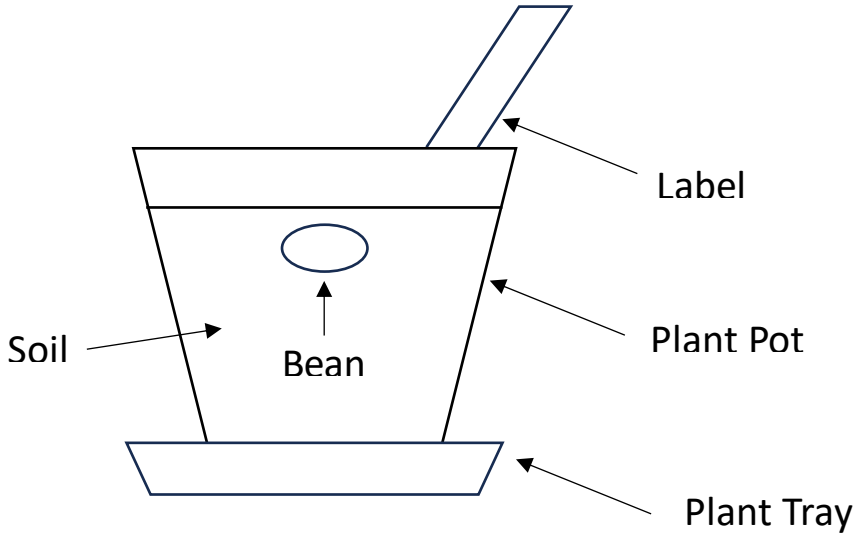
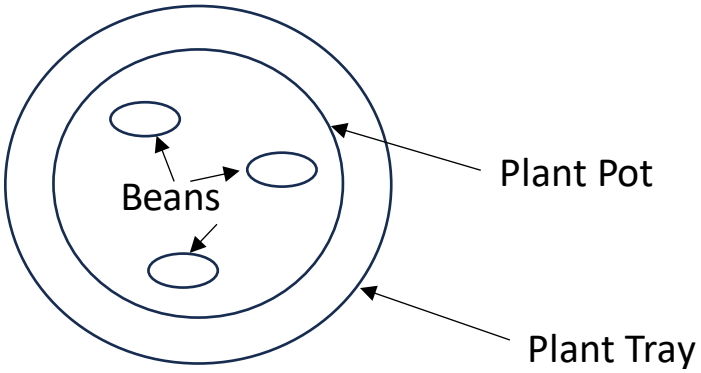
Plant Growing Experiments

General setup

Side view:



Top-down view:



General equipment list

- 5 Identical plant pots
- Soil
- 15 French Dwarf Runner Beans (3 per pot)
- 5 plant trays, one per pot
- Water
- Measuring cylinder
- Scales to measure weight
- Ruler to measure plant height
- Labels for each pot

General setup:

1. Use the scales to put the same amount of soil in each plant pot, filling the plant pot to three quarters full.
2. Carefully press three beans into the soil of each plant pot.
3. Carefully avoiding the seeds add labels to each pot with number and experiment.
4. Place the pots on trays to stop the water from leaking.
5. Gently give all 5 pots the same amount of water (about 10ml).
6. Place the pots in the polytunnel.

General method:

1. Check each pot at 12:30 each day (ignoring weekends).
2. Take any sensor readings before watering.
3. If the soil feels dry to the touch then gently add 20ml* of water to each of the pots. If it is very wet to the touch, do not water that day†.
4. Starting from week 2, on the last day (Friday) of each week, carefully measure the height of the plants. Take the tallest measurement from the seedlings in each pot. Note the number, colour and size of any leaves.

