

Candy Vault Coding Workshop

Sloan Museum of Discovery

Bosch Engineering

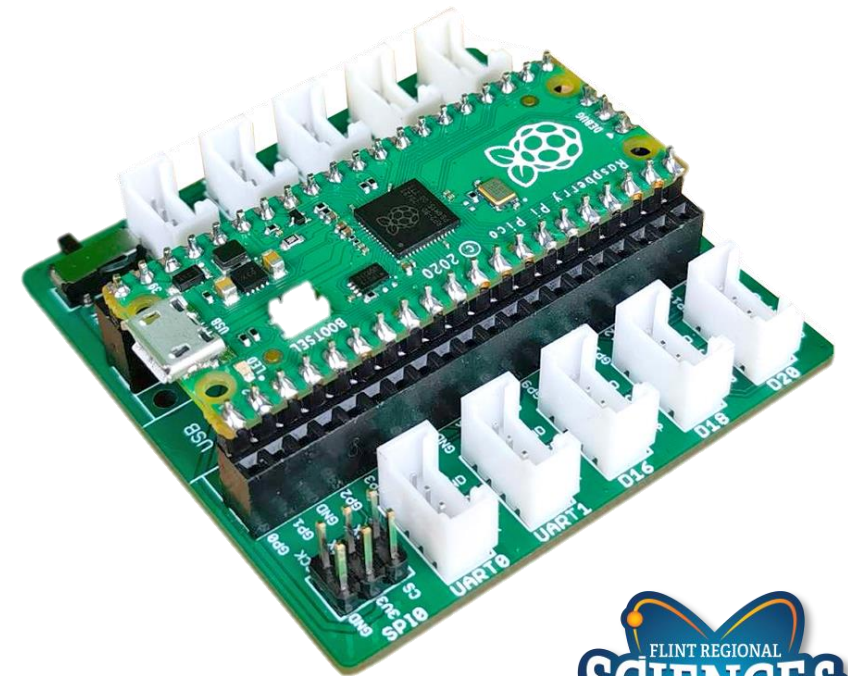
Getting Started

Let's get familiar with the workshop materials!

