Micro:bit Magic

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

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Outline

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

- # Intros: Us & You

Intros: Us & You

- Us

Intros: Us & You

- Us
- You: Roll Call & Intros

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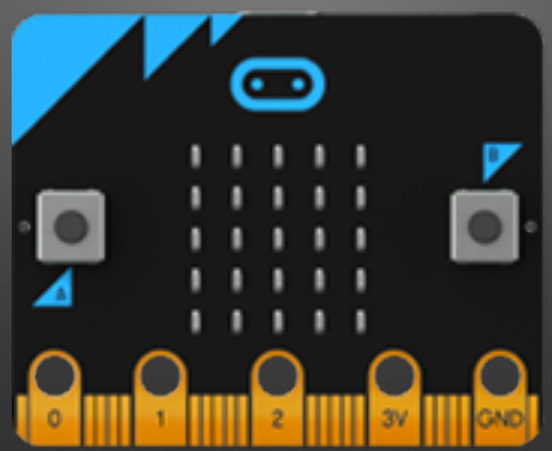
  - Who has Chrome? Who has an iOS Device with the App?

Intros: Us & You

- Us
- You: Roll Call & Intros
  - Who has Chrome? Who has an iOS Device with the App?
- Pair programming —pair up!

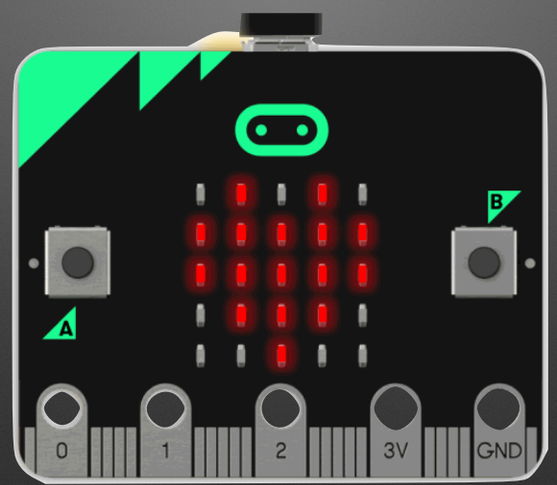
Intros: the micro:bit

Small



5xm x 4cm
Artwork source: http://microbit.org/images/microbit-features-temp.png

LED Grid



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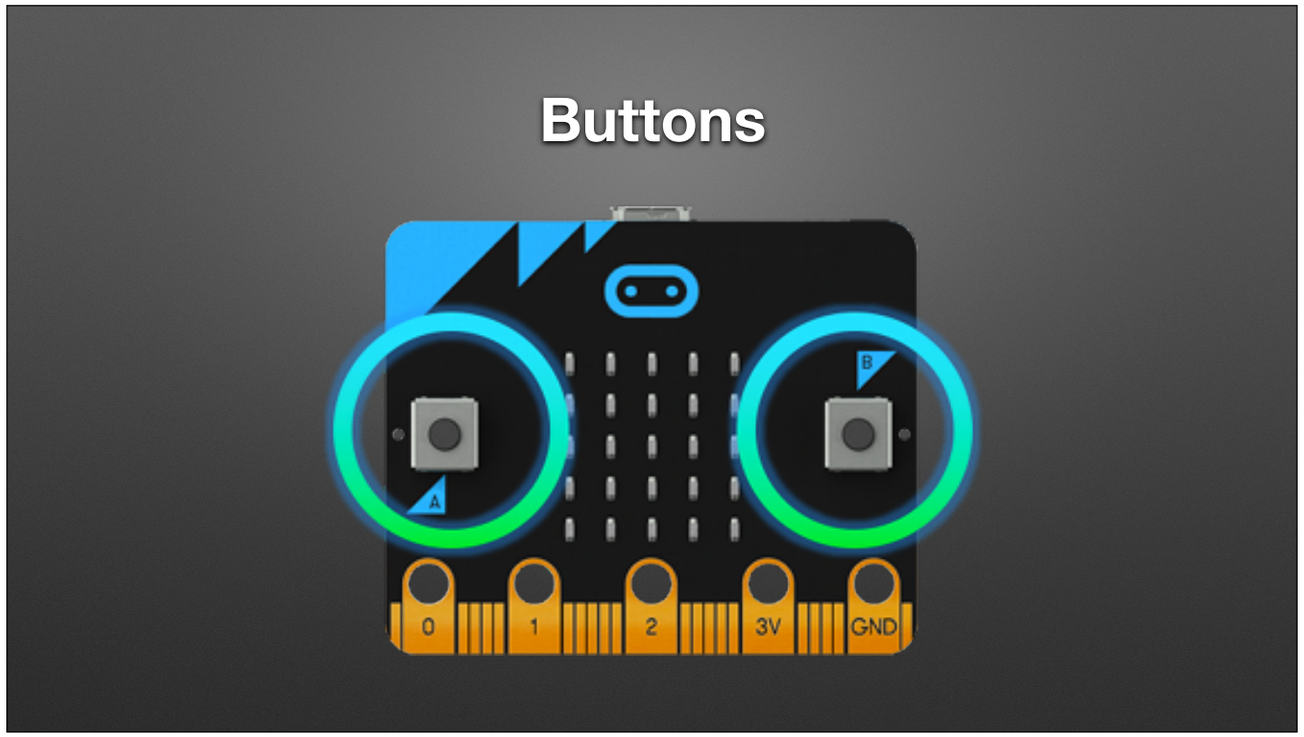

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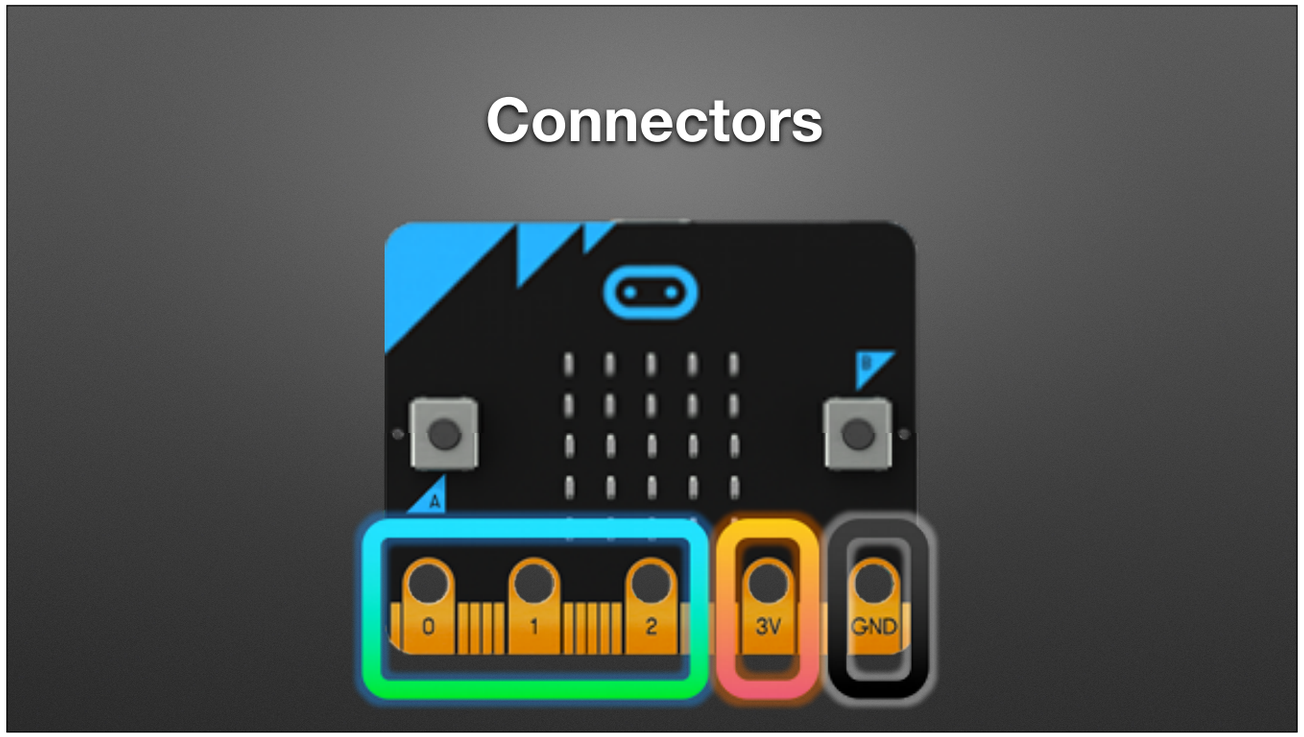
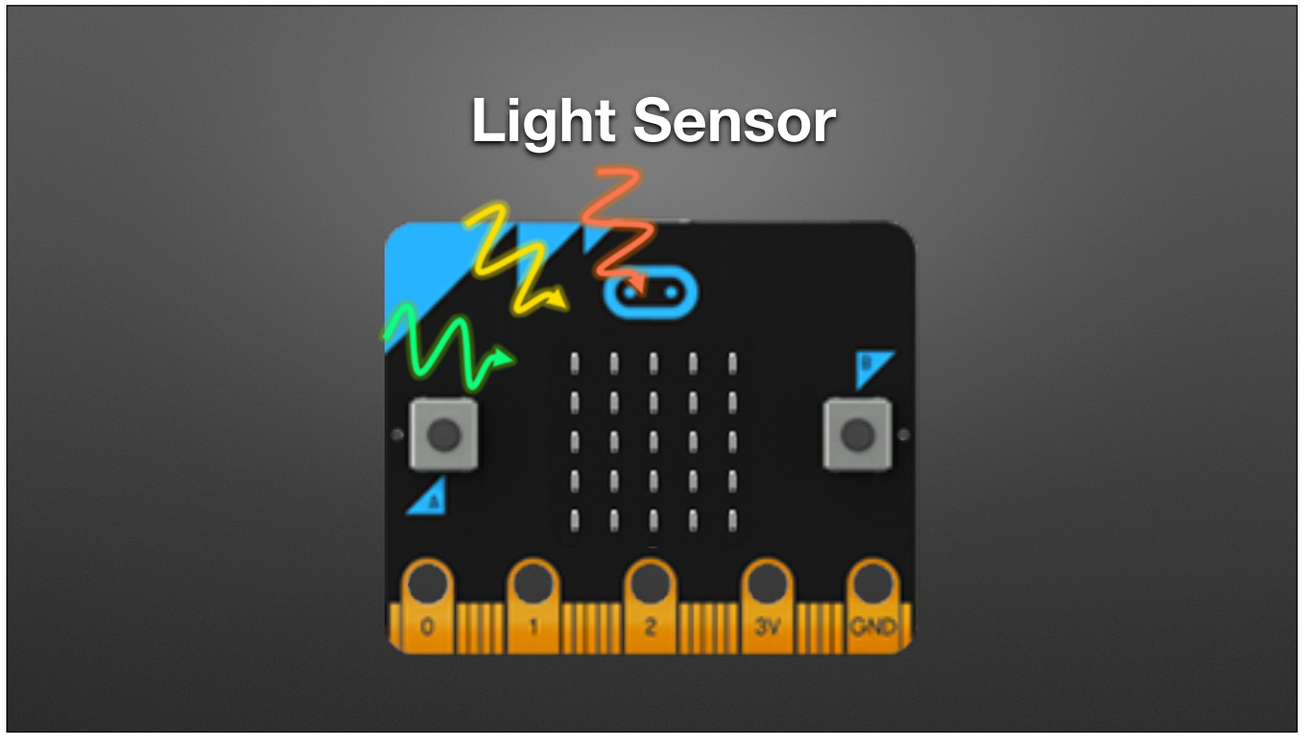
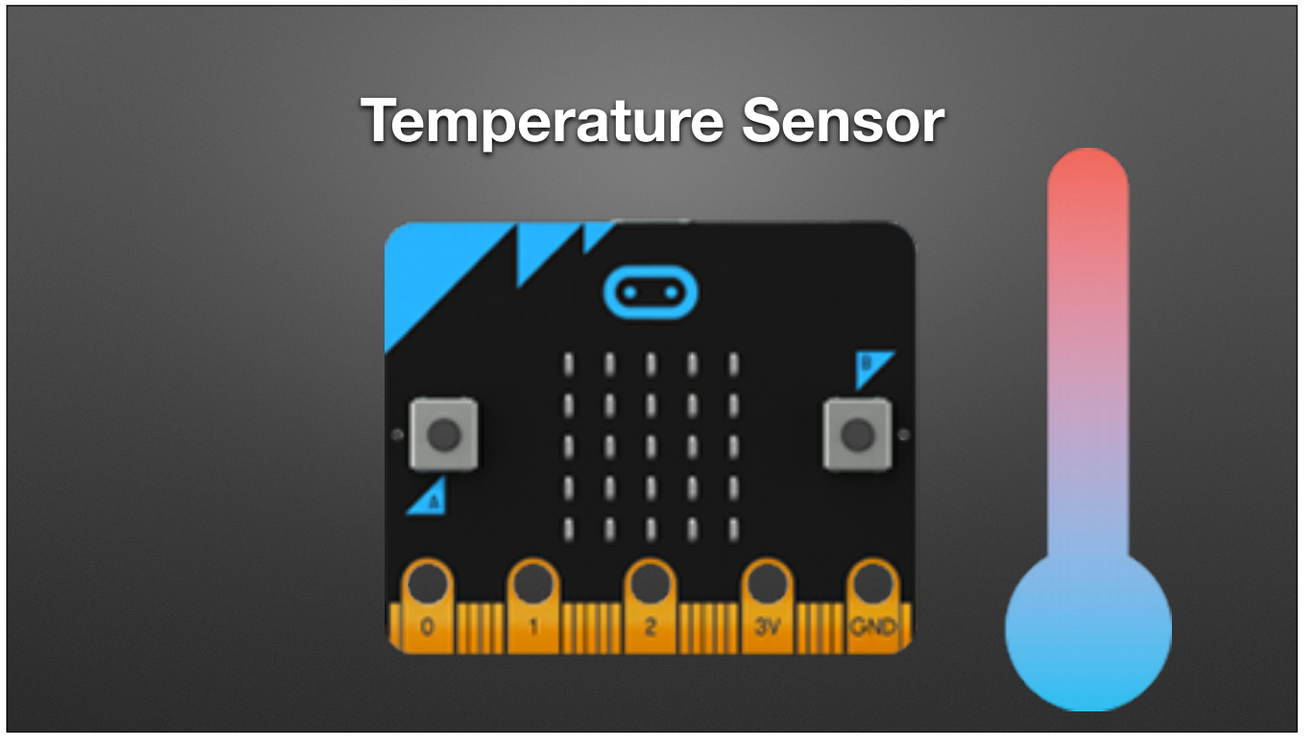