Plant growth result table, to be taken at the end of each week, starting at the end of week 2:

Date / Pot number	Growth (cm)				Number of leaves				Notes on colour and size of leaves			
	1	2	3	4	1	2	3	4	1	2	3	4
01/03/2024												
08/03/2024												
…												

Technology used:

Micro:bit v2
Keyestudio Microbit breakout board
Keyestudio 37 in 1 starter kit
Battery packs
Capacitive soil moisture sensors
Temt6000 ambient light sensor module
DHT22 Temperature and Humidity sensor

* You may wish to adjust this if the pot is very dry, e.g. if the pot is in a warm dry environment, it may need 40ml or more per day. Running an experiment on how much water to give first may be very useful.
† In a humid/enclosed environment, plants may retain the water better so not need as much.

Experiment 1: How much light do plants need?

In this experiment, we will be looking at how different amounts of light change a plant's growth.

What is changed for each pot:

1. No light
2. Light for 2.5 hours a day
3. Light for 6 hours a day
4. Light for 10 hours a day (length of daylight in March)
5. Light for 24 hours a day (optional extra pot)

Additional equipment:

- 3 x cardboard boxes with air holes
- Separate trays for each pot
- 1 Micro:bit, breakout board and power supply
- 2 Light sensors and wires
    - As the light sensor readings will be taken when the covers are off for pots 2-4, only one light sensor is needed on one of these pots. The other light sensor is for the pot remaining in the dark.
- Tape
- LED Light source with power supply and additional light sensor (optional extra equipment)

Additional setup:

1. Make three box covers with air holes. The air holes should be around the bottom when covering the pots to minimise light reaching the pots.
2. Connect the wires to the light sensors.
3. Tape the wires to hold the light sensors on the sides of pots 1 and 2, without them getting wet or dirty.
4. Ensure the wires are accessible outside of the box whilst covered. Label pins for each wire as necessary.

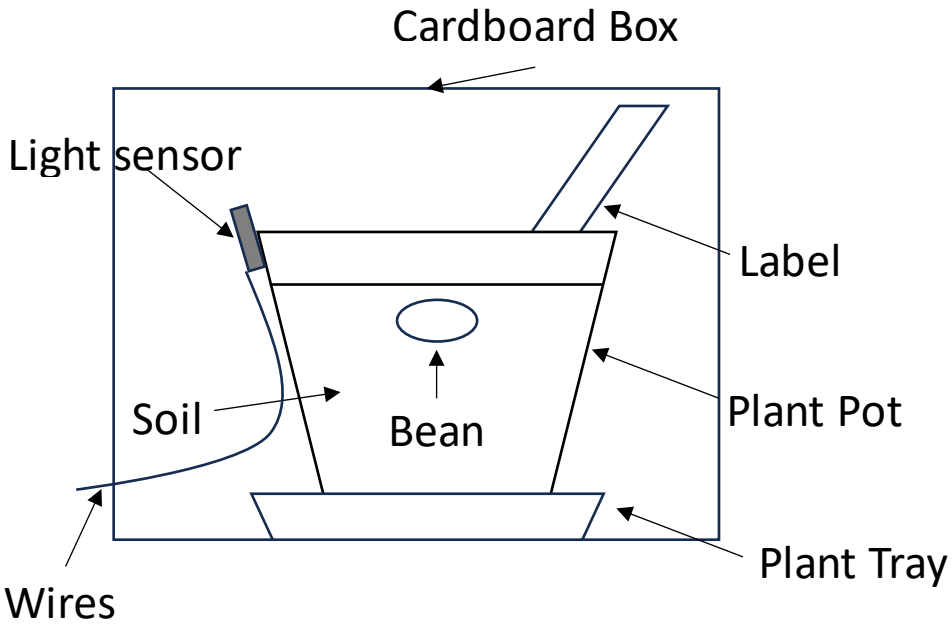
Additional method:

1. Keep pot 1 covered all the time.
2. Remove cover of pot 2 at morning breaktime (11.30am). Replace cover of pot 2 at afternoon breaktime (2pm).
3. Remove cover of pot 3 on arrival at school (8:50am). Replace cover of pot 3 when leaving school (3.10pm).
4. Keep pot 5 with a light shining on it all the time (for optional extra pot)
5. At 12.30pm, take three readings from each of the light sensors using the Micro:bit and record the average for each sensor (add three readings together and divide by three).
    a. When taking sensor readings, connect the S pin from the sensor to the yellow pin 0 on the breakout board. Sensor V and G pins should be connected to V and G breakout board pins.
    b. Make sure the program given in the method is uploaded to the Micro:bit.