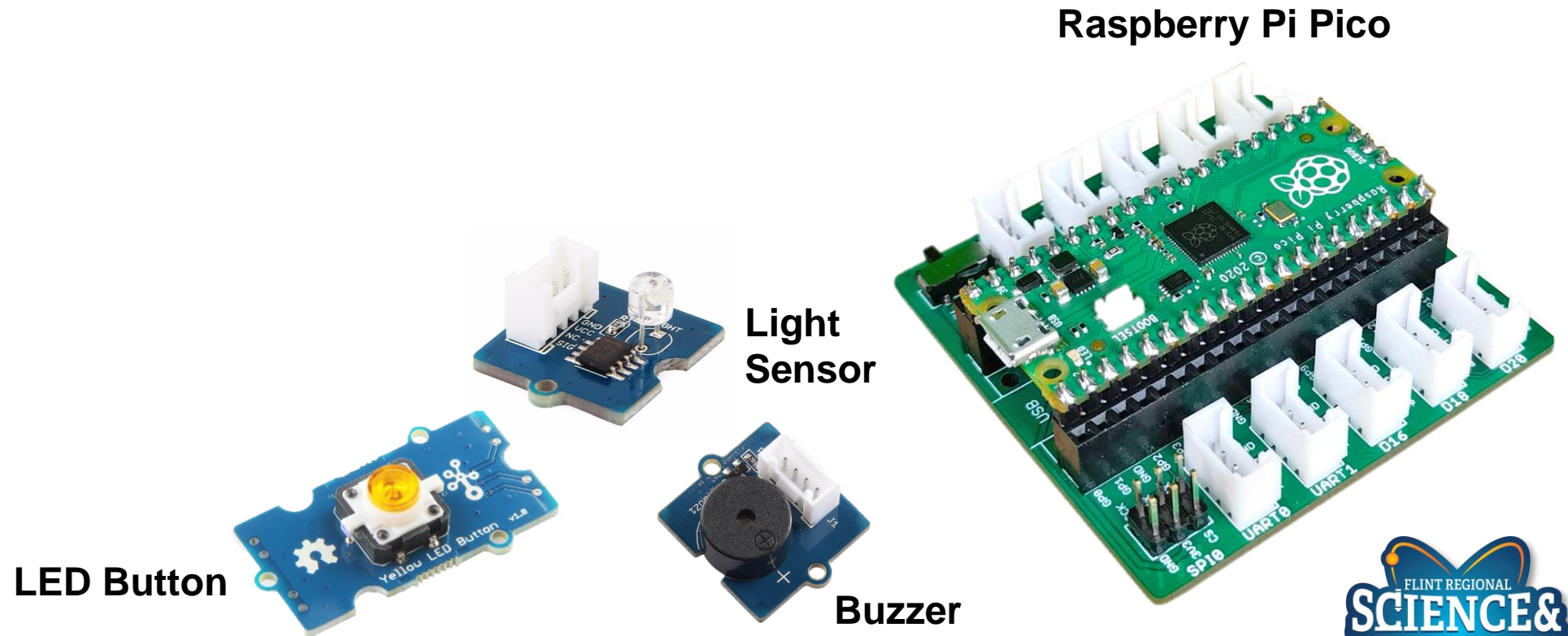
On Your Desk

On Your Desk

Raspberry Pi Pico

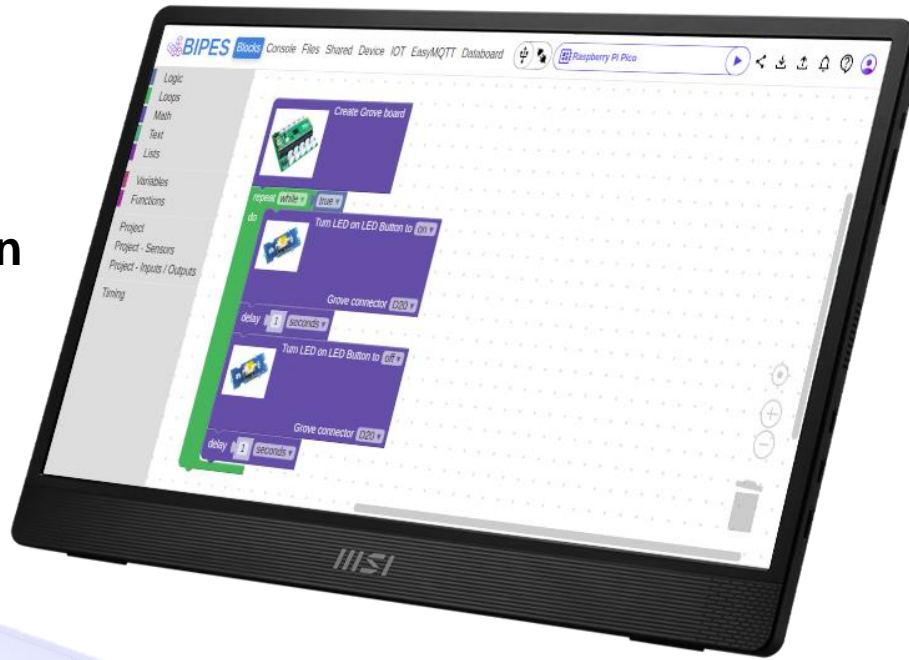


On Your Desk



On Your Desk

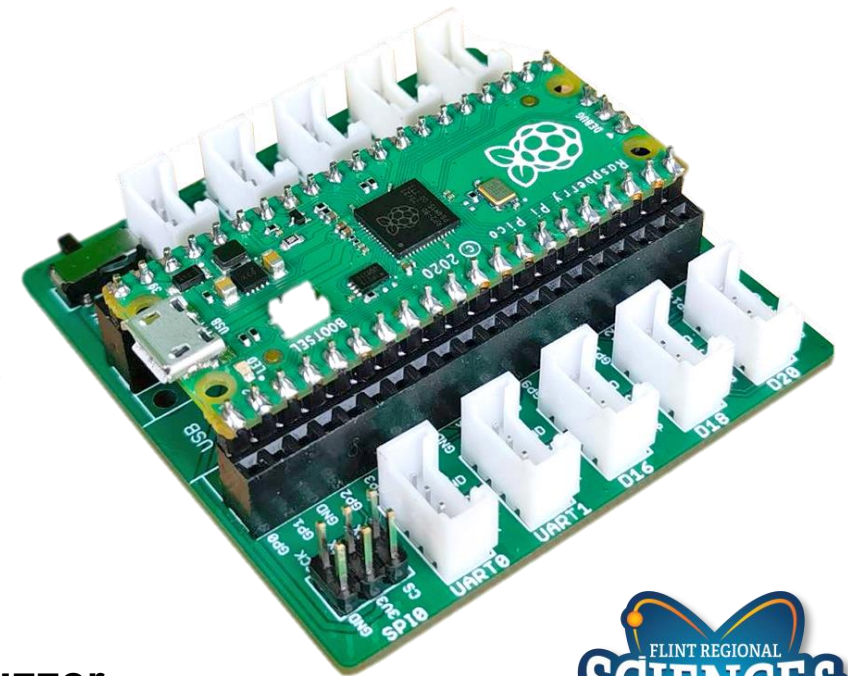
Screen



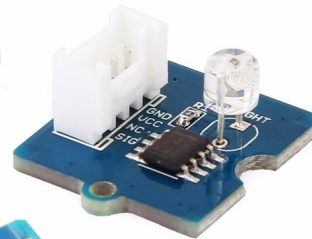
Keyboard



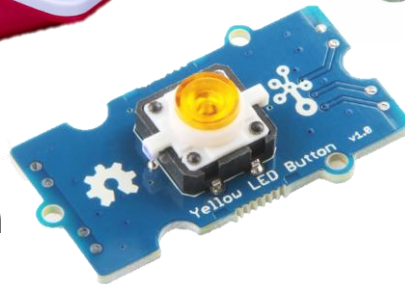
Raspberry Pi Pico



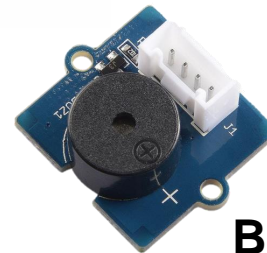
Light Sensor



LED Button

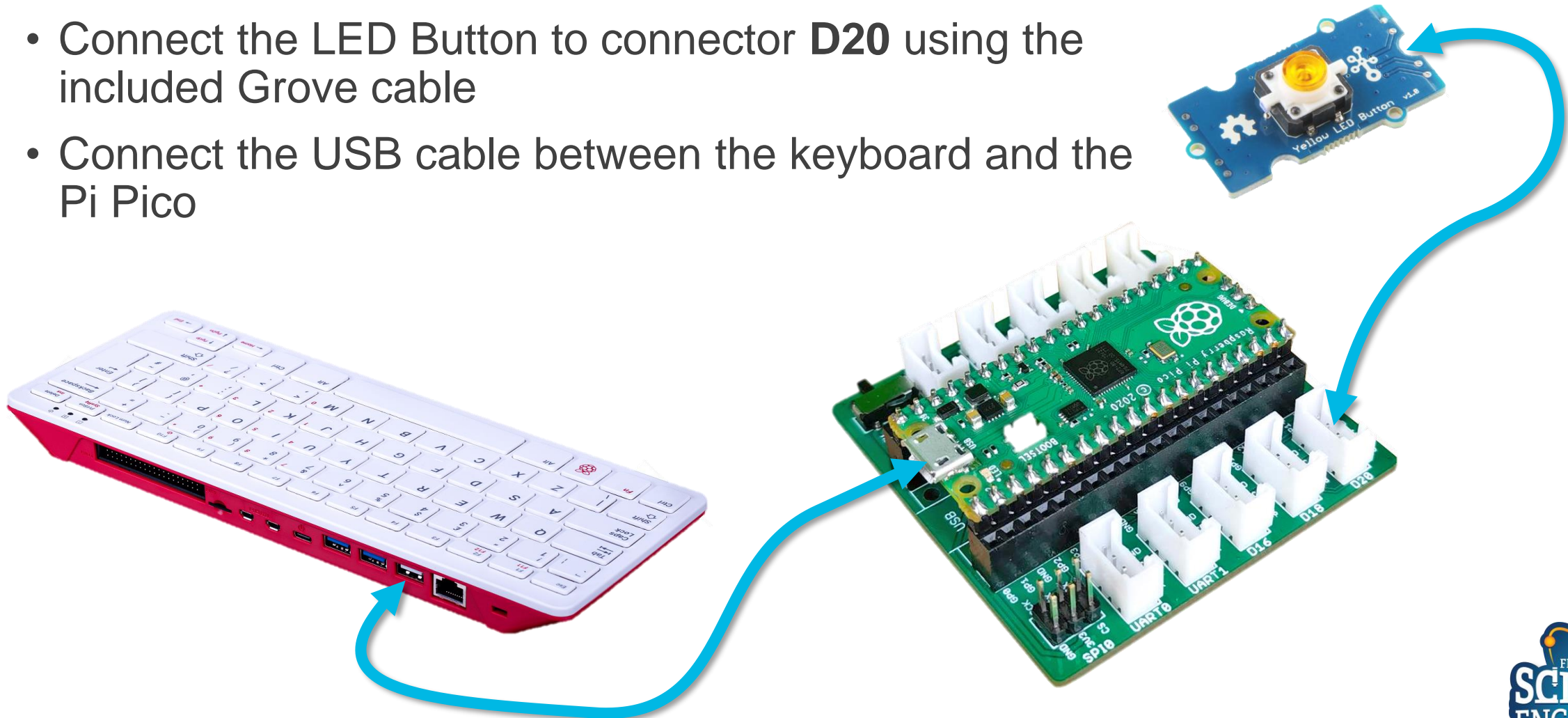


Buzzer



Connecting to your Pi Pico

- Connect the LED Button to connector **D20** using the included Grove cable
- Connect the USB cable between the keyboard and the Pi Pico

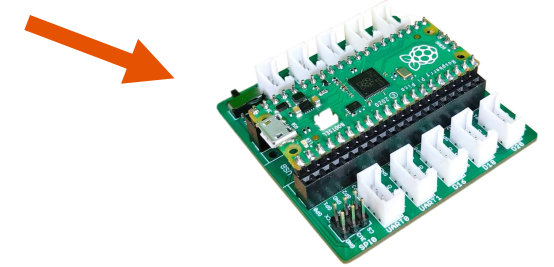


Run Your First Program

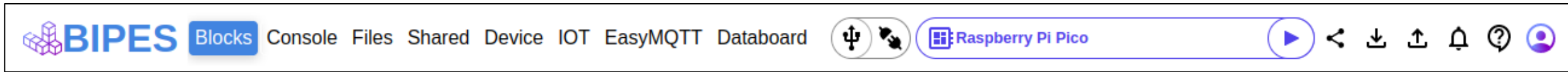
Programming the Pi Pico with BIPES

Run your first program

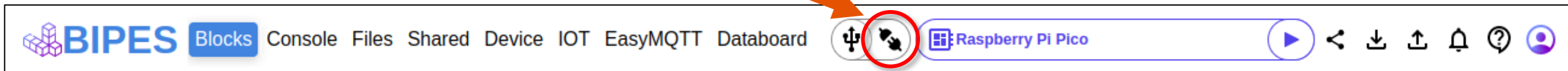
To run our code, we need to send it to the Pi Pico!



Toolbar



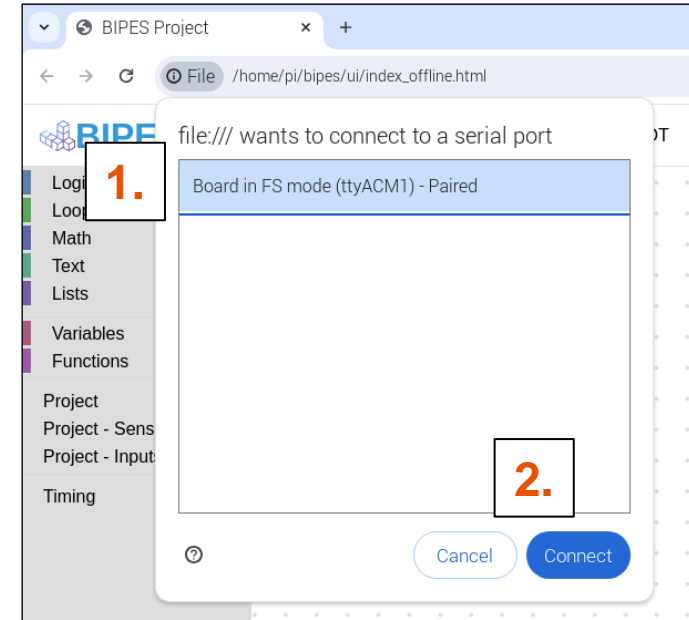
Connect Button



Run your first program

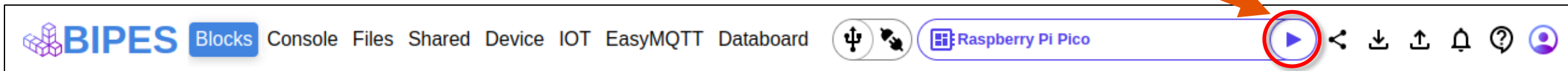
After clicking on the Connect button:

1. Click on “**Board in FS mode (ttyACMx)**”
2. Then, click on the blue Connect button.



3. Press the **Play** Button to run the code.

Play Button



When you run your code,
what happens to the Pi Pico and button?



Computer Code

What is computer code?



Computer Code

What is computer code?

- *Computer code* is a set of instructions that tell a computer how to complete a task
- Code is like a step-by-step checklist
 - First, do this!
 - Next, do that!



Computer Code

What is a programming language?



Computer Code

What is a programming language?

- A *programming language* is a collection of rules, key words, and other constructs that allow you to define the instructions
- This is our way of putting our tasks into a language that the computer can understand!



Activity: Blink

What is an LED?

- Light Emitting Diode
- An LED acts like a lightbulb
 - It can be either *on* or *off*
 - The Pi Pico controls if the LED is *on* or *off*!
- In our code, we have a block that acts like a light switch



Activity: Blink

What is an LED?

