Oide

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Supporting the Professiona Learning of School Leaders and Teachers

Leaving Certificate Computer Science

Advanced Micro:bit Workshop

Workshop Overview

Session 1 10:00 - 11:45	Introduction Part 1 – Radio Comms & Serial Data Part 2 – Circuits
Tea/Coffee 11:45 – 12:00	
Session 2 12:00 - 13:30	Part 1 – Expanding the micro:bit Part 2 – The Wind challenge
Lunch 13:30 - 14:30	
Session 3 14:30 - 16:30	Part 1 – Arrays & Solar Panel demo Part 2 – Group Activity

Supports Provided by Oide

National Workshops	Webinars	School Support	Scoilnet
Skills Workshops	Collaboratives	Oide website	CompSci

Leaving Certificate Computer Science

The Expression of Interest process to join the CPD programme (phase 6) for LCCS is open:

http://tinyurl.com/LCCS24-EOI

Purpose for the Day

To further explore Computer Science as a discipline with emphasis on Embedded Systems (ALT 4)

To empower teachers to draw upon a range of pedagogical approaches for teaching LCCS so that they can confidently develop their own advanced units of work.

Key Messages

There are many ways to navigate through the LCCS specification.

LCCS can be mediated through a constructivist pedagogical approach.

ALTs provide an opportunity to teach theoretical aspects of LCCS.

Group work is a key feature in the teaching, learning and assessment of LCCS.

Digital technologies can be used to enhance collaboration, learning and reflection.

Advanced micro:bit features can be used to introduce traditionally challenging (threshold concepts) at an earlier stage.

Learning Outcomes

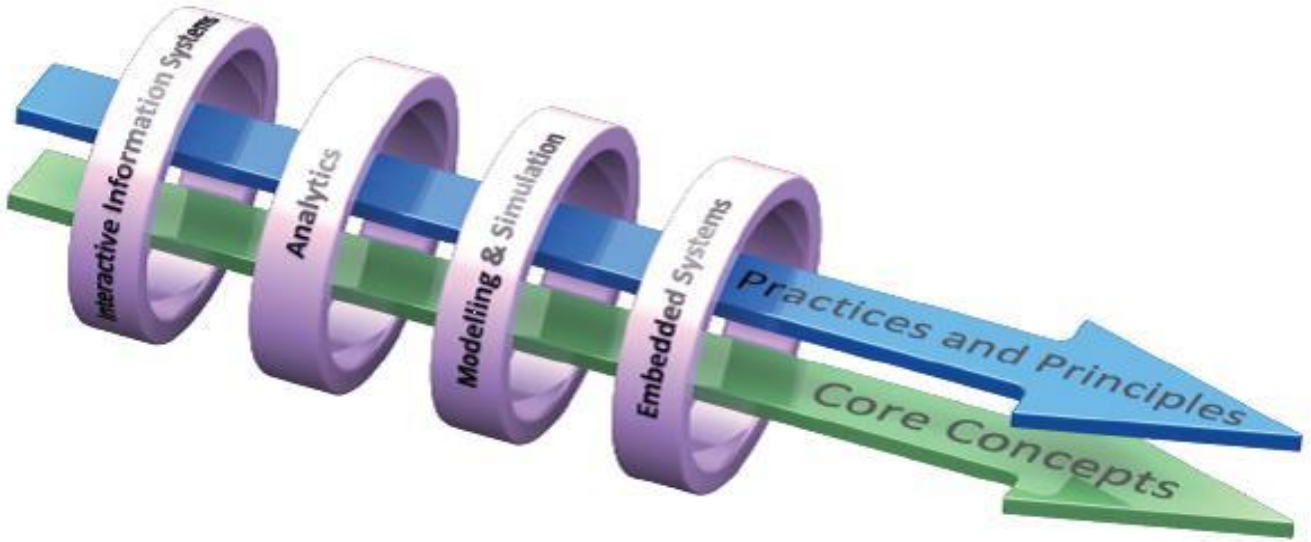

Figure 4: Structure of Leaving Certificate Computer Science

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Session 1: Radio Communications

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By the end of this session..

Participants will be enabled to…

…discuss the principles underlying radio communication on the micro:bit.

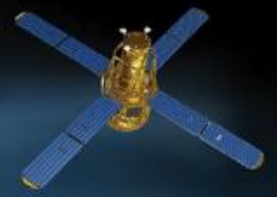
…illustrate the coding process for radio communication on the micro:bit, specifically focusing on incorporating temperature data into the code.

…demonstrate the process of graphing received data from micro:bit radio communication and saving it as a CSV file.

…enabled to complete a task involving radio communication on the micro:bit: including viewing received data and downloading the data to a CSV file

Channel Frequency Table

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	446.00625	5	446.05625
2	446.01875	6	446.06875
3	446.03125	7	446.08125
4	446.04375	8	446.09375

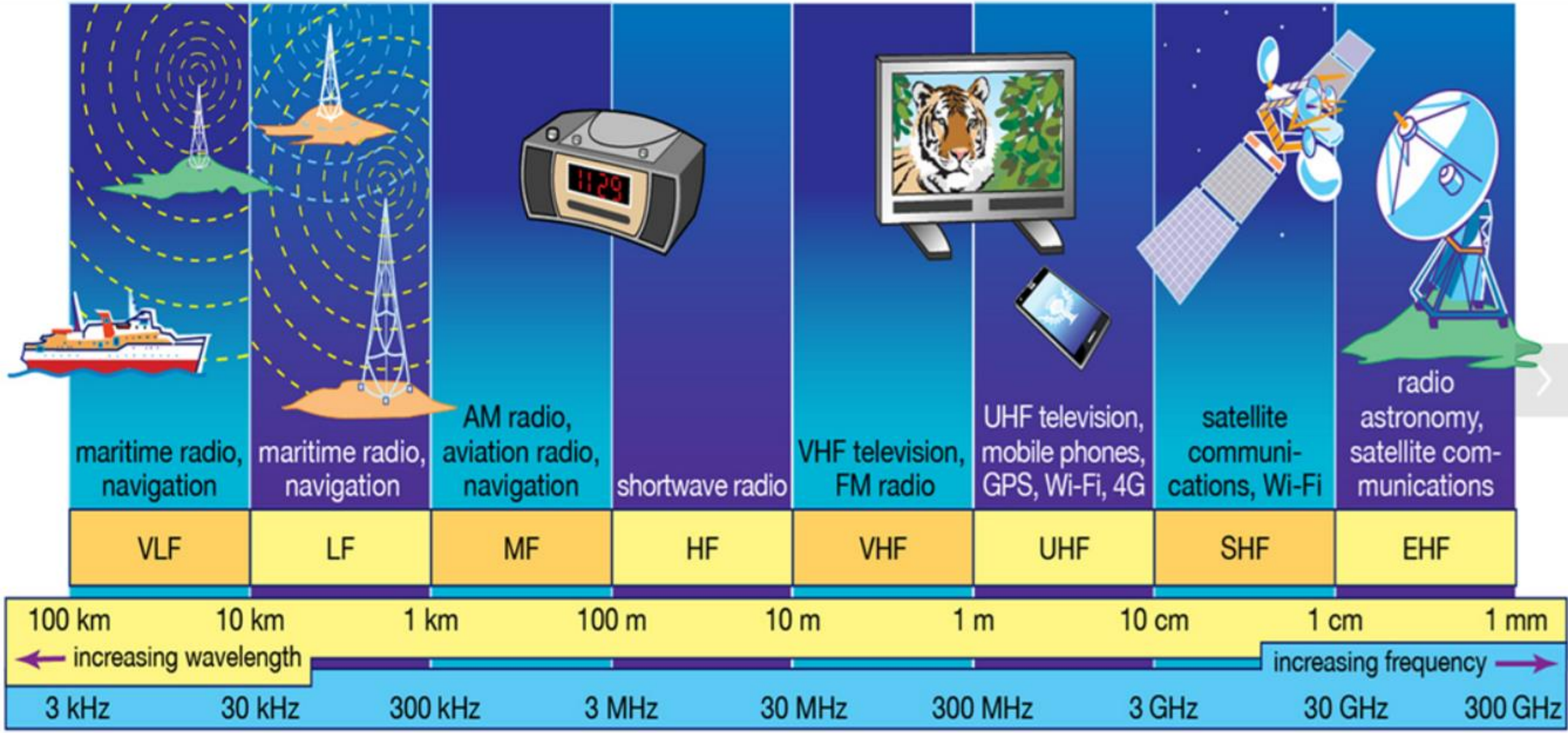


BBC Micro:bit

Band: (UHF) 2.4GHz ISM (Industrial, Scientific and Medical)

Frequency Range: 2.4GHz - 2.41GHz

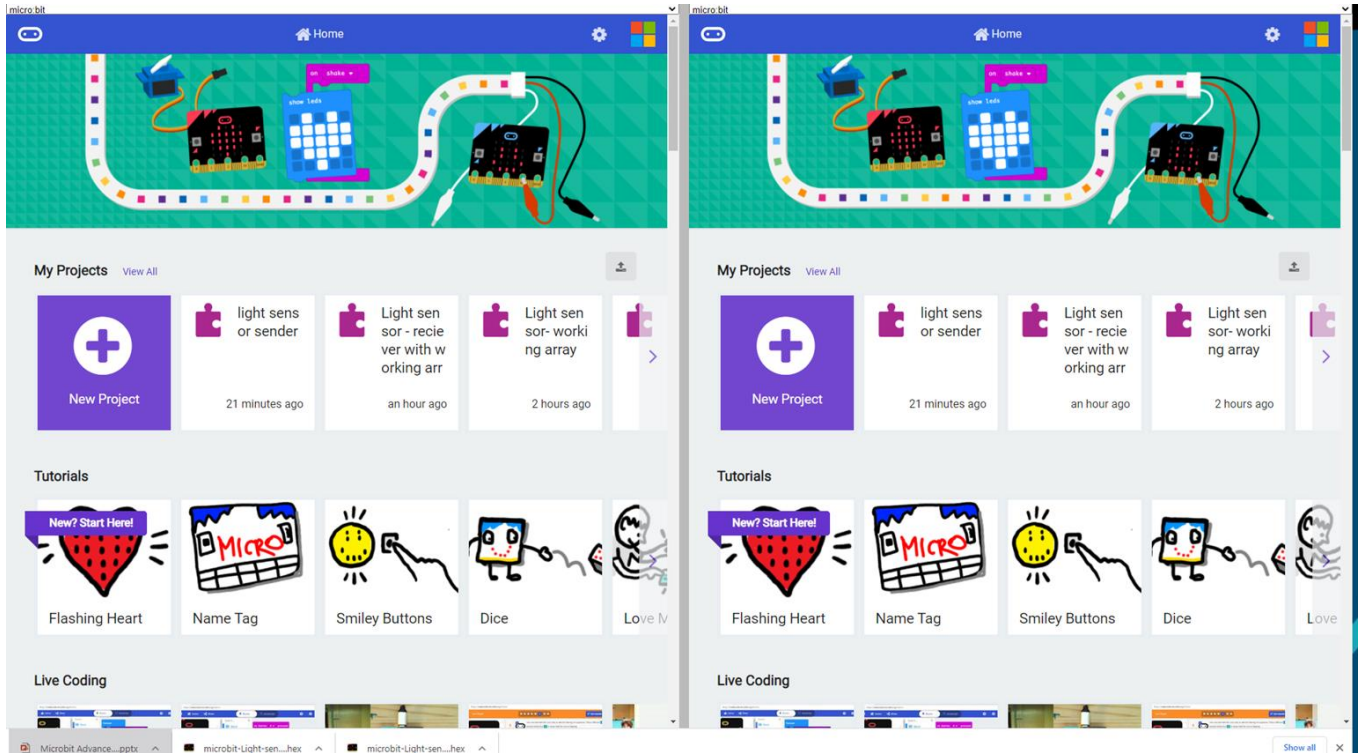
Image by NASA: Source IRTS Study Guide 2023



Radio Communication

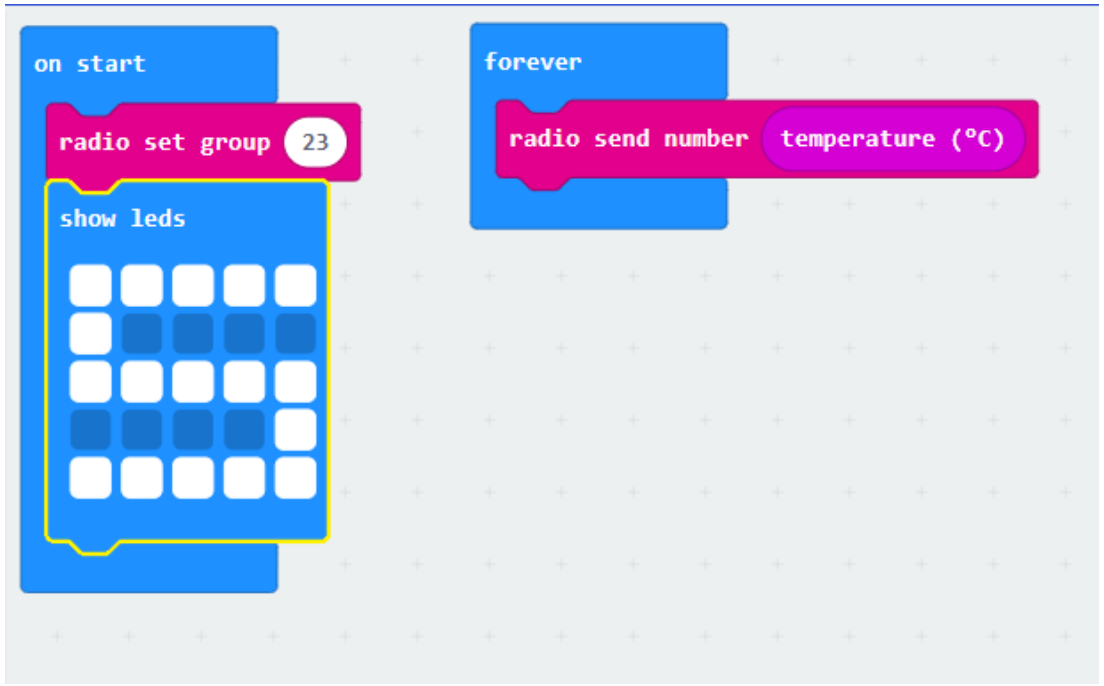
[Make Code Multi Editor]

https://makecode.com/multi#

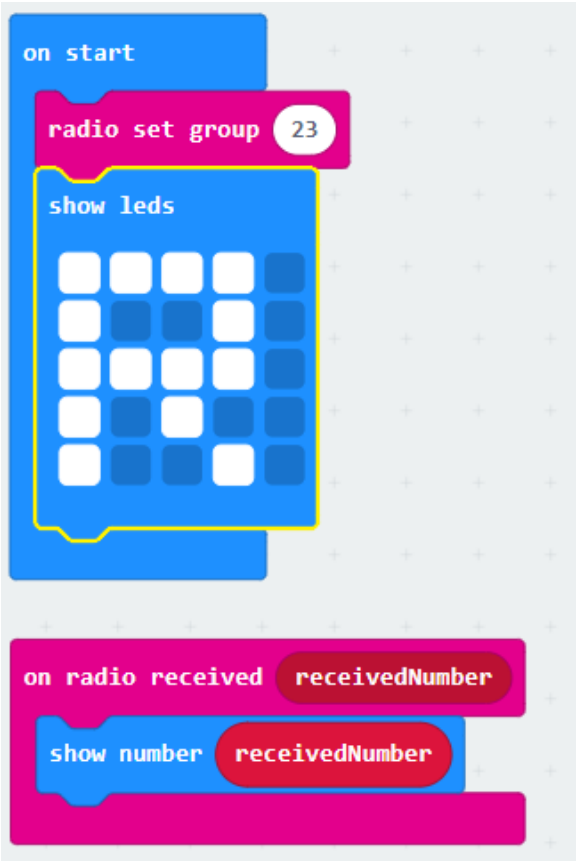


Radio Communication

SENDER CODE:



RECEIVER CODE:



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Serial Communication

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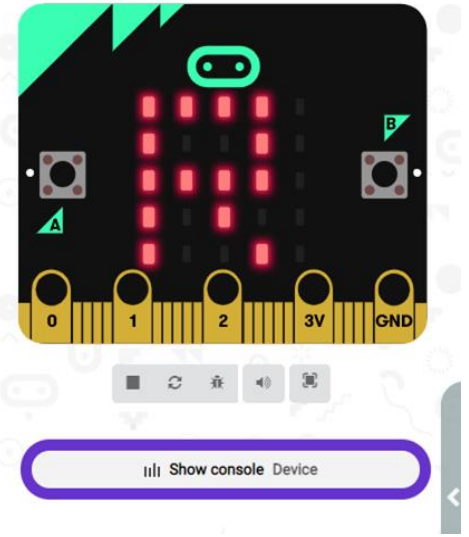
Serial Communication

https://makecode.microbit.org/



Group Task

Learning Activity Instructions

Part 1:

Send light level via radio signal from one micro:bit to another.
If the light level received is below 128 then get the receiver micro:bit to display that it is dark otherwise display it is bright.
Consider the design of your display.
Test to ensure this works on the virtual micro:bits.

