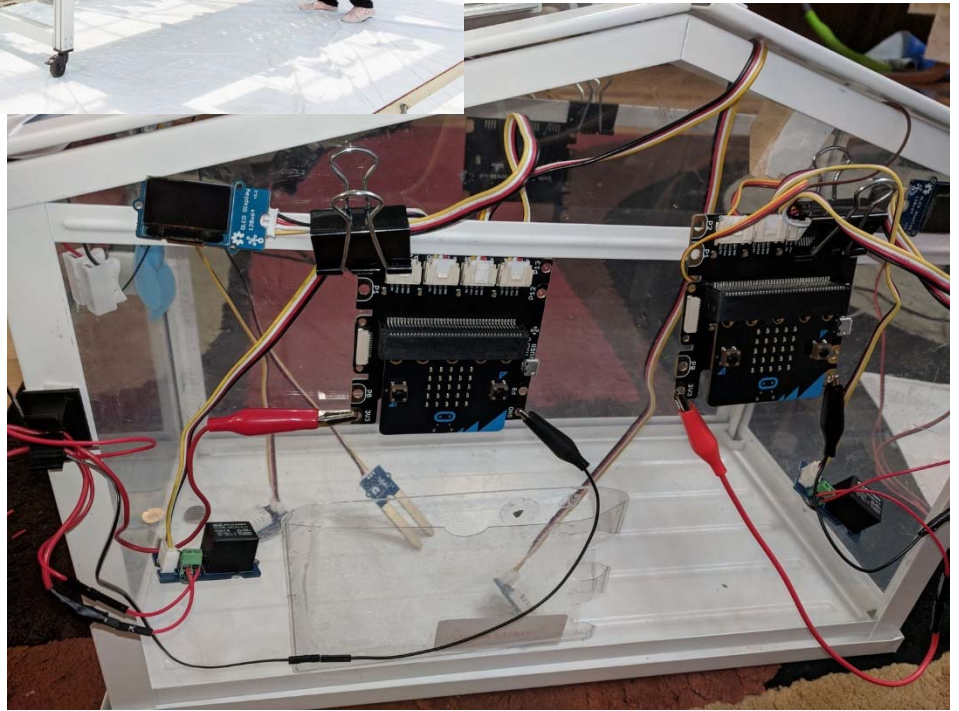


The Automated Greenhouse Project



Micro:bit: Quick Program Book

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Getting Started: Where to go and what you need

Software Components

- Programming Website: <https://makecode.microbit.org/#>

Hardware Components


To make a minimum greenhouse that controls both lighting and air flow one needs the following:

Parts	Where to buy
2 Microbits	https://www.digikey.com/product-detail/en/pimoroni-ltd/MBIT0004/1778-1040-ND/6928253
2 Grove Shields	https://www.digikey.com/products/en?mpart=103100063&v=1597
1 split micro-USB cable or	https://www.amazon.com/gp/product/B0179OXY9I/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1
2 6' micro-USB cable	https://www.amazon.com/AmazonBasics-Male-Micro-Cable-Black/dp/B072J1BSV6/ref=sr_1_4?keywords=3%27+micro+usb+cable&qid=1578354722&s=electronics&sr=1-4
1 Temperature Humidity Sensors	https://www.arrow.com/en/products/101020019/seeed-technology-limited
2 OLED screens	https://www.arrow.com/en/products/104030008/seeed-technology-limited
2 Relays	https://www.arrow.com/en/products/103020005/seeed-technology-limited
1 Servo	https://www.arrow.com/en/products/316010005/seeed-technology-limited
2 LED lights	https://www.amazon.com/Relassy-Spectrum-Professional-Seedling-Replacement/dp/B07H2YG7KQ/ref=pd_bxgy_86_img_3/136-0141958-1288017
2 Exhaust Fans	https://www.amazon.com/gp/product/B06XHM7YZV/ref=ppx_yo_dt_b_search_asin_title
1 circulating Fan	https://www.amazon.com/gp/product/B078MSFFH5/ref=ppx_yo_dt_b_search_asin_title
1 Propeller	https://www.amazon.com/gp/product/B073XL73F6/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1
2 Alligator Clips with Male Jumper Pins	https://www.amazon.com/Oiyagai-Alligator-Crocodile-Arduino-Raspberry/dp/B07CXLMBY7/ref=pd_sbs_147_3/136-0141958-1288017?th=1
2 Alligator Clips with Female Jumper Pins	https://www.amazon.com/Oiyagai-Alligator-Crocodile-Arduino-Raspberry/dp/B07CXMHKD4/ref=pd_sbs_147_3/136-0141958-1288017
2 Spring Terminal Blocks	https://www.amazon.com/ZRM-Connector-Self-Locking-Electric-Terminal/dp/B075MXTG5D/ref=sr_1_12
2(cut in half) female to female dupont jumper wires	https://www.amazon.com/dp/B07XMHL93S/ref=sspa_dk_detail_6
4 (2 red, 2 black) male jumper wires	https://www.amazon.com/dp/B07XMGN4VS/ref=sspa_dk_detail_6?th=1 (note can just get these and cut to use for the female ends above)
6- Four pin cables (short)	https://www.arrow.com/en/products/110990031/seeed-technology-limited
2 - Four pin cables (long)	https://www.arrow.com/en/products/110990038/seeed-technology-limited

