

Micro:bit Magic

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

Bill Siever
Washington University

Michael Rogers
Northwest Missouri State University

Outline

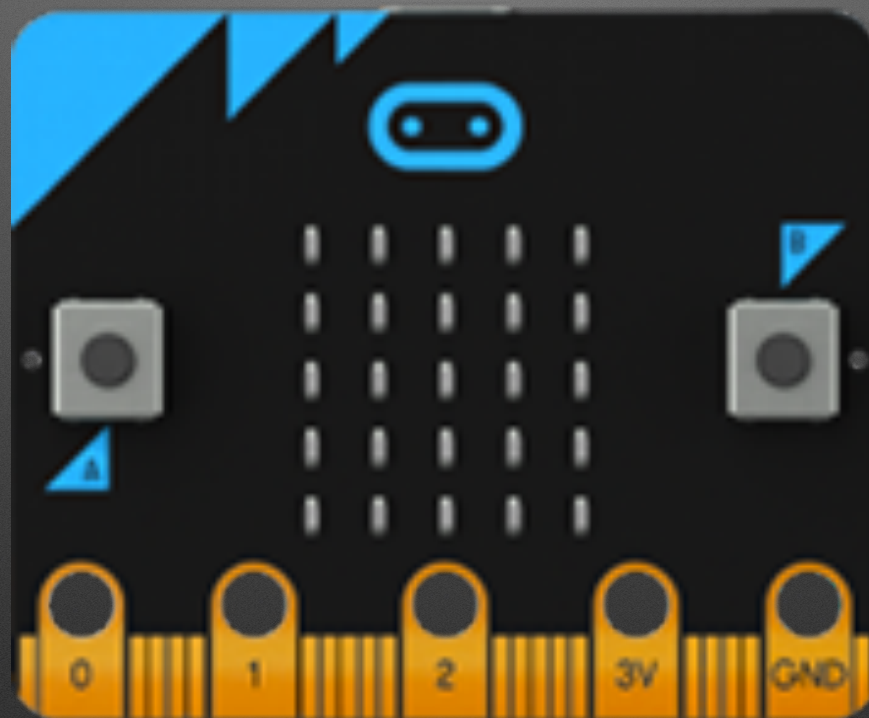
- Intros: Us, You, the micro:bit
- ★ Setup
- ★ “Hello, World!”: First Program
- ★ Programming: Logic & Action
- ★ Broadcast Basics & Firefly Fun
- ★ Motor Mayhem & Awesome Audio
- ★ Bluetooth Basics & Phone Phun
- Quick Tour: JavaScript & Building Blocks ?
- Quick Tour: IoT Insanity
- Conclusions

• Intros: Us & You

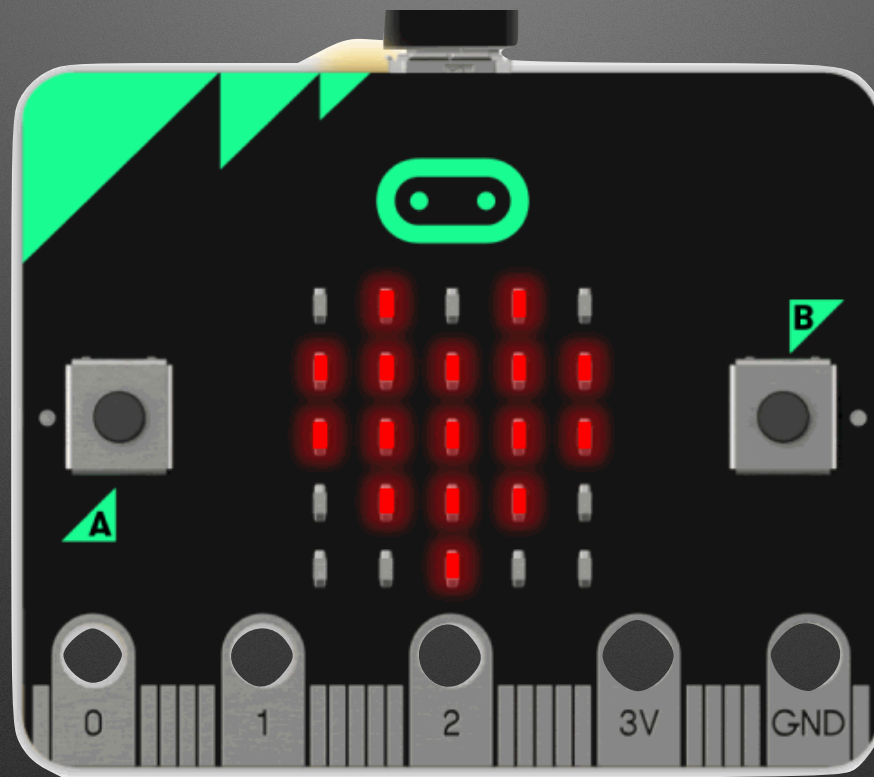
- Us
- You: Roll Call & Intros
 - Pair programming —pair up!

Intros: the micro:bit

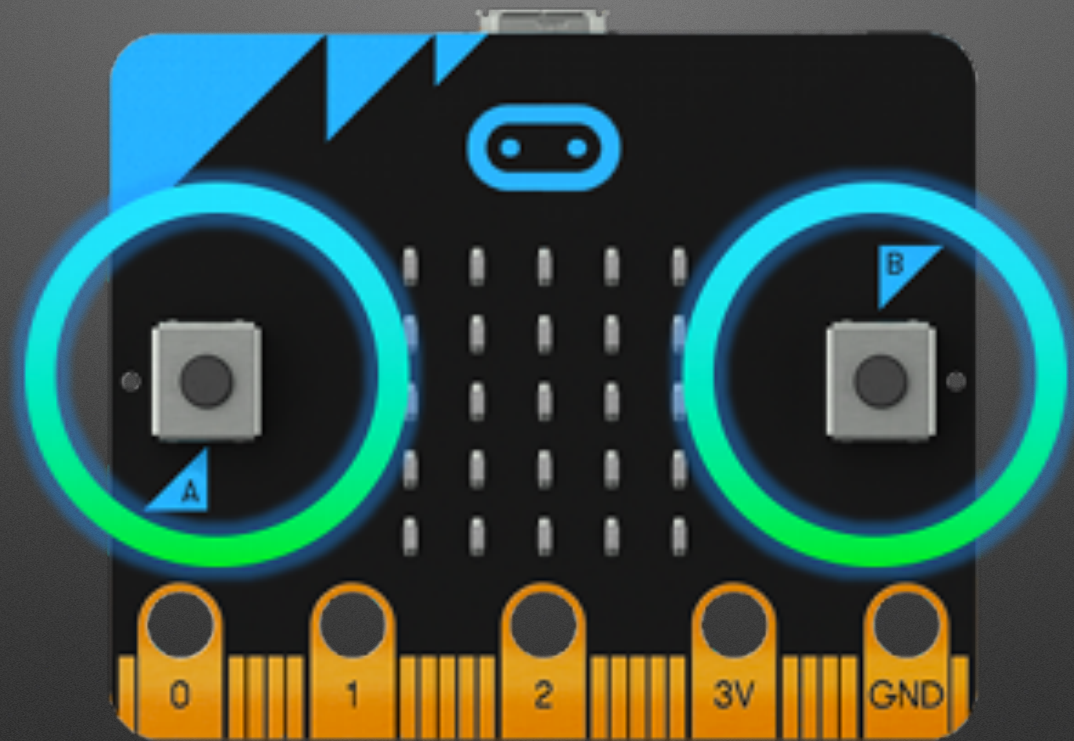
Small



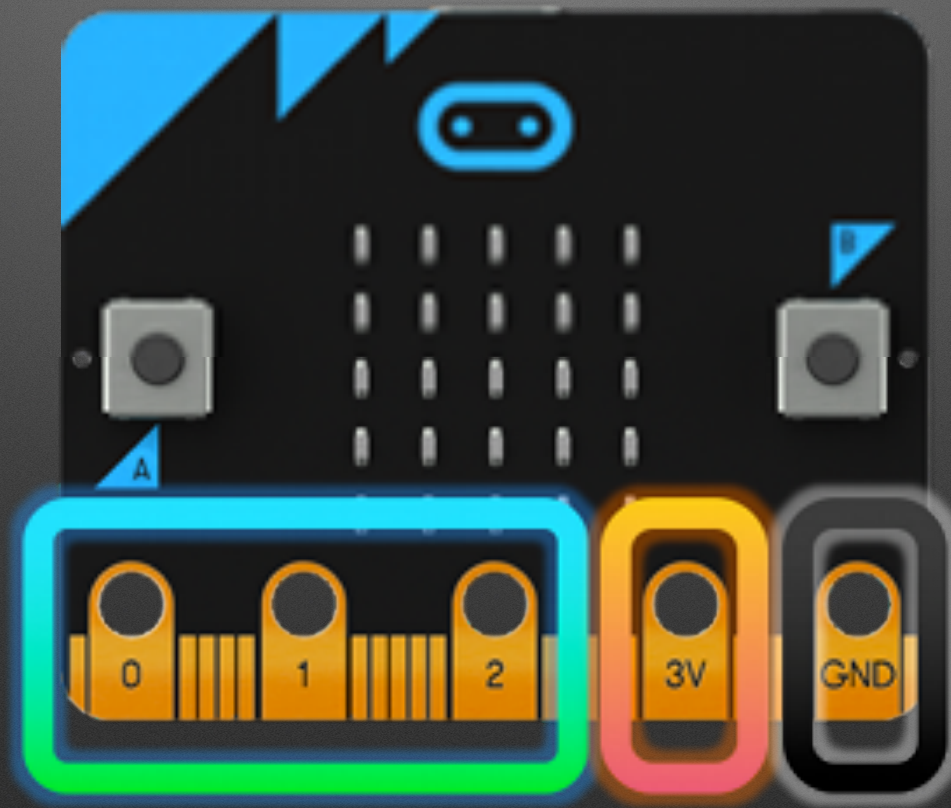
LED Grid



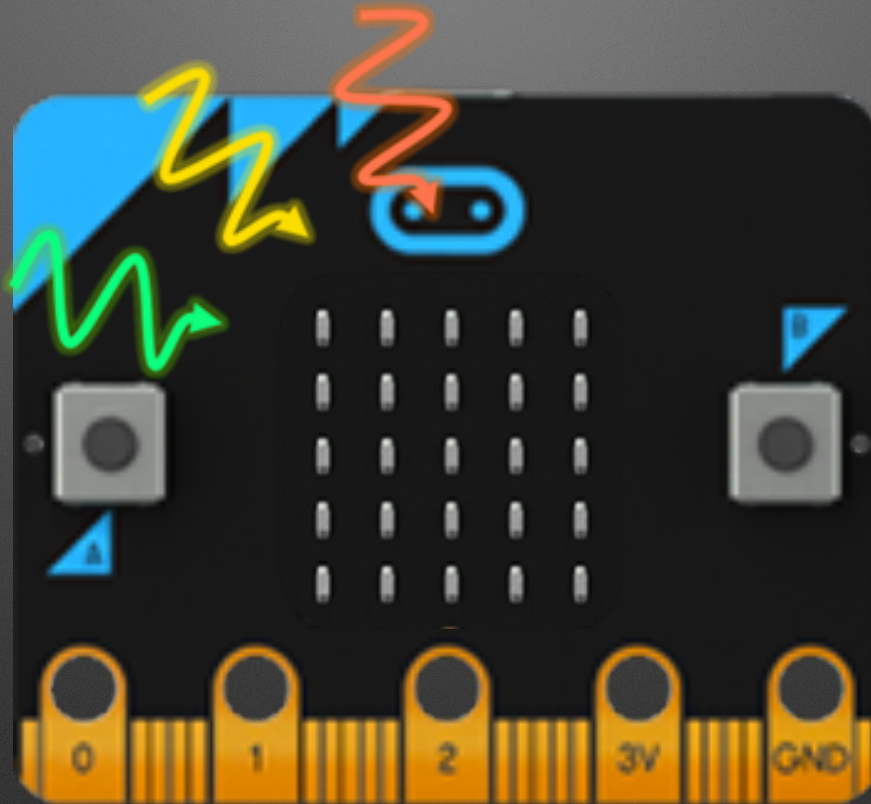
Buttons



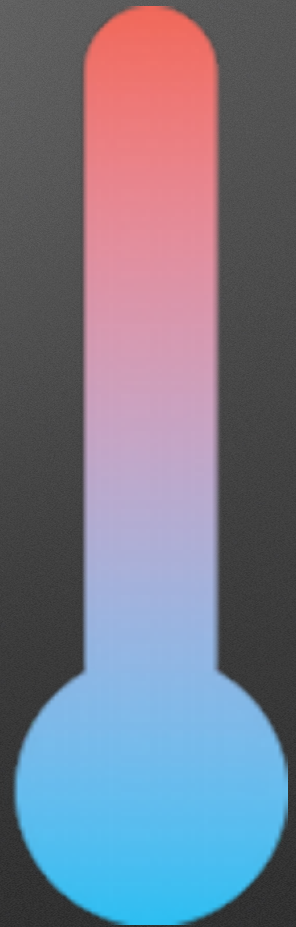
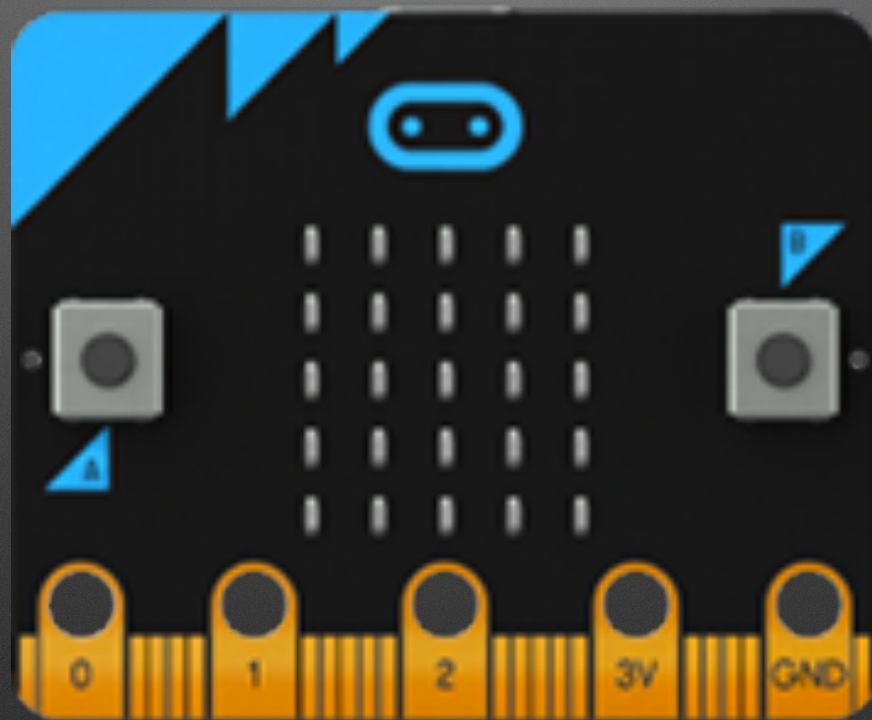
Connectors