Artwork source: http://microbit.org/images/microbit-features-pins.png

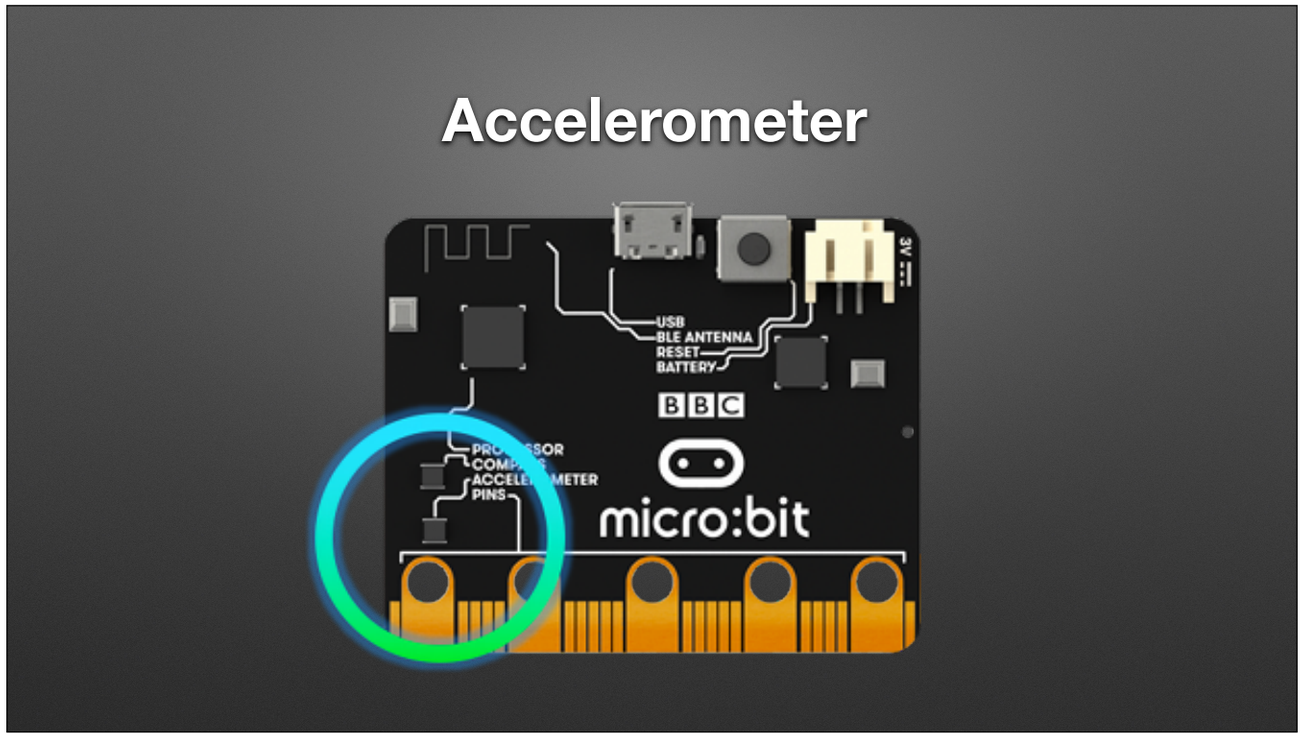


Artwork: http://microbit.org/images/microbit-features-light.png



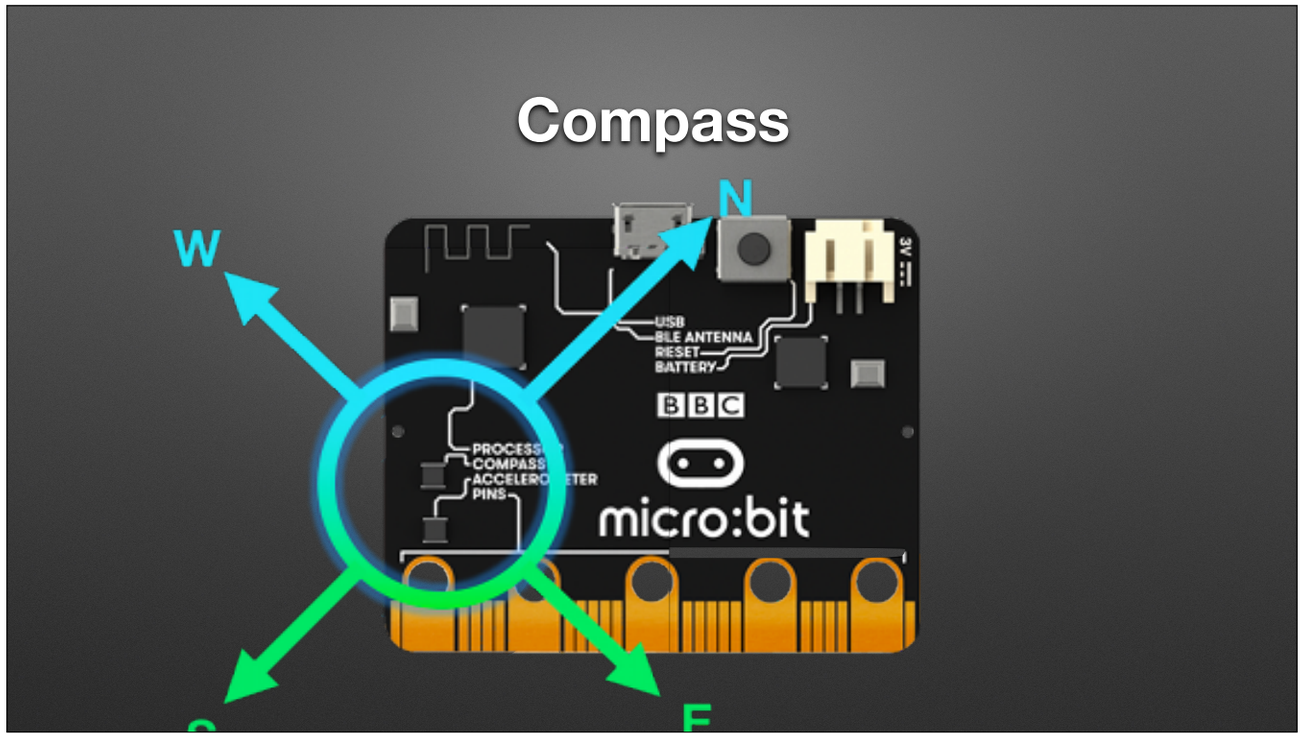
Within about 2 degrees C (die temperature)
Artwork source: http://microbit.org/images/microbit-features-temp.png

Accelerometer



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

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



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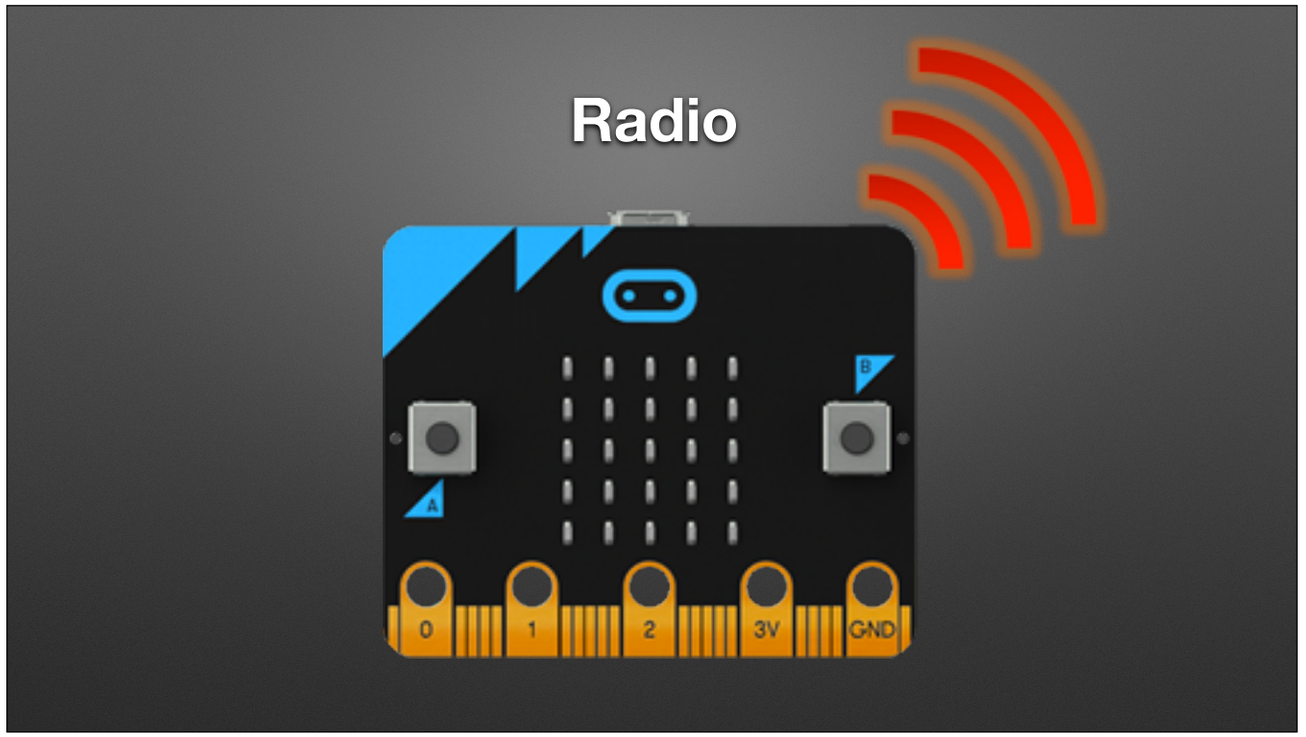
Artwork source:http://microbit.org/images/microbit-features-compass.png



5xm x 4cm
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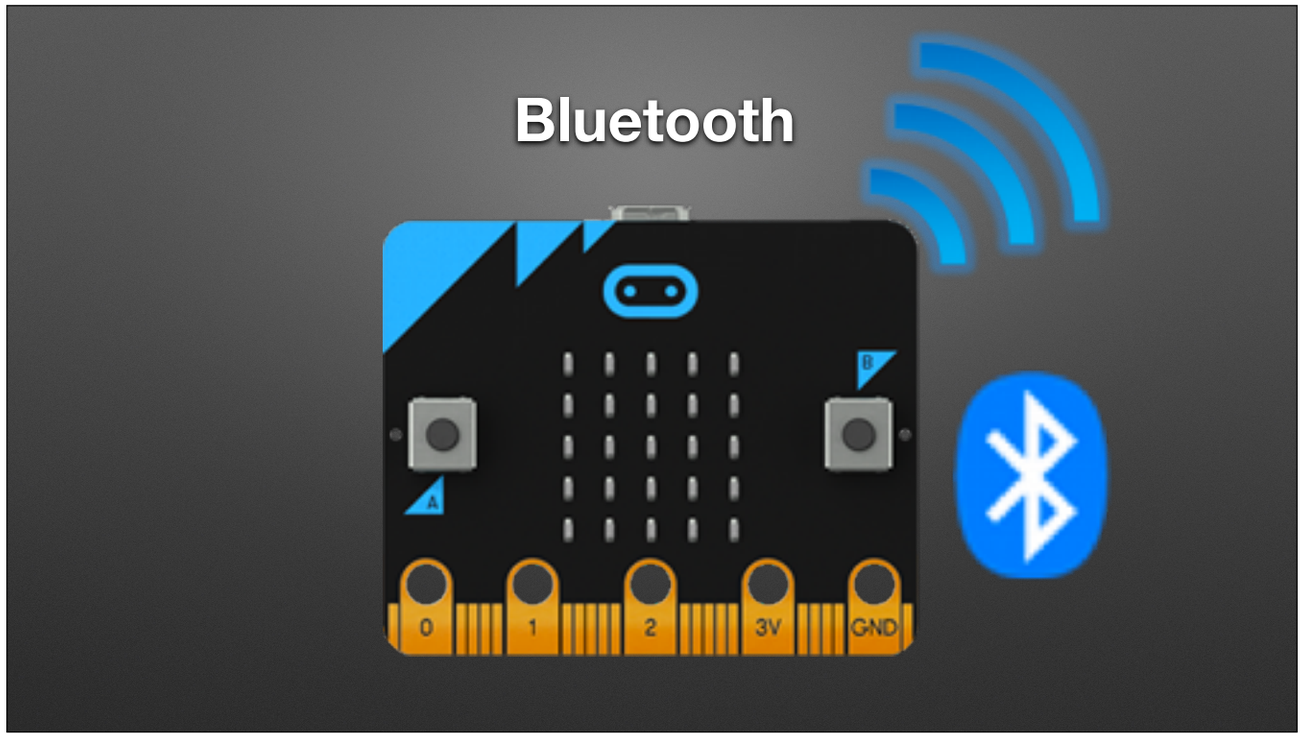
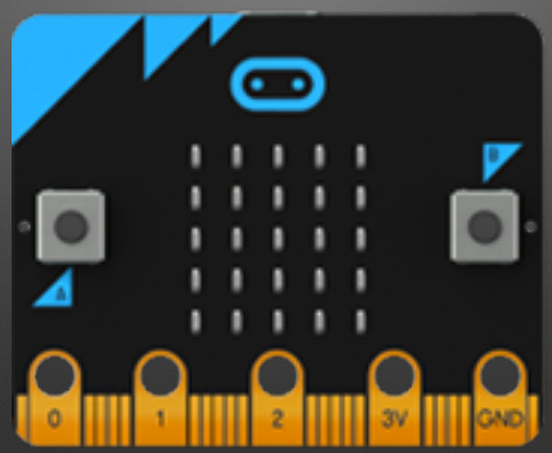


Bluetooth: It can talk to mobile devices!!!
Artwork source: http://microbit.org/images/microbit-features-bluetooth.png

Low Cost: ~$13 US



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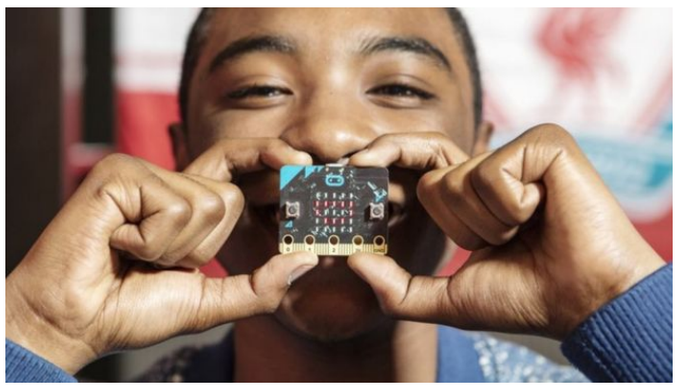
Thanks: Micro:bit Educational Foundation

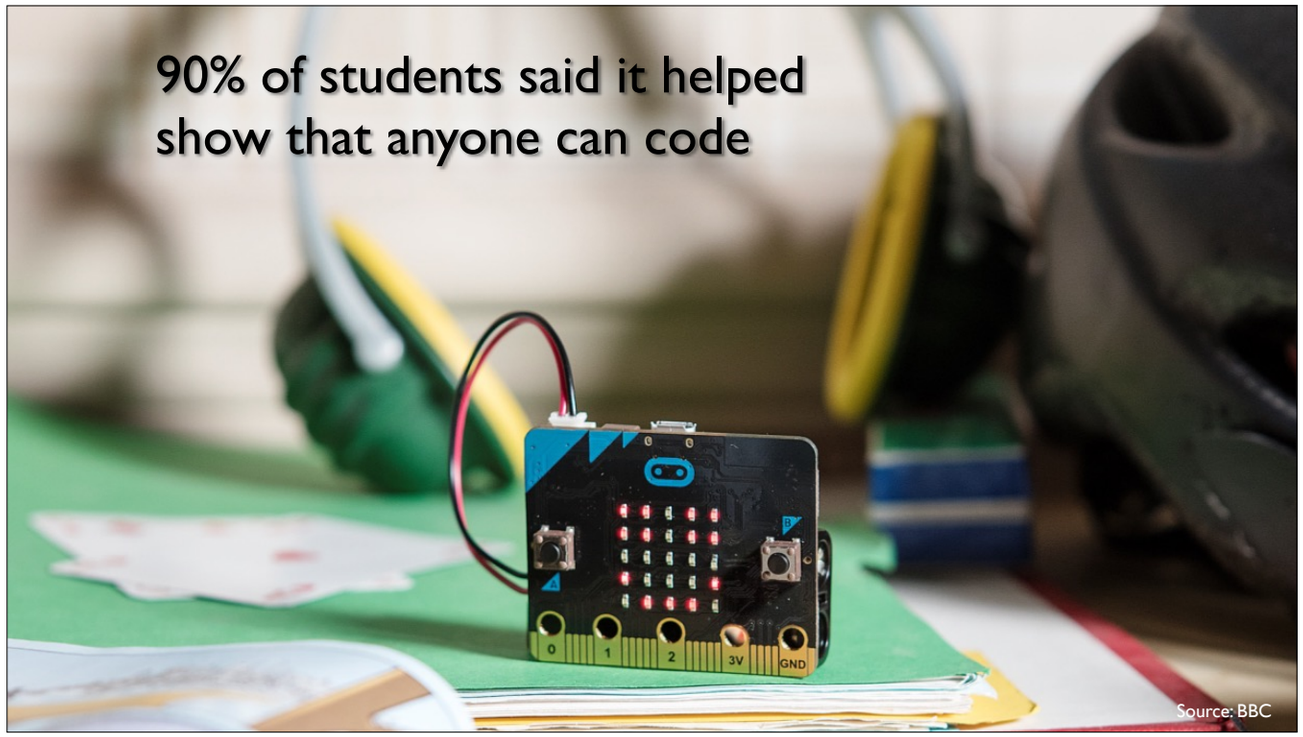
and Hal Speed

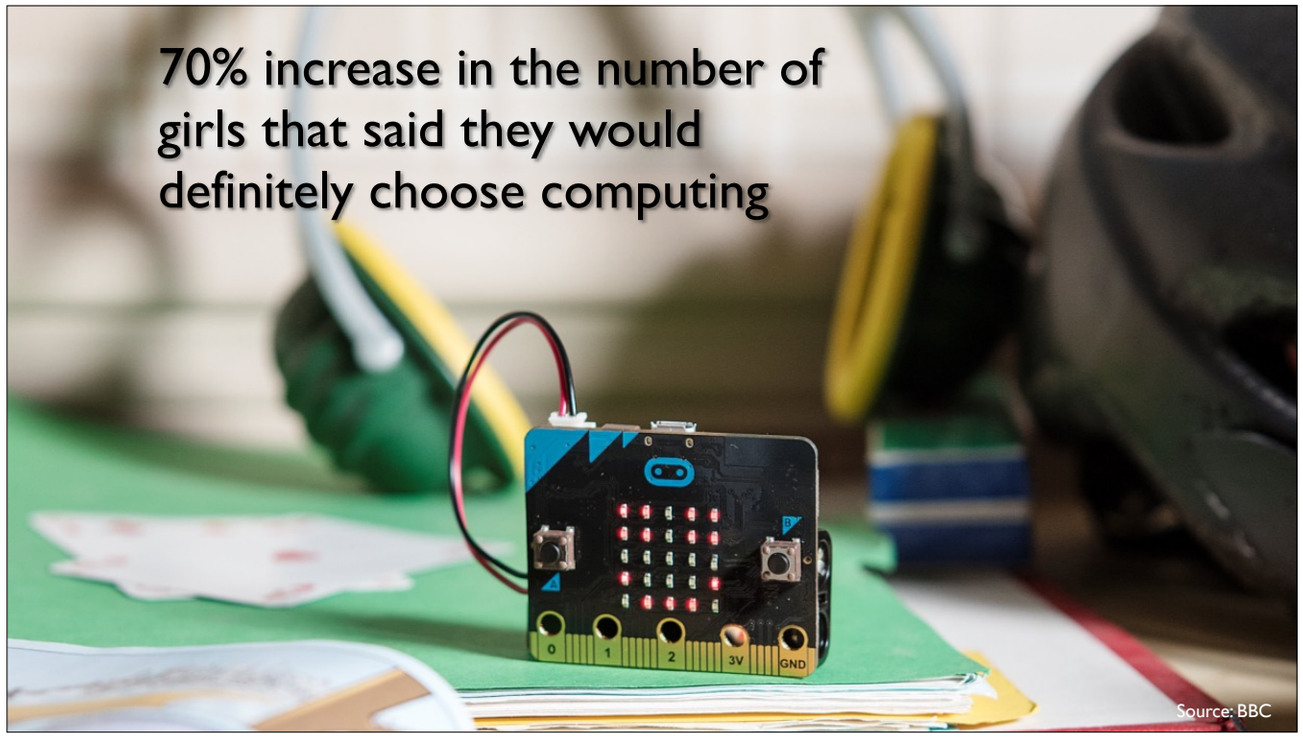
Thanks to The Micro:bit Educational Foundation and Hal Speed for the following slides. (Hal is Chief of Global Engagement; Micro:bit foundation is a non-profit)

2015

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




90% of students said it helped
show that anyone can code
0
1
2
3V
GND
Source: BBC


70% increase in the number of girls that said they would definitely choose computing
0
1
2
3V
GND
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.