Make a heartbeat then you're your name scroll with emojis

Hardware and Sensors

Micro:bit, LED Strip, Micro USB cable (Charging cable),

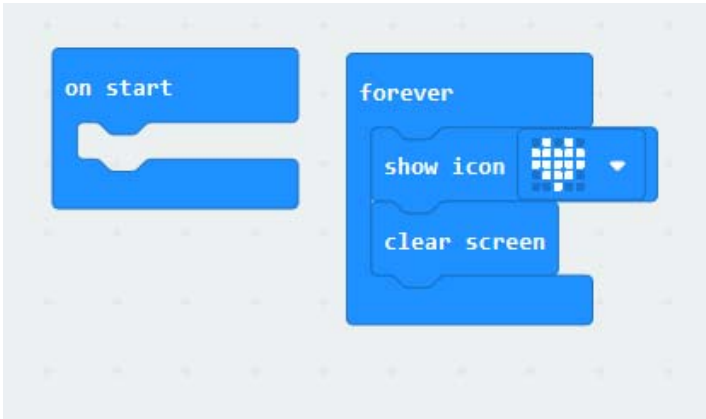


Block groups needed

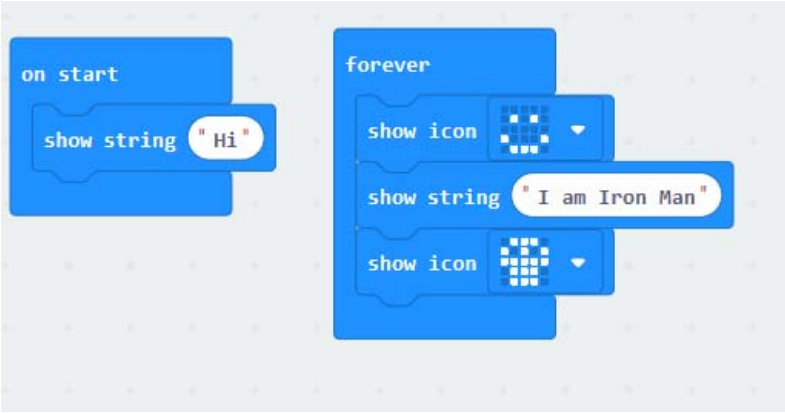
Basic

Extensions Needed

Program 1: This program will make a heart emoji flash on the screen



Program 2: This program starts with "HI" on the micro:bit then shows a smiley face then a phrase then a skull



Using some built in Sensors for Micro:bit (compass, and temperature)

