Microbit Sensor/ Water-Pump Experiment

IoT4Ag Outreach Workshop
7-6-2022

IoT4Ag
The Internet of Things for Precision Agriculture
an NSF Engineering Research Center

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UNIVERSITY *of* PENNSYLVANIA

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Objectives: SWBAT

1. Build and program a smart moisture detection sensor
2. Then Build and program a smart water pump.
3. Finally incorporate the two so that the water pump runs only when the sensor detects low moisture levels

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Students I can Statements Part 1:

1. I can follow instructions to correctly wire the sensor to the microbit to program it and correctly wire it to the battery pack for power.
2. I can follow instructions to program the micro.bit processor to read my name or the name of the program
3. I can program the the micro.bit processor to display the sensor readings

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Overview/Table of Contents

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Step 1 Be sure you have all of the materials you will need

YOUR KIT
Your workshop kit should consist of the following components

Micro:Bit microcontroller (this is what you will program to control your robot)		**Screw Driver**	
USB cable (this is for connecting the micro:bit to the computer to load your program onto the robot)		**One Watering Pump**	
Battery Pack (used to power the robot)		**Wire Connectors / Alligator Kits**	
One Soil Moisture Sensor		**Relay**	
Tubing		**Cups With Soil for Determining Soil Moisture**	

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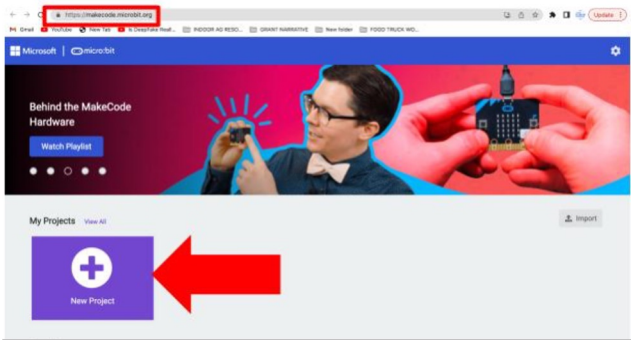
Step 2: See your name in lights / Give your project a name

Programming your Microbit

1. You can program the microbit by going to https://makecode.microbit.org
2. Click on "+ New Project".
3. Give your project a name in the dialog box.



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3. For the Code Options, you can select “Blocks, JavaScript or Python”. For this activity select “Blocks.”

4. Then click “Create”.

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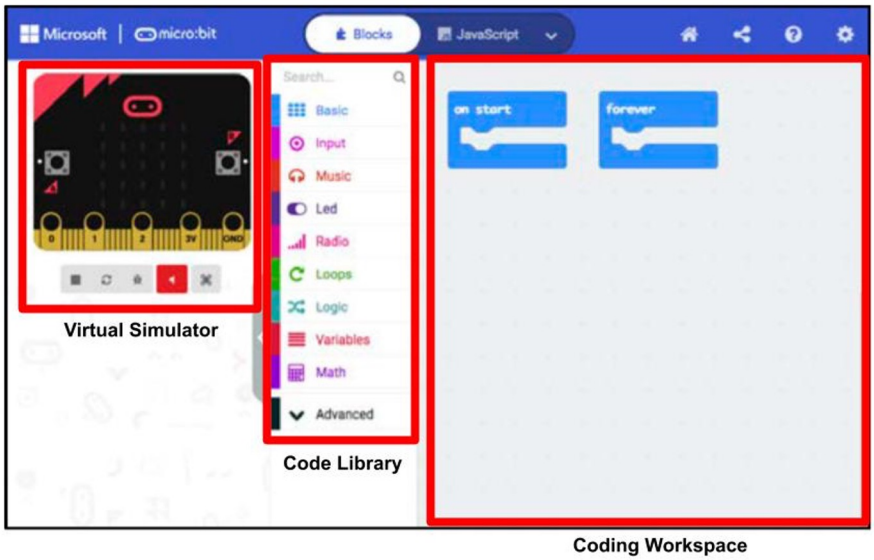
Your New Project Looks Like This



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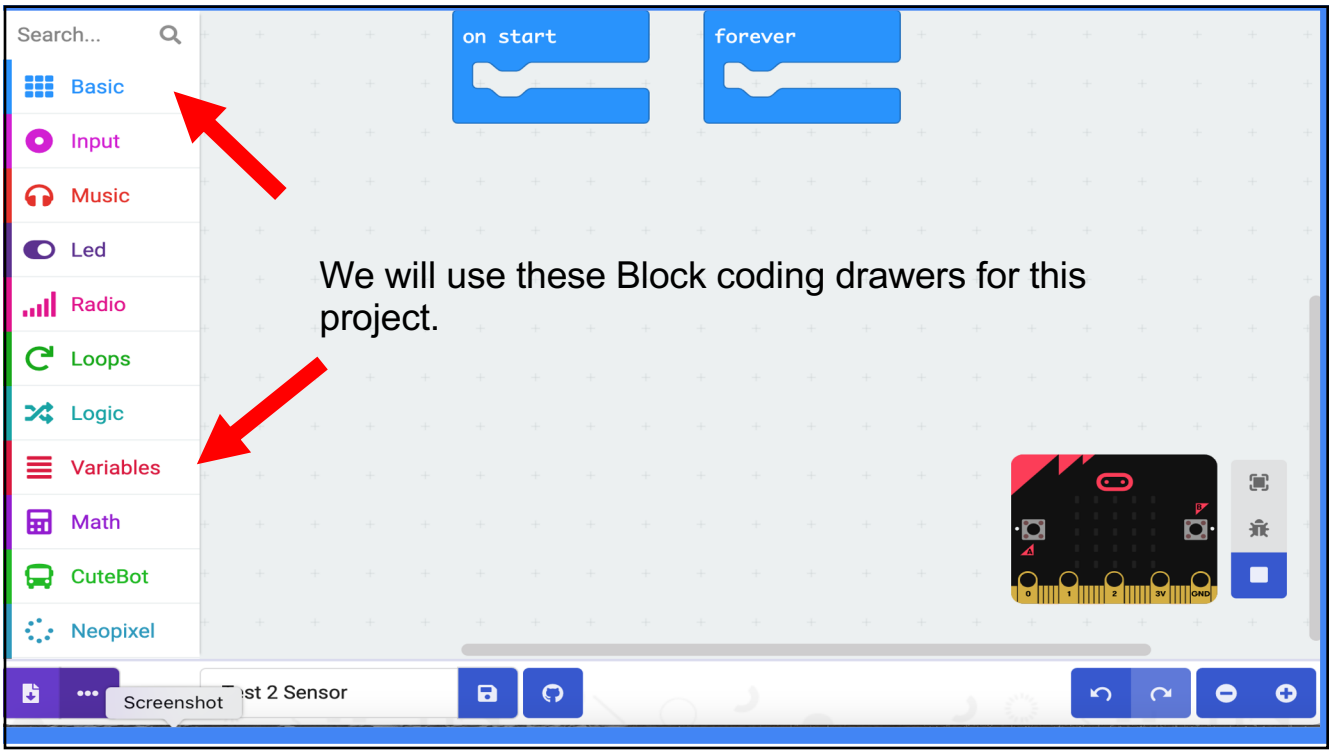
Search...
Basic
Input
Music
Led
Radio
Loops
Logic
Variables
Math
CuteBot
Neopixel
on start
forever
We will use these Block coding drawers for this project.
Screenshot
st 2 Sensor

