

Micro:bit Magic

Engaging K-12, CS1/2, and non-majors with IoT & Embedded

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Washington University in St. Louis

(Presentation developed in conjunction with Michael Rogers @ UW Oshkosh)

Outline

- Intros: Me, You, the micro:bit
- ★ Setup
- ★ “Hello, World!”: First Program
- ★ Programming: Logic & Action
- ★ Broadcast Basics
- ★ Awesome Audio & DHT-11
- ★ Bluetooth Basics & Phone Phun
- ★ Extensions & Graphing
- ★ Cutting the Cord
- Conclusions

- **Intros: Me & You**

- ## Intros: Me & You

- Me

- ## Intros: Me & You

- Me

- You: Roll Call & Intros

- ## Intros: Me & You

- Me
- You: Roll Call & Intros
 - Who has Chrome? Who has an iOS Device with the App?

- **Intros: Me & You**

Intros: Me & You

-

- Me

- ## Intros: Me & You

- Me

- You: Roll Call & Intros

- ## Intros: Me & You

- Me
- You: Roll Call & Intros
 - Name & School,

- ## Intros: Me & You

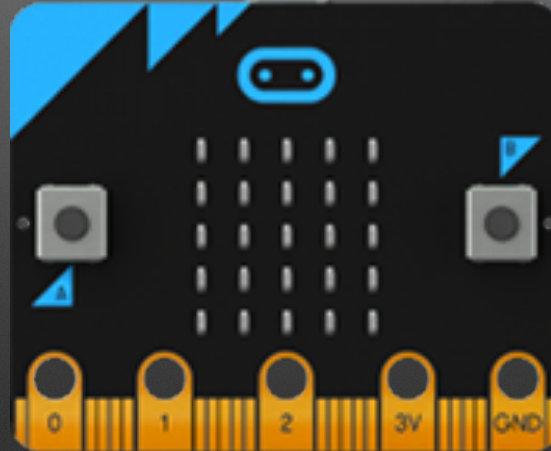
- Me
- You: Roll Call & Intros
 - Name & School,
 - School Mode? How's it going?

- ## Intros: Me & You

- Me
- You: Roll Call & Intros
 - Name & School,
 - School Mode? How's it going?
 - Any special interest in workshop?

Intros: the micro:bit

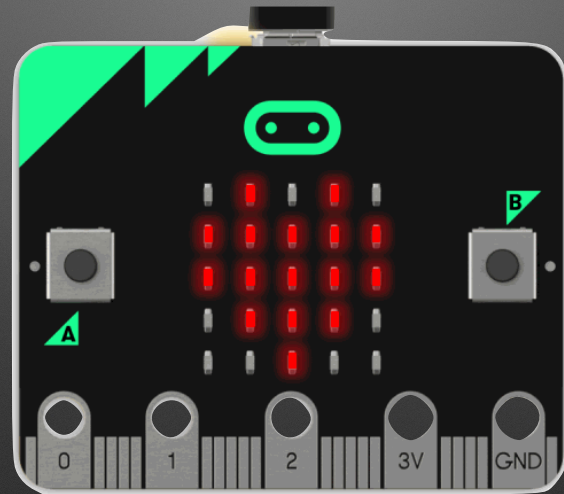
Small



5cm x 4cm

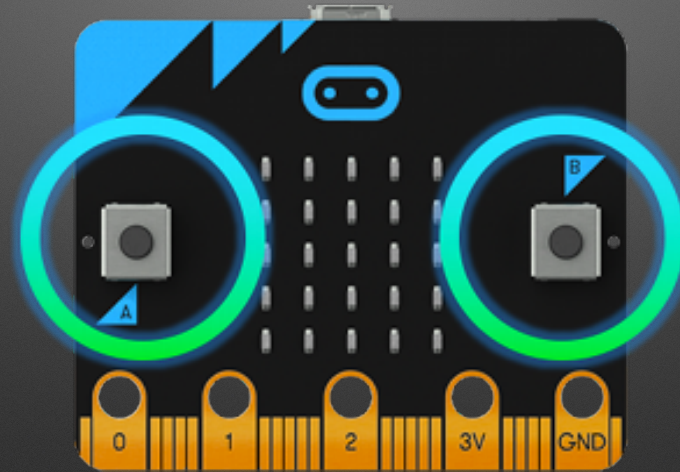
Artwork source: <http://microbit.org/images/microbit-features-temp.png>

LED Grid



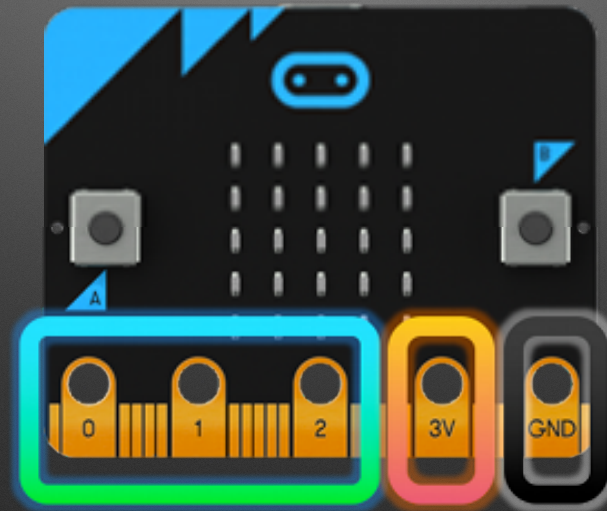
5xm x 4cm

Buttons



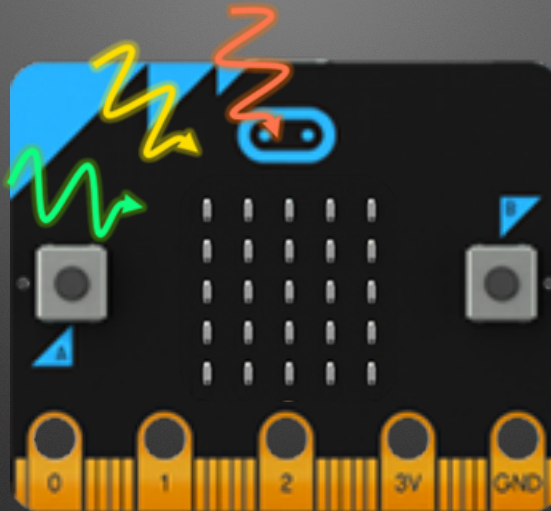
Artwork source: <http://microbit.org/images/microbit-features-buttons.png>

Connectors



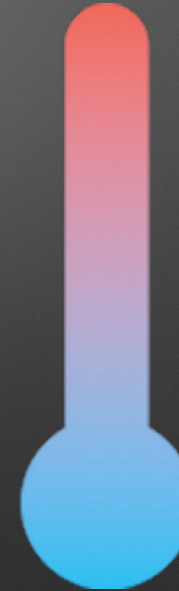
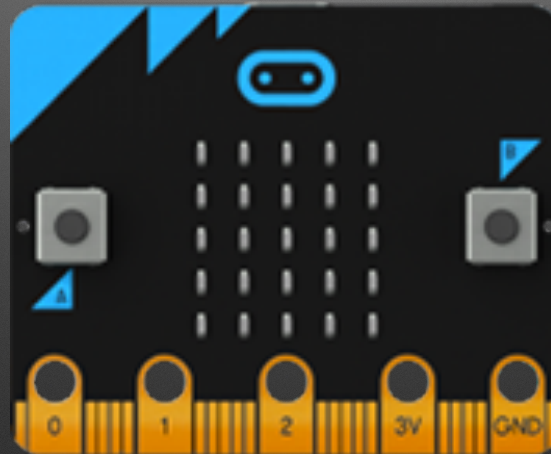
Artwork source: <http://microbit.org/images/microbit-features-pins.png>

Light Sensor



Artwork: <http://microbit.org/images/microbit-features-light.png>

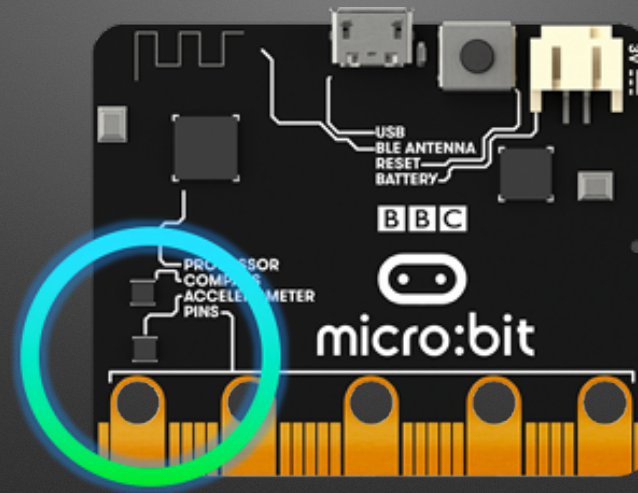
Temperature Sensor



Within about 2 degrees C (die temperature)

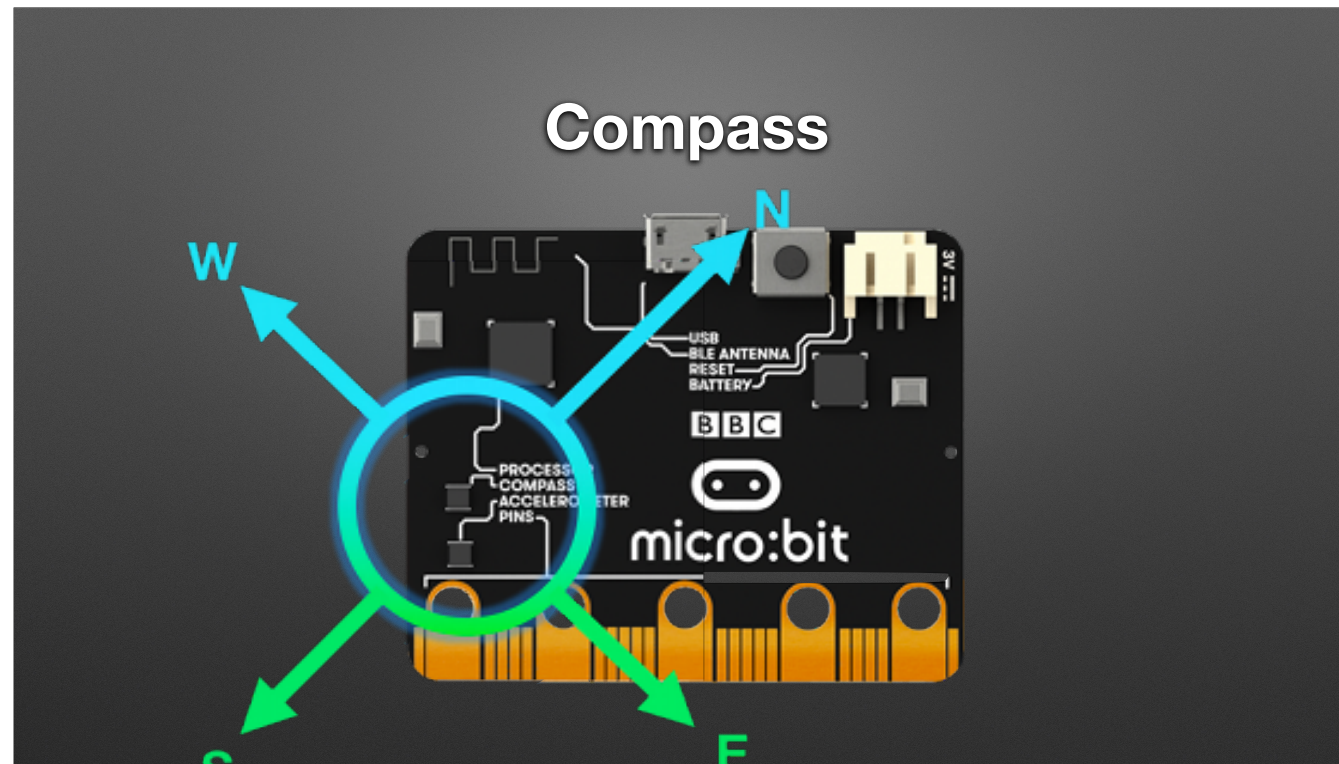
Artwork source: <http://microbit.org/images/microbit-features-temp.png>