Hardware and Sensors

Micro:bit, LED Strip, Micro USB cable (Charging cable),



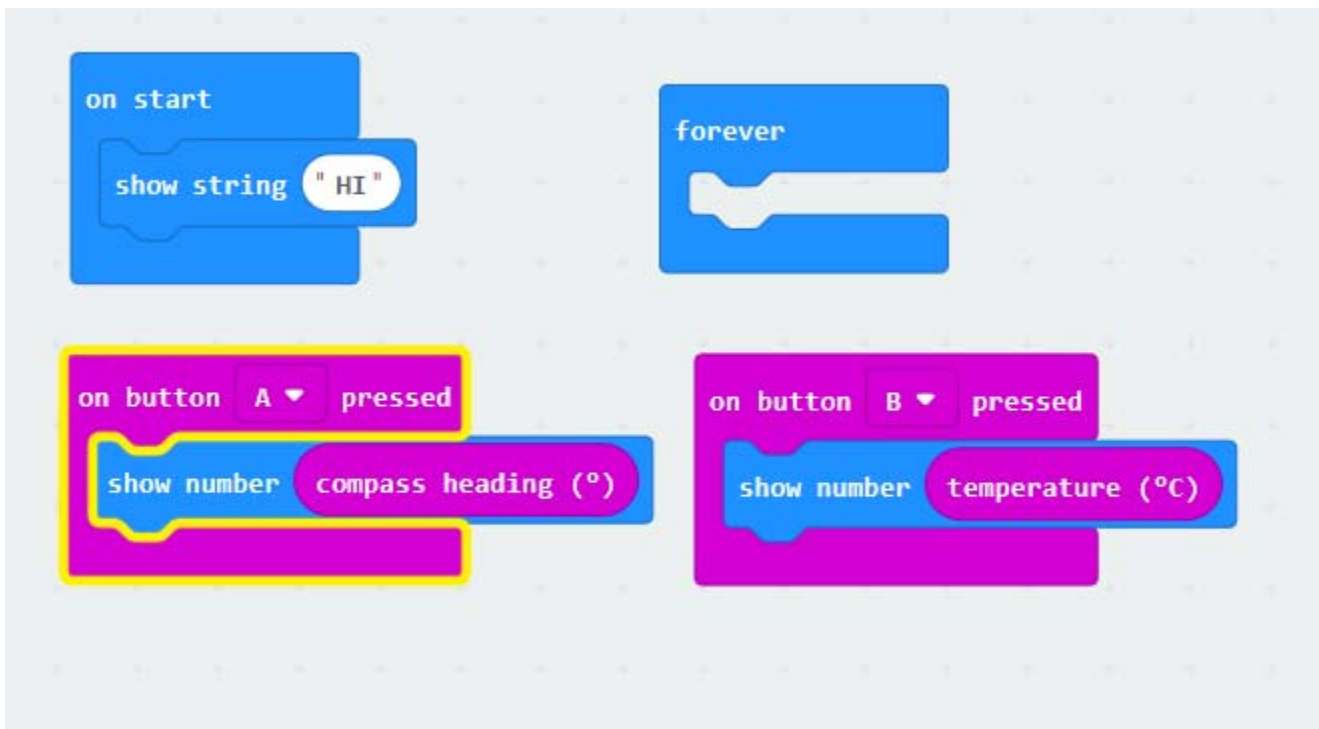
Block groups needed

Input

Basic

Extensions Needed

This program starts by showing the word HI on the micro:bit LED display. Then it waits until the buttons are pressed. This is your first IF-Then statement. IF button A is pressed THEN show the direction. IF button B is pressed THEN show the temperature



My First LED Strip Experiment

Hardware and Sensors

Grove Shield, Micro:bit, LED Strip, Micro USB cable (Charging cable), Gesture Sensor, Four Pin Connector Cable



Block groups needed

Neopixel

Basic

Extensions Needed



The Pin where you will plug in your LED strip. The Pin numbers are labeled on the Grove Shield.

```
on start
  set strip to NeoPixel at pin P0 with 30 leds as RGB (GRB format)

forever
  strip show color red
  pause (ms) 1000
  strip show color blue
  pause (ms) 2000
```

Change this number to the number of pixels (bulbs) on your LED Strip!

The drop down menu allows you to pick your colors!

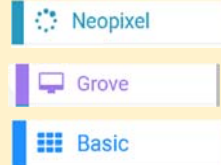
Use Gesture Sensor to Cause LED to light up different ways

Hardware and Sensors

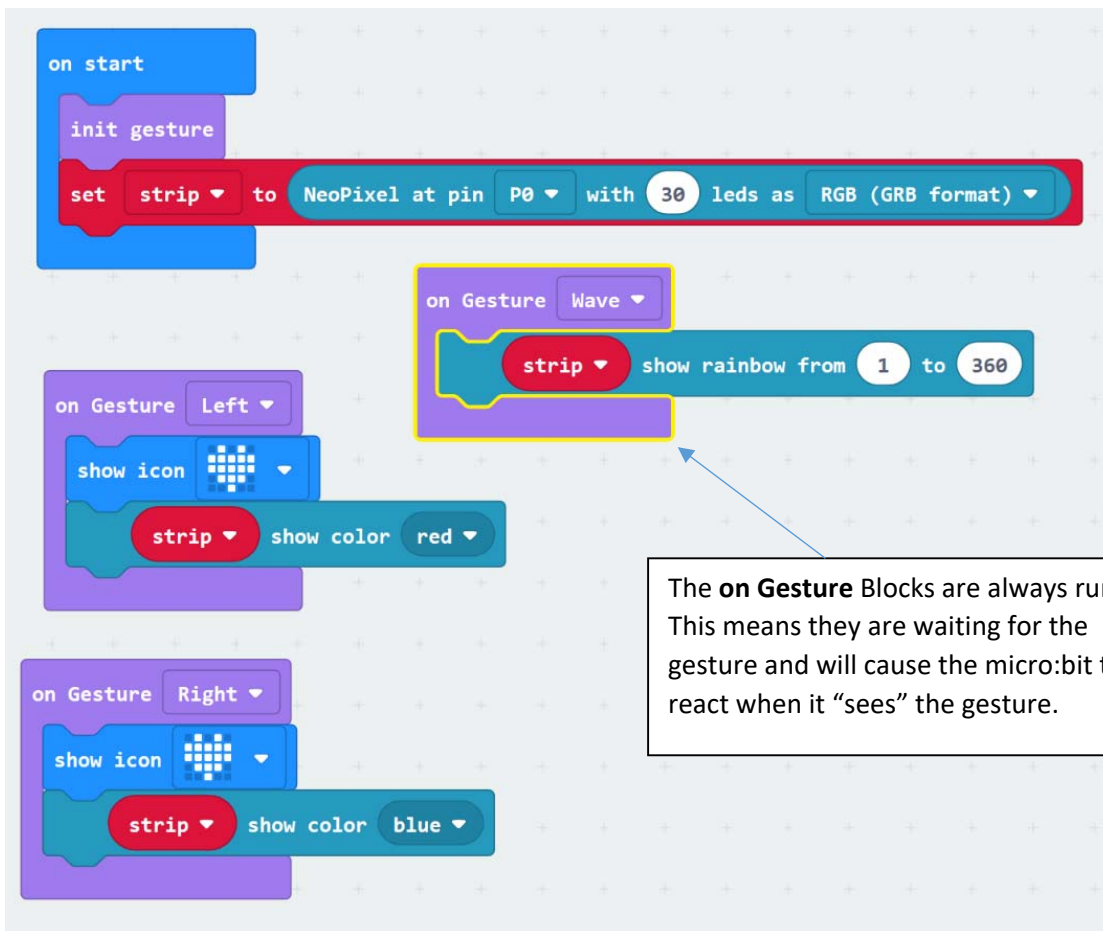
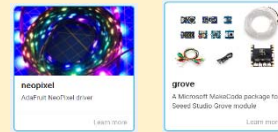
Grove Shield, Micro:bit, LED Strip, Micro USB cable (Charging cable), Gesture Sensor, Four Pin Connector Cable



