

# The Education University of Hong Kong

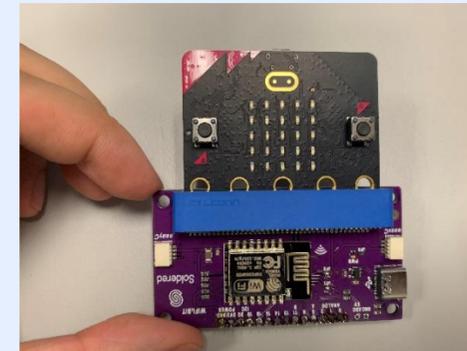
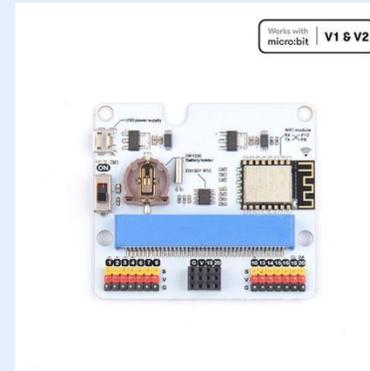
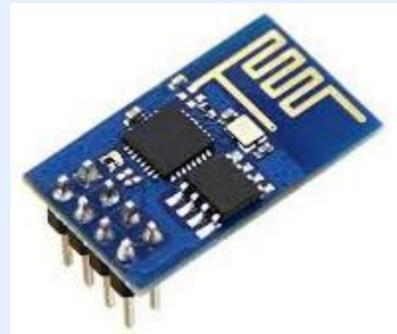
## 2022–2023 Quality Education Fund Thematic Network – Tertiary Institutes

### STEM Project Team

Professional Development Program (3)

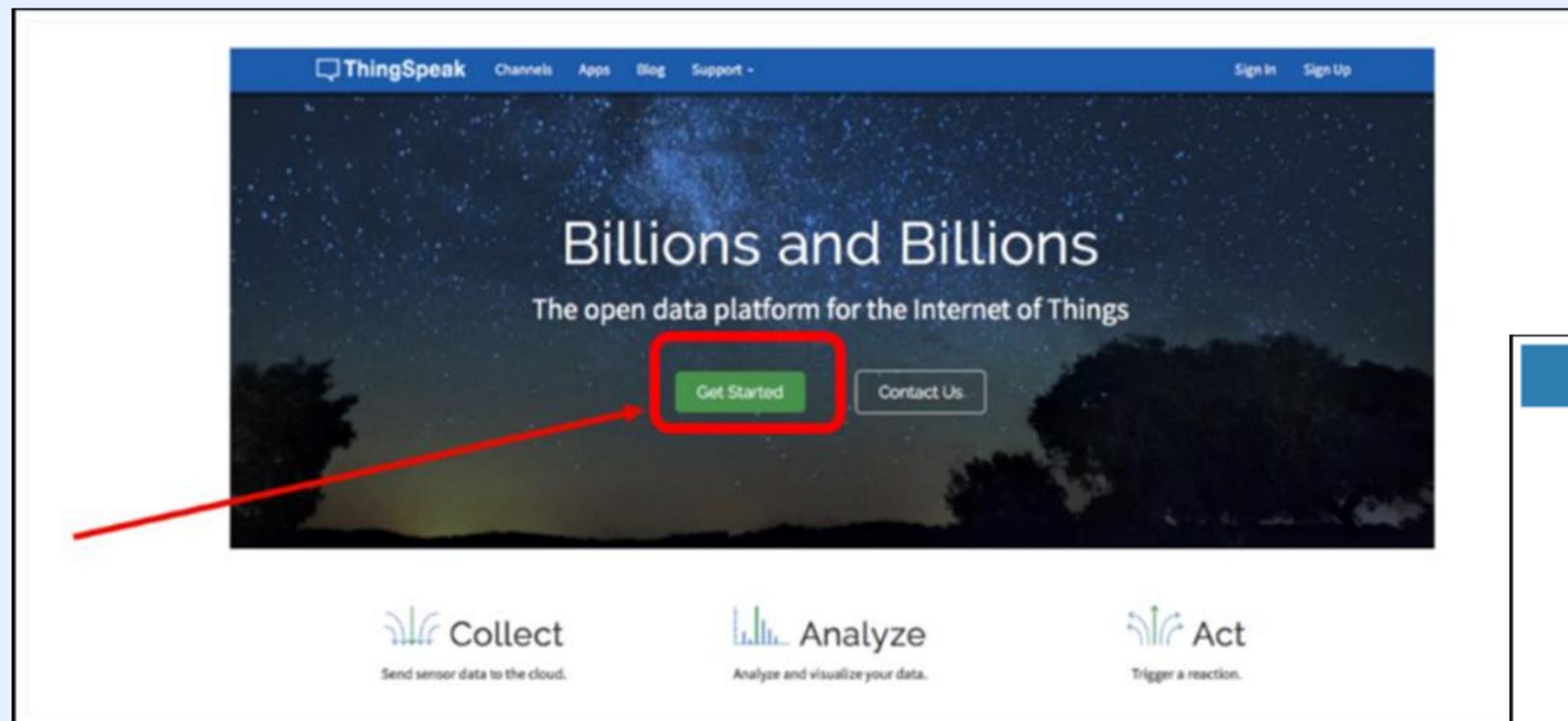
Facilitating Scientific Inquiry with Micro:bit and Internet  
of Things (IoT) Workshop

# Micro:bit IoT Board Comparison

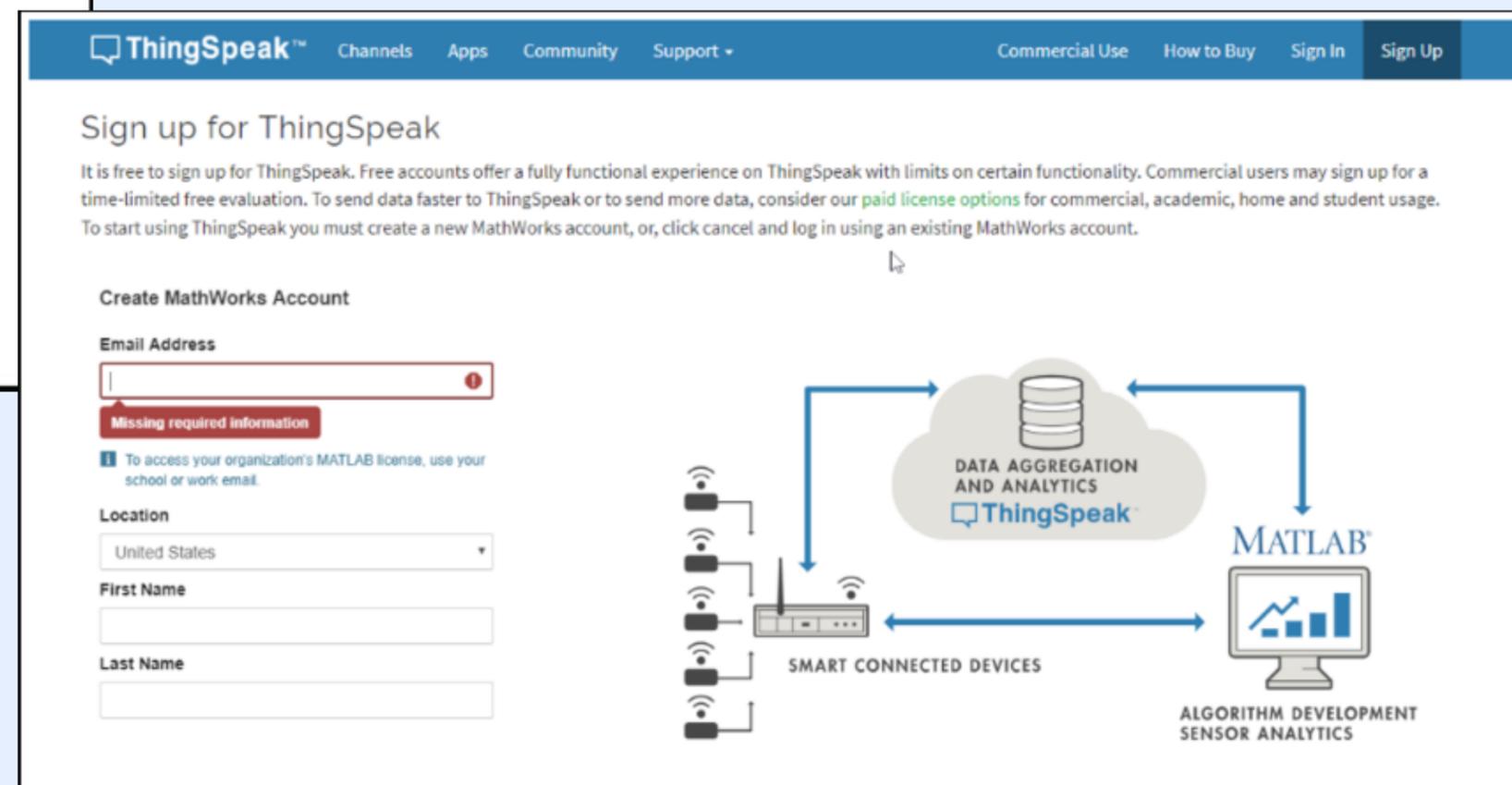


	Esp-01 Wifi module	iot:bit	WiFi:bit	MuseLab
Price (HKD)	6	130	159	646
Difficulty	Advance	Medium	Medium	Easy
Coding platform	Makecode	Makecode	Makecode	Makecode + Scratch + Snap!
IoT Platform Support	ThingSpeak	ThingSpeak, IFTTT, MQTT, Kidslot	ThingSpeak	Cisco, Amazon Alexa, Google Home, IFTTT, ThingSpeak
Source	Esp-01: Taobao or any local STEM material vendors	ELECFREAKS	ETC Educational Technology Connection (HK) Ltd	華輝無線電行有限公司 -門市

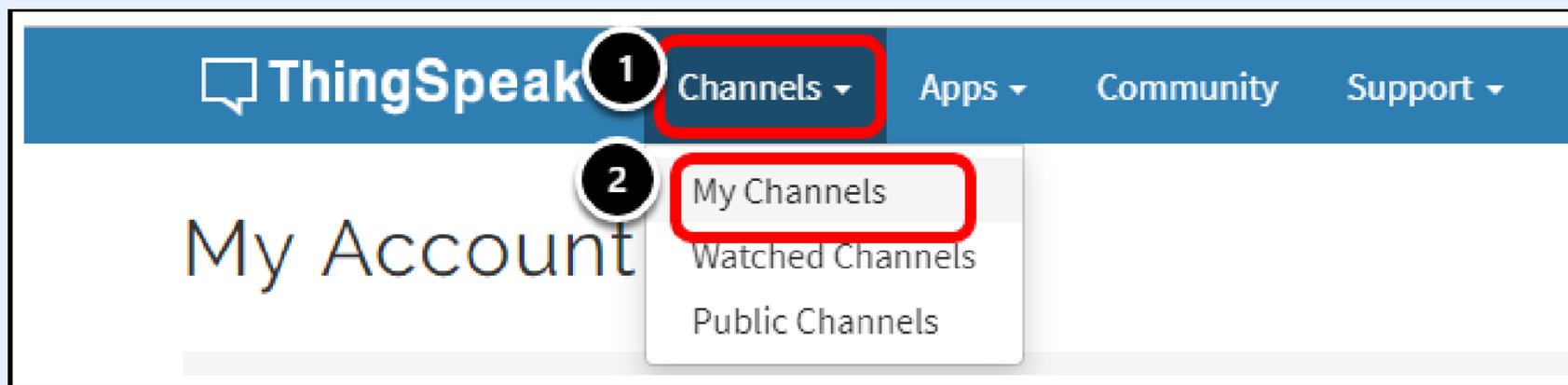
# ThingSpeak Set Up (1)



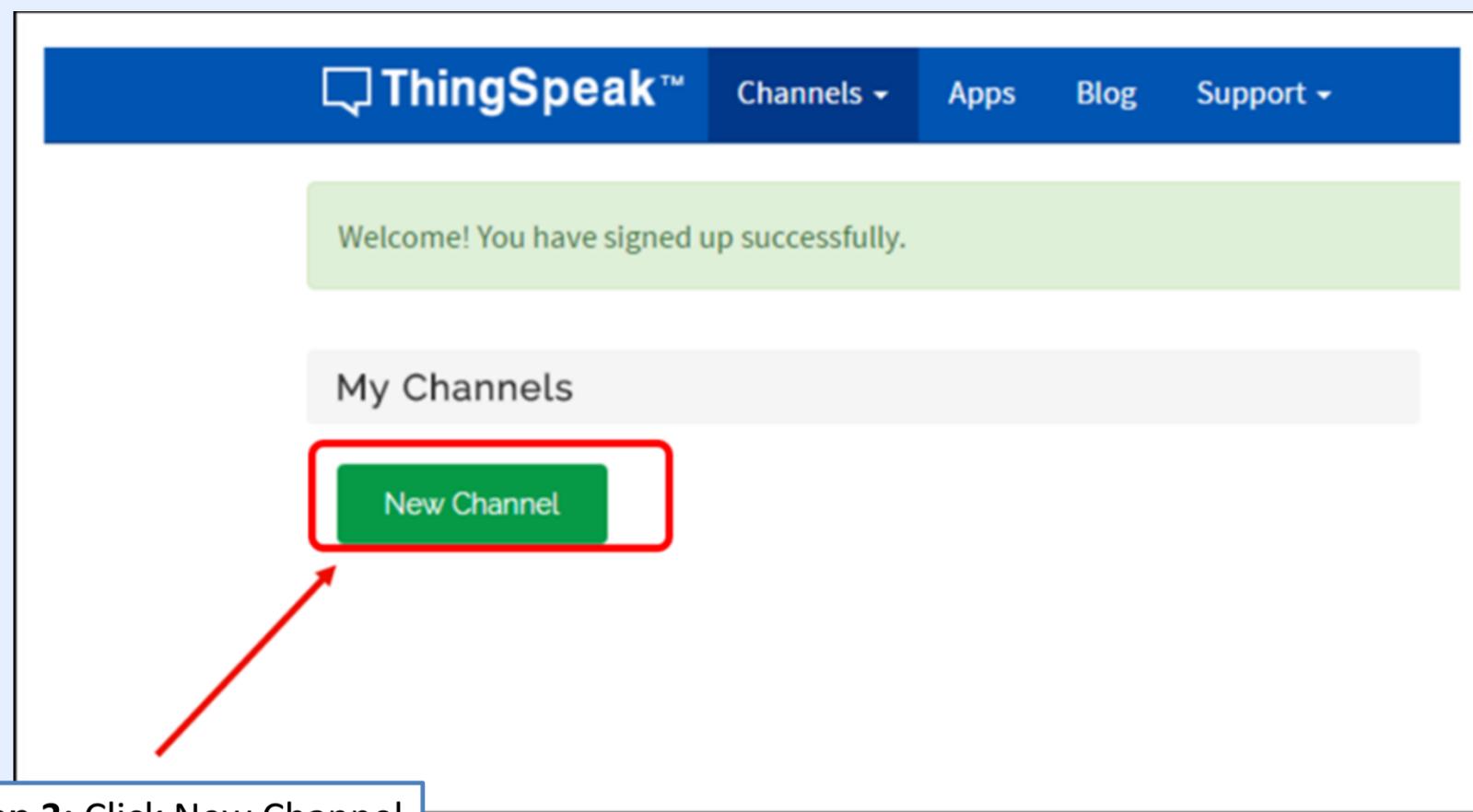
Step 1: Sign up in  
<https://thingspeak.com>



# ThingSpeak Set Up (2)



**Step 2:** After login 'ThingSpeak', click 'Channels' and choose 'My Channels'



**Step 3:** Click New Channel

# ThingSpeak Set Up (3)

## New Channel

Name  "IOT TESTING" (for example)