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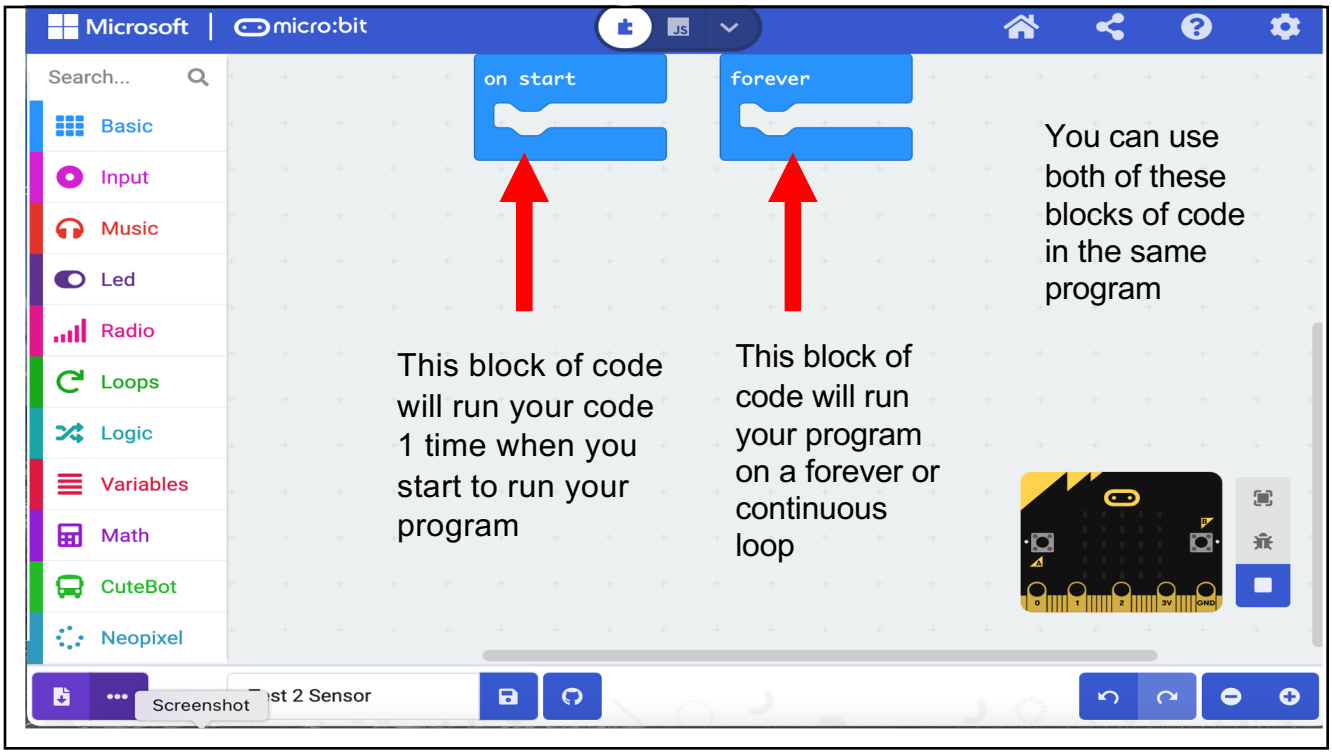
Microsoft
micro:bit
Search...
Basic
Input
Music
Led
Radio
Loops
Logic
Variables
Math
CuteBot
Neopixel
on start
forever
You can use both of these blocks of code in the same program
This block of code will run your code 1 time when you start to run your program
This block of code will run your program on a forever or continuous loop
Screenshot
st 2 Sensor

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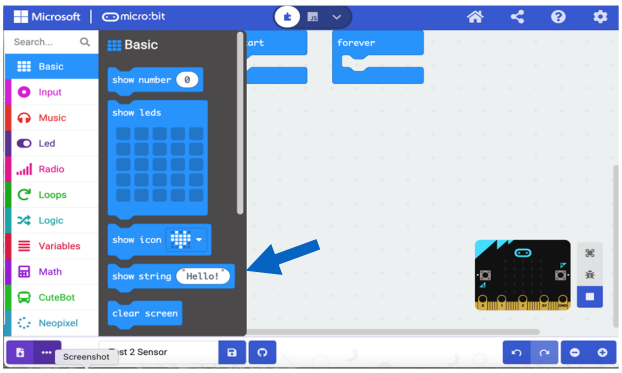
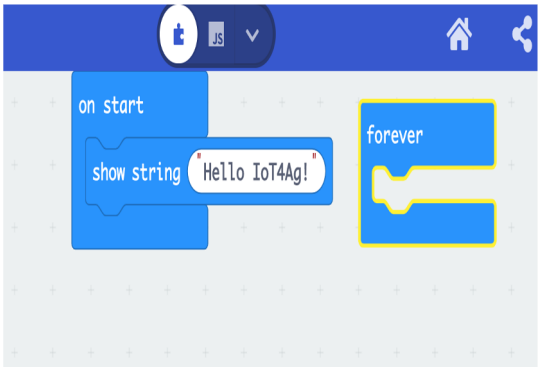
Step 5 Build your program to name your project

We are going to play around and have fun with this step

Click on “Basic” drawer of blocks.

Select “show string” block type in your name or the project name place the block inside the “On start” block





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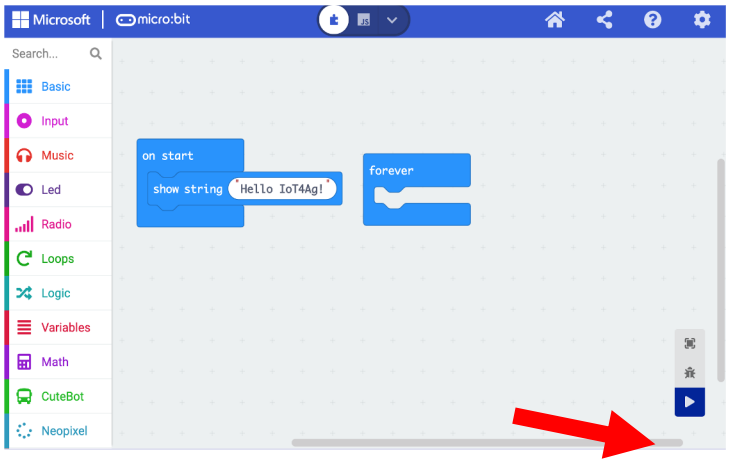
Click “play” and watch it play on your “Micro.bit Simulator”



You can play with your message here if you finish early.

Also try moving the message to the forever block and see what happens…

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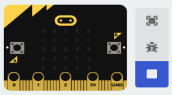
Your code in JavaScript


```
basic.showString("Hello IoT4Ag!")
basic.forever(function () {

})
```



Change the toggle button to switch from Block mode to JavaScript.

What do you notice is different about the code?

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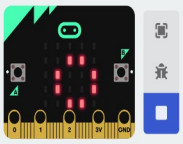
Your code in Python


```
basic.show_string("Hello IoT4Ag!")

def on_forever():
    pass
basic.forever(on_forever)
```



Now change the toggle button to switch from either JavaScript or Block mode to Python.

What do you notice is different about this code?

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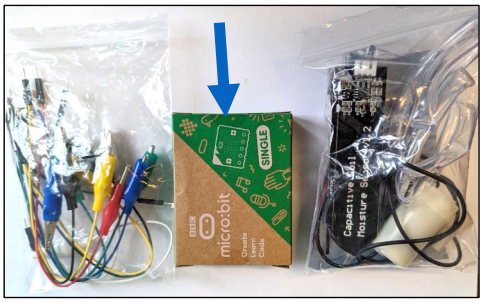
The program is now complete.
Step 6: is to plug the USB cable into the micro:bit and connect it to the computer.

Be careful to be gentle when making this connection.

Note: when you plug in the micro:bit to the computer for the first time it will run it's default greeting program that will buzz and flash its LEDs and say "hello".



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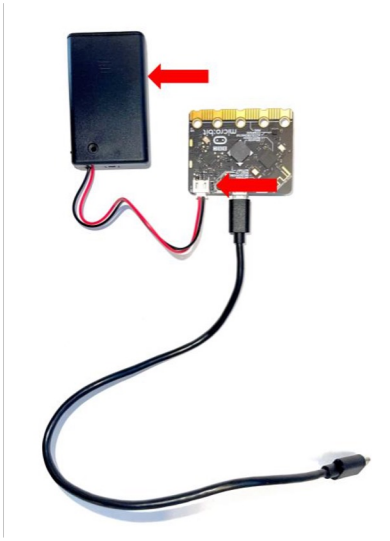
Step 7 Connecting Battery Pack to Micro.bit



To give the Micro.bit power, assemble the battery pack & connect it to the Micro.bit processor.