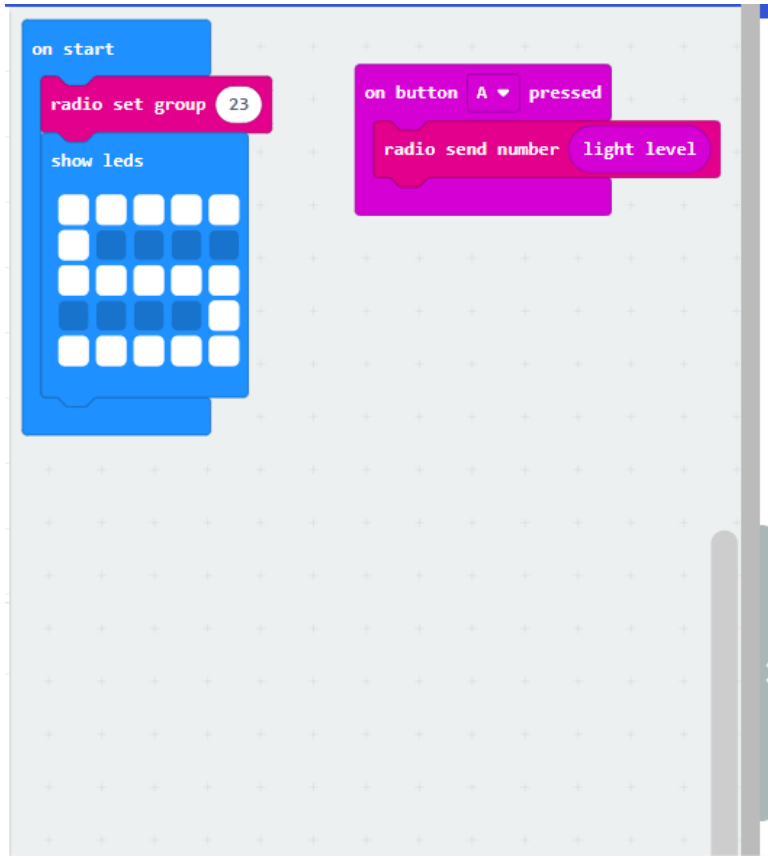
Part 2:

Open the receiver code in the normal micro:bit environment or in the offline version.
Now update the code so that the received data is sent across the serial port.
Don’t forget to plug in and pair your device, then download the code!
View the live data on the simulator and download the .csv file of data.

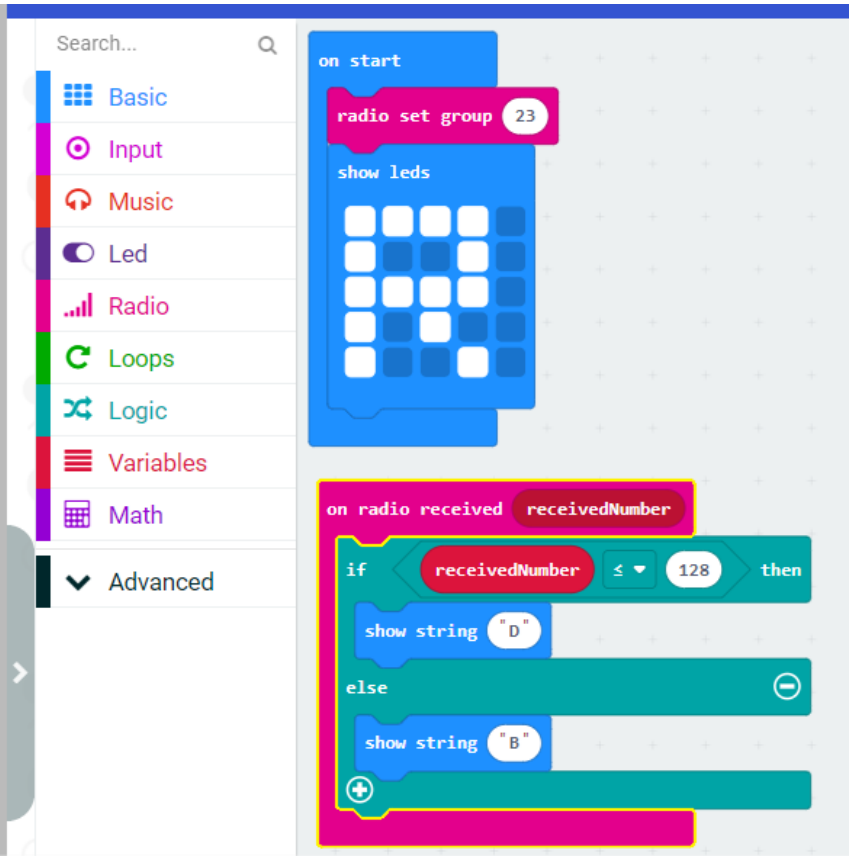
Solution – Part A

Oide

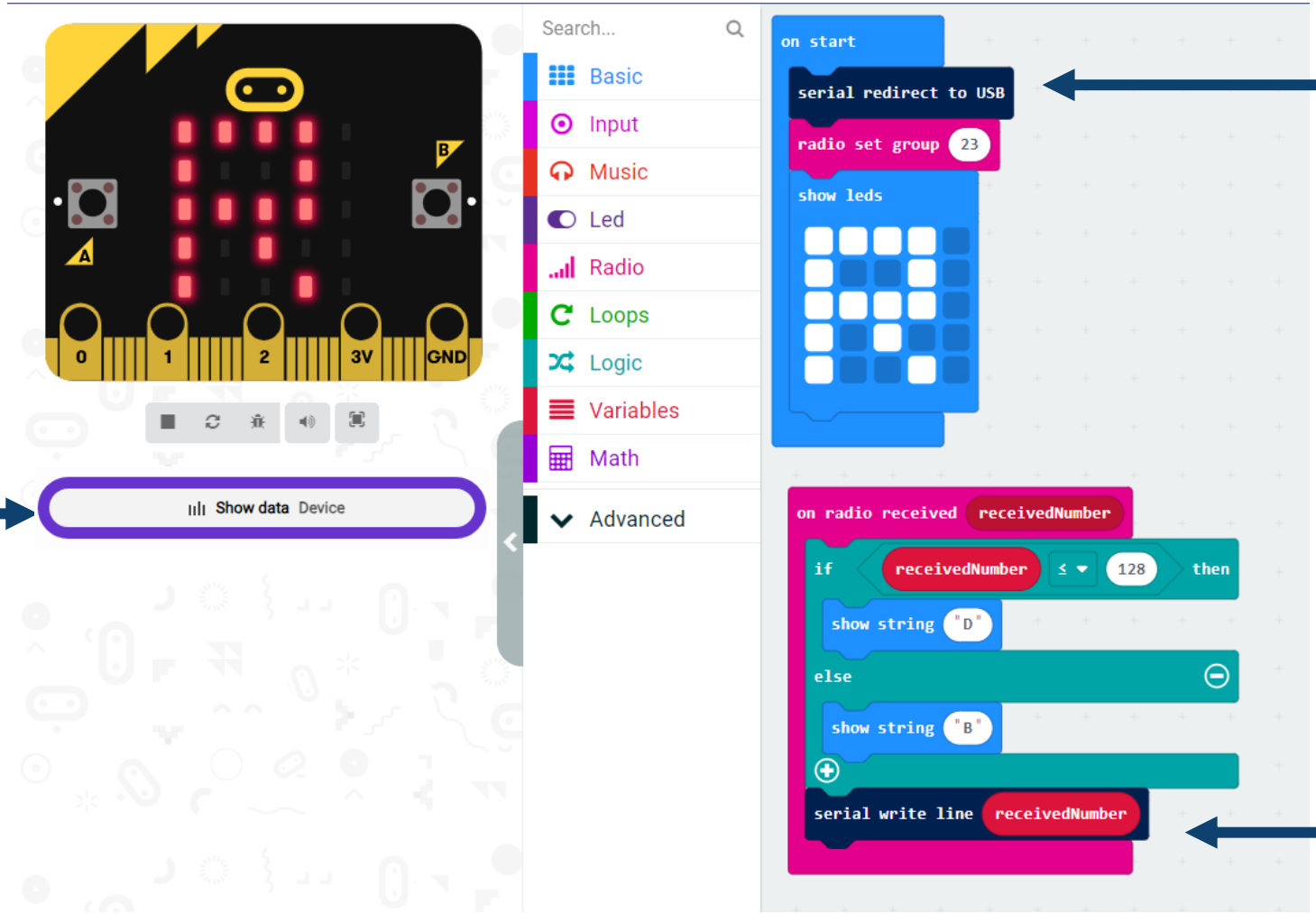
SENDER



RECEIVER



Solution – Part B



This takes a few minutes to display but then allows us to track the live data.

Added code to allow transmission via USB.

Added code to allow send the data down serial.

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Circuits

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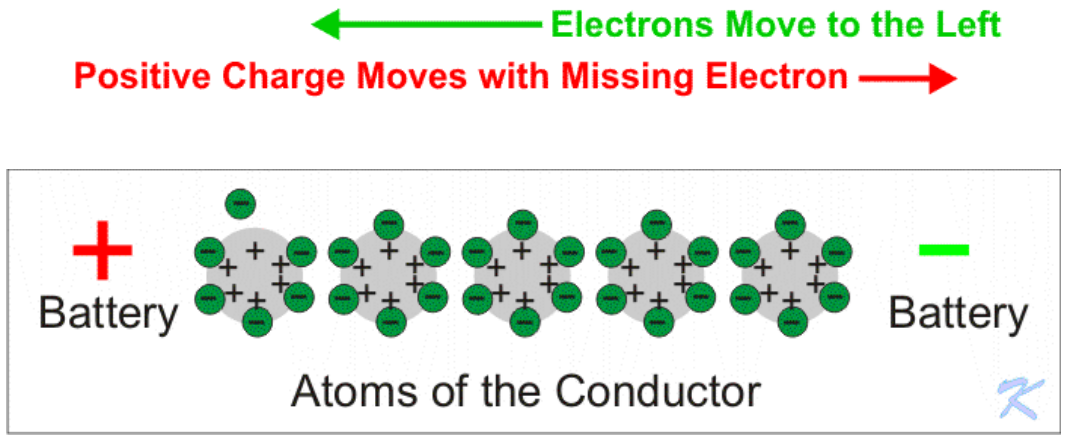
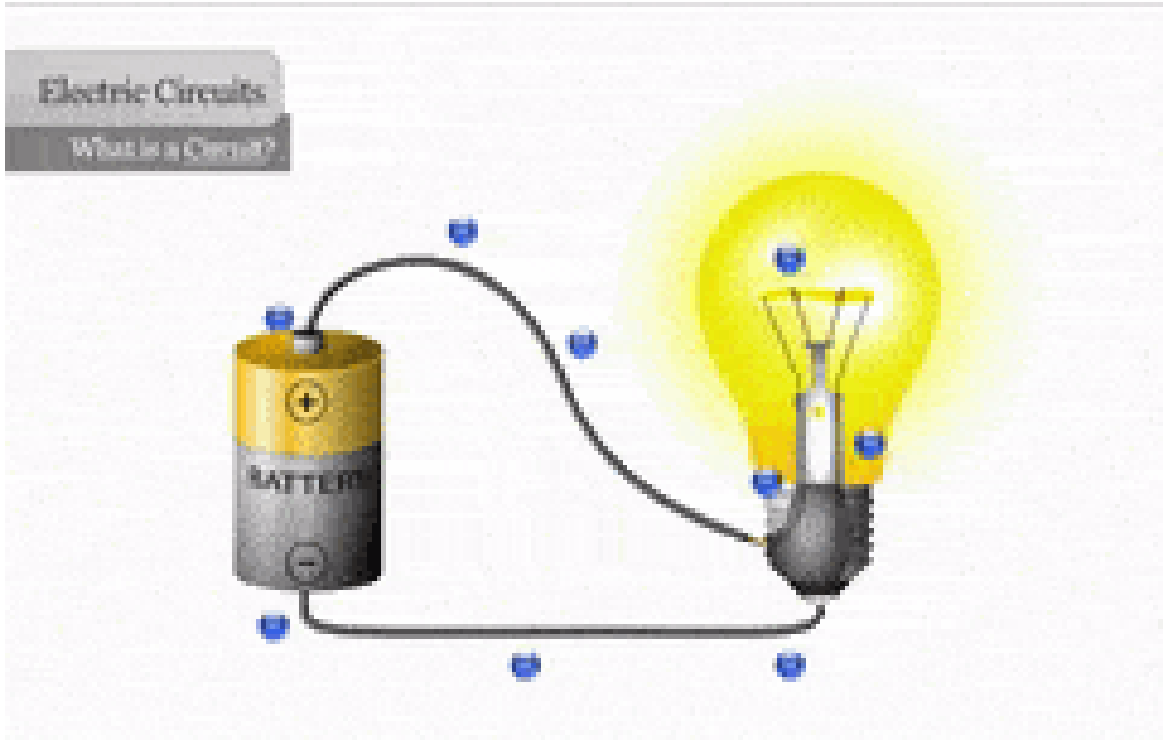
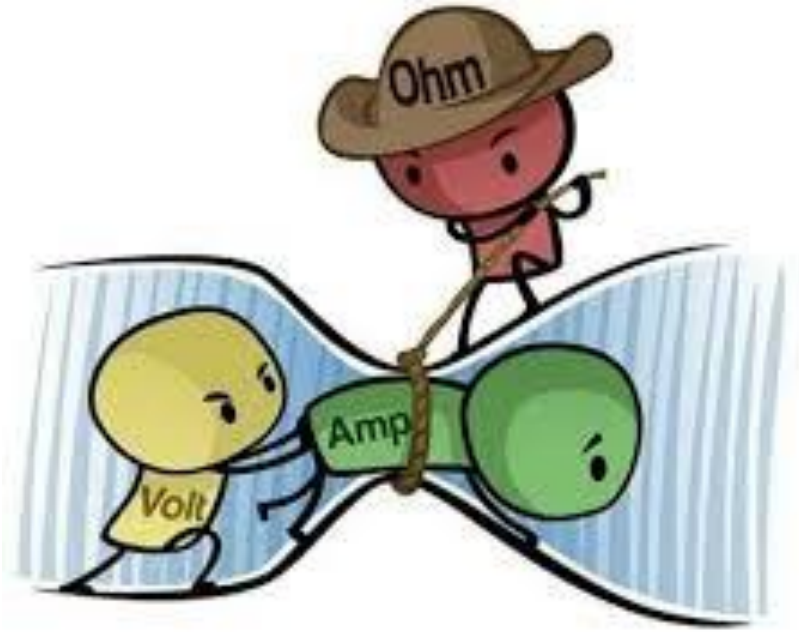
Circuits

Electricity flows through the circuit from negative to positive. The circuit must be complete for the current to flow.