Description

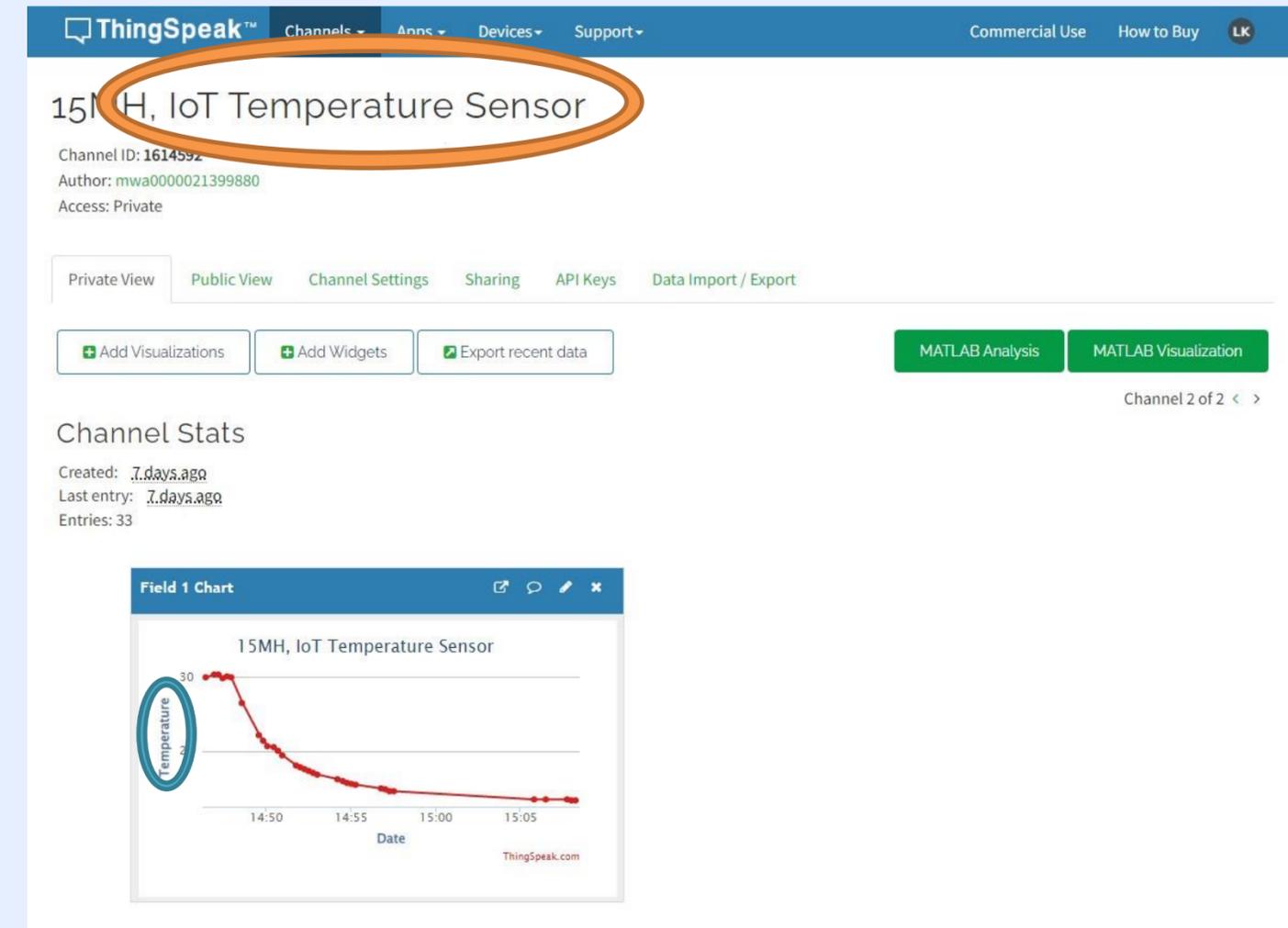
Field 1   "Temperature"

Field 2

Field 3

Field 4

**Step 4:** Enter the name of the Channel and add a name in 'Field' to record the data.



# ThingSpeak Guideline (1)

1. Share

2. Edit (clear data)

3. API Key (Coding)

4. Download data (Excel)

ThingSpeak Channel: 15MH, IoT Temperature Sensor

Channel ID: 1614591  
Author: mwa00000280  
Access: Private

Private View | Public View | Channel Settings | Sharing | API Keys | Data Import / Export

+ Add Visualizations | + Add Widgets | Export recent data

MATLAB Analysis | MATLAB Visualization

Channel 2 of 2 < >

Channel Stats

Created: 7 days ago  
Last entry: 7 days ago  
Entries: 33

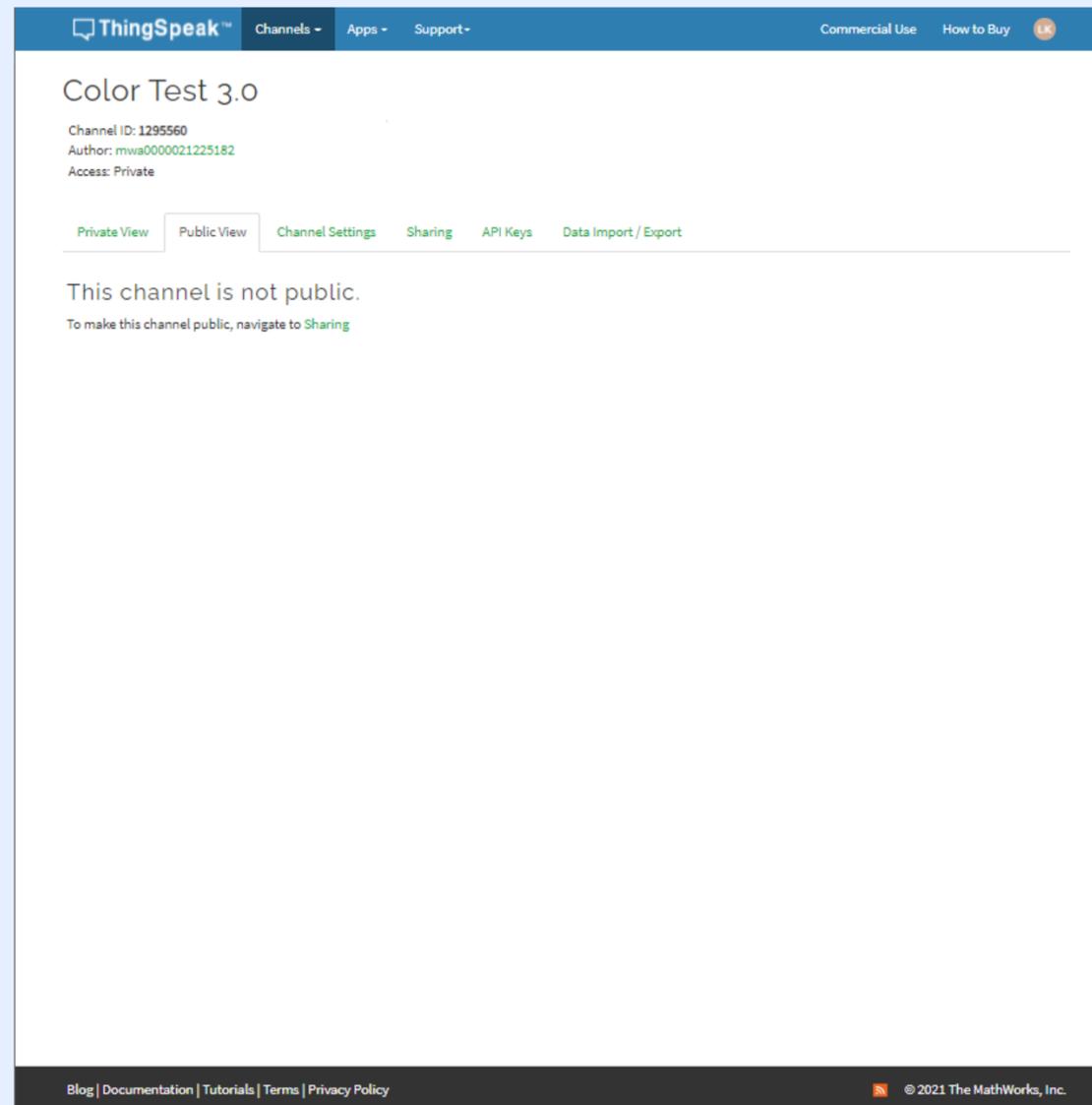
Field 1 Chart

15MH, IoT Temperature Sensor

Date	Temperature
14:50	30
14:51	30
14:52	28
14:53	26
14:54	25
14:55	24
14:56	23
14:57	22
14:58	21
14:59	20
15:00	20
15:01	19
15:02	19
15:03	19
15:04	19
15:05	19

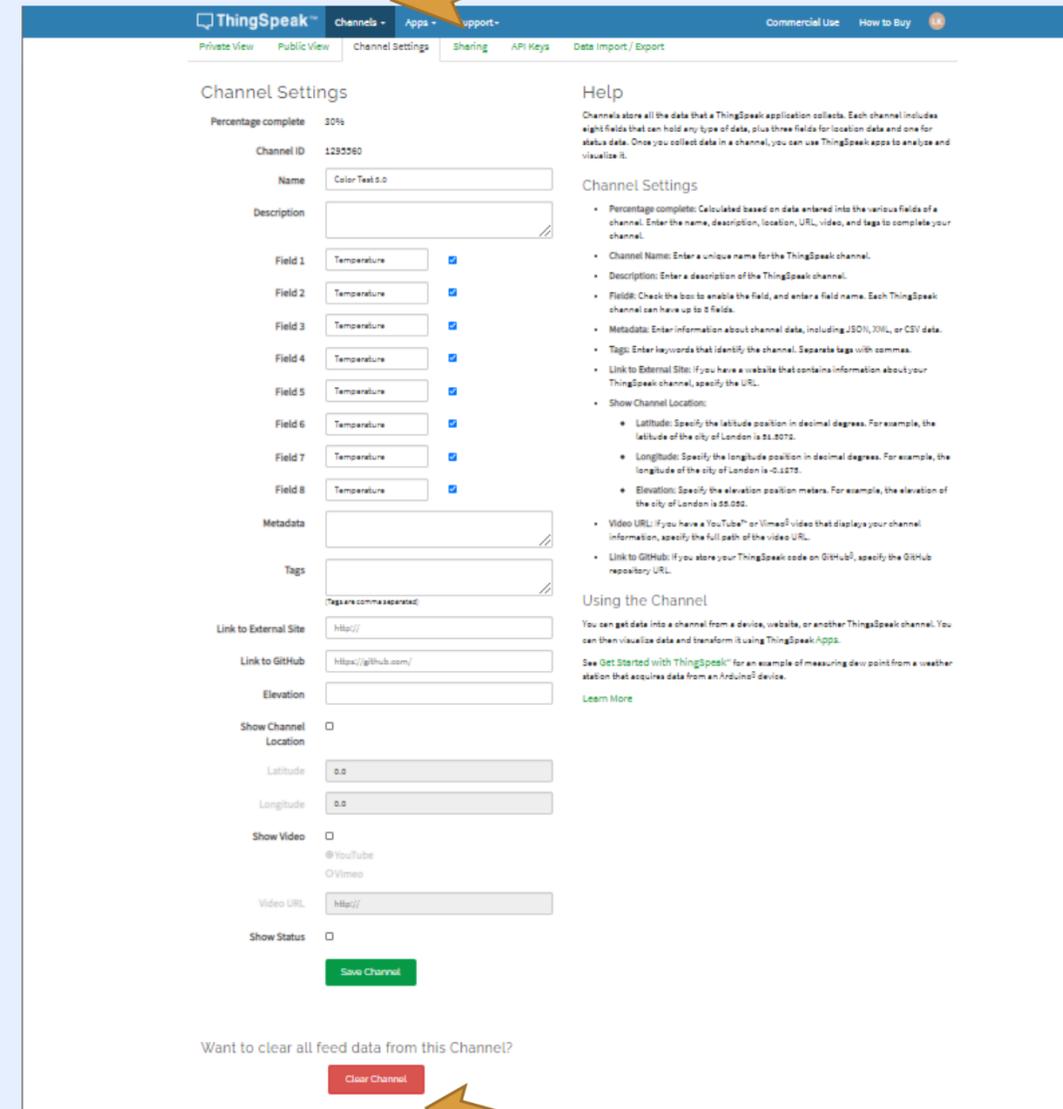
# ThingSpeak Guideline (2)

1.Share



The screenshot shows the ThingSpeak interface for a channel named "Color Test 3.0". The channel ID is 1295560, the author is mwa0000021225182, and the access is set to Private. A message states "This channel is not public. To make this channel public, navigate to Sharing". The "Channel Settings" tab is selected in the navigation bar.

2. Edit(clear data)



The screenshot shows the "Channel Settings" page for the same channel. It includes fields for Name, Description, and up to 8 data fields (all currently set to "Temperature"). There are sections for Metadata, Tags, Link to External Site, Link to GitHub, Elevation, Show Channel Location (with Latitude and Longitude fields), Show Video (with Video URL field), and Show Status. A "Save Channel" button is visible. At the bottom, a prompt asks "Want to clear all feed data from this Channel?" with a red "Clear Channel" button highlighted by an arrow.

Clear Channel

# ThingSpeak Guideline (3)

## 3. API Key (Coding)

Private View Public View Channel Settings Sharing **API Keys** Data Import / Export

### Write API Key

Key

[Generate New Write API Key](#)

### Read API Keys

Key

Note

### API Requests

[Write a Channel Feed](#)

```
https://api.thingspeak.com/update?api_key=GVU4MXNZ2MS5U6VR&field1=0
```

## 4. Download data(Excel)

ThingSpeak Channels Apps Support Commercial Use How to Buy

### Color Test 3.0

Channel ID: 1295560  
Author: mwa0000021225182  
Access: Public

Private View Public View Channel Settings Sharing API Keys **Data Import / Export**

### Import

Upload a CSV file to import data into this channel.

File  No file chosen

Time Zone

[Upload](#)

### Export

Download all of this Channel's feeds in CSV format.

Time Zone

[Download](#)

### Help

#### Import

The correct format for data import is provided in this [CSV Import Template File](#). Use the field names *field1*, *field2*, and so on, instead of custom field names.