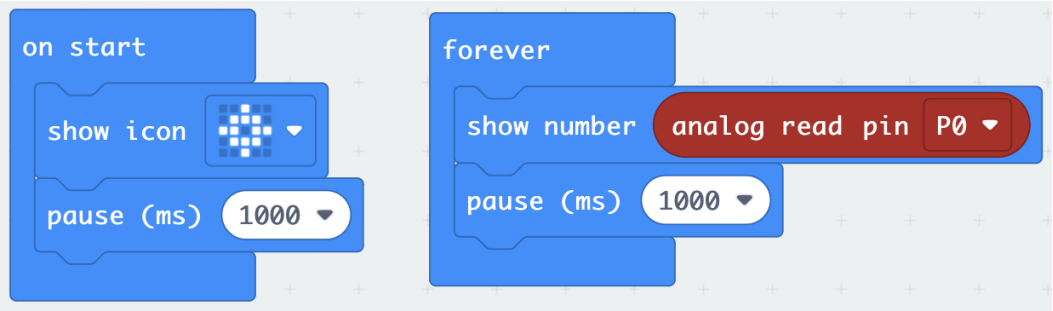
c. Connect the power pack and turn it on to start getting readings displayed on the Micro:Bit.

6. Add water to tray instead of on top.
7. When watering plants whilst covered, carefully lift the cover slightly, to add water to the tray.

Diagram for experiment 1:



Micro:bit Program



Sensor reading results table

Date	Sensor readings	
	Pot 1	Pots 2-4
20/02/2024		
21/02/2024		
…		

Experiment 2: How much water do plants need?

In this experiment, we will be looking at how different amounts of water change a plant's growth.

What is changed for each pot:

1. No water
2. 10ml water
3. 20ml water
4. 30ml water
5. 40ml water

Additional equipment:

- 5 Micro:bit, breakout board and power supply[‡]
- 5 Soil moisture sensors and wires. Alternative soil humidity sensor in 37 in 1 starter kit
- 5 plant trays/saucers, one for each pot

Additional setup:

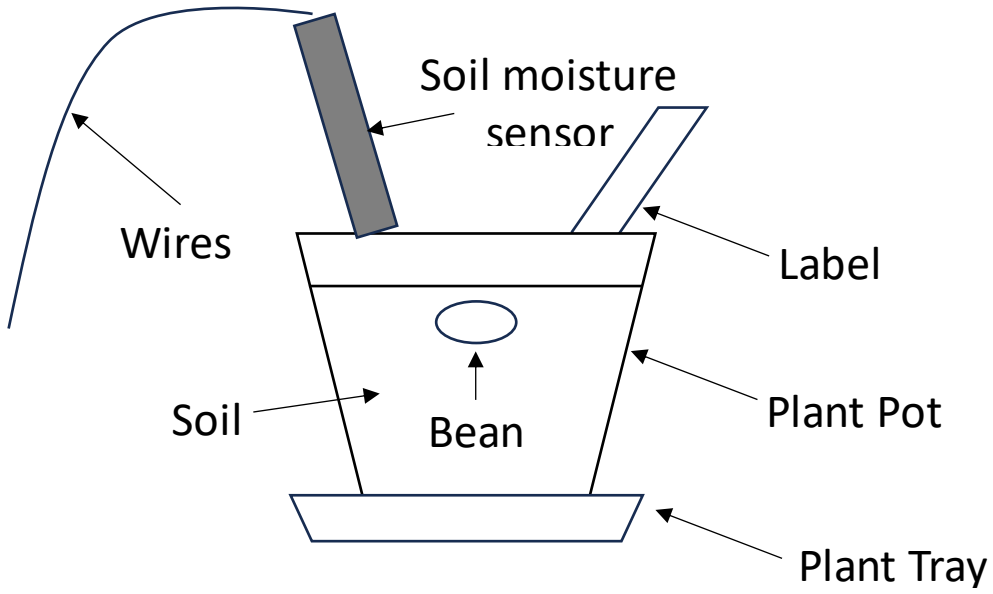
1. When giving initial water, give water based on pot amounts (0ml, 10ml, 20ml, 30ml, 40ml).
2. Attach the wires to the soil moisture sensors.
3. Carefully avoiding the seeds, insert the soil moisture sensors no deeper than covering the word "sensor" on the component. The sensor should be left in place between readings.

