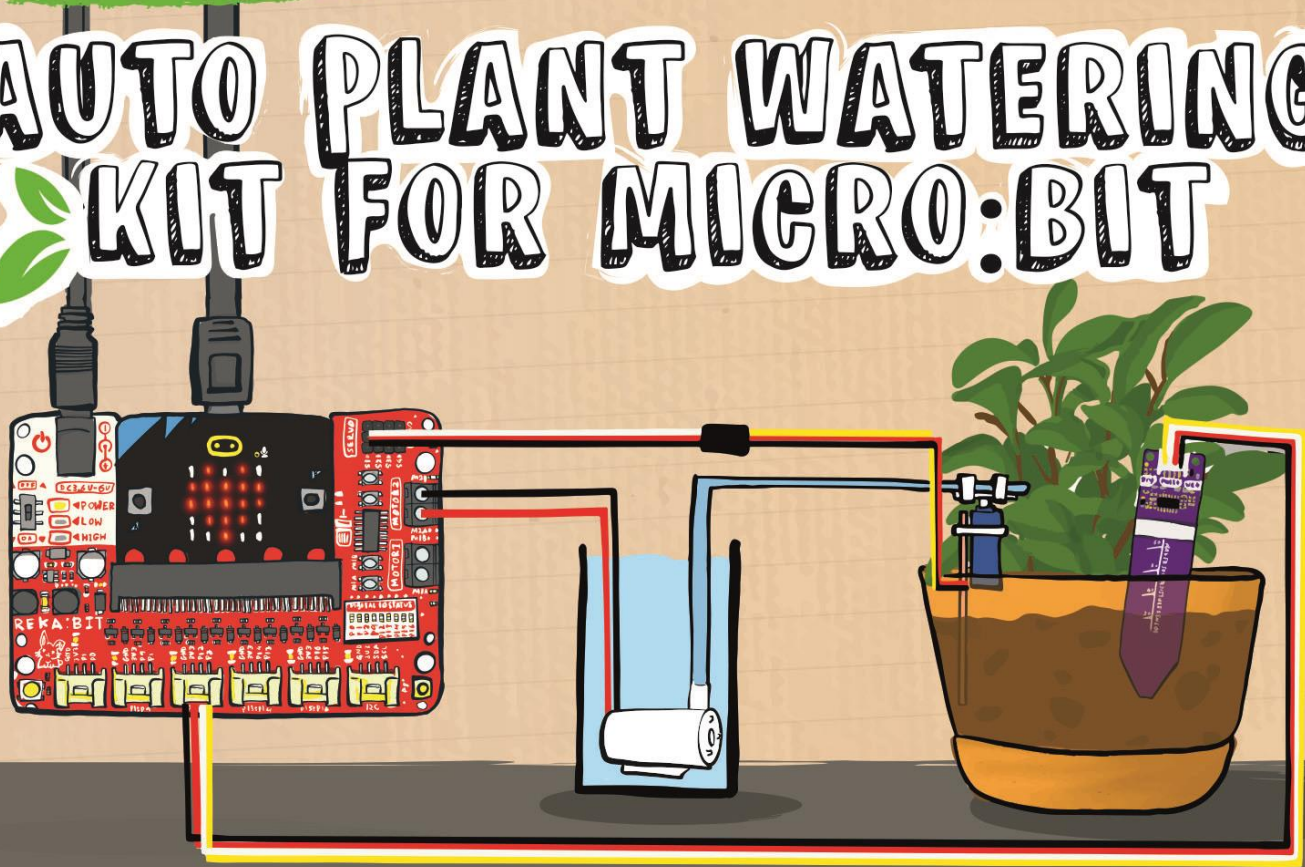


RBT PROJECT KIT

AUTO PLANT WATERING KIT FOR MICRO:BIT



Written by Goh Hao Zhen & Cheryl Ng | Illustrated by Suhana Oazmi

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AUTO PLANT WATERING KIT FOR MICRO:BIT

Written by
Goh Hao Zhen & Cheryl Ng

Illustration by
Suhana Oazmi

April 2022

Published by



WELCOME NOTE

Hi Jr Maker,

Do you sometimes forget to water your plant? If a plant goes without water for too long, it will wilt and die. We won't want that to happen, right?

In the following pages, we will guide you through the steps to build your own auto plant watering system. You'll learn how to program it to automatically water your plant when the soil is dry.

Once you have the system set up, you won't have to worry about your plant anymore, even when you're away for days!

Are you ready? Let's start!

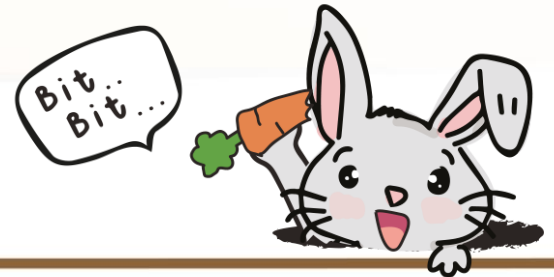


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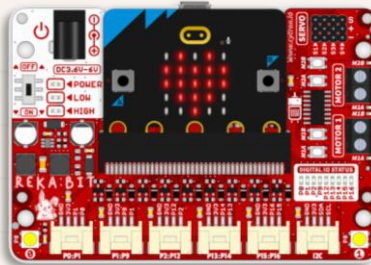
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WHAT'S IN THE KIT?

LESSON GUIDE



REKA:BIT (WITH OR WITHOUT MICRO:BIT)



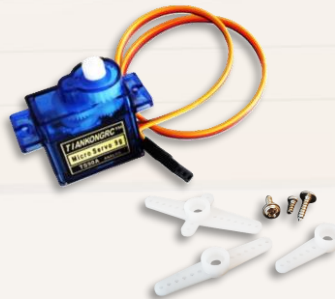
MAKER SOIL MOISTURE SENSOR



WATER PUMP WITH PIPE



SERVO MOTOR



POWER AND DATA CABLE

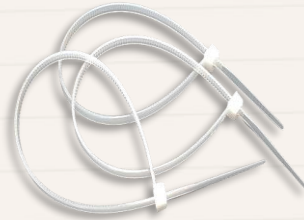


WHAT'S IN THE KIT?

POPSICLE STICK



CABLE TIES



DOUBLE-SIDED TAPES



50CM GROVE CABLE

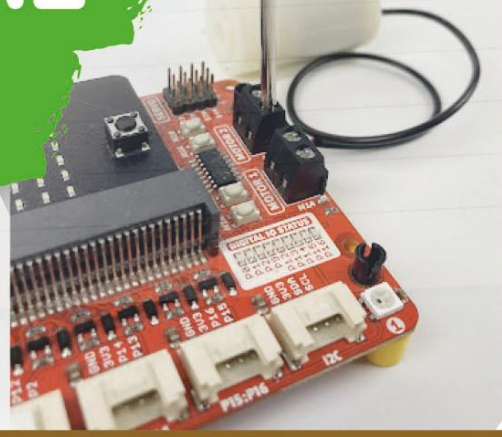
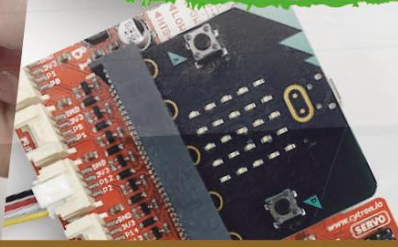


**SERVO EXTENSION
CABLE**



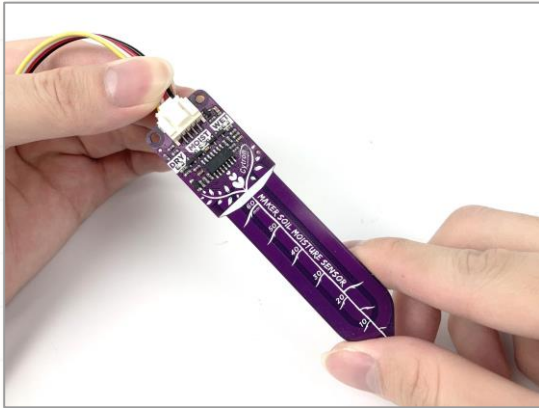
**BATTERY HOLDER &
AA BATTERIES**



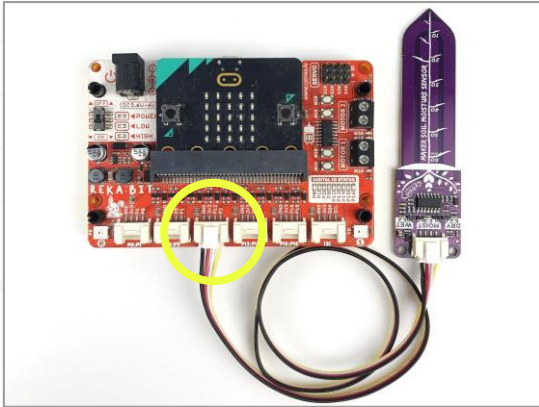


HARDWARE SETUP

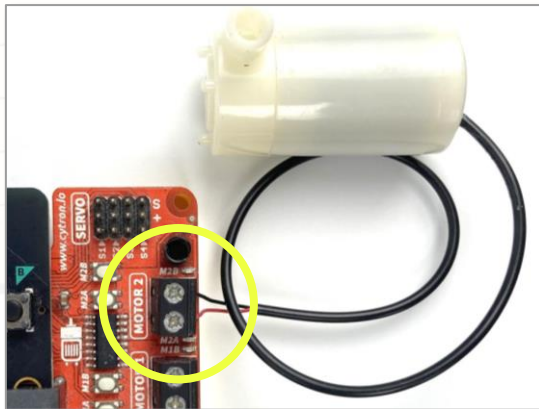
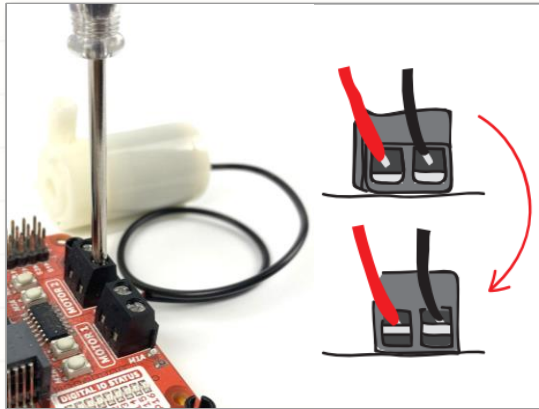
HARDWARE SETUP