Accelerometer



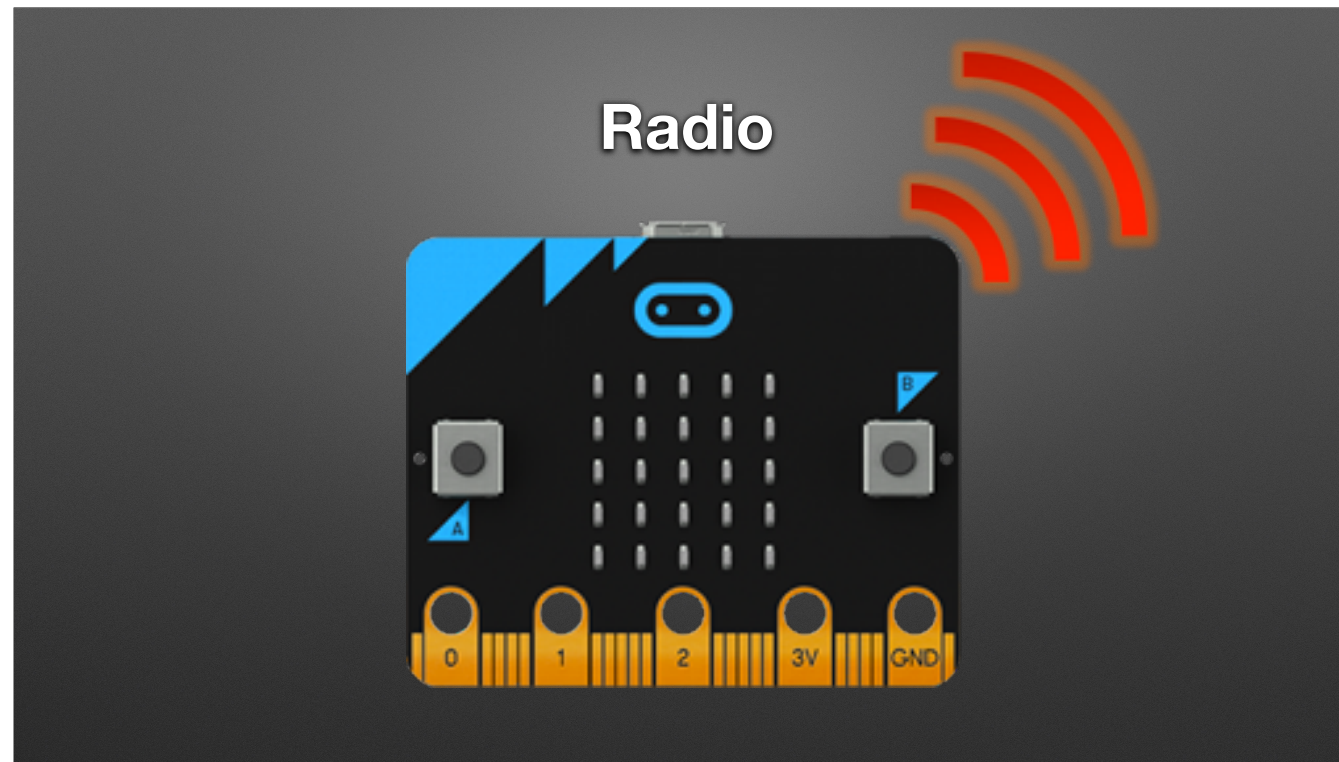
Detect/respond to tilt/tip/shake/etc.

Artwork source: <http://microbit.org/images/microbit-features-accelerometer.png>



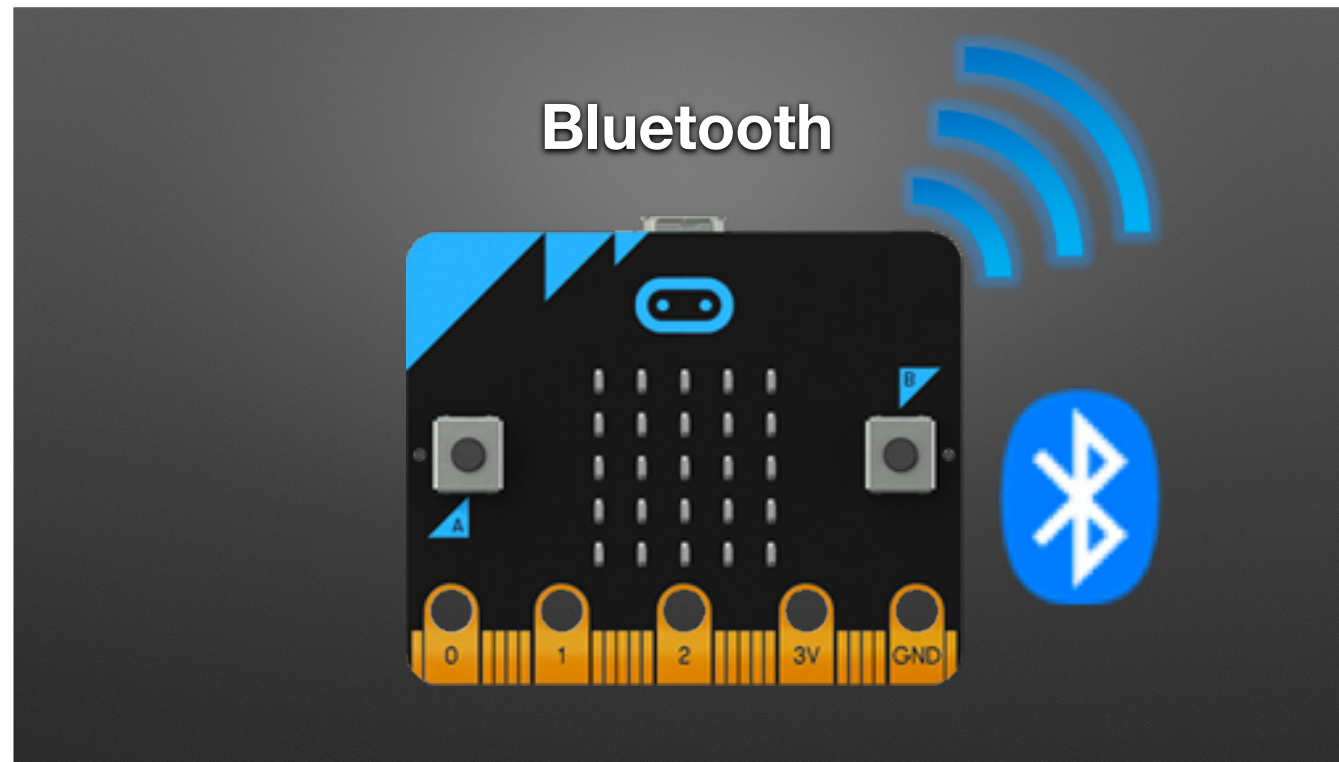
5xm x 4cm

Artwork source:<http://microbit.org/images/microbit-features-compass.png>



5xm x 4cm

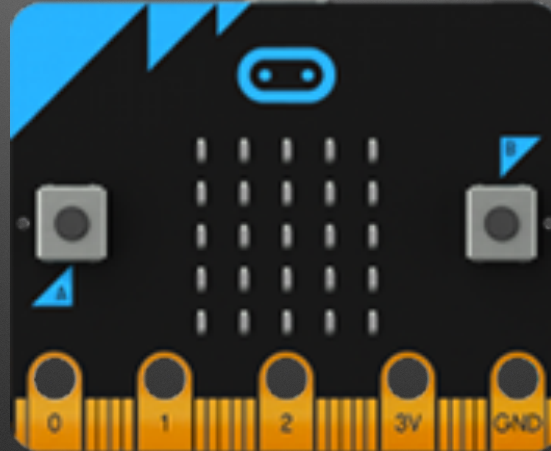
Artwork source: <http://microbit.org/images/microbit-features-radio.png>



Bluetooth: It can talk to mobile devices!!!

Artwork source: <http://microbit.org/images/microbit-features-bluetooth.png>

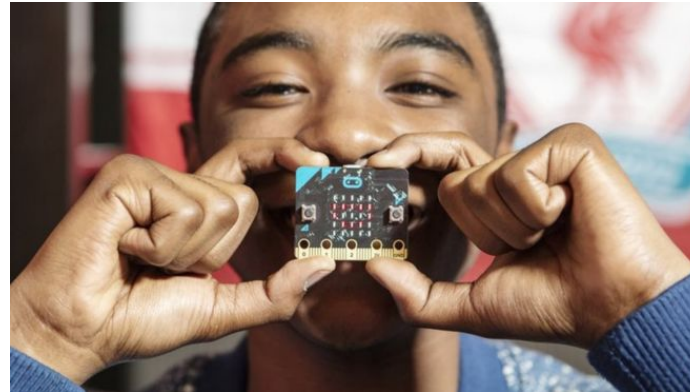
Low Cost: ~\$13 US



Artwork source: <http://microbit.org/images/microbit-features-temp.png>

2015

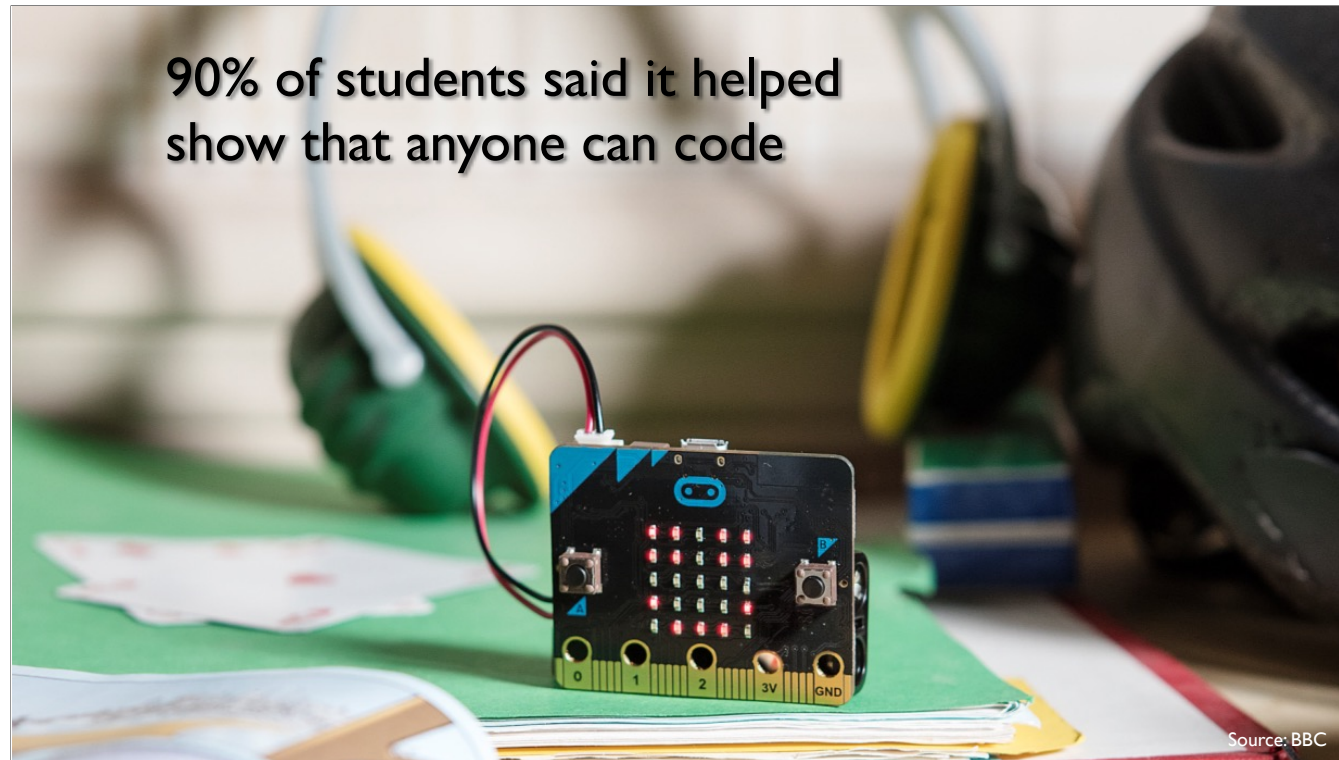
- BBC Make It Digital
- 29 partners
- 1 million micro:bit devices
- 11-12 year olds
- Across the U.K.