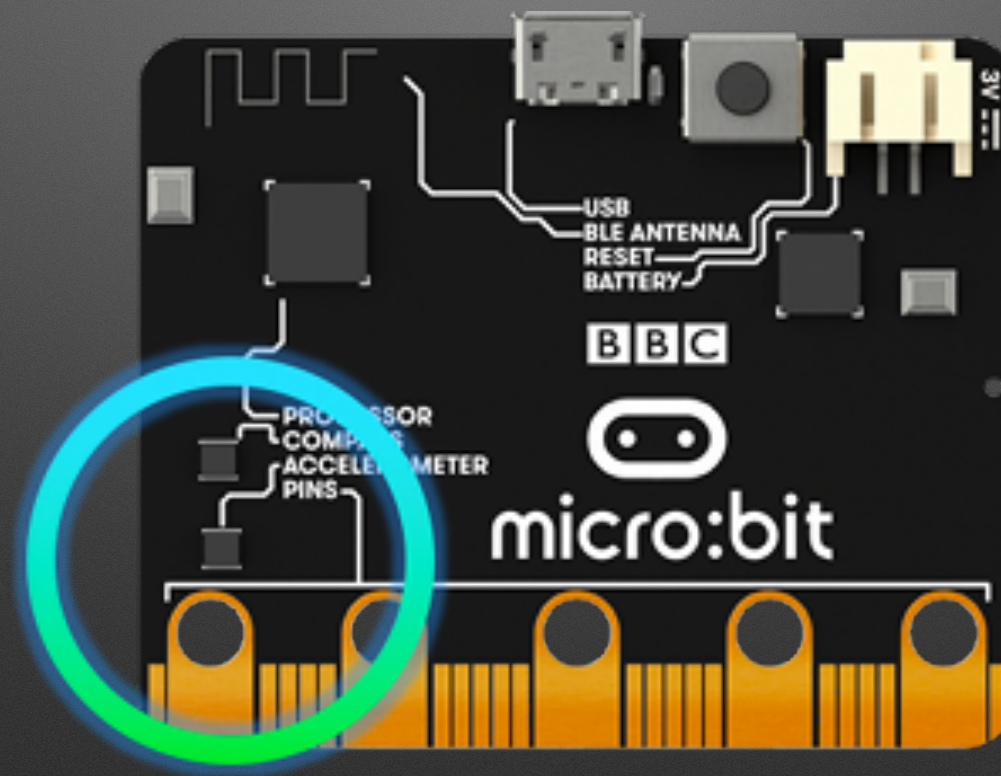
Light Sensor



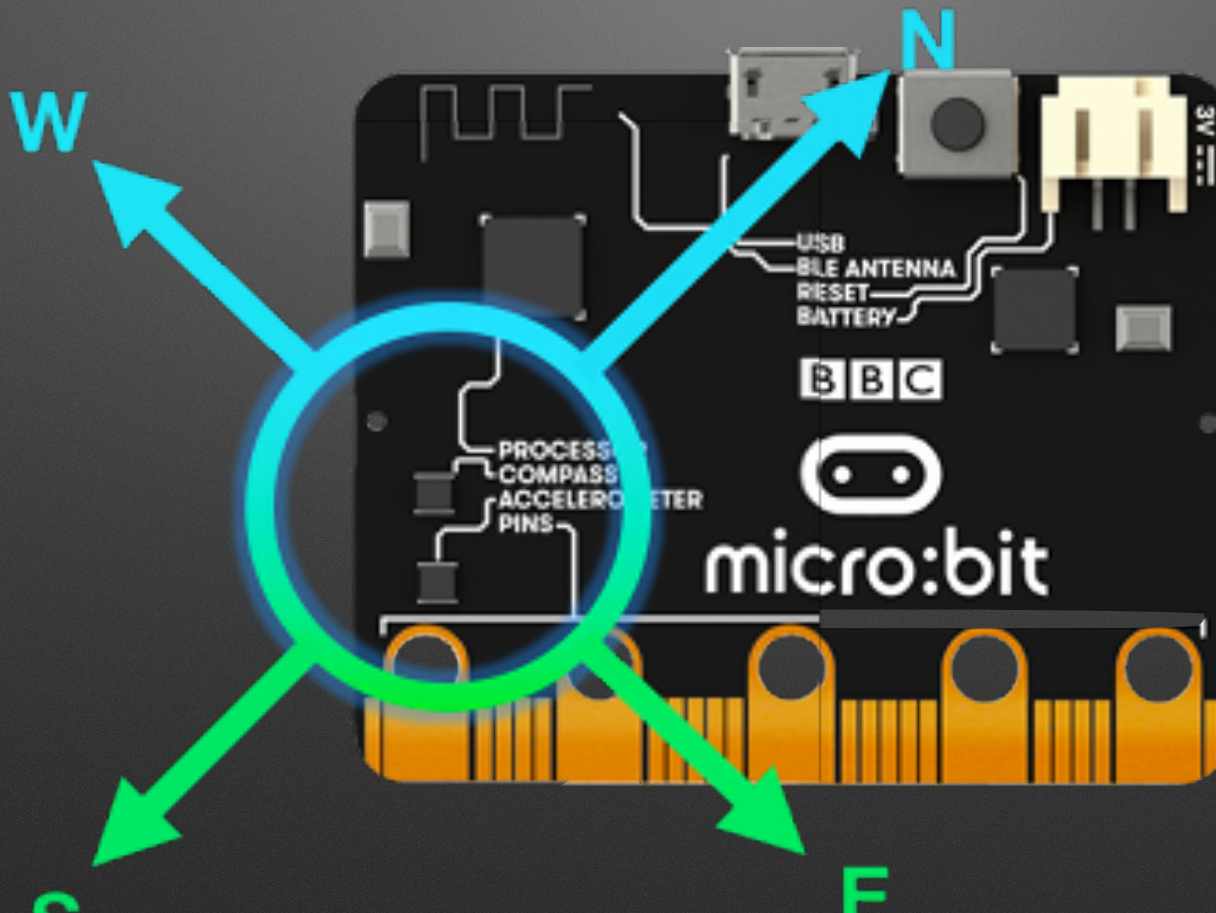
Temperature Sensor



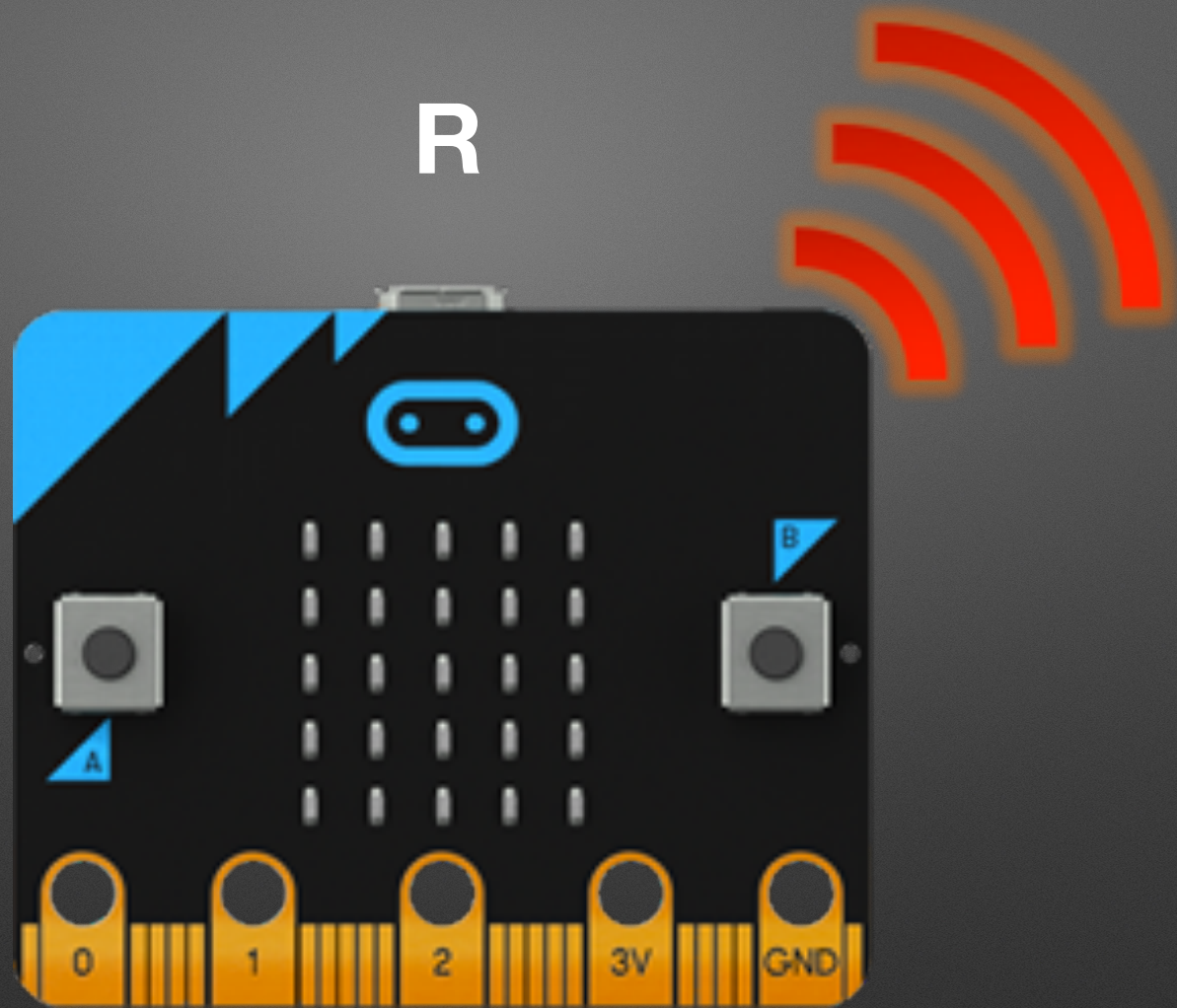
Accelerometer



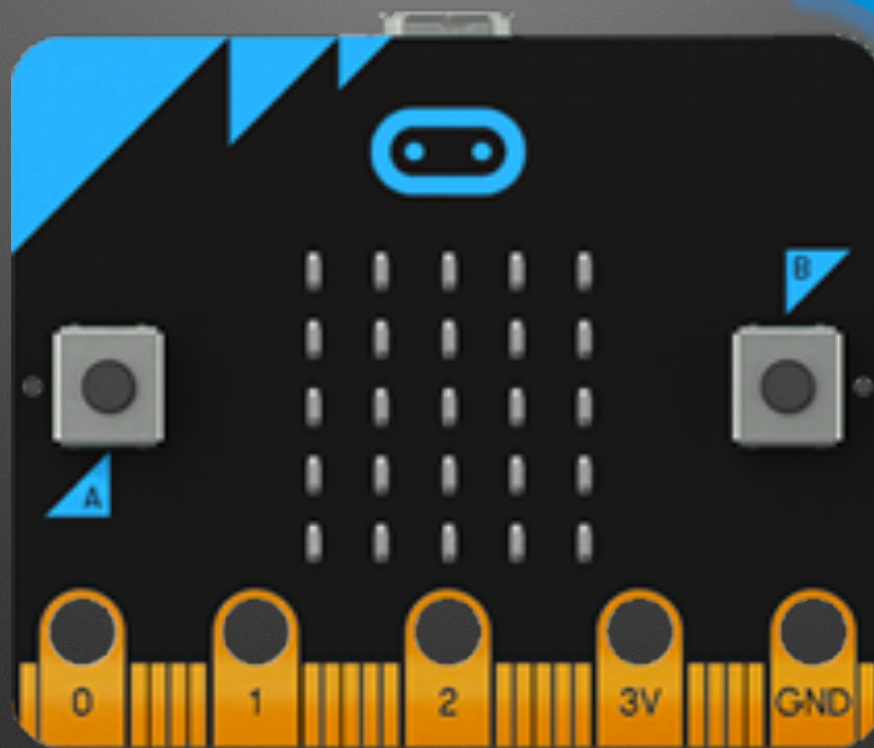
Compass



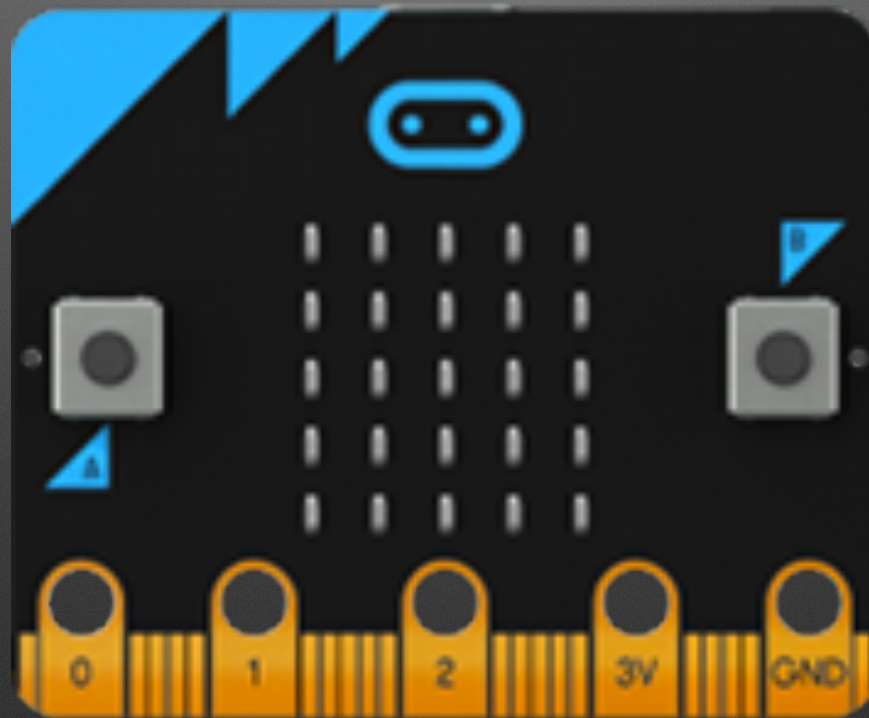
R



Bluetooth



Low Cost: ~\$13 US

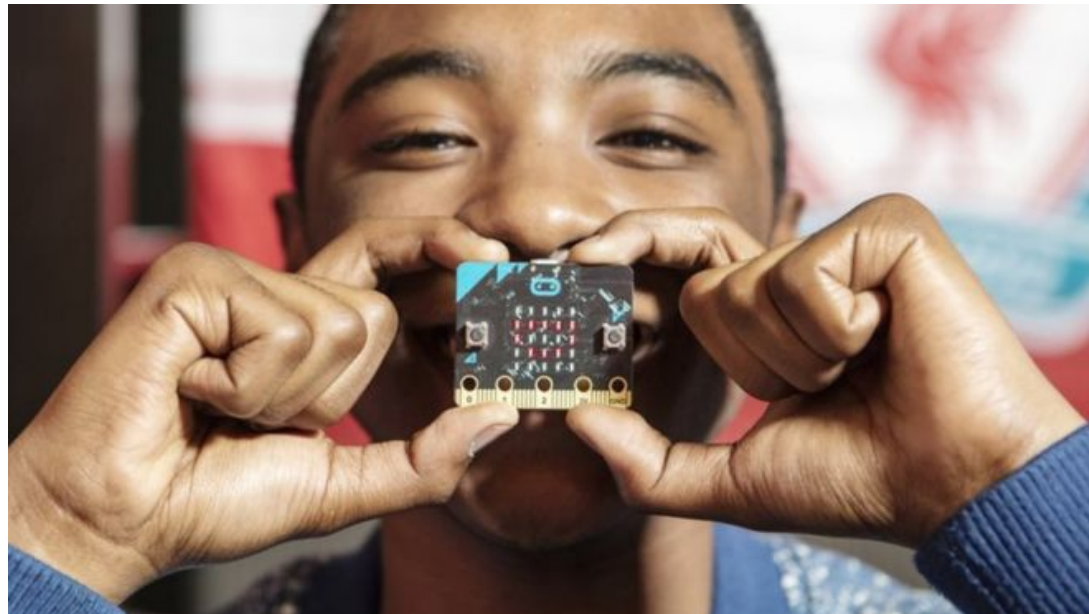


Thanks: Micro:bit Educational Foundation

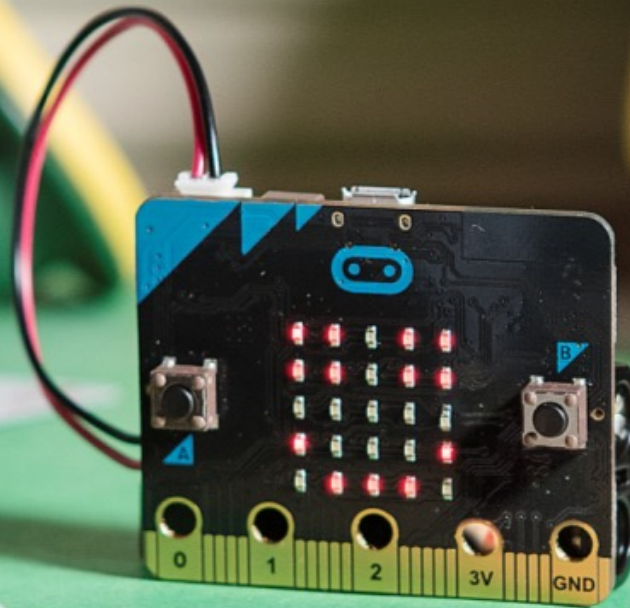
and Hal Speed

2015

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

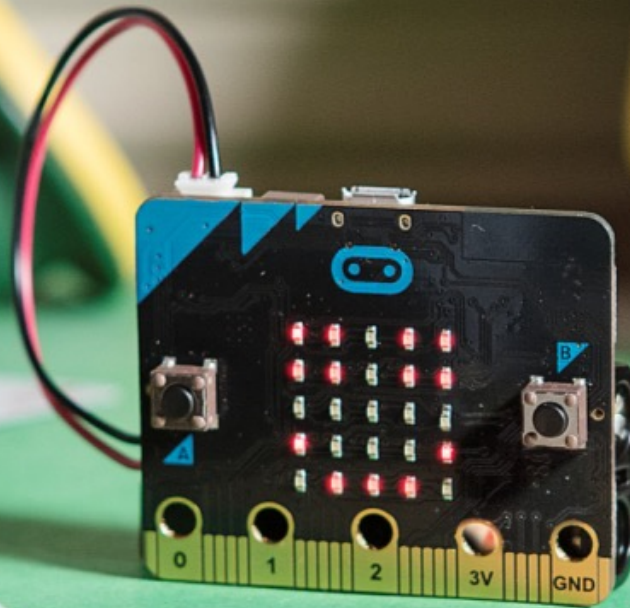


90% of students said it helped
show that anyone can code



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



4th Grade

Course E

5th Grade

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**



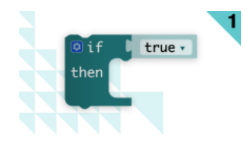
Lesson

**Course F -
Variables 1 -
Variables With A
Counter**



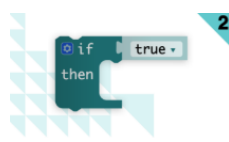
Lesson

**Course F -
Variables 2 -
Variables and
Emotions**



Lesson





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



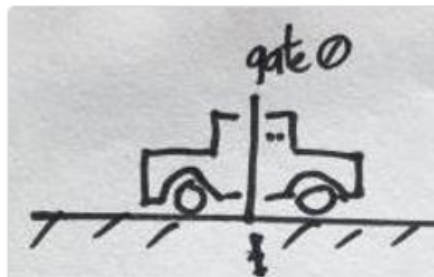
Lesson

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

Sample of Lessons

| Lesson | Resources |
|---|--|
|  Answering Machine | <ul style="list-style-type: none">• 5 Minute Lesson Plan (pdf) (pptx)• Teacher Notes (pdf) (docx)• Hex File (Tip: Save link for Mac, Save target for PC) |