1. Connect the Maker Soil Moisture Sensor to port **P2:P12** on REKA:BIT.



HARDWARE SETUP



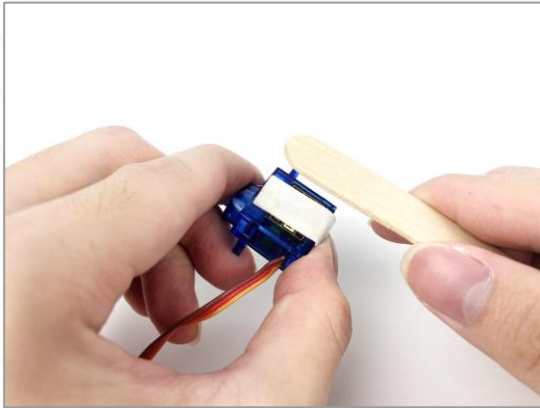
2. Connect the water pump wires to **MOTOR 2** terminal.

- Insert the exposed ends.
- Tighten the screws using a screwdriver.

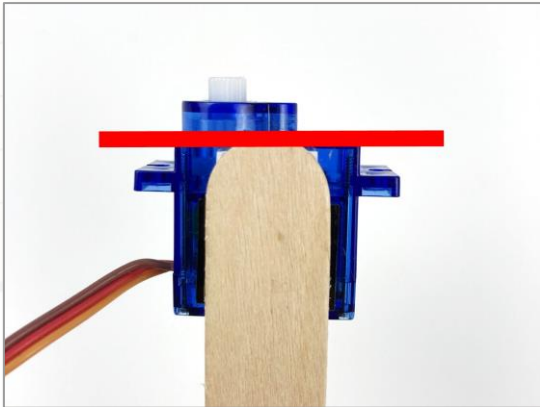
Note: Clamp the exposed wire lead, and not the insulator.

Wire	Port
Black	M2B
Red	M2A

HARDWARE SETUP

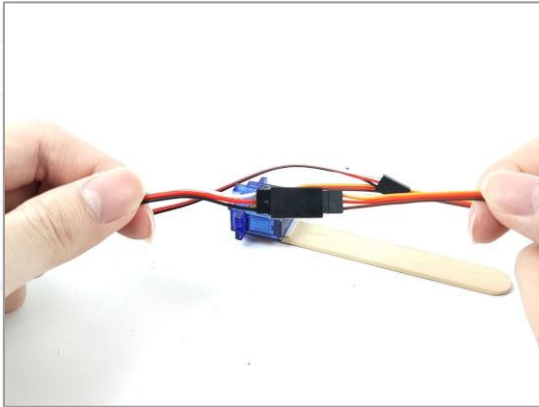
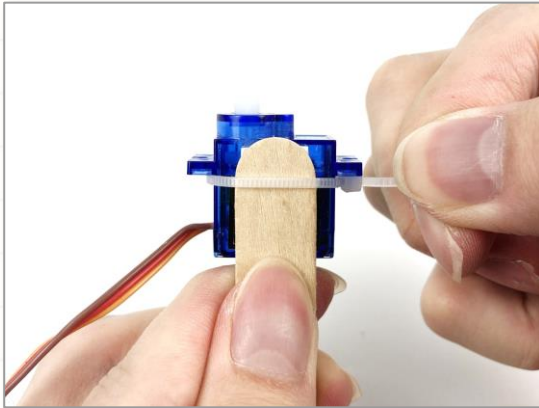


3. Use a double-sided tape to attach the servo motor to a popsicle stick.



Note: Make sure the popsicle stick does not protrude beyond the red line; this is to avoid blocking the servo horn movement.

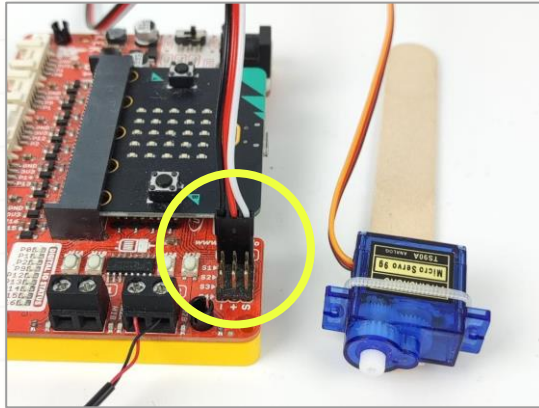
HARDWARE SETUP



4. Further secure the servo motor in place by using a cable tie.
5. Cut off the excess part of the cable tie.
6. Connect the servo extension cable to the servo motor cable.

Servo Motor	Extension Cable
Orange	White
Red	Red
Brown	Black

HARDWARE SETUP



7. Connect the servo extension cable to **servo port S1**.

Servo Extension	Port
White	S (Signal)
Red	+ (Power)
Black	- (Ground)

8. Attach the servo horn to the servo motor.

HARDWARE SETUP

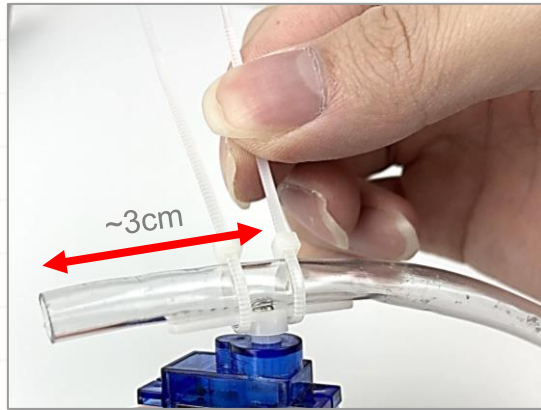


9. Tighten the screw to hold the servo horn in place.



10. Attach the water pipe to the water pump.

HARDWARE SETUP

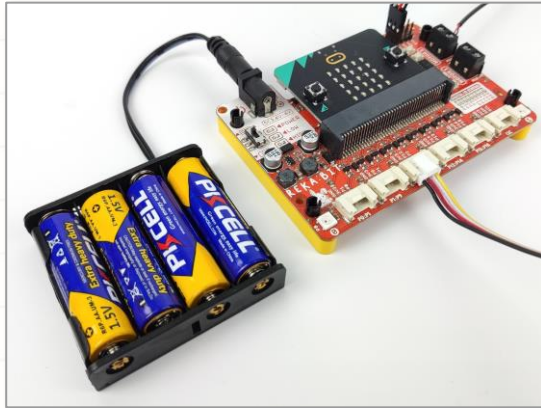


11. Attach the other end of the water pipe to the servo motor horn by using two cable ties.



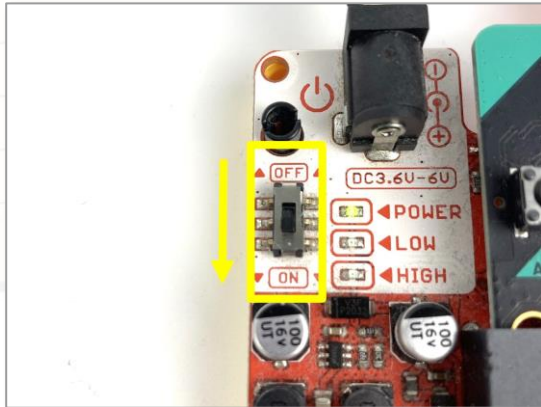
12. Cut off the excess part of the cable ties.

HARDWARE SETUP



13. Insert four AA batteries into the battery holder.

14. Connect the cable to the power jack.



15. Turn on your REKA:BIT.



EXPLORING MAKECODE AND ADDING EXTENSION

forever

show icon

show icon

Download again

Done

Download completed...

New!