GETTING SMART

10 New & Innovative EdTech Products Announced at ISTE 2017

http://www.gettingsmart.com/2017/06/10-innovative-new-products-announced-at-iste-2017/

micro:bit

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

Aligned to Code.org® Curriculum

4th Grade	5th Grade
Course E	Course F

Lesson
Course E - Loops 1 - Loops and Animations

Lesson
Course E - Loops 2 - Nested Loops and Scoreboards

Lesson
Course E - Functions 1 - A Simple Function for a Superhero

Lesson
Course E - Functions 2 - Functions for a Digital Pet

Lesson
Course F - Variables 1 - Variables With A Counter

Lesson
Course F - Variables 2 - Variables and Emotions

Lesson
Course F - Conditionals 1 - Conditionals with the Weather Predictor

Lesson
Course F - Conditionals 2 - Conditionals with Rock Paper Scissors Game

@microbit_edu @HalSpeed

http://microbit.org/teach/code-org-fundamentals/

micro:bit

Third-Party Curricula

Microsoft MakeCode Intro to CS
https://aka.ms/intro2cs

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

PLTW Gateway:
Computer Science for
Innovators and Makers
https://www.pltw.org/our-program/pltw-gateway-curriculum#curriculum-4

Let’s Play

★ “Hello, World!”: First Program

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

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- Block-based editor

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★ “Hello, World!”: First Program

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- Built-in simulator

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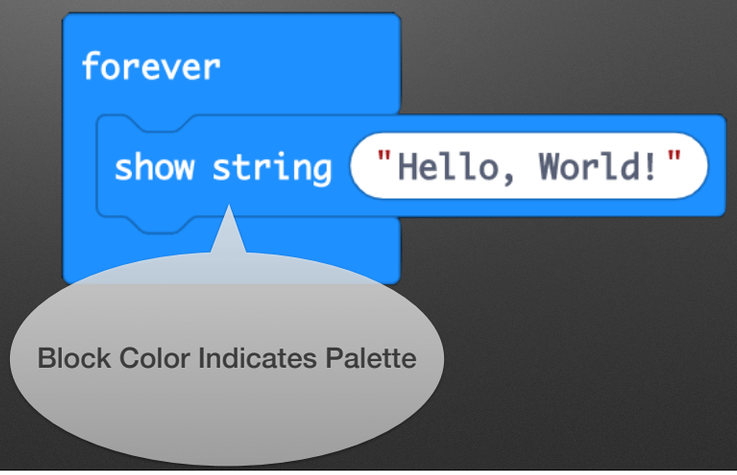

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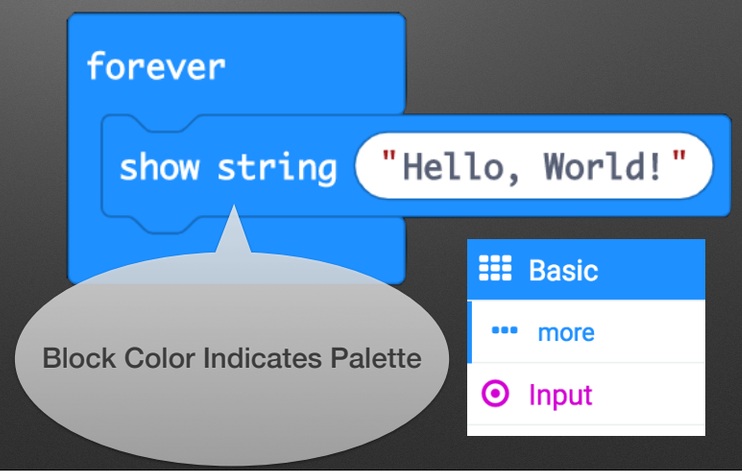

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Simulator
Block area

Blocks are just the beginning…

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- JavaScript

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- Python w/ REPL

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- Arduino / C++

Blocks are just the beginning…

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

Workshop Format

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- Moderate pace with small examples

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- Only covering blocks-based approach

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Workshop Format

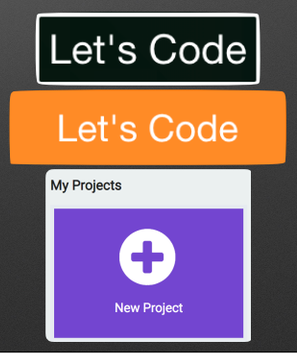
- Moderate pace with small examples
- Only covering blocks-based approach
- Will cover many “building blocks”, but not much depth
  - Putting pieces together for awesome projects left as an exercise for you…

★ 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 “Let’s Code” button on MakeCode
  4. Select “New Project”



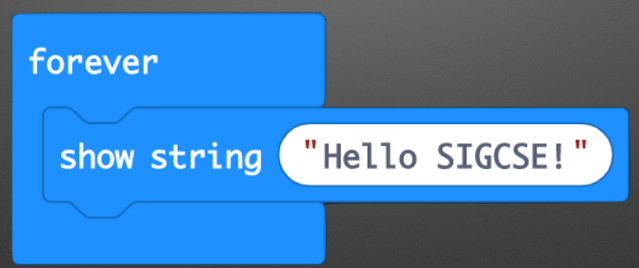
Personalization!

Personalization!

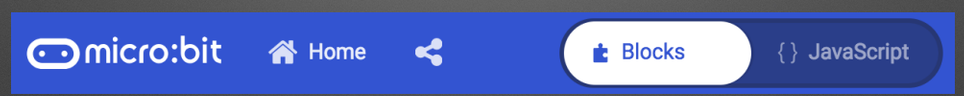
- Hello Bill / Hello Michael / Hello ….

Personalization!

- Hello Bill / Hello Michael / Hello ....



Aside: Text-based Languages



Aside: Storage

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  - No accounts (by default, but GitHub repositories can be used)

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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!

WebUSB

WebUSB

- Why: Get rid of Files!

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  - Faster programming

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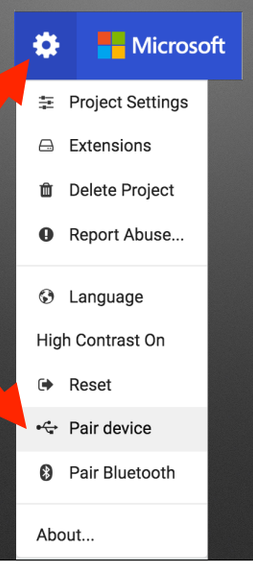
  - Additional Features: a Console!

WebUSB

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

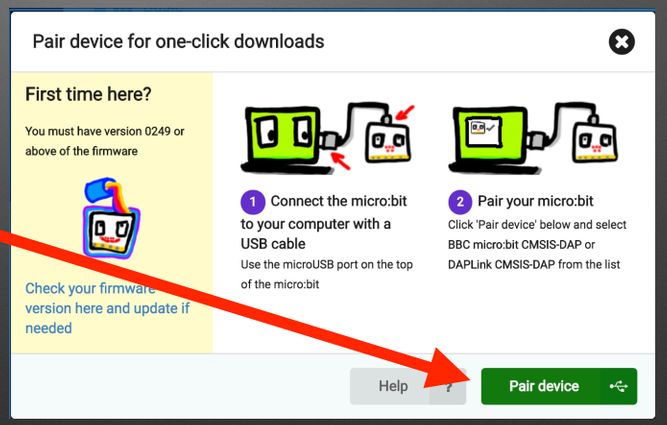
WebUSB Setup

1. Go to Gear Menu
2. Select Pair Device



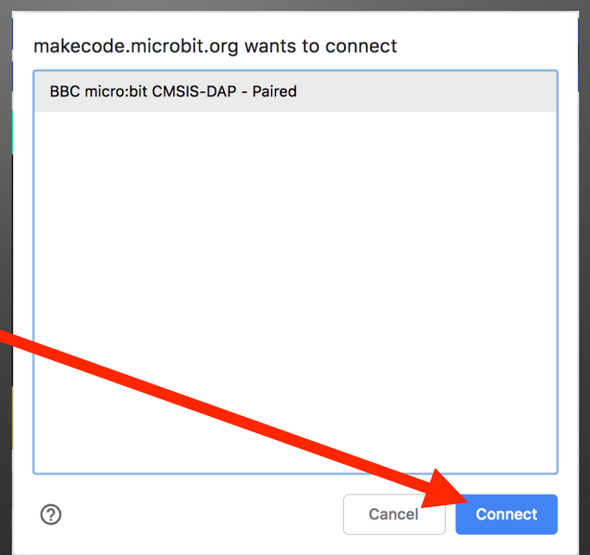
★ Setup: Chrome v65+

3. Select Pair Device



Setup: Chrome v65+

4. Connect

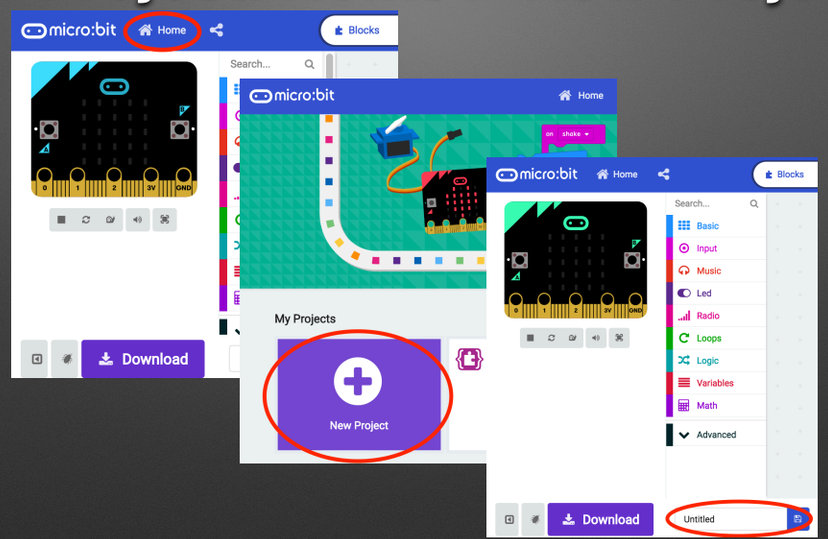


Try It!

Download

New Project: Home > New Project…

New Project: Home > New Project...



★ Programming: Logic & Action

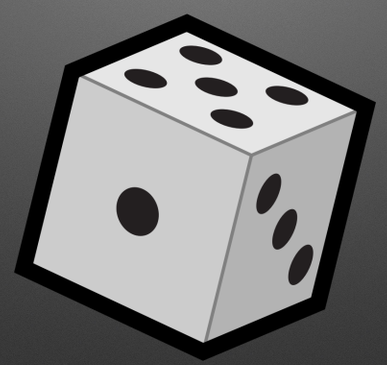
- Picking between *three* tough choices
  - Cookie, Cake, Pie
  - Super Strength, Invisibility, Telekisis
  - …

CS…Int division; Mod; Etc.

Obvious Solution…

https://openclipart.org/detail/17370/a-die
https://openclipart.org/detail/19632/scissors

Obvious Solution…



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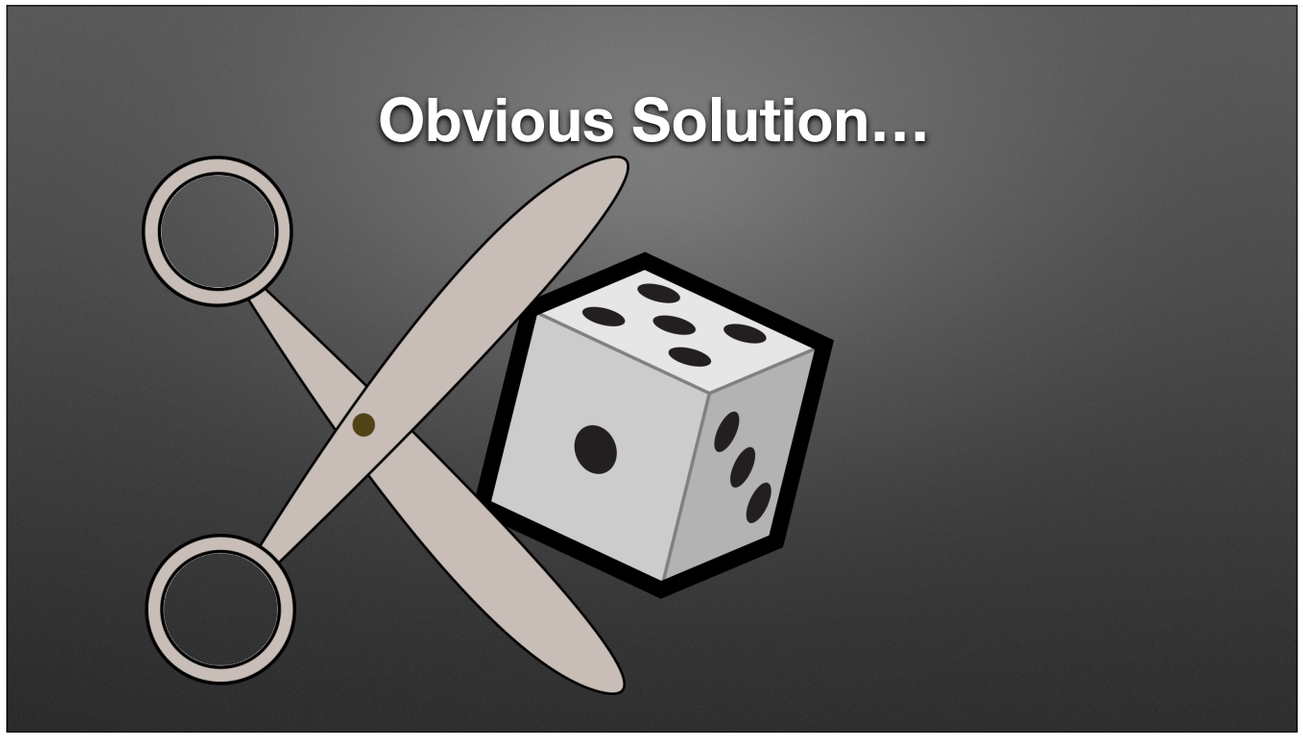