Place the batteries into the battery pack & attach the cover.

Note: The screw provided in the kit is not necessary to install.

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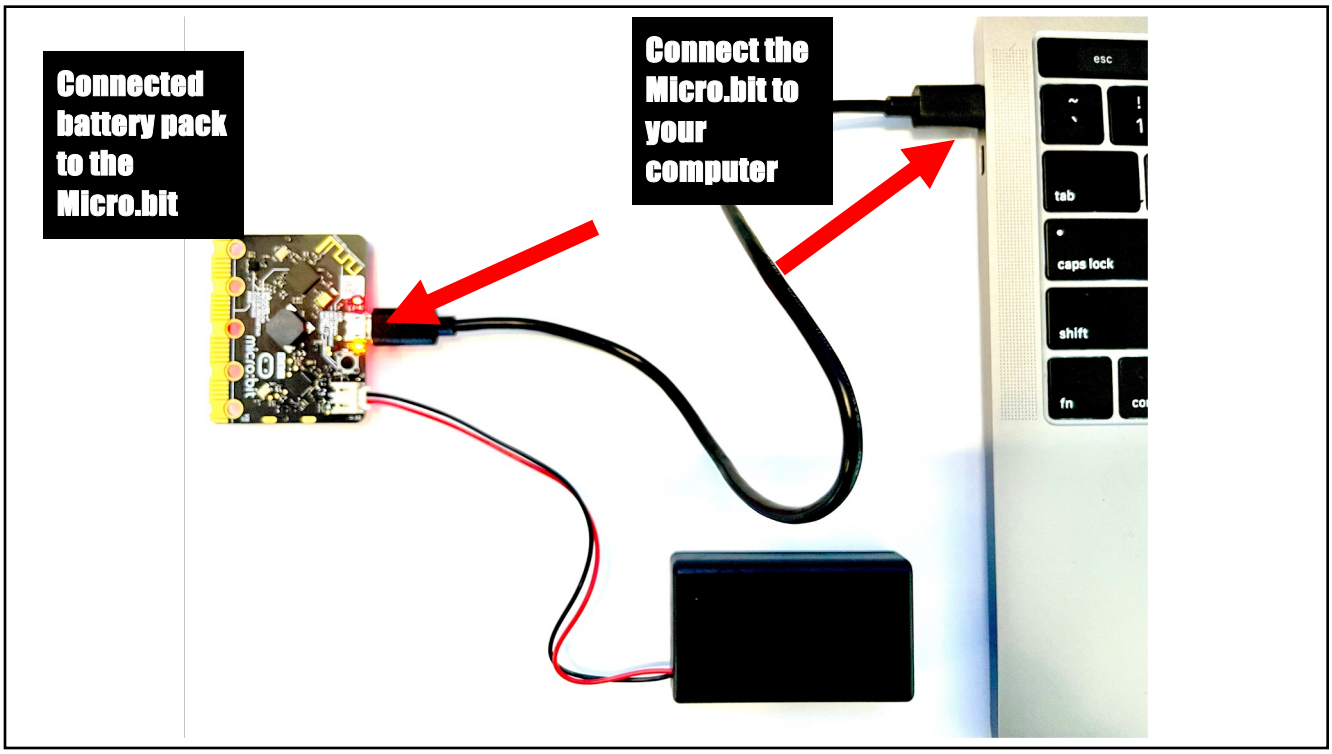

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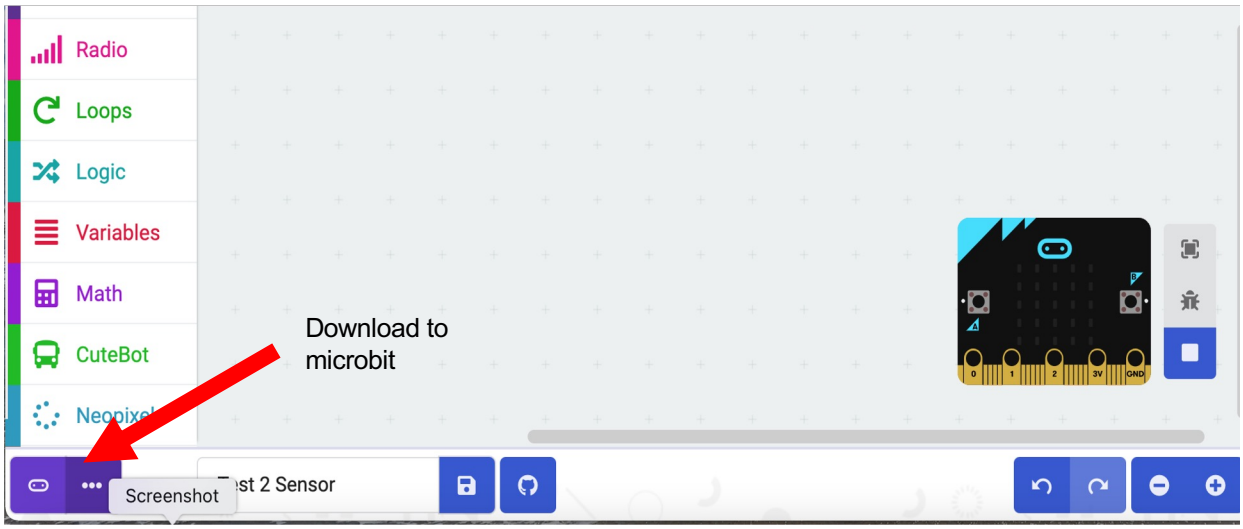
Step 8 Save your “message” code to the micro.bit (The short way)



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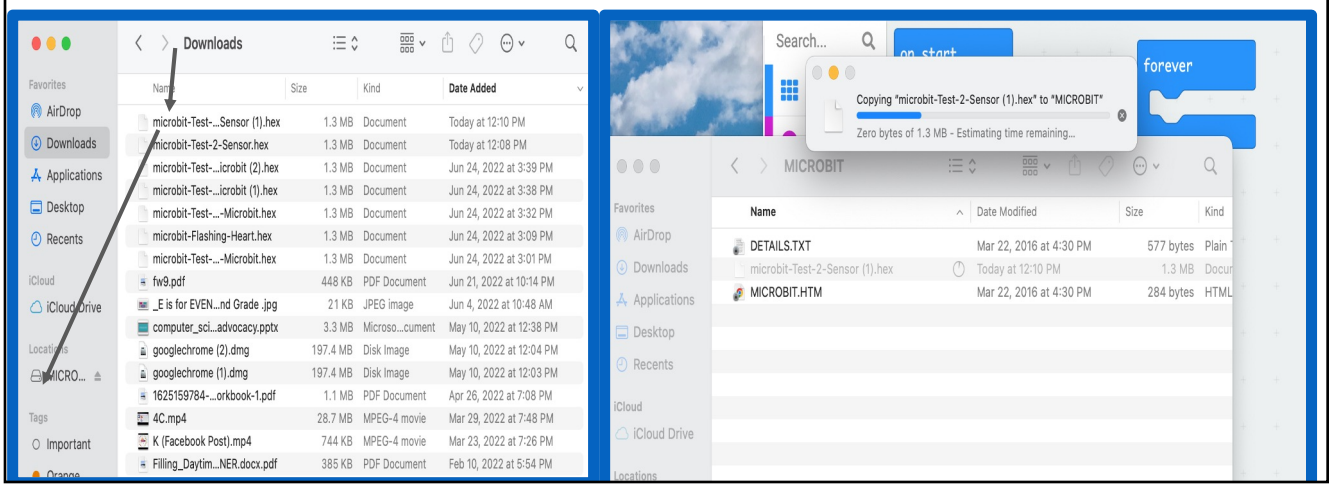
Step 8(The long way): Go to “File” select “Downloads”
In the Finder, drag the latest download to the Micro.bit
Processor attached to your computer