Download your code faster by pairing with web usb! Pair now

Don't show this again

Help

Download again

Done

show icon

start

show string

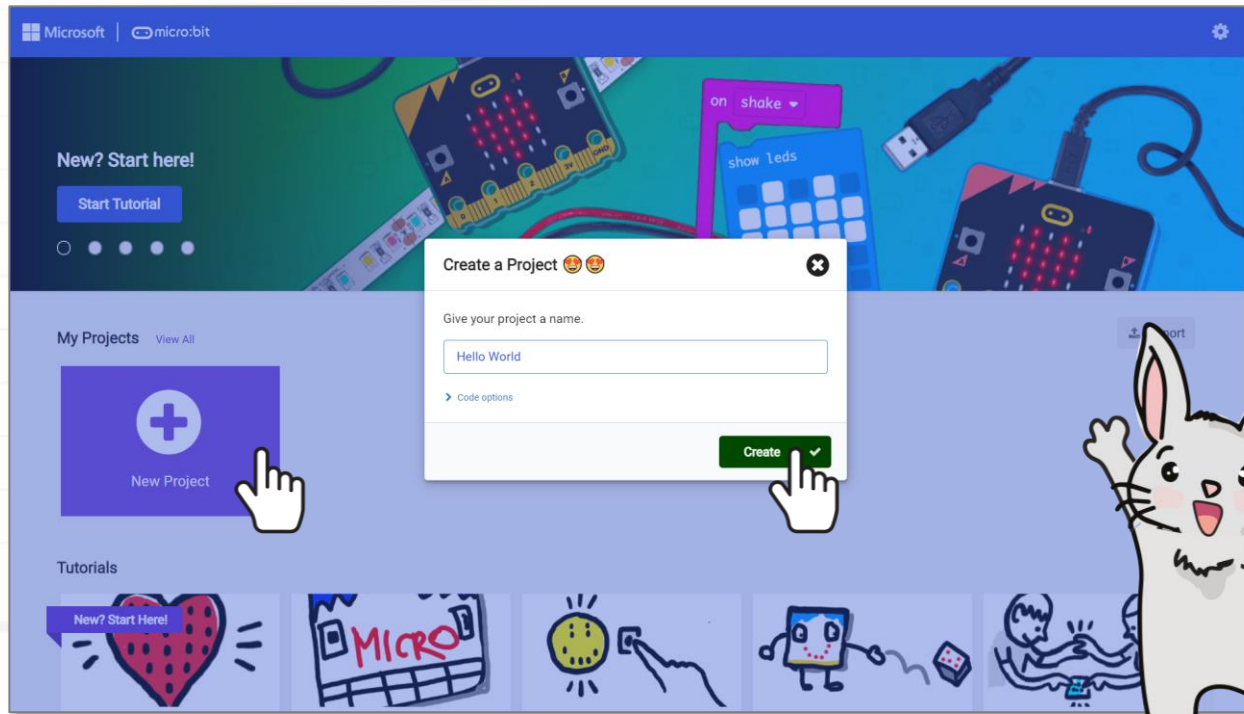
'Hello!'

show icon

Loops

Logic

1. In your browser, go to MakeCode Editor <https://makecode.microbit.org>.
2. Click **“New Project”**, give your project a name and click **“Create”**.



<https://makecode.microbit.org>

A

B

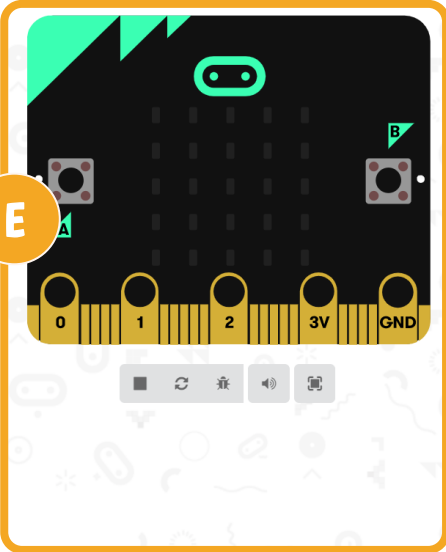
C

D

Microsoft | micro:bit

Blocks

JavaScript



E

Search...

- Basic
- Input
- Music
- Led
- Radio
- Loops
- Logic
- Variables
- Math
- Advanced

F



G

H

Download

I

Hello World!

J

K

L



A Choose to program in Blocks, JavaScript or Python.

B Publish and share your project.

C Open help menu.

D Change settings, connect device, add extensions, etc.

E **Simulator** - Show you a simulation of your code.

F **Toolbox/Category Drawer** - Get the coding blocks that you need here.

G **Programming Workspace** - Build your code here by snapping blocks together.

H Click to download your code to REKA:BIT.

I Name and save current project to your computer.

J Create GitHub repository


K Undo/Redo

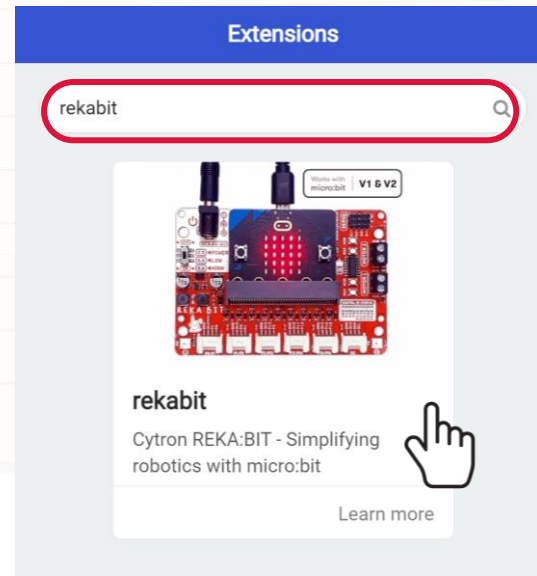
L Zoom in/out



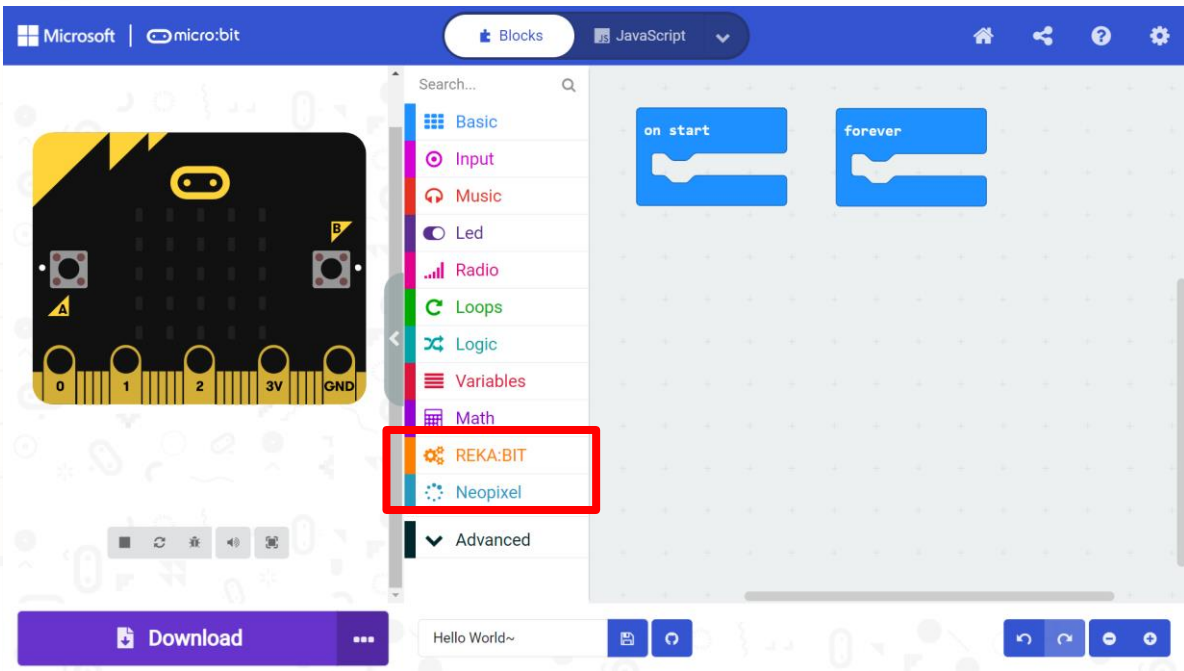
ADD REKA:BIT EXTENSION

Next, you need to add REKA:BIT extension to your MakeCode. Note: **REKA:BIT extension** is a set of custom blocks that we add to MakeCode Editor to enable us to easily program REKA:BIT board.

1. Click the “settings”  icon.
*at the upper right hand corner
2. Select “**Extensions**”.
3. Search for “**rekabit**”.
4. Click to select rekabit extension.



After it is done loading, you'll notice new category drawers for REKA:BIT and Neopixel in your MakeCode Editor. Now, let's start coding!



Let's start!

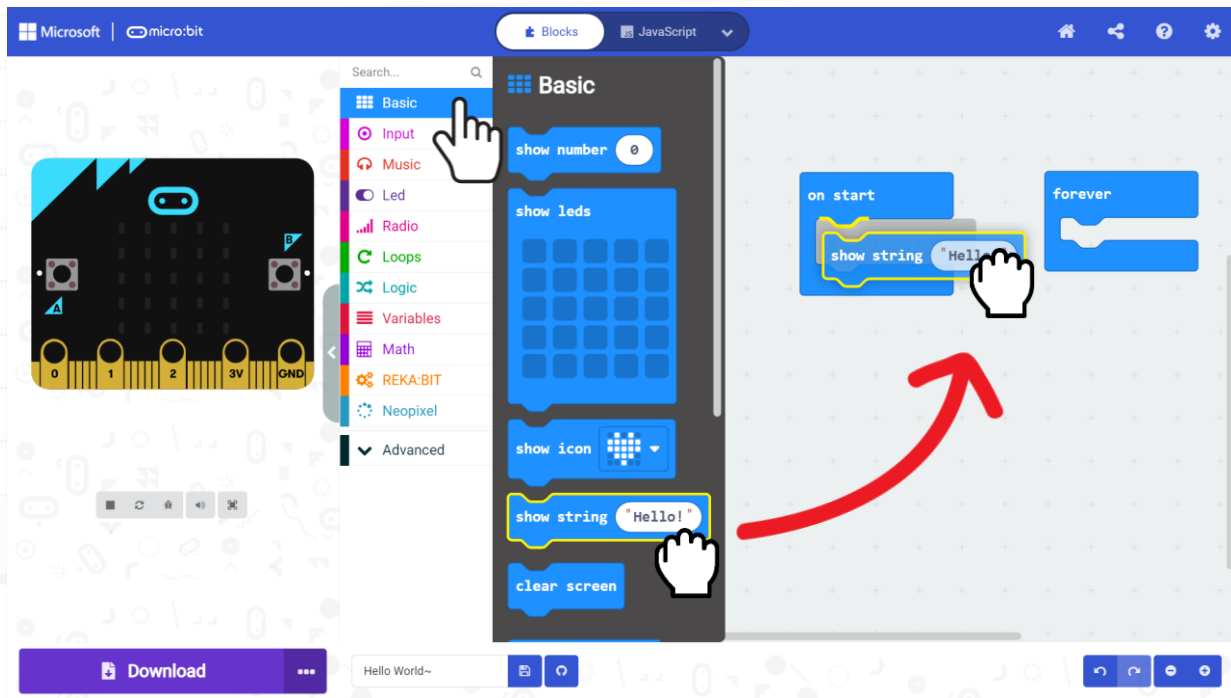


LESSON 1:

HELLO!