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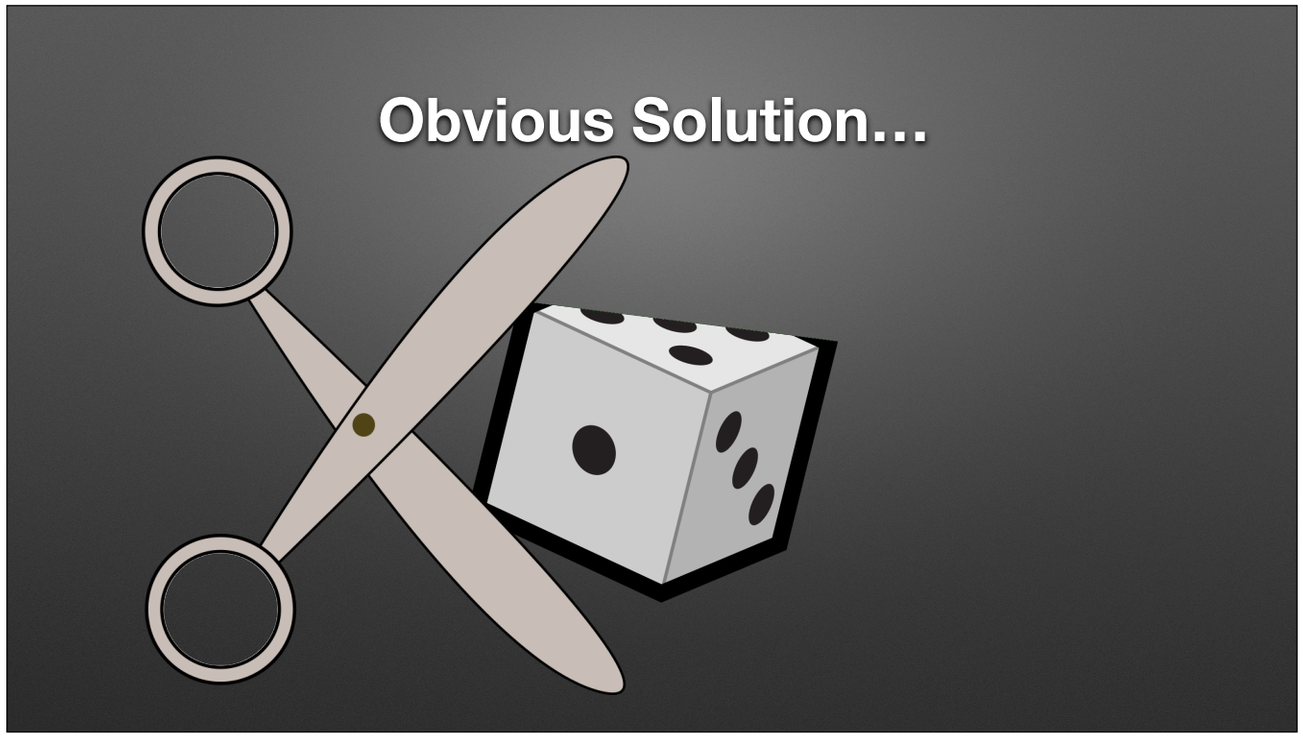

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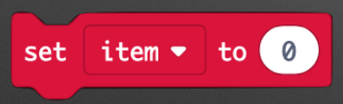
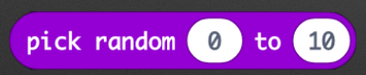
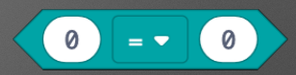
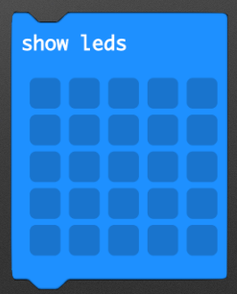
Parts





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

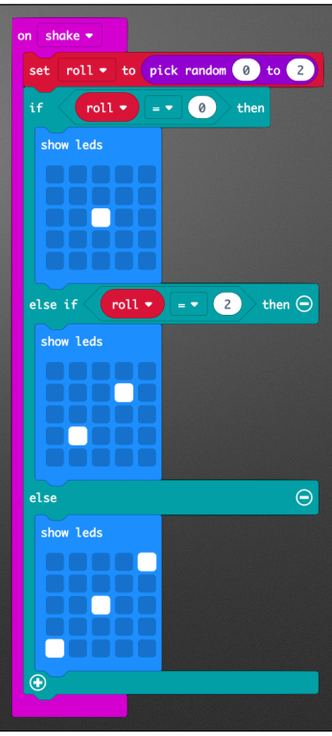




Let’s play…

Get started w/ Shake & Show Random Number

A solution

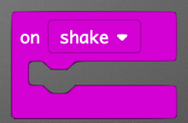


Full Program: 03-Roll.hex

Concepts

Concepts

- Event driven programming

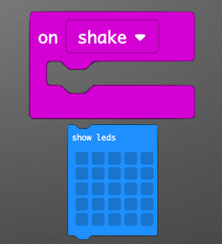


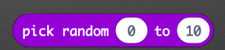
Concepts

- Event driven programming
- Bitmapped Graphics

Concepts

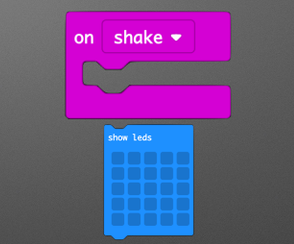
- Event driven programming
- Bitmapped Graphics
- Ranges & Representations

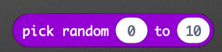


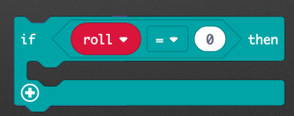


Concepts

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







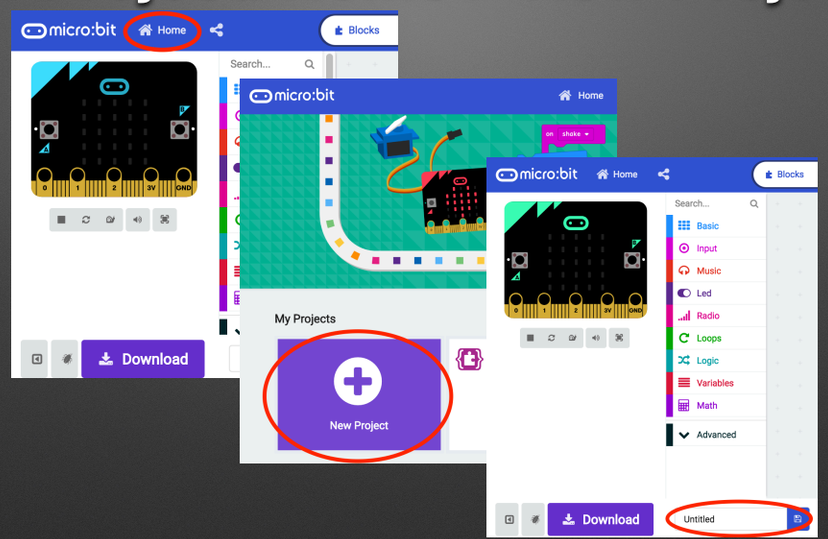
Pedagogy

- Active Learning
- Discovery Based
- Constructionist

Great…but all concepts can be done with scratch.

New Project: Home > New Project…

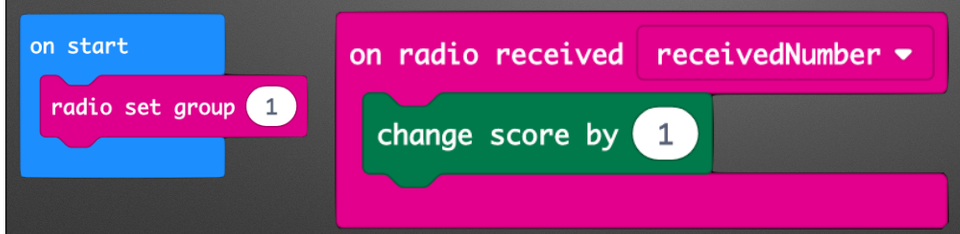
New Project: Home > New Project...



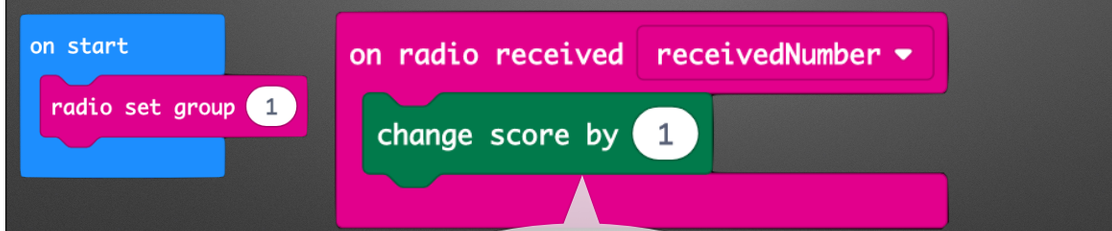
Broadcast Basics

- Radio Palette: Broadcast Based Radio Transmissions
  - String, Number, Key/Value Pairs, …

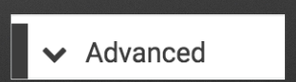
Receiver

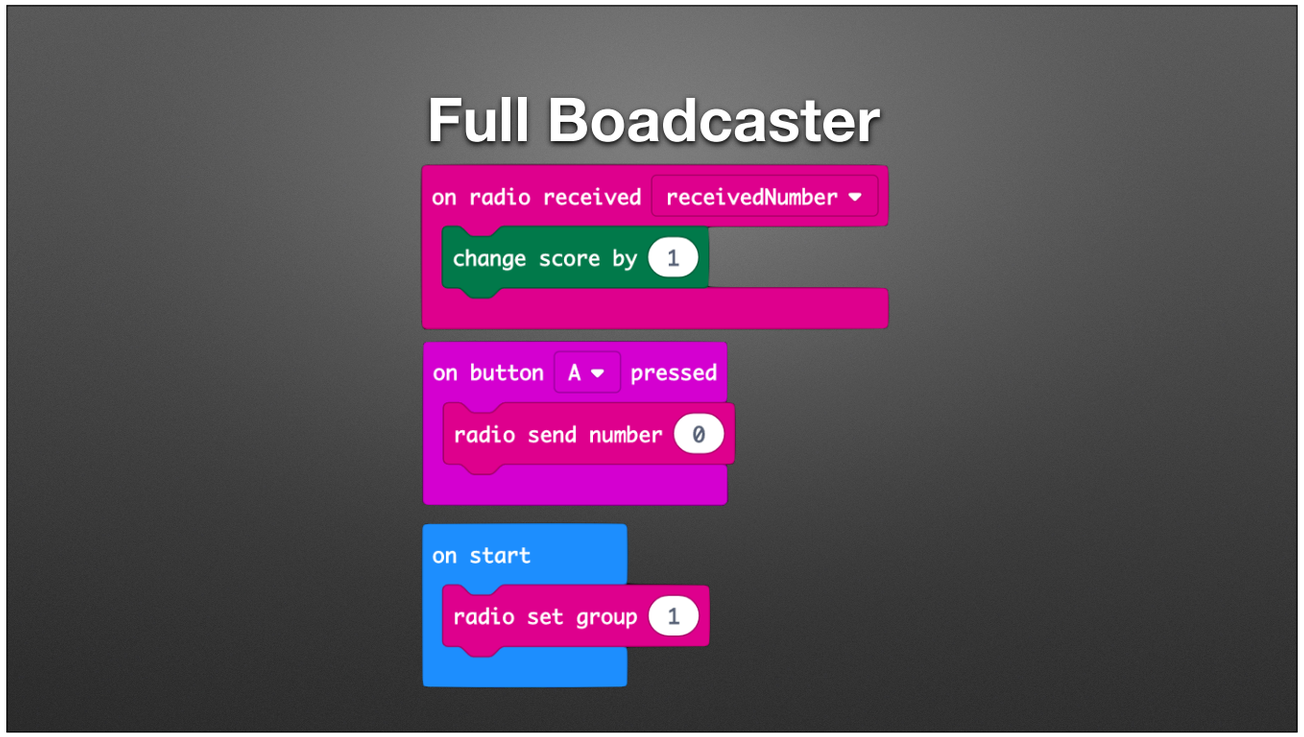

on start
radio set group 1
on radio received receivedNumber
change score by 1

Receiver



"Game" blocks in "Advanced" Section of Palette





Full Program: 04-FullAutoBroadcaster.hex

Concepts

Broadcasting can be done with Scratch

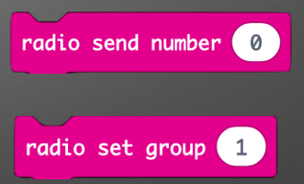
Concepts

- Broadcasting

Broadcasting can be done with Scratch

Concepts

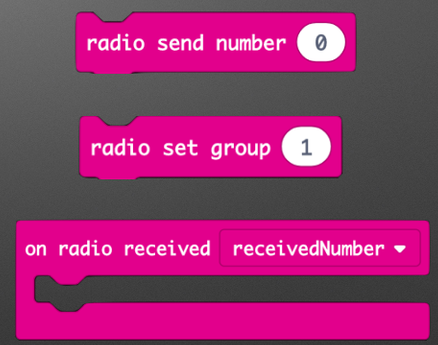
- Broadcasting
- Network Addresses



Broadcasting can be done with Scratch

Concepts

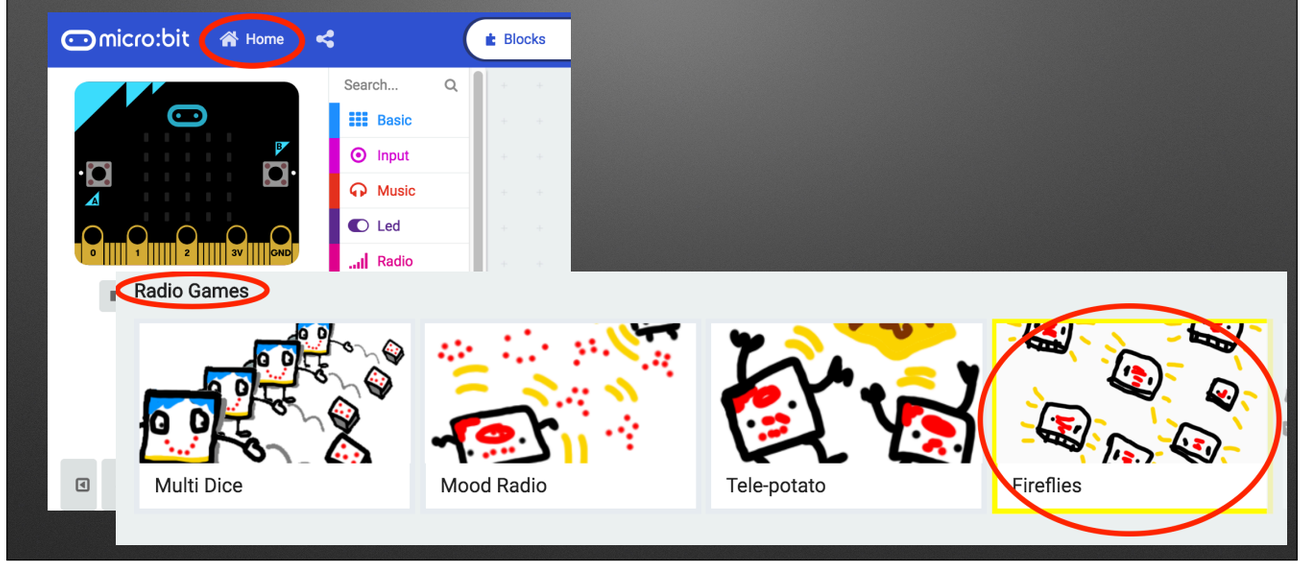
- Broadcasting
- Network Addresses
- Asynchronous clocks / Sync problems



Broadcasting can be done with Scratch

★ & Firefly Fun

★ & Firefly Fun

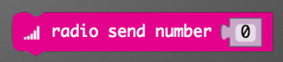

micro:bit
Home
Blocks
Search...
Basic
Input
Music
Led
Radio
Radio Games
Multi Dice
Mood Radio
Tele-potato
Fireflies