**CSV Import Format**

```
dateTime,field1,field3,field4,field8,elevation  
2019-01-01T10:11:12-05:00,11,33,44,88,10
```

#### Other Import and Export Options

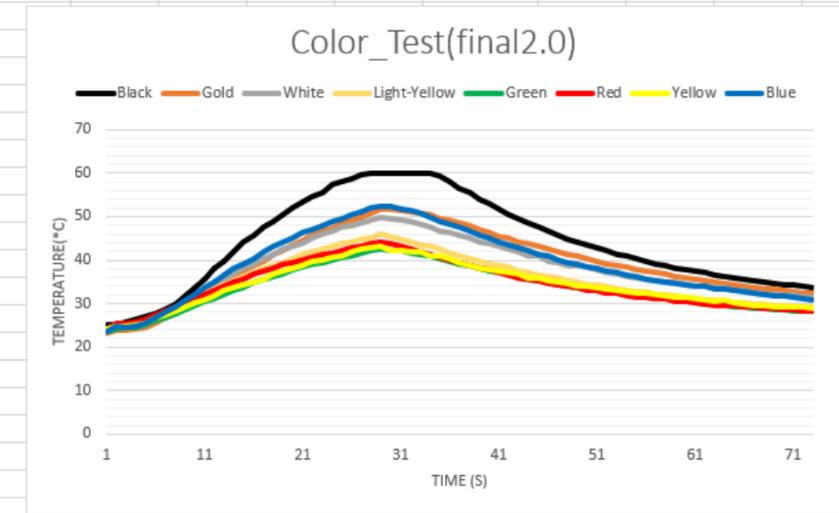
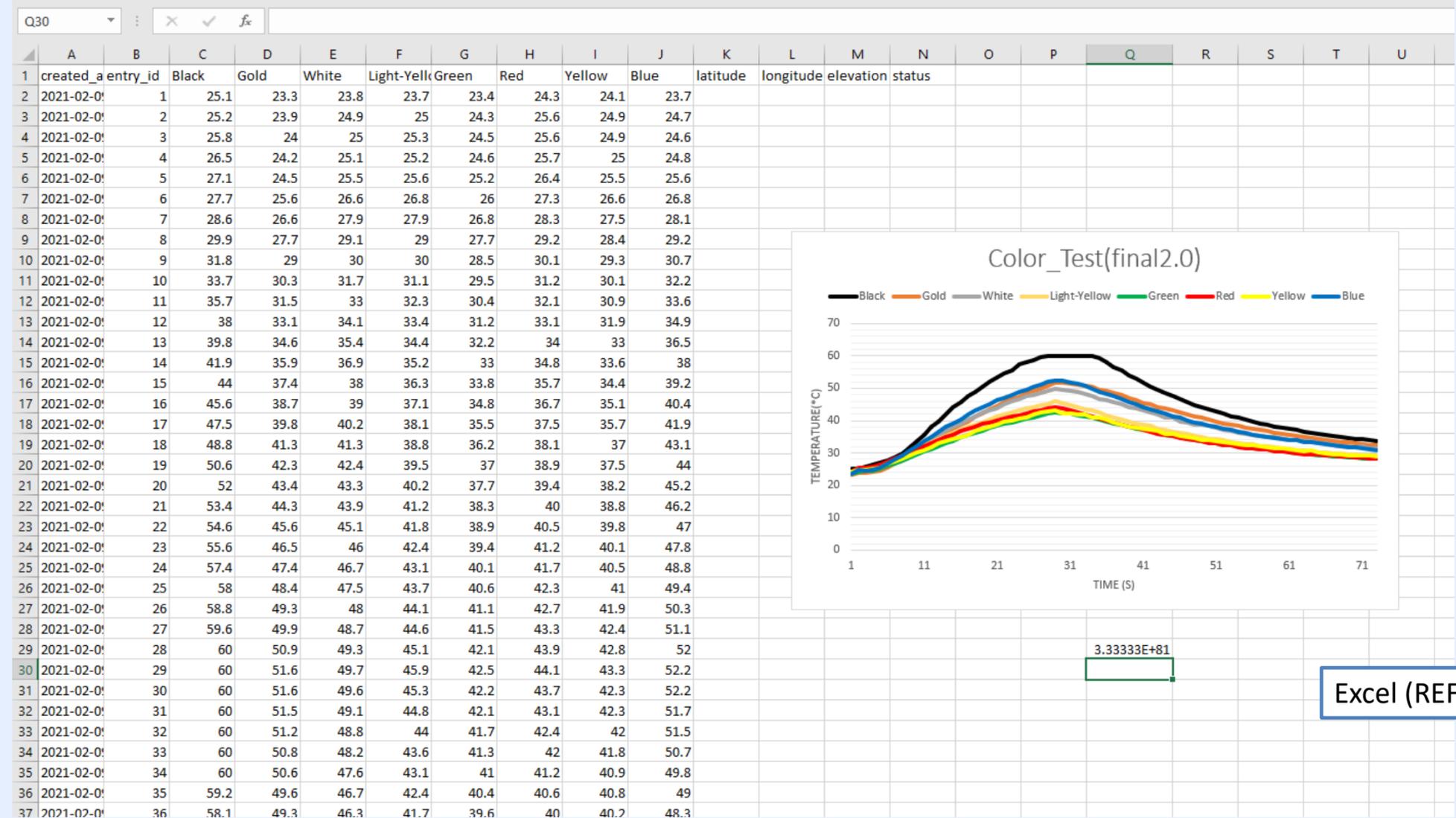
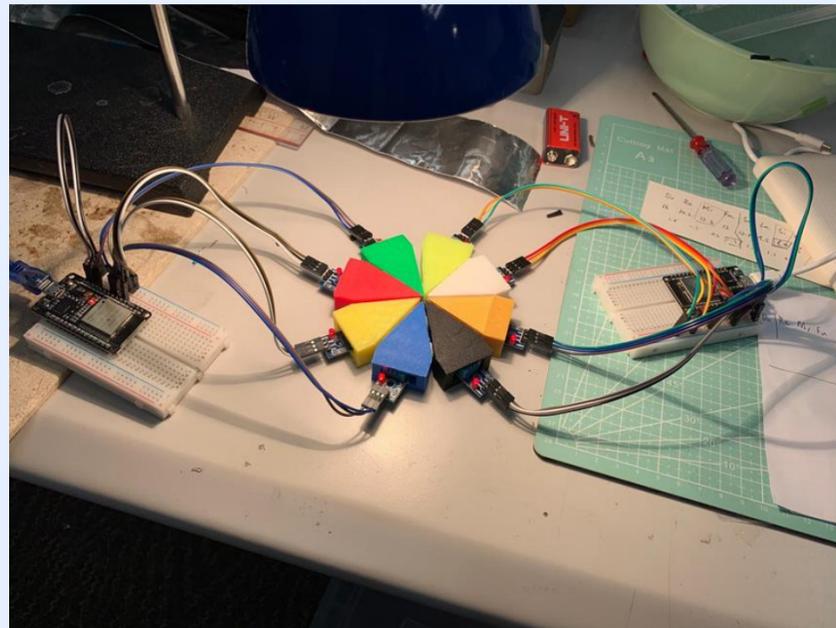
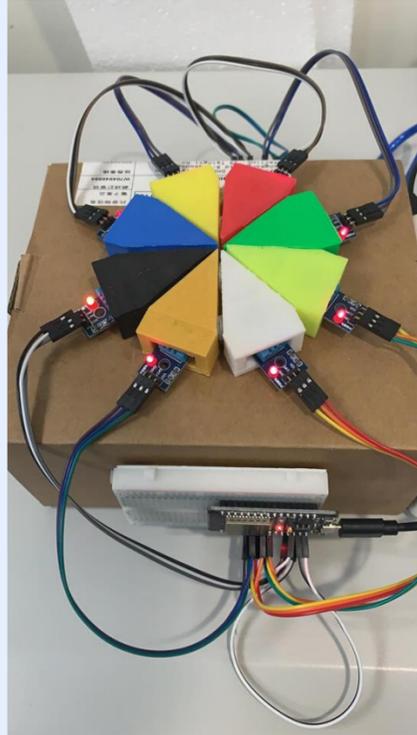
You can also use MATLAB, the REST API, or the MQTT API to import and export channel data.

[Read Data](#)  
[Write Data](#)

**\*GMT+8:00 - Hong Kong**

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# ThingSpeak & Excel Reference



3.33333E+81

Excel (REFERENCE)

# ThingSpeak Public View Sharing

testing

Channel ID: 1281894

Author: mwa0000020852618

Access: Public

Private View

Public View

Channel Settings

Sharing

API Keys

Data Import / Export

## Channel Sharing Settings

- Keep channel view private
- Share channel view with everyone
- Share channel view only with the following users:

Email  
Address

Enter email here

Add User

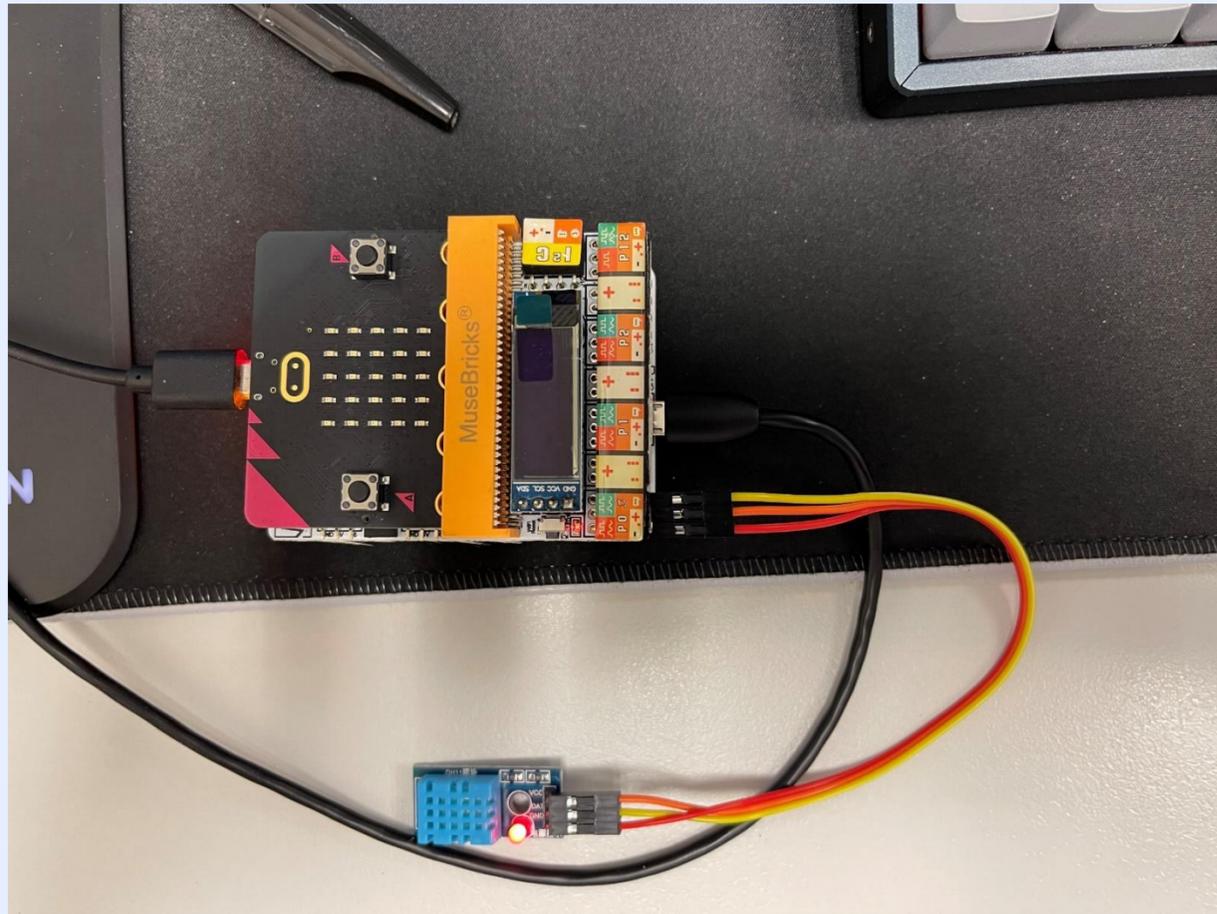
## Help

ThingSpeak allows you to control who can view the data in your channel. Irrespective of the settings on this tab, reading data from or writing data to the fields of a channel requires the appropriate API key for the channel.

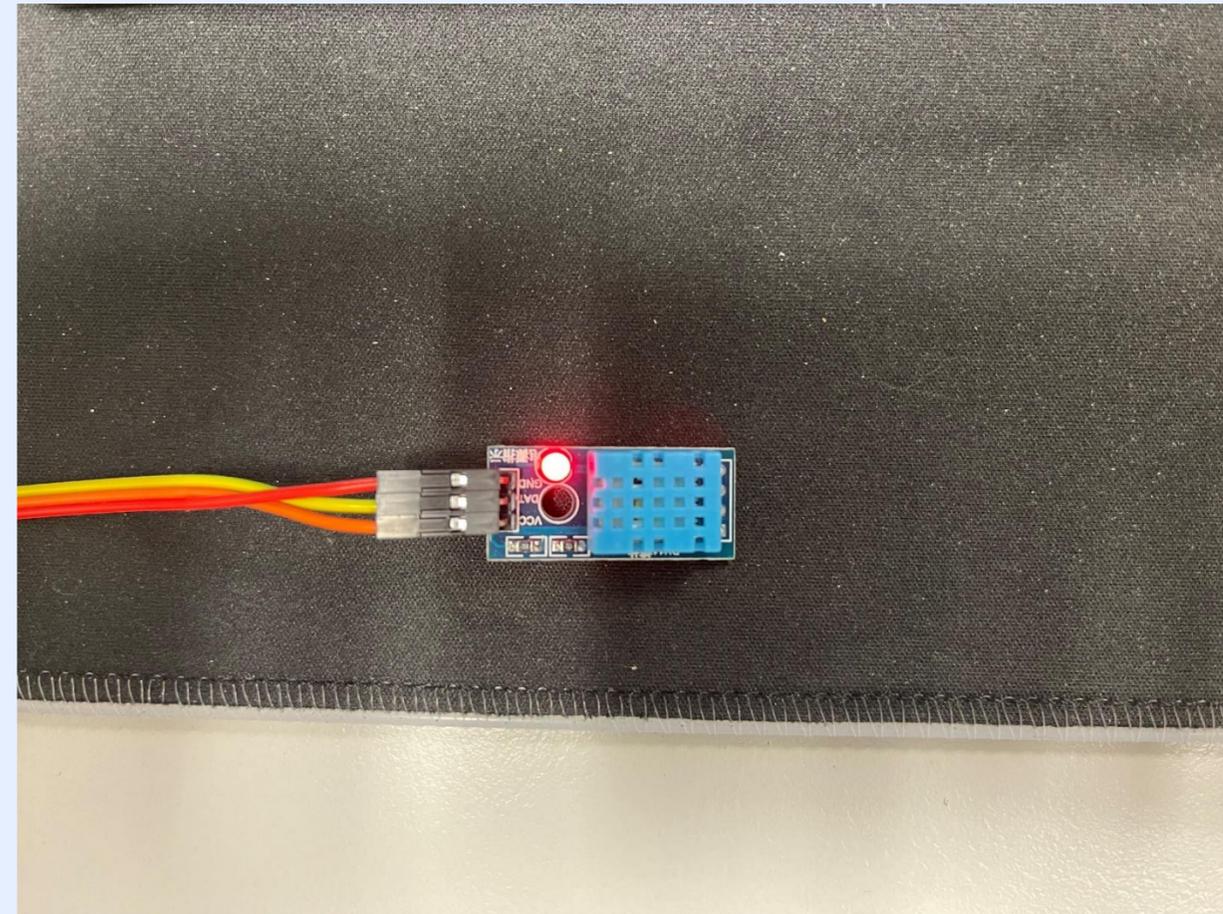
## Channel Sharing Settings

- **Keep channel view private:** Selecting this option keeps your channel private. Only you will be able to see the channel view.
- **Share channel view with everyone:** Selecting this option makes the public view of your channel viewable by anyone browsing the ThingSpeak website.
- **Share channel view only with the following users:** Selecting this option shares the private view of your channel only with specific ThingSpeak users.

# MuseLab

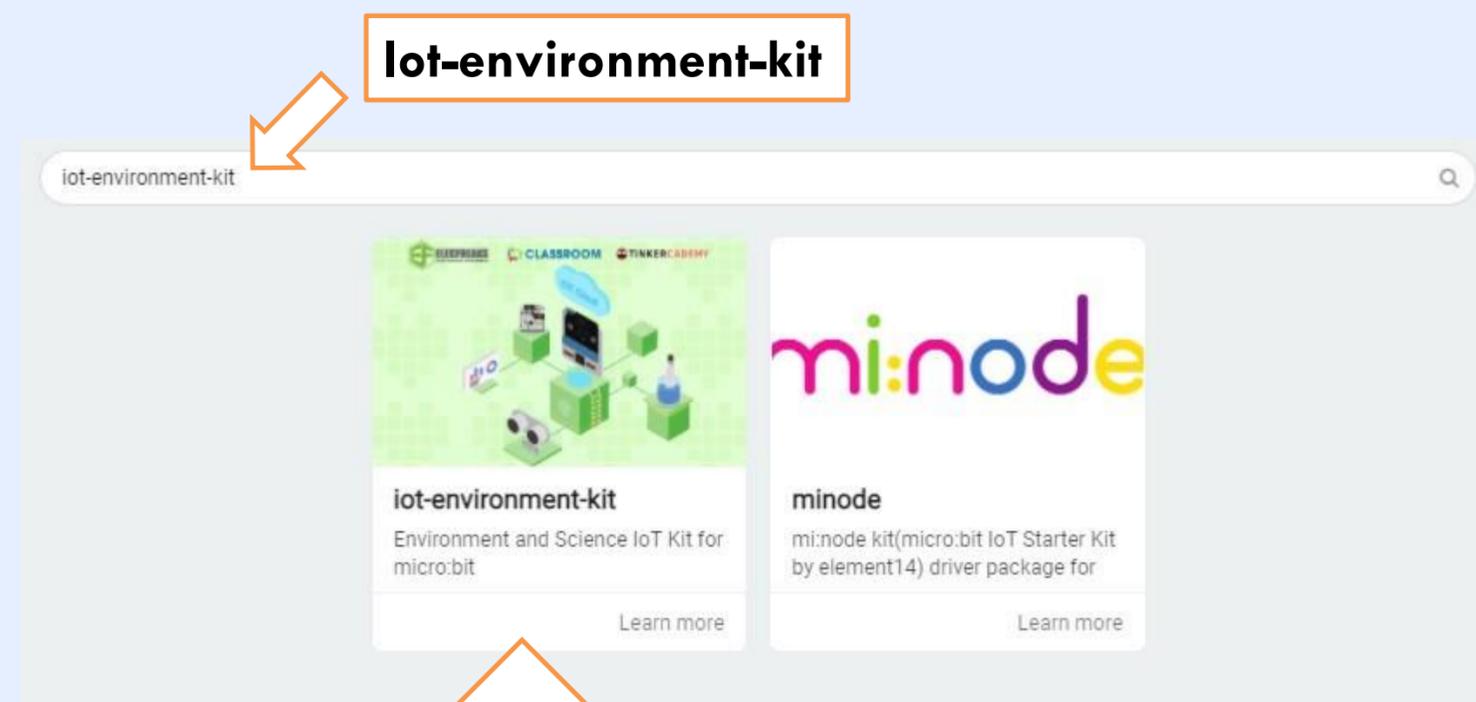
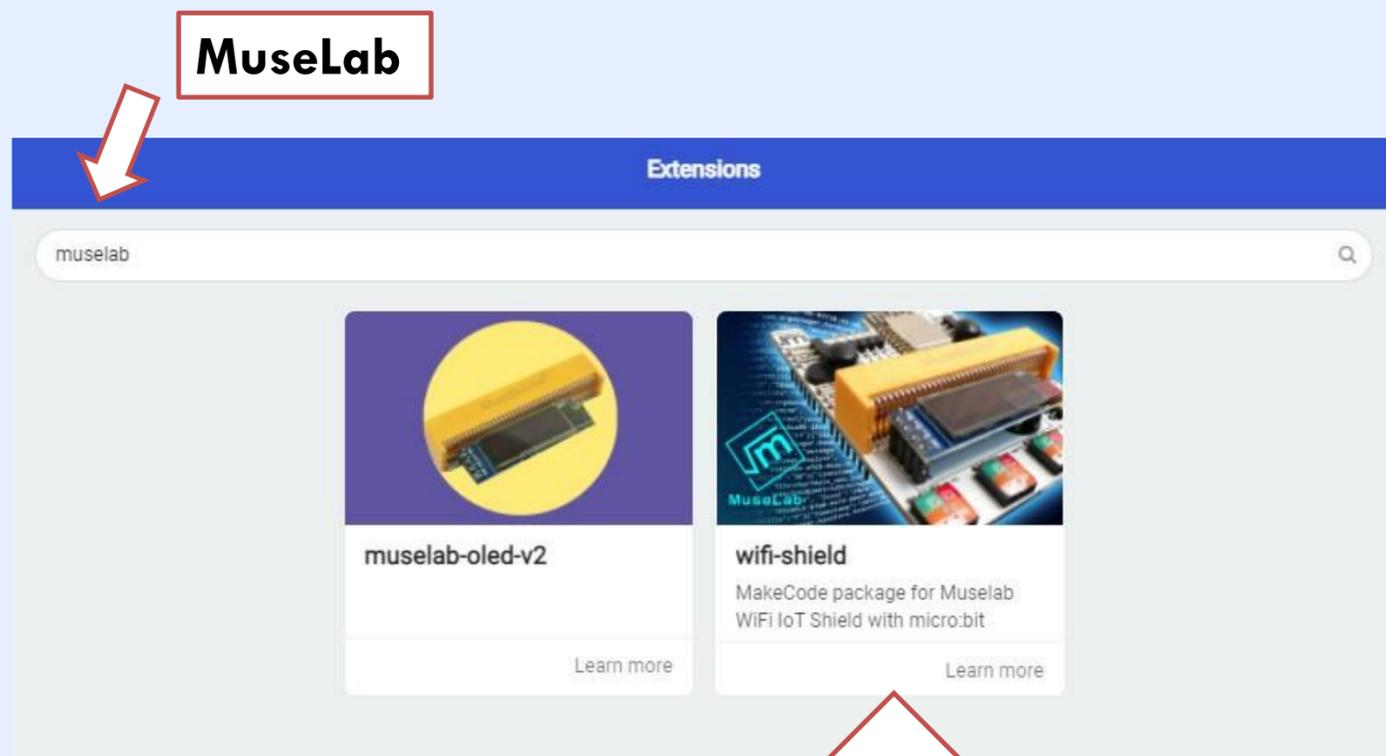