Additional method:

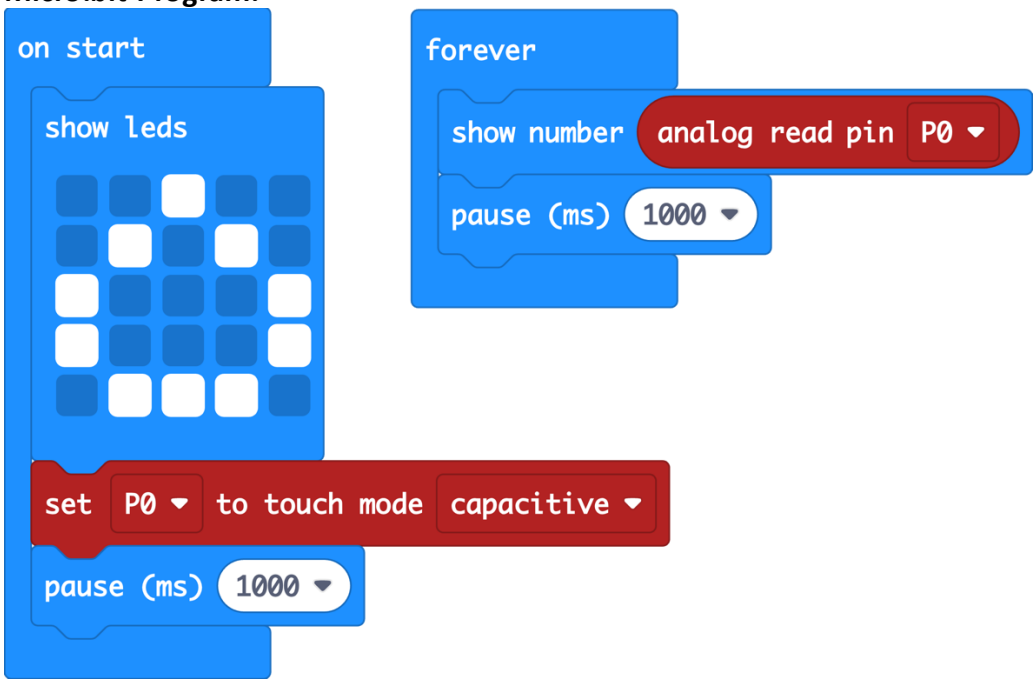
1. At 12.30pm, take three readings from each of the soil moisture sensor using the Micro:bit and record the average for each sensor (add three readings together and divide by three)
    a. When taking sensor readings, connect the AOut pin from the sensor to the yellow pin 0 on the breakout board. Sensor VCC and GND pins should be connected to V and G breakout board pins.
    b. Make sure the program given in the method is uploaded to the Micro:bit.
    c. Connect the power pack and turn it on to start getting readings displayed on the Micro:Bit.
    d. Take a second set of readings after watering the plant.
2. If the soil in pot 3 feels dry, add water to the plant tray based on pot amounts (0ml, 10ml, 20ml, 30ml, 40ml), up to limit of what the plant tray can hold.