|  Guess the Number | <ul style="list-style-type: none">• 5 Minute Lesson Plan (pdf) (pptx)• Teacher Notes (pdf) (docx)• Hex File |
|  Temperature | <ul style="list-style-type: none">• 5 Minute Lesson Plan (pdf) (pptx)• Teacher Notes (pdf) (docx)• Hex File |
|  Die Roll | <ul style="list-style-type: none">• 5 Minute Lesson Plan (pdf) (pptx)• Teacher Notes (pdf) (docx)• Hex File |

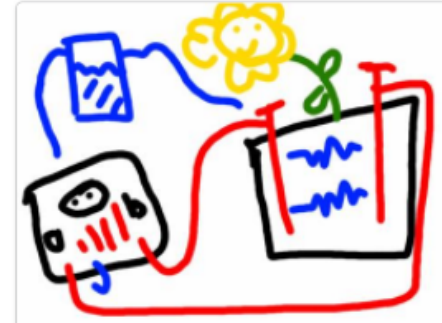
STEM Lessons



Timing gates



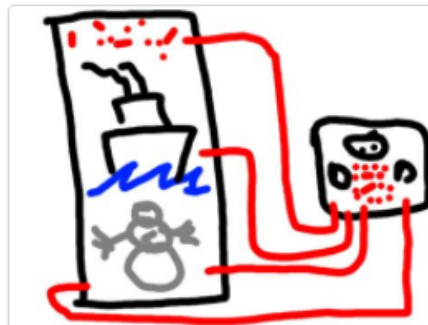
Soil Moisture



Plant Watering



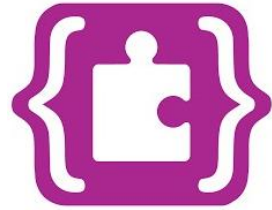
Reaction Time



States of Matter

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

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 |



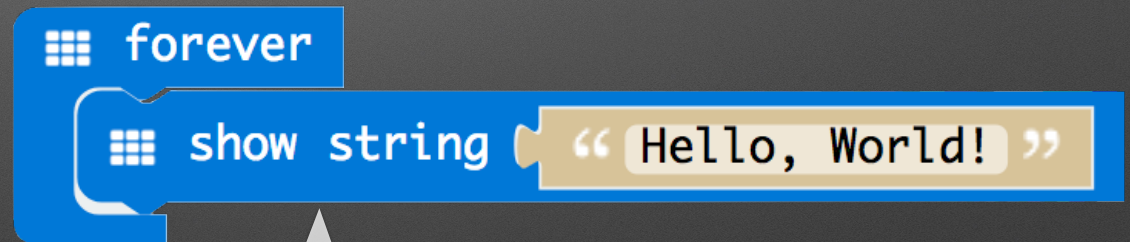
PLTW Gateway:
Computer Science for
Innovators and Makers

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

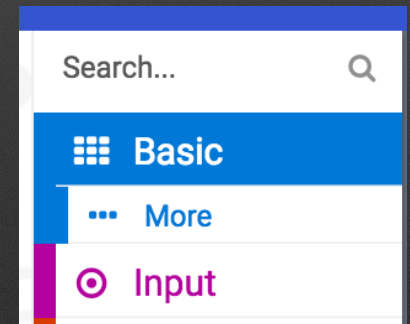


“Hello, World!”: First Program

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



Block Color Indicates Palette



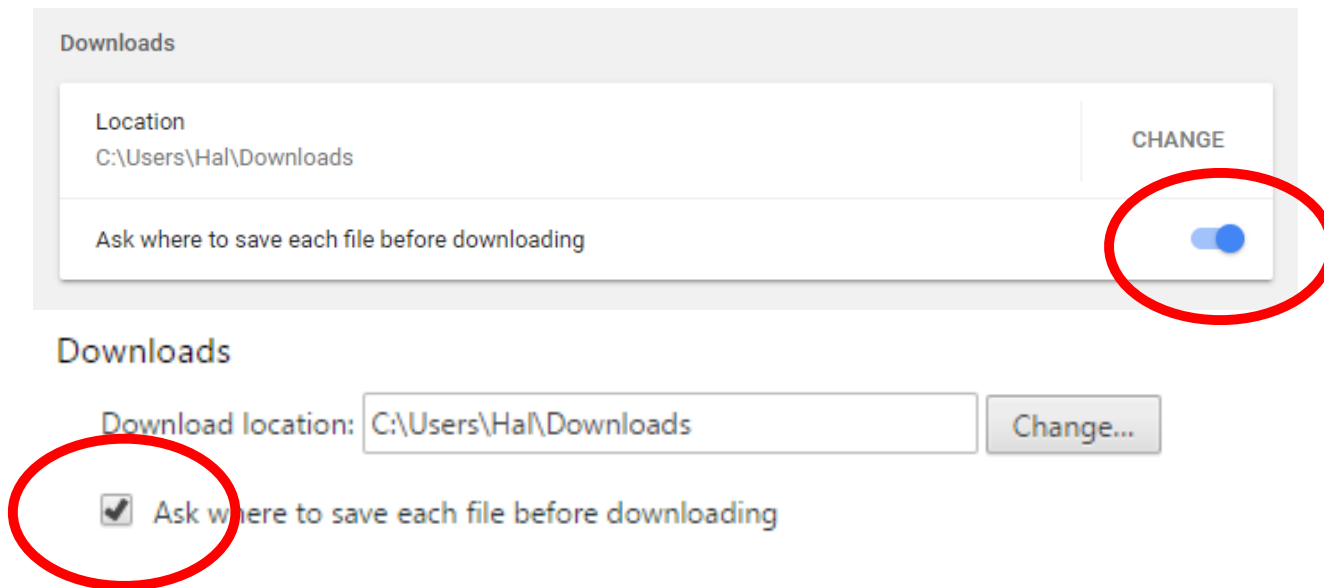


Setup

- Hardware Handout — *Thanks Microbit Foundation!*
 1. Pull out the micro:bit box / open
 2. Connect via USB cable
- Browser
 1. Open microbit.org
 2. Select “Let’s Code”
 3. Click “Let’s Code” button