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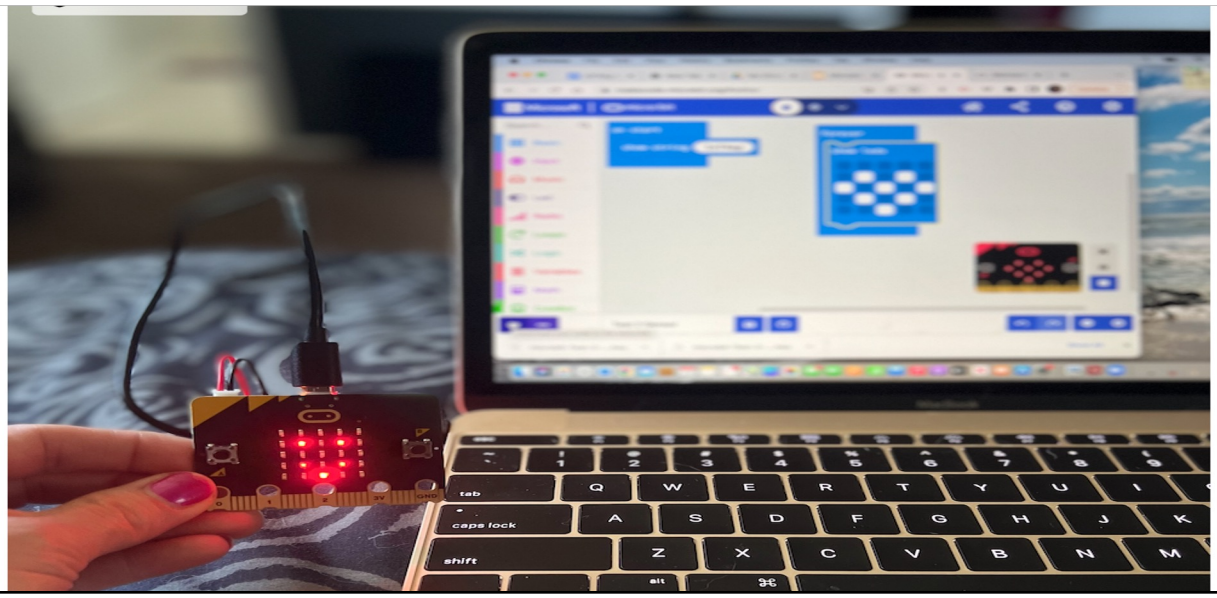
Watch Your Code in Action on the Micro.bit



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Build and Send Code To The Moisture Sensor

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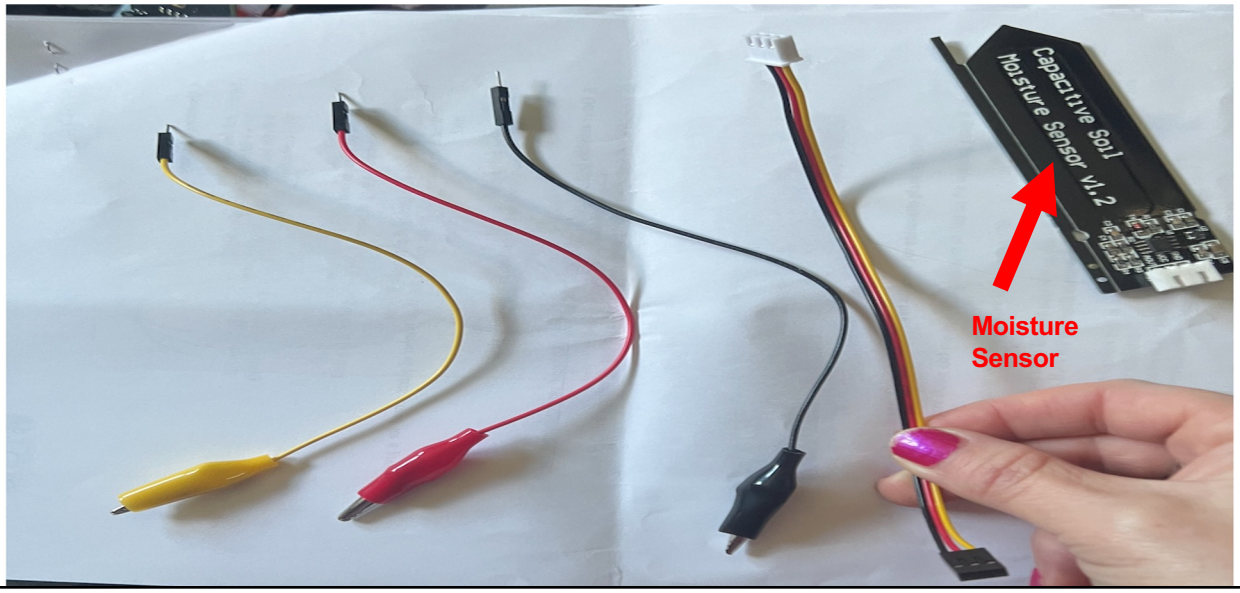
Step 1: Locate the sensor and the red, yellow and black wire cables



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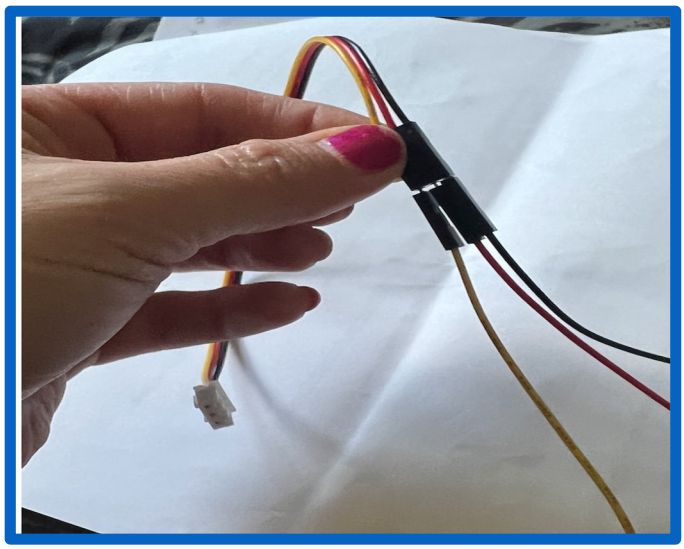
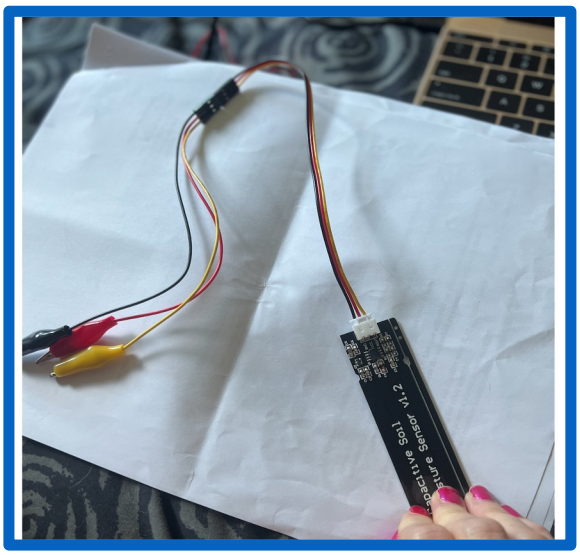
Step 2: Connect the cables to the sensor





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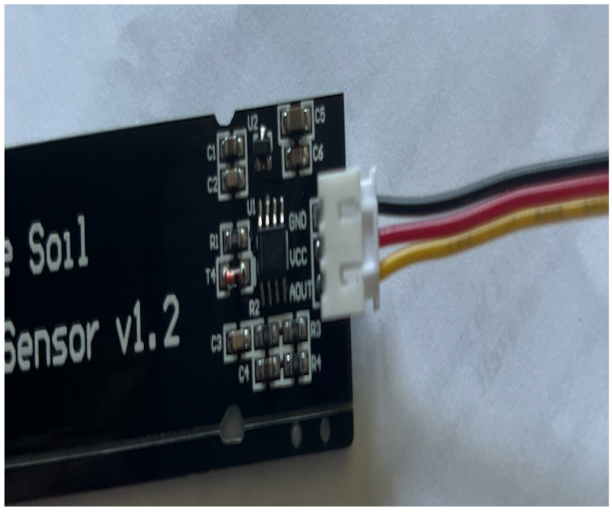
What does each wire do?