[‡] Up to 3 soil sensors can be attached to one microbit, however to get most accurate reading, it is recommended to just connect 1 soil sensor. Ensure microbit is powered with 5V.

Diagram for experiment 2:



Micro:bit Program:



Note, if using the sensor from the starter kit, remove the block to set P0 to touch mode capacitive.

Sensor reading results table

Date	Sensor readings			
	Pot 1	Pot 2	Pot 3	Pot 4
20/02/2024				
21/02/2024				
…				

Experiment 3: What colour light do plants best grow in?

In this experiment, we will be looking at how different colours of light change a plant's growth.

What is changed for each pot:

1. Day light (natural)
2. Red light
3. Blue light
4. Purple light
5. Optional: Other colours if available, e.g. could use LEDs from starter kit if power is available

Additional equipment:

- 3 x cardboard boxes with air holes around the base and coloured cellophane lids
- Separate trays for each pot
- 4 x light sensors and wires
- 1 Micro:bit, breakout board and power supply
- Tape
- Coloured cellophane in different colours (e.g. red and blue)

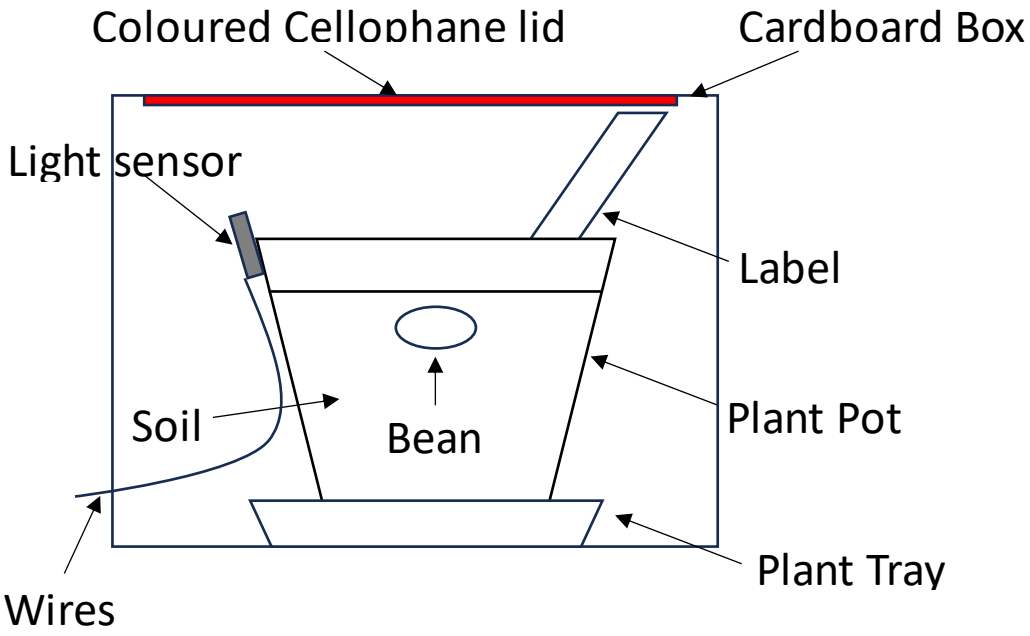
Additional setup:

1. Make three boxes with cellophane lids, where one has a red lid, one has a blue lid, and one combines red and blue to make a purple lid.
2. Connect the wires to the light sensor.
3. Tape the wires to hold the light sensor on the side of the pot without it getting wet.
4. Ensure the wires are accessible outside of the box whilst covered. Label pins for each wire as necessary.