- Light Emitting Diode
- An LED acts like a lightbulb
 - It can be either *on* or *off*
 - The Pi Pico controls if the LED is *on* or *off*!
- In our code, we have a block that acts like a light switch

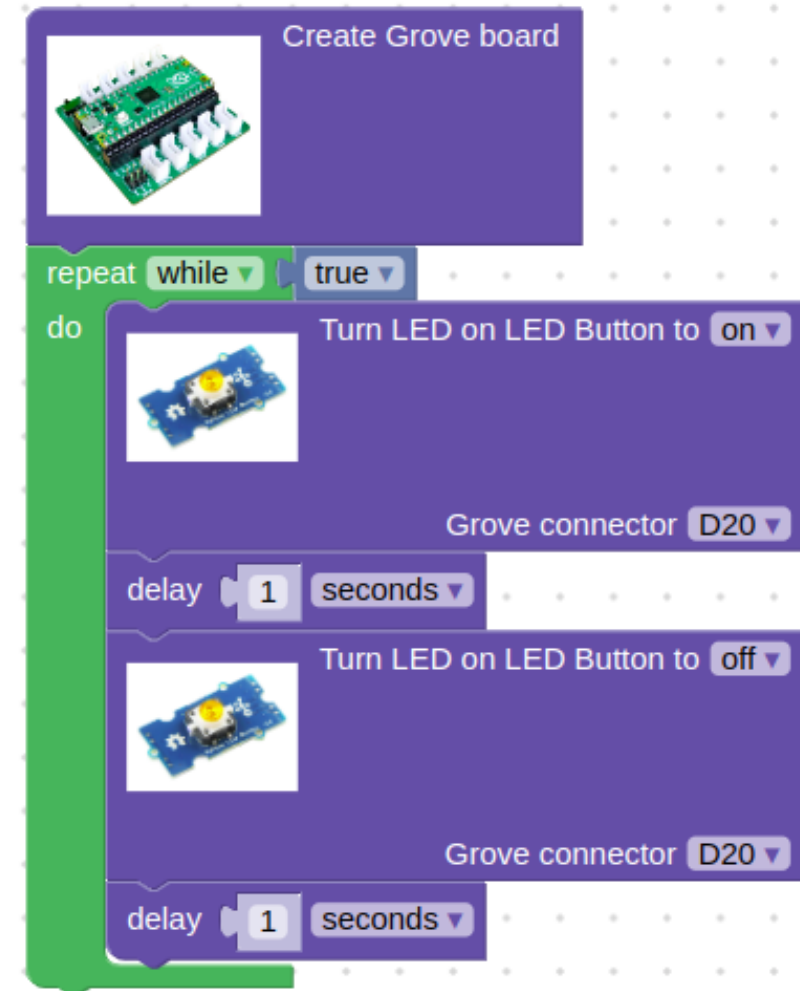


When you run the code, what things do you notice about the blinking light?

Activity: Blink

What is a while loop?

- A *while loop* is a special instruction that tells the computer:
 - Do something over and over again, as long as a specific thing is true.
- As long as some condition is true, do:
 - instruction #1
 - instruction #2
- A *condition* is something the computer checks in order to make a decision.



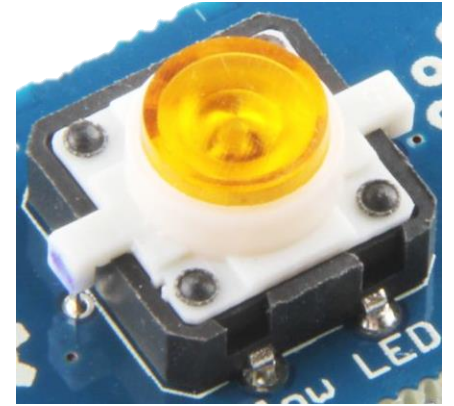
Activity #2: Button

Let's add a button to control the LED!

Activity #2: Button

- The LED on your desk is also a **button**!

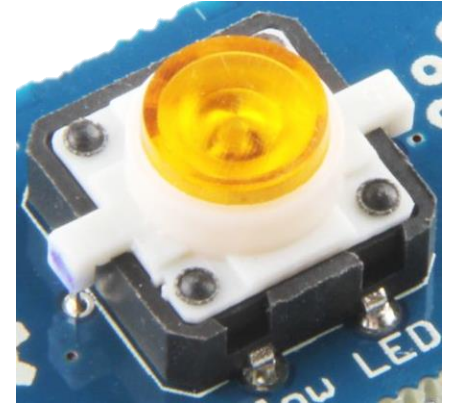
Example button



Activity #2: Button

- The LED on your desk is also a **button**!
- We can check if a button is pressed by using its **value**.
 - A button has two possible values:
 - If the button is pressed: **1**
 - If the button is not pressed: **0**

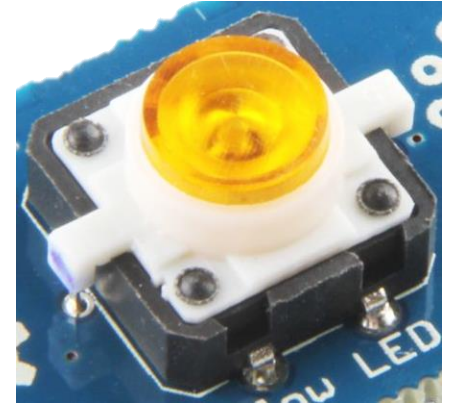
Example button



Activity #2: Button

- The LED on your desk is also a **button**!
- We can check if a button is pressed by using its **value**.
 - A button has two possible values:
 - If the button is pressed: **1**
 - If the button is not pressed: **0**
- Let's think about a real-world example: A doorbell!
 - What happens when you press a doorbell?
 - What is happening when the doorbell is not pressed?

Example button

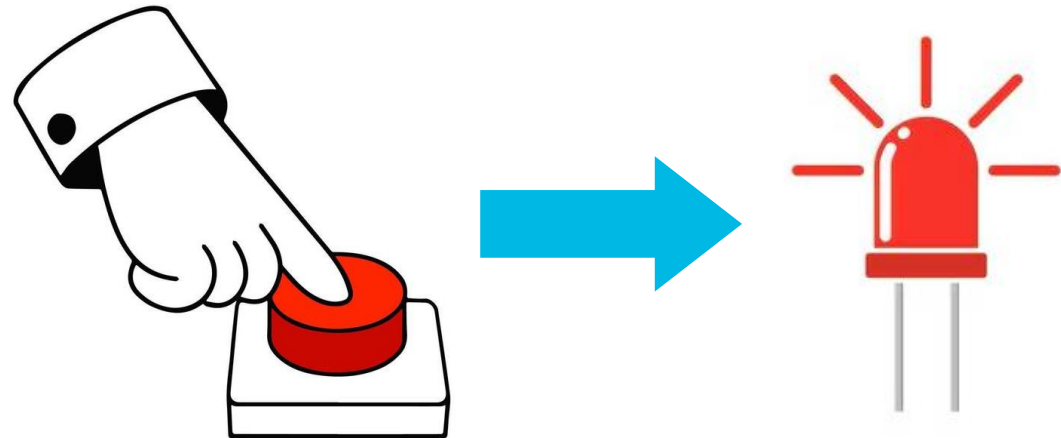


Activity #2: Button

What is an “if” statement?

- An *if statement* runs code based on a condition.
- A *condition* checks if something has happened.

If this happens,
 do something
otherwise
 do something else



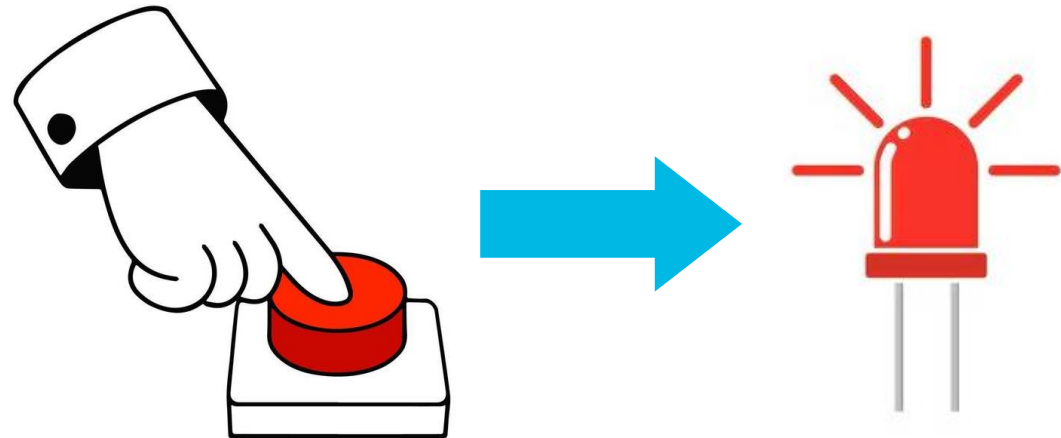
Activity #2: Button

What is an “if” statement?

- An *if statement* runs code based on a condition.
- A *condition* checks if something has happened.