Black wire is the Grounding wire

Red wire is the Voltage "power" wire

Yellow wire is the Programming wire

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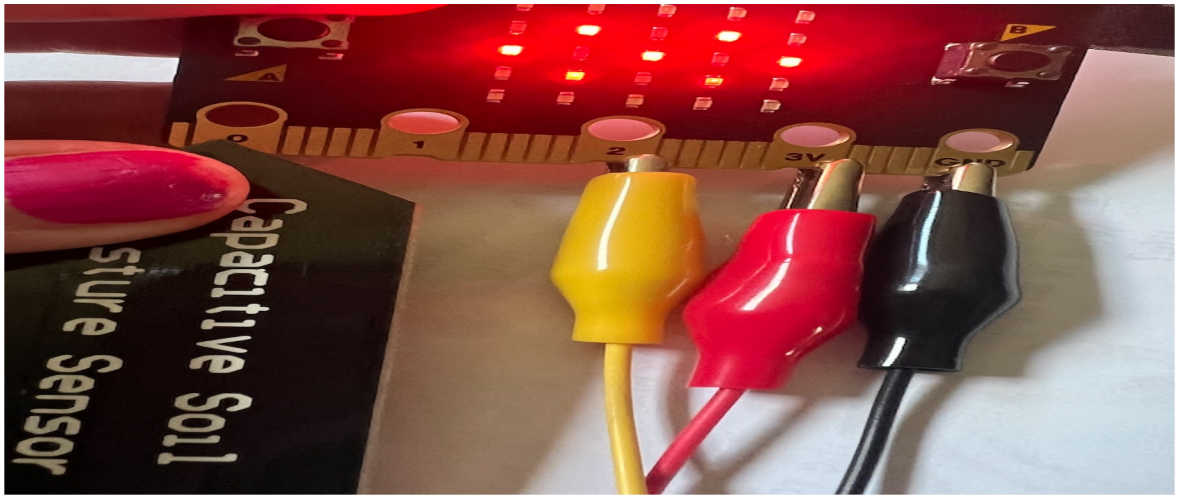
Step 3: Connect the Sensor to the Micro.bit



Attach the alligator clips as the diagram shows

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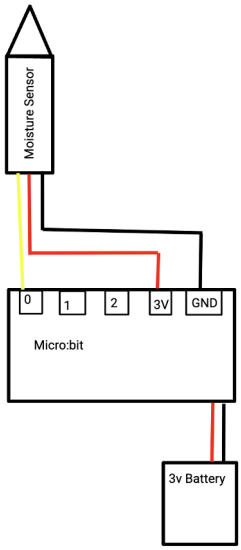
Step 3: Connect the Sensor to the Micro.bit



The connection of the moisture sensor to the Micro.bit should look like this diagram

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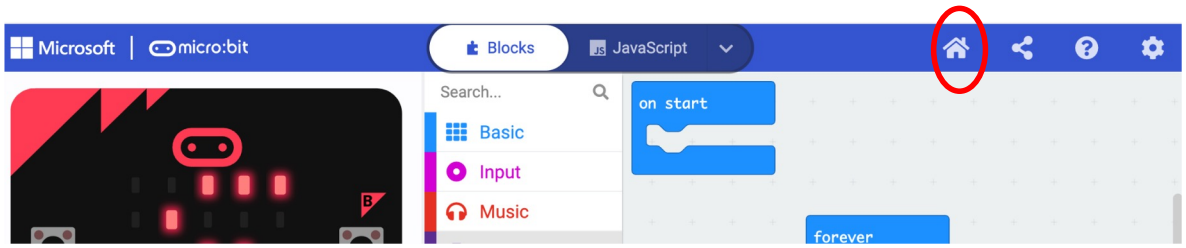
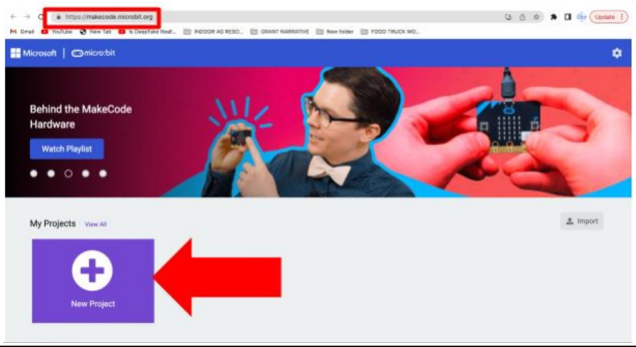
Create a new project for using the moisture sensor





Go to the home screen & then select a new project

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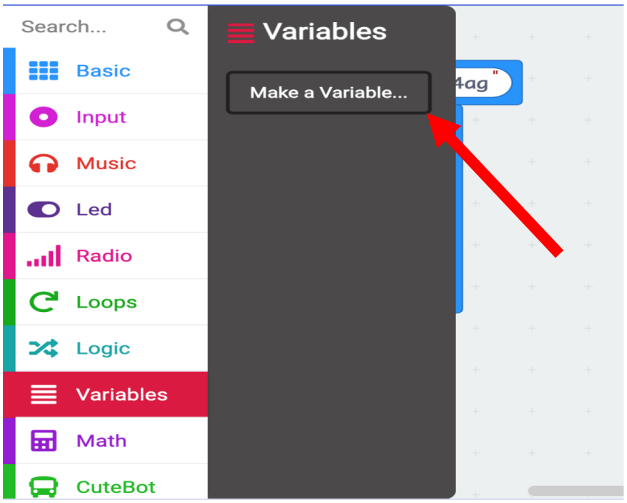
Step 4: Code the Micro.bit to display the sensor output



Open the variables draw and click on make a variable.

A variable is something that can change

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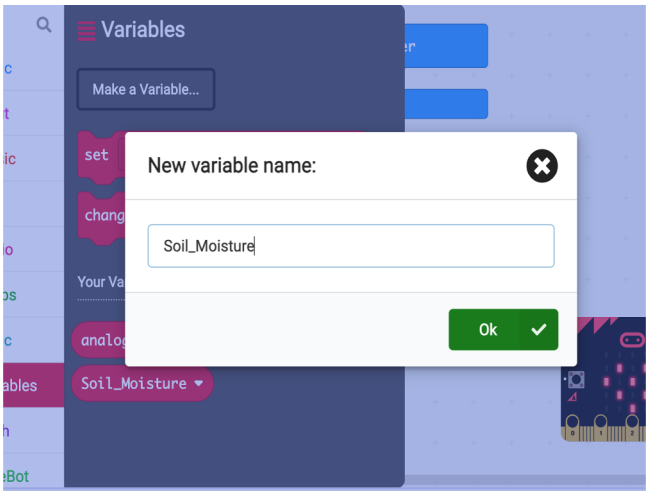
Create variables



Assign a new name to your new variable as: “Soil_Moisture”