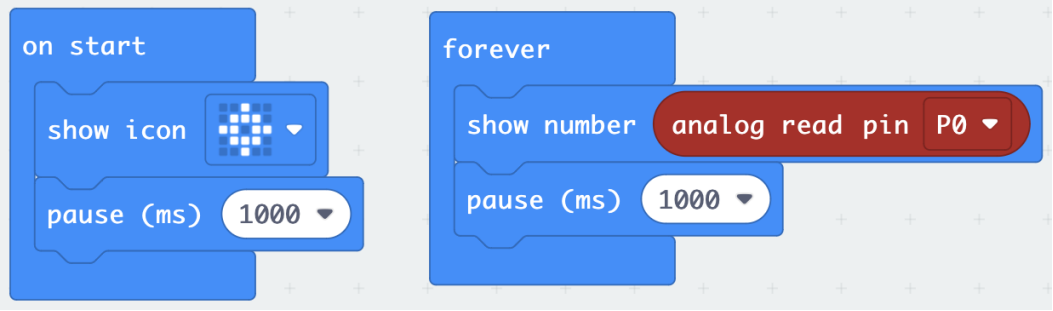
Additional method:

1. At 12.30pm, take three readings from each of the light sensor using the Micro:bit and record the average for each sensor (add three readings together and divide by three).
    a. When taking sensor readings, connect the S pin from the sensor to the yellow pin 0 on the breakout board. Sensor V and G pins should be connected to V and G breakout board pins.
    b. Make sure the program given in the method is uploaded to the Micro:bit.
    c. Connect the power pack and turn it on to start getting readings displayed on the Micro:Bit.
2. When watering, add water to the plant trays whilst trying to minimise how much natural light gets in.

Diagram for experiment 3:



Micro:bit Program:



Sensor reading results table:

Date	Sensor readings			
	Pot 1	Pot 2	Pot 3	Pot 4
20/02/2024				
21/02/2024				
…				

Experiment 4: How much soil do plants need?

In this experiment, we will be looking at how different amounts of soil change a plant's growth.

What is changed for each pot:

1. No soil
2. Quarter fill with soil
3. Half fill with soil
4. Three quarters fill with soil
5. Fill with soil

Additional equipment:

- 1 Micro:bit, breakout board and power supply.
- 1 x Humidity/Steam sensor (from Keyestudio starter kit) and wires.

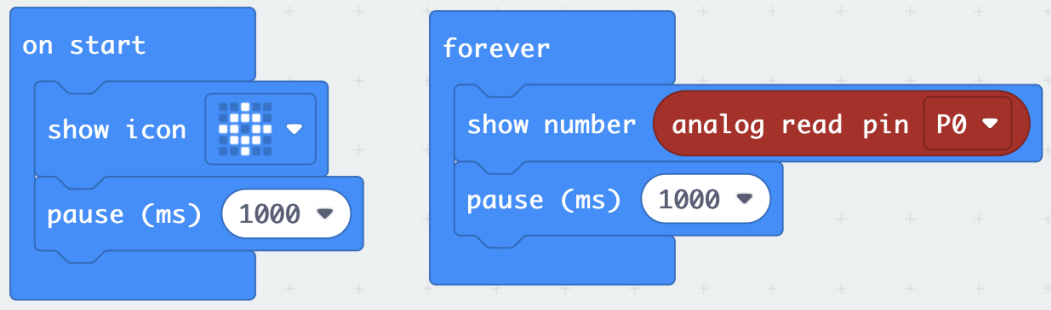
Additional setup:

- Attach the wires to the humidity sensor.
- The sensor is to measure the humidity generally in the polytunnel. It can be placed on a table beside the plant pots without being attached to any one pot.

Additional method:

1. At 12.30pm, take three readings from the humidity sensors using the Micro:bit and record the average for each sensor (add three readings together and divide by three).
    a. When taking sensor readings, connect the S pin from the sensor to the yellow pin 0 on the breakout board. Sensor V and G pins should be connected to V and G breakout board pins.
    b. Make sure the program given in the method is uploaded to the Micro:bit.
    c. Connect the power pack and turn it on to start getting readings displayed on the Micro:Bit.