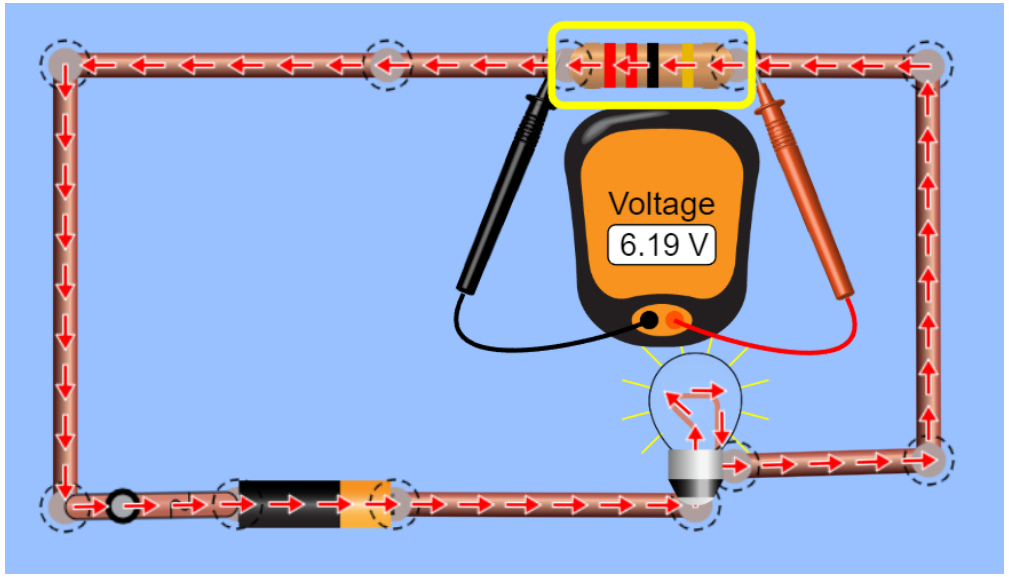


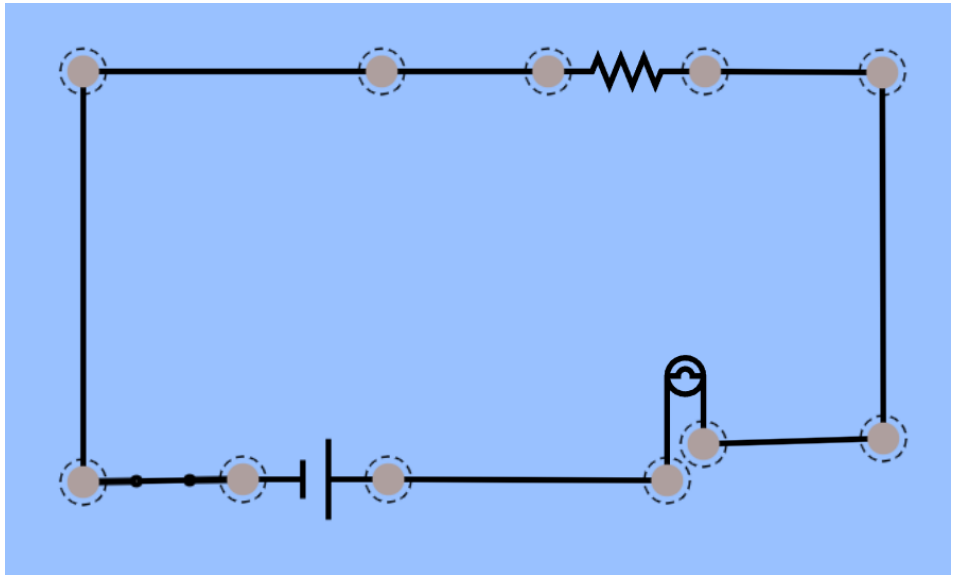
Voltage, Current and Resistance



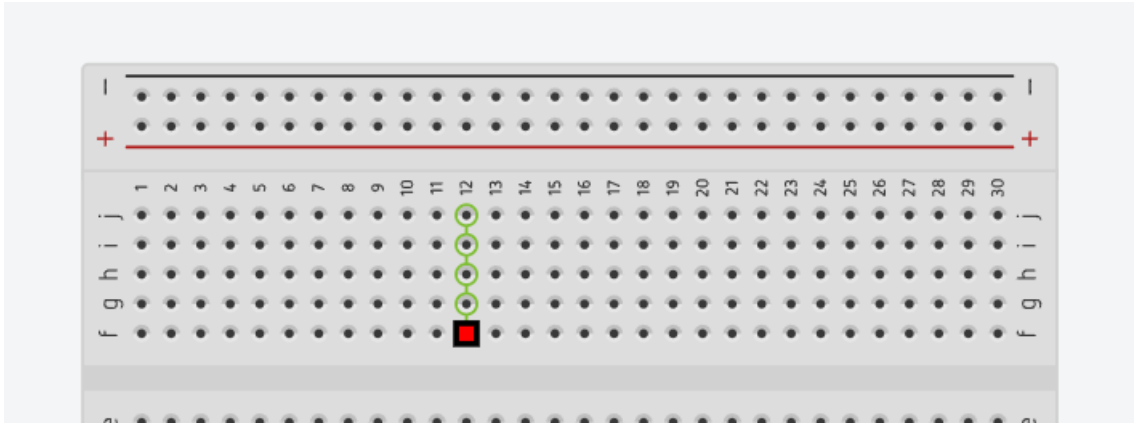
https://ohmify.com/courses/learn-electronics-1/

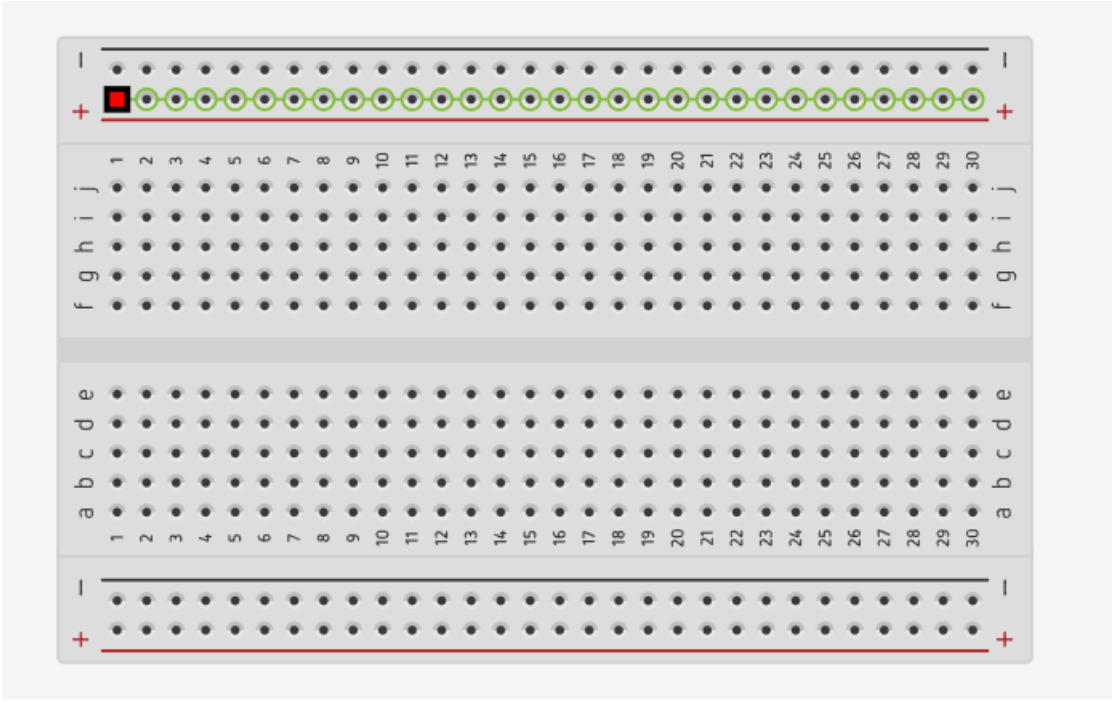
Basic circuits



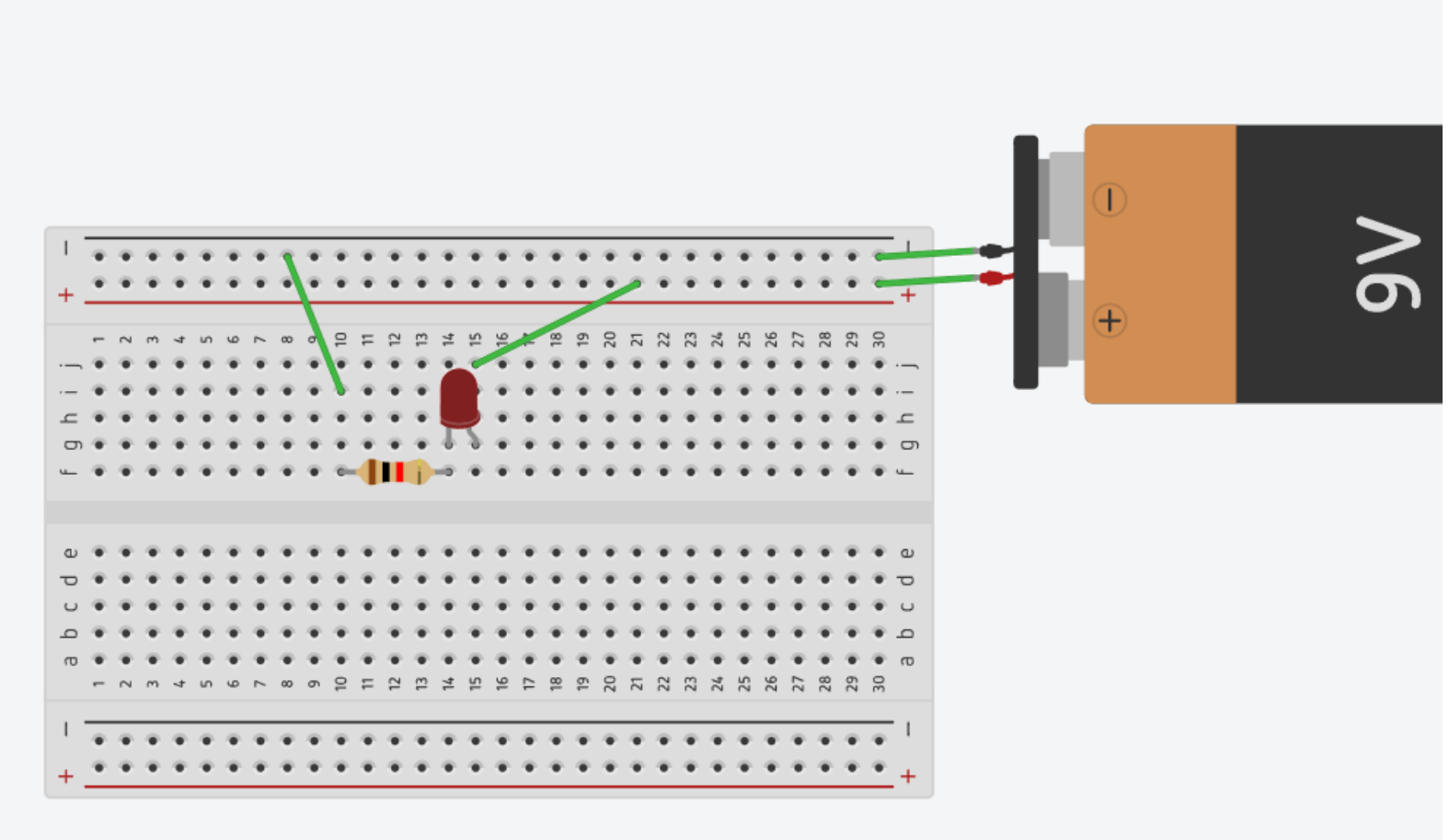


Tinkercad and breadboards





Building a simple circuit using a breadboard



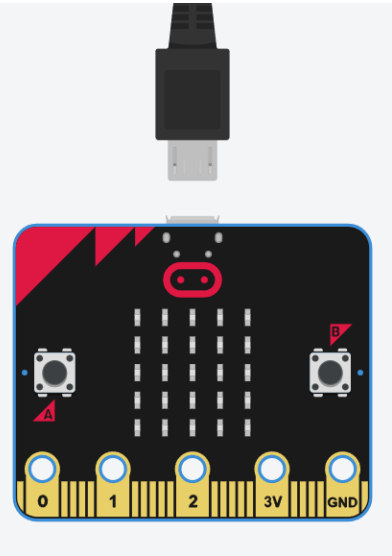
Group Activity Instructions

Go to tinkercad.com

Recreate the simple circuit.

Investigate what happens if…

- The LED is reversed?
- The resistor is placed on the other side of the LED?
- The resistance value is changed?

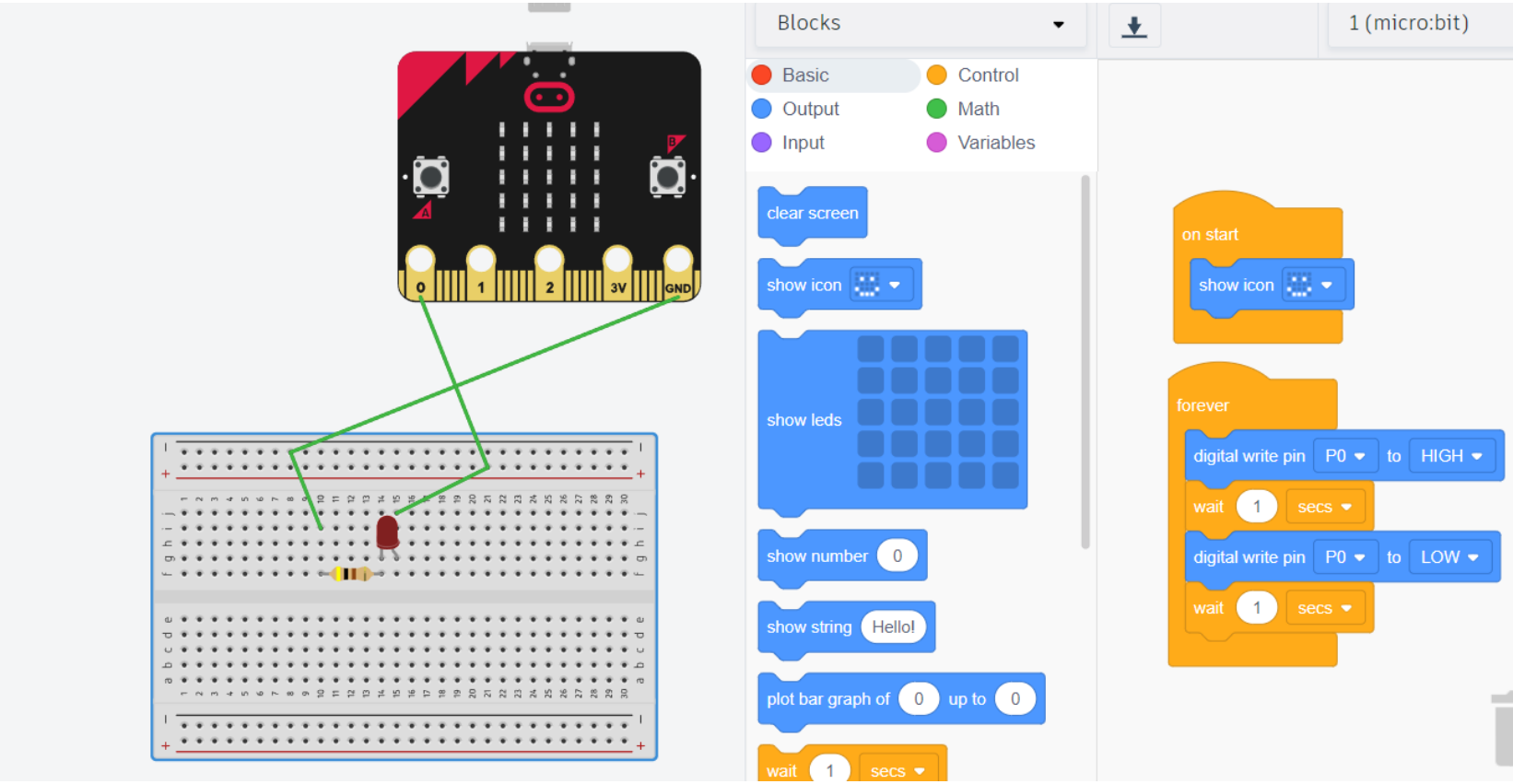


Modify

Using a **virtual micro:bit**, try get the LED to flash on and off.