Block groups needed



Extensions Needed



```
on start
  init gesture
  set strip to NeoPixel at pin P0 with 30 leds as RGB (GRB format)

on Gesture Wave
  strip show rainbow from 1 to 360

on Gesture Left
  show icon [Micro:bit icon]
  strip show color red

on Gesture Right
  show icon [Micro:bit icon]
  strip show color blue
```

The **on Gesture** Blocks are always running. This means they are waiting for the gesture and will cause the micro:bit to react when it “sees” the gesture.

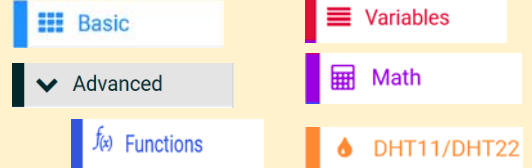
Use Temperature Sensor to show data on micro:bit LED Display

Hardware and Sensors

1 Grove Shield, 1 Micro:bit , 1 Micro USB cable (Charging cable), Temperature/Humidity Sensor, Four Pin Connector Cable



Block groups needed



Extensions Needed



on start

forever

- call Get TemHumData
- call Show Data on MicroBit

function Show Data on MicroBit

- show string "T="
- show number round Temp
- show leds
- show string "H="
- show number round Humidity

function Get TemHumData

- Query DHT22
- Data pin P0
- Pin pull up true
- Serial output true
- Wait 2 sec after query true
- pause (ms) 2000
- set Temp to Read temperature
- set TempF to Temp x 9 ÷ 5
- set Temp to TempF + 32
- pause (ms) 2000
- set Humidity to Read humidity

Be sure to put Temperature and Humidity Sensor into the right Pin!!

Must keep the pause. Cannot read sensor too often!

Create a function called Show Data on Microbit to show information

Make three variables, Temp, TempF, and Humidity. Read from Sensor and convert the temperature from Celsius to Fahrenheit.

Change Color of LED strip based on shaking the micro:bit

Hardware and Sensors

Grove Shield, Micro:bit , Micro USB cable (Charging cable), LED Strip



Block groups



Extensions Needed



```
on start
  set strip to NeoPixel at pin P0 with 30 leds as RGB (RGB format)

forever
  set x to acceleration (mg) x
  set y to acceleration (mg) y
  set z to acceleration (mg) z
  strip shift pixels by 1
  strip set pixel color at 0 to red x green y blue z
  strip show
  pause (ms) 100
```

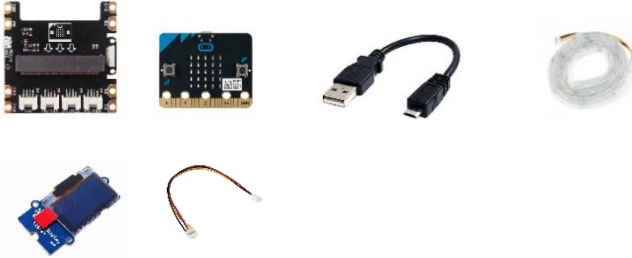
Watch your pixels. You will see the lights change one by one as it moves down the LED strip. That is a shift of the pixels by one!

The color of pixel is controlled by the acceleration in each direction.

My second FUNCTION: Writing text to my screen and lighting up the LED Strip

Hardware and Sensors

Grove Shield, Micro:bit , Micro USB cable (Charging cable), LED Strip, OLED Screen, Four Pin Wire



Block groups

Basic

Advanced

Functions

Neopixel

OLED

Extensions Needed



```
on start
  set strip to NeoPixel at pin P8 with 60 leds as RGB (GRB format)
  initialize OLED with width 128 height 64
  show string "starting program..."
  pause (ms) 2000
  clear OLED display

function ShowDataonScreen
  show string "My LED Strip"
  show string "is going to Blink"
  pause (ms) 3000
  clear OLED display

function Blink
  strip show color red 255 green 0 blue 0
  pause (ms) 1000
  strip show color red 0 green 255 blue 0
  pause (ms) 1000
  strip show color red 0 green 0 blue 255
  pause (ms) 1000

forever
  call Blink
  call ShowDataonScreen
```

Be sure to call all of your functions you want to run!

Two functions. One that controls what appears your screen and the second function Blink, makes your LED strip blink. If you change things in your functions those changes will run in the forever loop.