If this happens,
 do something
otherwise
 do something else

If the button is pressed,
 do turn the LED on
otherwise
 do turn the LED off

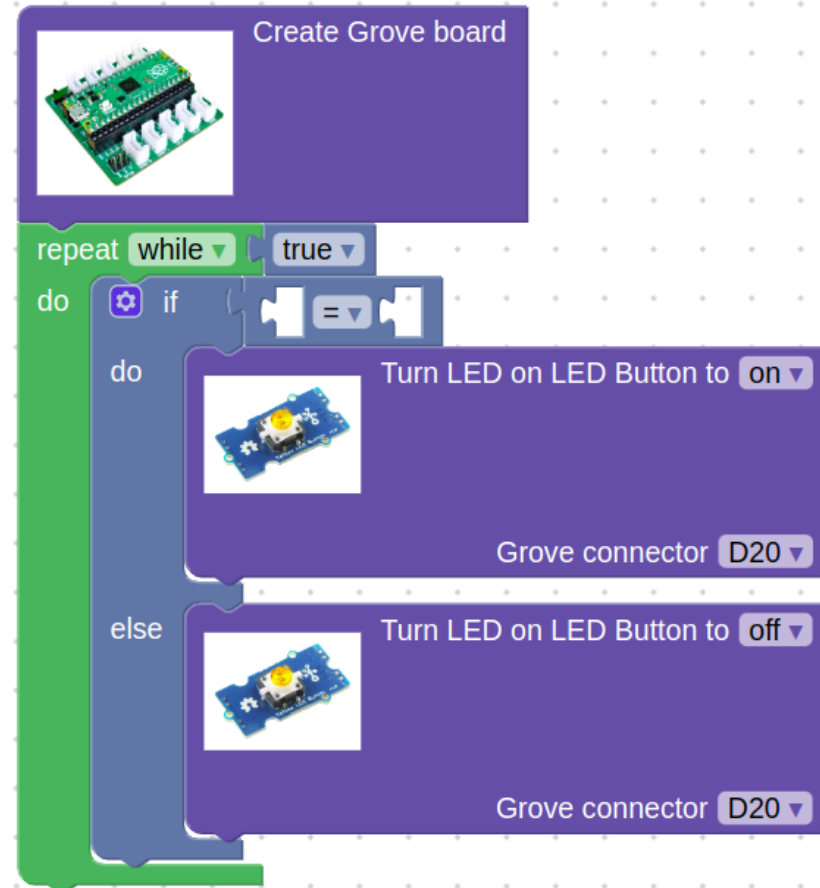


Activity #2: Button

Let's work on our if statement.
We need:

If the button is pressed,
do turn the LED on
otherwise
turn the LED off

What code blocks are missing
from our starting code?

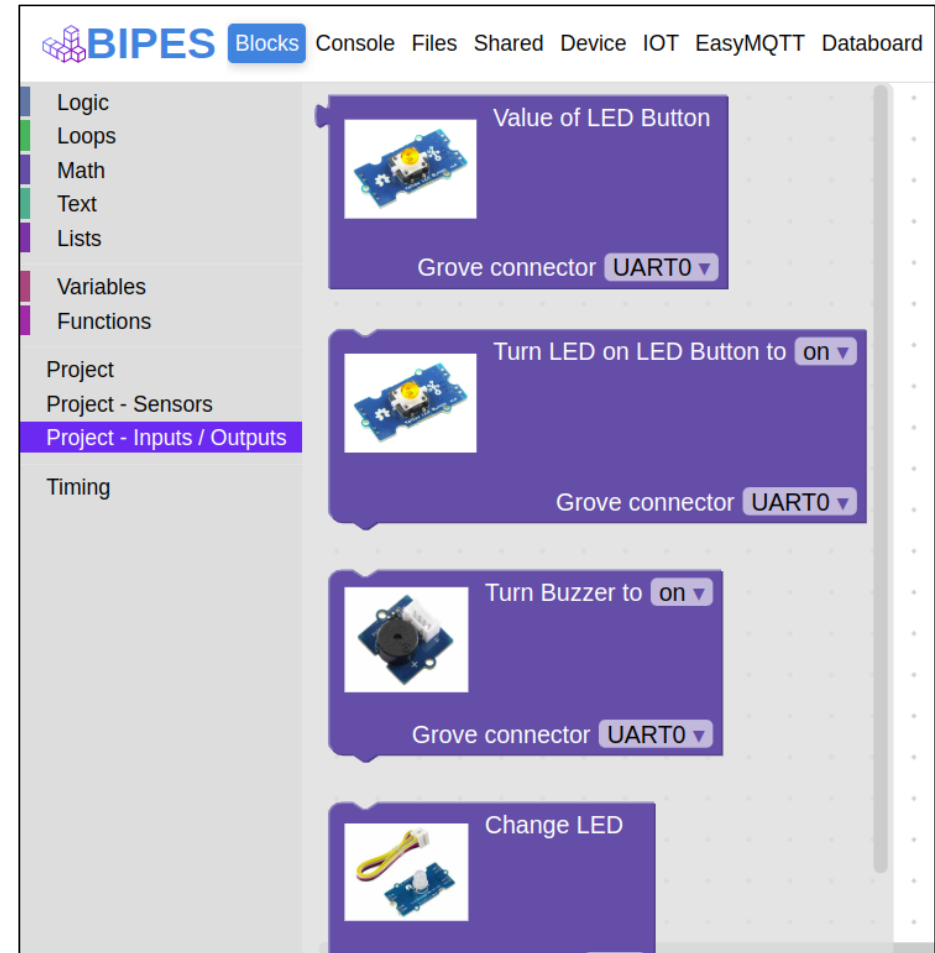


```
Scratch code blocks:  
1. Create Grove board (purple block)  
2. repeat while true (green block)  
3. do if (blue block)  
4. do Turn LED on LED Button to on (purple block)  
5. Grove connector D20 (dropdown)  
6. else Turn LED on LED Button to off (purple block)  
7. Grove connector D20 (dropdown)
```


Activity #2: Button

The missing blocks are for the condition!

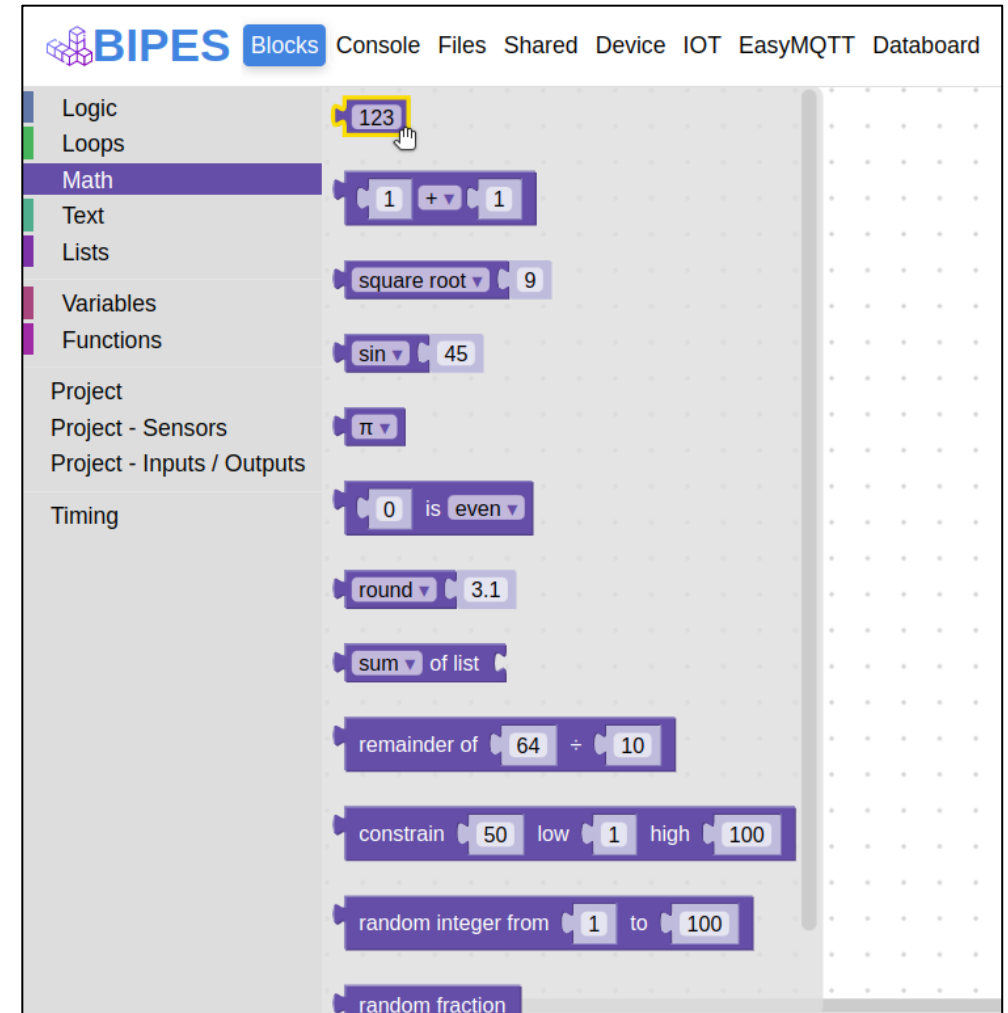
- In the blocks toolbar, click on the **Project – Inputs / Outputs** section.
- Click and drag the Value of LED Button block.
- Make sure your connector is correct! In the Grove connector dropdown, select **D20**.



Activity #2: Button

To complete the condition, we need to check the value of the button.