Group Activity: Breakout

Solution


Blocks
1 (micro:bit)
Basic
Control
Output
Math
Input
Variables
clear screen
show icon
show leds
show number 0
show string Hello!
plot bar graph of 0 up to 0
wait 1 secs
on start
show icon
forever
digital write pin P0 to HIGH
wait 1 secs
digital write pin P0 to LOW
wait 1 secs
0
1
2
3V
GND

Oide

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Session 2:
Expanding the Micro:bit with Peripherals and Sensors

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By the end of this session..

Participants will…

…learn how to physically construct and control electronic circuits using a breadboard

…understand the colour code system used on resistors

…connect a light sensor and learn how to perform an analog reading

…explore other capabilities of the micro:bit such as motors, motor driver boards, and other sensors.

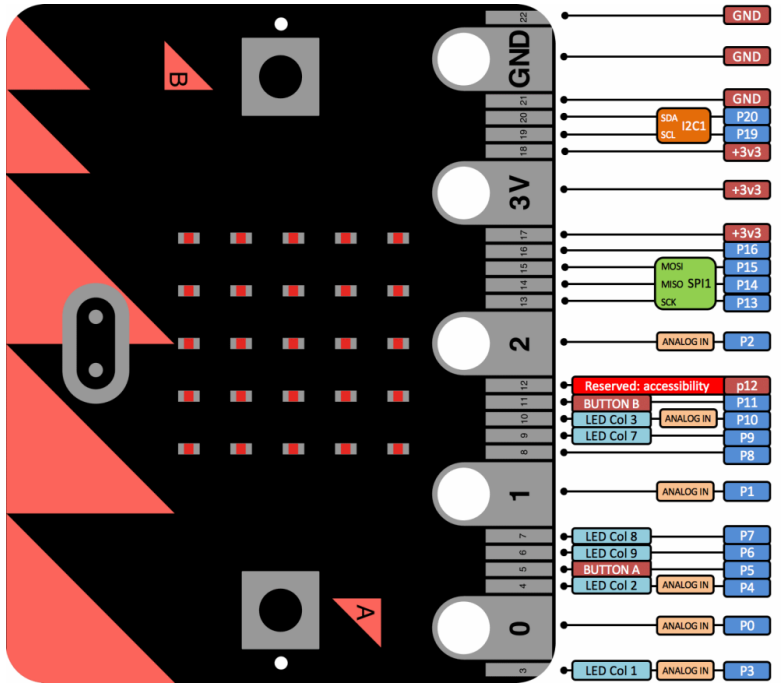
…generate a voltage by blowing on a fan blade and measure this voltage

Breakout Pins

The micro:bit is capable of outputting 3v and 90mA in order to power external devices.

The micro:bit has 25 pins which can be connected to sensors, motors and other devices.

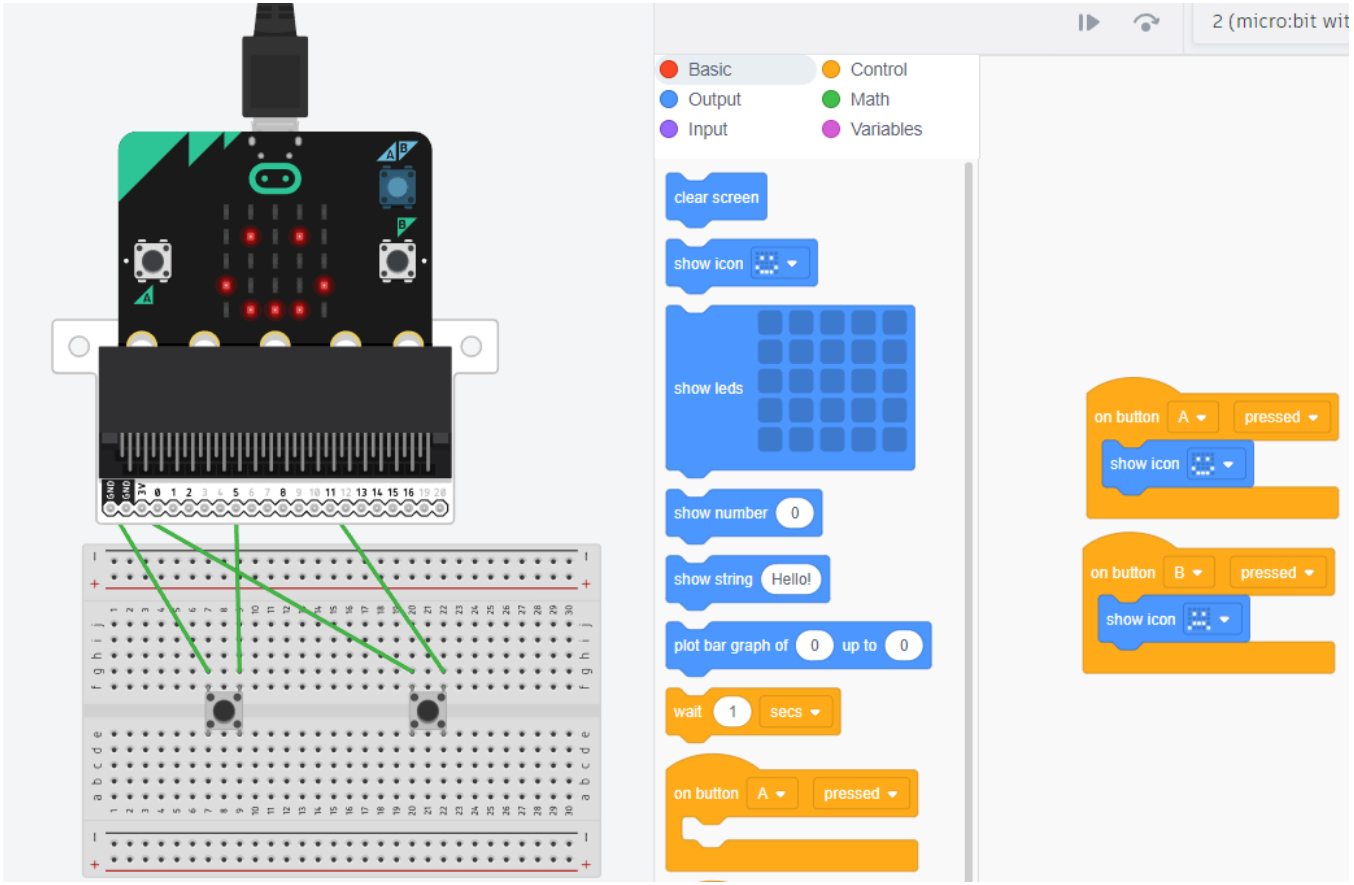
Some pins have dedicated functions and limitations.



Breakout Board and Breadboards

https://kitronik.co.uk/products/5601b-edge-connector-breakout-board-for-bbc-microbit-pre-built

Say "Hello" to the micro:bit

- 

TINKERCAD

Make Physical

Reading resistors

- https://www.calculator.net/resistor-calculator.html

10 kΩ ±5% (J)

Number of Bands: 4 Band

1st Band Color:

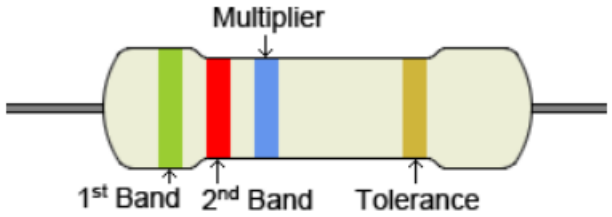
black ● brown ○ red ○ orange ○ yellow ○ green ○ blue ○ violet ○ grey ○ white

2nd Band Color:

black ● brown ○ red ○ orange ○ yellow ○ green ○ blue ○ violet ○ grey ○ white

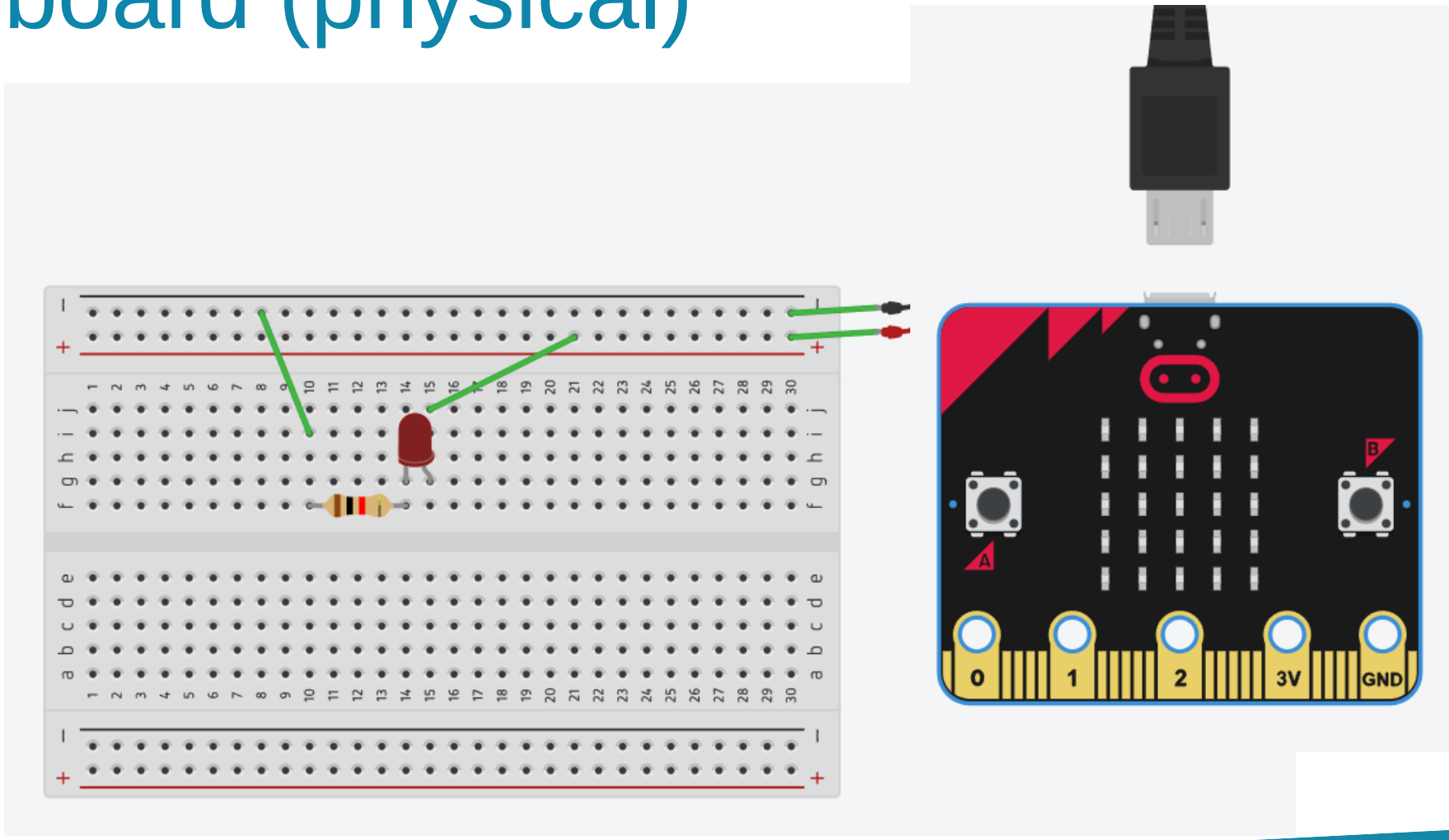
Multiplier Color:

black ○ brown ○ red ● orange ○ yellow

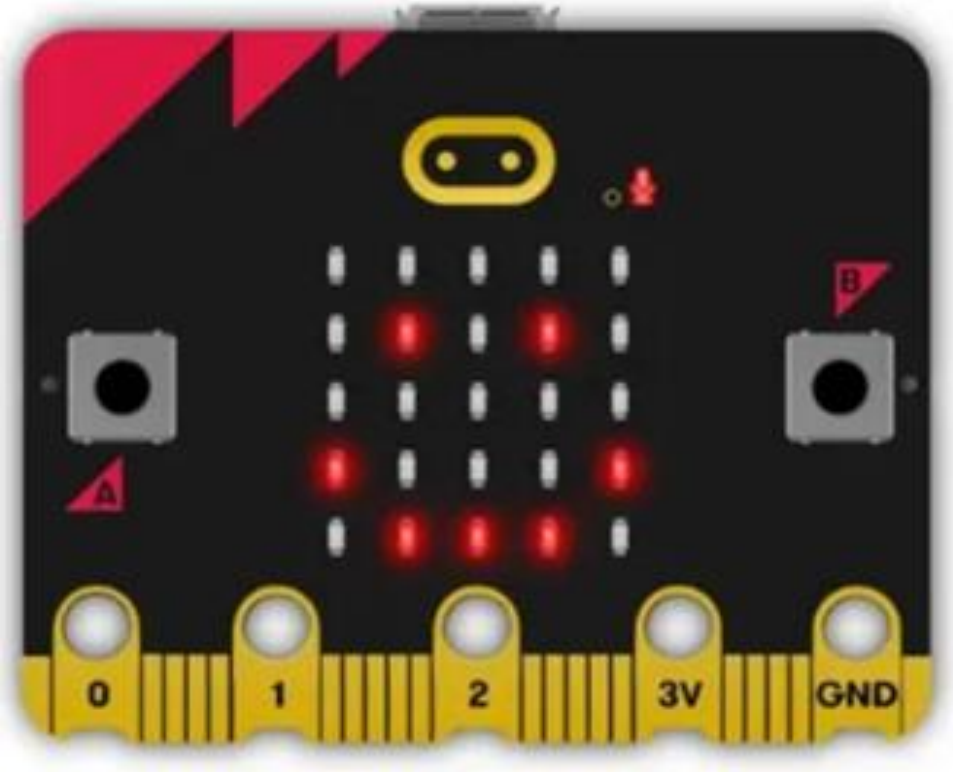


Color	1st, 2nd Band Significant Figures	Multiplier	Tolerance
Black	0	× 1	
Brown	1	× 10	±1% (F)
Red	2	× 100	±2% (G)
Orange	3	× 1K	±0.05% (W)