Concepts

Broadcasting can be done with Scratch

Concepts

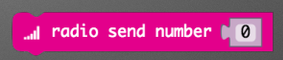
- Broadcasting



Broadcasting can be done with Scratch

Concepts

- Broadcasting

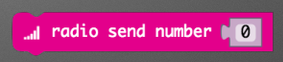


- Network Addresses

Broadcasting can be done with Scratch

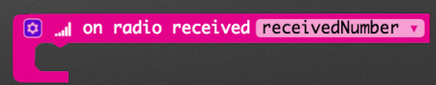
Concepts

- Broadcasting



- Network Addresses

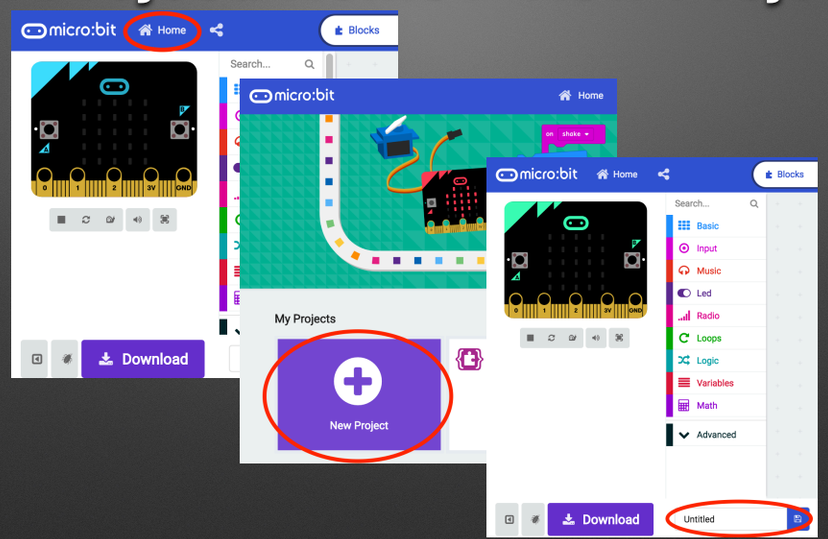
- Asynchronous clocks / Sync problems



Broadcasting can be done with Scratch

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

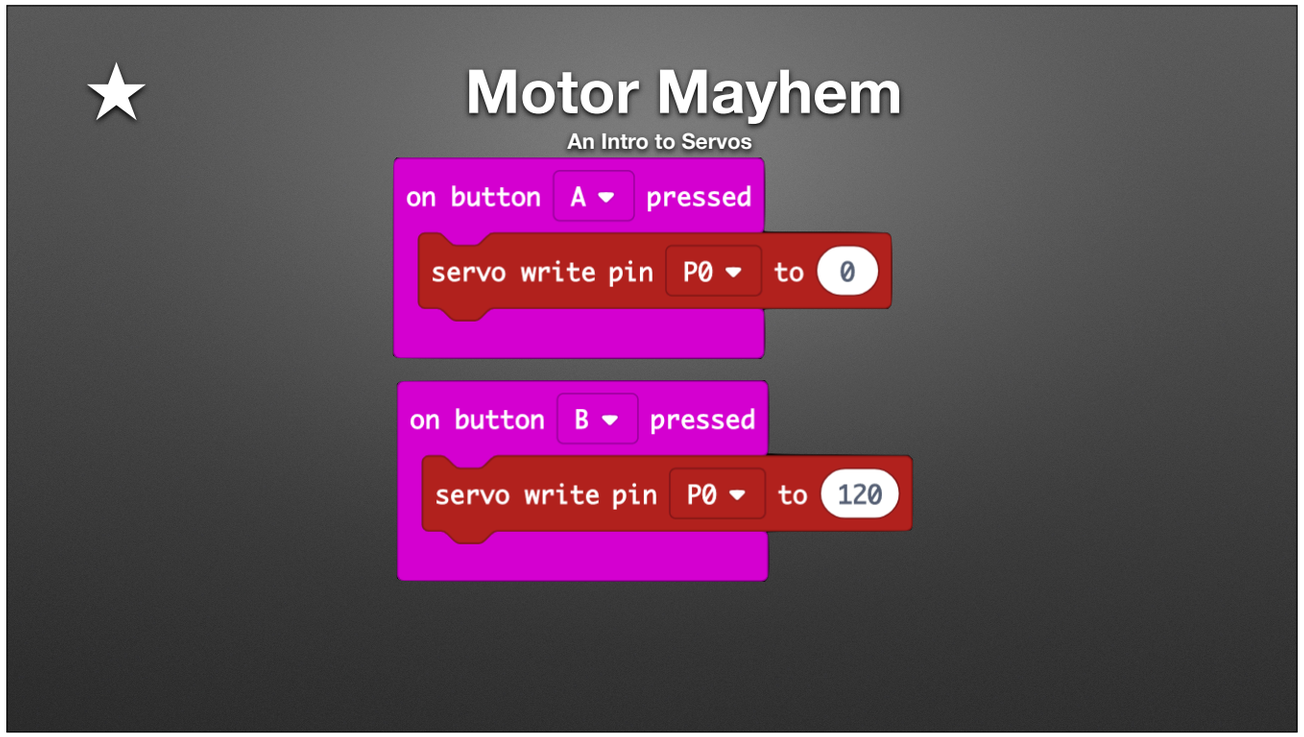
Concepts

- I/O

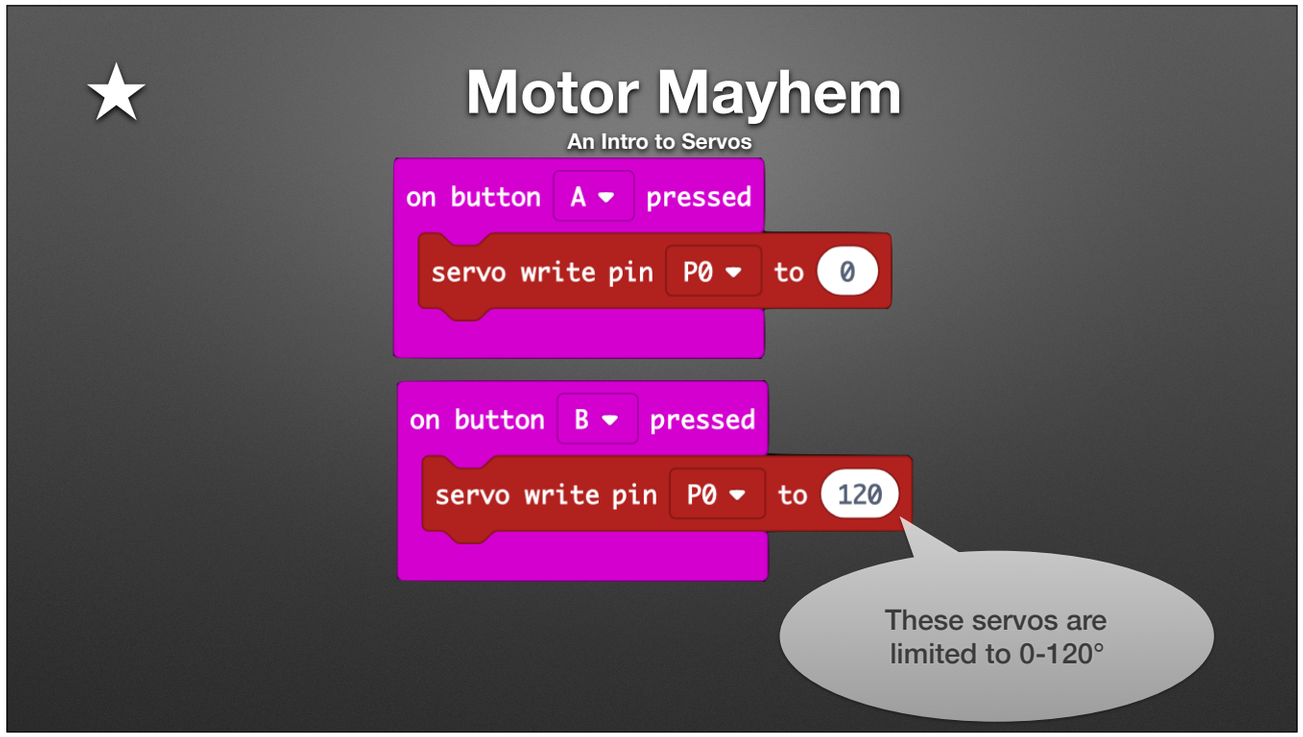
Concepts

- I/O
- Basic Electric Circuits/Electronics


Motor Mayhem
An Intro to Servos


Motor Mayhem
An Intro to Servos
on button A pressed
servo write pin P0 to 0
on button B pressed
servo write pin P0 to 120

Program


Motor Mayhem
An Intro to Servos
on button A pressed
servo write pin P0 to 0
on button B pressed
servo write pin P0 to 120
These servos are limited to 0-120°

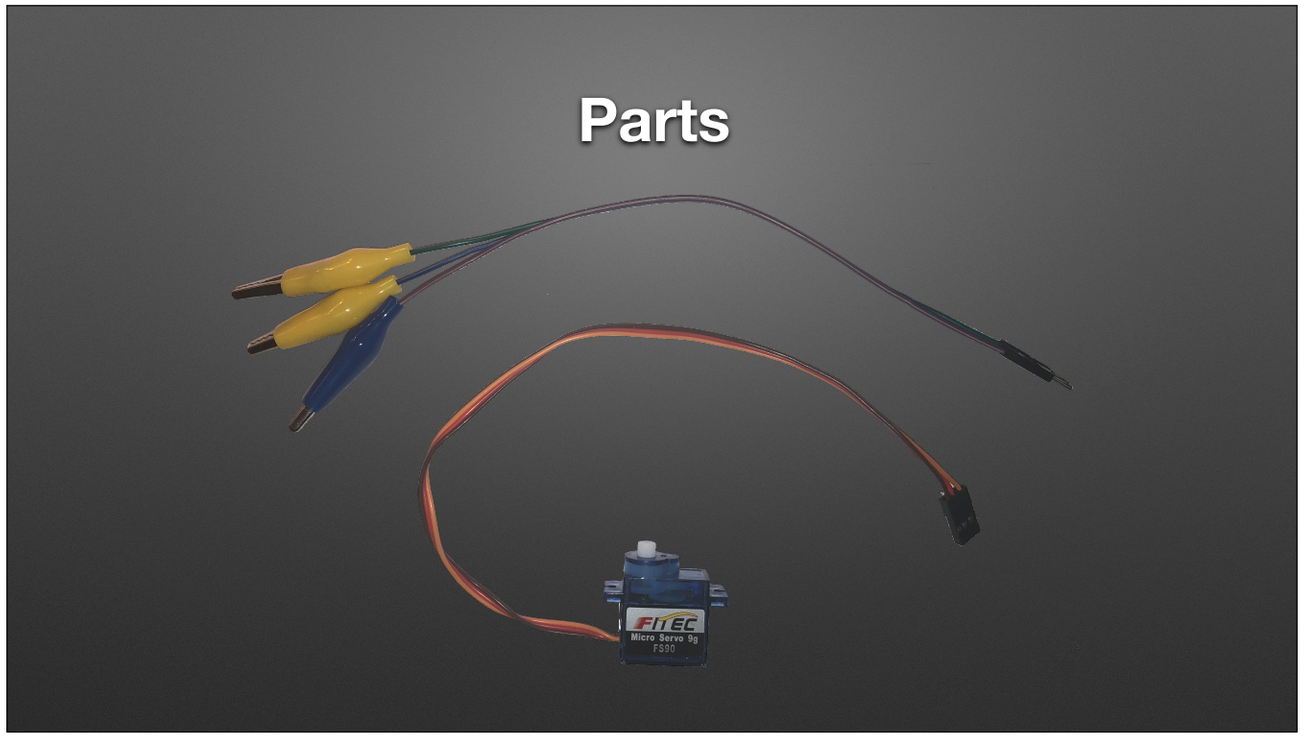
Program

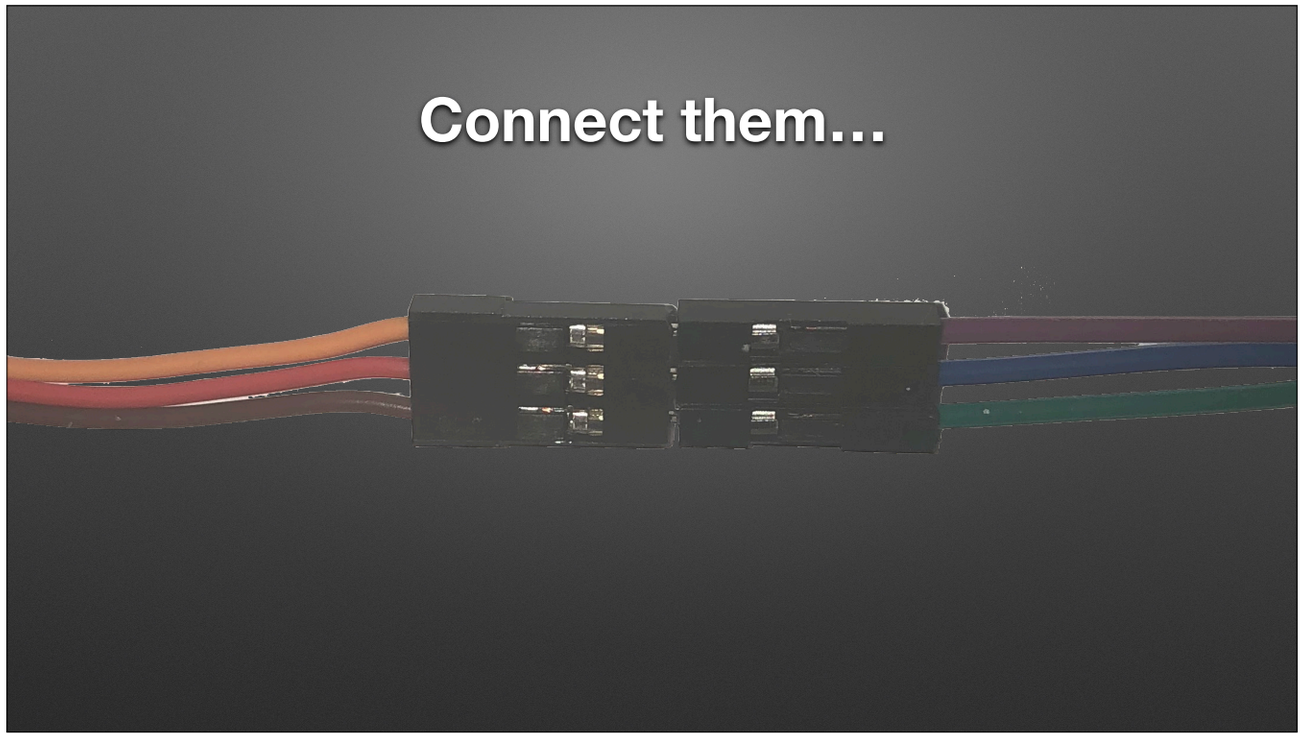
Testing…

- 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

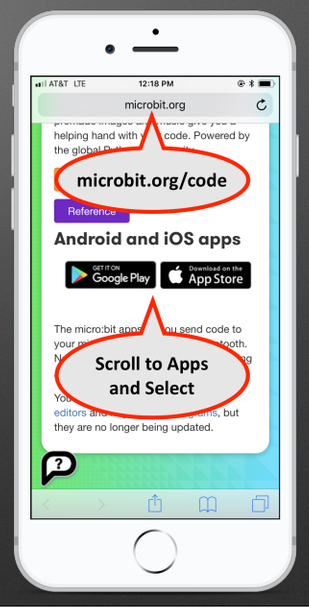
Inchworm Insanity

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

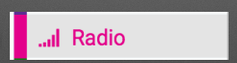
Break

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 

- Not a group broadcast

Bluetooth Background

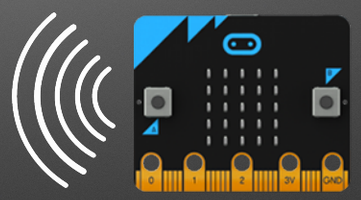
Bluetooth Background

Central

Bluetooth Background

Central

Peripheral



Bluetooth Background

Bluetooth Background

Central

Bluetooth Background

Central

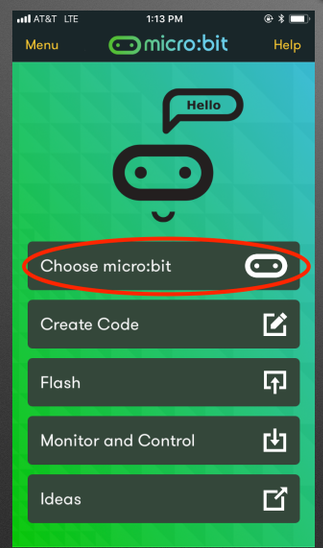
Bluetooth Basics

- 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

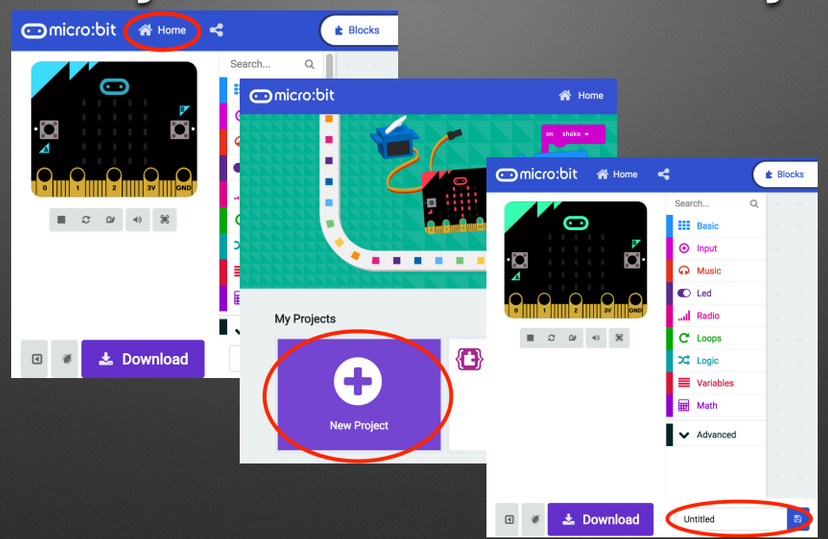
Pairing



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

New Project: Home > New Project…

New Project: Home > New Project...