IoT Temperature Monitoring System



DHT11 humidity/temperature sensors

# MakeCode extensions

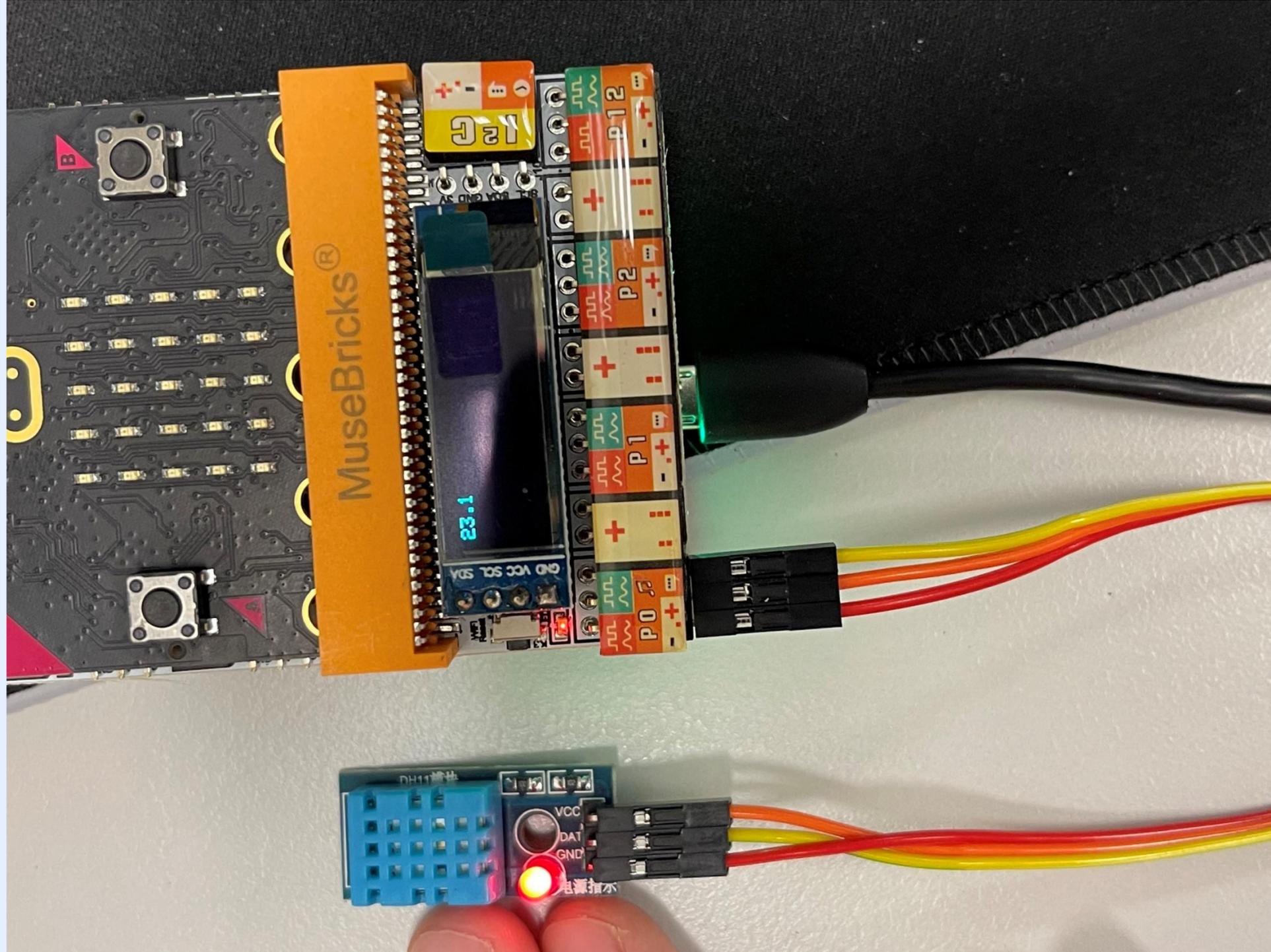


# Makecode Coding

The image displays the Makecode IDE interface for a project named "MuseloT".

- Left Sidebar (Category Menu):** Lists various blocks including Basic, Input, Music, Led, MuseIoT, MuseRover, MuseLoRa, Muse21, Digital\_Sensor, Radio, Loops, Logic, Variables, Math, MuseOLED, and Octopus.
- Central Workspace (more block):** Contains several sensor blocks: "value of wind speed(m/s) at pin P1", "value of pm10( $\mu\text{g}/\text{m}^3$ ) at pin P13", "value of pm2.5( $\mu\text{g}/\text{m}^3$ ) at pin P14", and "value of dht11 temperature( $^{\circ}\text{C}$ ) at pin P15".
- Right Workspace (MuseloT block):** Contains sections for "Booster" (Initialize Muselab WiFi Booster and OLED, Initialize Muselab WiFi Booster), "WIFI" (Set wifi to ssid, Set hotspot to ssid), and "Cloud" (Send Thingspeak key\* with field1, field2, field3; Send data.muselab.cc key\* with field1, field2, field3).
- Main Canvas (Script):** Shows a block-based script:
  - on start:** Initialize Muselab WiFi Booster, Set wifi to ssid "IoT" pwd "eduhk+IoT+2018".
  - forever loop:** set temp to value of dht11 temperature( $^{\circ}\text{C}$ ) at pin P0, initialize OLED, show number temp, Send Thingspeak key\* "F4H20G3X19PP0QV5", field1 temp, field2 0, field3 0, pause (ms) 1000.

# Circuit



# Circuit 2

```
on start
  Initialize Muselab WiFi Booster
  Set wifi to ssid "IoT" pwd "eduhk+IoT+2018"
  show icon [grid icon]

forever
  initialize OLED
  set temp to value of dht11 temperature(°C) at pin P0
  show number temp
  pause (ms) 2000
  set humi to value of dht11 humidity(0~100) at pin P0
  show number humi
  pause (ms) 2000
  Send Thingspeak key* "F4H20G3X19PP0QV5"
  field1 temp
  field2 humi
  field3 0
```

[https://makecode.microbit.org/\\_1owL0fdM5W8i](https://makecode.microbit.org/_1owL0fdM5W8i)

# ThingSpeak

Private View

Public View

Channel Settings

Sharing

API Keys

Data Import / Export

+ Add Visualizations

+ Add Widgets

Export recent data

MATLAB Analysis

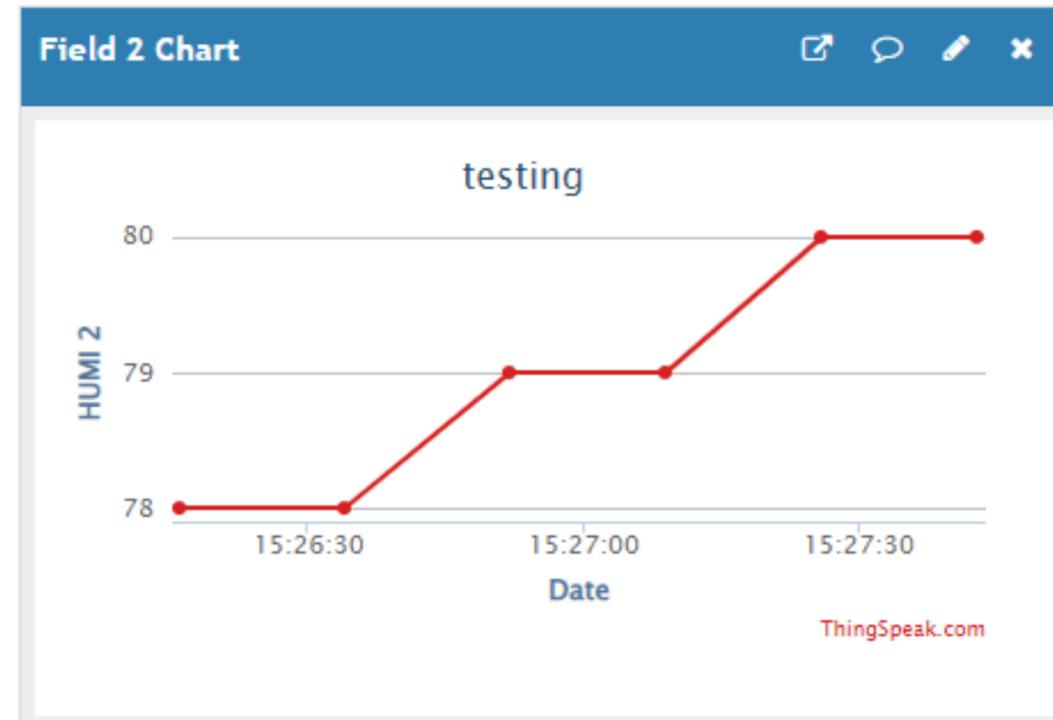
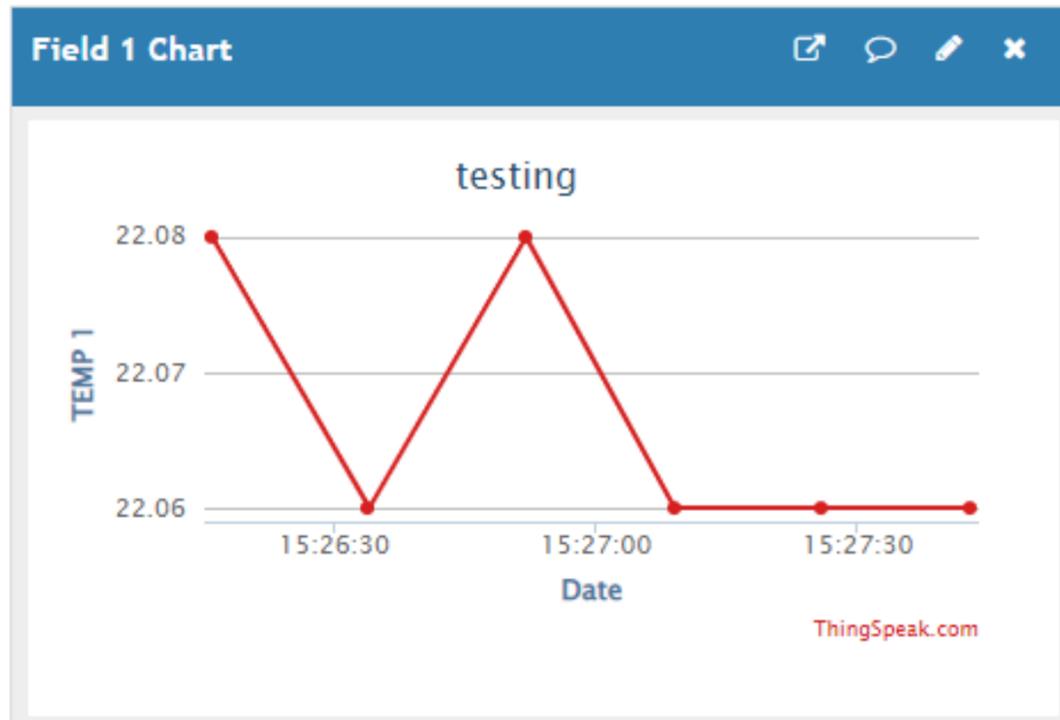
MATLAB Visualization

## Channel Stats

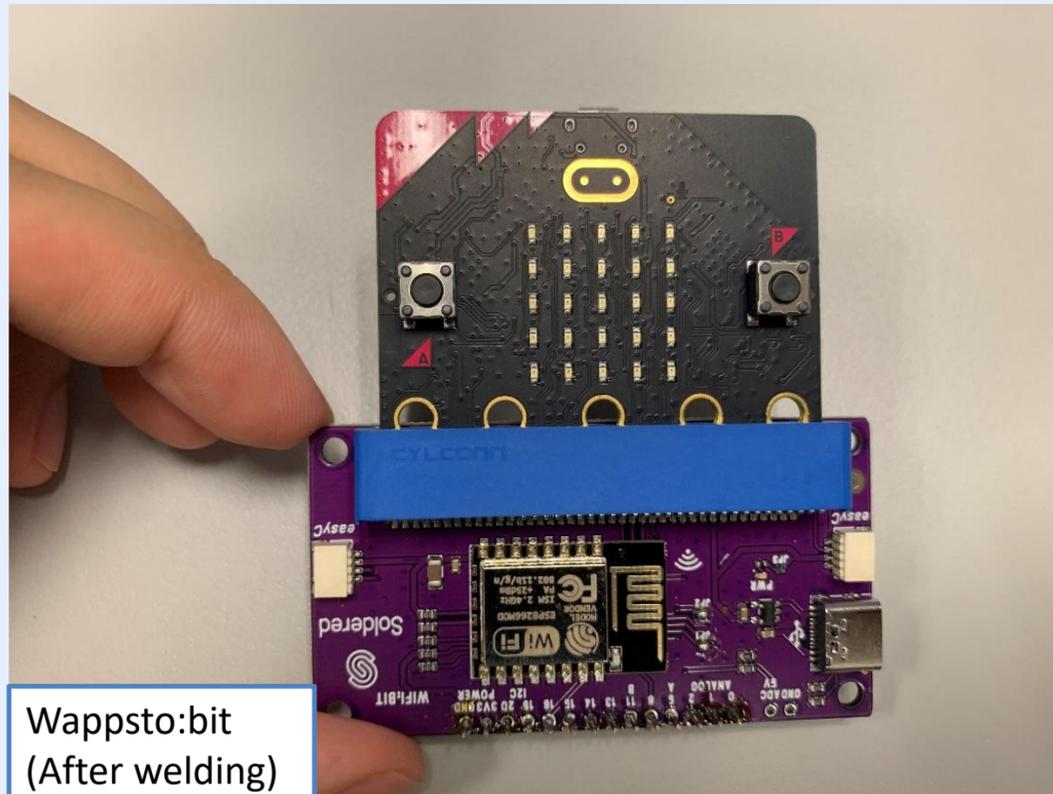
Created: [about a year ago](#)

Last entry: [less than a minute ago](#)