Building a simple circuit using a breadboard (physical)



Using a sensor

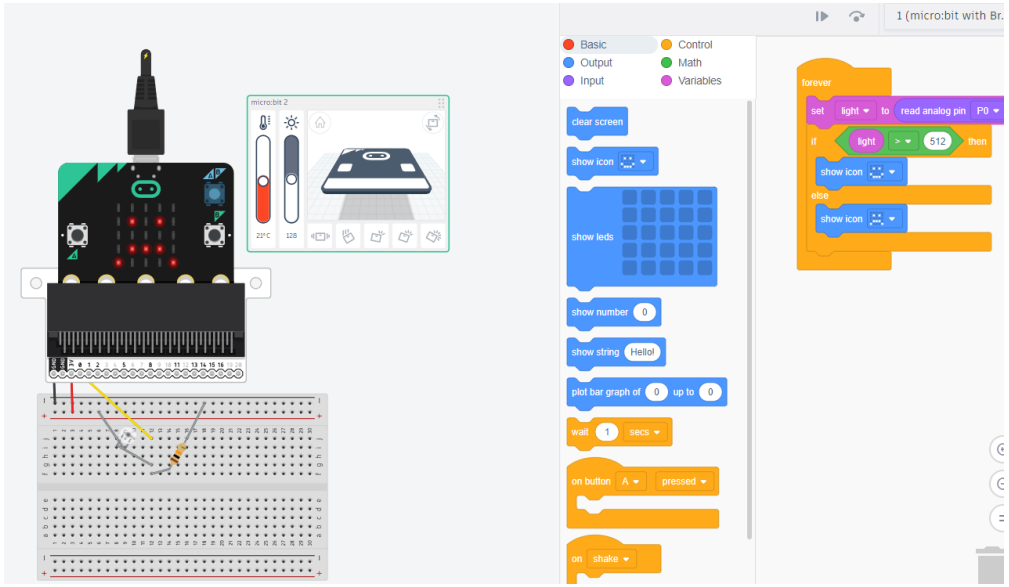


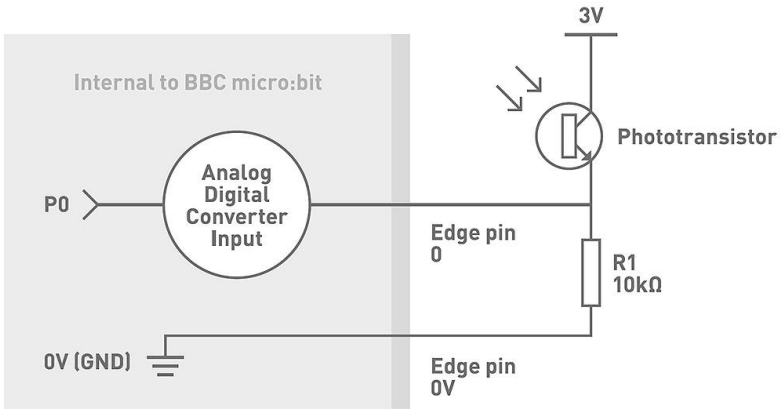
The data to/from your sensor will usually connect to pin 0, 1 or 2.

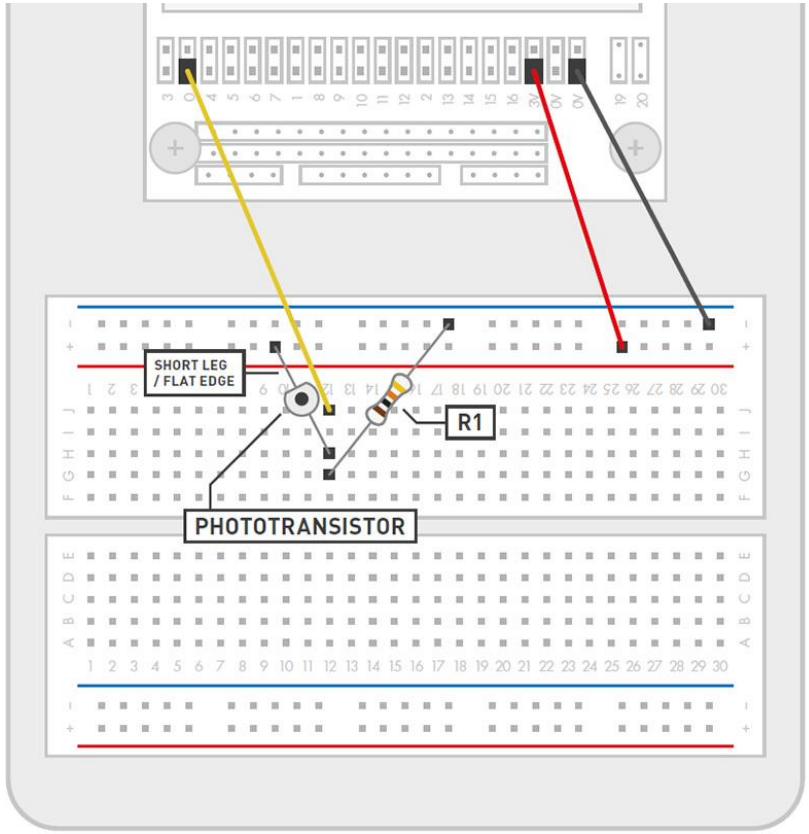
The sensor will be powered through connection to the powered, 3V pin.

Connecting the sensor to ground completes the circuit and allows electricity to flow.

Using a light sensor and analog inputs





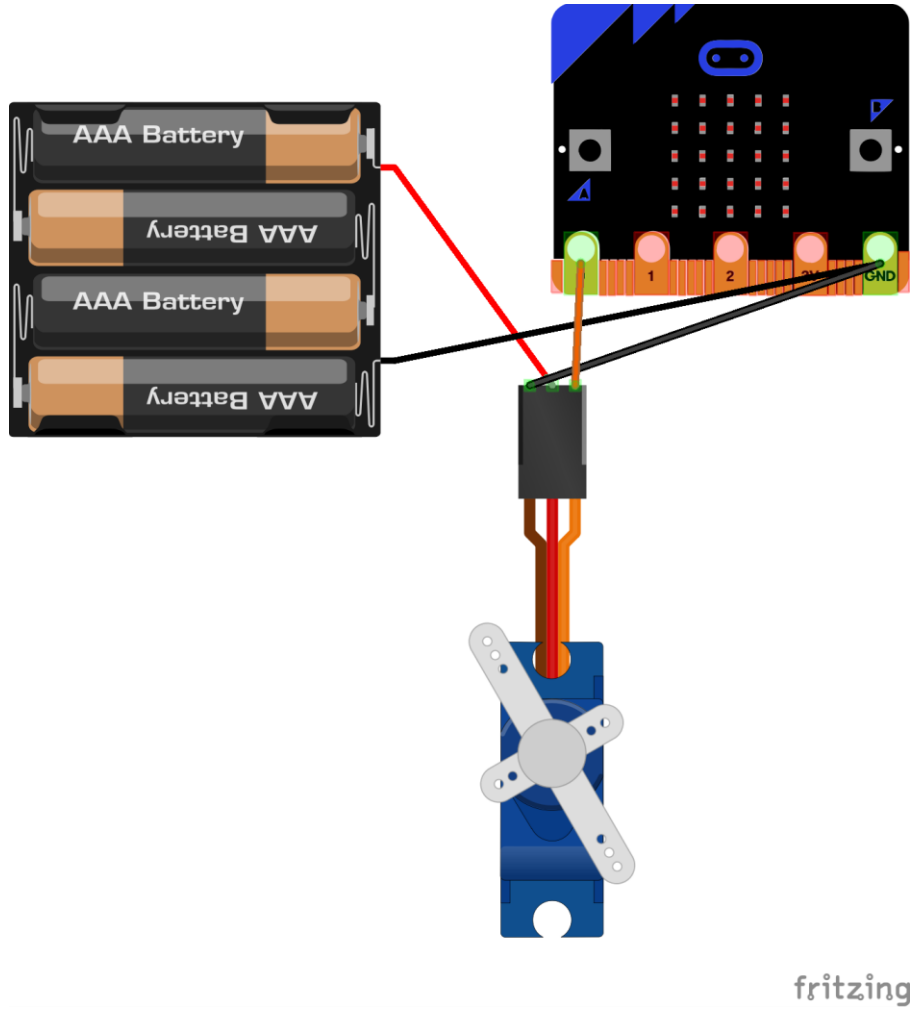


TINKERCAD

Make Physical

Other capabilities of the Micro:Bit

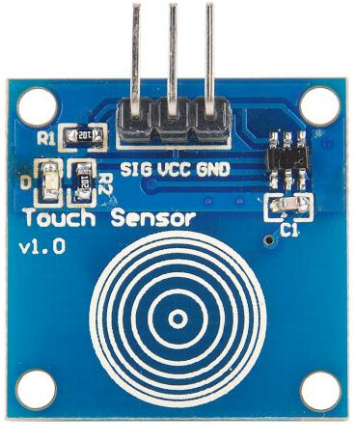
- Sensors
- Basic DC Motors
- Servo Motors
- Motor Driver Boards

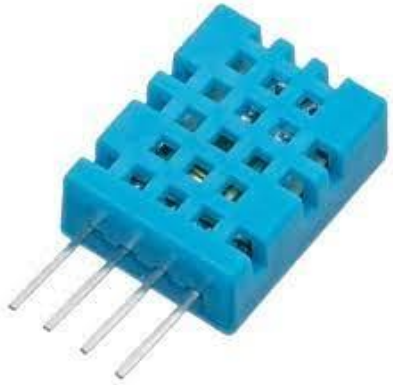


Sensors and Peripherals

Sensors and peripherals usually have 3 pins but can have 4, or sometimes even 5.

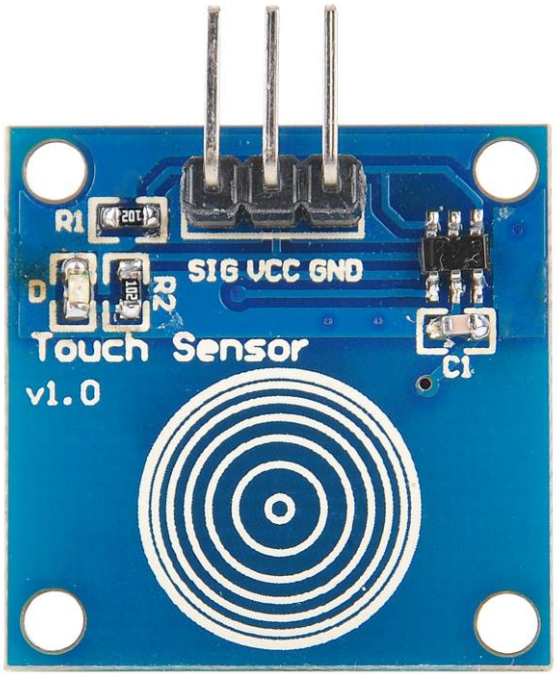
They usually have a power, ground and signal or data connection.





Sometimes the extra pins can be ignored, sometimes they are necessary.

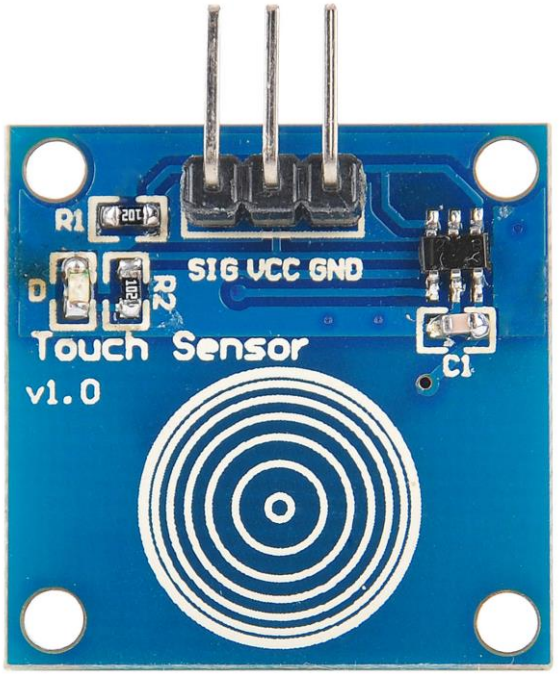
Simple connections - Power



Power is labelled by VCC, or + (plus)

(sometimes it is the only pin not labelled).

Simple connections - Data/Control

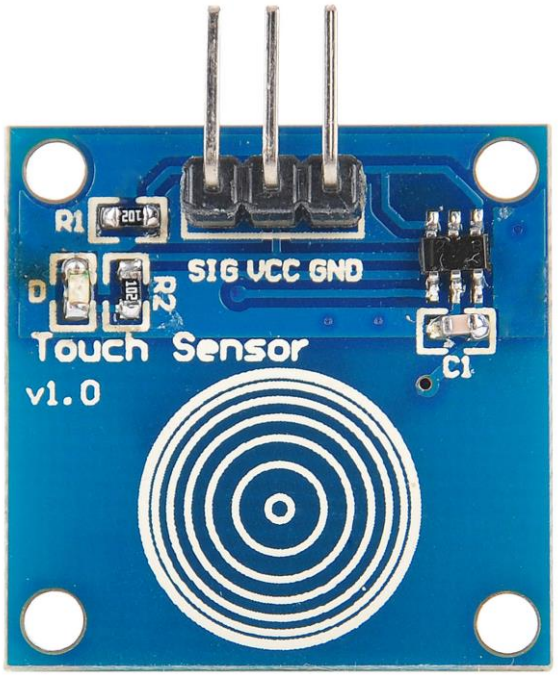


The data pin is usually labelled Sig, S, or D.

The data to/from the sensor can either be digital (zero or one) or analog (any number within a certain range).

Pins labelled DO and AO correspond to data out and analog out, respectively.

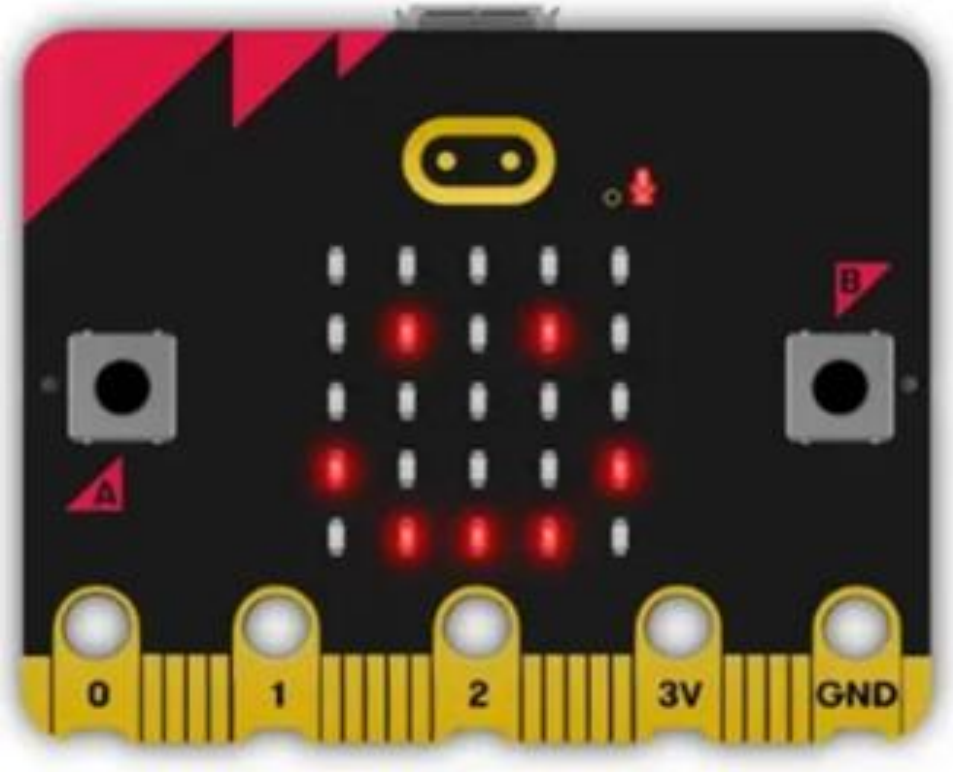
Simple connections - Ground



The ground pin is usually labelled Gnd, G, or - (minus).