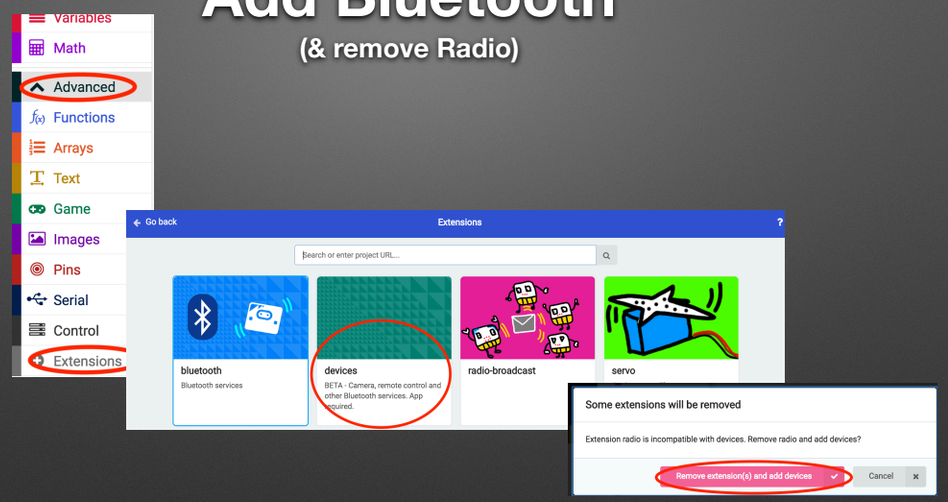
Add Bluetooth

(& remove Radio)

FIXME

Add Bluetooth

(& remove Radio)

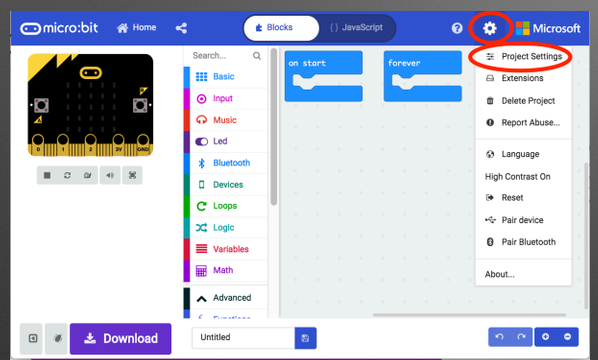


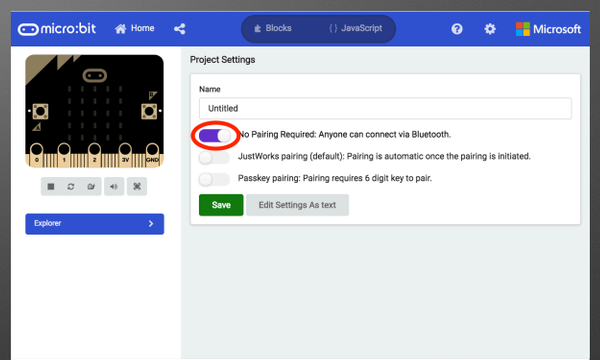
FIXME

Project Settings

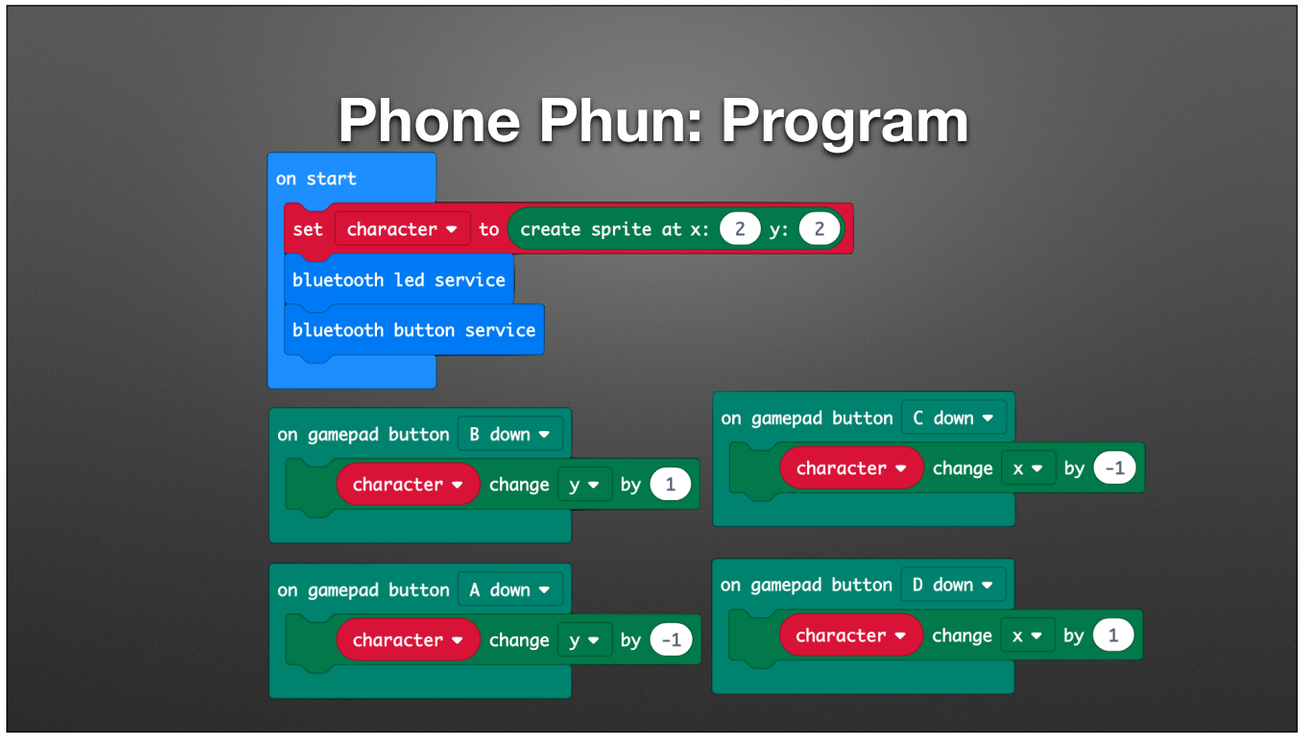
Pairing only works prior to installing a bluetooth sketch.
May need to re-load a blank sketch and then start pairing process.
Each sketch will need this setting.
Need to know name of YOUR microbic

Project Settings

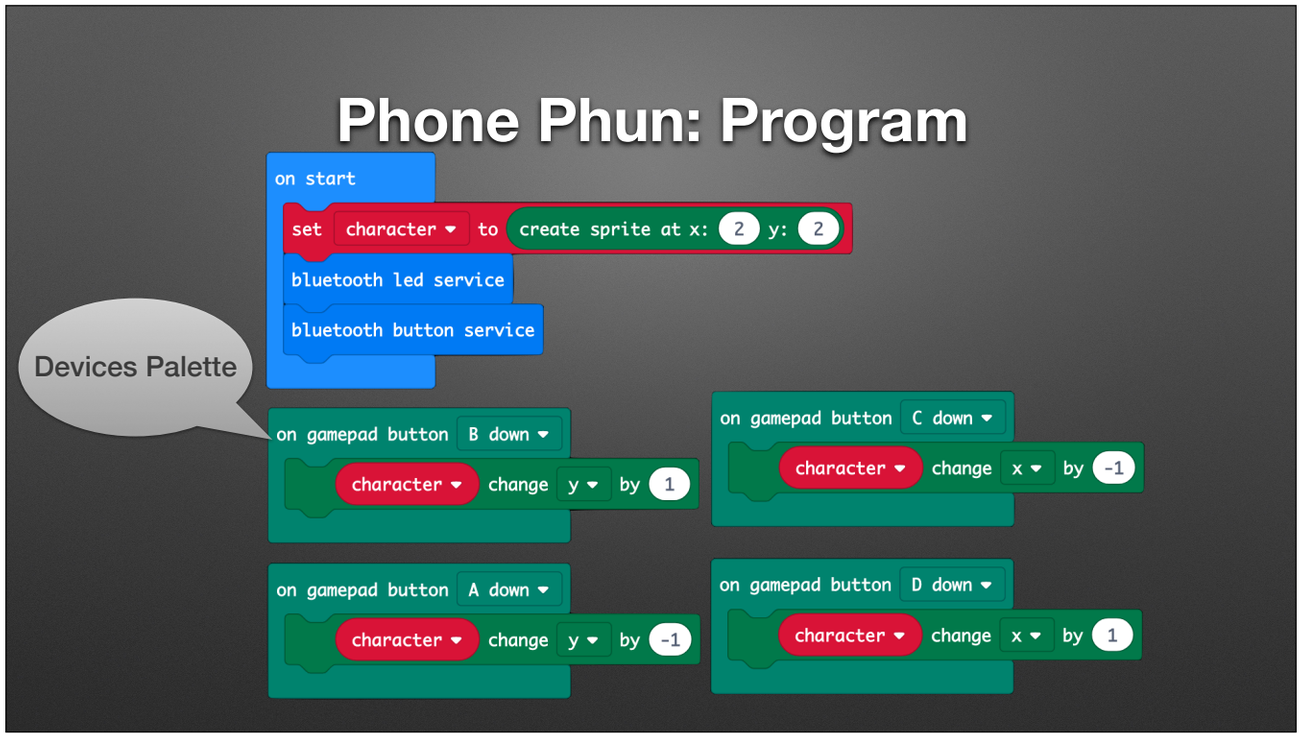




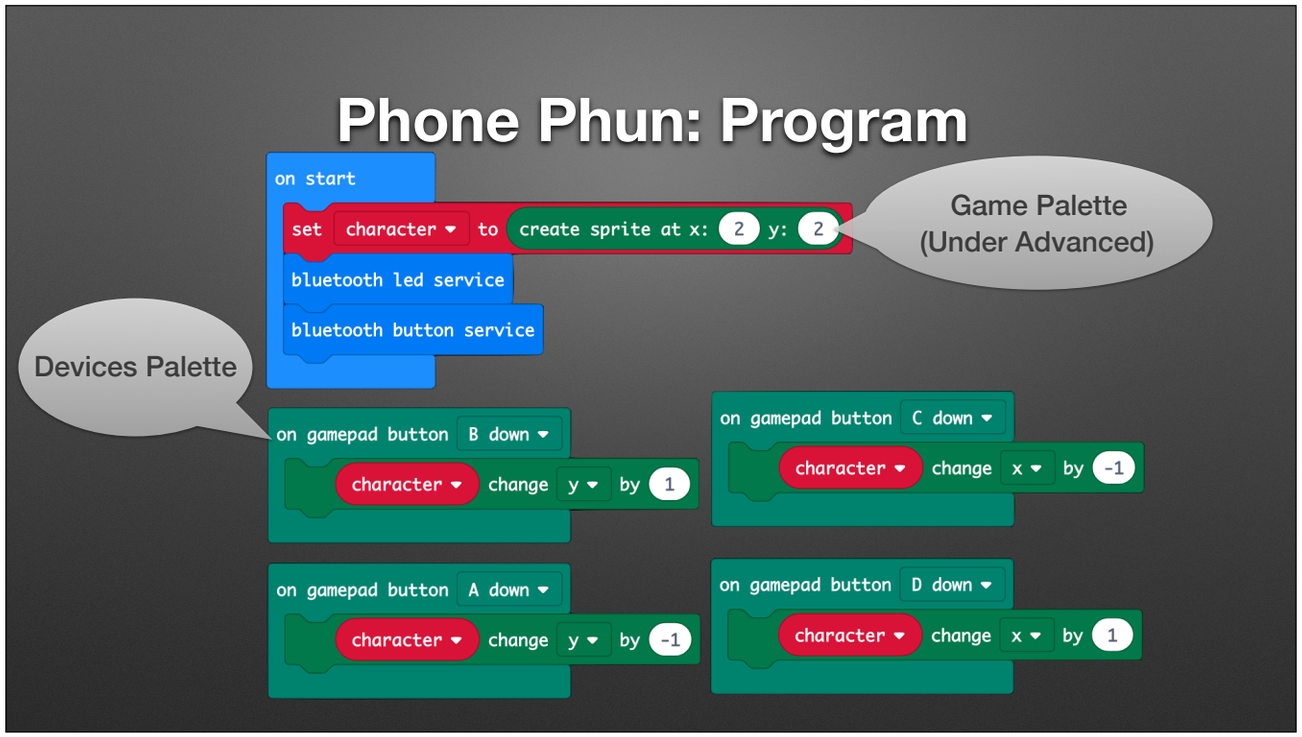
Pairing only works prior to installing a bluetooth sketch.
May need to re-load a blank sketch and then start pairing process.
Each sketch will need this setting.
Need to know name of YOUR microbic



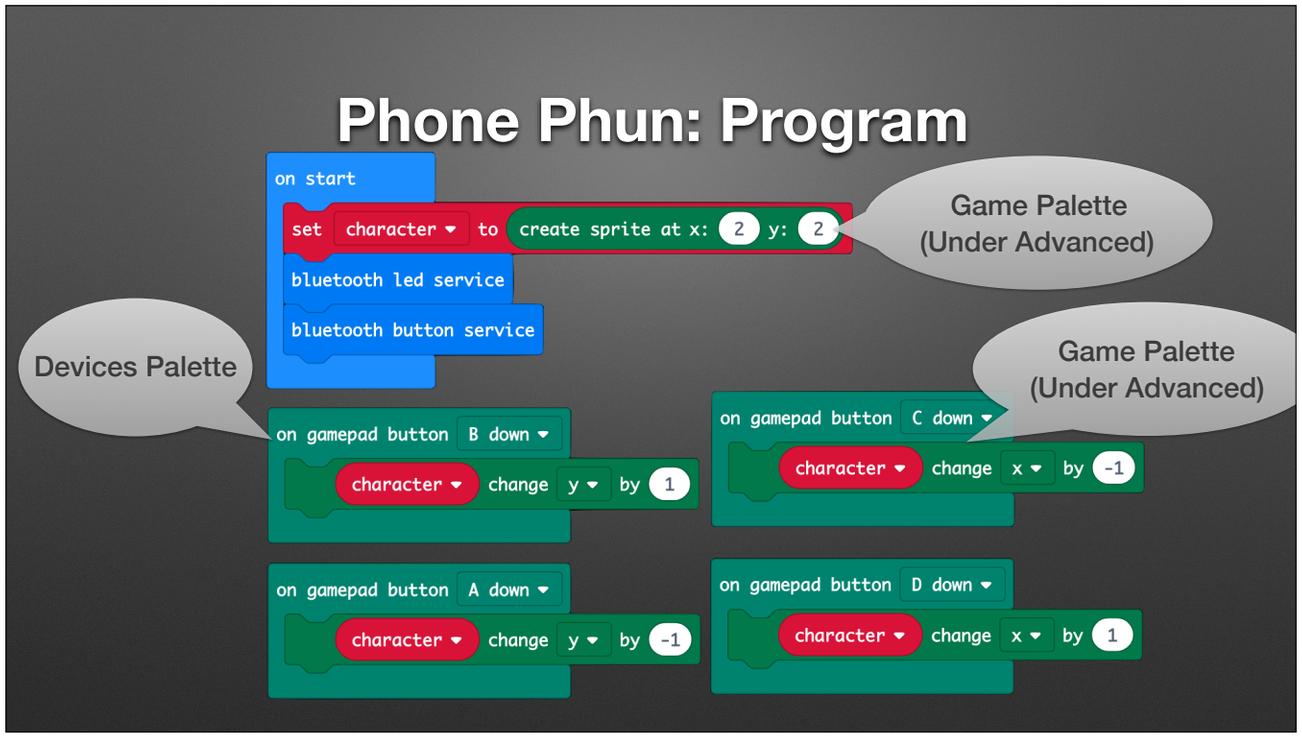
Use right-click “duplicate”
Full Program: 07-BluetoothControl.hex