17 © Micro:bit Educational Foundation 2018
@microbit_edu @HaISpeed

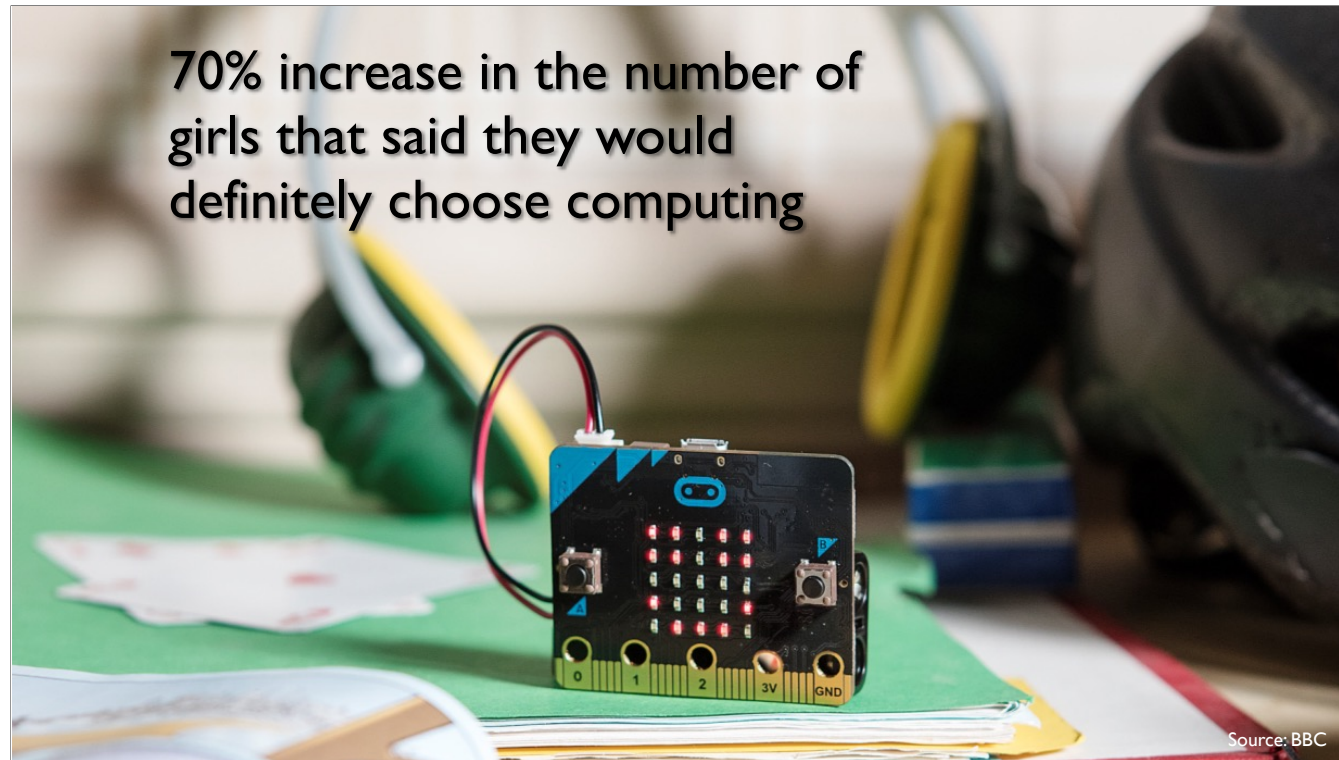


90% of students said it helped
show that anyone can code



Source: BBC

70% increase in the number of girls that said they would definitely choose computing



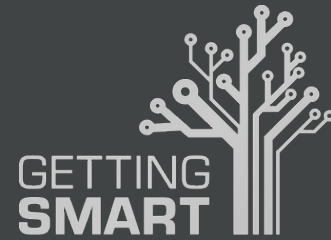
Source: BBC

2016 Micro:bit Educational Foundation Formed

To empower children, parents and
teachers around the globe to learn
and innovate using the micro:bit

2017

micro:bit available in the U.S.


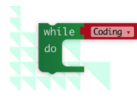








10 New & Innovative EdTech
Products Announced at ISTE 2017

Lessons Aligned to Code.org CS Fundamentals

- Lessons extend the concepts taught in the Code.org curriculum by using micro:bit and MakeCode
- Course E – Loop and Functions
- Course F – Variables and Conditionals



4 th Grade				5 th Grade			
Course E				Course F			
							
Lesson	Lesson	Lesson	Lesson	Lesson	Lesson	Lesson	Lesson
Course E - Loops 1 - Loops and Animations	Course E - Loops 2 - Nested Loops and Scoreboards	Course E - Functions 1 - A Simple Function for a Superhero	Course E - Functions 2 - Functions for a Digital Pet	Course F - Variables 1 - Variables With A Counter	Course F - Variables 2 - Variables and Emotions	Course F - Conditionals 1 - Conditionals with the Weather Predictor	Course F - Conditionals 2 - Conditionals with Rock Paper Scissors Game

Third-Party Curricula



Microsoft MakeCode Intro to CS

<https://aka.ms/intro2cs>

- | | |
|---------------------------|-------------------------------|
| 1. Making | 8. Coordinate Grid System |
| 2. Algorithms | 9. Booleans |
| 3. Variables | 10. Music and Arrays |
| 4. Conditionals | 11. Bits, Bytes, and Binary |
| 5. Iteration | 12. Radio |
| 6. Review/Mini-Project | 13. Arrays |
| 7. Coordinate Grid System | 14. Independent Final Project |

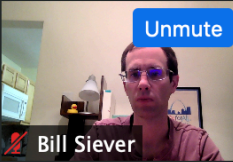


PLTW Gateway:
Computer Science for
Innovators and Makers

[https://www.pltw.org/our-program/
pltw-gateway-
curriculum#curriculum-4](https://www.pltw.org/our-program/pltw-gateway-curriculum#curriculum-4)

Let's Play

Multi-tasking Mode



Unmute

⋮

Bill Siever

Unmute My Audio

Stop Video

Pin Video

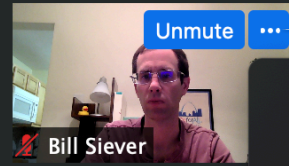
Rename

Add Profile Picture

Hide Self View

Assign to type Closed Caption

Multi-tasking Mode



- Unmute My Audio
- Stop Video
- Pin Video
- Rename
- Add Profile Picture
- Hide Self View
- Assign to type Closed Caption

1. Pick “...” on my tile

Multi-tasking Mode

Unmute

...

Bill Siever

Unmute My Audio

Stop Video

Pin Video

Rename

Add Profile Picture

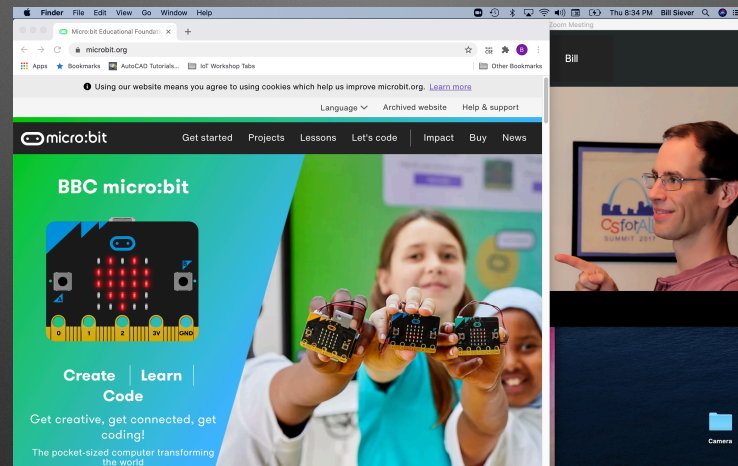
Hide Self View

Assign to type Closed Caption

1. Pick "...” on my tile

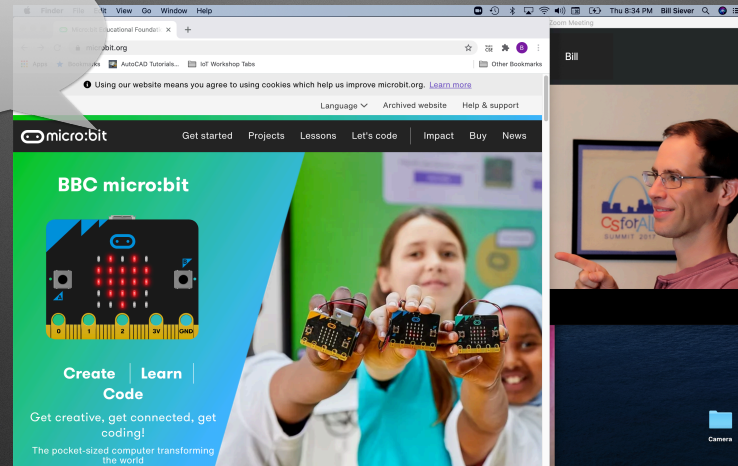
2. Pin me

Multi-tasking Mode



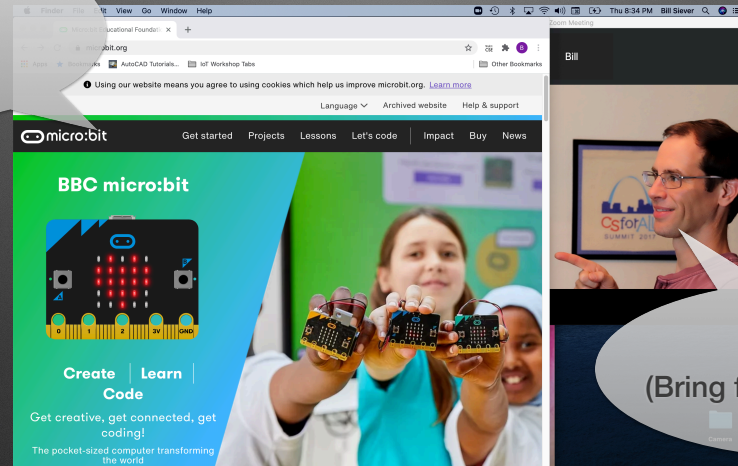
Multi-tasking Mode

1. Browser



Multi-tasking Mode

1. Browser



2. Me/video
(Bring forward as needed)





“Hello, World!”: First Program

Environment: Palette, Color & Icon coded; Most used features are prominent, others are on “...more” menu.

Simulator

Block area



“Hello, World!”: First Program

- Block-based editor



“Hello, World!”: First Program

- Block-based editor

forever

show string

"Hello, World! "



“Hello, World!”: First Program

- Block-based editor
- Built-in simulator

forever

show string

"Hello, World! "



“Hello, World!”: First Program

- Block-based editor
- Built-in simulator
- Deployment to Micro:bit

forever

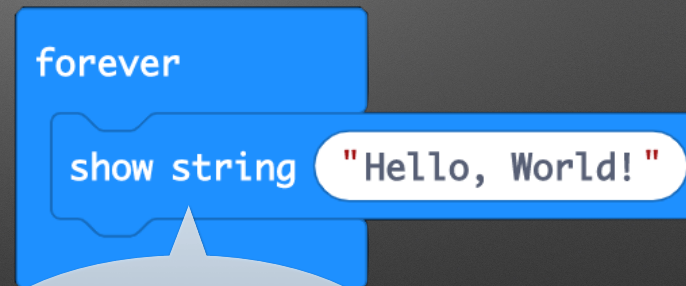
show string

"Hello, World! "



“Hello, World!”: First Program

- Block-based editor
- Built-in simulator
- Deployment to Micro:bit

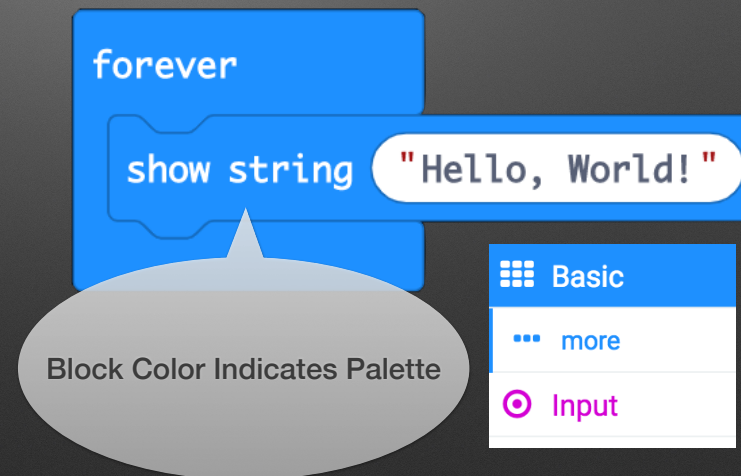


Block Color Indicates Palette



“Hello, World!”: First Program

- Block-based editor
- Built-in simulator
- Deployment to Micro:bit



Blocks are just the beginning...

Blocks are just the beginning...

- JavaScript/Python

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- JavaScript/Python
- Python w/ REPL

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- Python w/ REPL
- Arduino / C++

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- JavaScript/Python
- Python w/ REPL
- Arduino / C++
- Commercial IDEs / C++

Blocks are just the beginning...