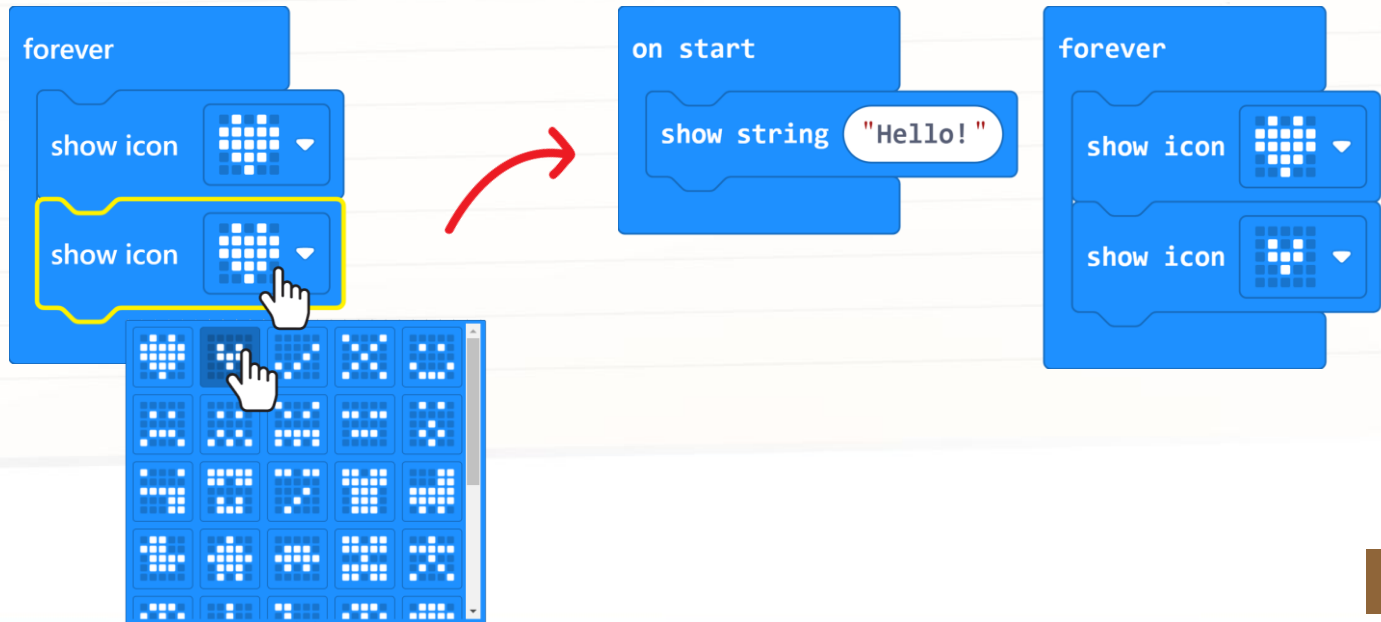
LESSON 1 : HELLO !

1. Click **[Basic]** and select **[show string]** block.
2. Click, drag and snap **[show string]** block to **[on start]** block.



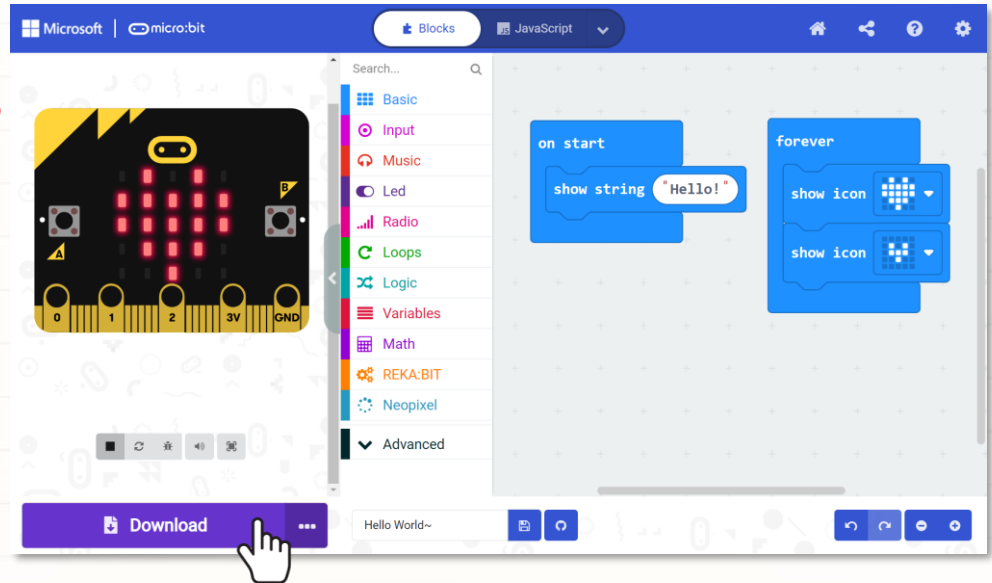
LESSON 1 : HELLO !

3. Click **[Basic]** again and select **[show icon]** block.
4. Click, drag and snap **[show icon]** block to **[forever]** block
5. Repeat steps 3 and 4 to add another **[show icon]** block.
6. Click on the icon of the second block and select 'small heart'.



LESSON 1 : HELLO !

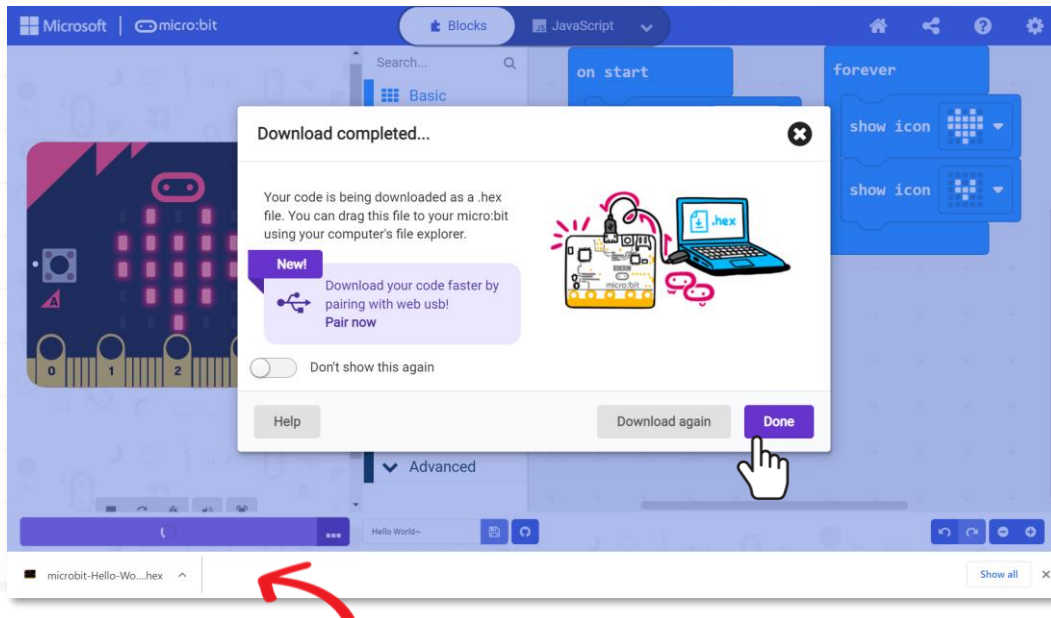
The **simulator** will display how your program will look like running on a micro:bit.



7. Connect REKA:BIT to your laptop with the USB cable provided.
8. Click the **[Download]** button to flash code to your device.

LESSON 1 : HELLO !

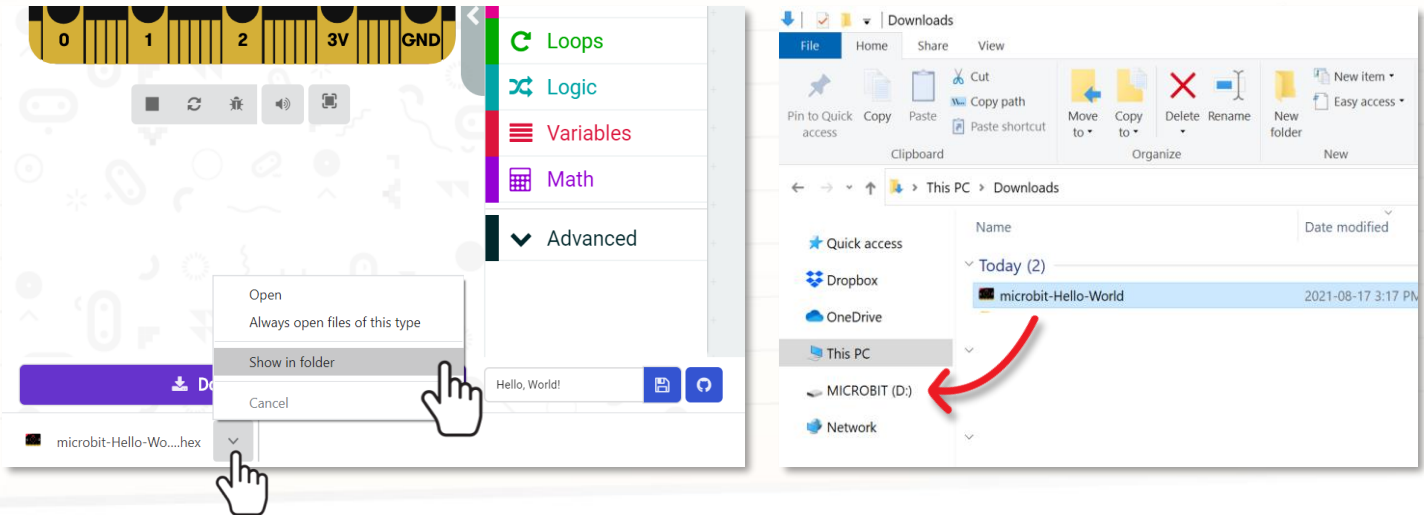
A “Download completed...” pop-up window will appear on your screen. Click [Done] to close the window.