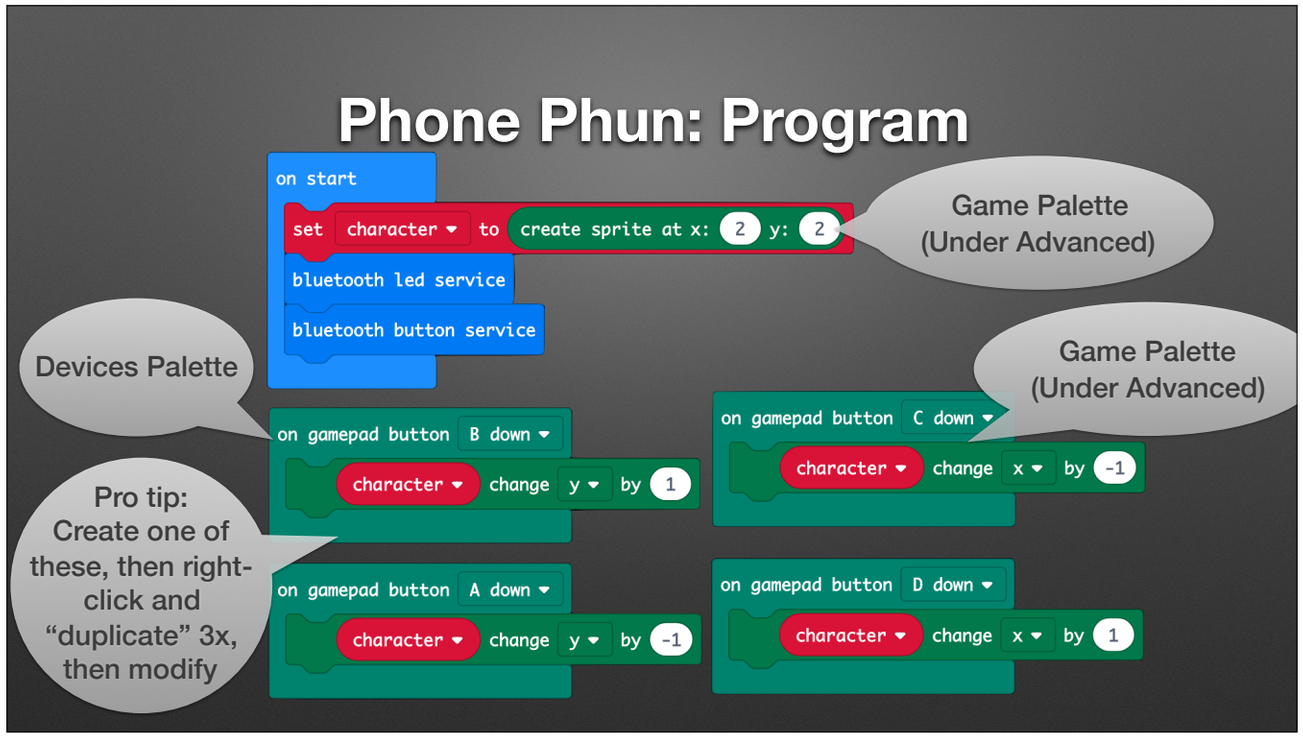
Use right-click “duplicate”
Full Program: 07-BluetoothControl.hex



Use right-click “duplicate”
Full Program: 07-BluetoothControl.hex

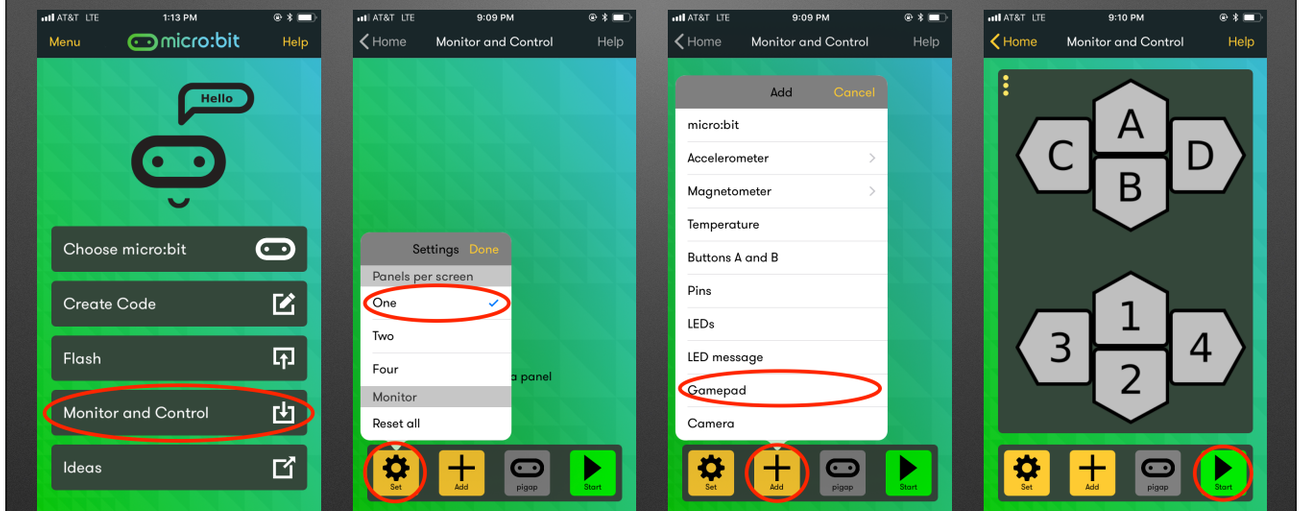


Use right-click “duplicate”
Full Program: 07-BluetoothControl.hex



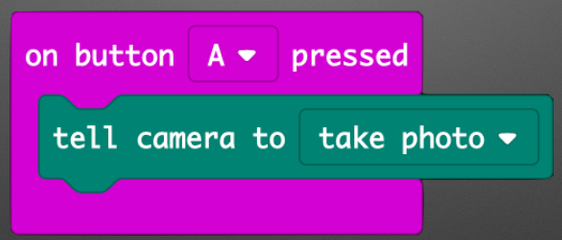
Use right-click “duplicate”
Full Program: 07-BluetoothControl.hex

App Configuration



Micro:bit Shutter Release

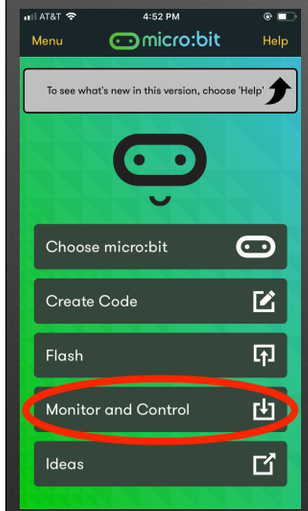
Program

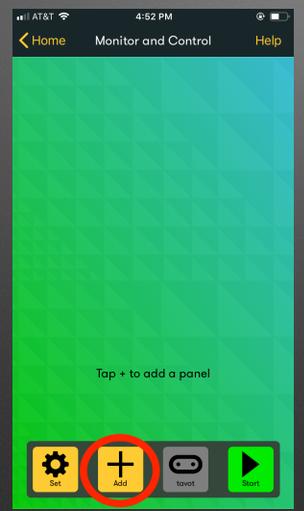


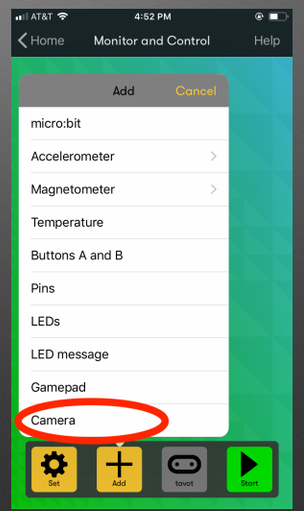
Full program: 08-Selfie.hex

App Config

App Config


AT&T
4:52 PM
Menu
micro:bit
Help
To see what's new in this version, choose 'Help'
Choose micro:bit
Create Code
Flash
Monitor and Control
Ideas


AT&T
4:52 PM
Home
Monitor and Control
Help
Tap + to add a panel
Set
Add
tavot
Start


AT&T
4:52 PM
Home
Monitor and Control
Help
Add
Cancel
micro:bit
Accelerometer
Magnetometer
Temperature
Buttons A and B
Pins
LEDs
LED message
Gamepad
Camera
Set
Add
tavot
Start


AT&T LTE
4:53 PM
Home
Monitor and Control
Help
SIGCSE Selfie!
Micro:bit Shutter Release
Set
Add
tavot
Start

SIGCSE Selfie!