This is required to complete the circuit and let electricity flow through the sensor.

Simple connections - Recap



The data to/from your sensor will usually connect to pin 0, 1 or 2.

The sensor will be powered through connection to the powered, 3V pin.

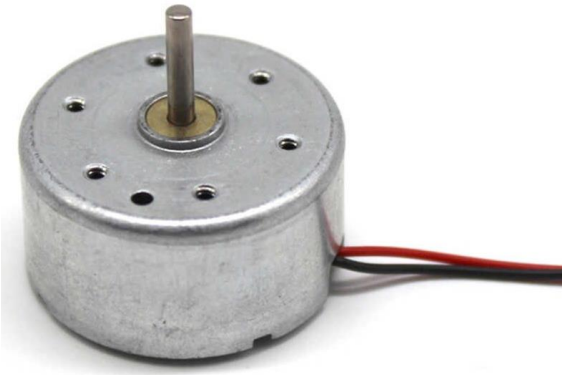
Connecting the sensor to ground completes the circuit and allows electricity to flow.

Basic Motors

DC Motors convert electric energy into kinetic energy.

Power ratings typically range from 3 to 6 volts for educational/recreational motors.

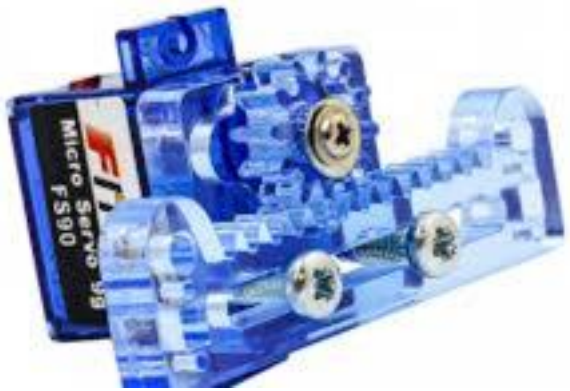
They are not polarized and can be reversed easily.



Servo Motors

Servo motors can take input from the micro:bit and are available in 180 and 360 degree variants.

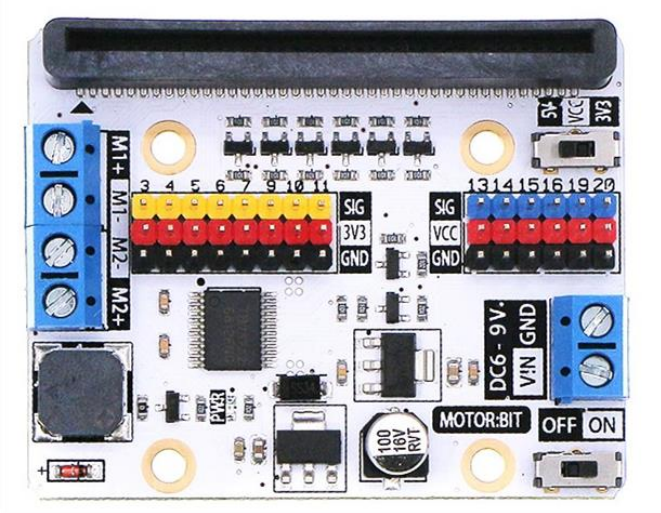
3 volt Servos are available that are specifically designed for the MB.



Motor Driver Boards

Motor Driver boards enable the MB to driver more powerful motors.

They do this by taking an external power input of 6 – 10.8 volts. The boards also provide pins which can used for sensors or lower powered servo’s.



Oide

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Wind Power Challenge

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COMPUTER SCIENCE

By the end of this activity..

Participants will …

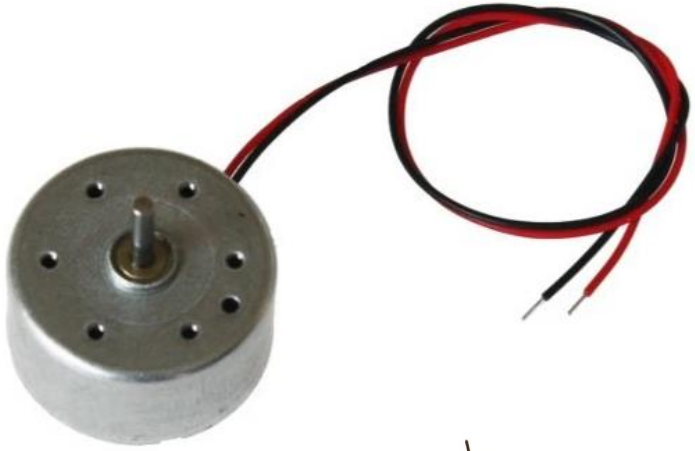
…generate a voltage by blowing on a fan blade to spin a motor.

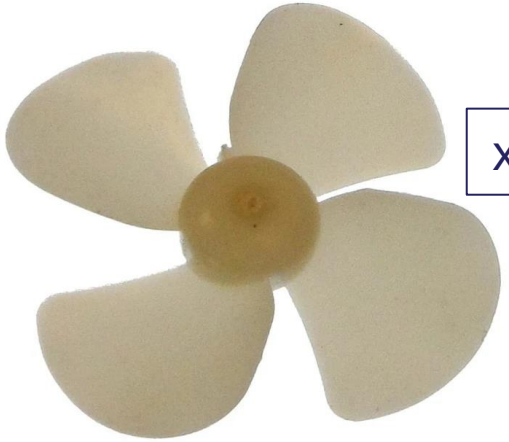
…read the voltage using an analog input pin on the BBC micro:bit

…keep track of the highest reading

Components

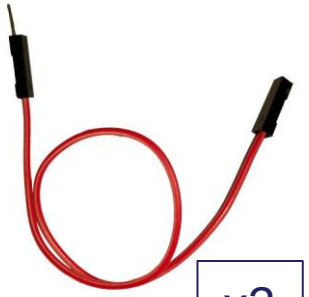
x1





x1

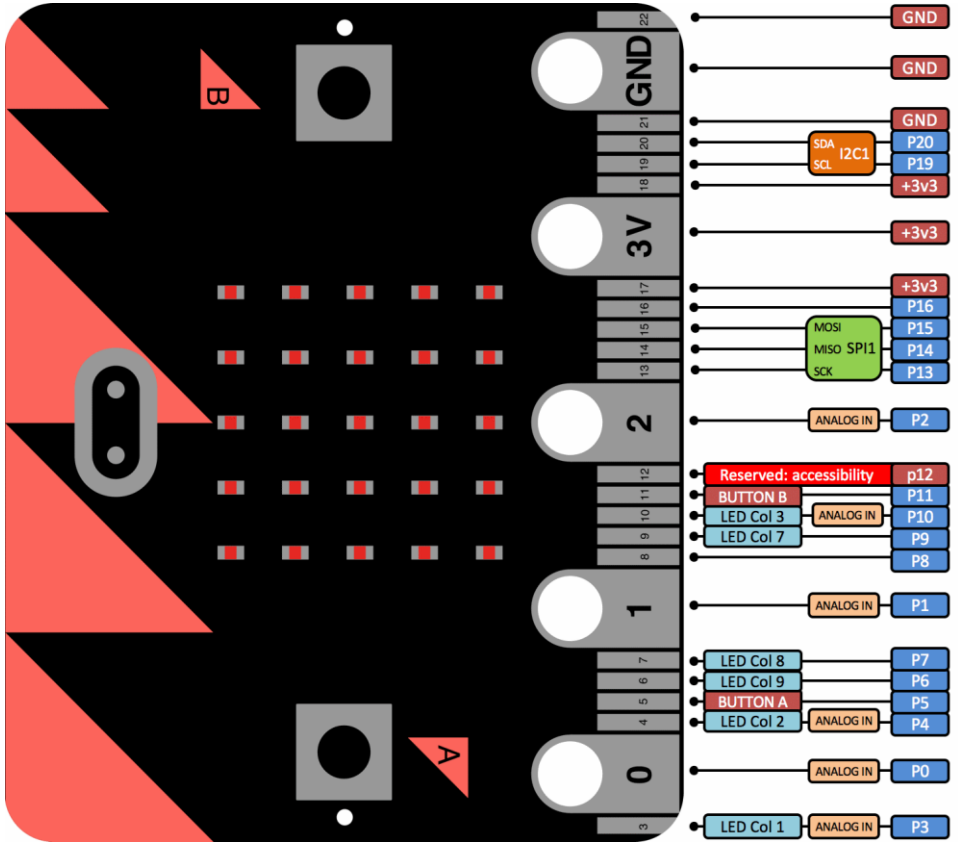
x2



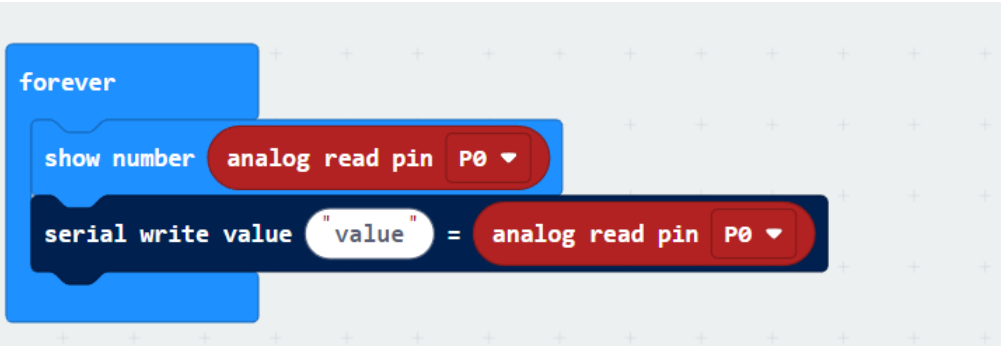
x2

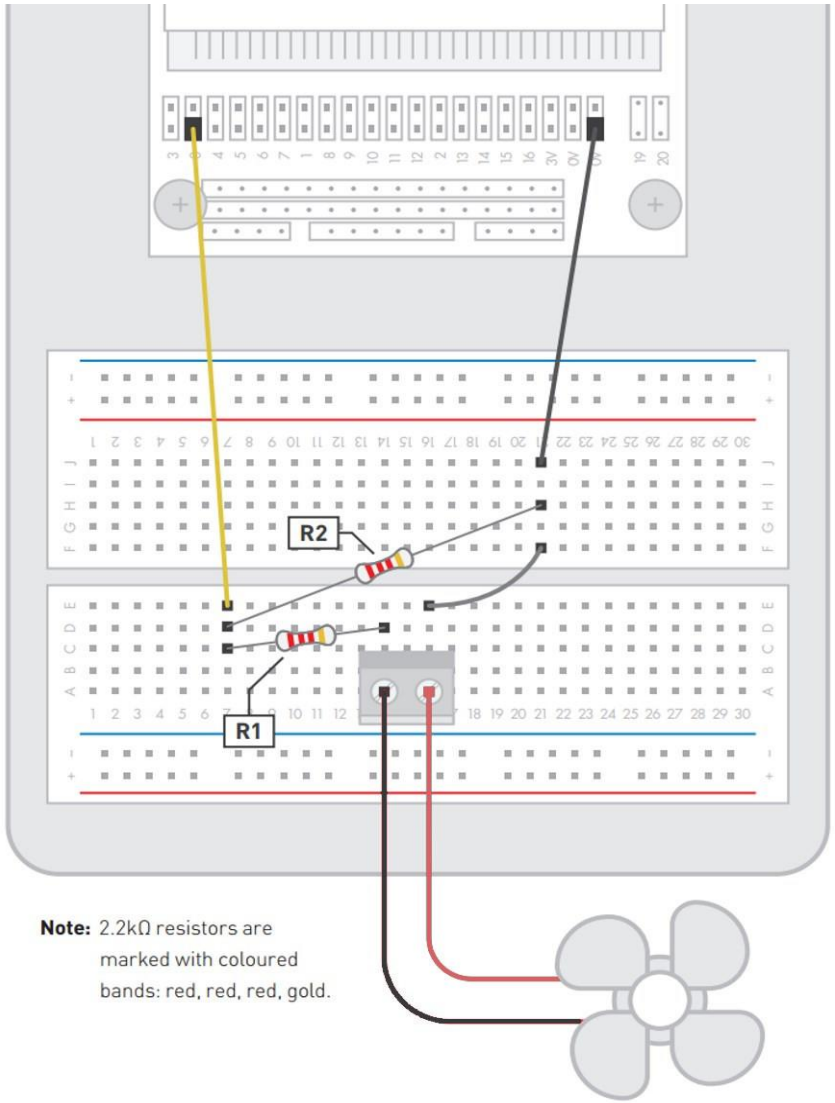
x1

Breakout Board/Breadboard



Wiring Diagram





Instructions

Step 1

- Code and test in simulator
- Read the voltage via the analogue input pin on the micro:bit.
- Keep track of the highest value read.
- Display the highest value on button press.

Step 2

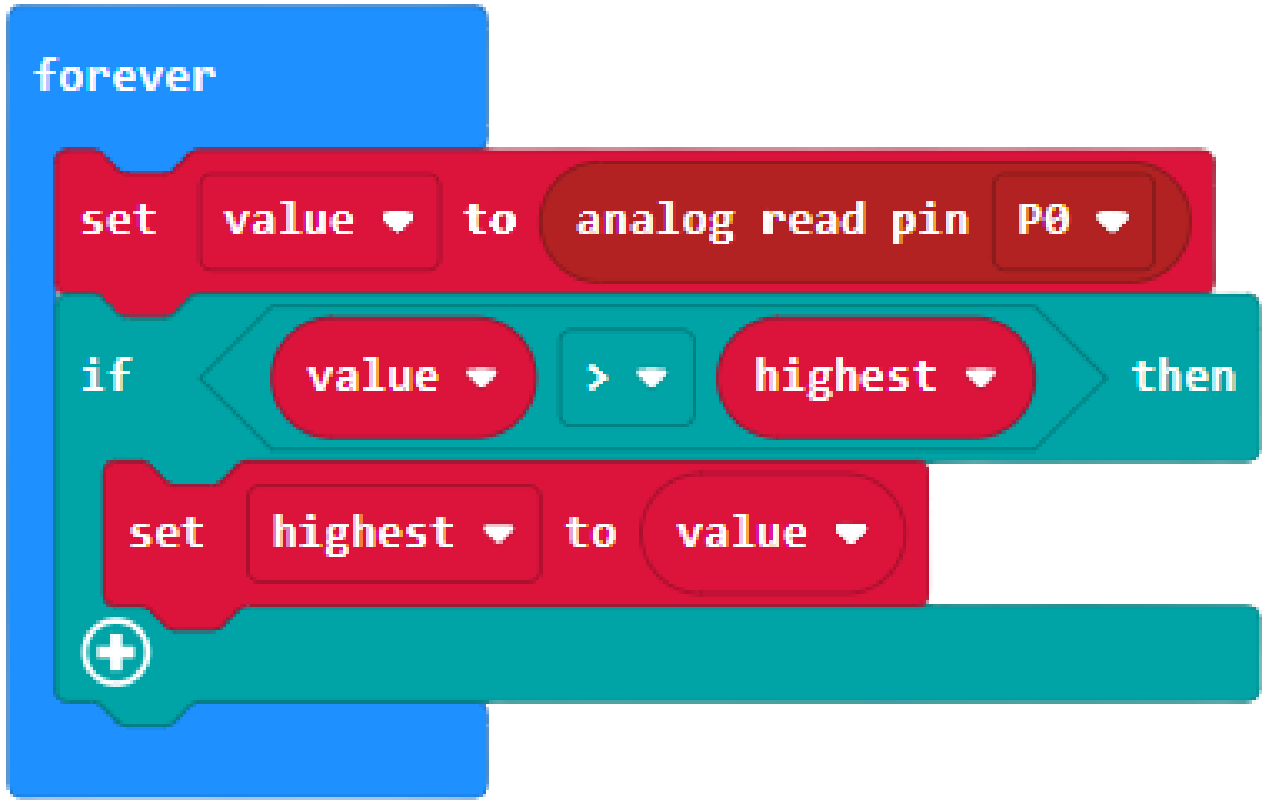
- Wire up the physical micro:bit
- Using the wiring diagram as a guide, connect the physical micro:bit to the breadboard to complete the learning activity.