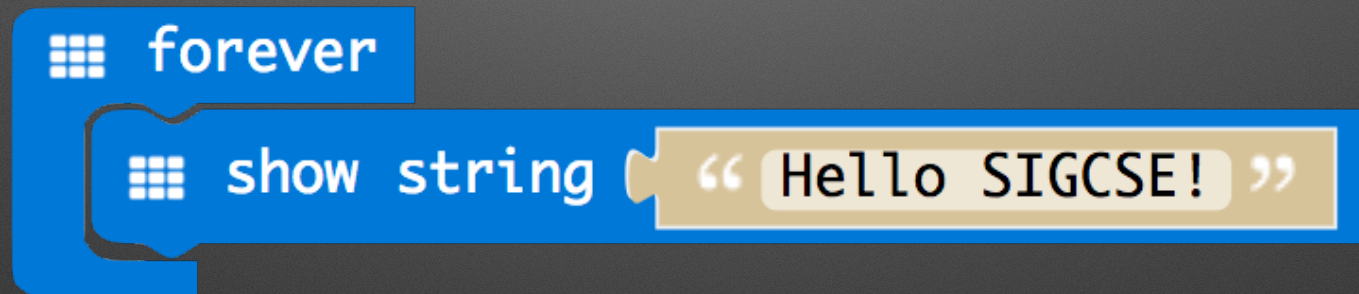
Chrome Setup

- `chrome://settings/downloads` - OR - Show advanced settings...

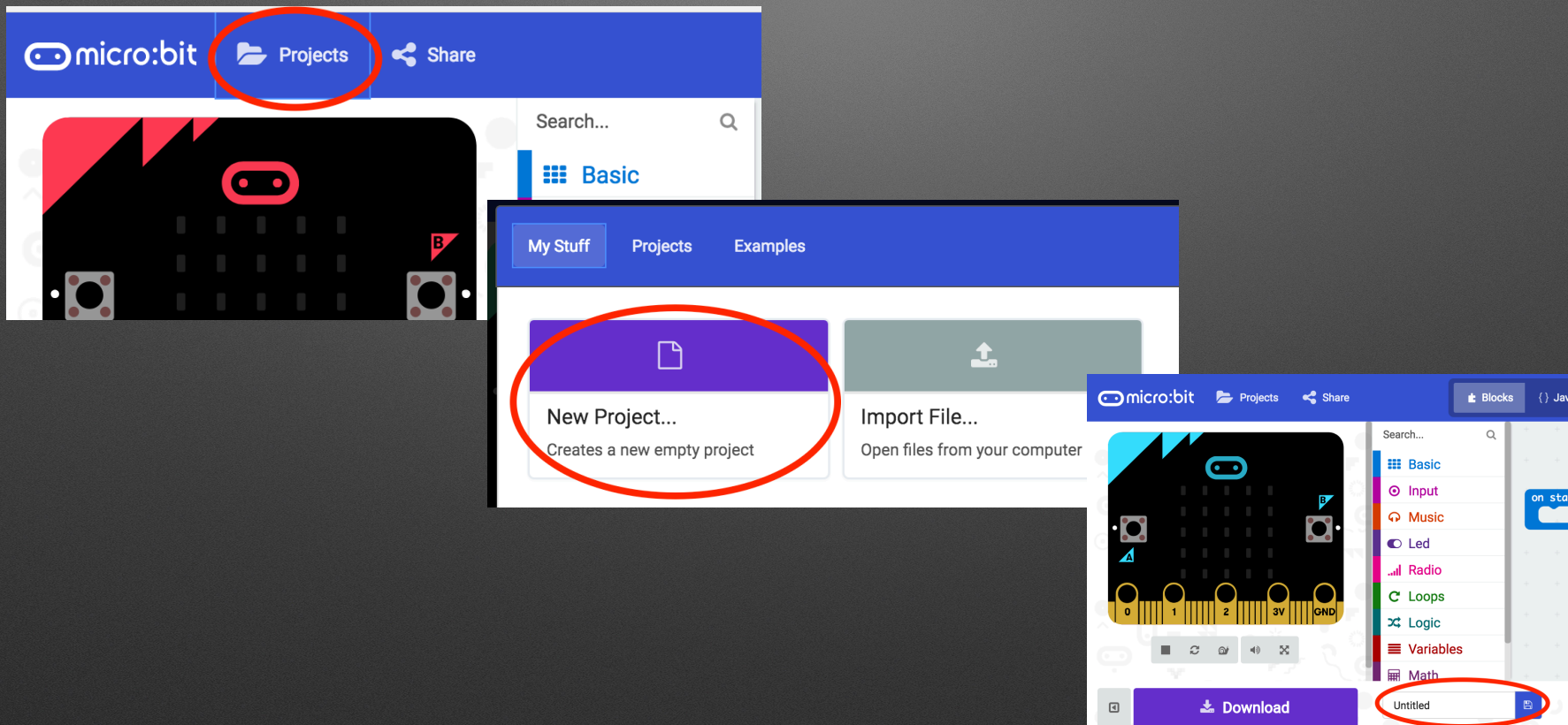


Personalization!

- Hello Bill / Hello Michael / Hello



New Project: Projects > New Project...

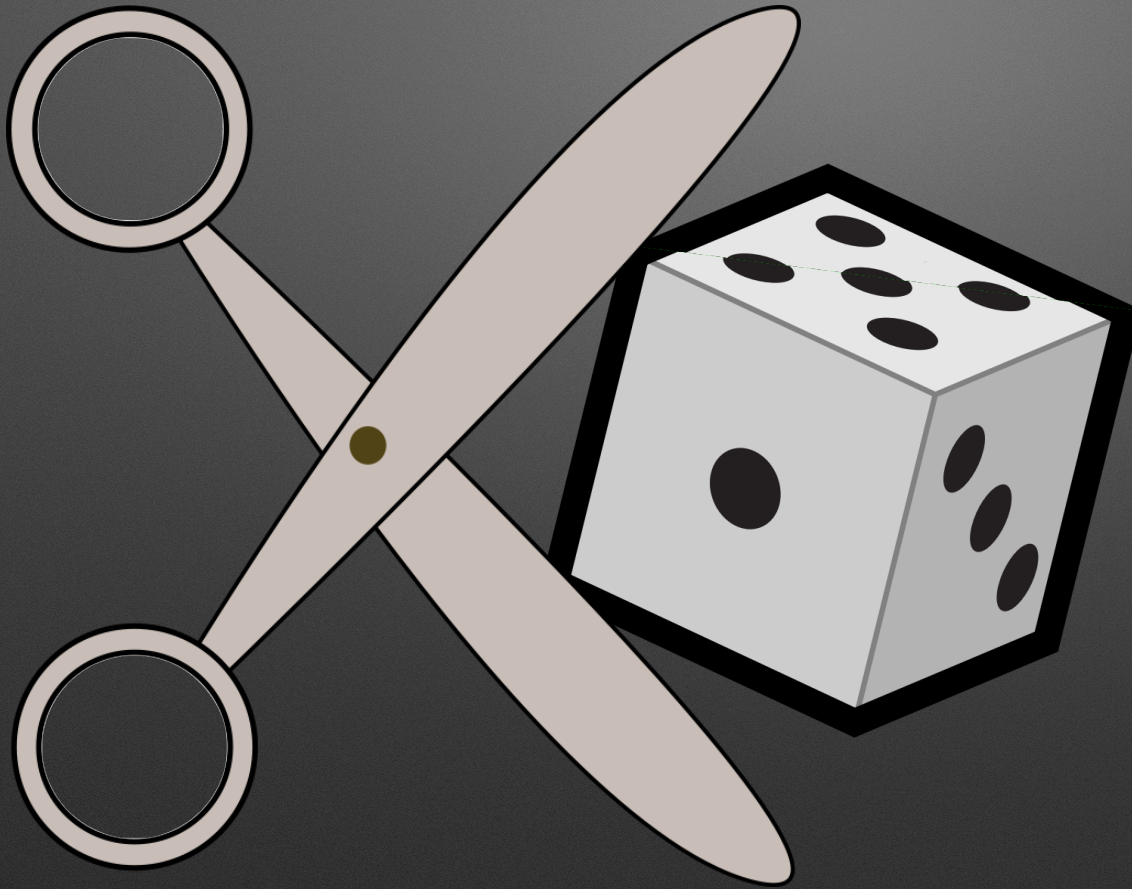




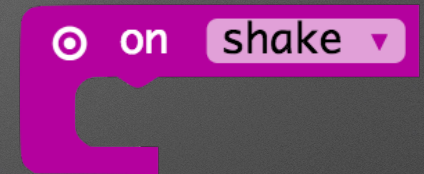
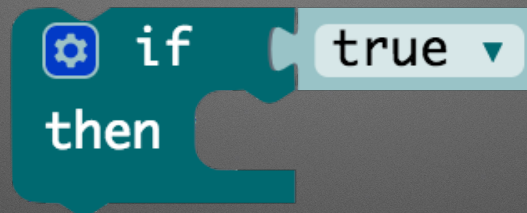
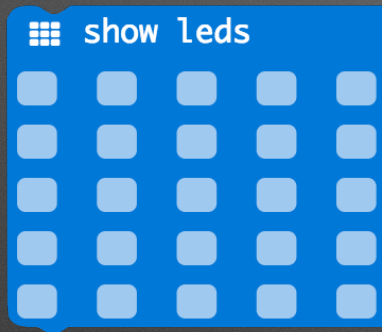
Programming: Logic & Action

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

Obvious Solution...



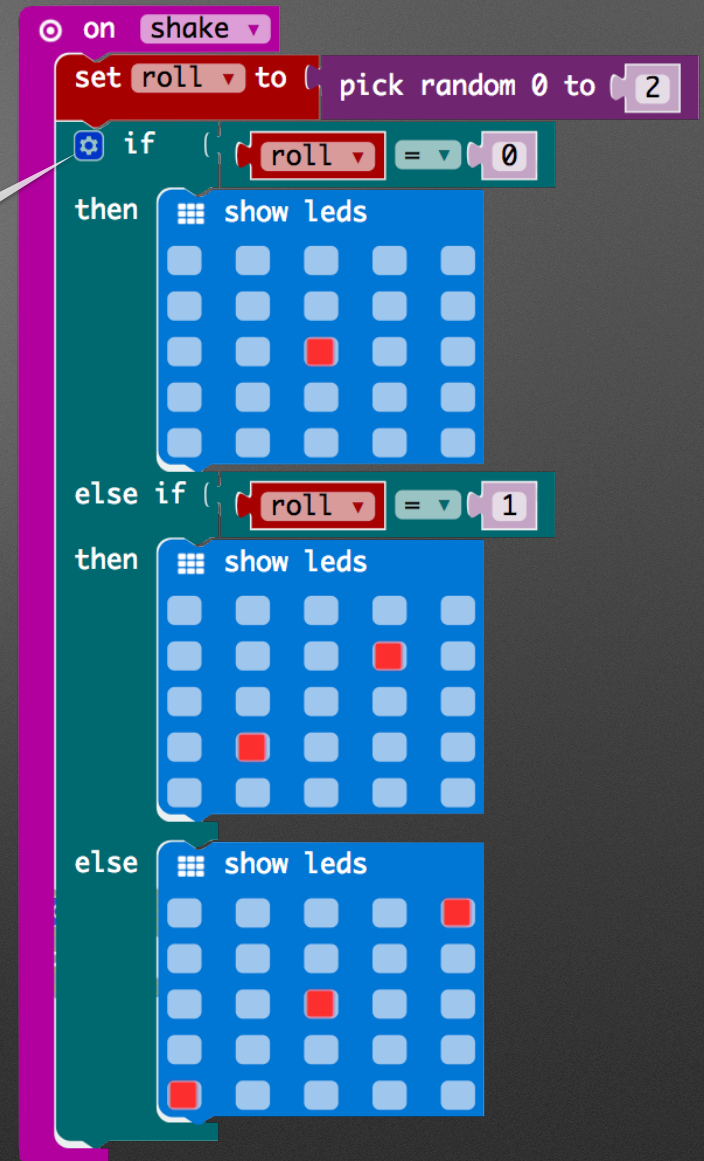
Parts



1. Color indicates Palette
2. Incremental Development:
Try parts in Simulator

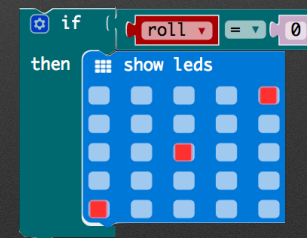
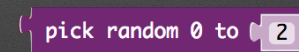
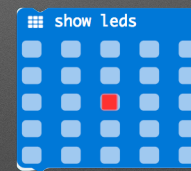
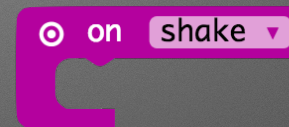
Solution