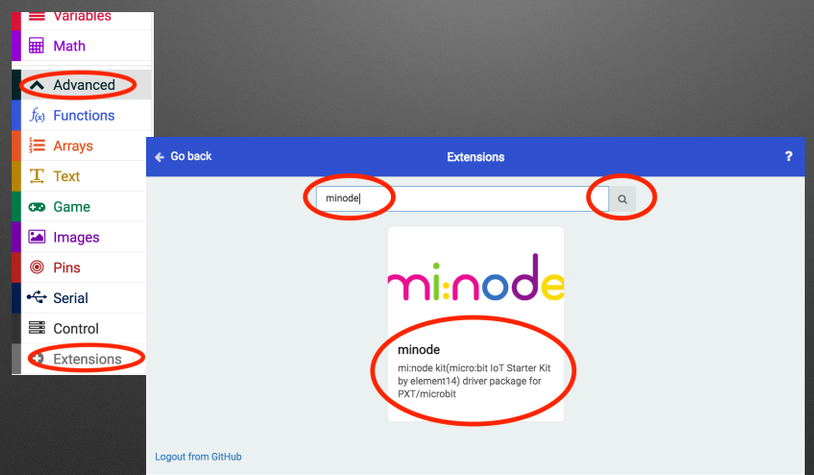
Extra Hardware: Extensions

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

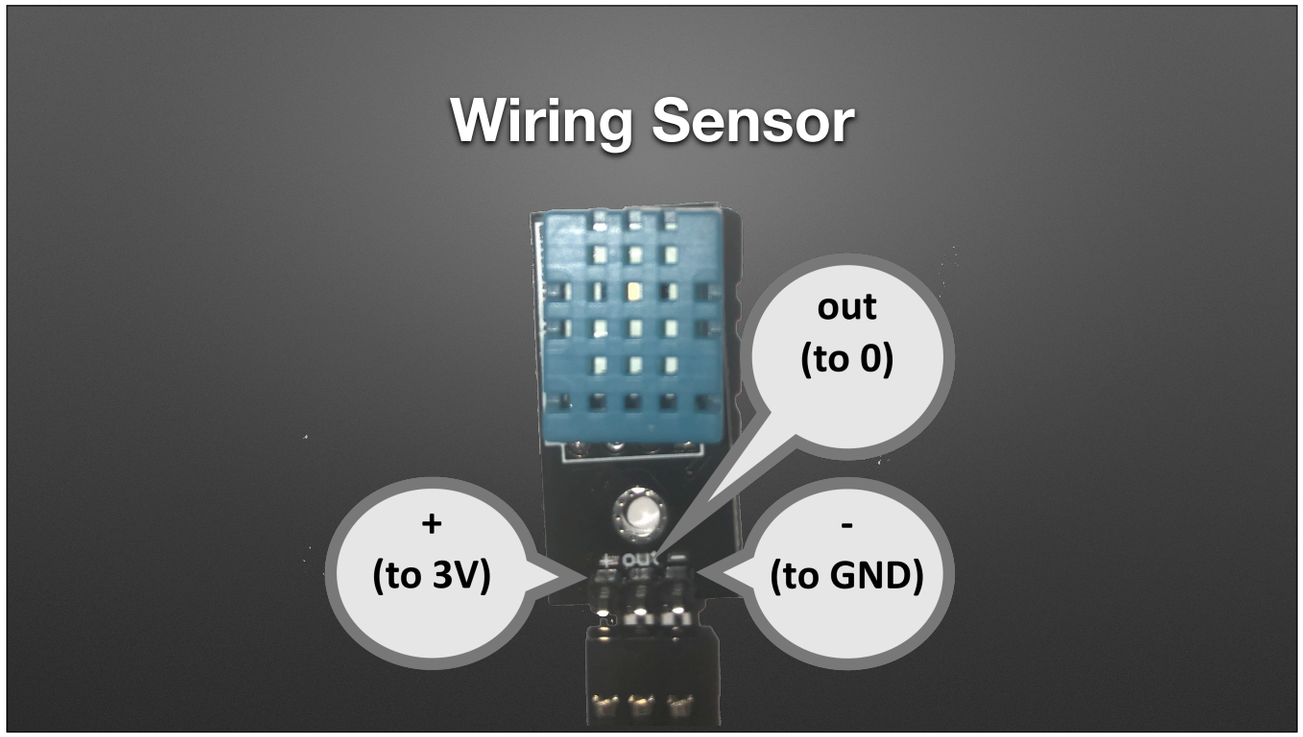
Extra Hardware: Extensions

FIXME

Extra Hardware: Extensions

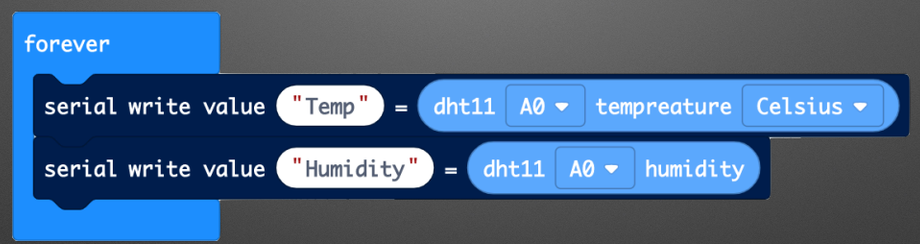


FIXME



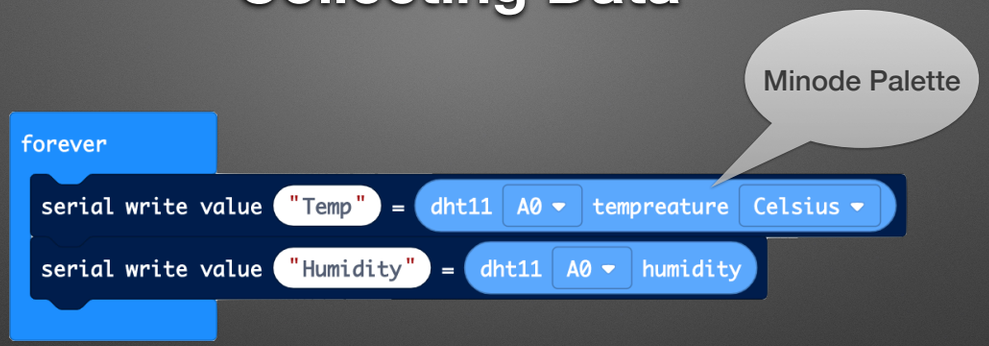
TODO

Collecting Data



Full Program: 09-TempHumidity.hex

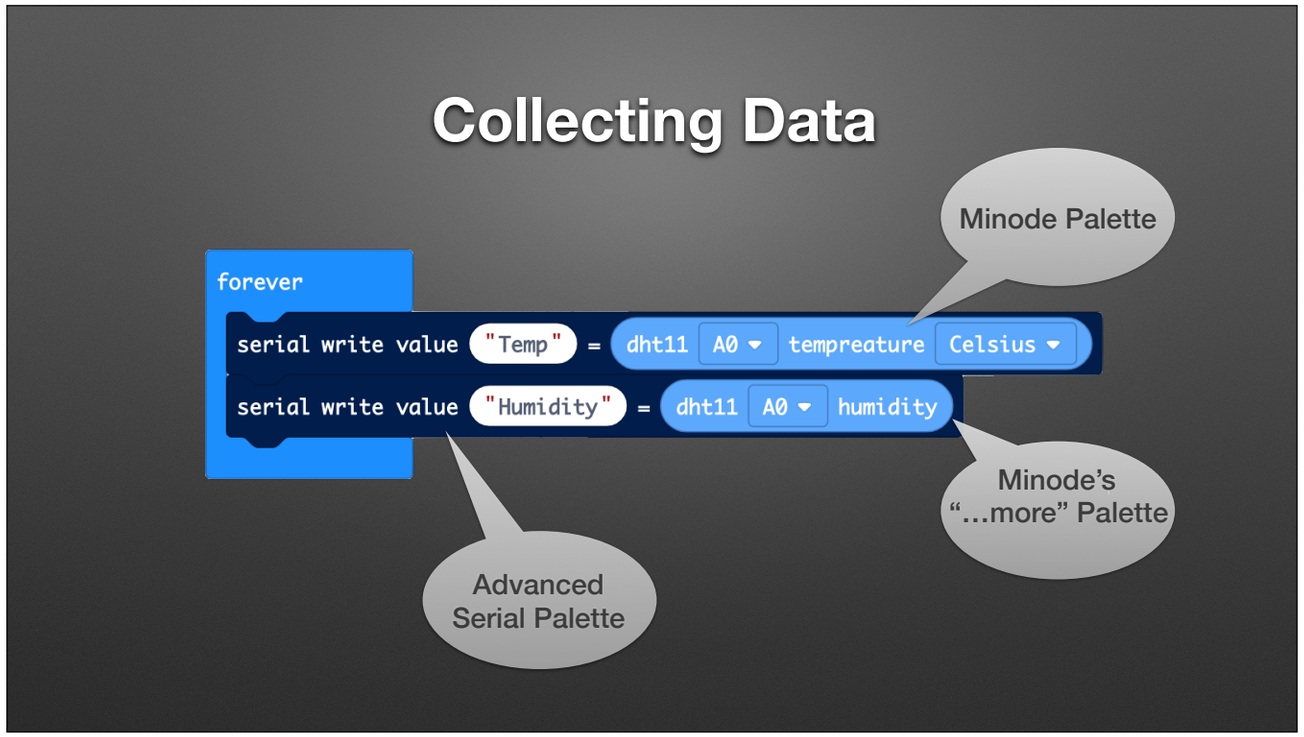
Collecting Data



Full Program: 09-TempHumidity.hex

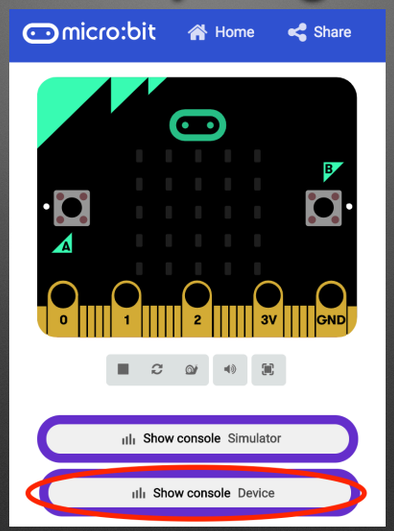
Collecting Data

Full Program: 09-TempHumidity.hex



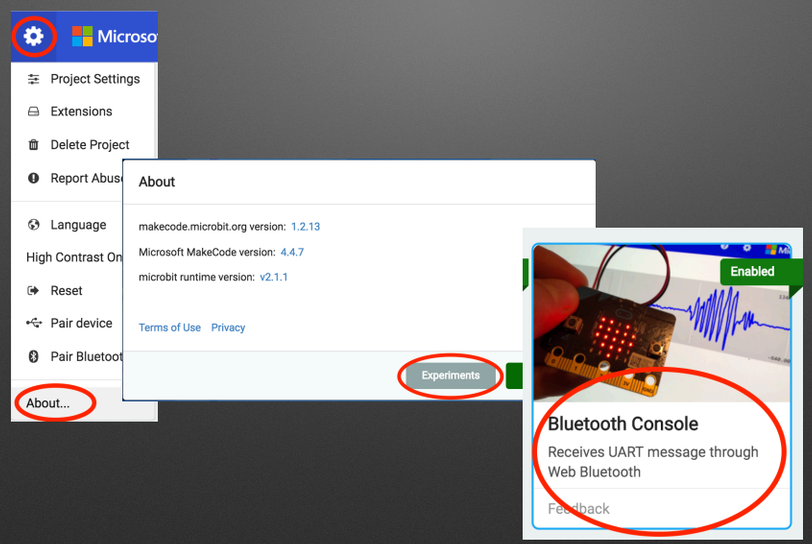
Full Program: 09-TempHumidity.hex

Graphing

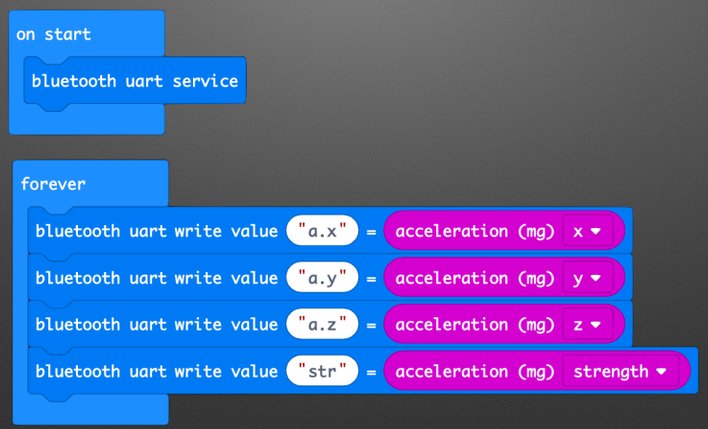

micro:bit
Home
Share
B
A
0
1
2
3V
GND
Show console Simulator
Show console Device

Bluetooth Streaming: Setup

Bluetooth Streaming: Setup



Bluetooth Streaming: Program



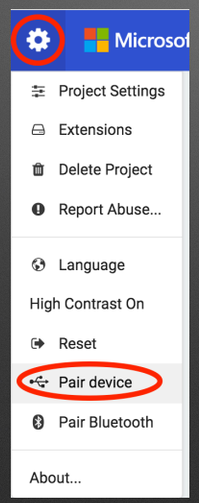
Full Program: 12-WirelessAccel.hex

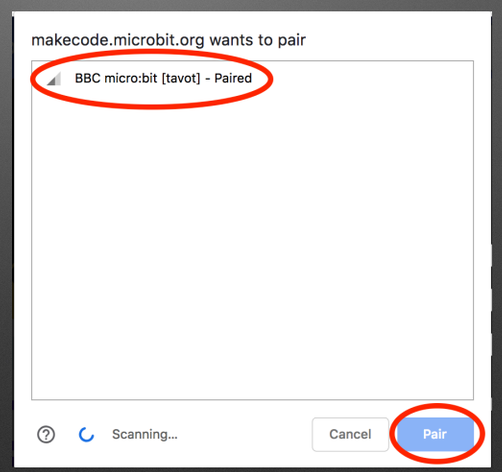
Pairing Process

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

Pairing Process

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



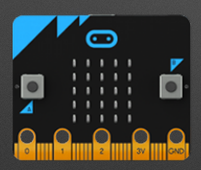


IoT Example Overview

AdaFruit.io

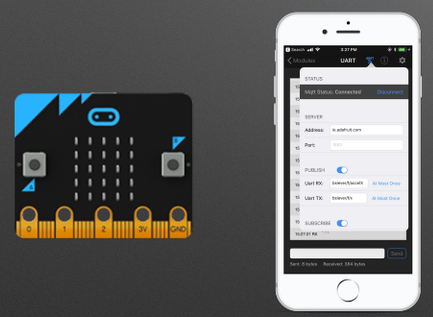
https://cdn-learn.adafruit.com/guides/images/000/001/691/medium800/Adafruit-IO-Logo.png

AdaFruit.io



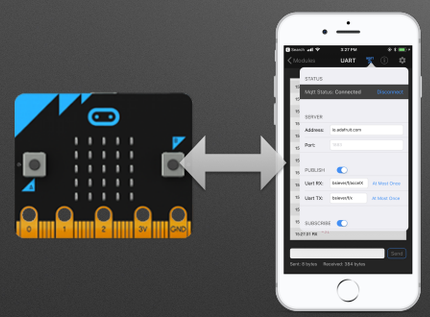
https://cdn-learn.adafruit.com/guides/images/000/001/691/medium800/Adafruit-IO-Logo.png

AdaFruit.io



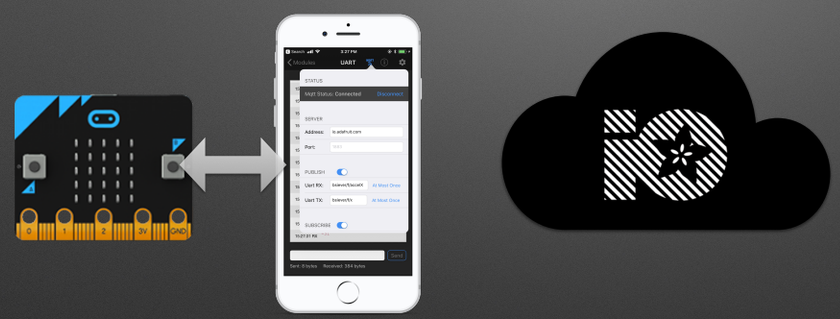
https://cdn-learn.adafruit.com/guides/images/000/001/691/medium800/Adafruit-IO-Logo.png

AdaFruit.io



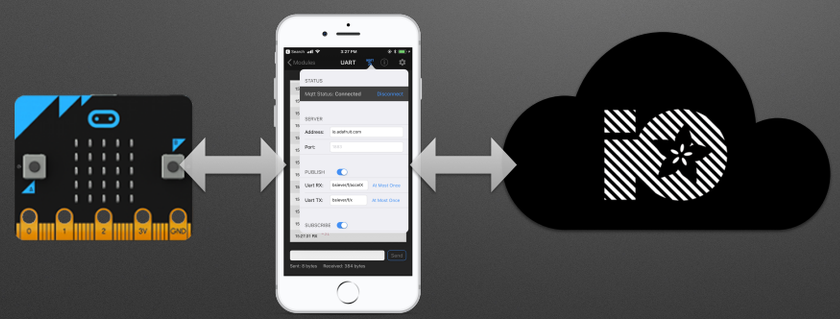
https://cdn-learn.adafruit.com/guides/images/000/001/691/medium800/Adafruit-IO-Logo.png

AdaFruit.io



https://cdn-learn.adafruit.com/guides/images/000/001/691/medium800/Adafruit-IO-Logo.png

AdaFruit.io



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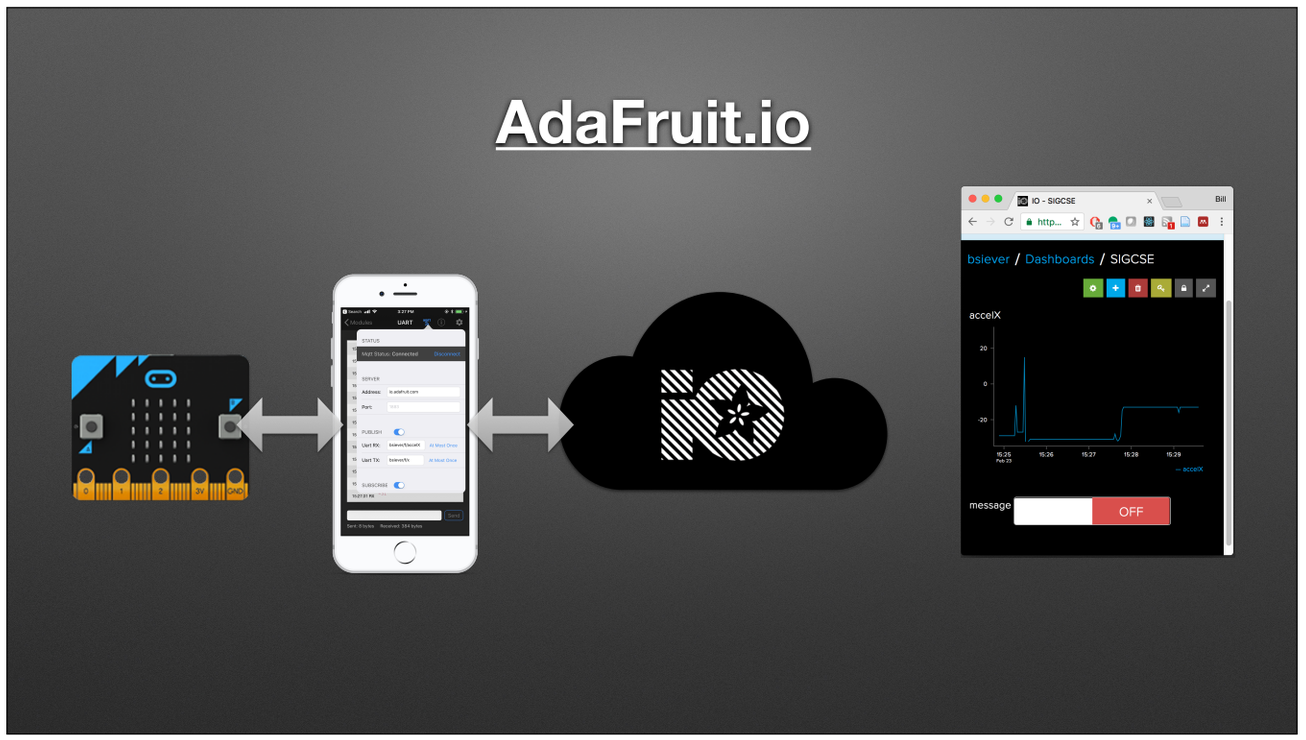

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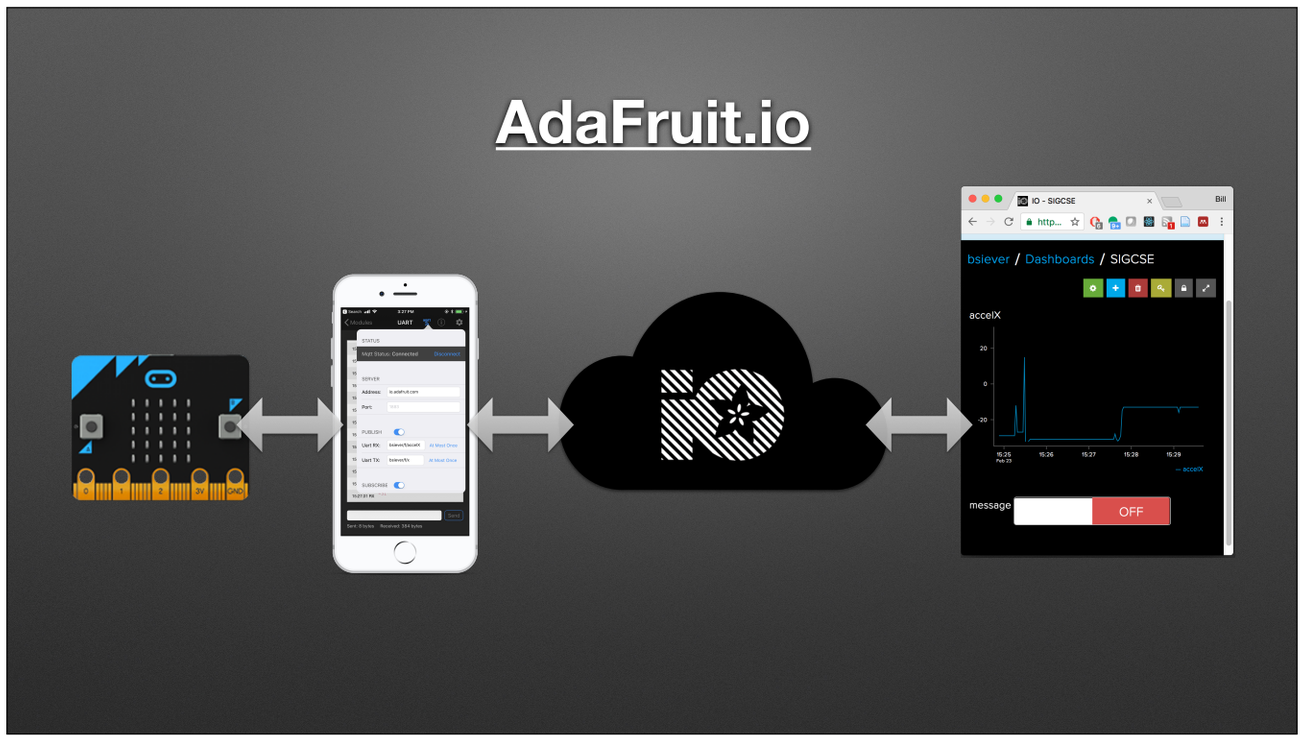

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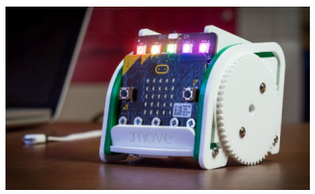
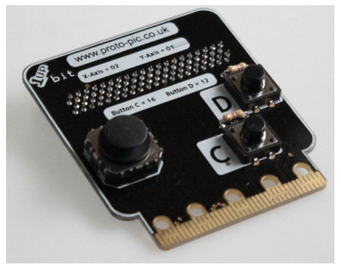
Hardware Ecosystem

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

micro:bit





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Misc.

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

Bill’s SIGCSE Blog Post
https://tinyurl.com/SIGCSE19uBit

Questions / Discussion

Remove Add Bluetooth

(& remove Radio)

Remove Add Bluetooth

(& remove Radio)