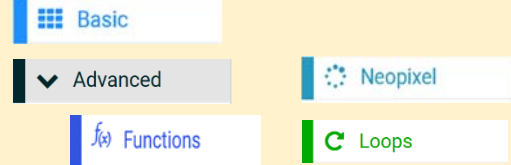
My First Function! Make the LED Strip Blink (Red, Blue, Green) Function

Hardware and Sensors

Grove Shield, Micro:bit , Micro USB cable (Charging cable), LED Strip, OLED Screen, Four Pin Wire



Block groups



Extensions Needed



on start

set strip to NeoPixel at pin P0 with 60 leds as RGB (GRB format)

forever

call Blink

function Blink

repeat 5 times

do

strip show color red 255 green 0 blue 0

pause (ms) 1000

strip show color red 0 green 255 blue 0

pause (ms) 1000

strip show color red 0 green 0 blue 255

pause (ms) 1000

For white Red=255, green = 255, blue =255. You can control the colors by entering different combinations of numbers for red, blue and green.

Light two LED pixels (bulbs) at a time and have the move down the LED Strip

Hardware and Sensors

Grove Shield, Micro:bit , Micro USB cable (Charging cable), LED Strip, OLED Screen, Four Pin Wire



Block groups

Basic

Advanced

Functions

Neopixel

Loops

Extensions Needed



```
on start
  set strip to NeoPixel at pin P0 with 60 leds as RGB (GRB format)

forever
  call Two At A Time

function Two At A Time
  for index from 0 to 60
  do
    strip set pixel color at index to red
    strip show
    pause (ms) 200
    strip set pixel color at index - 1 to blue
    strip show
    strip clear
```

The for loop is a count. The variable index is counted from 0 to 60 one step at a time.

The pixel (Bulb) will turn red based on the value of the index variable. So the first will be red, then the second, then the third....

This block turns the pixel blue that is one behind the pixel that turns red. Why the index -1.

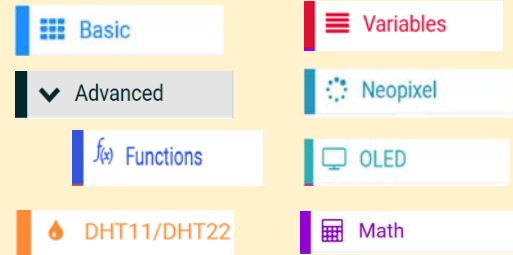
Show Temperature and Humidity Data on small OLED Screen

Hardware and Sensors

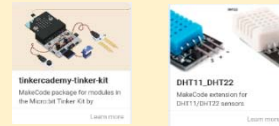
Grove Shield, Micro:bit , Micro USB cable (Charging cable), LED Strip, OLED Screen, Four Pin Wire



Block groups needed



Extensions Needed



Note, we left this block here so if we wanted to add an LED Strip it would be started.

```

on start
  set strip to NeoPixel at pin P2 with 30 leds as RGB (GRB format)
  initialize OLED with width 128 height 64
  show string "starting program..."
  pause (ms) 500
  clear OLED display

  forever
    call Get TemHumData
    call ShowDataonScreen

  function ShowDataonScreen
    show string "Temperature="
    show number round Temp
    show string "Humidity="
    show number round Humidity
    pause (ms) 3000
    clear OLED display

  function Get TemHumData
    Query DHT22
    Data pin P0
    Pin pull up true
    Serial output true
    Wait 2 sec after query true
    pause (ms) 2000
    set Temp to Read temperature
    set TempF to Temp x 9 ÷ 5
    set Temp to TempF + 32
    pause (ms) 2000
    set Humidity to Read humidity
  
```

From the DHT22 block. Starts the sensor. Be sure to select the right pin!!

Need to create three variables, Temp, TempF, and Humidity.

Converts from Fahrenheit to Celsius.

Note: The Screen can only go the I2C port on the Grove Shield!

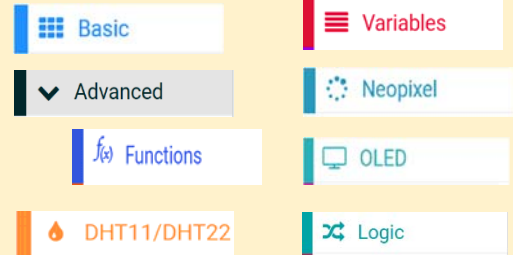
If Then: Use Temperature Data to Change LED Strip Color

Hardware and Sensors

Grove Shield, Micro:bit , Micro USB cable (Charging cable), LED Strip, OLED Screen, Four Pin Wire, Temperature/Humidity Sensor



Block groups needed



Extensions Needed



Two Variables that are your conditions. TempHigh is too hot!

And HumidHigh is when the humidity gets too high. You can change these!.

```

on start
  set strip to NeoPixel at pin P2 with 30 leds as RGB (GRB format)
  initialize OLED with width 128 height 64
  show string "starting program..."
  pause (ms) 500
  clear OLED display

function variables
  set HumidHigh to 45
  set TempHigh to 72

function Control LED Strip
  if Temp > TempHigh then
    strip show color red
  else
    strip show color green

function Get TemHumData
  Query DHT22
  Data pin P0
  Pin pull up true
  Serial output true
  Wait 2 sec after query true
  pause (ms) 2000
  set Temp to Read temperature
  set TempF to Temp * 9 / 5
  set Temp to TempF + 32
  pause (ms) 2000
  set Humidity to Read humidity

function ShowDataonScreen
  show string "Temperature="
  show number round Temp
  show string "Humidity="
  show number round Humidity
  pause (ms) 3000
  clear OLED display

forever
  call variables
  call Get TemHumData
  call ShowDataonScreen
  call Control LED Strip
  
```

IF your temperature recorded by the sensor is over what you think is hot turn your LED Strip RED! If not turn it green!