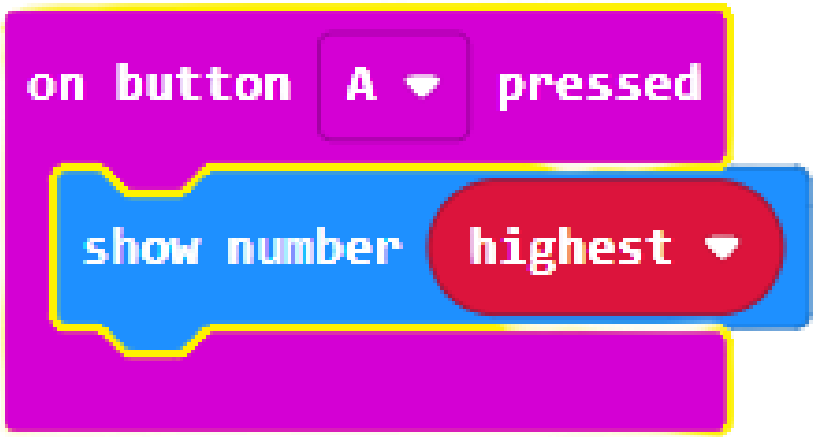
Extension activity

- Wire up an LED and get it to turn on and off based on the wind speed generated.

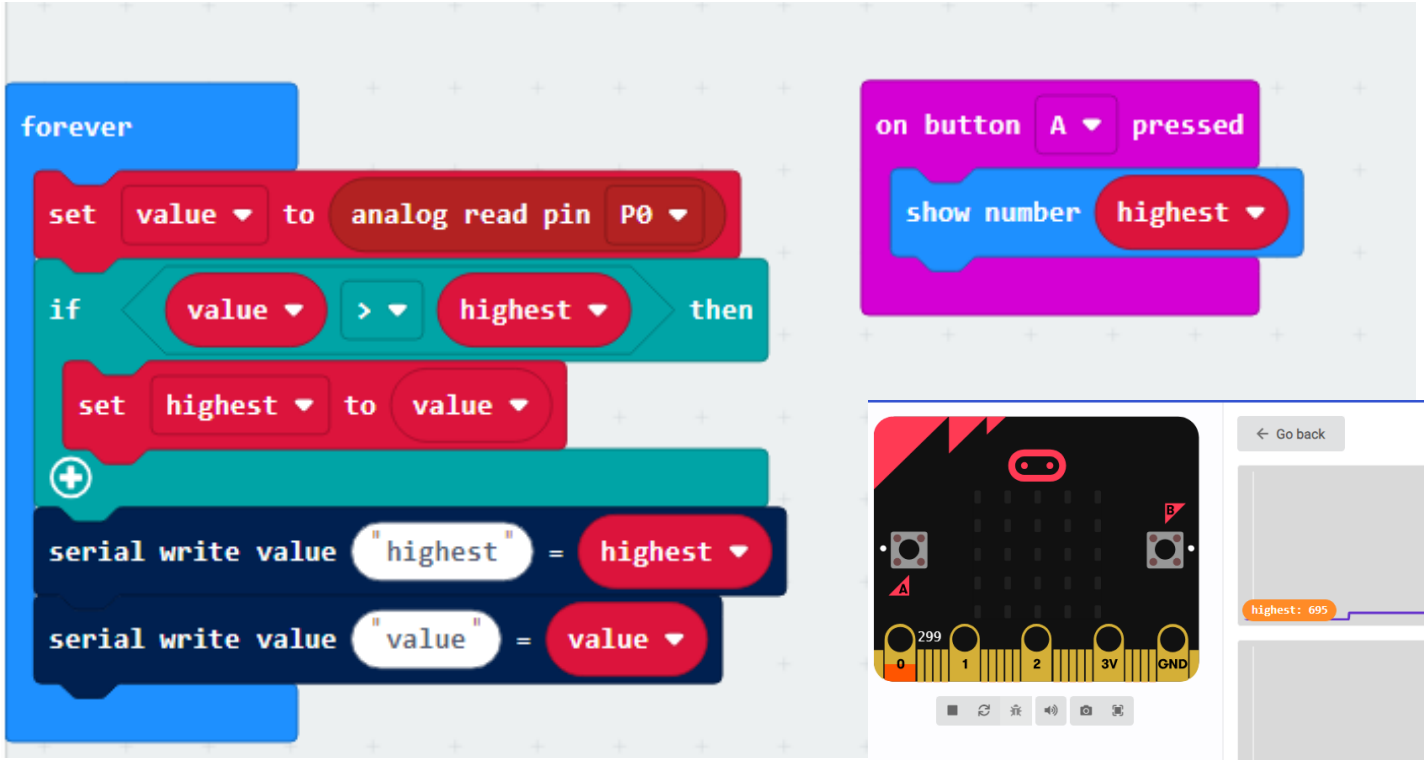
Group Activity

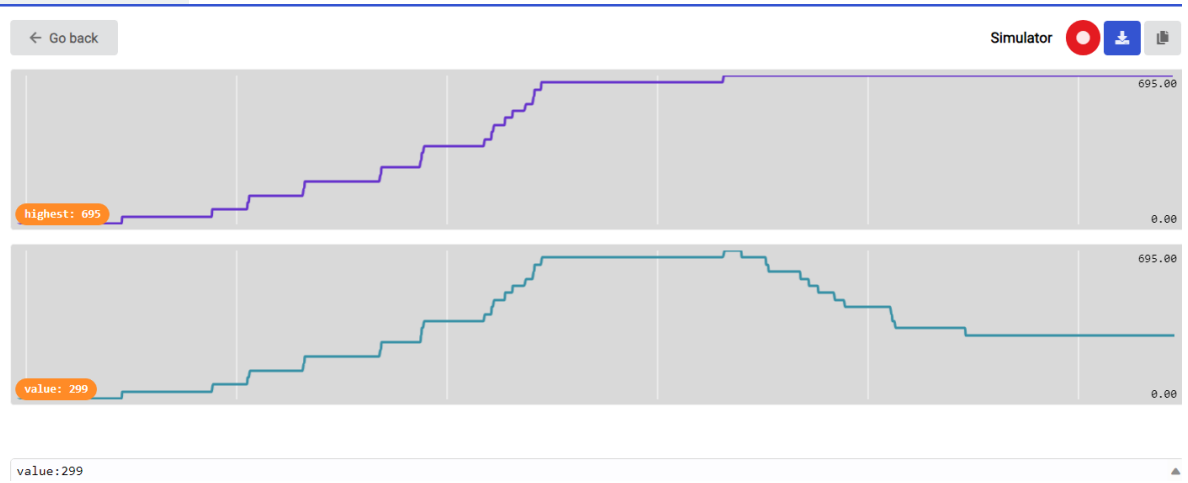
Solution1


forever
set value to analog read pin P0
if value > highest then
set highest to value

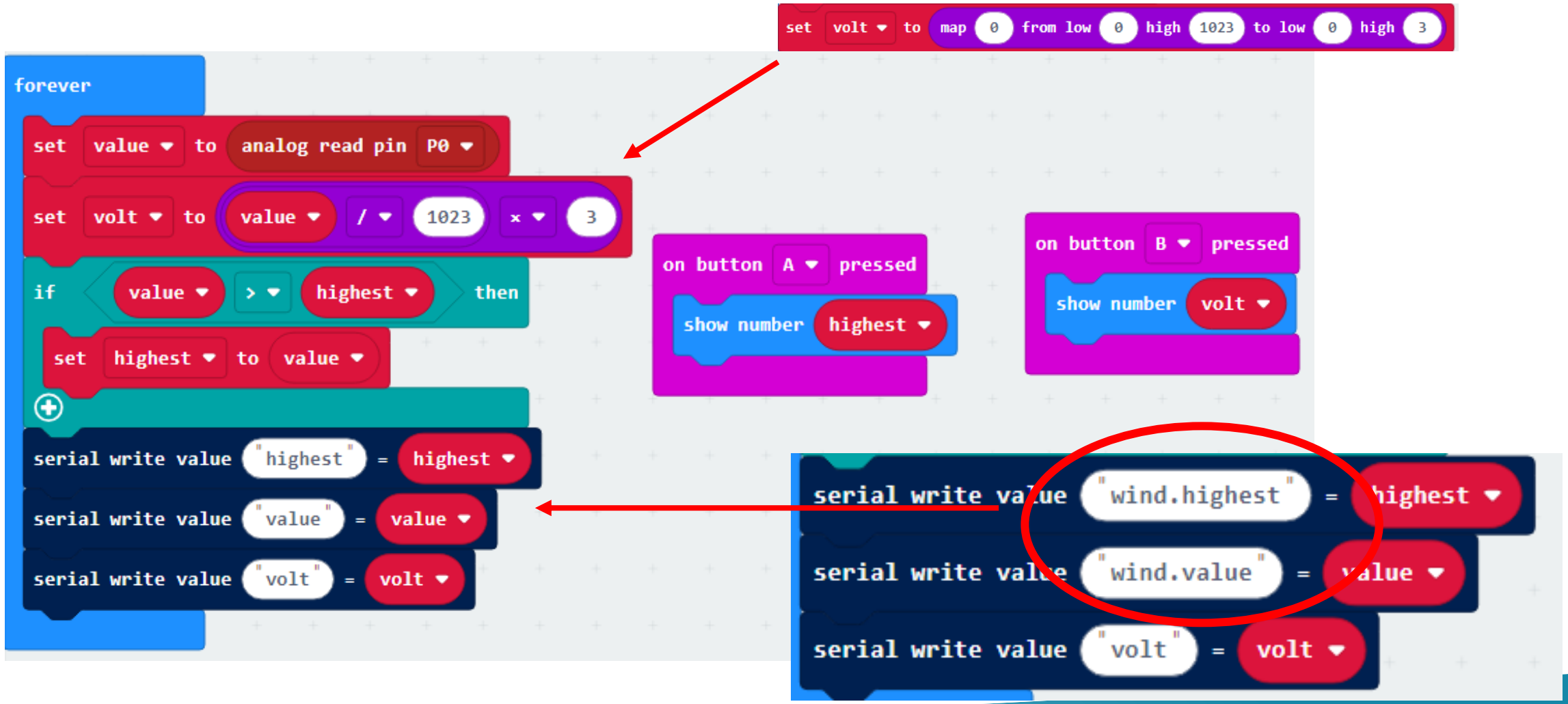

on button A pressed
show number highest

Solution2 - Predict



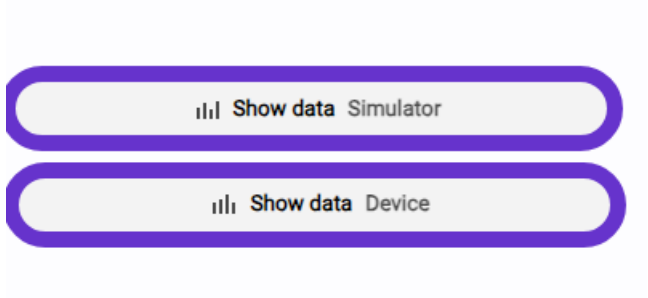


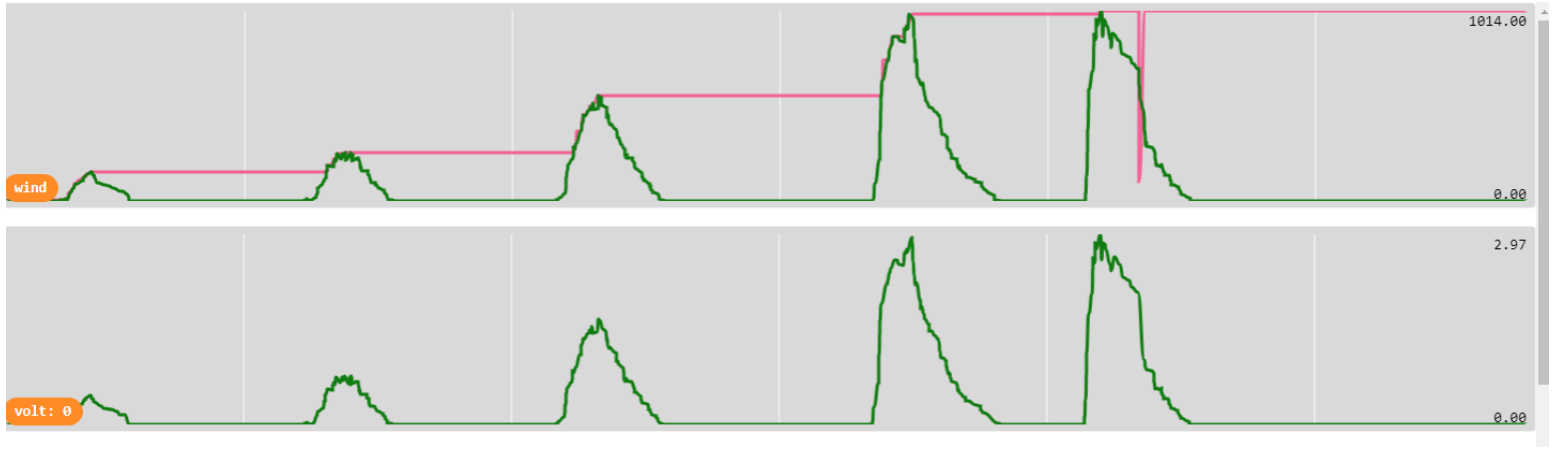
Solution3


set volt to map 0 from low 0 high 1023 to low 0 high 3
forever
set value to analog read pin P0
set volt to value / 1023 x 3
if value > highest then
set highest to value
serial write value "highest" = highest
serial write value "value" = value
serial write value "volt" = volt
on button A pressed
show number highest
on button B pressed
show number volt
serial write value "wind.highest" = highest
serial write value "wind.value" = value
serial write value "volt" = volt

Solution3: Data Analysis

Solution3 (physical)





Reflection

Oide

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Supporting the Professional Learning of School Leaders and Teachers

Session 3:
Arrays & The Solar Challenge

LEAVING CERTIFICATE COMPUTER SCIENCE

By the end of this session…

Participants will have…

...explored the use of arrays in programming

...learned how to set up an array

...learned how to add and remove values to an array

...found total and averaged array values

...applied the knowledge gained to practical array examples on the micro:bit platform.