Pro Tip: Blocks with a button icon have additional features (else-if)



Concepts

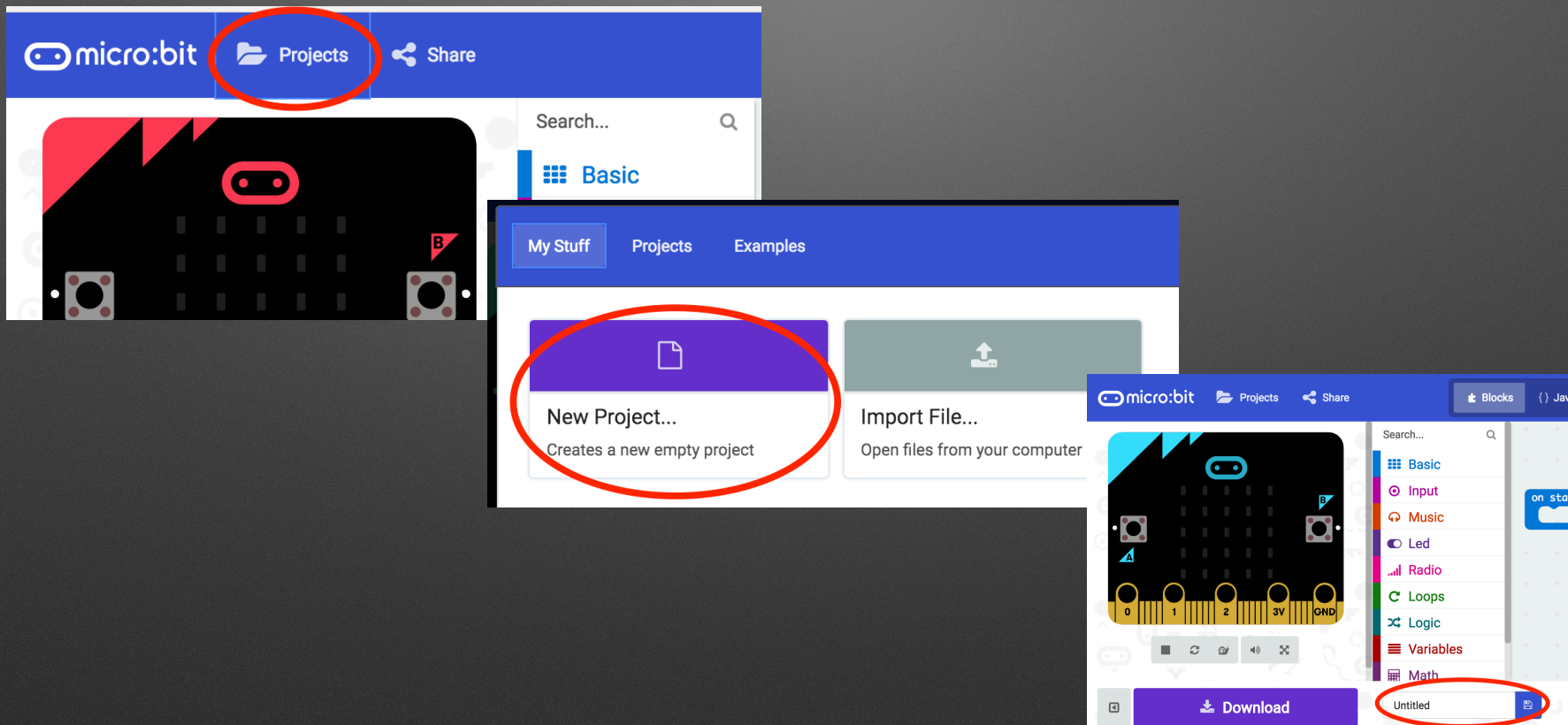
- Event driven programming
- Bitmapped Graphics
- Ranges & Representations
- Logic



Pedagogy

- Active Learning
- Discovery Based
- Constructionist

New Project: Projects > New Project...

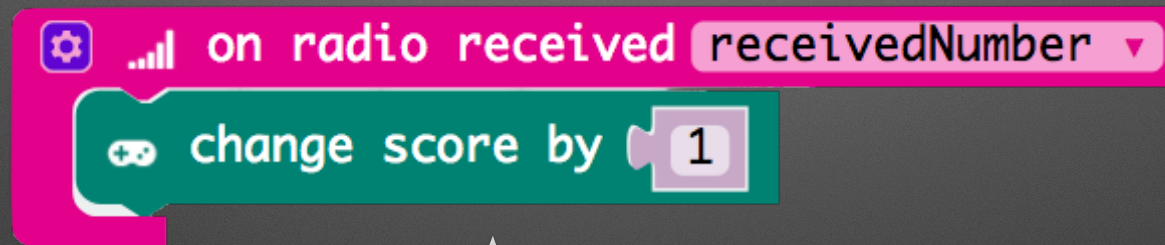




Broadcast Basics

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

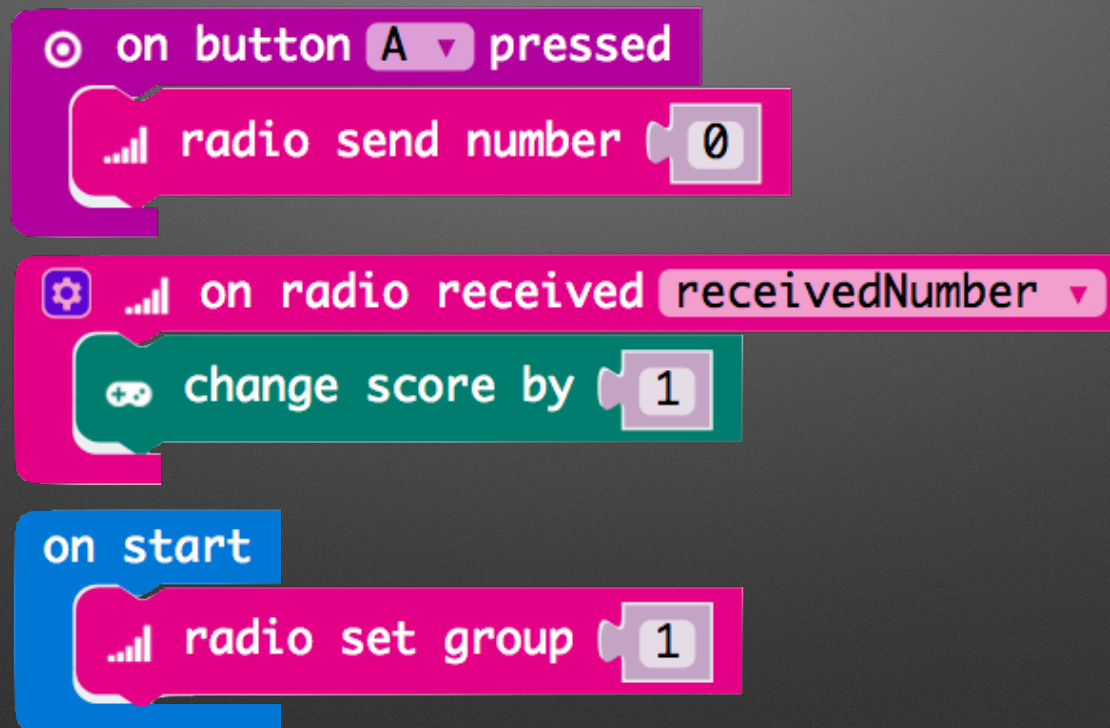
Receiver



“Game” blocks in “Advanced”
Section of Palette

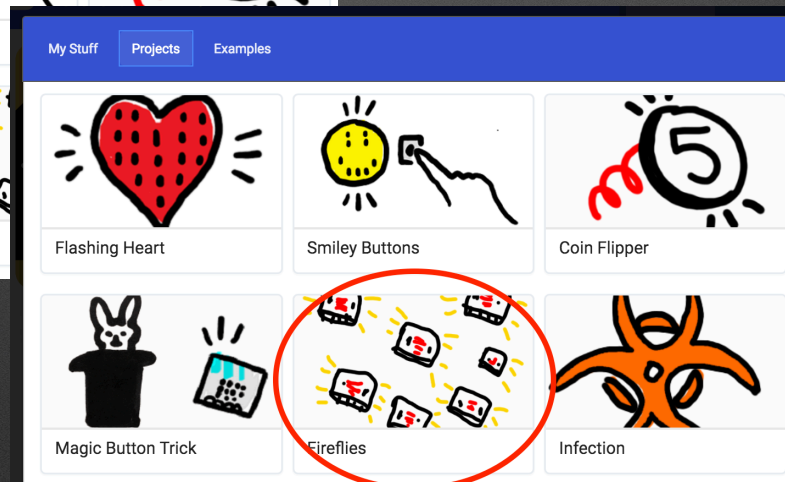
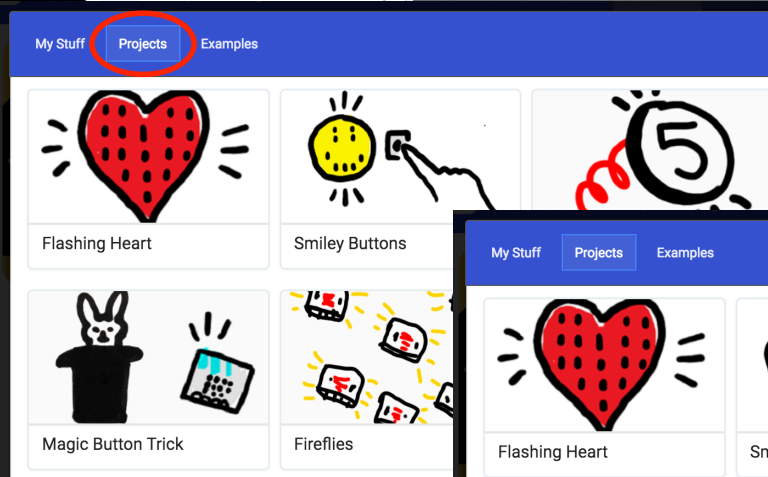
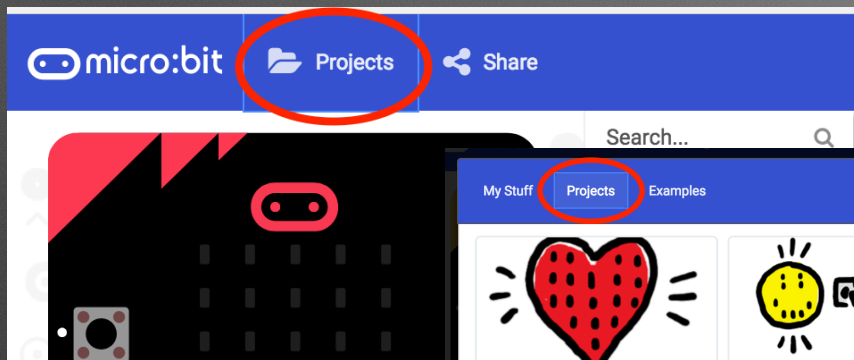
▼ Advanced

Full Boadcaster



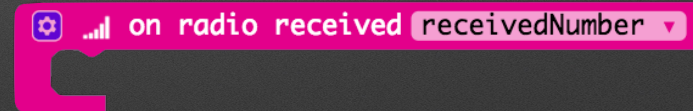
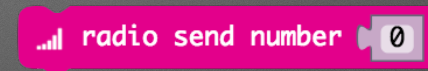