You'll see a downloaded .hex file at the bottom left of the browser.

LESSON 1 : HELLO !

9. Click on the arrow icon and select **'Show in folder'**.
10. Click and drag the highlighted microbit-xxx.hex file to the MICROBIT drive, as if you were copying a file to a flash drive.



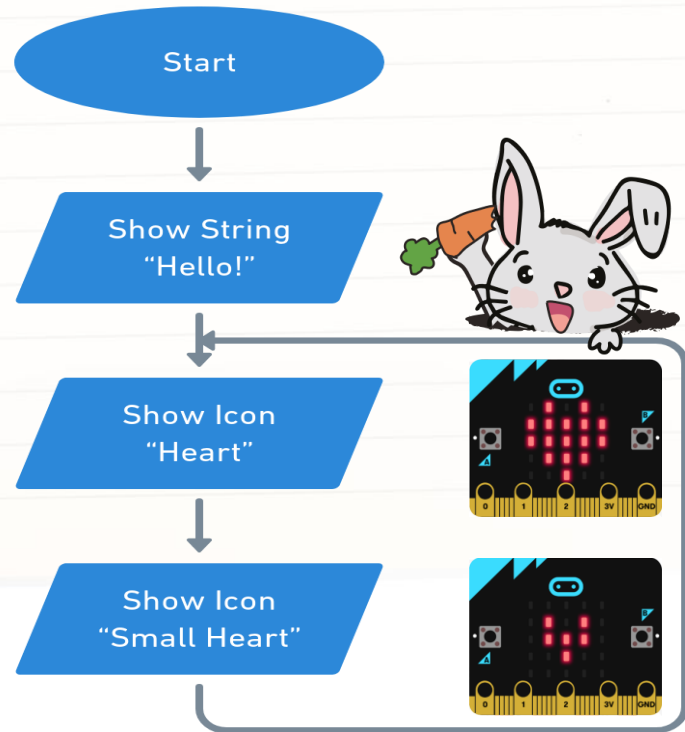
Note: Make sure your REKA:BIT is connected to your computer.

LESSON 1 : HELLO !

You will see the text “Hello!” scroll across the micro:bit LED display, and then followed by a beating heart animation which loops forever.

When powered up, the code in the **[on start]** block is executed one time.

The code in the **[forever]** block runs over and over again (in an endless loop) until the power is switched off.



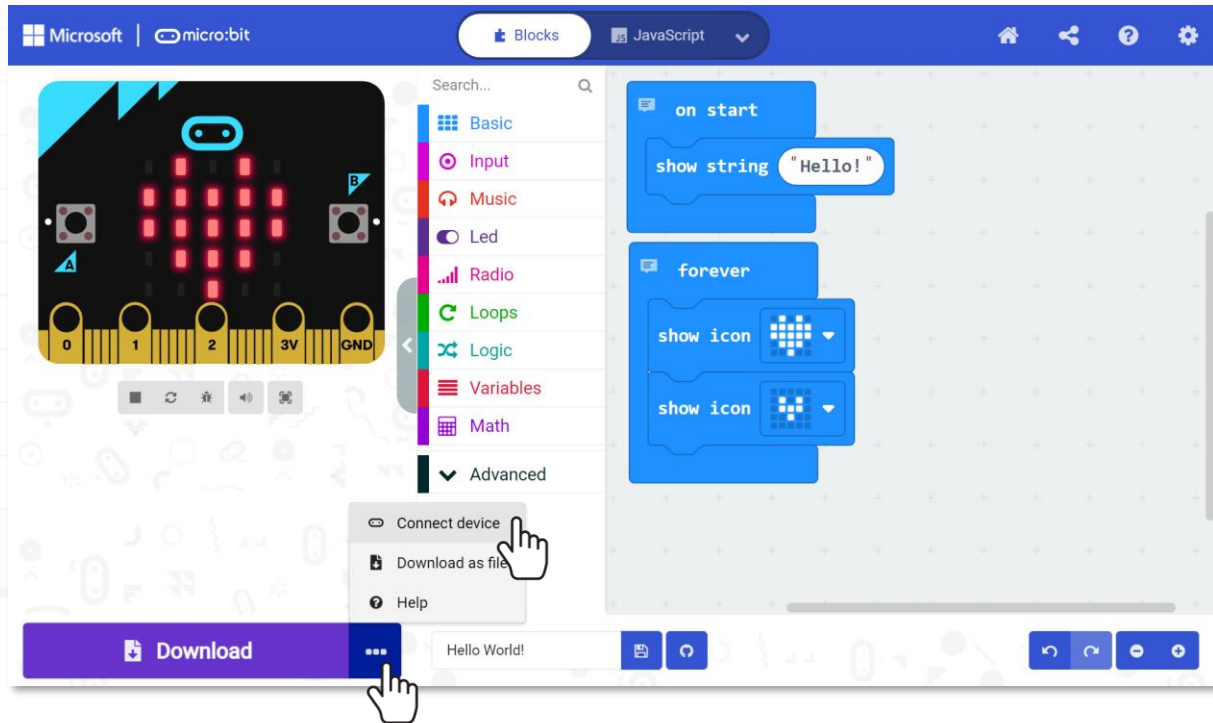
DO YOU KNOW ?

You can pair REKA:BIT with your computer to make it easier to flash your code. Once connected, you can directly download code to your REKA:BIT board with just ONE single click. Yeah!~

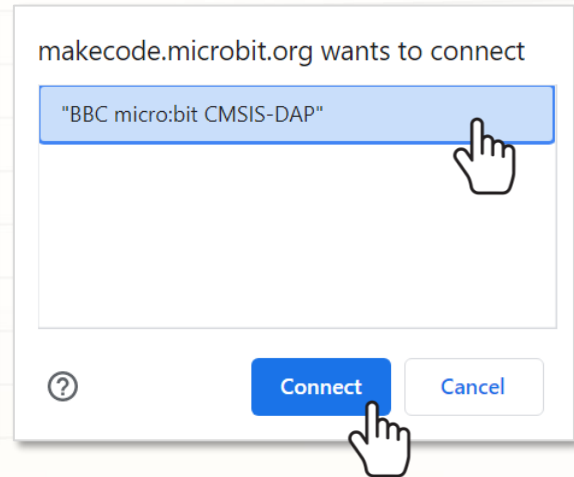
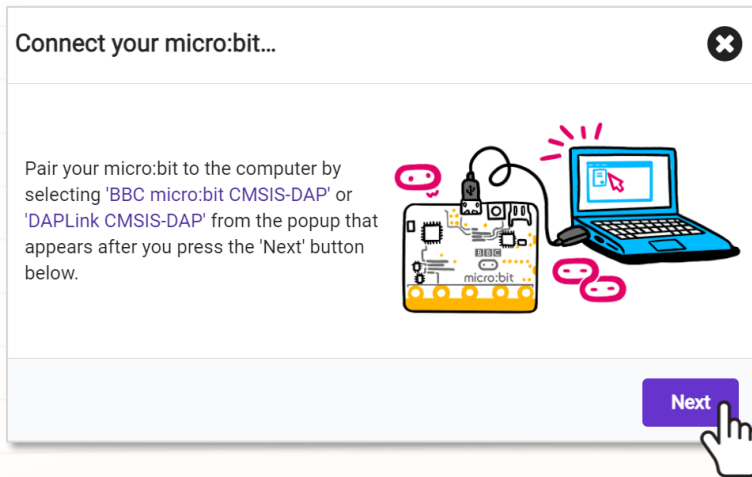
Note: You need to use either the new Edge or Chrome browser; and have the latest firmware on your micro:bit device.



1. Plug in REKA:BIT to your PC. Click the three dots next to the **[Download]** button, and then select **[Connect device]**.



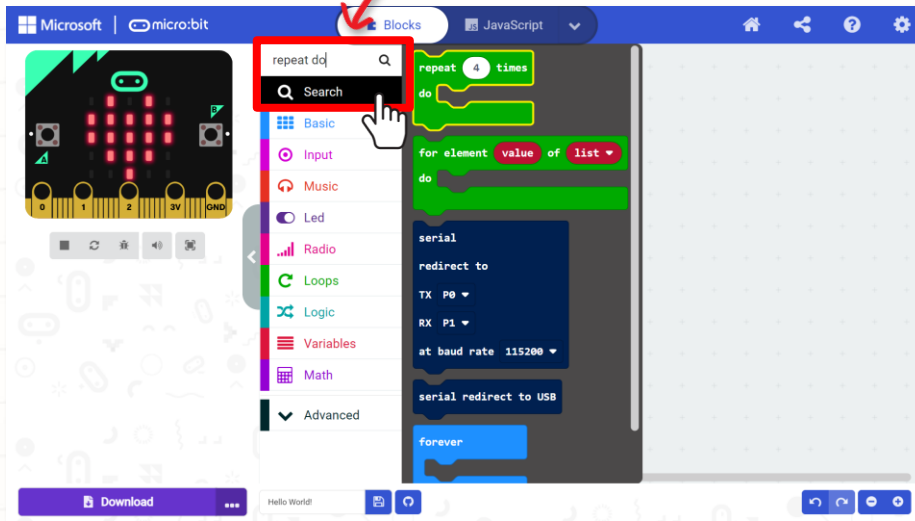
2. Follow the on-screen instructions. Select '**BBC micro:bit CMSIS-DAP**' or '**DAPLink CMSIS-DAP**' from the list and then click [**Connect**].