...initialised an array on the micro:bit

...adding values to an array on the micro:bit, specifically those received through radio communication.

...sent values them over the serial port and downloaded the corresponding CSV file

...demonstrated the creation of a simple graph in Excel based on array data

...enhanced proficiency in total and averaging operations on arrays on micro:bit

TASK

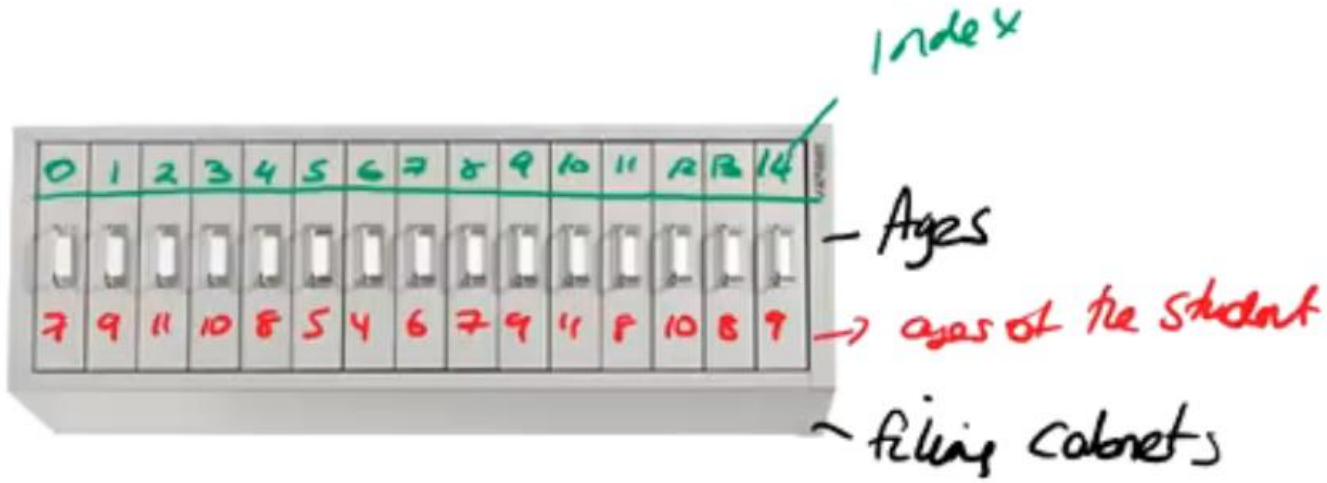
Assume: Light level is being sent via radio signal from one micro:bit to another.

AIM:
Take the light level received and store it in an array.

When button A pressed the array data is analysed to do the following:
Get the total of all the values in the array
Get the average value for that day

When Button B is pressed all data in the array is:
Displayed
Sent via the serial port.

What is an array?



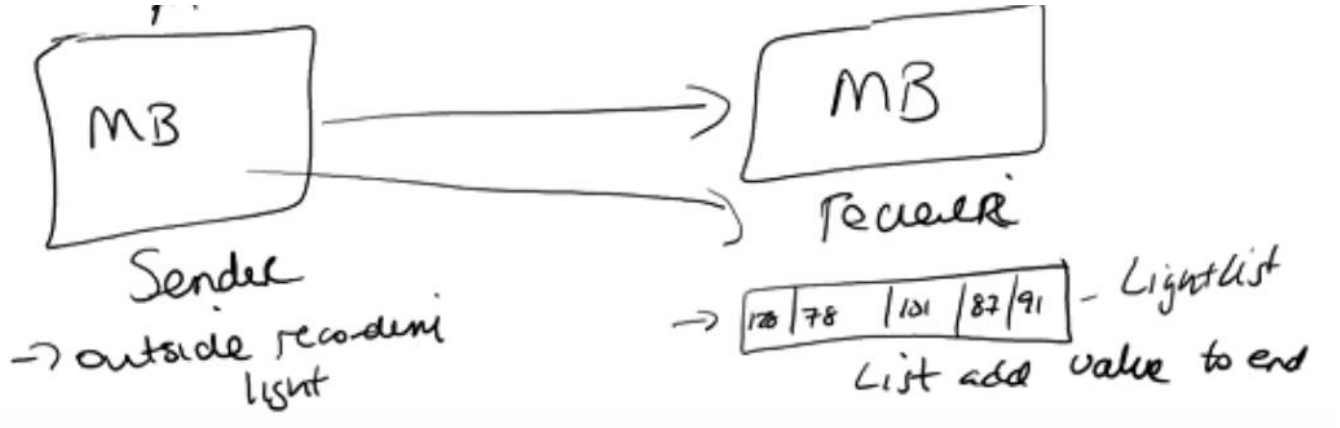
Name of Array = Ages

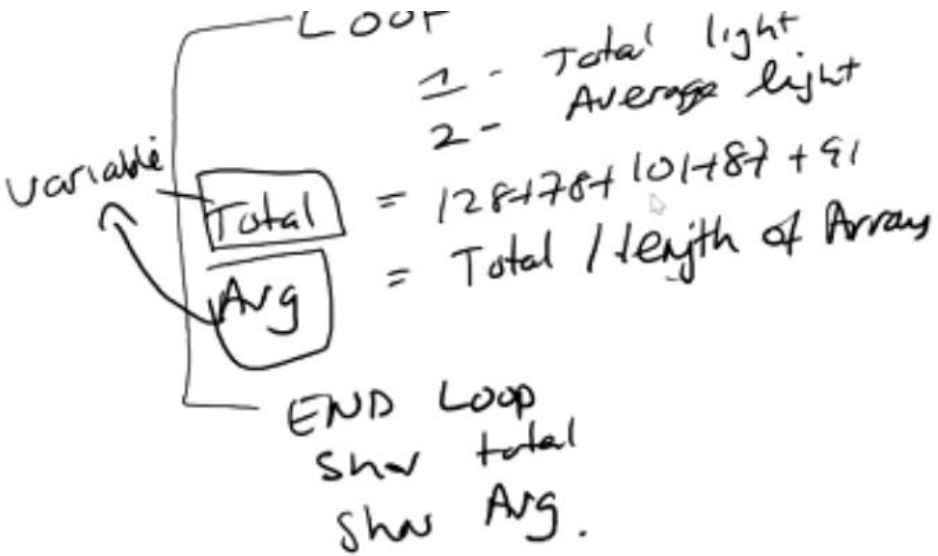
Index of Array =

Ages (5) = 5

Ages (14) = 9

Pseudocode


MB
MB
Receiver
Sender
→ outside recodeni light
→ 128 | 78 | 101 | 87 | 91
- LightList
List add value to end

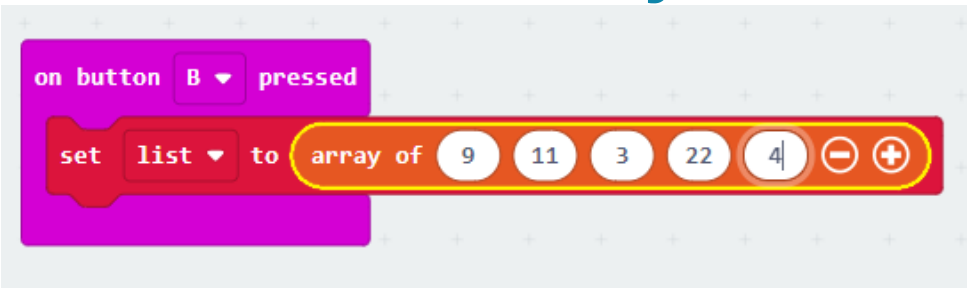

LOOP
1 - Total light
2 - Average light
variable
Total = 128+78+101+87+91
Avg = Total / length of Array
END Loop
Show total
Show Avg.

Use of Arrays to save multiple values.

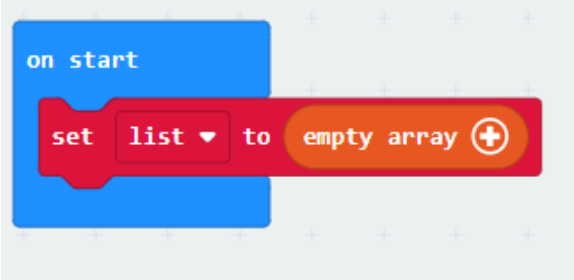
Next Step is to code this on the micro:bit.

https://makecode.com/

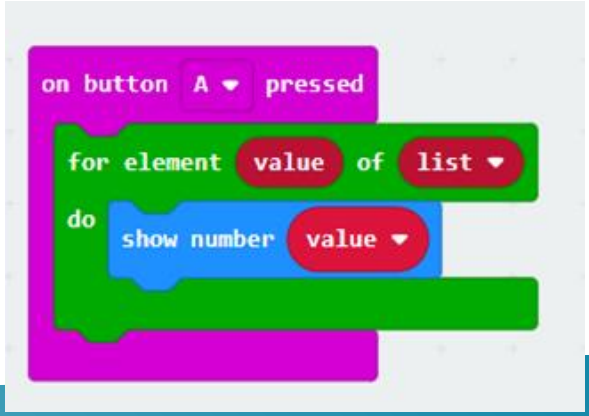
Set values in array



Initialise Array

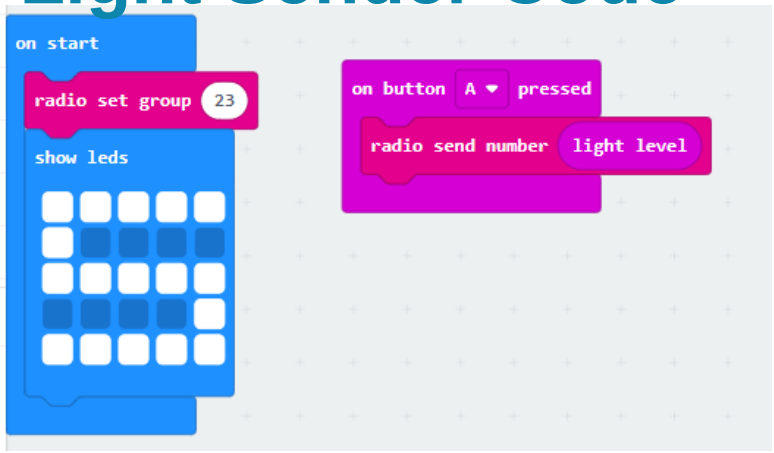


Loop through all values in Array



Use of Arrays to save multiple values.

Light Sender Code



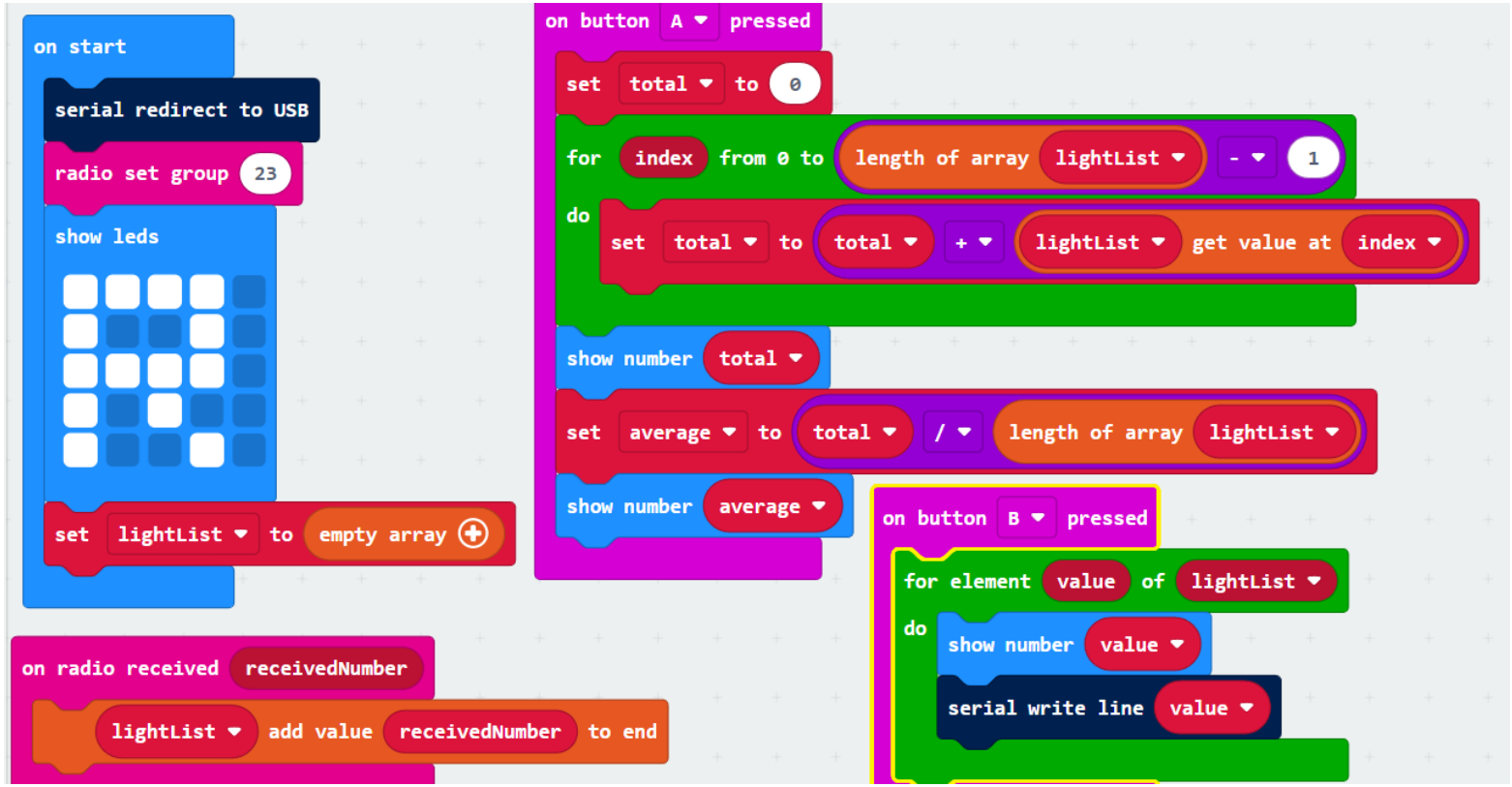
OnStart – Here the radio channel is set and an S is displayed so when powered it is easy to see that this micro:bit is the sender.

OnButtonAPressed – Here the light level from the sender micro:bit is sent to the receiver.

Use of Arrays to save multiple values.

This is the Receiver Code.

This is explained on the next slide.



Receiver Code with Array and Serial Explanation:

OnStart –Ensure data can be sent via the USB, Set radio channel to 23, show the letter R to indicate that this micro:bit is the receiver and finally initialise the array to an empty array.

OnRadioReceived- This receives the light level from the sender and adds the value to the end of the array.

OnButtonAPressed – In this part we are looping through the array and getting the total and the average for the values in the array.

OnButtonBPressed - This part loops through the array and sends all the values along the serial port. This can be used to generate a CSV file or to be picked up by another application like Python or be sent to storage in a database.

We are also showing each value after it is sent but this is not essential it is just a debugging part of the code to ensure that the values are processed.

Oide

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Supporting the Professional Learning of School Leaders and Teachers

Group Activity

LEAVING CERTIFICATE
COMPUTER SCIENCE

Group Activity

Make something based on today's learning:

- Using a sensor
- An array
- Radio

Oide

An Roinn Oideachais
Department of Education