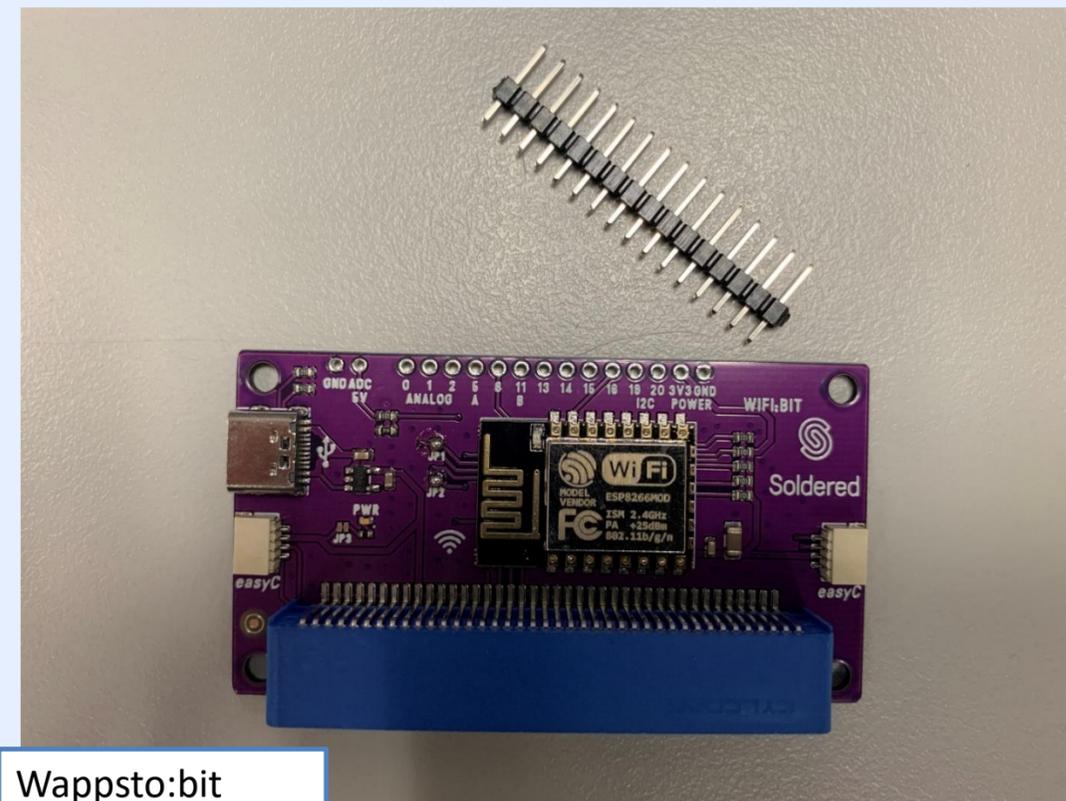
Entries: 6



# Wifi:bit



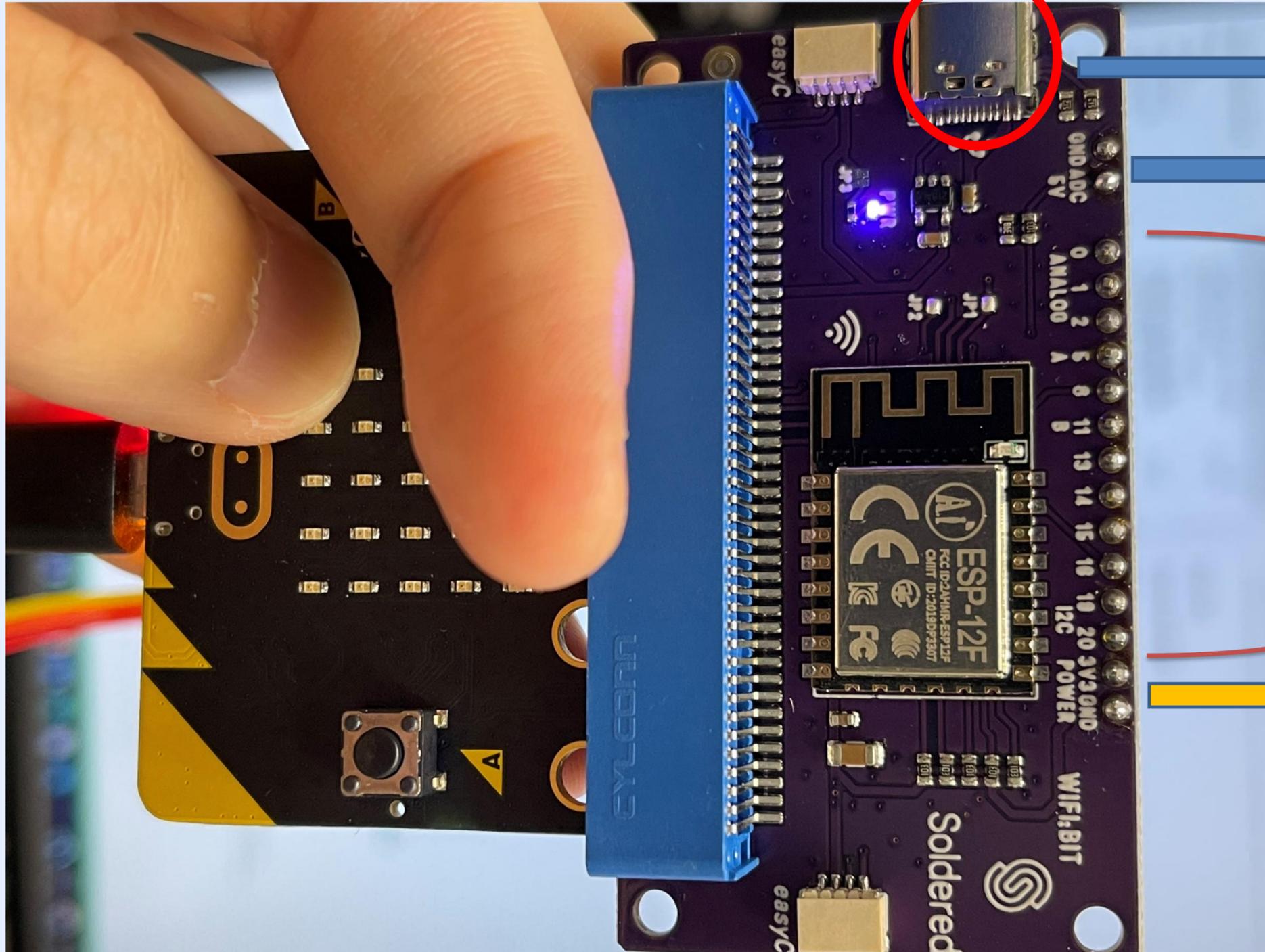
Wappsto:bit  
(After welding)



Wappsto:bit  
(Before welding)

ESP-8266

# Wifi:bit



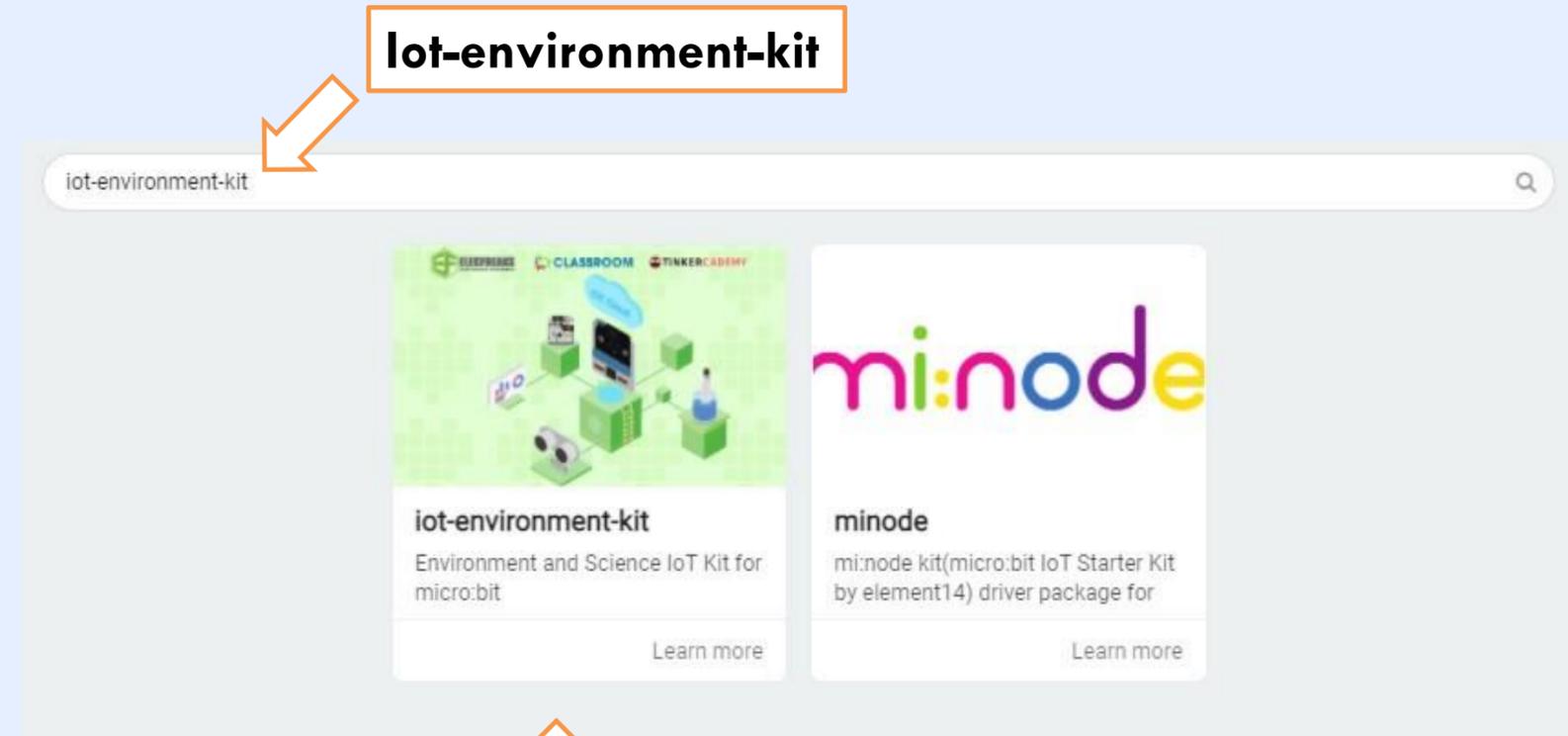
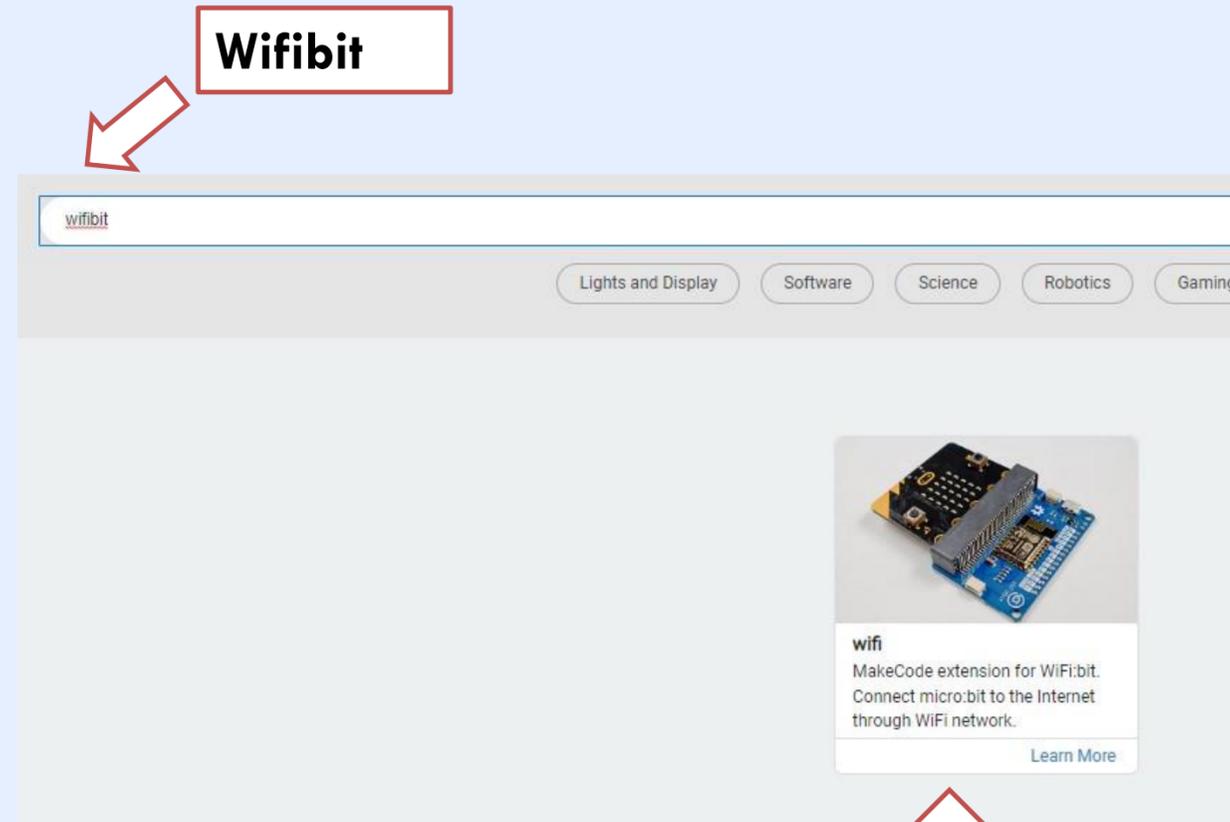
Power supply for Wifi:bit (Usb-type c)

5V power supply and GND

Data Pin

3.3V power supply and GND

# MakeCode extensions



Or you may use the sample code: [https://makecode.microbit.org/\\_afK4hM8FUKfk](https://makecode.microbit.org/_afK4hM8FUKfk)

# Coding (1)

Search... WiFi:bit

- Basic
- Input
- Music
- Led
- Radio
- WiFi:bit
- Loops
- Logic
- Variables
- Math
- Extensions
- Advanced
- Functions
- Arrays
- Text
- Game
- Images
- Pins
- Serial
- Control

connect to WiFi:bit

connect to WiFi network "SSID", "key"

disconnect from WiFi network

execute AT command "AT" and then wait 1000 ms

execute HTTP method GET

host: google.com

port: 80

path: /search?q=something

Blynk: write "510" to "A0", token is 14dabda3551b4dd5ab46464af582f7d2

Blynk: read "A0", token is 14dabda3551b4dd5ab46464af582f7d2

CRLF

on start

connect to WiFi:bit

connect to WiFi network "SSID", "key"

forever

execute HTTP method GET

host: api.thingspeak.com

port: 80

path: /search?q=something

1

2

**After downloading extension, WiFi:bit**

Search... Text

- Basic
- Input
- Music
- Led
- Radio
- WiFi:bit
- Loops
- Logic
- Variables
- Math
- Extensions
- Advanced
- Functions
- Arrays
- Text
- Game
- Images
- Pins
- Serial
- Control

length of "Hello"

join "Hello" "World"

parse to number "123"

split "this" at ""

"this" includes ""

"this" find index of ""

"this" is empty

substring of "this" from 0 of length 10

compare "this" to ""

char from "this" at 0

convert 0 to text

text from char code 0

on start

connect to WiFi:bit

connect to WiFi network "SSID", "key"

forever

execute HTTP method GET

host: api.thingspeak.com

port: 80

path: join "Hello" "World"

3

# Coding (2)

```
forever
  set temp to value of dht11 temperature(°C) at pin P0
  show number temp
  execute HTTP method GET
  host: "api.thingspeak.com"
  port: 80
  path: join "/update?api_key=F4H20G3X19PP0QV5&field1=" temp
```

ThingSpeak write API Key

Important\*

API Requests

Write a Channel Feed

```
https://api.thingspeak.com/update?api_key=NBUA2KF3L01BH9JP&field1=0
```

「api.thingspeak.com」 「/update ..... field1=」

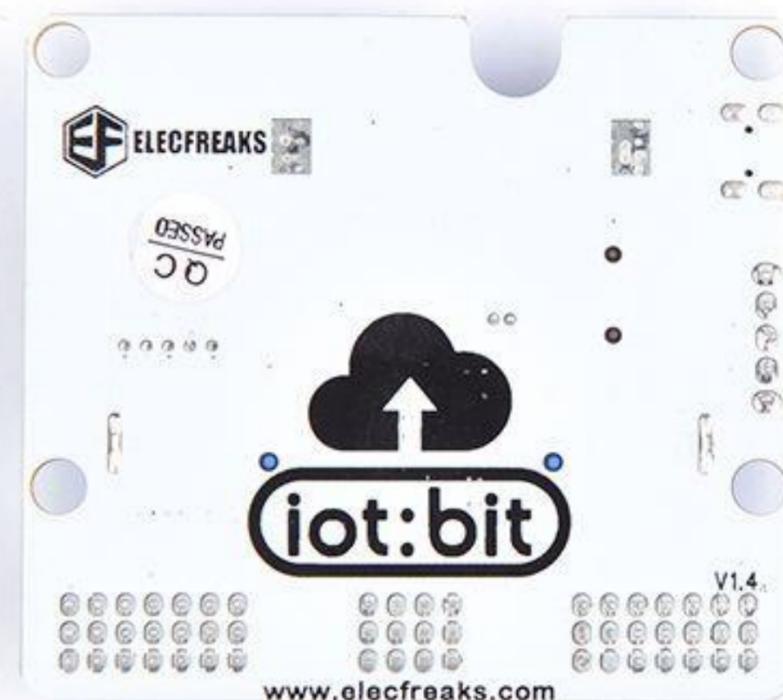
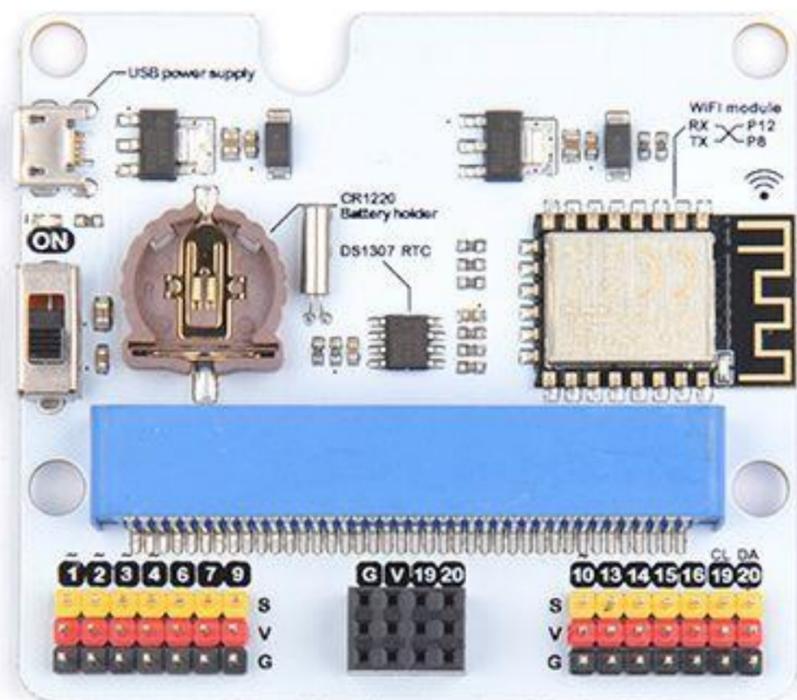
Upload Data to one field