Use Temperature Data to Turn on a Relay and run a fan

Hardware and Sensors

Grove Shield, Micro:bit, MicroUSB cable, 3 Four Pin Wires, Temperature/Humidity Sensor, screen, Relay, 2 Alligator Clips (for power), terminal block, fan with propeller, 2 wires, and (optional) LED Strip



Block groups needed

- Basic
- Advanced
- Functions
- Pins
- Variables
- Neopixel
- OLED
- Logic
- DHT11/DHT22

Extensions Needed

- Linker Academy Linker Kit
- DHT11_DHT22
- neopixel

Note: If not using the LED Strip can remove or replace with a different function

```

on start
  set strip to NeoPixel at pin P2 with 30 leds as RGB (GRB format)
  initialize OLED with width 128 height 64
  show string "starting program..."
  pause (ms) 500
  clear OLED display

function variables
  set HumidHigh to 45
  set TempHigh to 72

function Get TemHumData
  Query DHT22
  Data pin P0
  Pin pull up true
  Serial output true
  Wait 2 sec after query true
  pause (ms) 2000
  set Temp to Read temperature
  set TempF to Temp * 9 / 5
  set TempC to TempF + 32
  pause (ms) 2000
  set Humidity to Read humidity

function Control Relay/Fan
  if Temp > TempHigh then
    digital write pin P1 to 1
  else
    digital write pin P1 to 0

function Control LED Strip
  if Temp > TempHigh then
    strip show color red
  else
    strip show color green

function ShowDataonScreen
  show string "Temperature="
  show number round Temp
  show string "Humidity="
  show number round Humidity
  pause (ms) 3000
  clear OLED display

forever
  call variables
  call Get TemHumData
  call Control Relay/Fan
  call ShowDataonScreen
  call Control LED Strip
  
```

This function turns on by writing the number 1 to P1 (relay is plugged into) if the temperature is too high. If the temperature is ok, then it writes 0 to turn the relay off.

Controlling both Temperature and Humidity with an If-Then Statement

Hardware and Sensors

Grove Shield, Micro:bit, MicroUSB cable, 3 Four Pin Wires, Temperature/Humidity Sensor, screen, Relay, 2 Alligator Clips (for power), terminal block, fan with propeller, 2 wires, and (optional) LED Strip



Block groups needed

Basic

Advanced

Functions

Pins

Variables

Neopixel

OLED

Logic

DHT11/DHT22

Extensions Needed



The change here is including a Boolean comparison (and/or) statement that tests if the Temperature OR the Humidity is too high. If either is high, then the fan turns on. Could also replace the OR with AND then both conditions would need to be true.

```

on start
  set strip to Neopixel at pin P2 with 30 leds as RGB (GRB format)
  initialize OLED with width 128 height 64
  show string "starting program..."
  pause (ms) 500
  Clear OLED display

function ShowDataonScreen
  show string "Temperature-"
  show number round Temp
  show string "Humidity-"
  show number round Humidity
  pause (ms) 3000
  Clear OLED display

function Get TemHumData
  Query DHT22
  Data pin P9
  Pin pull up true
  Serial output true
  Wait 2 sec after query true
  pause (ms) 2000
  set Temp to Read temperature
  set TempF to Temp * 9 / 5
  set Temp to Temp + 32
  pause (ms) 2000
  set Humidity to Read humidity

function variables
  set HumidHigh to 45
  set TempHigh to 72

function Control Relay/Fan
  if Temp > TempHigh or Humidity > HumidHigh then
    digital write pin P1 to 1
  else
    digital write pin P1 to 0

function Control LED Strip
  if Temp > TempHigh or Humidity > HumidHigh then
    strip show color red
  else
    strip show color green
  