If you have problems connecting your device, you can refer to <https://makecode.microbit.org/device/usb/webusb/troubleshoot> for more info and guidance.

DO YOU KNOW?

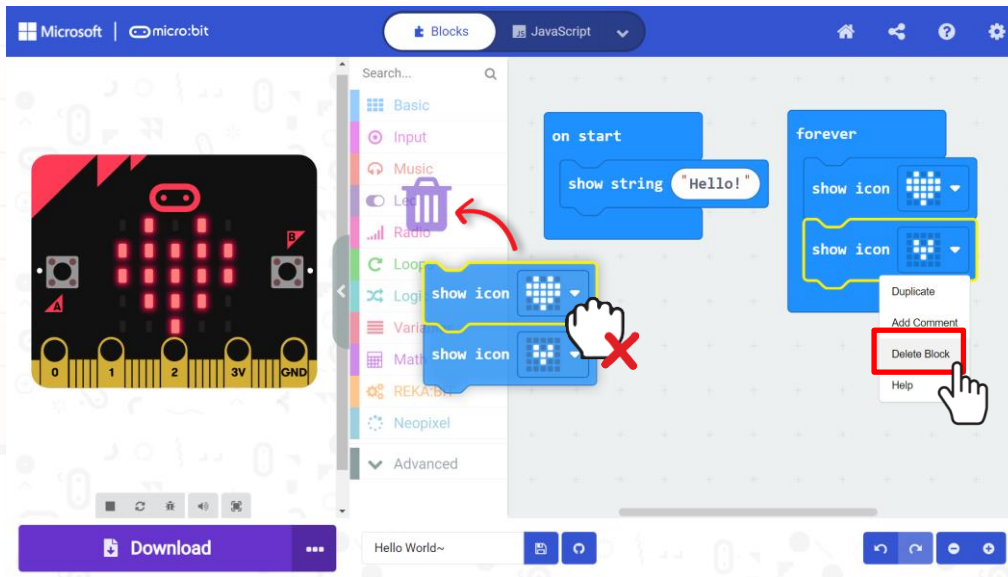
You can type keywords in the **search box** to find coding blocks that you need.



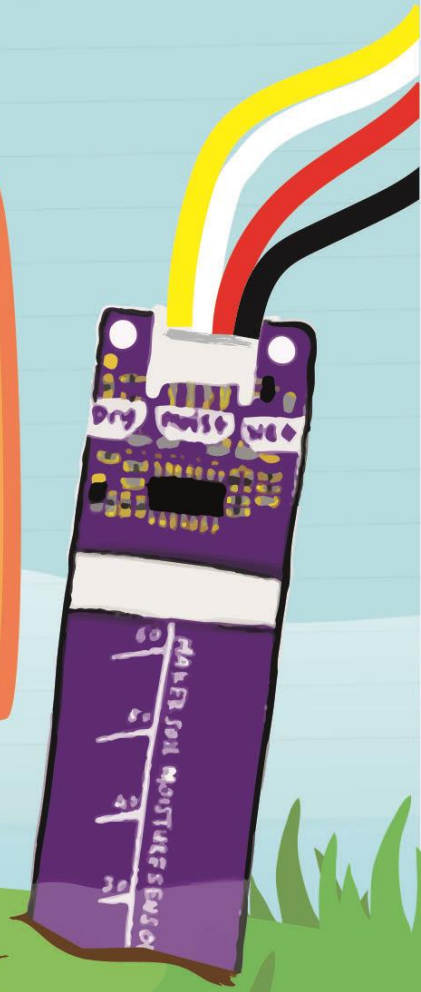
And if you have a sample code for reference, you can easily find blocks you need to build the code by referring to the colour of each block and clicking the category drawer with the same colour.

DO YOU KNOW?

You can delete blocks by clicking and dragging the unwanted blocks to the Toolbox area. Release to delete the blocks when the bin icon appears. Alternatively, you can right click the block and select **“Delete Block”**.

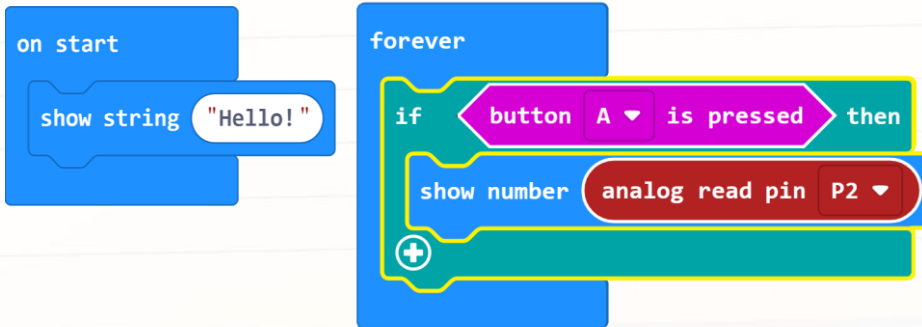


LESSON 2:
WHAT'S THE SOIL
MOISTURE LEVEL?



LESSON 2 : WHAT'S THE SOIL MOISTURE LEVEL?

1. Delete the **[show icon]** blocks from the previous lesson and then add the following highlighted blocks to the **[forever]** block. You can find the blocks in their respective category drawers below by referring to the colour of each block.

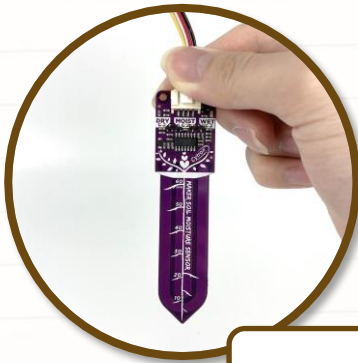


Note: Remember to change the pin number to **P2** as we've connected the Maker Soil Moisture Sensor to port P2 on REKA:BIT.

2. Flash the code to your REKA:BIT.

LESSON 2 : WHAT'S THE SOIL MOISTURE LEVEL?

3. Power up your REKA:BIT. Press **Button A** to check the moisture level reading for the following conditions:
- Hold the sensor in mid-air. Make sure the sensor probe is dry.
 - Insert the sensor probe in a cup of water.



Do you notice that the reading is high when the sensor probe is dry? And the reading is relatively lower when the sensor probe is inserted in a cup of water?

4. Record the reading for each condition in the space provided.


EXPLORE & OBSERVE

Next, insert the sensor probe into the soil of a potted plant (until the white line). Slowly add water into the pot and periodically read the soil moisture level by pressing Button A.

What trend do you observe? Does the value increase  or decrease  when water is added?

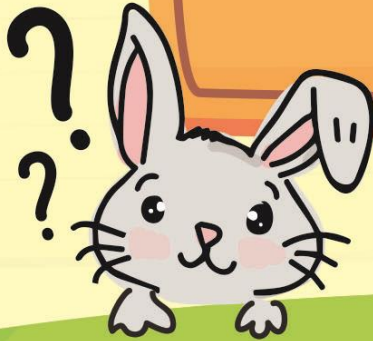
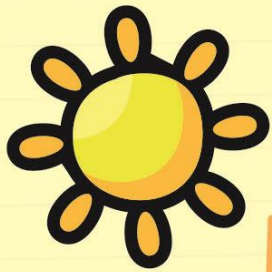
Stop watering when you observe that the soil is suitably moist for your plant. Record the reading.

Note: Different plants require different amounts of water.



Optimum moisture level for my plant:

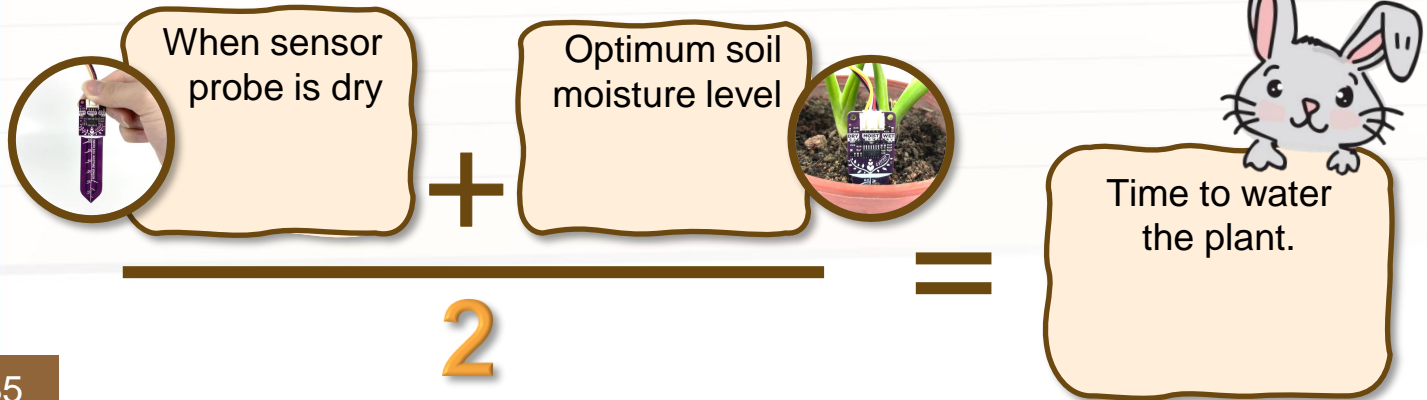




LESSON 3 : DRY? MOIST? WET?