# Coding (upload 2 fields)

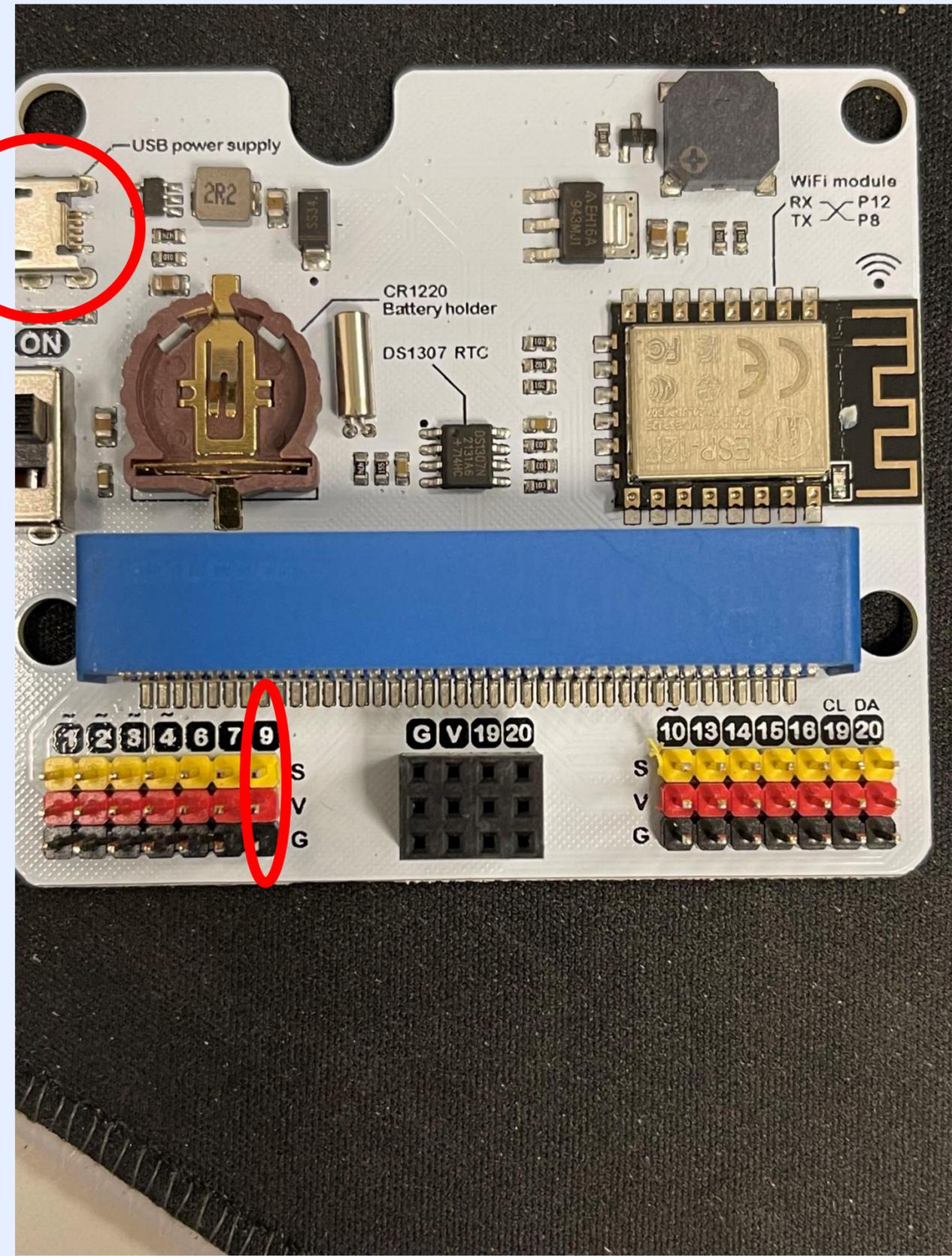
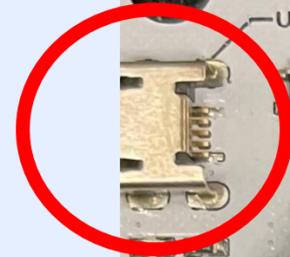
```
forever
  set temp to value of dht11 temperature(°C) at pin P1
  set humi to value of dht11 humidity(0~100) at pin P1
  show number temp
  show number humi
  execute HTTP method GET
  host: "api.thingspeak.com"
  port: 80
  path: join "/update?api_key=F4H20G3X19PP0QV5&field1=" temp
  execute HTTP method GET
  host: "api.thingspeak.com"
  port: 80
  path: join "/update?api_key=F4H20G3X19PP0QV5&field2=" humi
```

# iot:bit

Works with  
micro:bit | V1 & V2

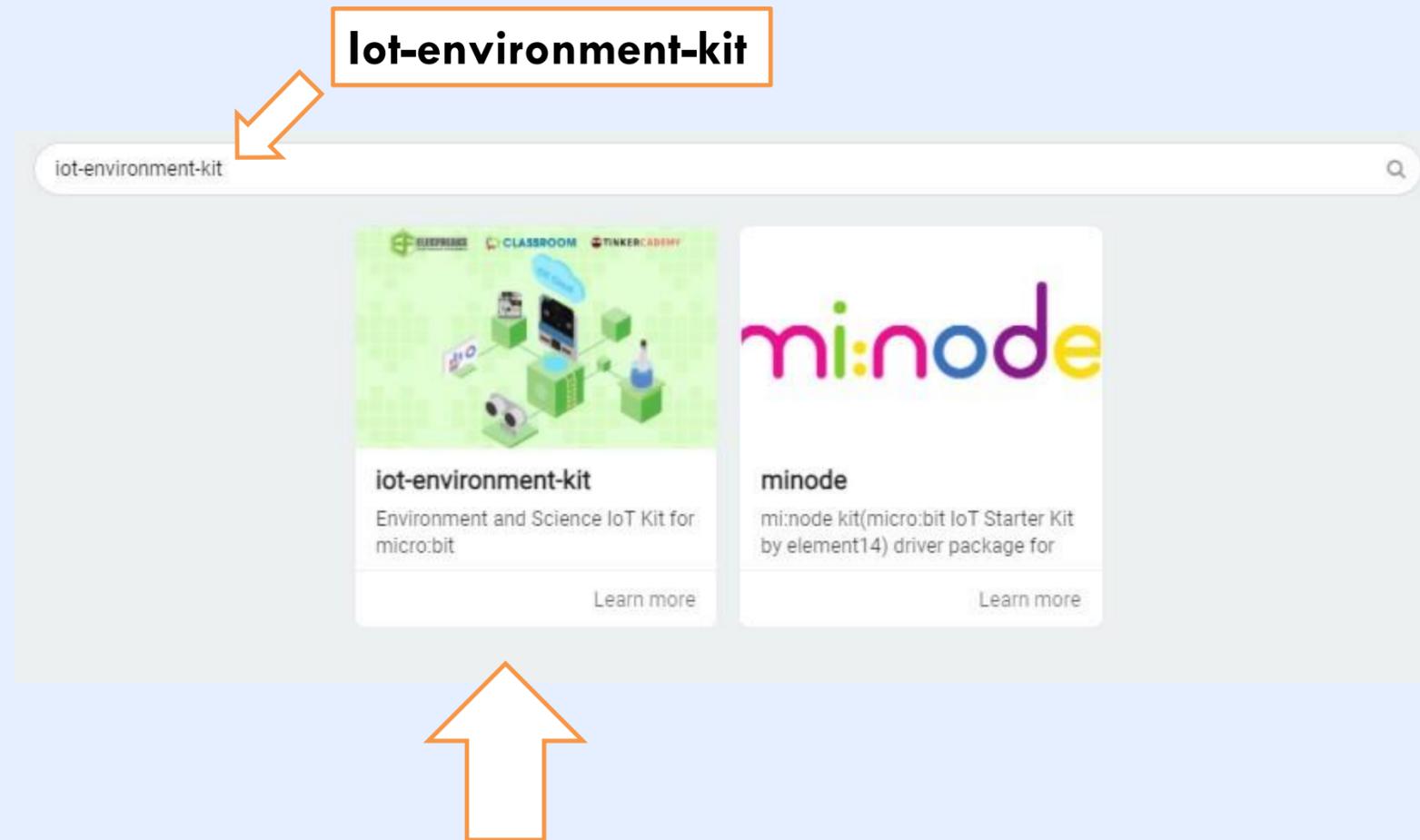


Power supply for  
iot:bit



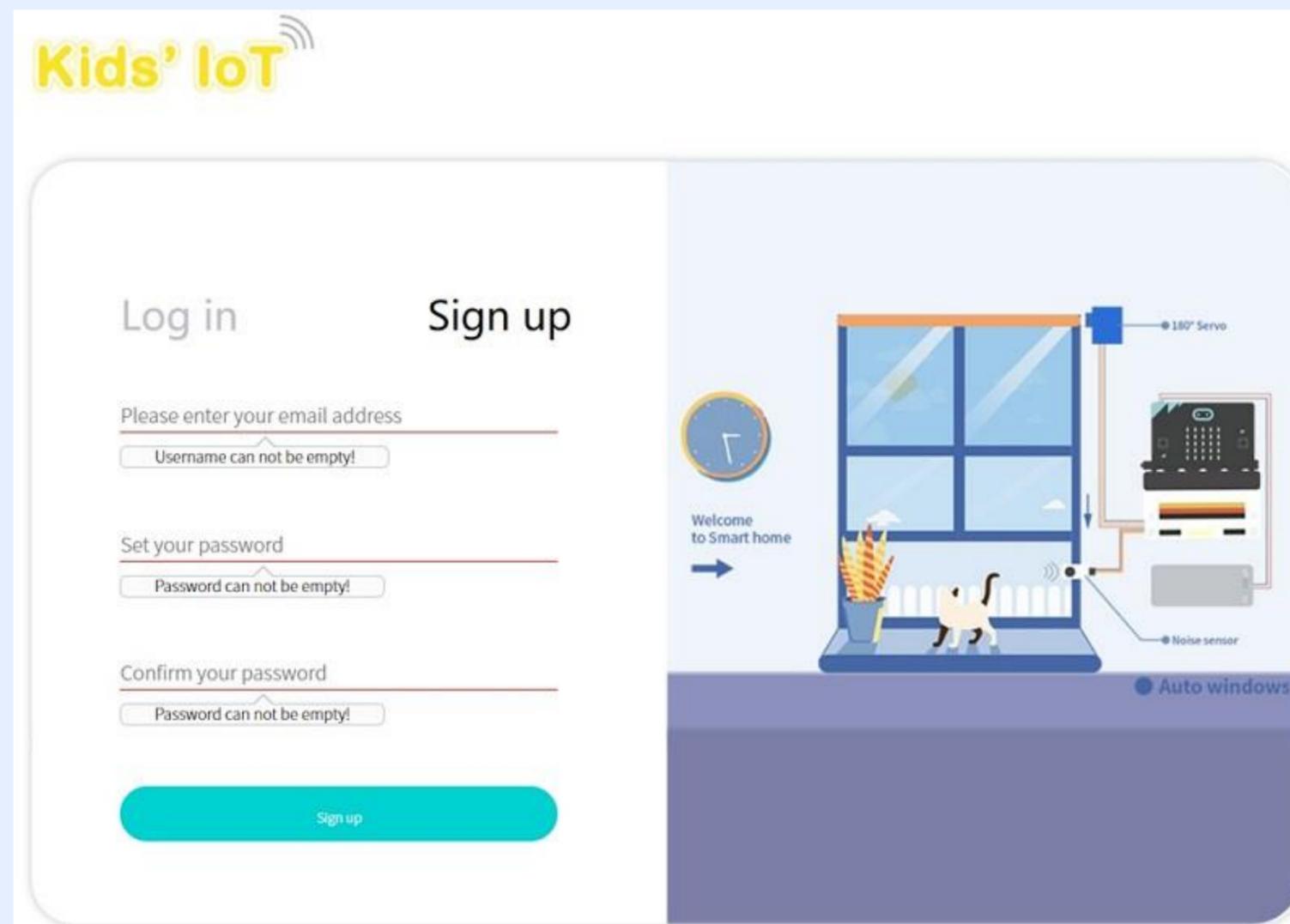
S = Data pin  
V = 3.3v power  
G = GND

# MakeCode extensions



# Coding 1 (KidsIoT)

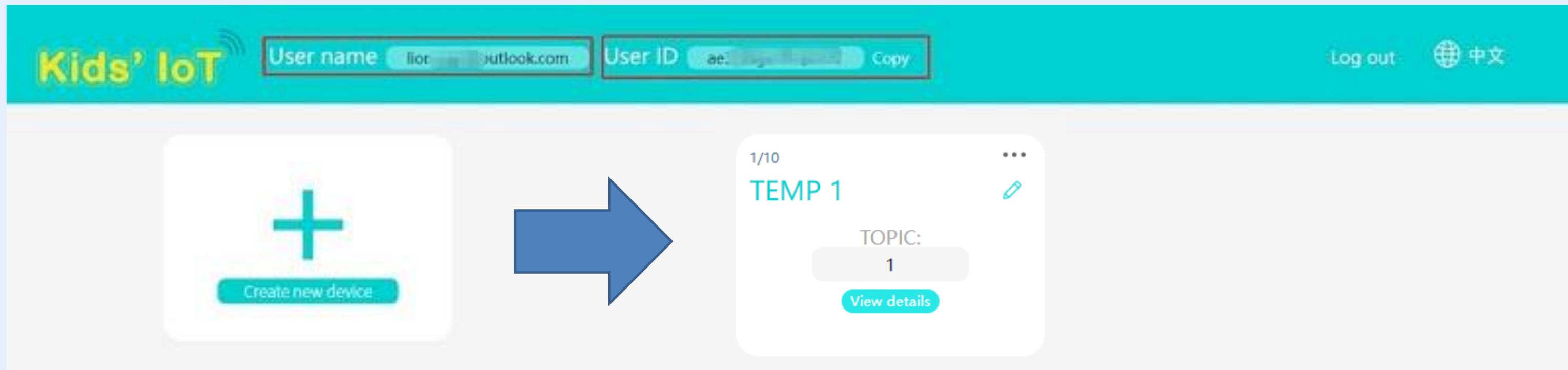
- KidsIoT is a platform for IoT(Internet of Things) produced by ElecFreaks with only three minutes to get connected, it can achieve a remote control to the micro:bit.
- Step 1: Go to <https://www.kidsiot.cn/>
- Step 2: Sign Up



- Step 3: Login
- Step 4: Click “log in” to enter the device manage interface, the “User Name” on the top left corner is your email address, the unique “User Token (User ID)” on the top right corner is the only identification code for this platform which is corresponding to your account.



- Step 5: Create new device, “Topic” is the only identification code (the only device in the account), and you can revise the device name (only 10 devices can be created). Click “View Details” to see the data table and figure.