& Firefly Fun



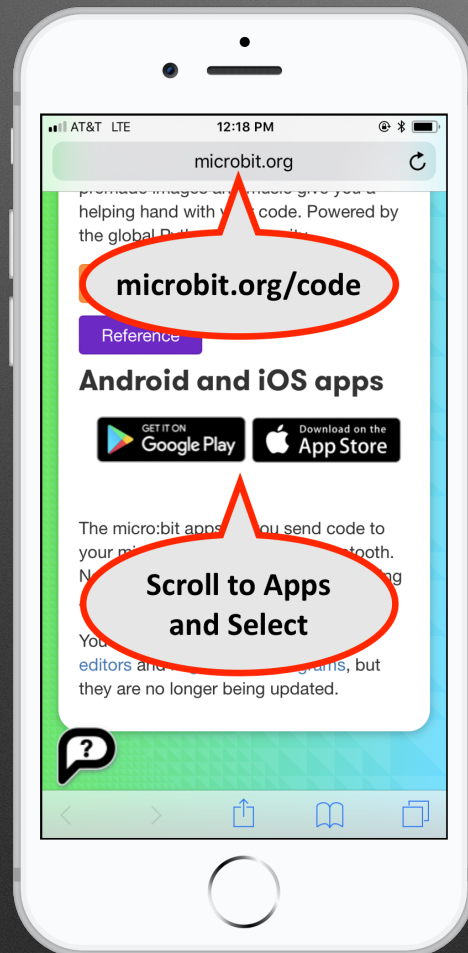
Concepts

- Broadcasting
- Network Addresses
- Asynchronous clocks / Sync problems



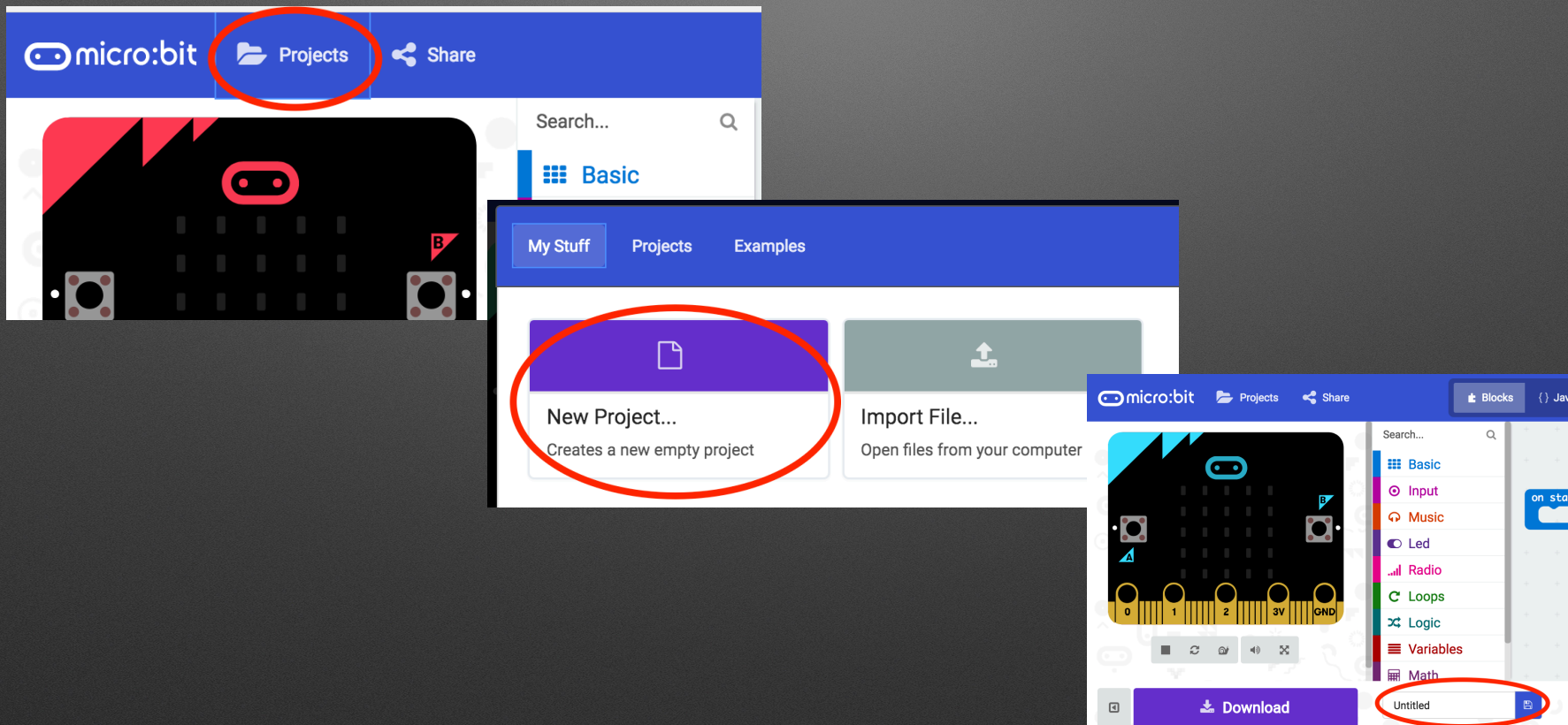
Break & App Install

Android & iOS



**Android
(optional)
Search for &
Install
Bitty
Controller
(\$1.99)**

New Project: Projects > New Project...



Goody Bag: Hardware



Motor Mayhem

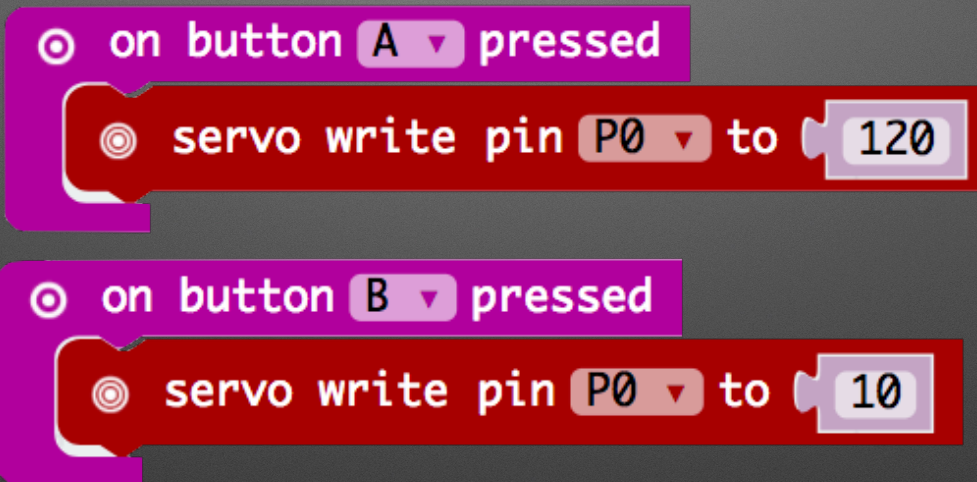
An Intro to Servos
(Unfortunately, very poor quality servos...)



Motor Mayhem

An Intro to Servos

(Unfortunately, very poor quality servos...)



Inchworm Insanity

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



Awesome (?) Audio

Concepts

- I/O

Bluetooth Background

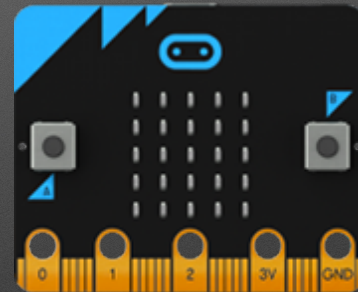
- Uses different protocol than  Radio
- Not a group broadcast

Bluetooth Background

Central



Peripheral



Bluetooth Background

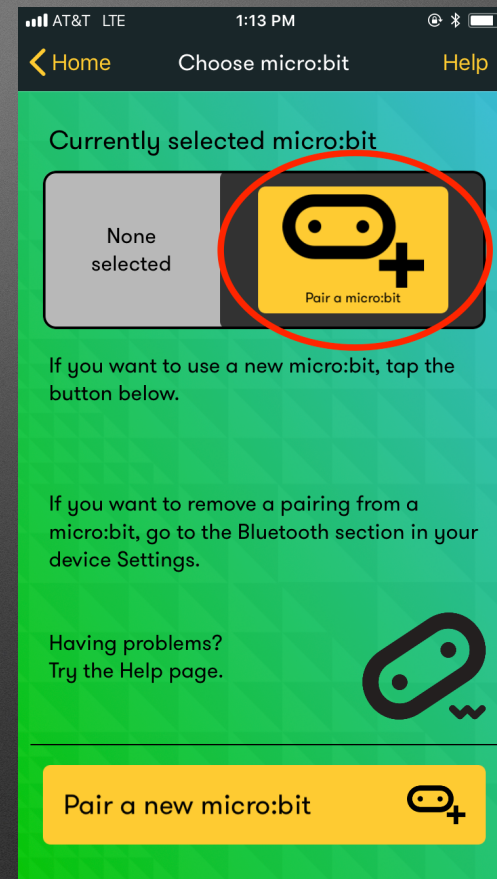
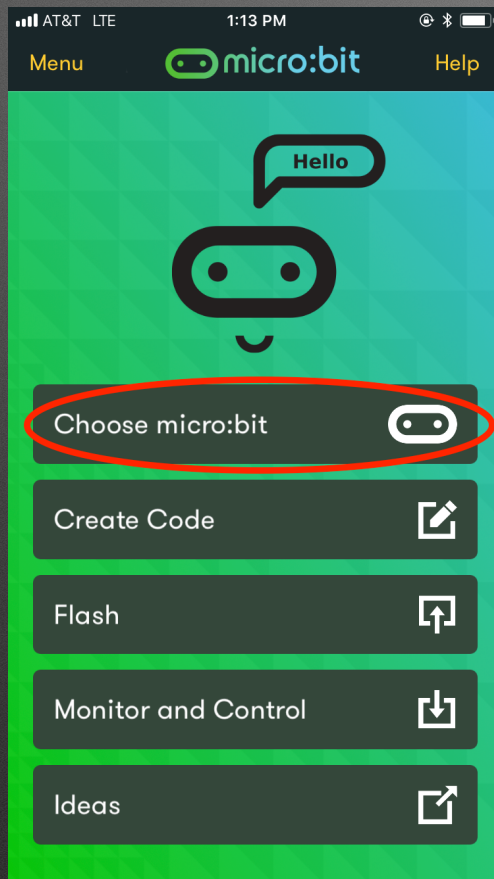
Central



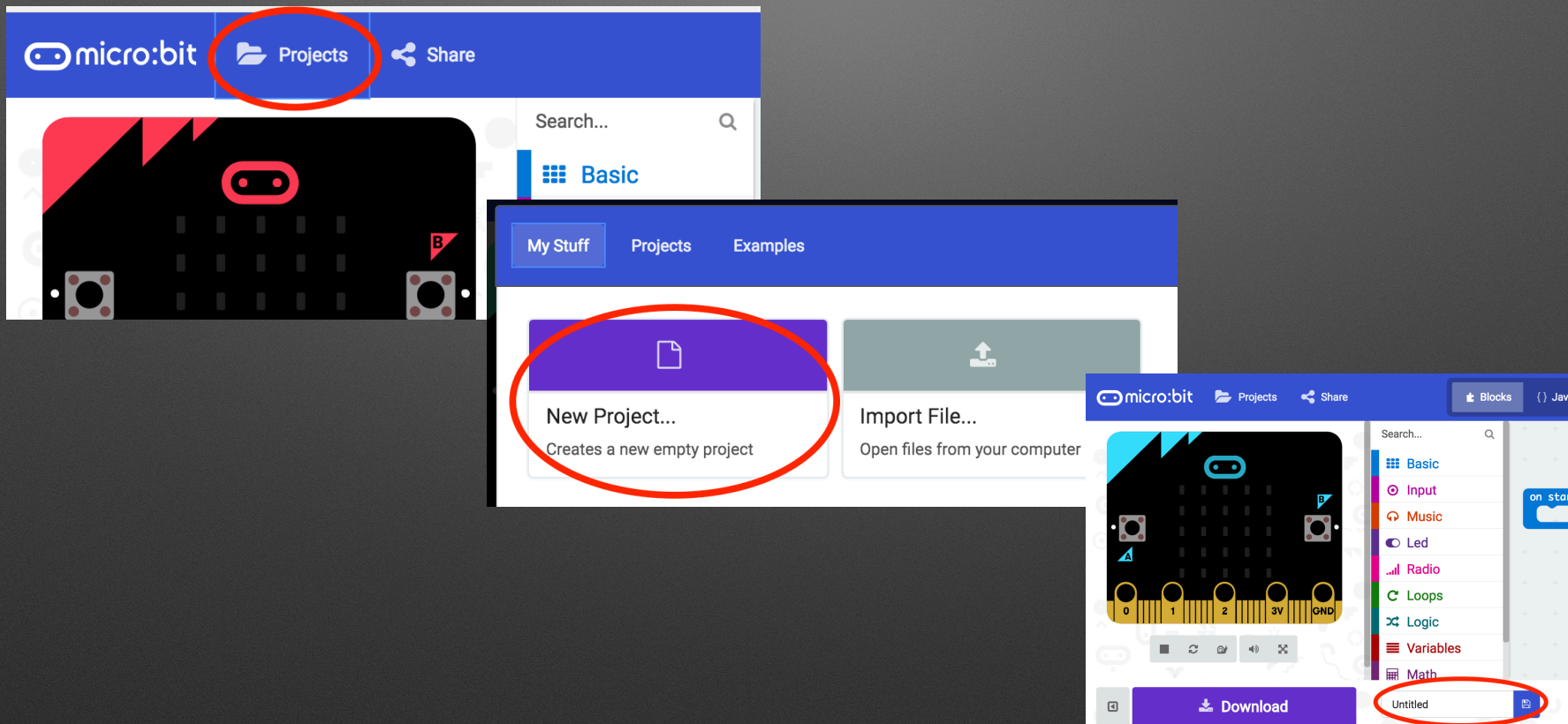
Bluetooth Background

- 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)
 - Just Works (default. Pretty safe here)
 - Passkey Pairing (more secure)

Pairing

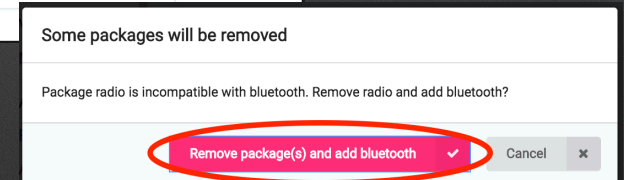
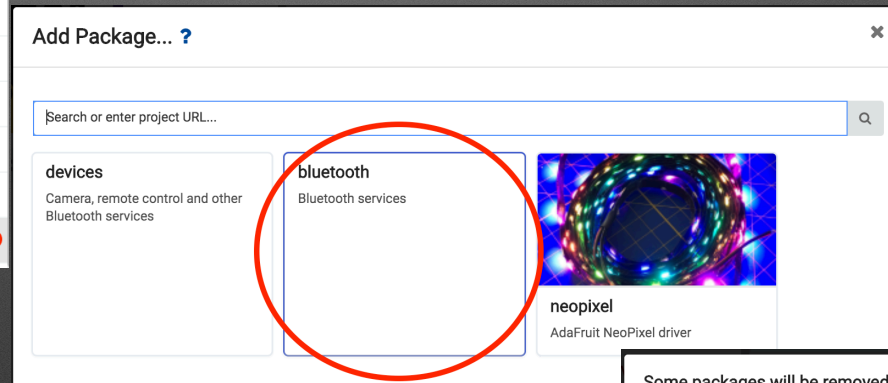
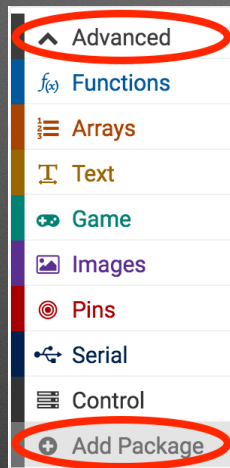


New Project: Projects > New Project...