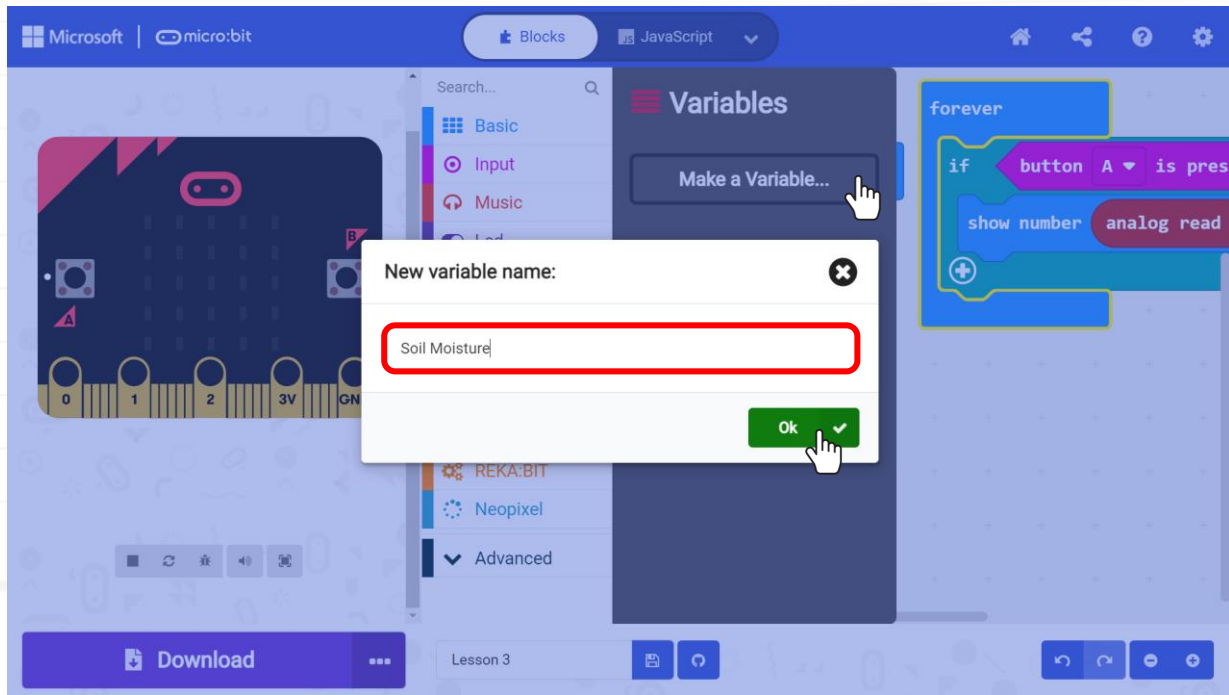
All plants need water to survive! If the soil is too dry, the plant will wilt and die. Let's program REKA:BIT to monitor the soil moisture level and alert us when the soil is drying out and the plant needs watering.

Fill in the blanks with readings taken earlier in Lesson 2; then calculate to determine the threshold value.



LESSON 3 : DRY? MOIST? WET?

1. Click **Variables** category and select **“Make a Variable”**.
2. Name the new variable **“Soil Moisture”** and click [Ok].



LESSON 3 : DRY? MOIST? WET?

3. Add the highlighted blocks to your code. You can find the blocks you need from the following category drawers.

Basic

Logic

Variables

REKA:BIT

Pins

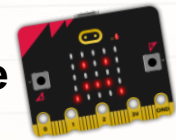
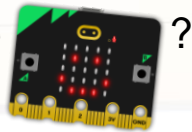
```
on start
  show string "Hello!"

forever
  set Soil Moisture to analog read pin P2
  if button A is pressed then
    show number Soil Moisture
  if Soil Moisture > 650 then
    set all RGB pixels to red
    show icon Basic
  else
    set all RGB pixels to green
    show icon Basic
```

Replace this number with the value you calculated on page 35.

LESSON 3 : DRY? MOIST? WET?

4. Flash the code to your REKA:BIT.
5. Make sure the sensor is inserted into the soil until the white line.
6. Power up your REKA:BIT board and observe the following:
 - i. RGB LEDs on REKA:BIT - Do they light up in **RED** or **GREEN**?
 - ii. LED display on micro:bit - Is it showing a **sad face** or a **smiley face** ?



Do you know what they mean?



LESSON 4:
WATER THE
PLANT



LESSON 4 : WATER THE PLANT

Next, let's program REKA:BIT to **automatically water the plant** when the soil is dry.

1. Add the highlighted blocks to your code. You can find the blocks you need from these category drawers.

Basic

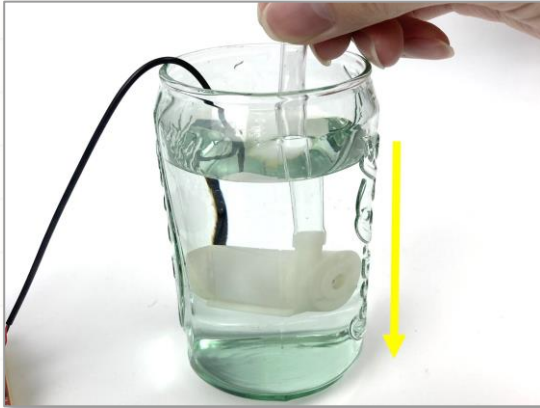
REKA:BIT

2. Flash the code to your REKA:BIT.

Note: Remember to change the motor number to **M2** as the water pump is connected to MOTOR 2 on REKA:BIT.

```
forever
  set Soil Moisture to analog read pin P2
  if button A is pressed then
    show number Soil Moisture
  if Soil Moisture > 650 then
    set all RGB pixels to red
    show icon [dots]
    run motor M2 forward at speed 128
    pause (ms) 5000
    brake motor M2
  else
    set all RGB pixels to green
    show icon [dots]
```

LESSON 4 : WATER THE PLANT



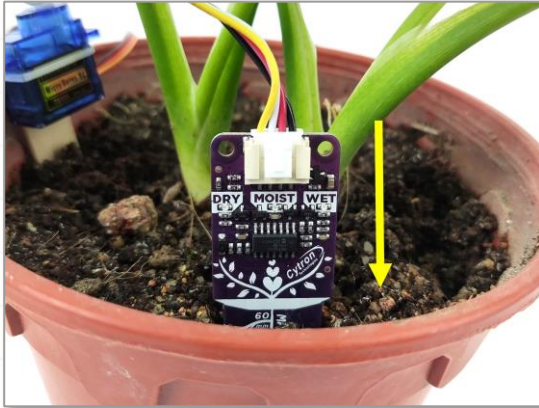
3. Submerge the water pump in a cup (or any suitable container) filled with water.



4. Insert the popsicle stick (with servo motor and water pipe attached) into the soil.

Note: If the soil is very hard, you will need to loosen the soil first before you insert the stick.

LESSON 4 : WATER THE PLANT



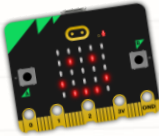
5. Insert the Maker Soil Moisture Sensor into the soil (at a safe distance away from the water pipe).

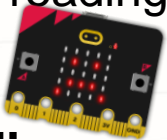
Note: Make sure the exposed part of the sensor stay dry.



6. Power up REKA:BIT and now your plant will automatically be watered when the soil is dry.

LESSON 4 : WATER THE PLANT

When the soil is **moist**, you'll see a smiley face  and the RGB LEDs on REKA:BIT will light up in **GREEN**.

When the soil is **dry** (i.e. sensor reading is higher than the set threshold), you'll see a sad face  and the RGB LEDs will light up in **RED** ...

The motor will then be activated to pump water for 5 seconds.

Note: If you want to test whether your project is working, simply pull out the Maker Soil Moisture sensor and wipe it dry – that should trigger the system to pump water!





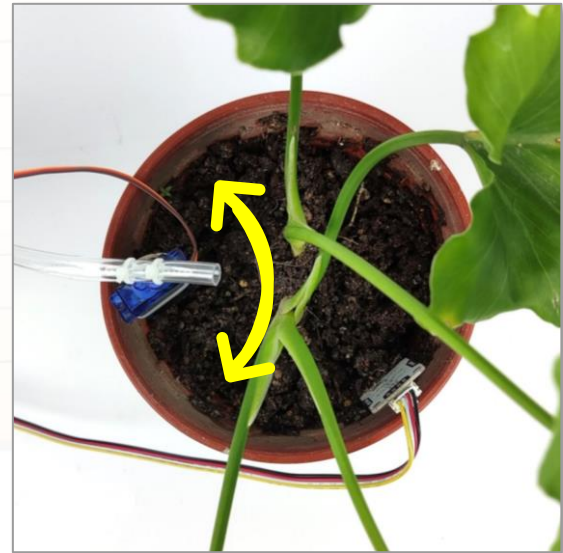
LESSON 5:
SERVO MOTOR,
DIRECT THE PIPE!



LESSON 5 : SERVO MOTOR. DIRECT THE PIPE

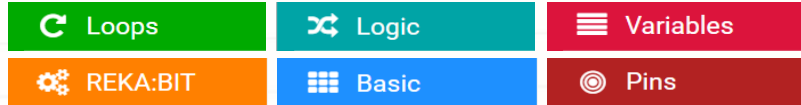
You might have observed that only a small area in the pot is watered. Let's improve the project by directing the pipe to cover a wider area.

To do that, we will program the servo motor to **rotate between 30 and 150 degrees** when the water pump is activated; and **stop when the optimum soil moisture level is achieved**.



LESSON 5 : SERVO MOTOR. DIRECT THE PIPE

1. Replace the **[pause (ms) 5000]** block in your code with the following blocks from



```
forever
  set Soil Moisture to analog read pin P2
  if button A is pressed then
    show number Soil Moisture
  +
  if Soil Moisture > 650 then
    set all RGB pixels to
    show icon
    run motor M2 forward at speed 128
    pause (ms) 5000
    brake motor M2
  else
    set all RGB pixels to
    show icon
```

replace with...

```
run motor M2 forward at speed 128
while Soil Moisture > 500
do
  set servo S1 position to 30 degrees
  pause (ms) 1000
  set servo S1 position to 150 degrees
  pause (ms) 1000
  set Soil Moisture to analog read pin P2
brake motor M2
```

Replace this number with the optimum soil moisture level for your plant (p. 33).