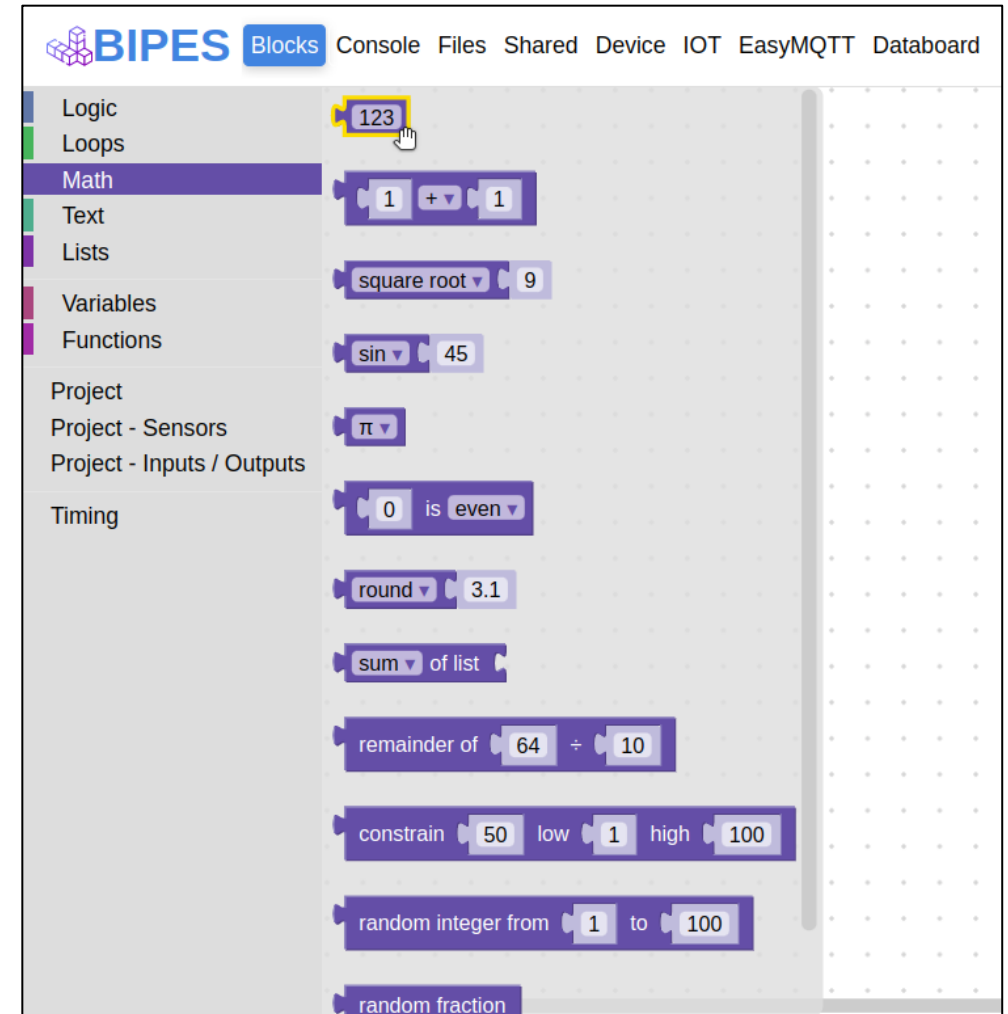
- In the blocks toolbar, click on the **Math** section.
- Click and drag the block used for numbers.
- What does the number used in the condition need to be?
 - Pressed:
 - Not Pressed:



Activity #2: Button

To complete the condition, we need to check the value of the button.

- In the blocks toolbar, click on the **Math** section.
- Click and drag the block used for numbers.
- What does the number used in the condition need to be?
 - Pressed: **1**
 - Not Pressed: **0**



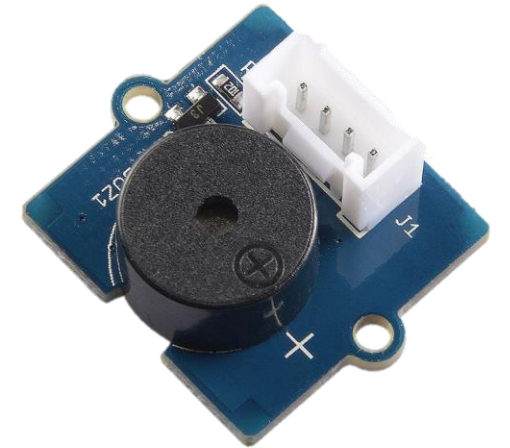
Activity #3: Buzzer

Let's replace the LED with a buzzer!

Activity #3: Buzzer

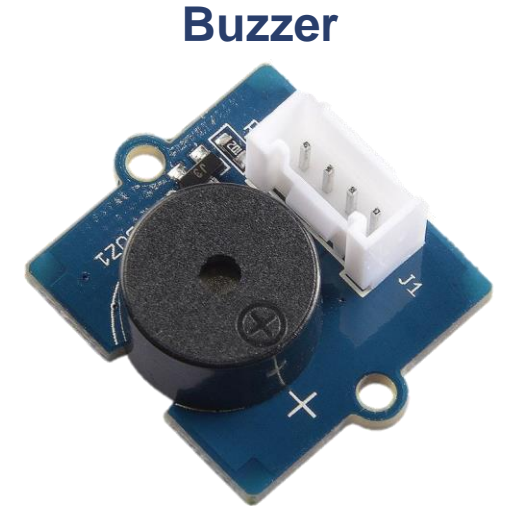
- The next device we are going to use is a **buzzer**!
- The buzzer can be either **on** or **off**.

Buzzer



Activity #3: Buzzer

- The next device we are going to use is a **buzzer**!
- The buzzer can be either **on** or **off**.
- Is there another device we have used already that behaves similarly?



Activity #3: Buzzer

- The next device we are going to use is a **buzzer**!
- The buzzer can be either **on** or **off**.
- Is there another device we have used already that behaves similarly?



Before we move on, plug the Buzzer into connector D18.

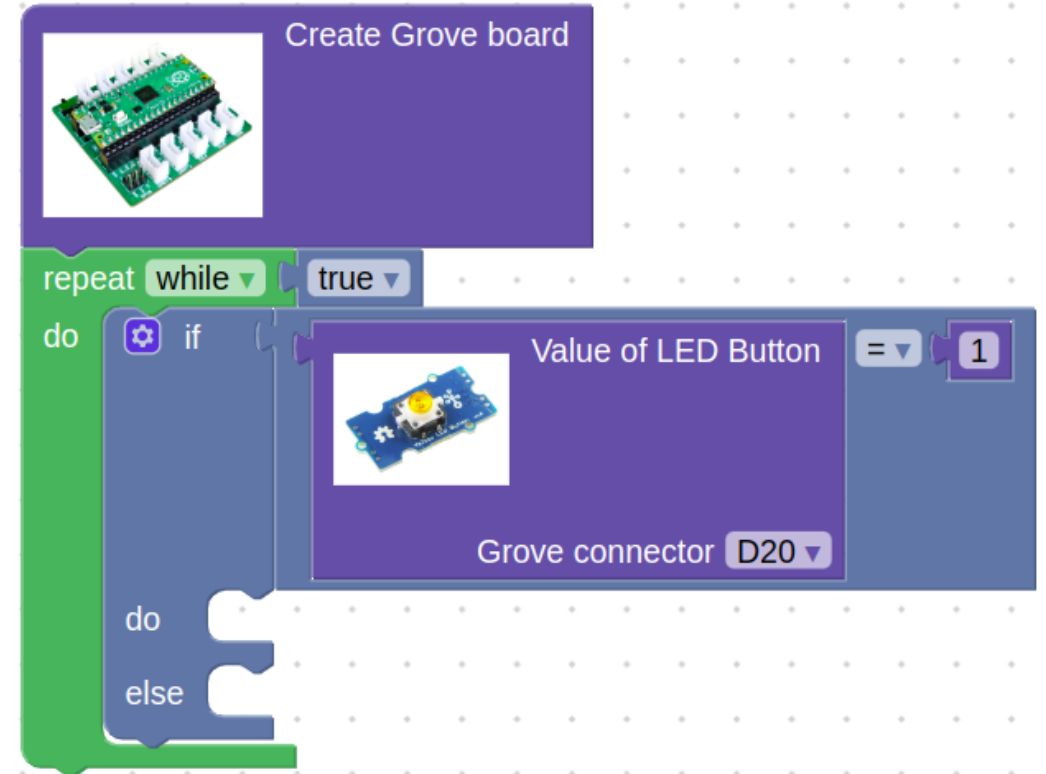
Activity #3: Buzzer

Let's work on the if statement for the buzzer.

We need:

