAD - https://www.tinkercad.com/things