Note: Remember to change the servo number to **S1** as the servo motor is connected to servo port S1 on REKA:BIT.

LESSON 5 : SERVO MOTOR. DIRECT THE PIPE

```
on start
  show string "Hello!"

forever
  set Soil Moisture to analog read pin P2
  if button A is pressed then
    show number Soil Moisture
  if Soil Moisture > 650 then
    set all RGB pixels to red
    show icon [red icon]
    run motor M2 forward at speed 128
  while Soil Moisture > 500
    do
      set servo S1 position to 30 degrees
      pause (ms) 1000
      set servo S1 position to 150 degrees
      pause (ms) 1000
    set Soil Moisture to analog read pin P2
  brake motor M2
  else
    set all RGB pixels to green
    show icon [green icon]
```

2. Flash the code to your REKA:BIT and power it up.

Scan QR for sample code with comments.



[https://link.cytron.io/
auto-plant-watering-
project-code](https://link.cytron.io/auto-plant-watering-project-code)



NOTES

Observe the direction that the water pipe is pointing at when the servo motor rotates. If it points away from the pot, you will need to pull out the popsicle stick (with servo and water pipe attached) and reposition it.



Important Reminder:



Make sure that water from the pipe flows onto the soil in the pot and does NOT wet the Maker Soil Moisture Sensor and REKA:BIT - to avoid damaging electronic components on the board.

ADDITIONAL ACTIVITIES

woohoo!

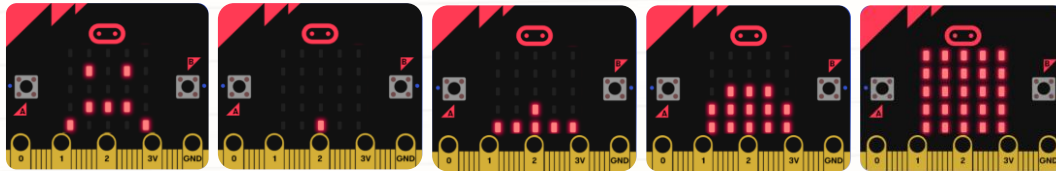


let's try!



ADDITIONAL ACTIVITY 1

A) Visualize Soil Moisture Level (LED matrix on micro:bit)



The number of LED lighted up on micro:bit corresponds with the soil condition – when it is suitably moist, all LEDs will light up; and as the soil dries out, the LEDs will turn off one by one until the threshold is reached and the system is triggered to pump water.

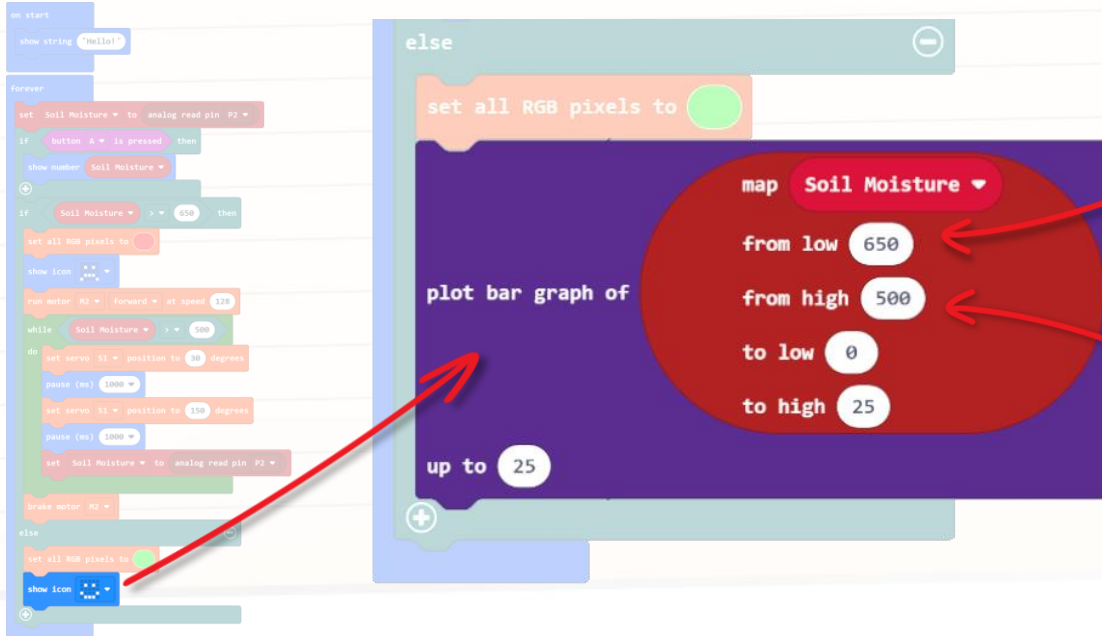
ADDITIONAL ACTIVITY 1

1. Replace the **[show icon]** block in your code with the following blocks from

 Led

 Pins

 Variables



The image shows a Scratch code editor with a script on the left and a zoomed-in view of a 'plot bar graph' block on the right. The 'plot bar graph' block is configured with the following settings:

- map: Soil Moisture
- from low: 650
- from high: 500
- to low: 0
- to high: 25
- up to: 25

Red arrows point from the text on the right to the '650' and '500' values in the 'plot bar graph' block.

Replace this number with the value you calculated on page 35.

Replace this number with the optimum soil moisture level for your plant (p. 33)

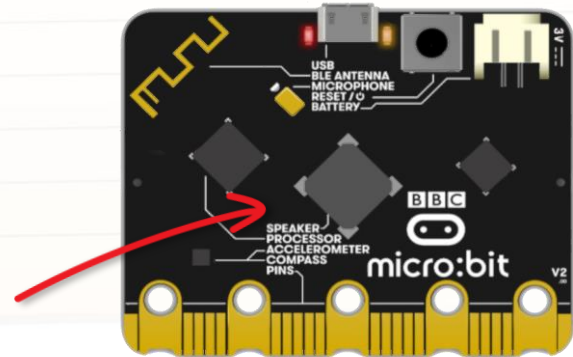
2. Flash the code to your REKA:BIT and power it up.

ADDITIONAL ACTIVITY 2

B) Music On

Do you know you can program your REKA:BIT (with micro:bit V2) to play melodies and sound notifications? For example, you can program it to play a relaxing melody when the soil is suitably moist and play an irritating tone repetitively when it is too dry.

To do that we just add blocks from the  Music category drawer.



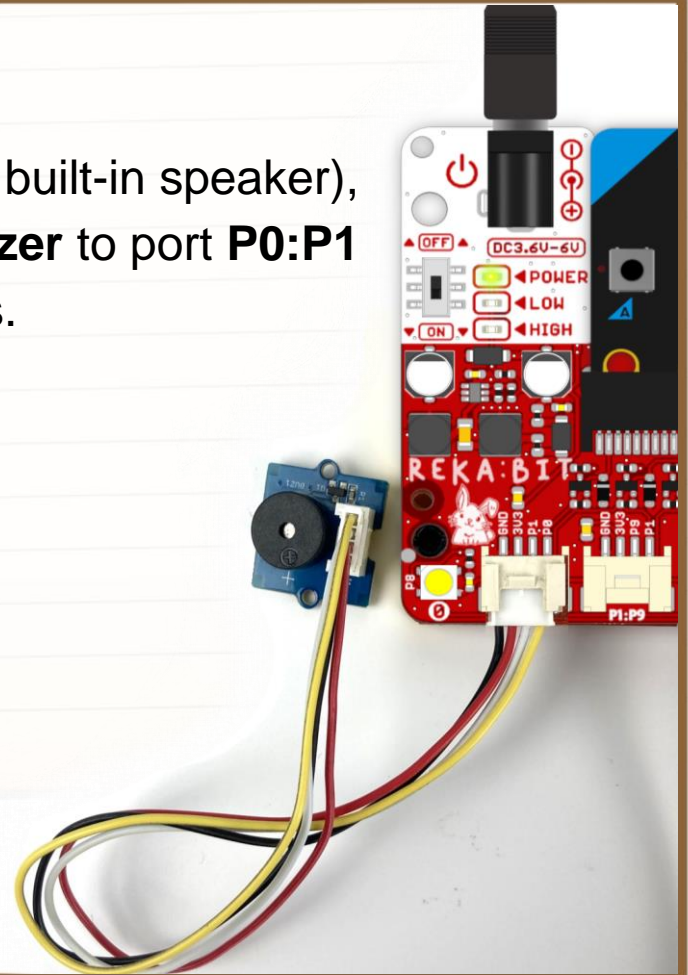
micro:bit V2 comes with a built-in speaker

ADDITIONAL ACTIVITY 2

If you're using **micro:bit V1** (without built-in speaker), you will need to plug in a **Grove buzzer** to port **P0:P1** on REKA:BIT in order to play sounds.

You can get one at ...

<https://cytron.io/p-grove-buzzer>



Woohoo.. Congrats! You've built your own auto plant watering system and learned to program REKA:BIT using MakeCode.

Psst... do you know that you can reuse components in this kit to build other projects? Yes, you can!

For example, you can build an auto pet feeder, a decorative water fountain, etc.

Scan the QR code for more micro:bit project ideas and if you need extra components, you can get them at www.cytron.io

Get creative and keep making ~



[https://link.cytron.io/
apw-projects](https://link.cytron.io/apw-projects)



RBT PROJECT KIT

AUTO PLANT WATERING
KIT FOR MICRO:BIT