[Return to device list](#)

### Equipment\_2

Last 10  Last 100 [Export Data](#)

No.	Time	Data
1	2019-11-02 16:13:58	29
2	2019-11-02 16:13:53	25
3	2019-11-02 16:13:48	42
4	2019-11-02 16:13:43	46
5	2019-11-02 16:13:38	48
6	2019-11-02 16:13:33	50
7	2019-11-02 16:13:28	47
8	2019-11-02 16:13:21	47
9	2019-11-02 16:13:16	15
10	2019-11-02 16:13:11	30



Remote Control

# Write Code

```
on start
  set ESP8266 RX P8 TX P12 Baud rate 115200
  connect Wifi SSID = "IoT" KEY = "eduhk+IoT+2018"
  if Wifi connected true then
    show icon [WiFi icon]
  +
  forever
    Connect KidsIot with userToken: "c1f8KnvLE5LWJQ9a" Topic: "1"
    Upload data value of dht11 temperature(°C) at pin P1 to kidsiot
    Connect KidsIot with userToken: "c1f8KnvLE5LWJQ9a" Topic: "2"
    Upload data value of dht11 humidity(0~100) at pin P1 to kidsiot
    pause (ms) 2000
```

# Special Function (Remote Control)

**Kids' IoT** User name  User ID 6YqrAhurNXIN  Log out 中文

Return to device list

### Equipment\_2

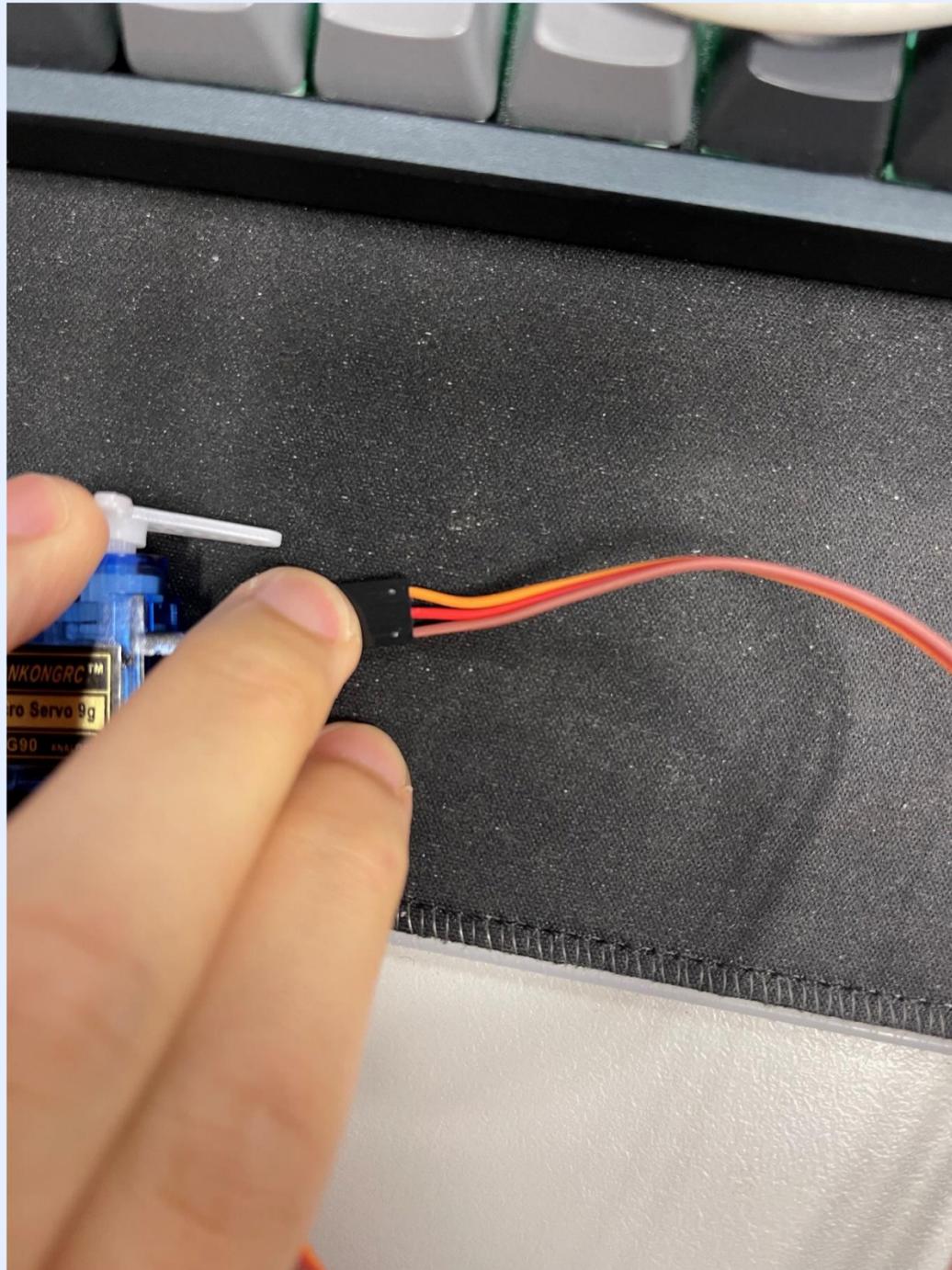
Last 10 Last 100 Export Data

No.	Time	Data
1	2019-11-02 16:13:58	29
2	2019-11-02 16:13:53	25
3	2019-11-02 16:13:48	42
4	2019-11-02 16:13:43	46
5	2019-11-02 16:13:38	48
6	2019-11-02 16:13:33	50
7	2019-11-02 16:13:28	47
8	2019-11-02 16:13:21	47
9	2019-11-02 16:13:16	15
10	2019-11-02 16:13:11	30

Remote Control

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# Special Function (Remote Control)



Micro Servo SG90 Analog

Orange -> Data

Red -> 3.3v

Brown -> GND

# Write Code (Remote Control)

```
on start
  set ESP8266 RX P8 TX P12 Baud rate 115200
  connect Wifi SSID = "IoT" KEY = "eduhk+IoT+2018"
  if Wifi connected true then
    show icon [grid icon]
```

```
forever
  Connect KidsIot with userToken: "c1f8KnvLE5LWJQ9a" Topic: "1"
  Upload data value of dht11 temperature(°C) at pin P1 to kidsiot
  Connect KidsIot with userToken: "c1f8KnvLE5LWJQ9a" Topic: "2"
  Upload data value of dht11 humidity(0~100) at pin P1 to kidsiot
  pause (ms) 2000
```

```
When switch on
  servo write pin P10 to 180
  pause (ms) 2000
  servo write pin P10 to 0
```

[https://makecode.microbit.org/\\_XvCUup55w0J6](https://makecode.microbit.org/_XvCUup55w0J6)

# Coding 2 (ThingSpeak)

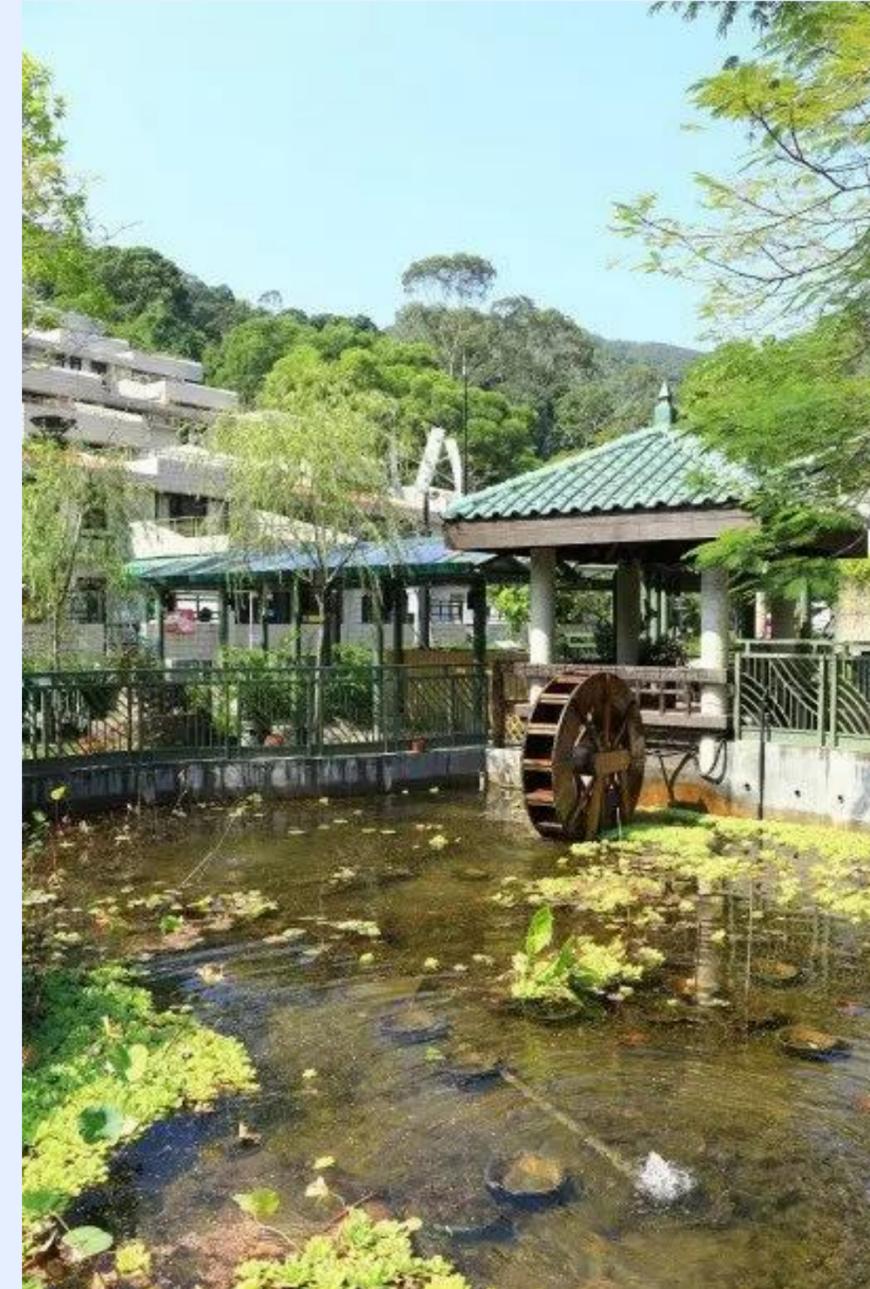
```
on start
  set ESP8266 RX P8 TX P12 Baud rate 115200
  connect Wifi SSID = "IoT" KEY = "eduhk+IoT+2018"
  if Wifi connected true then
    show icon [grid icon]
  +
  +

forever
  show number value of dht11 temperature(°C) at pin P1
  connect thingspeak
  set data to send ThingSpeak
  Write API key = "F4H20G3X19PP0QV5"
  Field 1 = value of dht11 temperature(°C) at pin P1
  +
  Upload data to ThingSpeak
  pause (ms) 2000
```

[https://makecode.microbit.org/\\_J2qChEMhY6Fp](https://makecode.microbit.org/_J2qChEMhY6Fp)

# Activity

- Copy your Public view link
- Paste your public view link into below Google document:  
[https://docs.google.com/document/d/1Qok\\_1ETj\\_aNvYPk8cFFf7tDqQhfXdMzcemEoiqfzmWoU/edit?usp=sharing](https://docs.google.com/document/d/1Qok_1ETj_aNvYPk8cFFf7tDqQhfXdMzcemEoiqfzmWoU/edit?usp=sharing)
- Data Collection (DHT11 humidity/temperature) in the EdUHK Campus (15 mins)  
You may go to the Eco-garden, fish pond outside Bio lab and roof top in block E, etc.
- Come back and share your result

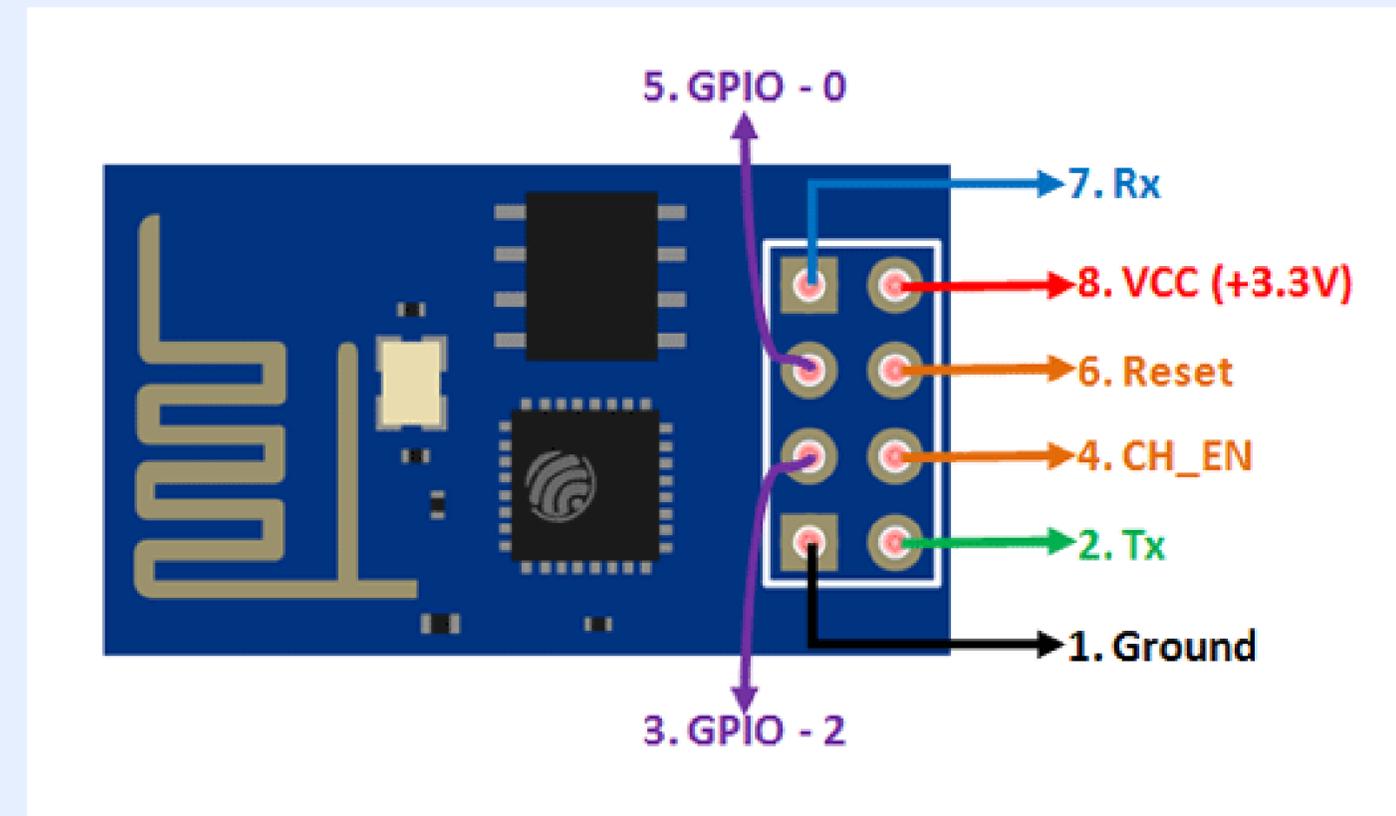
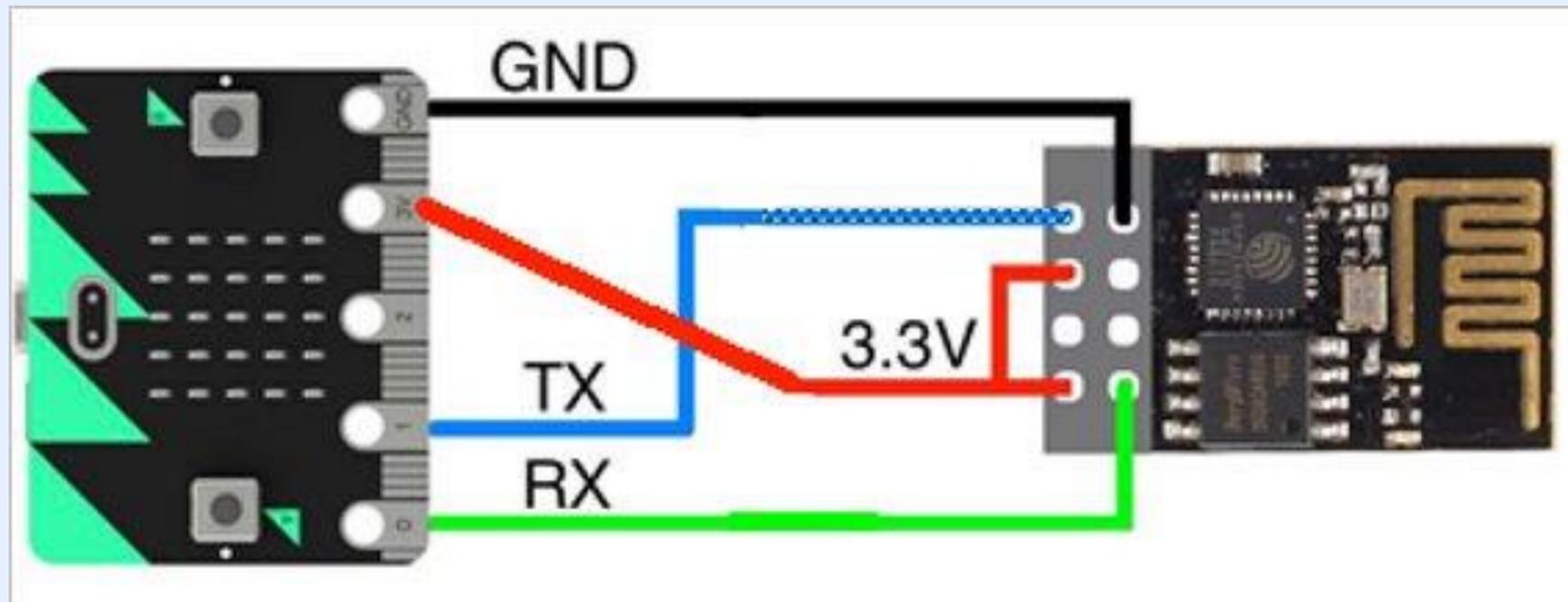