- JavaScript/Python
- Python w/ REPL
- Arduino / C++
- Commercial IDEs / C++
- Rust

Workshop Format

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- Moderate pace with small examples

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- Only covering blocks-based approach

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- Will cover many “building blocks”, but not much depth

Workshop Format

- Moderate pace with small examples
- Only covering blocks-based approach
- Will cover many “building blocks”, but not much depth
 - Putting pieces together for awesome projects left as an exercise for you...



Setup

- Hardware Handout
 1. Open Box
 2. Pull out micro:bit
 3. Pull out micro USB cable (under cardboard)
 4. Connect via USB cable



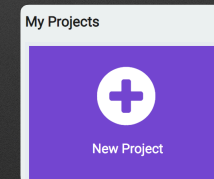
Setup

- Browser

1. Open microbit.org
2. Select “Let’s Code”
3. Click “MakeCode editor” button
4. Select “New Project”

Let's code

{ } MakeCode editor



Personalization!

Personalization!

- Hello Bill / Hello

Personalization!

- Hello Bill / Hello

forever

show string

"Hello CCSC:MW"

Aside: Text-based Languages

 Home

 Share

 Blocks

 JavaScript



 JavaScript

 Python

Aside: Storage

Aside: Storage

- Projects are stored in the cloud

Aside: Storage

- Projects are stored in the cloud
 - No accounts (by default, but GitHub repositories can be used)

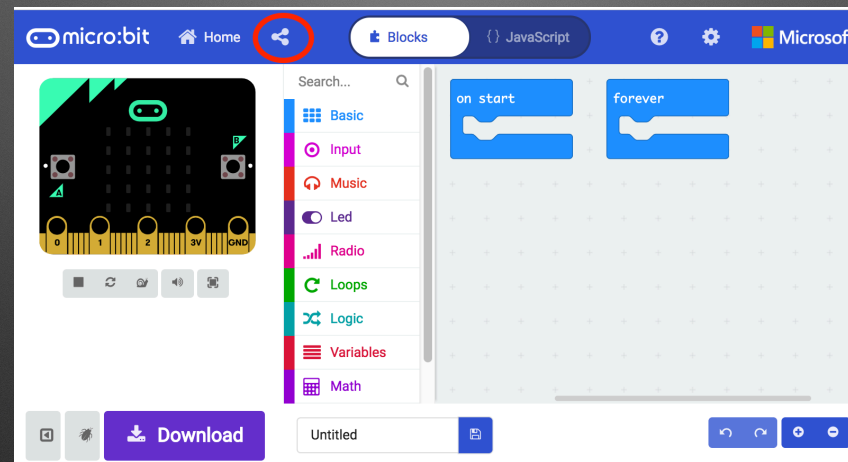
Aside: Storage

- Projects are stored in the cloud
 - No accounts (by default, but GitHub repositories can be used)
 - Based on *machine you're on!*

Aside: Storage

- Projects are stored in the cloud
 - No accounts (by default, but GitHub repositories can be used)
 - Based on *machine you're on!*
- But...Downloaded files can be restored via Drag & Drop!

Sharing via URL



WebUSB

WebUSB

- Why: Get rid of Files!

WebUSB

- Why: Get rid of Files!
- Faster programming

WebUSB

- Why: Get rid of Files!
- Faster programming
- Additional Features: a Console!

WebUSB

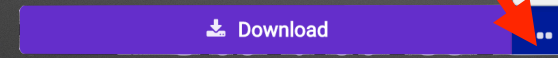
- Why: Get rid of Files!
 - Faster programming
 - Additional Features: a Console!
- How: Chrome 65+ & Setup



WebUSB Setup

1. Go to ... Menu on Download button

2. Select Pair Device

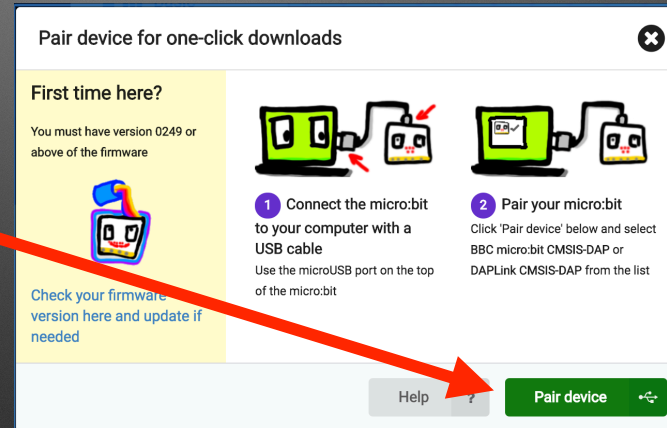


- Pair device
- Download to micro:bit



Setup: Chrome v65+

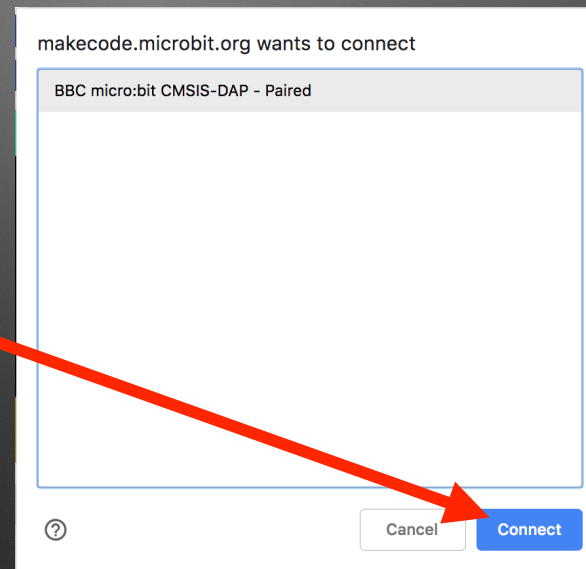
3. Select Pair Device





Setup: Chrome v65+

4. Connect

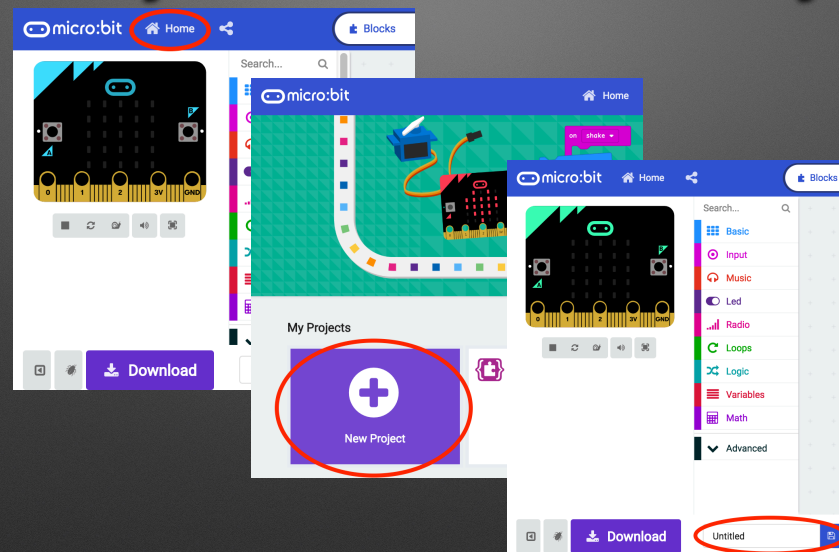


Try It!

 Download

New Project: Home > New Project...

New Project: Home > New Project...





Programming: Logic & Action

- Picking between *three* tough choices
 - Cookie, Cake, Pie
 - Super Strength, Invisibility, Telekinesis
 - ...

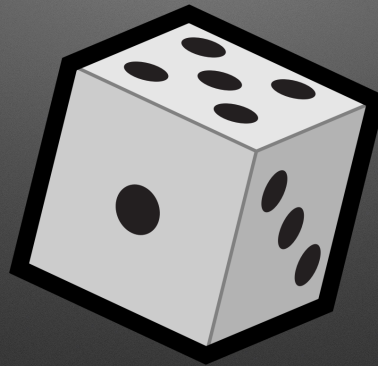
CS...Int division; Mod; Etc.

Obvious Solution...

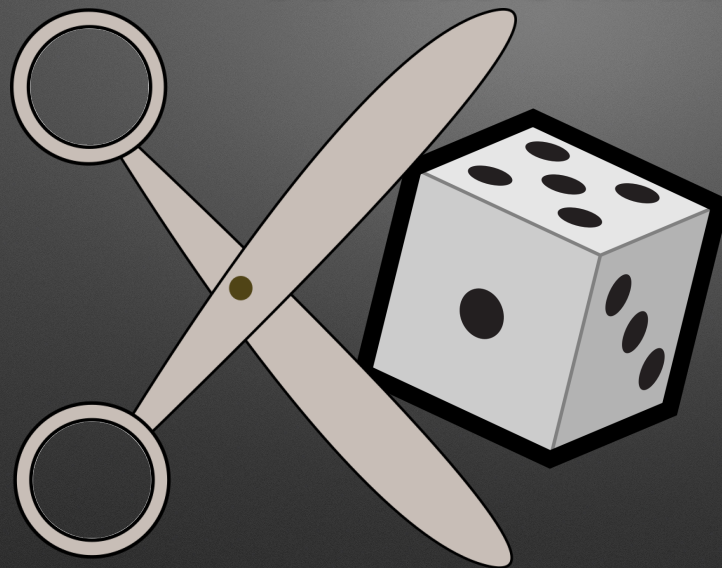
<https://openclipart.org/detail/17370/a-die>

<https://openclipart.org/detail/19632/scissors>

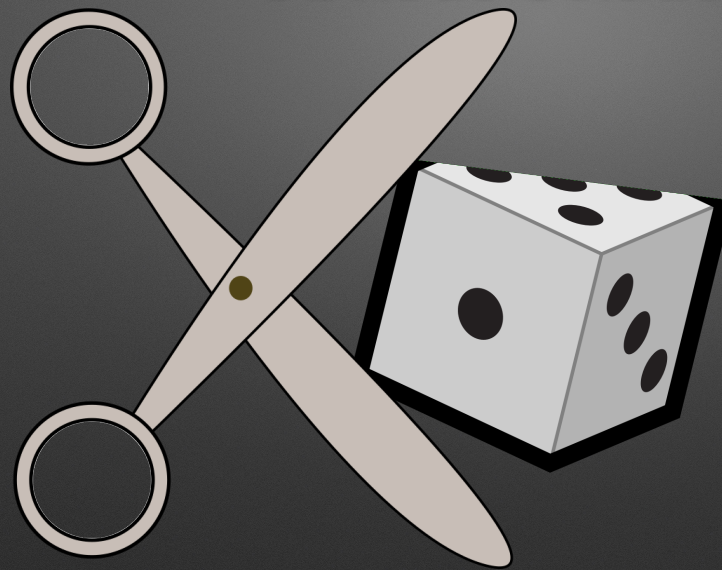
Obvious Solution...



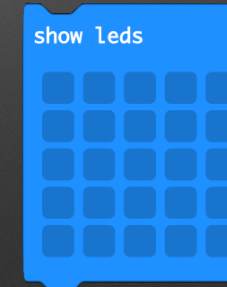
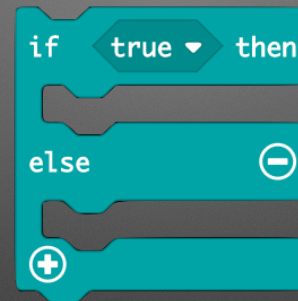
Obvious Solution...



Obvious Solution...



Parts

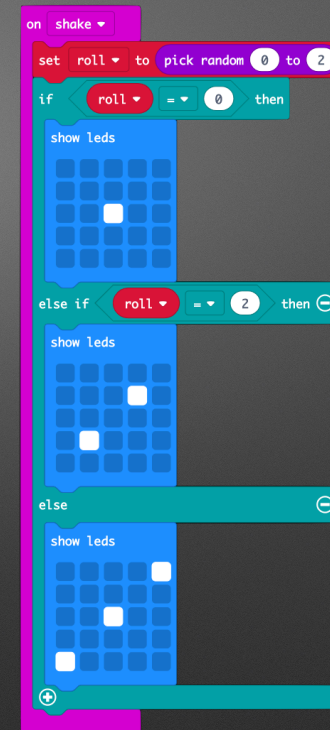


1. Color indicates Palette
2. Incremental Development:
Try parts in Simulator
3. Play...Start with showing 0/1

Let's play...