```

Share a Message: send signals between two micro:bits

Hardware and Sensors

2 Micro:bit, 2 MicroUSB cables, battery or power source (need to power both micro:bits)



Block groups needed

Basic

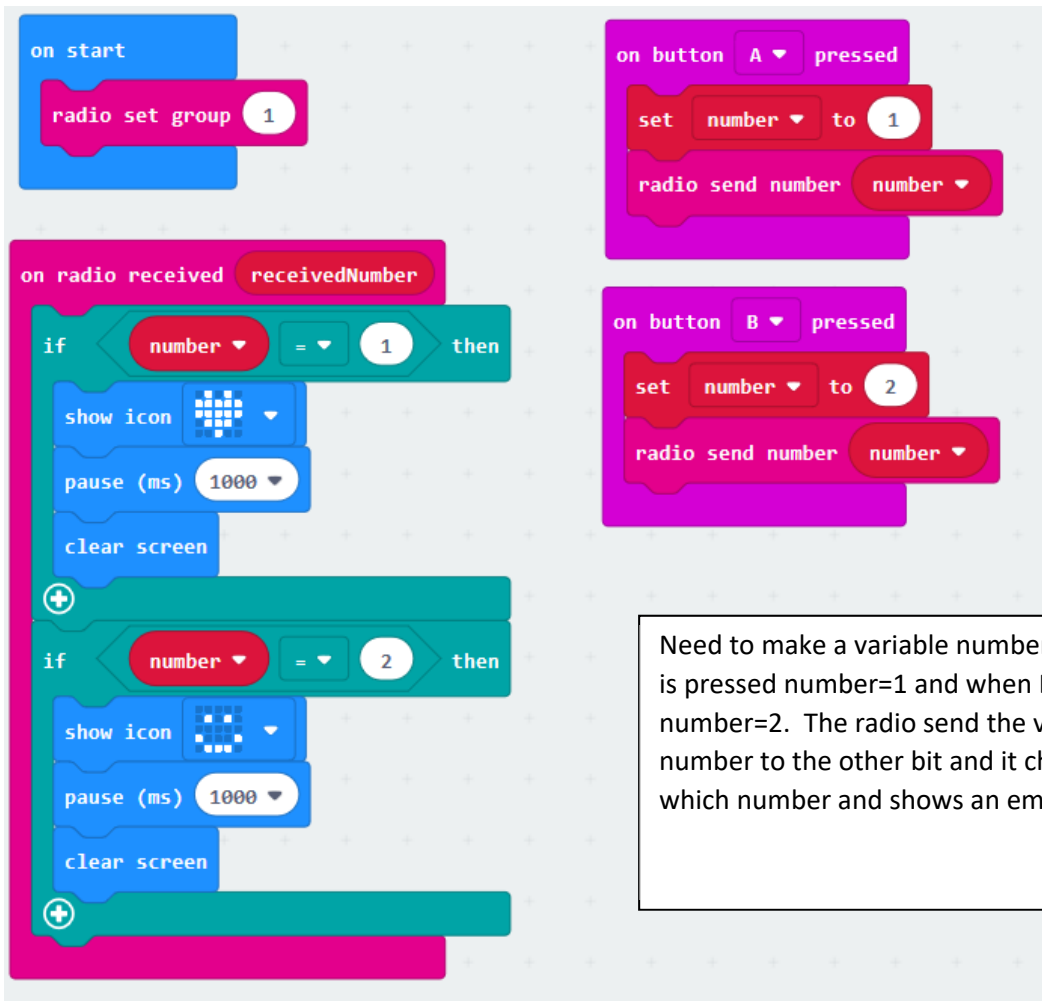
Variables

Radio

Input

Extensions Needed

This code should be put on both micro:bits!!



The image shows two columns of Scratch code blocks. The left column is for the 'on start' event and the 'on radio received' event. The right column is for 'on button A pressed' and 'on button B pressed' events.

on start

- radio set group 1

on radio received receivedNumber

- if number = 1 then
 - show icon [grid]
 - pause (ms) 1000
 - clear screen
- if number = 2 then
 - show icon [grid]
 - pause (ms) 1000
 - clear screen

on button A pressed

- set number to 1
- radio send number number

on button B pressed

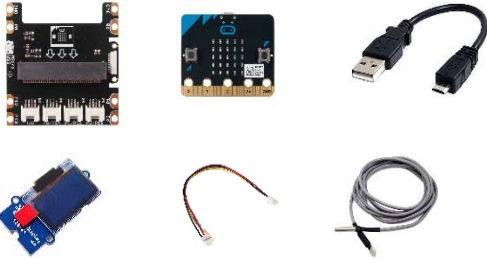
- set number to 2
- radio send number number

Need to make a variable number. When A is pressed number=1 and when B = pressed number=2. The radio send the value of number to the other bit and it checks which number and shows an emoji.

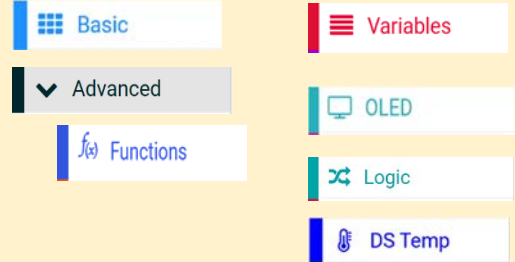
Water Temperature Sensor

Hardware and Sensors

Grove Shield, Micro:bit, MicroUSB cable, 3 Four Pin Wires, Temperature/Humidity Sensor, screen, Relay, 2 Alligator Clips (for power), terminal block, fan with propeller, 2 wires, and (optional) LED Strip



Block groups needed



Extensions Needed



Note: you will need to enter this url in the extension search: <https://github.com/bsiever/microbit-dstemp-alpha>

```

on start
  initialize OLED with width 128 height 64
  show string "Starting the Program"
  pause (ms) 100
  clear OLED display

forever
  call variables
  call Get Water Temperature

function variables
  set WaterTempHigh to 70

function Get Water Temperature
  set h20temp to Temp. in Celsius on P2
  set h20temp to h20temp * 9
  set h20temp to h20temp + 5
  set h20temp to h20temp + 32
  show string "Water Temp = "
  show number round h20temp
  pause (ms) 2000
  clear OLED display
  if h20temp > WaterTempHigh then
    show icon
  else
    show leds
  
```

Be sure to make sure your code pin matches where the water temperature sensor is attached to the shield!