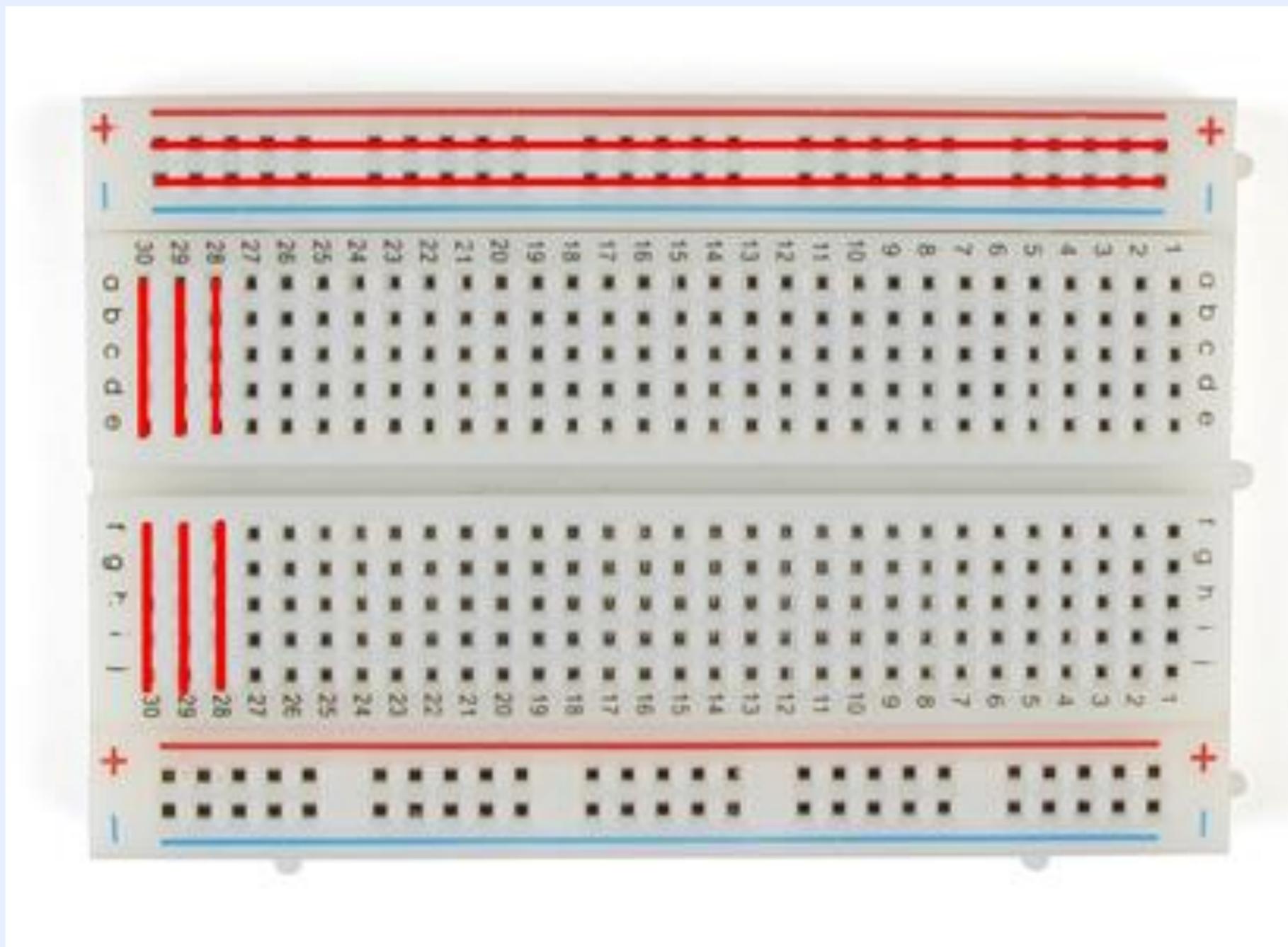
# Connect Wifi without extension board

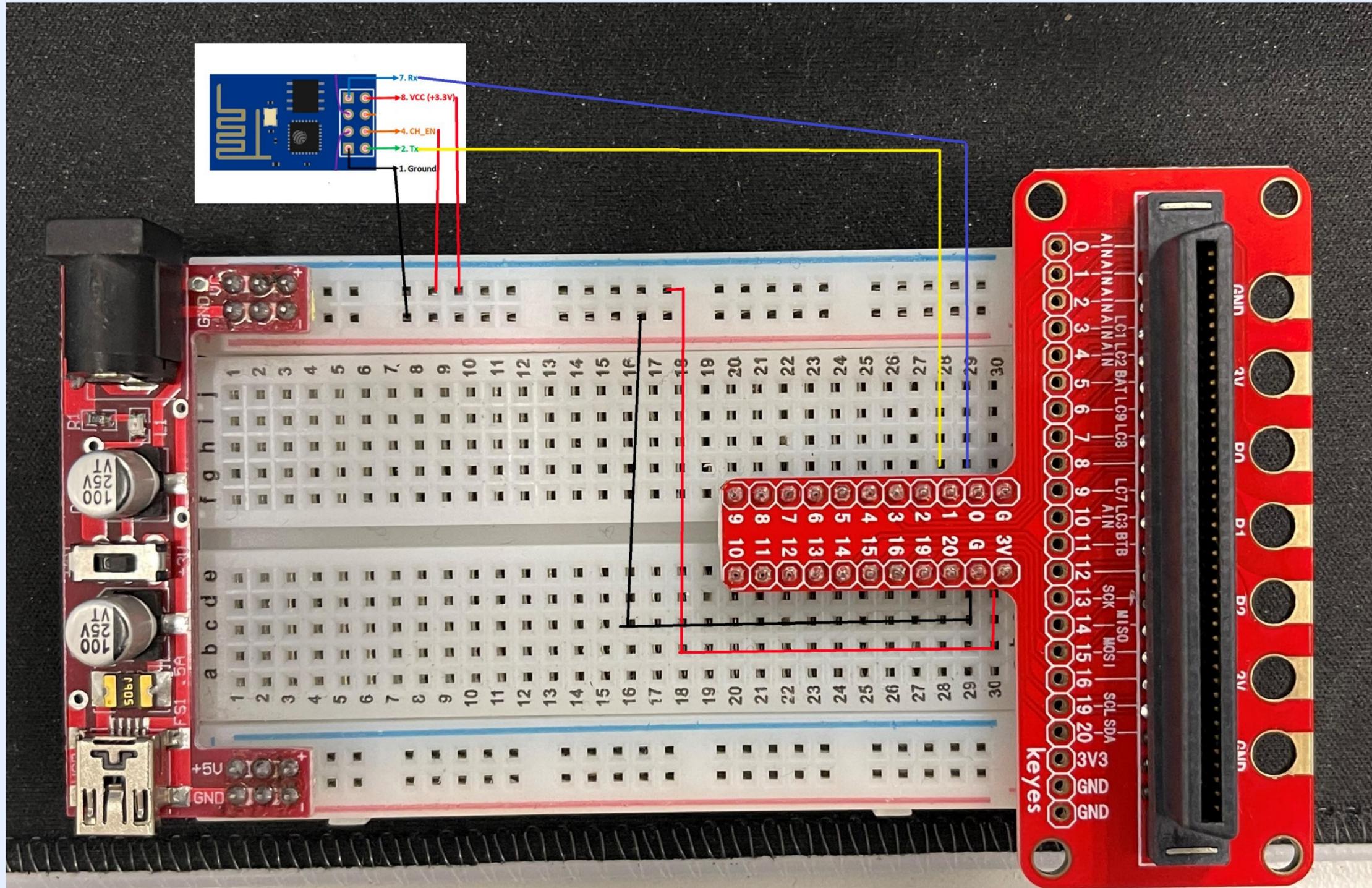


Esp-01/s

# Connect Wifi without extension board







# Make code

esp8266

Lights and Display Software Science Robotics Gaming Networking Individual sensors



**ESP8266\_ThingSpeak**  
MakeCode extension for ESP8266 and ThingSpeak

[Learn More](#)



**esp8266**  
Extension for ESP8266 WiFi Module AT Mode - by Cytron Technologies

[Learn More](#)



**iot-environment-kit**  
Environment and Science IoT Kit for micro:bit

[Learn More](#)



**PTKidsBIT-IoT**  
Makecode extensions for PTKidsBIT: IoT

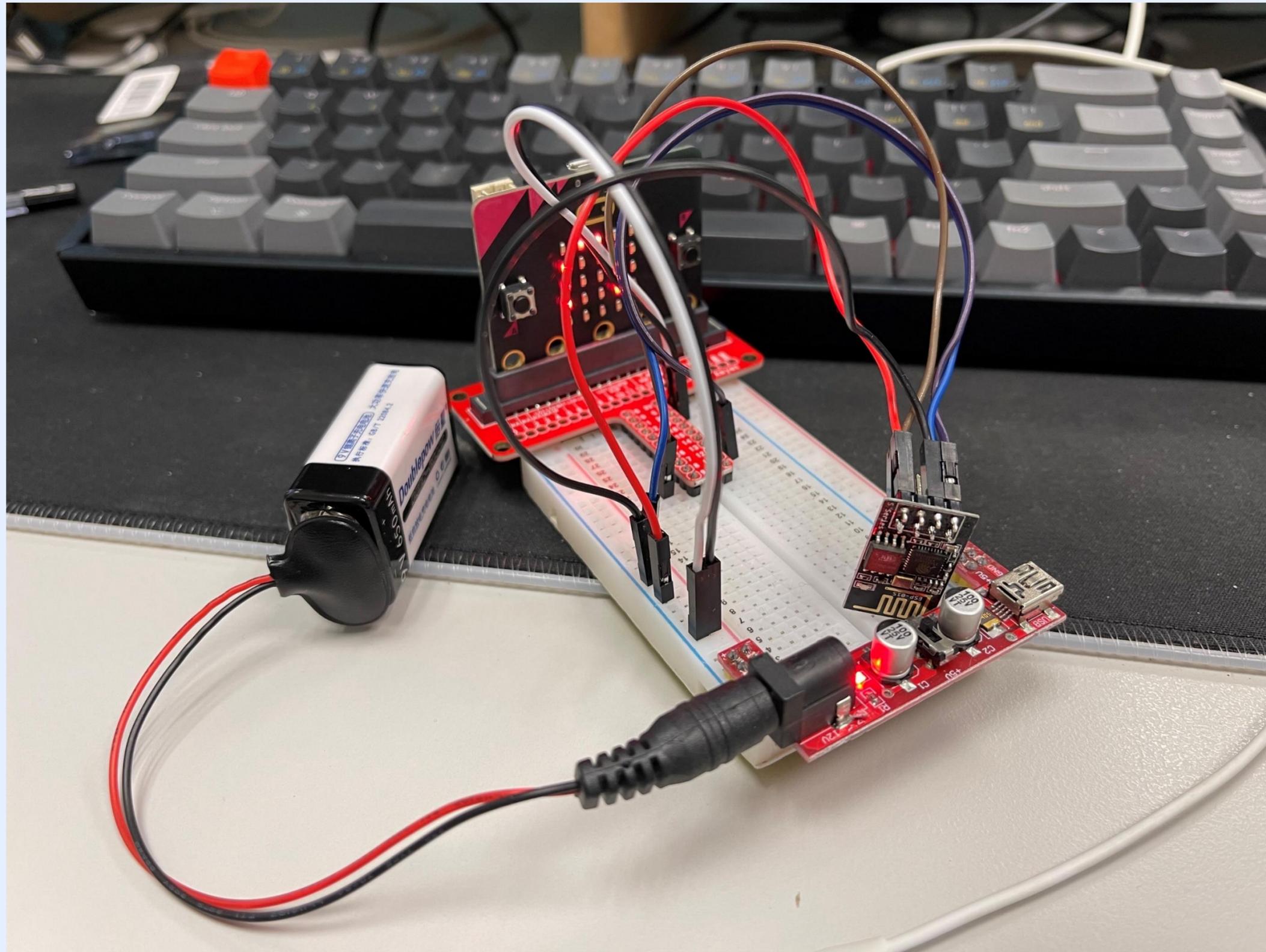
[Learn More](#)

# Make code

```
on start
  Initialize ESP8266
  RX (Tx of micro:bit) P8
  TX (Rx of micro:bit) P12
  Baud rate 115200
  Wifi SSID = "IoT"
  Wifi PW = "eduhk+IoT+2018"
  if Wifi connected ? then
    show icon [WiFi icon]
  else
    show icon [WiFi icon]

forever
  set temp to value of dht11 temperature(°C) at pin P1
  set humi to value of dht11 humidity(0~100) at pin P1
  show number temp
  show number humi
  Upload data to ThingSpeak
  URL/IP = "api.thingspeak.com"
  Write API key = "F4H20G3X19PP0QV5"
  Field 1 = temp
  Field 2 = humi
  Field 3 = 0
  Field 4 = 0
  Field 5 = 0
  Field 6 = 0
  Field 7 = 0
  Field 8 = 0
```

[https://makecode.microbit.org/\\_UsqVoU3f74zE](https://makecode.microbit.org/_UsqVoU3f74zE)



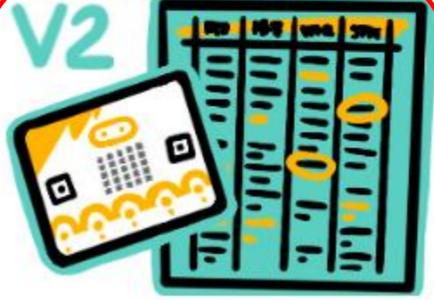
One more thing ...

# Micro:bit v2 Data logging (non-IoT)

data 

Lights and Display   Software   Science   Robotics   Gaming   Networking   Individual sensors

 Import File



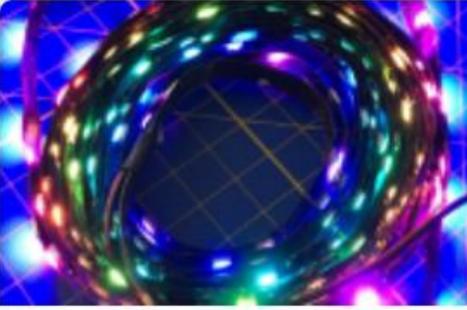
**datalogger**  
Data logging to flash memory.  
micro:bit (V2) only.

[Learn More](#)



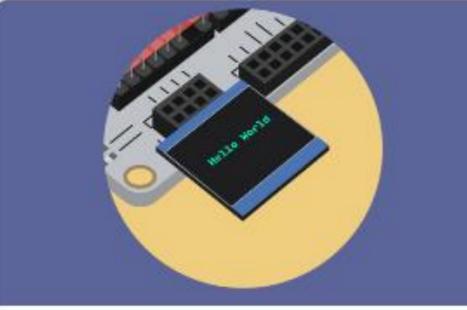
**data-streamer**  
Data Streamer support in  
MakeCode for micro:bit

[Learn More](#)



**neopixel**  
A Neo-Pixel package for pxt-  
microbit

[Learn More](#)



**oled-ssd1306**  
Tinkercademy MakeCode package  
for using the SSD1306 OLED  
controller with micro:bit

[Learn More](#)



**grove**  
A Microsoft MakeCode package for  
Seed Studio Grove module

[Learn More](#)

# Code Sample: Movement data logger

The code sample consists of several Scratch blocks:

- on start** (blue):
  - set logging to false
  - show icon (grid icon)
  - set columns to "x"
    - "y"
    - "z"
- on button A pressed** (purple):
  - set logging to true
  - show icon (grid icon)
- on button B pressed** (purple):
  - set logging to false
  - show icon (grid icon)
- on log full** (green):
  - set logging to false
  - show leds (4x4 grid)
- every 100 ms** (green):
  - if logging then
    - log data
      - column "x" value acceleration (mg) x
      - column "y" value acceleration (mg) y
      - column "z" value acceleration (mg) z
- on button A+B pressed** (purple):
  - set logging to false
  - show icon (grid icon)
  - delete log
  - set columns to "x"
    - "y"
    - "z"

[https://makecode.microbit.org/\\_h1zWUJ7gdJKF](https://makecode.microbit.org/_h1zWUJ7gdJKF)