Get started w/ Shake & Show Random Number

A solution



Full Program: 03-Roll.hex

Concepts

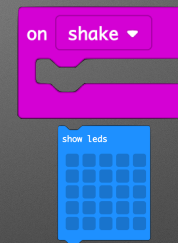
Concepts

- Event driven programming



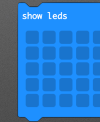
Concepts

- Event driven programming
- Bitmapped Graphics



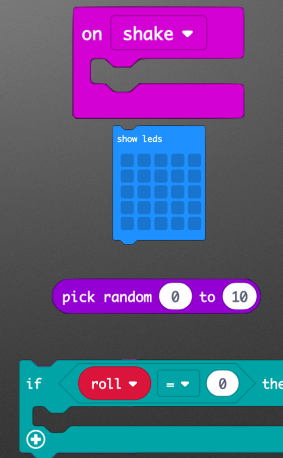
Concepts

- Event driven programming
- Bitmapped Graphics
- Ranges & Representations



Concepts

- Event driven programming
- Bitmapped Graphics
- Ranges & Representations
- Boolean Logic



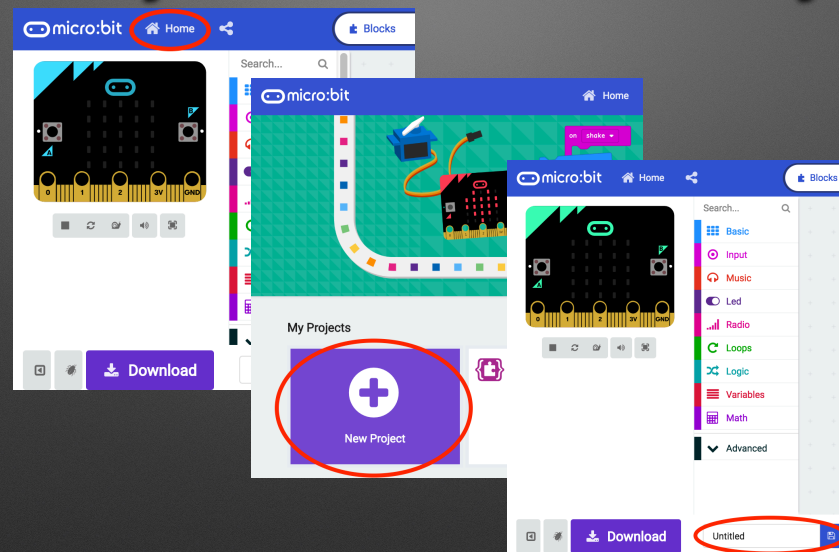
Pedagogy

- Active Learning
- Discovery Based
- Constructionist

Great...but all concepts can be done with scratch.

New Project: Home > New Project...

New Project: Home > New Project...





Broadcast Basics

- Radio Palette: Broadcast Based Radio Transmissions
 - String, Number, Key/Value Pairs, ...
- In the basic editor...
- In the Multi Editor!
 - <https://makecode.microbit.org/---multi#>

Concepts

Broadcasting can be done with Scratch

Concepts

- Broadcasting

radio send number 0

Concepts

- Broadcasting

radio send number 0

- Network Addresses

radio set group 1

Concepts

- Broadcasting

radio send number 0

- Network Addresses

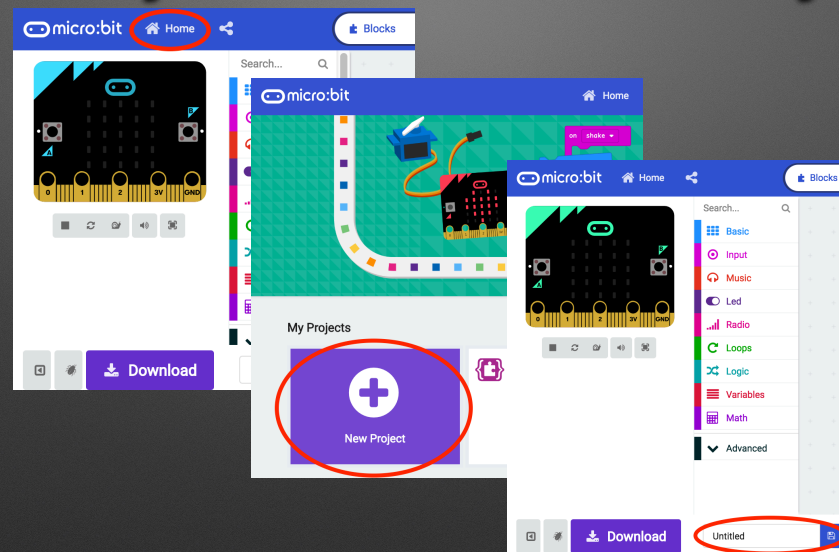
radio set group 1

- Asynchronous clocks / Sync problems

on radio received receivedNumber

New Project: Home > New Project...

New Project: Home > New Project...



Goody Bag: Hardware



Awesome (?) Audio

Show an example of playing a note / Using Clips to connect to headphones

Parts: 2 Clips + Headphone



Concepts

Concepts

- I/O

Concepts

- I/O
- Basic Electric Circuits/Electronics



Motor Mayhem

An Intro to Servos



Motor Mayhem

An Intro to Servos

on button pressed

servo write pin to

on button pressed

servo write pin to

Program



Motor Mayhem

An Intro to Servos

on button pressed

servo write pin to

on button pressed

servo write pin to

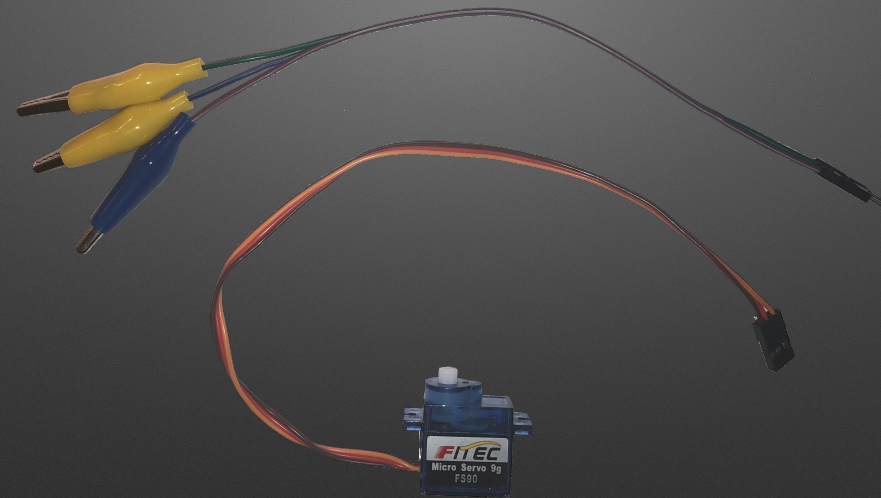
These servos are
limited to 0-120°

Testing...

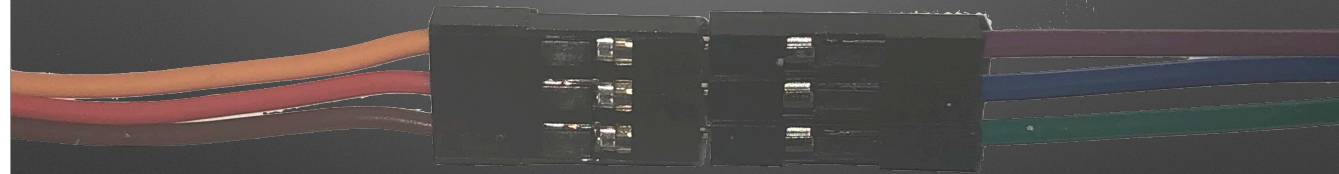
- Test in Simulator

TODO: Add picture

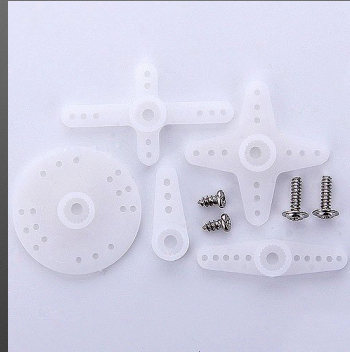
Parts



Connect them...



Add a Horn



Pic Source: https://www.amazon.com/gp/product/B07CM87WBQ/ref=ppx_yo_dt_b_asin_title_o03_s00?ie=UTF8&psc=1

Clip to micro:bit

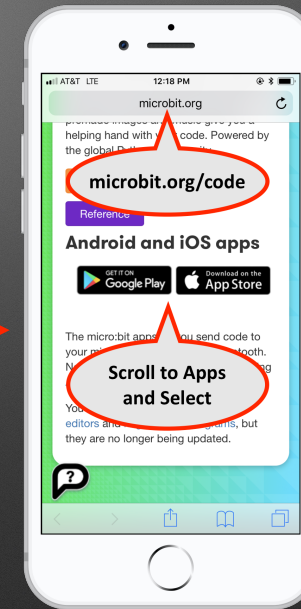
- Match color on Servo to pad name on micro:bit (clip colors don't matter)
 - Brown on Servo to GND on micro:bit
 - Red on Servo to 3V on micro:bit
 - Orange on Servo to 0 on micro:bit

Inchworm Insanity


<https://makecode.microbit.org/projects/inchworm>

Break

1. Firmware Update
 - A. Go to <https://tinyurl.com/uBitUpdate>
 - B. Follow Instructions to Upgrade
2. App Install
 - A. Open Browser on phone to <http://microbit.org/code>
 - B. Scroll to Apps and Select



Bluetooth Background

- Uses different protocol than  Radio
- Not a group broadcast

Bluetooth Background

Bluetooth Background

Central

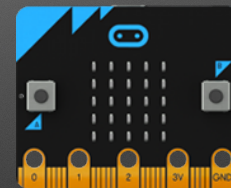


Bluetooth Background

Central



Peripheral



Bluetooth Background

Bluetooth Background

Central



Bluetooth Background



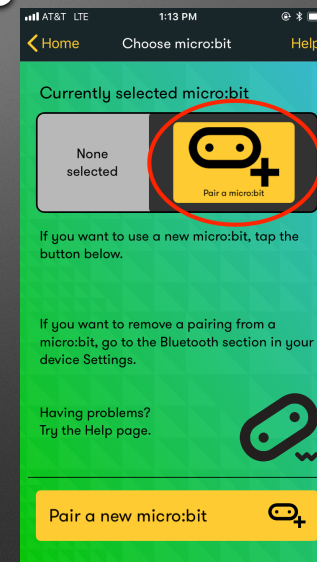
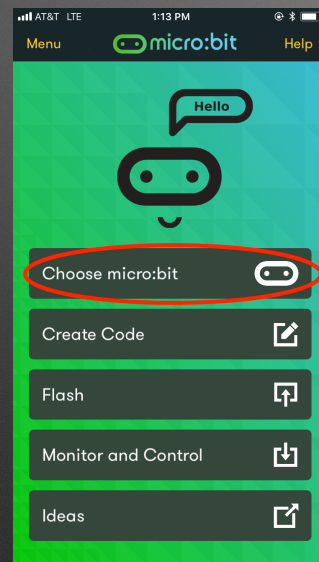
Bluetooth Basics

- Bluetooth has various levels of security
 - “Pairing” — Forming a “permanent” bond
(Exchanging security info. once and storing it)
- Block editor supports three types
 - No pairing (“insecure” - we’ll use this)
 - Just Works (default; pretty safe)
 - Passkey Pairing (more secure)

Pairing

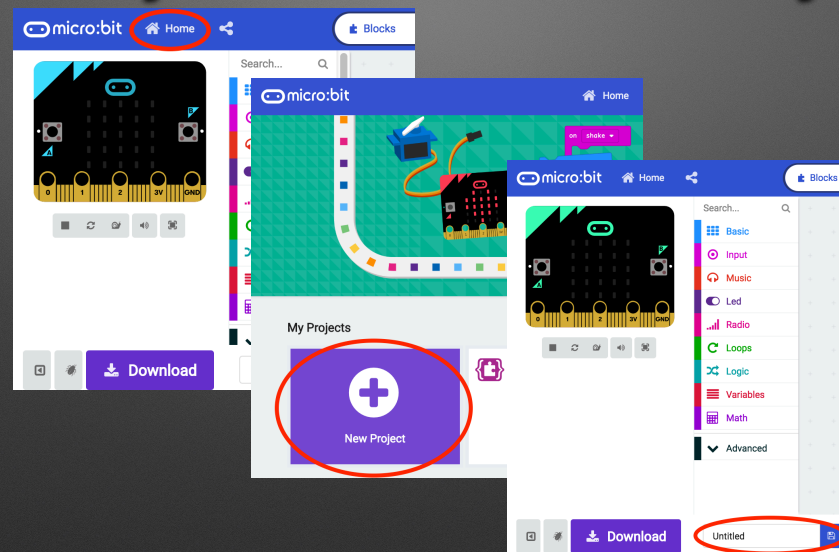
Follow instructions to pair. NOTE THE NAME of your Micro:bit!!!! Will need it later

Pairing



New Project: Home > New Project...