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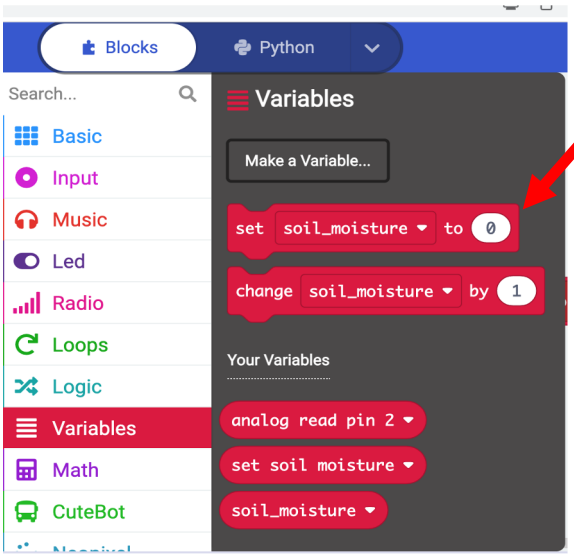
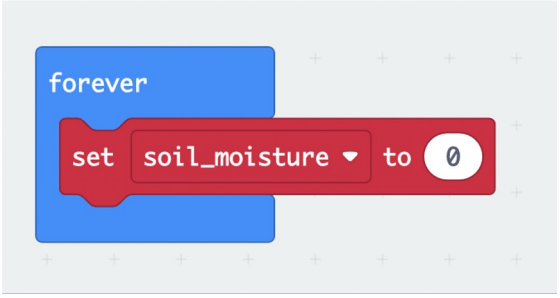
These are the variable blocks you created



Put the “set” soil_moisture in the forever block. This step should look like this:



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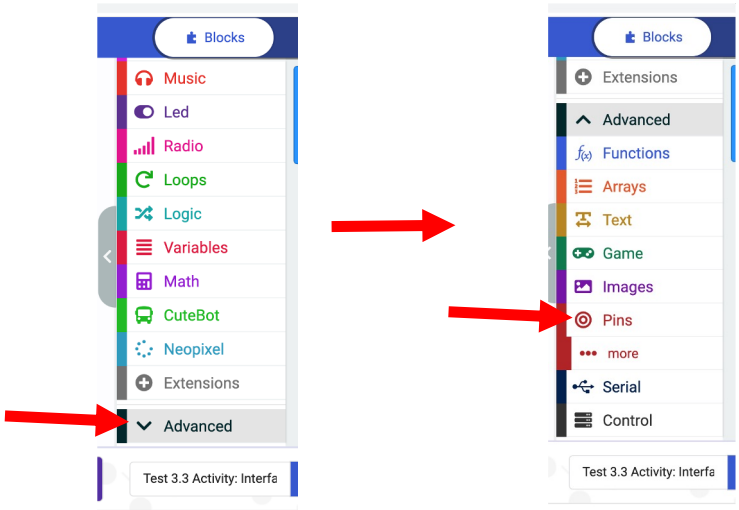
Selecting Pins



Next we will select the pin. The pin is location where info from the sensor is received by the Micro.bit.

To program the Micro.bit to read the sensor select “Advanced drawer” then “Pins drawer ”

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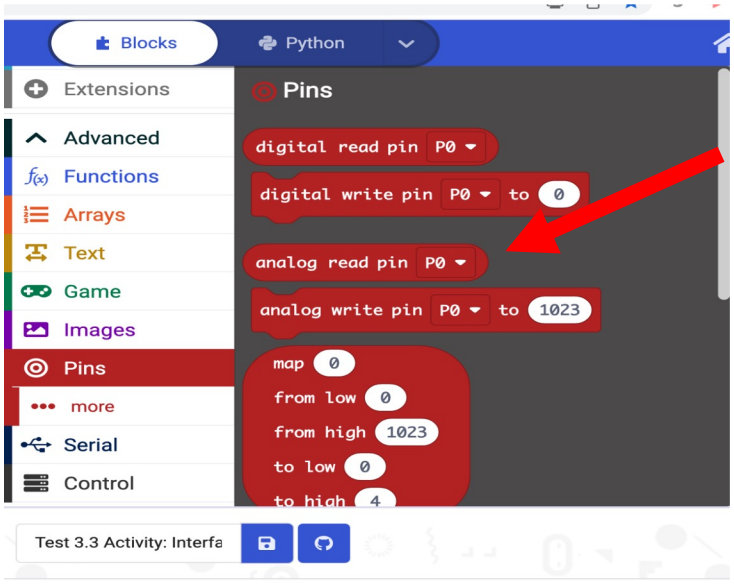
Selecting Pins



Select the “analog read pin” command

Use the drop down arrow to select “P2” instead of “P0”

Drag this command into the workspace in the “set moisture” command. It should look like this

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These are the variable blocks you created

Drag the “analog read pin”

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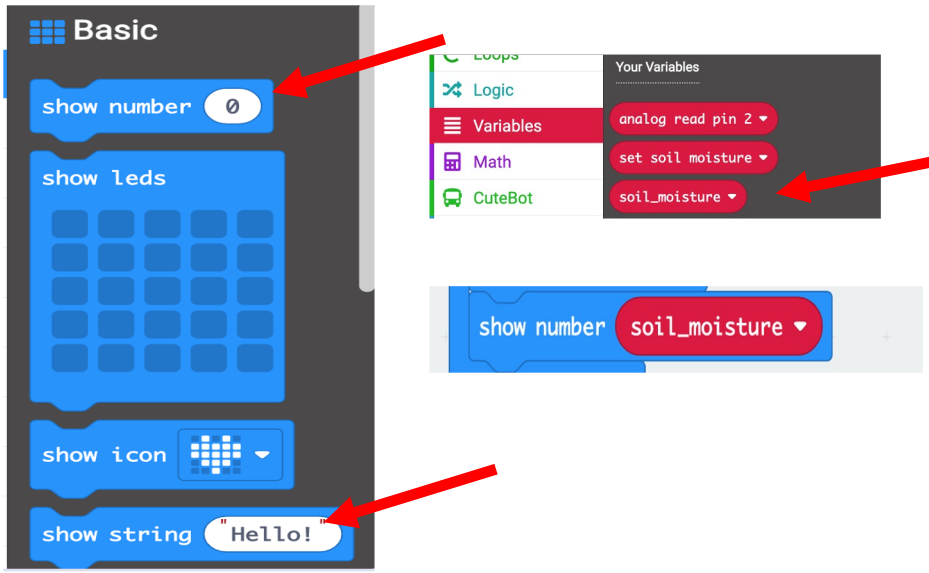
Displaying the Sensor Reading



Open the Basic drawer to select “show string” command and “show number” command.

Put these in the forever block under the “set soil moisture” command.

In the “show number” command, drag in the “soil moisture” variable from the variable drawer.

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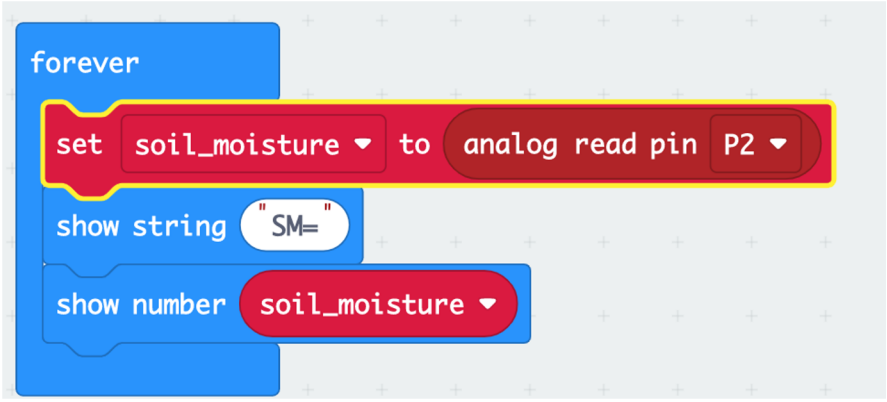
Putting your code together



You code should look like this when you finish.