If the button is pressed,
do turn the buzzer on
otherwise
turn the buzzer off

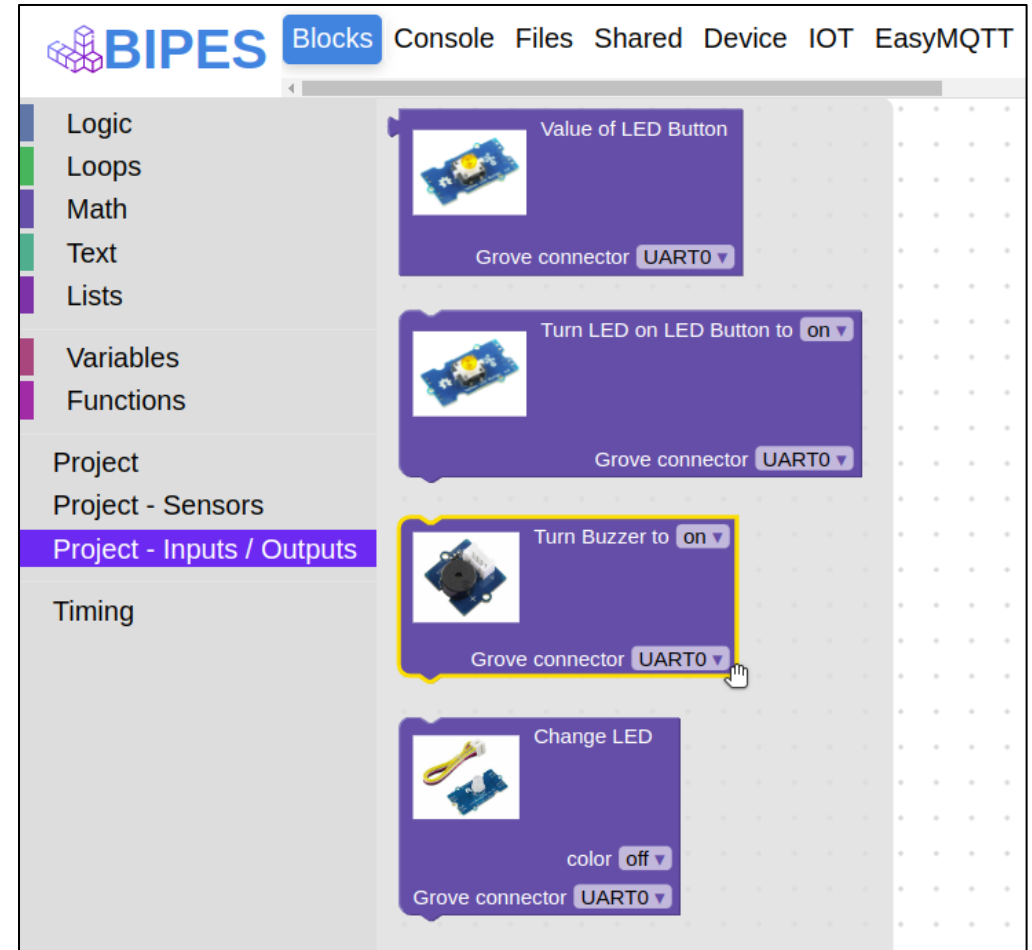
What code blocks are missing this time from our starting code?



Activity #3: Buzzer

The missing pieces are:
the actions!

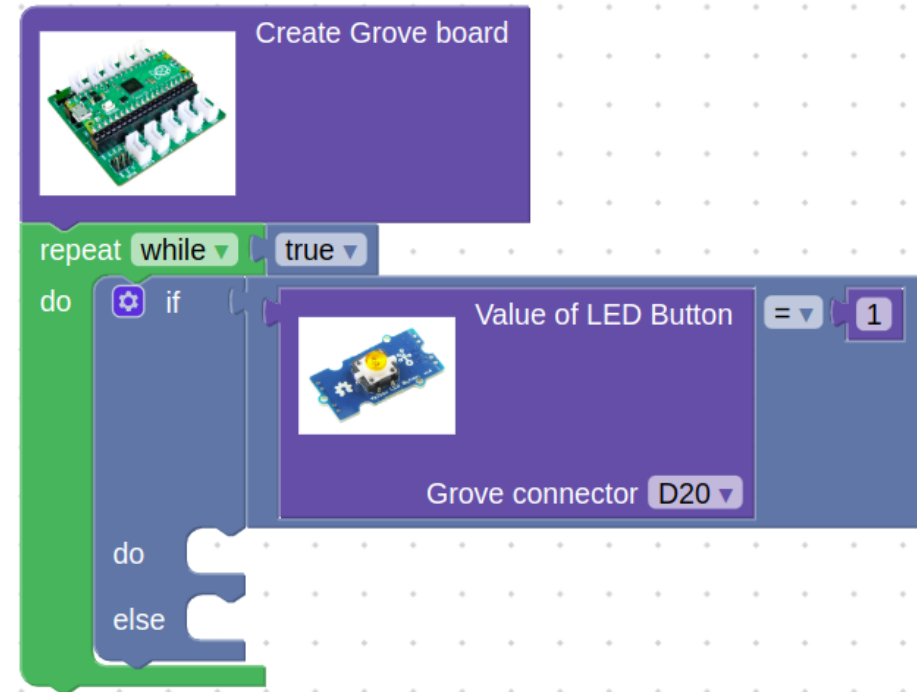
- In the blocks toolbar, click on the **Project – Inputs / Outputs** section.
- Add two code blocks for “Turn Buzzer to on/off”
- Make sure your connector is correct! In the Grove connector dropdown, select **D18**.



Activity #3: Buzzer

The missing pieces are:
the actions!

- In the blocks toolbar, click on the **Project – Inputs / Outputs** section.
- Add two code blocks for “Turn Buzzer to on/off”
- Make sure your connector is correct! In the Grove connector dropdown, select **D18**.



- **Where should each code block go?**

Activity #4: Light Sensor

Let's learn about light sensors and set up our vault!

Activity #3: Light Sensor

How does a light sensor work?

- The amount of light is converted into a number

Light Sensor



Activity #3: Light Sensor

How does a light sensor work?

- The amount of light is converted into a number
- Unlike the LED, button, and buzzer, the light sensor has a wide range of possible values!
 - When 0% light is detected: **0**
 - When 100% light is detected: **65,535**

Light Sensor



Activity #3: Light Sensor

Light Sensor



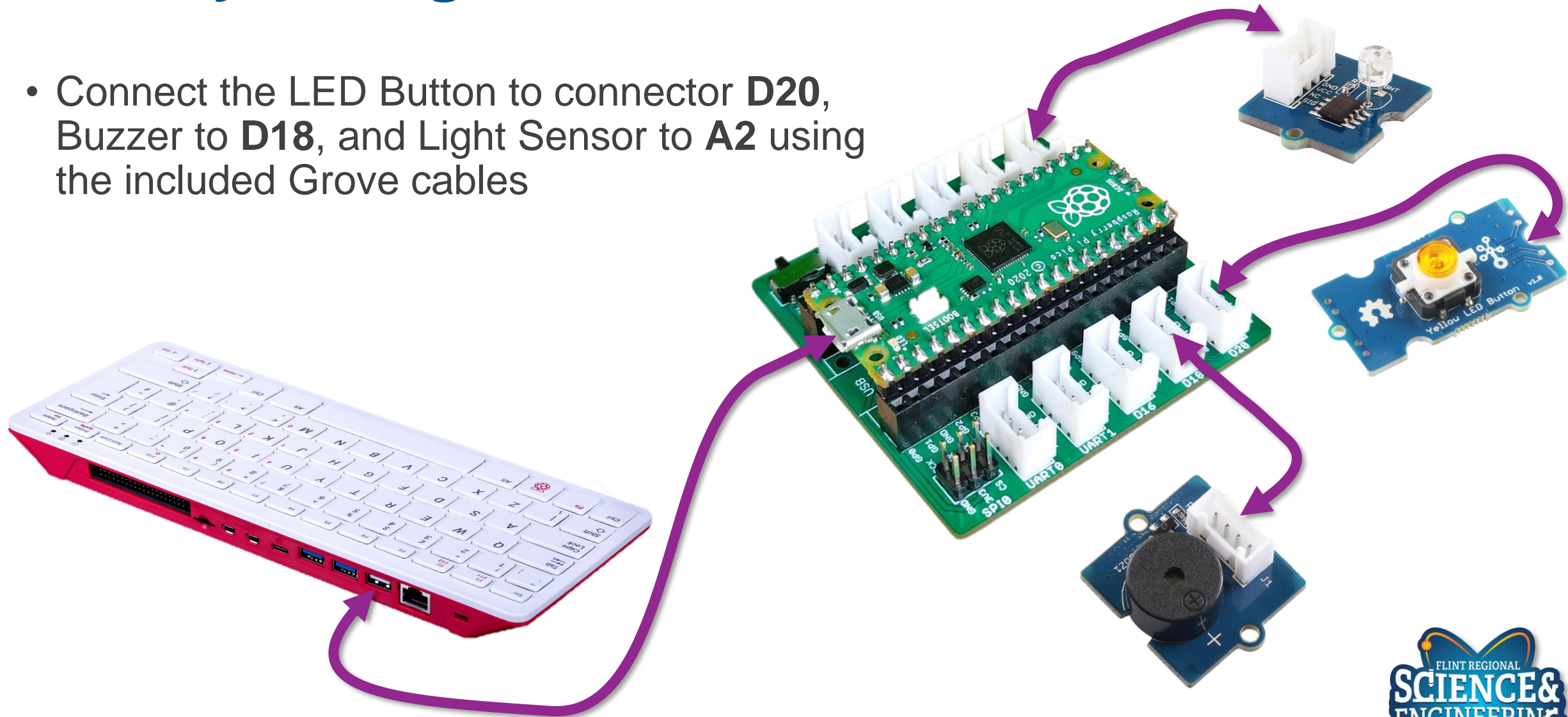
How does a light sensor work?

- The amount of light is converted into a number
- Unlike the LED, button, and buzzer, the light sensor has a wide range of possible values!
 - When 0% light is detected: **0**
 - When 100% light is detected: **65,535**

Before we move on, plug the Light Sensor into connector slot A2.