New Project: Home > New Project...



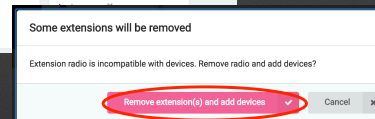
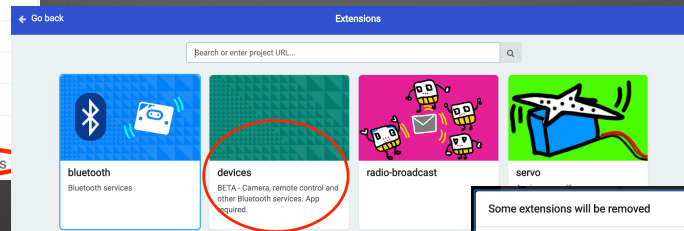
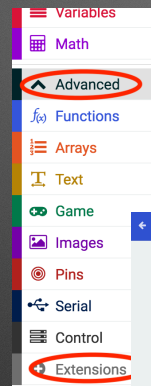
Add Bluetooth

(& remove Radio)

FIXME

Add Bluetooth

(& remove Radio)



Project Settings

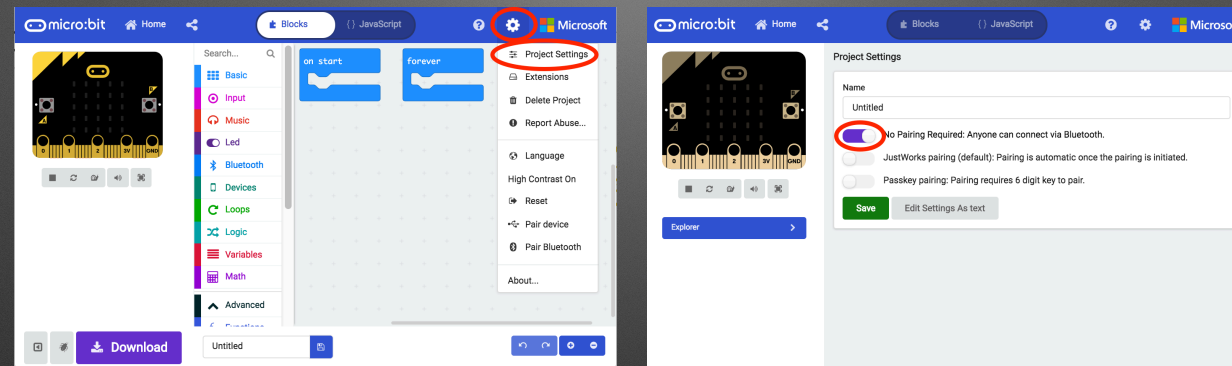
Pairing only works prior to installing a bluetooth sketch.

May need to re-load a blank sketch and then start pairing process.

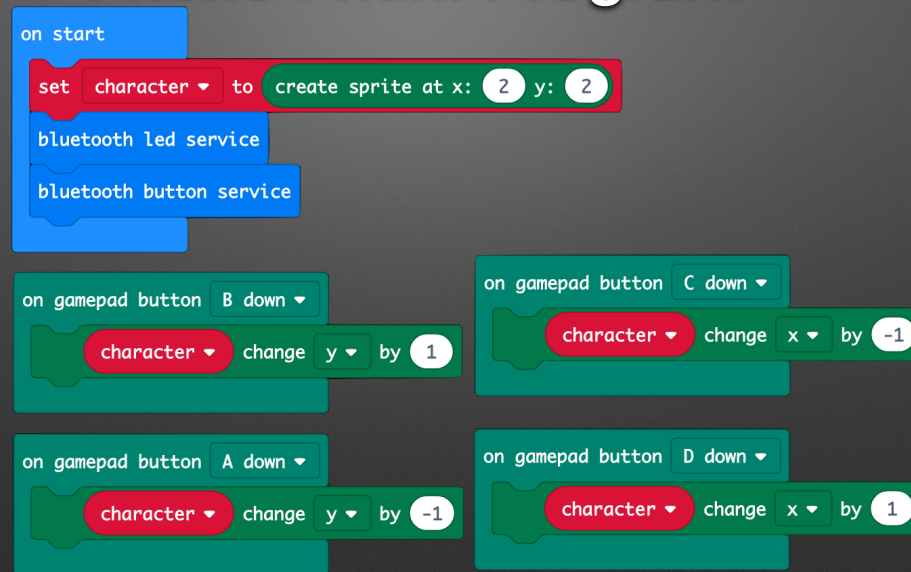
Each sketch will need this setting.

Need to know name of YOUR microbic

Project Settings



Phone Phun: Program

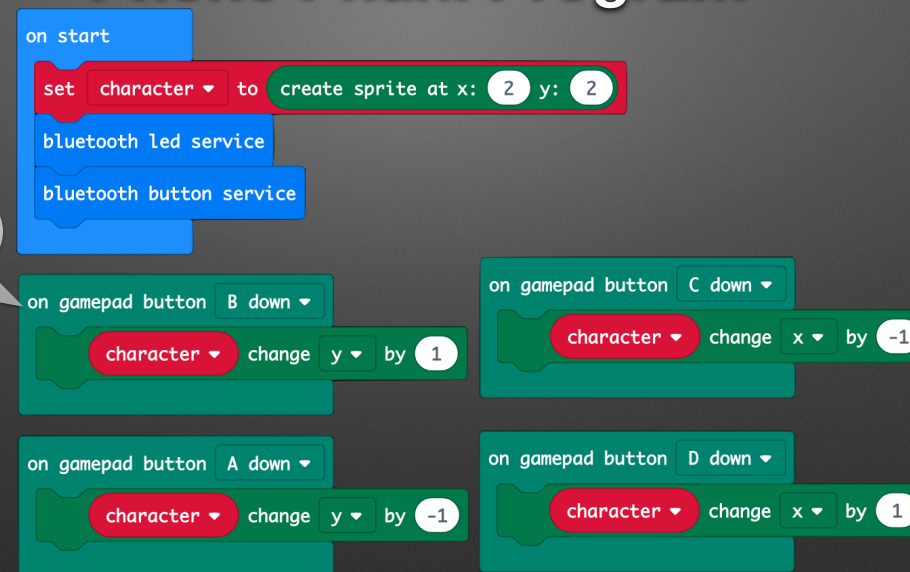


Use right-click "duplicate"

Full Program: 07-BluetoothControl.hex

Phone Phun: Program

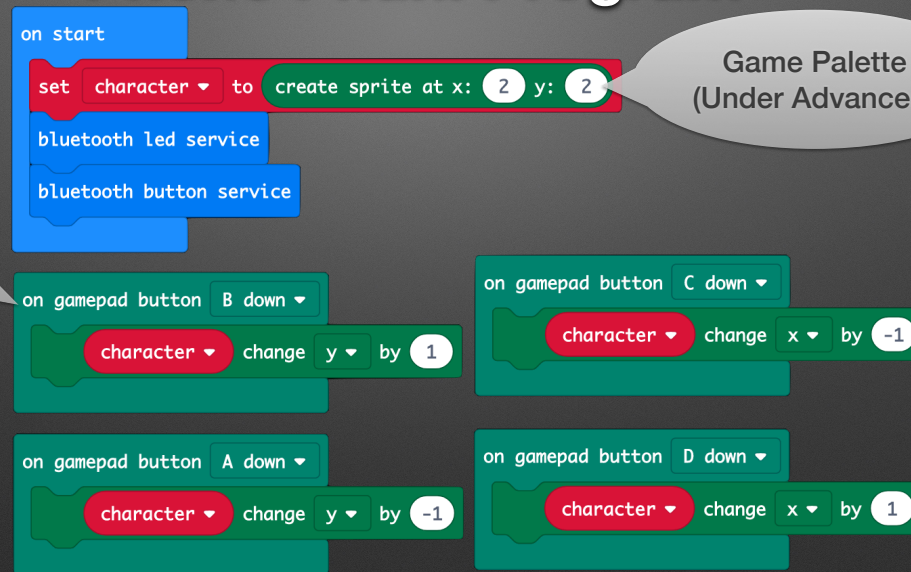
Devices Palette



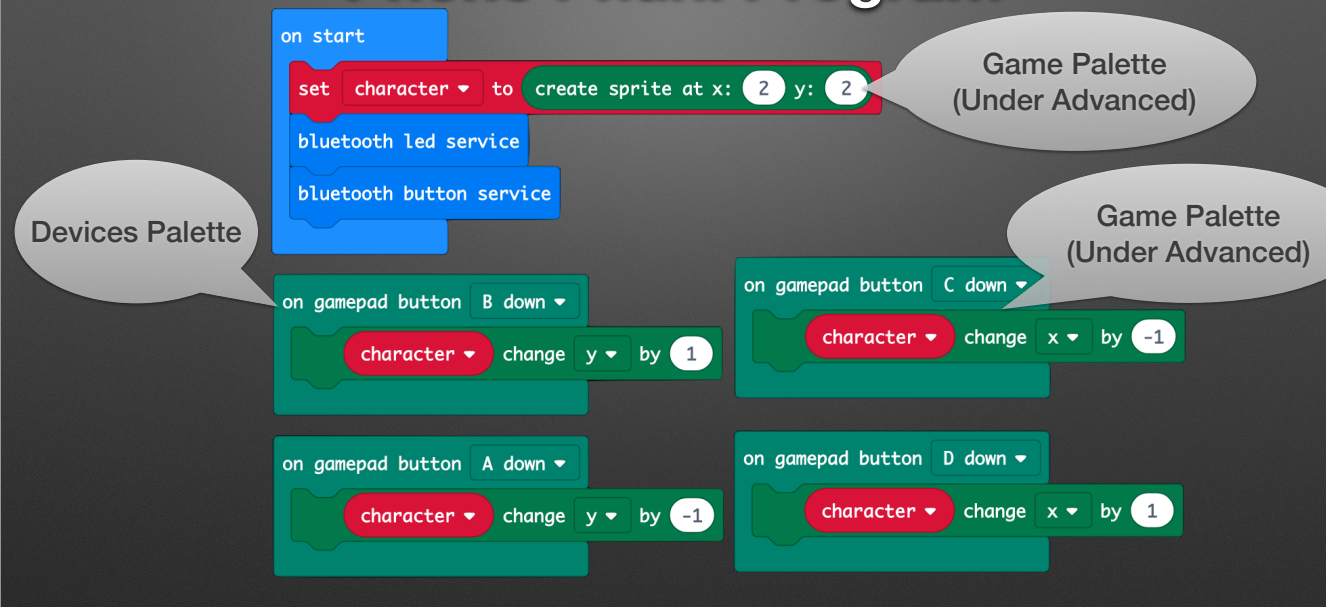
Phone Phun: Program

Devices Palette

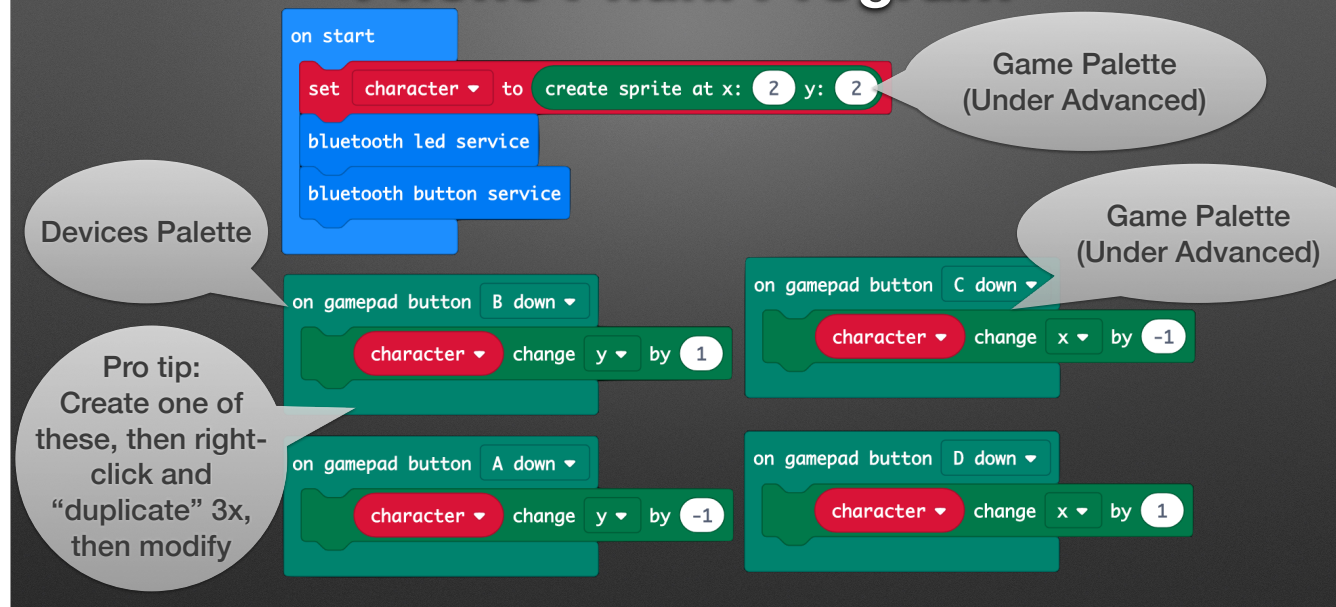
Game Palette
(Under Advanced)