It should be in the forever block

You will need to type in SM = into the show string command. SM stands for soil moisture

You can send your new code to work the moisture sensor to the Micro.bit

If you forgot how to send the code to the Micro.bit, refer back to slide 20

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Take measurements using the moisture sensor

You should see readings appear on the Micro.bit display. You may want to let the sensor stabilize for a few moments before taking your reading.

Observe a baseline measurement of the air. Record this number.

Place the tip (**just the tip**) of the black triangular moisture sensor in a cup of **water** and observe the readings.Record your readings.

Place the tip (**just the tip**) of the moisture sensor in a cup of **dry soil** and observe the readings.Record your readings.

Place the tip (**just the tip**) of the moisture sensor in a cup of **wet or damp soil** and observe the readings.Record your readings.

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Data Table

Type of Measurement	Value on Micro.bit Sensor
Air	
Water	
Dry Soil	
Wet Soil	

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Build Water Pump and Connect it to Micro.bit

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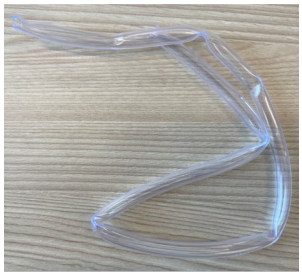
Step 1 Gather materials

One Watering Pump

Wire Connector/ Alligator Clips

Plastic Tubing



Relay

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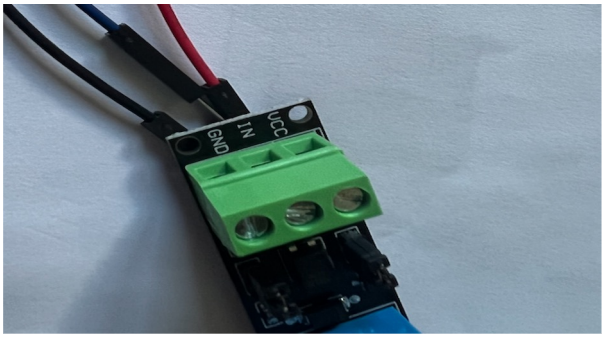
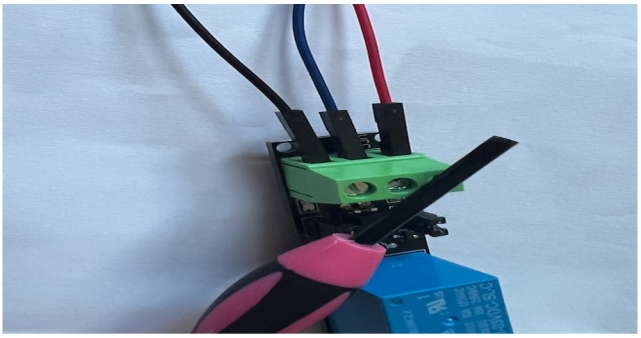
Step 2 Connect the wires to the relay using the screwdriver





3 wires go out of the relay on the “GRD/IN/UCC” side of the relay

2 wires go out of the other side of the relay on the “NC/COM/ON”

These are the wires are shown in the “wire connector/ alligator clips” picture on the previous slide

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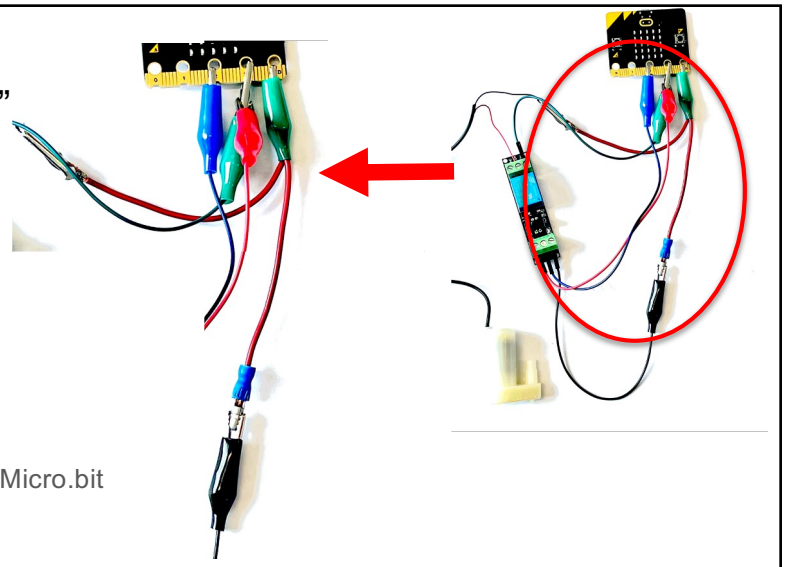
Step 3: Connect the “splitter” connection”



The bottom of the splitter will go to the Micro.bit

Attach the flat end will of the splitter to the alligator clip from the GRD or Black Colored wire from the relay. The other end of the splitter goes to the black wire from the pump

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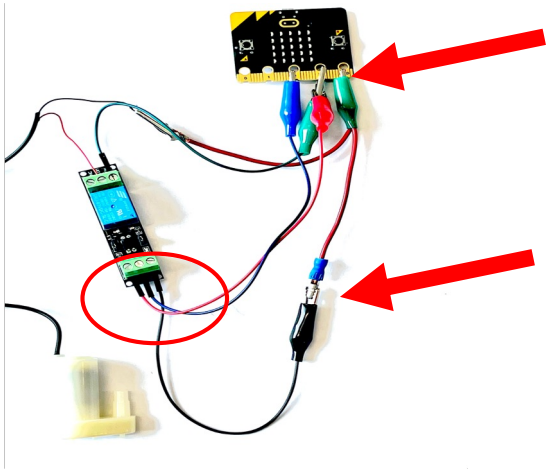
Step 4: Connect the alligator clips on the “GRD” side of relay or the splitter to the Micro.bit



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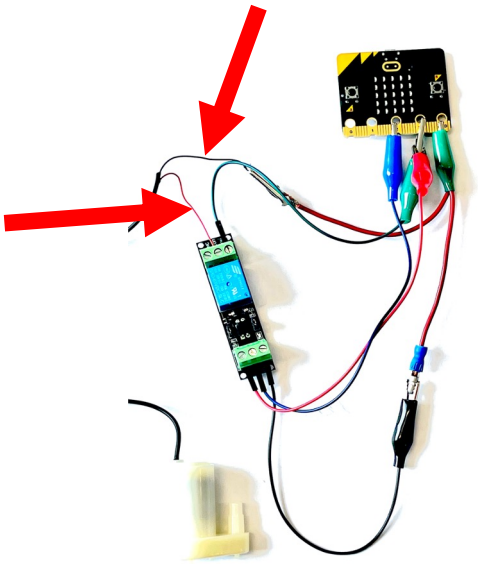
Step 5: Connect the wires from the water pump to the relay and Micro.bit

The red wire from the water pump gets inserted into the relay.

The black wire from the pump gets clipped into the other alligator clip from the splitter.