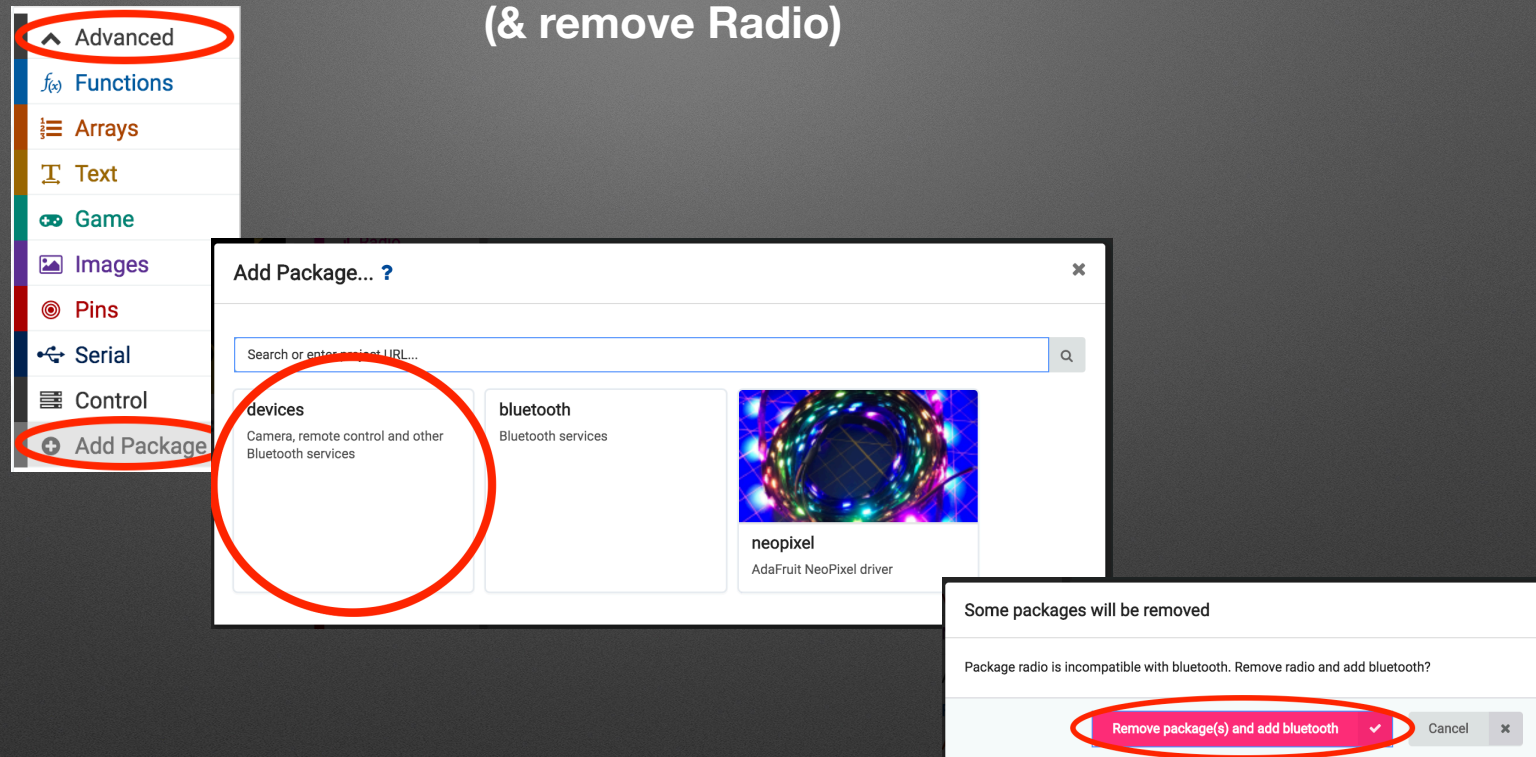
Remove Add Bluetooth

(& remove Radio)

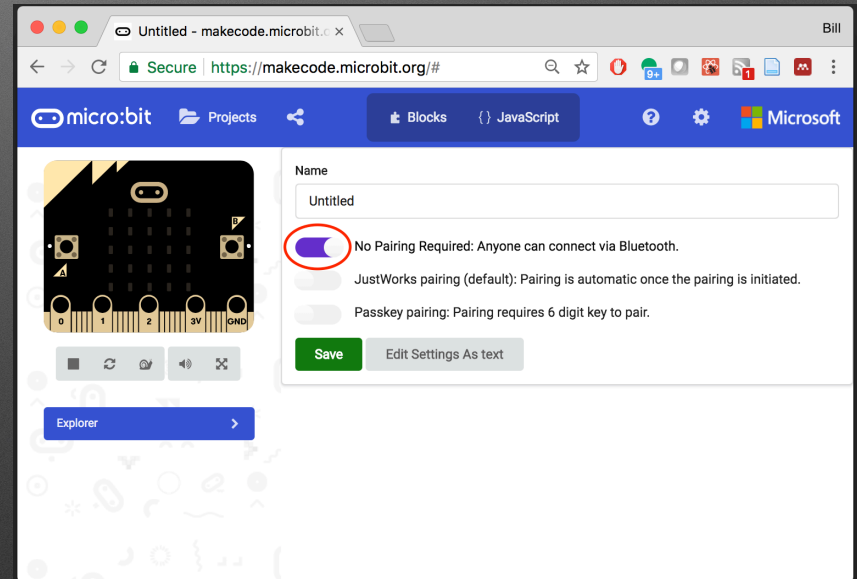
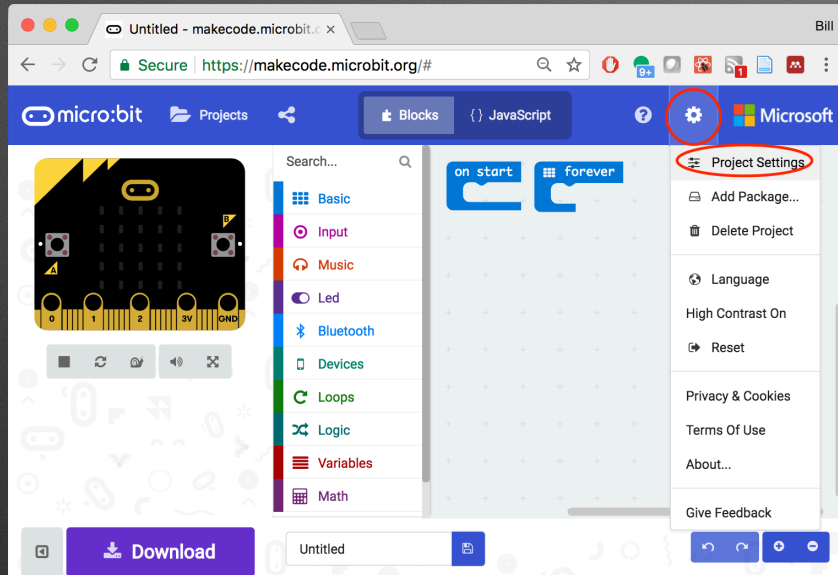


Remove Add Bluetooth

(& remove Radio)