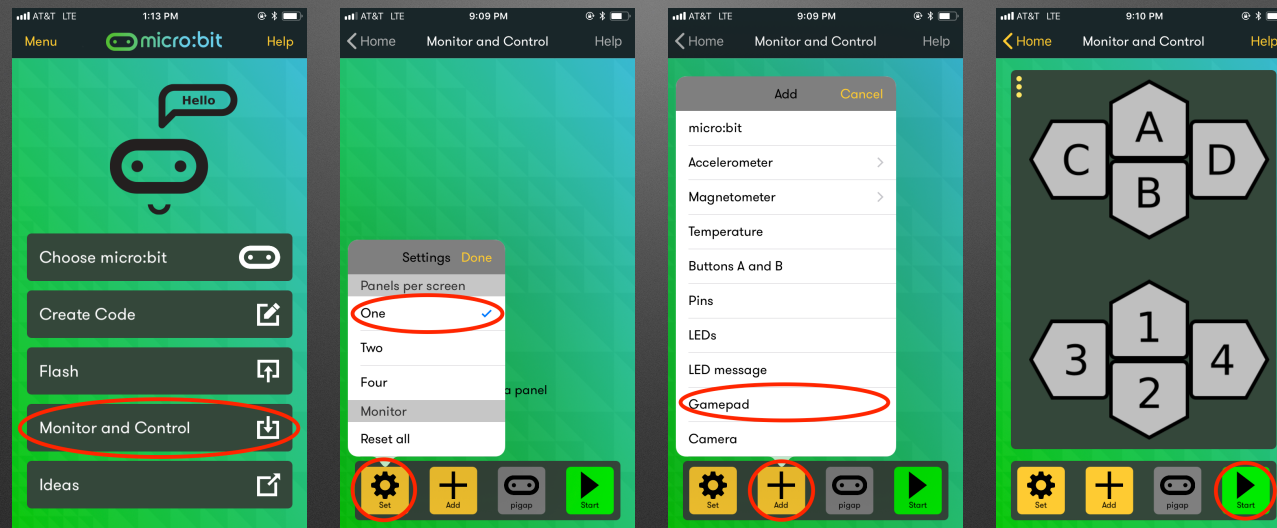
Phone Phun: Program



Phone Phun: Program

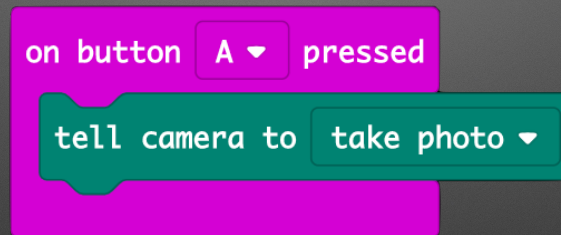


App Configuration



Micro:bit Shutter Release

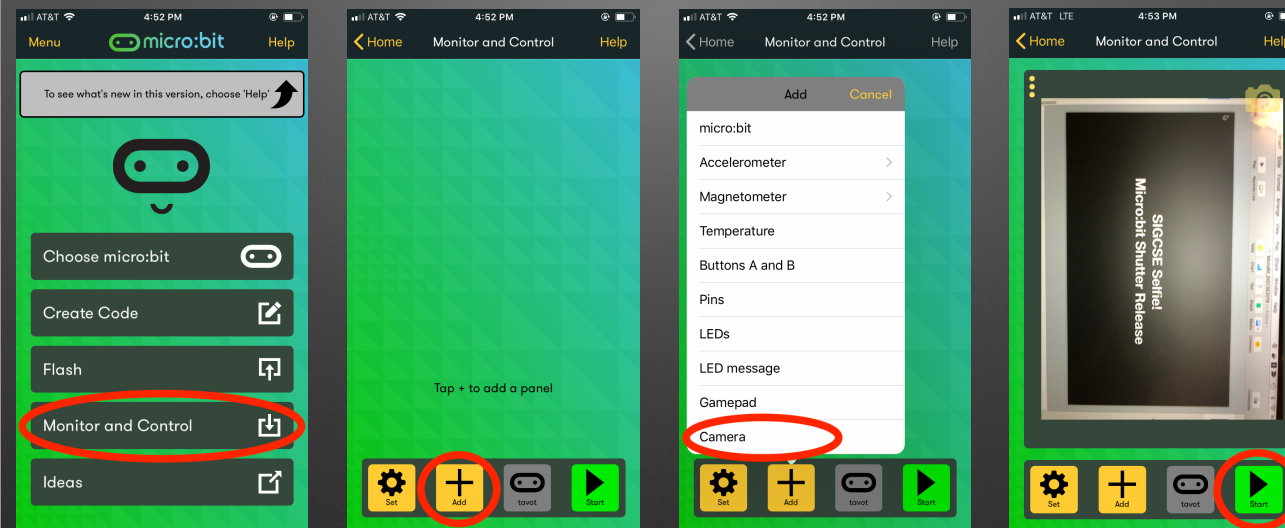
Program



Full program: 08-Selfie.hex

App Config

App Config



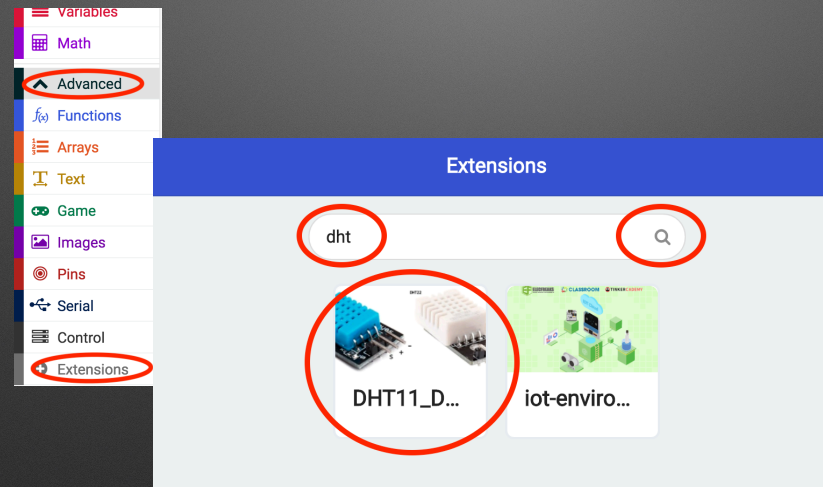
Extra Hardware: Extensions

- Extensions...extend
 - Additional hardware support (today)
 - Additional simulator features