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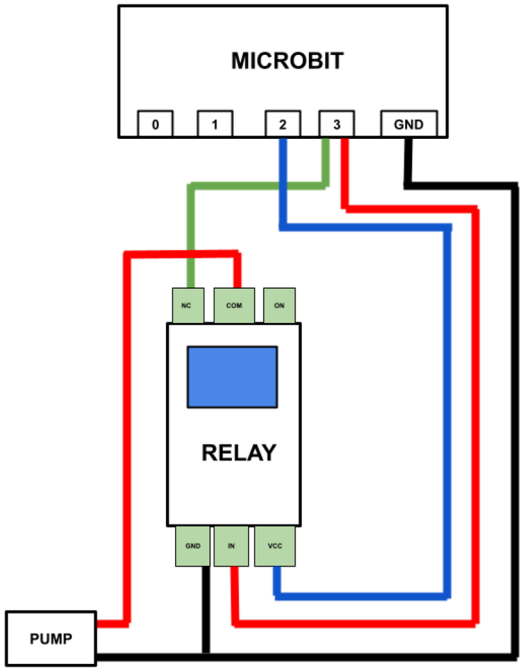

The connection of the water pump to the Micro.bit should follow this diagram

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Program the Pump

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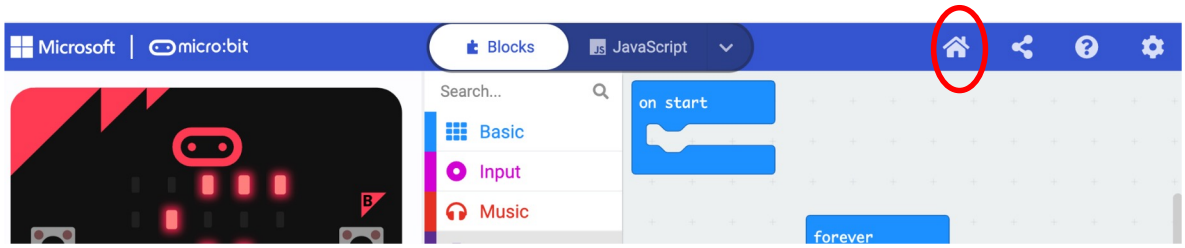
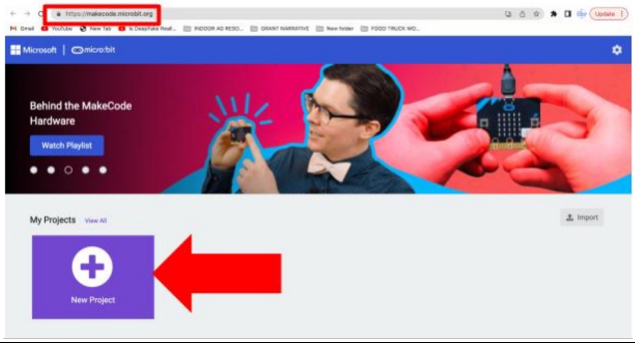
Create a new project for using the water pump





Go to the home screen & then select a new project

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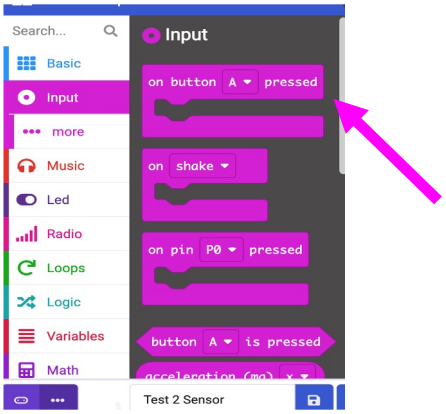
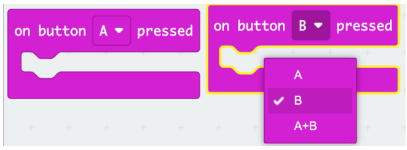
Step 1: Select the “Input” drawer choose “on button _ when pressed”





You will select the “on button A” from the input drawer.

You will select this command twice.

The second time change the dropdown from “A” to “B”

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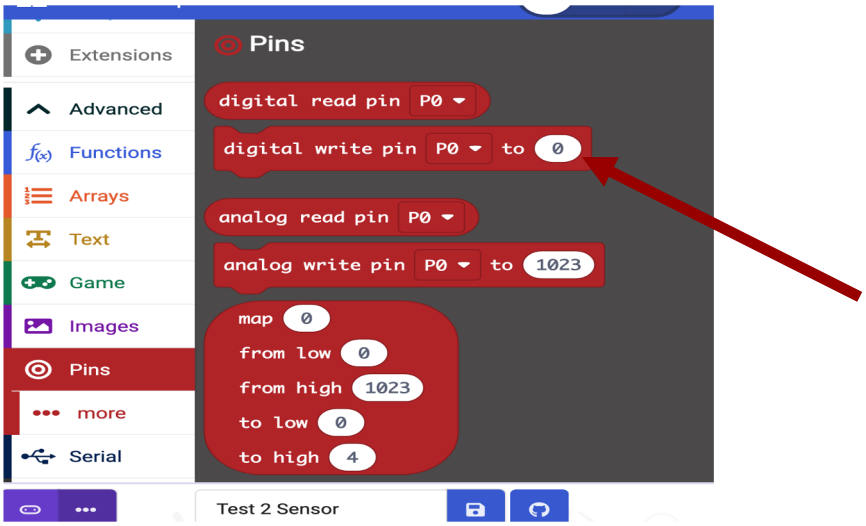
Step 2: Select “Pins” drawer



Choose the pins drawer and select the “digitalwrite pin” command.

Add this to both the “on button _” blocks

These blocks should be free floating in the workspace or not connected to the “on start” nor “forever” block

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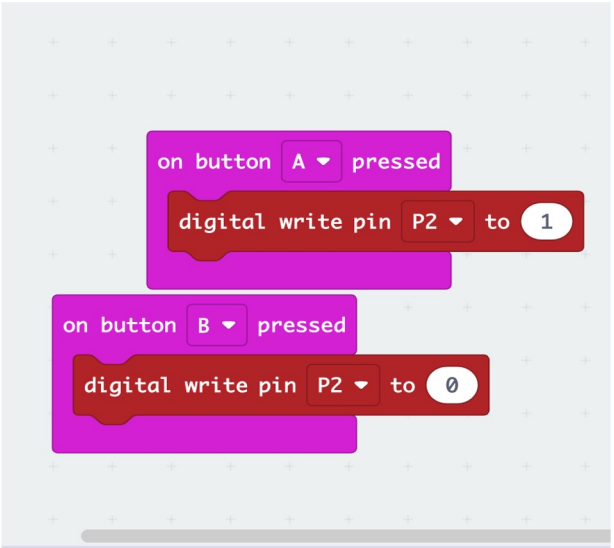
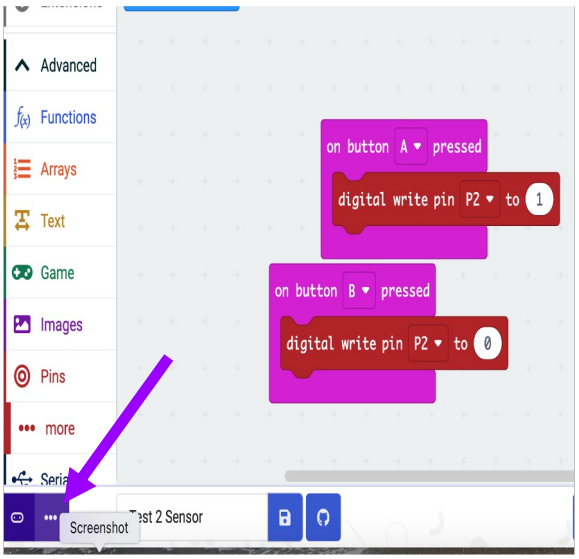
Step 3 : Put your code together and download it





It should look like this…

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What should happen?

When you press **A** on the micro.bit the pump will turn on

When you press **B** on the micro.bit the pump will turn off

50

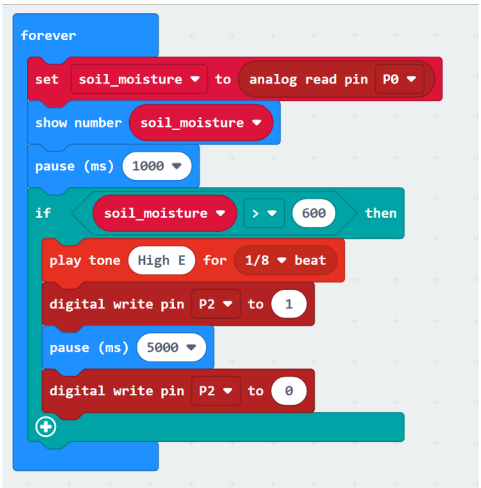
What's next?

How would you control the pump with the sensor?

51

What's next?

How would you control the pump with the sensor?



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