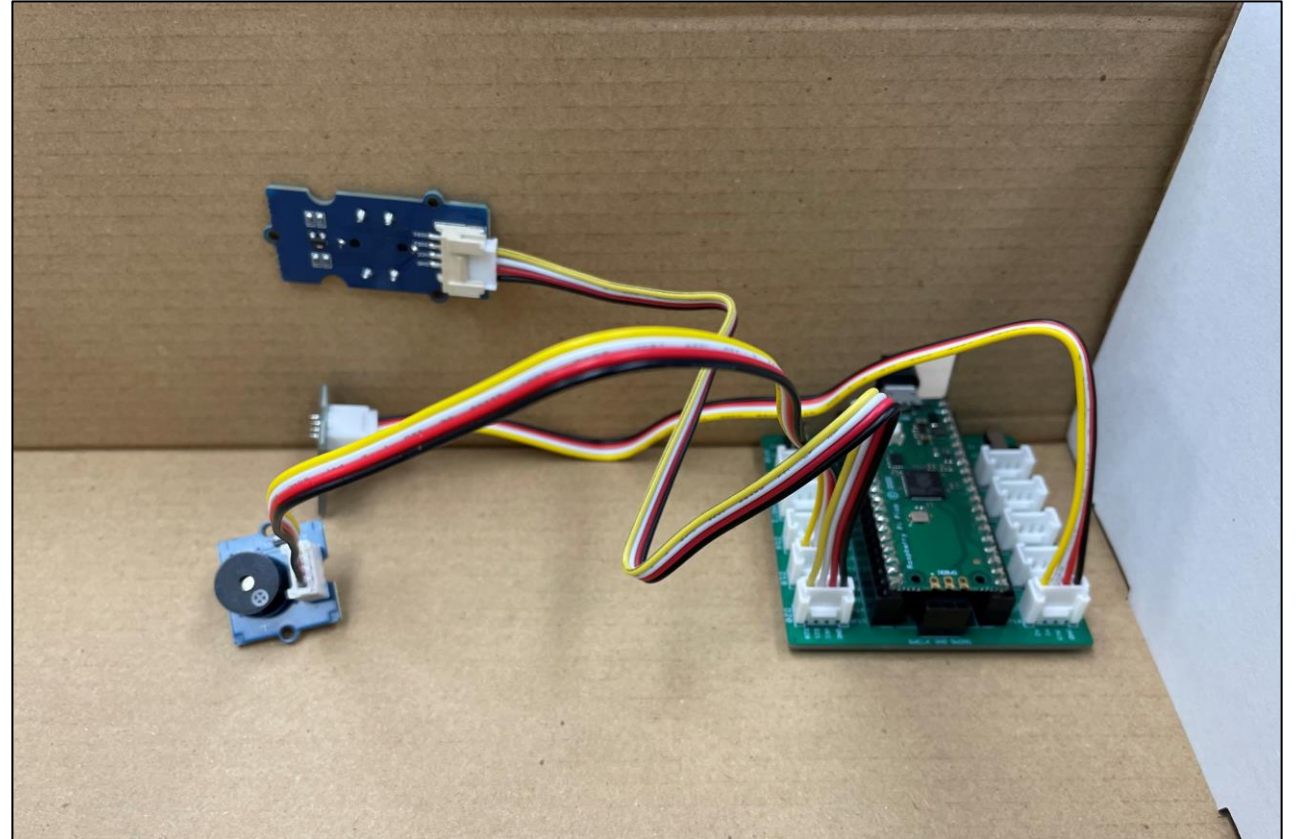
Activity #3: Light Sensor

- Connect the LED Button to connector **D20**, Buzzer to **D18**, and Light Sensor to **A2** using the included Grove cables



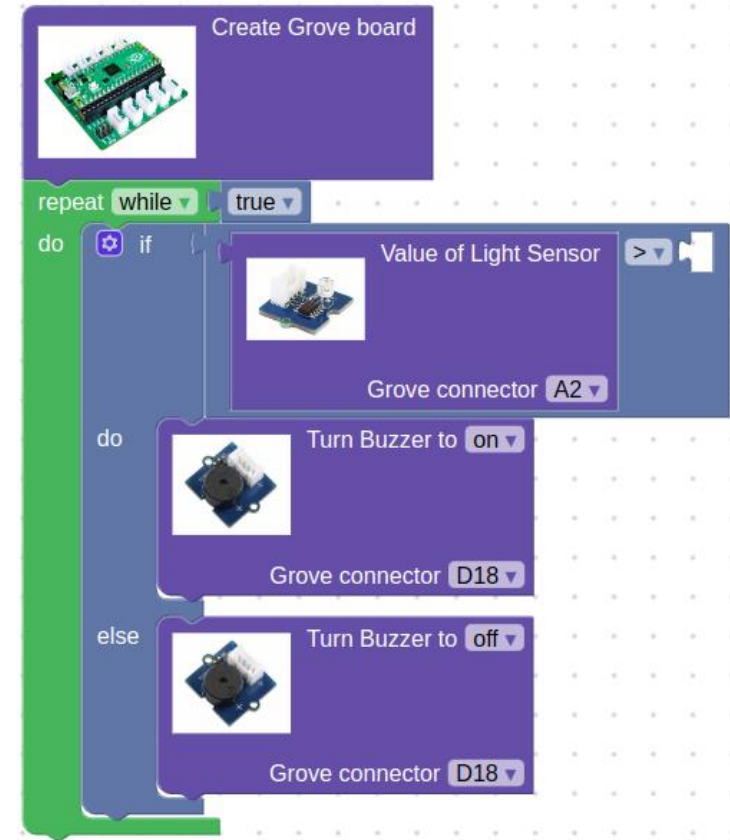
Activity #3: Light Sensor

- Unplug the bigger end of the Pi Pico cable from your keyboard
- Run the bigger end of the cable through the bottom right hole of the vault
- Place your Pi Pico in the top right corner of the vault
- Finally, connect the bigger end of the USB cable back to the keyboard!



Activity #3: Light Sensor

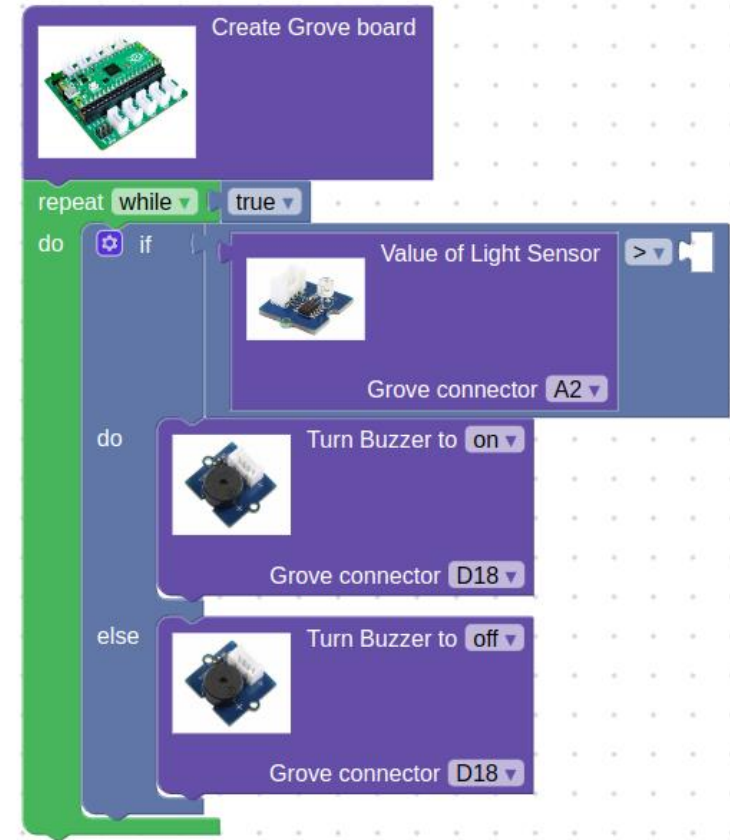
Let's work on the if statement for the light sensor.



Activity #3: Light Sensor

Let's work on the if statement for the light sensor.

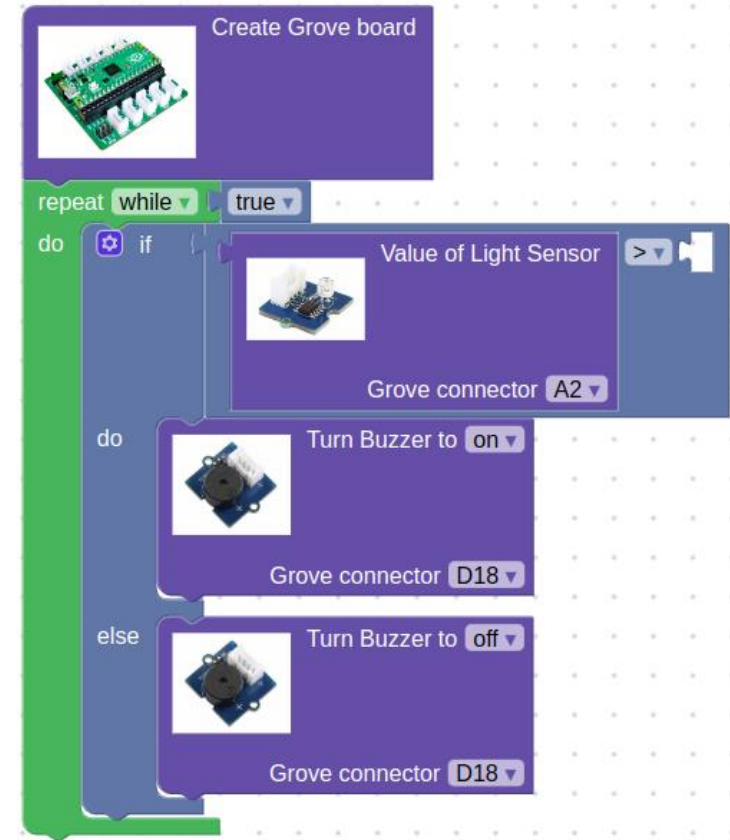
If the box is open,
 do turn the buzzer on
otherwise
 turn the buzzer off



Activity #3: Light Sensor

Let's work on the if statement for the light sensor.