Converts the temperature from Celsius to Fahrenheit. Do not need these blocks if comfortable with Celsius.

An option could be to add an LEDStrip that will change color. We just put an X on the micro:bit board if the water is too warm and a Y if ok.

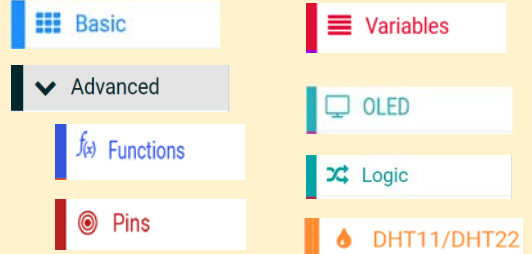
Control LED Lights with Micro:bit light sensor

Hardware and Sensors

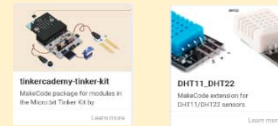
Grove Shield, Micro:bit, MicroUSB cable, 3 Four Pin Wires, Temperature/Humidity Sensor, screen, Relay, 2 Alligator Clips (for power), terminal block, fan with propeller, 2 wires, LED light bulbs



Block groups needed



Extensions Needed



```

on start
  initialize OLED with width 128 height 64
  show string "Starting the Program"
  pause (ms) 100
  clear OLED display

forever
  call Get and Share Light Data
  call variables
  call Get and Share Water Temperature
  call Do something with Water Data
  call Control Lights

function variables
  set WaterTempHigh to 70

function Control Lights
  if lux < LightlevelLow then
    digital write pin P1 to 1
    show icon [LED on]
  else
    digital write pin P1 to 0
    show icon [LED off]

function Get and Share Light Data
  set light1 to light level * 11
  change light1 by 90
  set lux to light1
  insert newline
  show (without newline) string "Lux="
  show (without newline) number lux
  pause (ms) 2000
  clear OLED display

function Get and Share Water Temperature
  set h20temp to Temp. in Celsius on P2
  set h20temp to h20temp * 9
  set h20temp to h20temp ÷ 5
  set h20temp to h20temp + 32
  show string "Water Temp ="
  show number round h20temp
  pause (ms) 2000
  clear OLED display

function Do something with Water Data
  if h20temp > WaterTempHigh then
    show icon [LED on]
  else
    show leds [LED off]
  
```

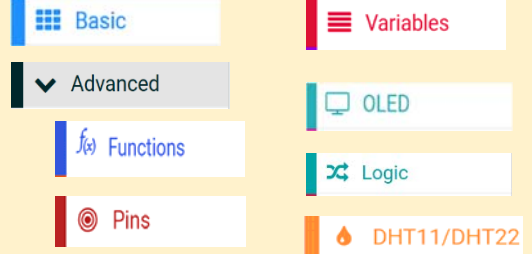
Control Servos and Exhaust Fans

Hardware and Sensors

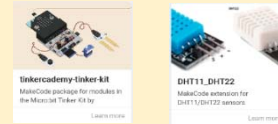
Grove Shield, Micro:bit, MicroUSB cable, 3 Four Pin Wires, Temperature/Humidity Sensor, screen, Relay, 2 Alligator Clips (for power), terminal block, exhaust fans, 2 wires, Servo



Block groups needed



Extensions Needed



```

on start
  pause (ms) 100
  initialize OLED with width 128 height 64
  servo write pin P2 to 90
  show string "starting program..."
  pause (ms) 1000
  clear OLED display

forever
  call Variables
  call GetTempHumidity
  call Control Exhaust Fans
  call Control Servo

function Variables
  set TempHigh to 70
  set HumidHigh to 40

function Control Exhaust Fans
  if Temp > TempHigh or humidity > HumidHigh then
    digital write pin P1 to 1
    show icon ***
  else
    digital write pin P1 to 0
    show icon ***

function Control Servo
  if Temp > TempHigh or humidity > HumidHigh then
    servo write pin P2 to 0
    show string "Window should be open"
  else
    servo write pin P2 to 90
    show string "window should be closed"
    pause (ms) 1000
    clear OLED display

function GetTempHumidity
  Query DHT22
  Data pin P8
  Pin pull up true
  Serial output false
  Wait 2 sec after query true
  if Last query successful? then
    pause (ms) 2000
    set humidity to Read humidity
    pause (ms) 2000
    set Temp to Read temperature * 9 / 5 + 32
    pause (ms) 2000
    show string "Temperature="
    show number round Temp
    show string "Humidity="
    show number round humidity
    pause (ms) 3000
    clear OLED display
  
```


PIR Sensor (Passive Infra-red Sensors).

Hardware and Sensors

Grove Shield, Micro:bit, MicroUSB cable, 1 Four Pin Wire, 1 PIR sensor



Block groups needed

- Basic
- Logic
- Advanced
- Functions
- Pins

Extensions Needed



```
function Proximity
  if digital read pin P1 = 0 then
    strip show color red
  else
    strip show color blue
end function

forever
  call Proximity
end forever

on start
  set strip to NeoPixel at pin P0 with 30 leds as RGB (GRB format)
```