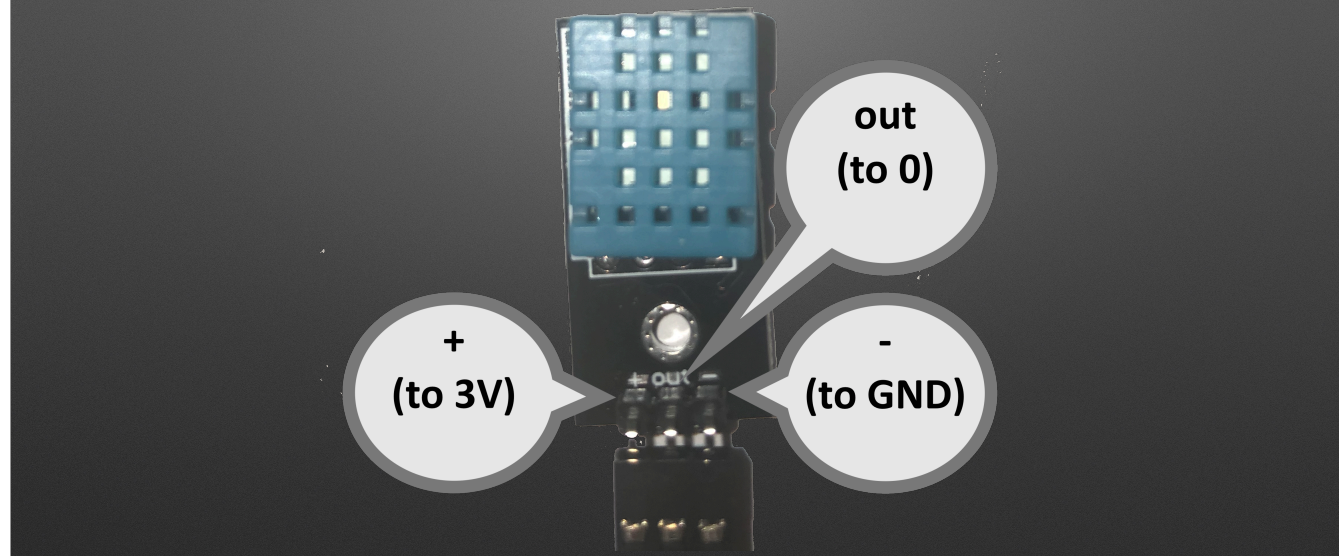
Extra Hardware: Extensions

FIXME

Extra Hardware: Extensions

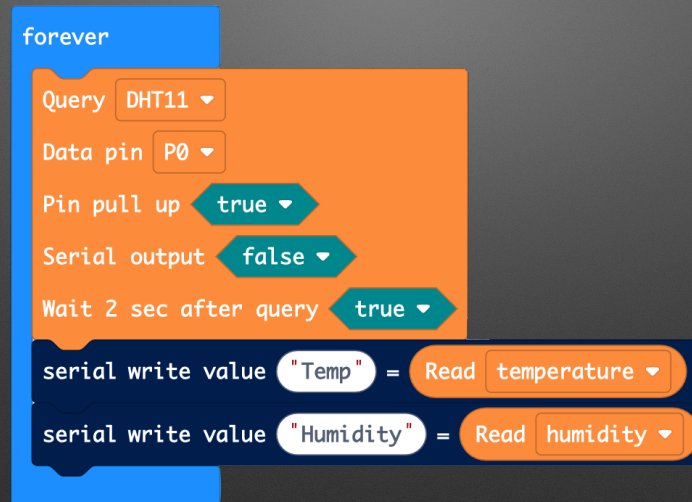


Wiring Sensor



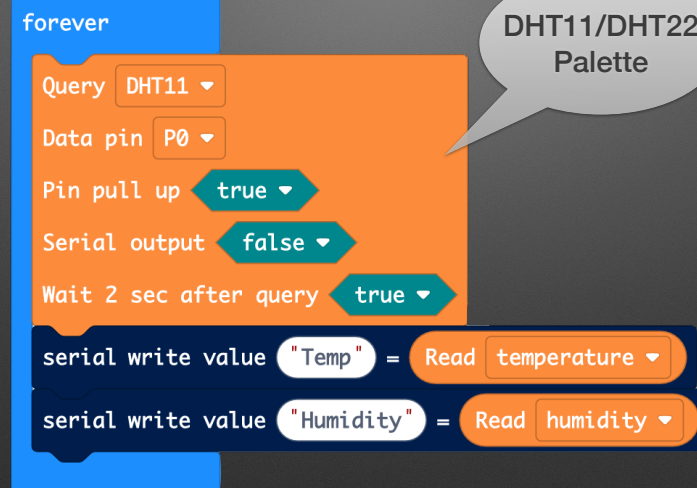
TODO

Collecting Data

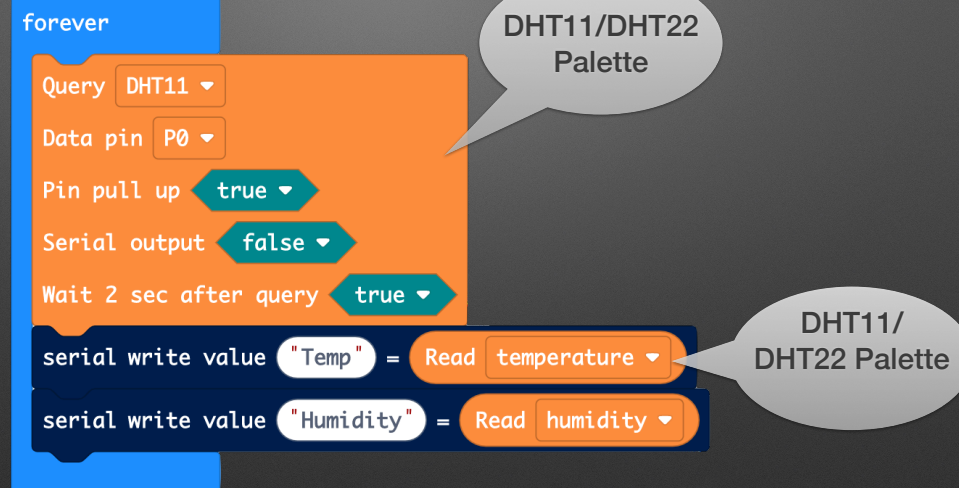


Full Program: 09-TempHumidity.hex

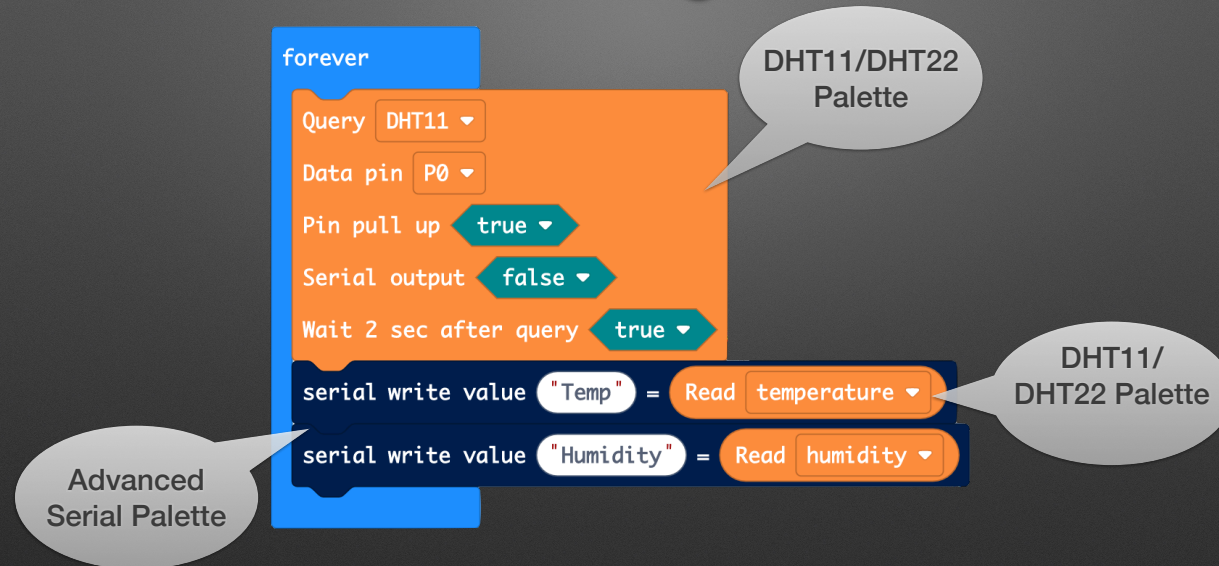
Collecting Data



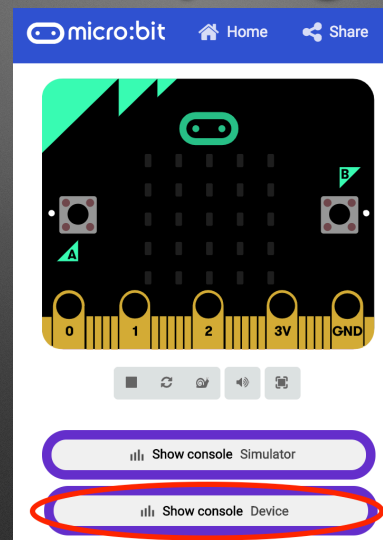
Collecting Data



Collecting Data

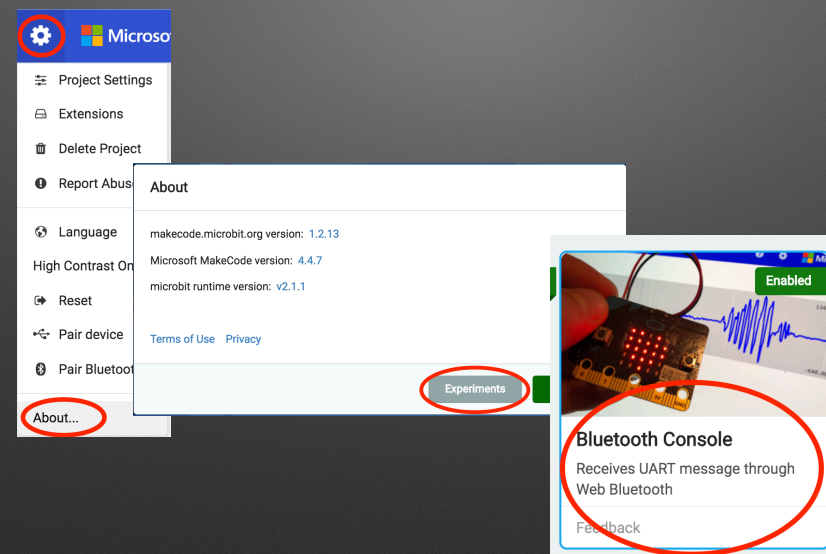


Graphing



Bluetooth Streaming: Setup

Bluetooth Streaming: Setup



Project Settings

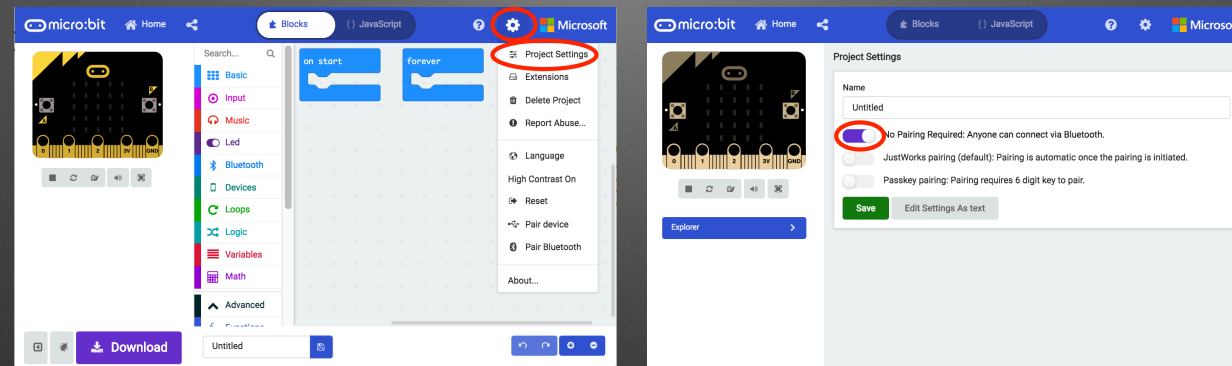
Pairing only works prior to installing a bluetooth sketch.

May need to re-load a blank sketch and then start pairing process.

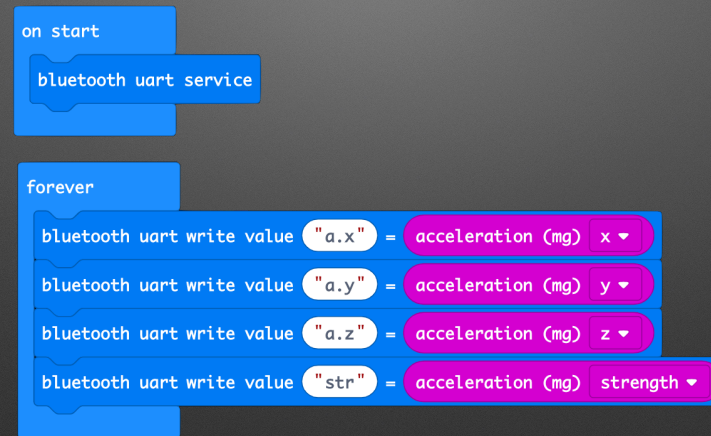
Each sketch will need this setting.

Need to know name of YOUR microbic

Project Settings



Bluetooth Streaming: Program



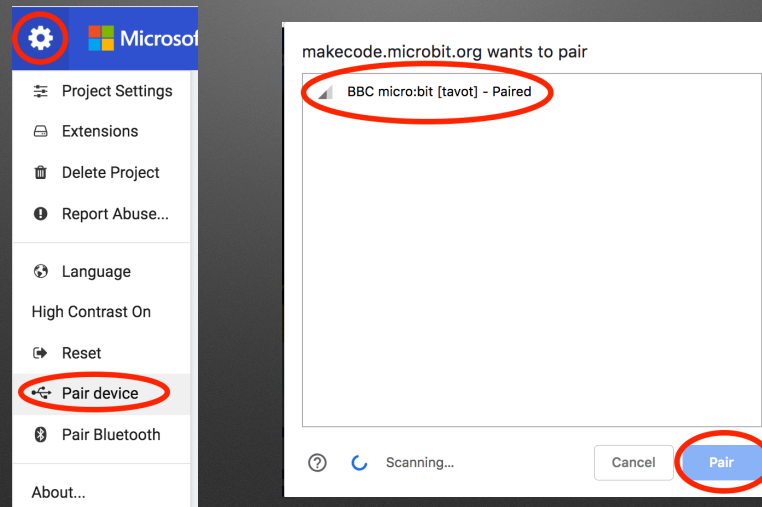
Full Program: 12-WirelessAccel.hex

Pairing Process

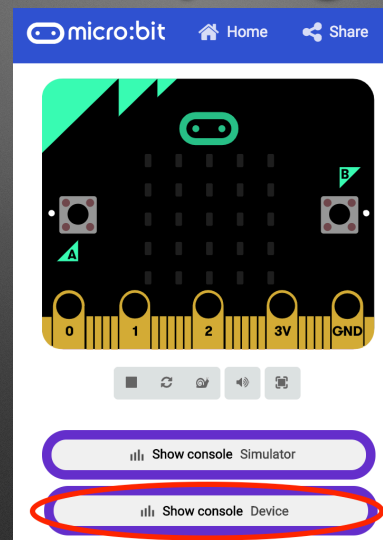
(Settings>No Pairing Required;
but need to connect to micro:bit)

Pairing Process

(Settings>No Pairing Required;
but need to connect to micro:bit)



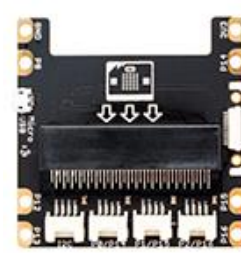
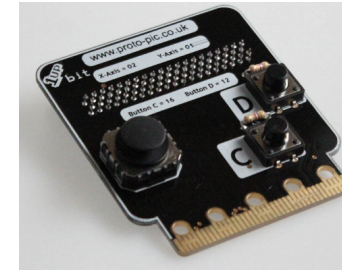
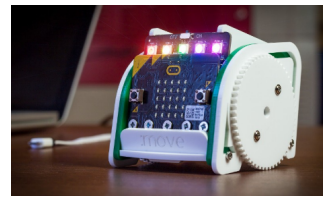
Graphing



Hardware Ecosystem



<http://microbit.org/assets/documents/microbit-accessories.pdf>



Misc.

- Address Safety!
- Low voltage / low current vs. Mains power

Questions / Discussion / Requests



Remove Add Bluetooth
(& remove Radio)

Remove Add Bluetooth

(& remove Radio)

Advanced

Functions

Arrays

Text

Game

Images

Pins

Serial

Control

Add Package

Add Package... ?

Search or enter project URL...

devices
Camera, remote control and other
Bluetooth services

bluetooth
Bluetooth services

neopixel
Adafruit NeoPixel driver

Some packages will be removed

Package radio is incompatible with bluetooth. Remove radio and add bluetooth?

Remove package(s) and add bluetooth

Cancel