If the box is open,
 do turn the buzzer on
otherwise
 turn the buzzer off



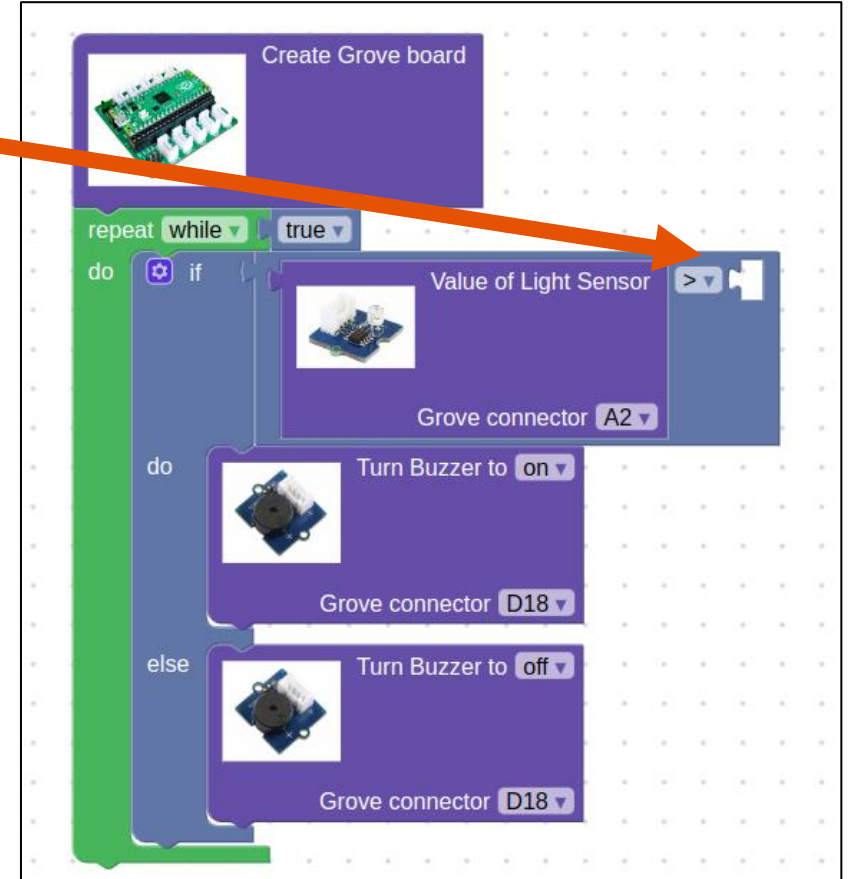
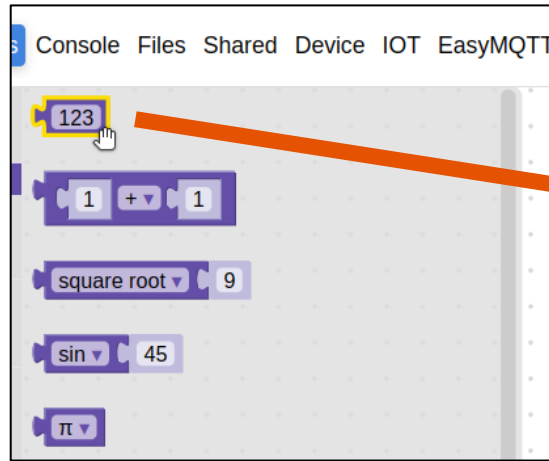
```
repeat while true
do
  if Value of Light Sensor > Grove connector A2
  do
    Turn Buzzer to on
    Grove connector D18
  else
    Turn Buzzer to off
    Grove connector D18
```

The image shows a Scratch code editor with the following blocks: a 'Create Grove board' block, a 'repeat while true' loop, an 'if' block with the condition 'Value of Light Sensor > Grove connector A2', a 'do' block containing 'Turn Buzzer to on' and 'Grove connector D18', and an 'else' block containing 'Turn Buzzer to off' and 'Grove connector D18'.

We know the light sensor gives values from 0 to 65,535.
What code block is missing this time from our starting code?

Activity #3: Light Sensor

If the box is open,
do turn the buzzer on
otherwise
turn the buzzer off



Activity #3: Light Sensor

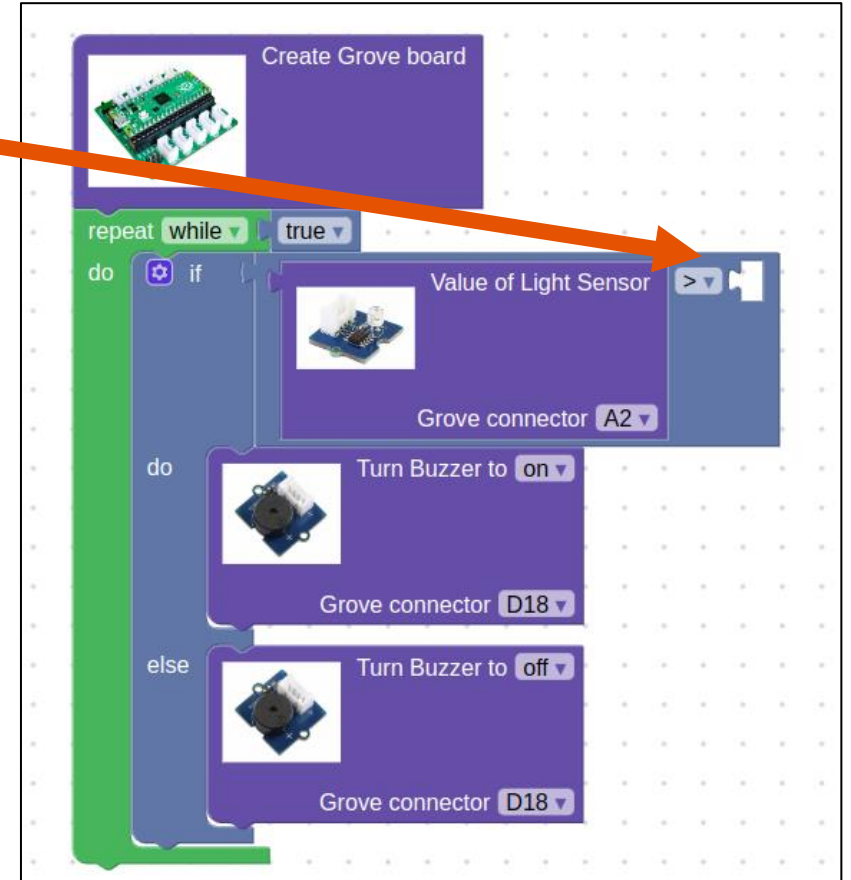
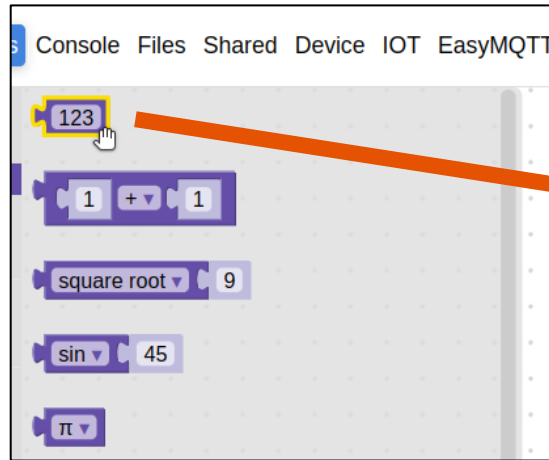
If the box is open,
do turn the buzzer on
otherwise
turn the buzzer off

Goal:

Find a value for the condition that matches our real-world use case!

Bonus Goal: Try to find the range of possible values that work!

Min: 0, Max: 65,535



The Candy Vault

Let's put everything together and create our candy vault!

Activity #5: Vault

Questions

- Do you see any code blocks in the starting code for the vault, that we have talked about today?

```
Scratch code blocks:  
1. Create Grove board  
2. repeat while true  
   do  
     set time_counter to 0  
     repeat while  
       Value of Light Sensor (Grove connector A2) > 5000 and Value of LED Button (Grove connector D20) = 0  
     do  
       set time_counter to time_counter + 1  
       if time_counter > 50  
         do  
           Turn Buzzer to on (Grove connector D18)  
           delay 0.1 seconds  
           Turn Buzzer to off (Grove connector D18)  
         repeat while Value of Light Sensor (Grove connector A2) > 5000  
         do  
           delay 0.1 seconds
```

Activity #5: Vault

Questions

- Do you see any code blocks in the starting code for the vault, that we have talked about today?
- What are some code blocks you see that we have not talked about today?

The image shows a Scratch script for a vault simulation. The script starts with a 'Create Grove board' block. It then enters a 'repeat while true' loop. Inside this loop, there is a 'do' block containing a 'set time_counter to 0' block. This is followed by another 'repeat while' loop. The inner loop's condition is 'Value of Light Sensor > 5000 and Value of LED Button = 0'. Inside the inner loop, there is a 'do' block containing a 'set time_counter to time_counter + 1' block, an 'if time_counter > 50' block, and a 'do' block containing 'Turn Buzzer to on' (Grove connector D18), a 'delay 0.1 seconds' block, and 'Turn Buzzer to off' (Grove connector D18). After the inner loop, there is a 'repeat while' loop with the condition 'Value of Light Sensor > 5000'. Inside this loop, there is a 'do' block containing a 'delay 0.1 seconds' block.

The Candy Vault

Great work! It's time to decorate the candy vault!

Thank you!