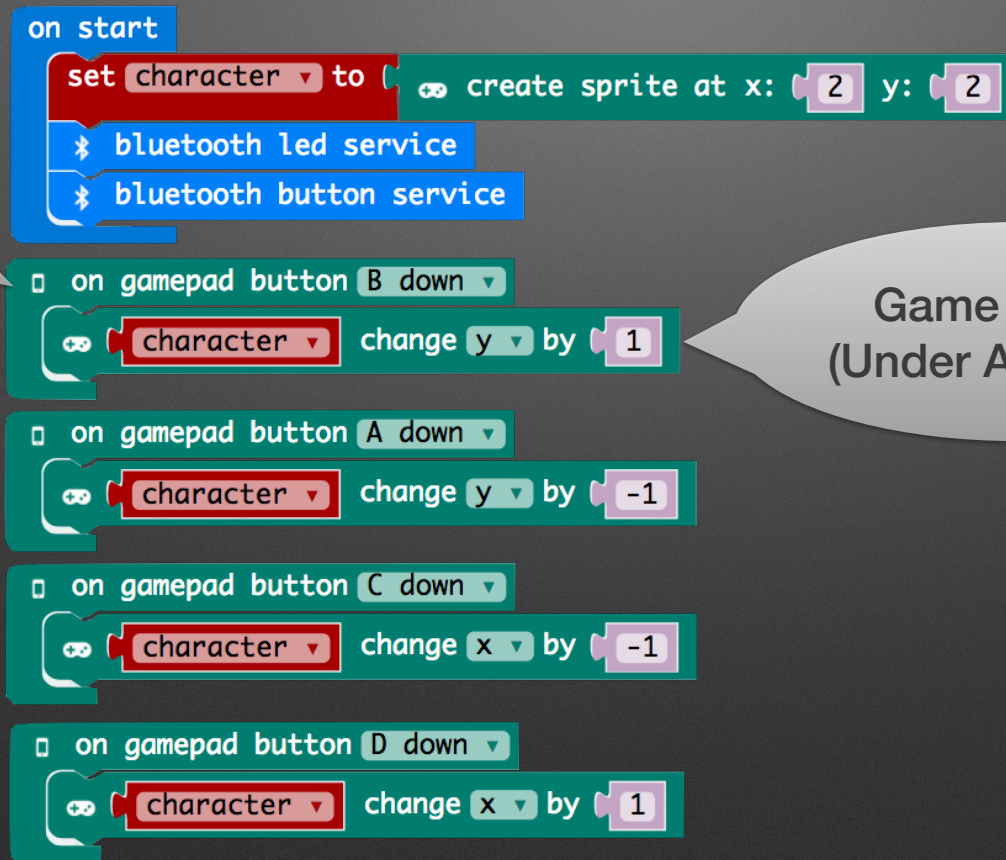


Project Settings



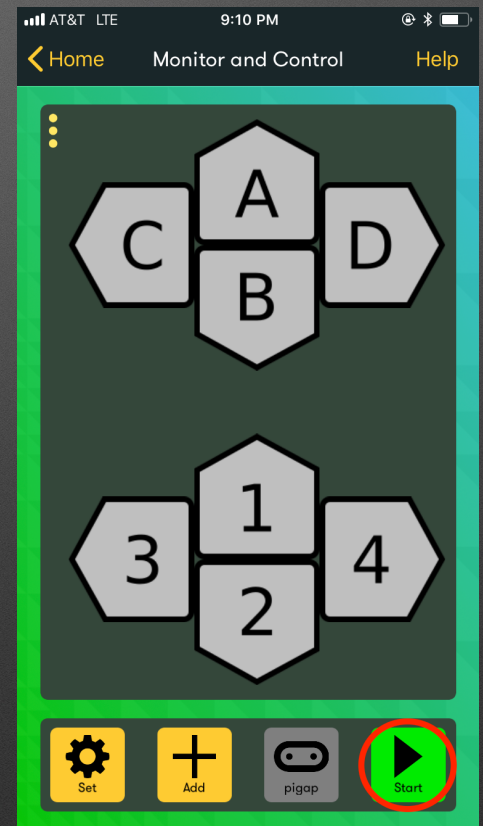
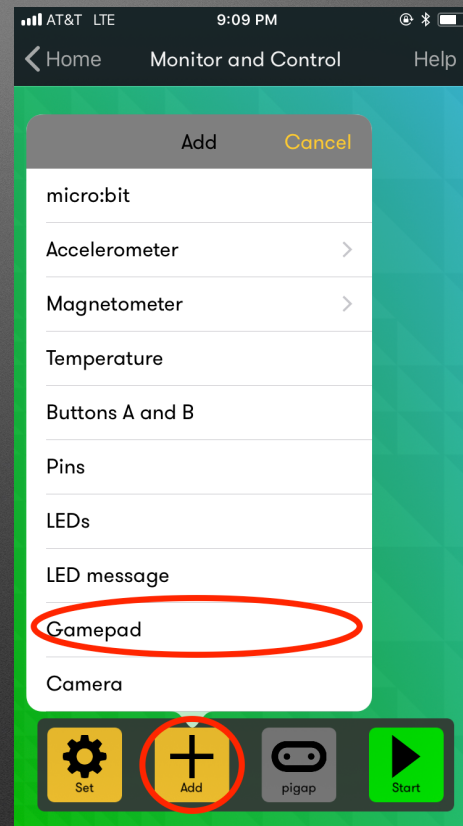
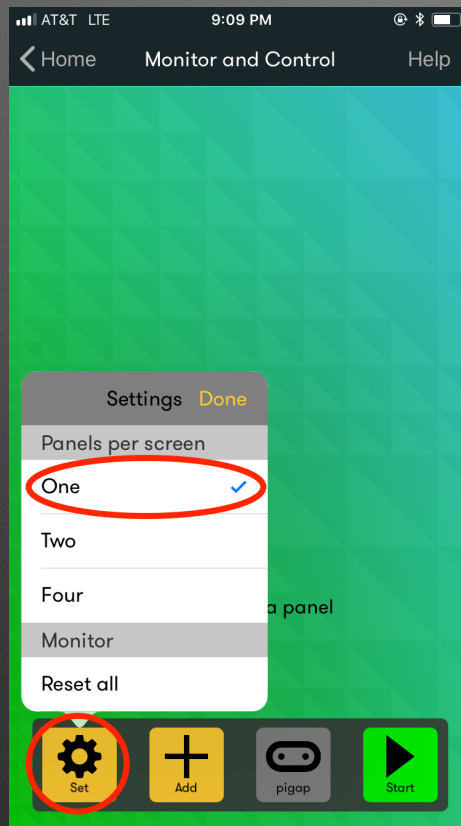
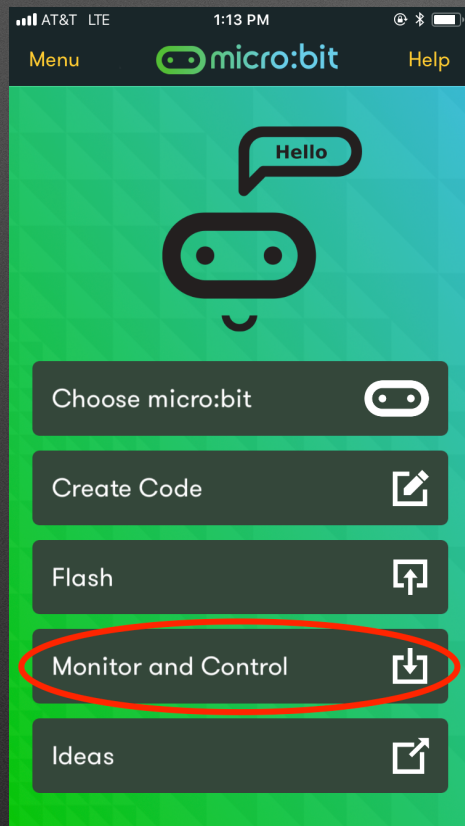
Program

Devices Palette



Game Palette
(Under Advanced)

App Configuration



Apps for Data Logging: bittydatalogger

Program

on start

* bluetooth accelerometer service

* bluetooth temperature service

Concepts

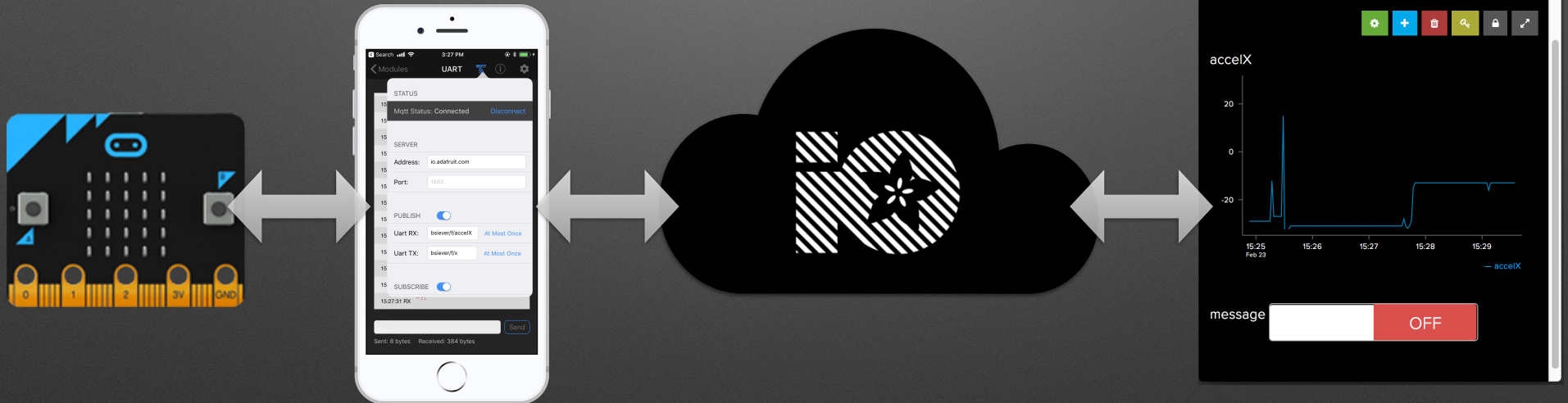
- Data Formats (CSV vs. JSON)
- Data Analysis

Question: Can this bootstrap advanced topics?

Text Based Languages: JavaScript!

IoT Example

AdaFruit.io



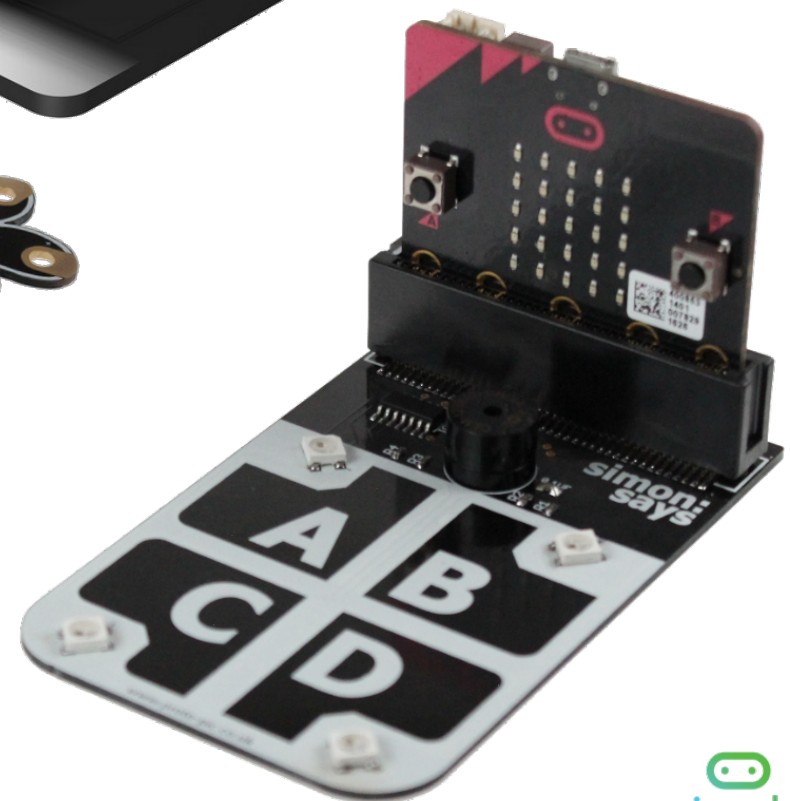
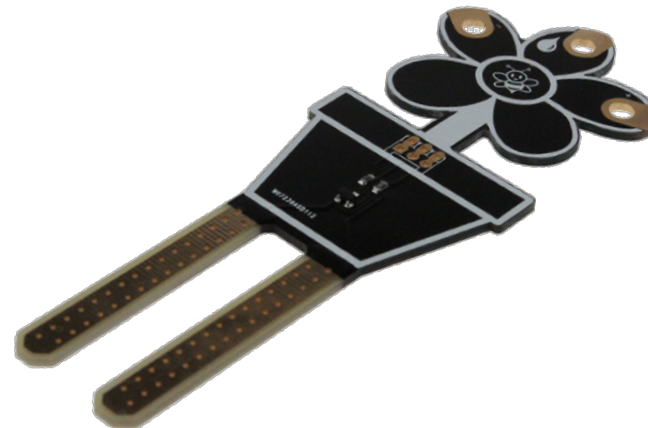
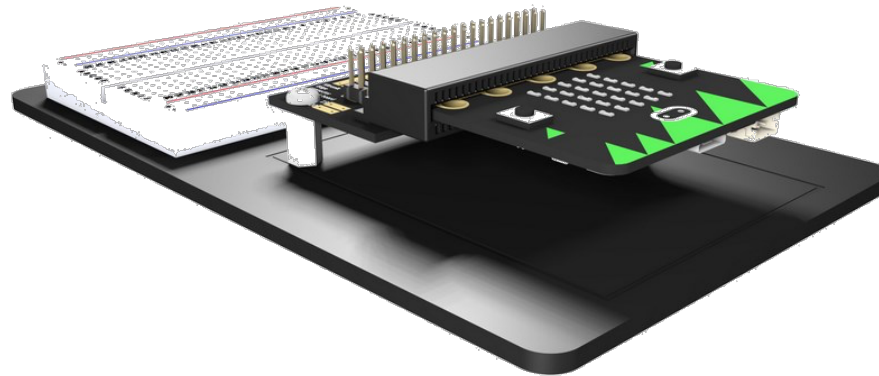
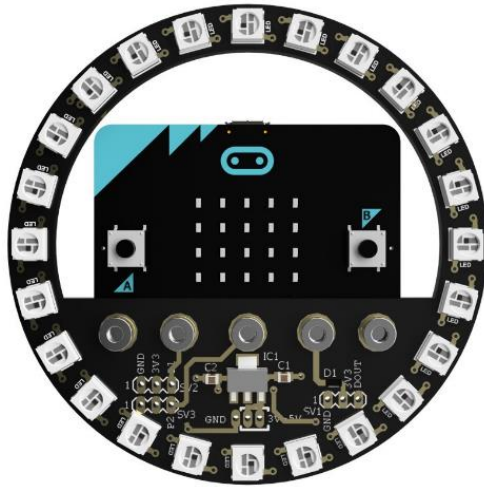
Misc.

- C (C++) / Arduino
- Phone acts as border router
- AdaFruit.io can tie into other services:
 - Texts/Notifications (IFTTT), Webhooks, etc.

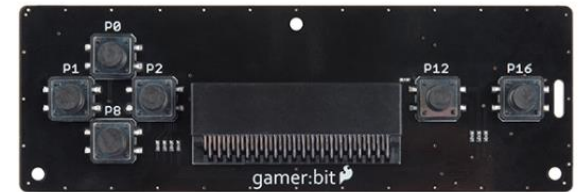
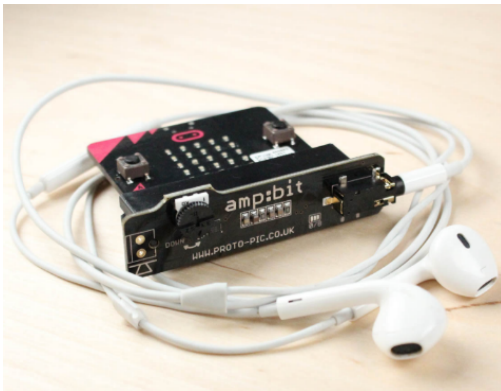
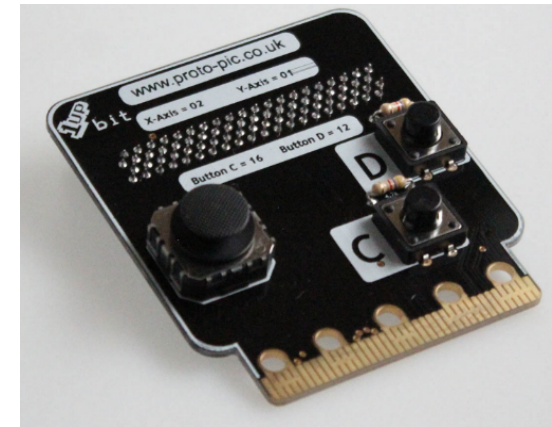
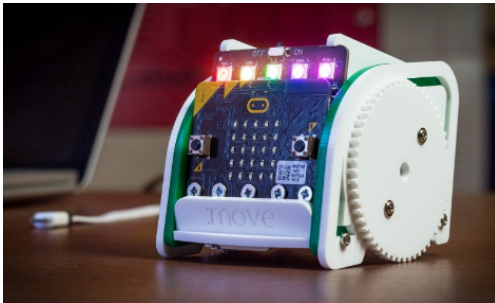
Demo

<https://io.adafruit.com/bsiever/dashboards/sigcse>

Hardware



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



U.S. Resellers



Available via DonorsChoose.org



- AKJ Education is an approved DonorsChoose.org vendor and micro:bit reseller
- Teachers enter projects and request classroom materials
- Individuals and companies can donate money towards the purchase of those materials

Misc.

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

Bill's SIGCSE Blog Post
<http://bit.ly/sigcsemb>

Questions / Discussion