Micro:bit Program



Sensor reading results table:

Date	Sensor readings
20/02/2024	
21/02/2024	
…	

Experiment 5: What is the best temperature to grow plants?

In this experiment, we will be looking at how different temperatures change a plant's growth. The plants will need to be places in different locations so it will not be possible to control conditions to the same level as other experiments, e.g. Carbon Dioxide levels in a classroom will be higher than in the polytunnel.

What is changed for each pot:

1. Above a radiator in the classroom
2. Away from radiator in the classroom
3. Sheltered outside (so it doesn't get blown away)
4. In polytunnel
5. Any other agreed location with different temperature (optional extra pot)

Additional equipment:

- 1 Micro:bit, breakout board and power supply
- 4 Temperature/Humidity sensors and wires
- Tape

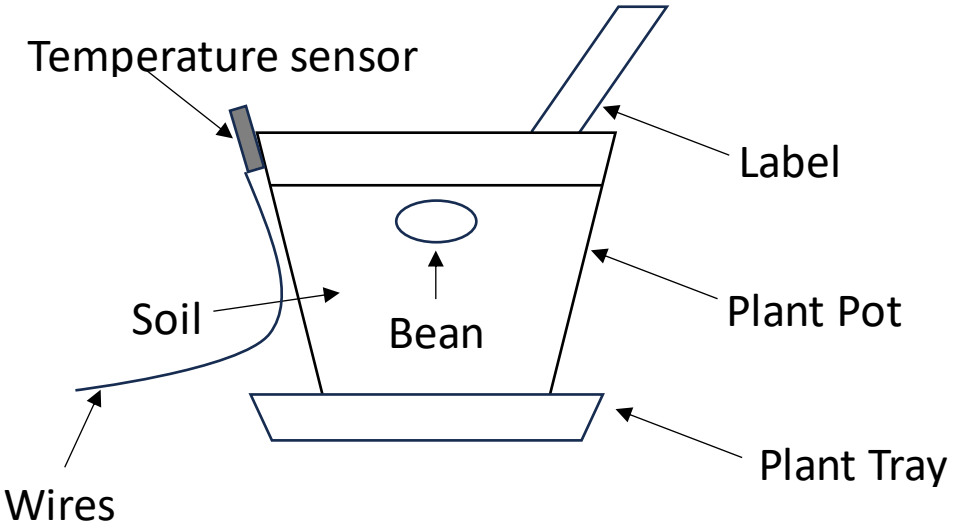
Additional setup:

- Connect the wires to the temperature sensor.
- Tape the wires to hold the temperature sensor on the side of the pots, without them getting wet.
- Place the pots in their locations.

Additional method:

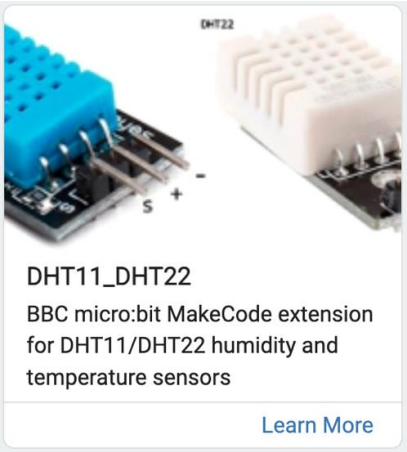
1. At 12.30pm, go to each of the pots to take three readings from the temperature-humidity sensors, for both temperature and humidity, using the Micro:bit and record the average for each sensor (add three readings together and divide by three).
    a. When taking sensor readings, connect the "out" pin from the sensor to the yellow pin 0 on the breakout board. Sensor + and - pins should be connected to V (+) and G (-) breakout board pins.
    b. Make sure the program given in the method is uploaded to the Micro:bit.
    c. Connect the power pack and turn it on to start getting readings displayed on the Micro:bit.

Diagram for experiment 5:

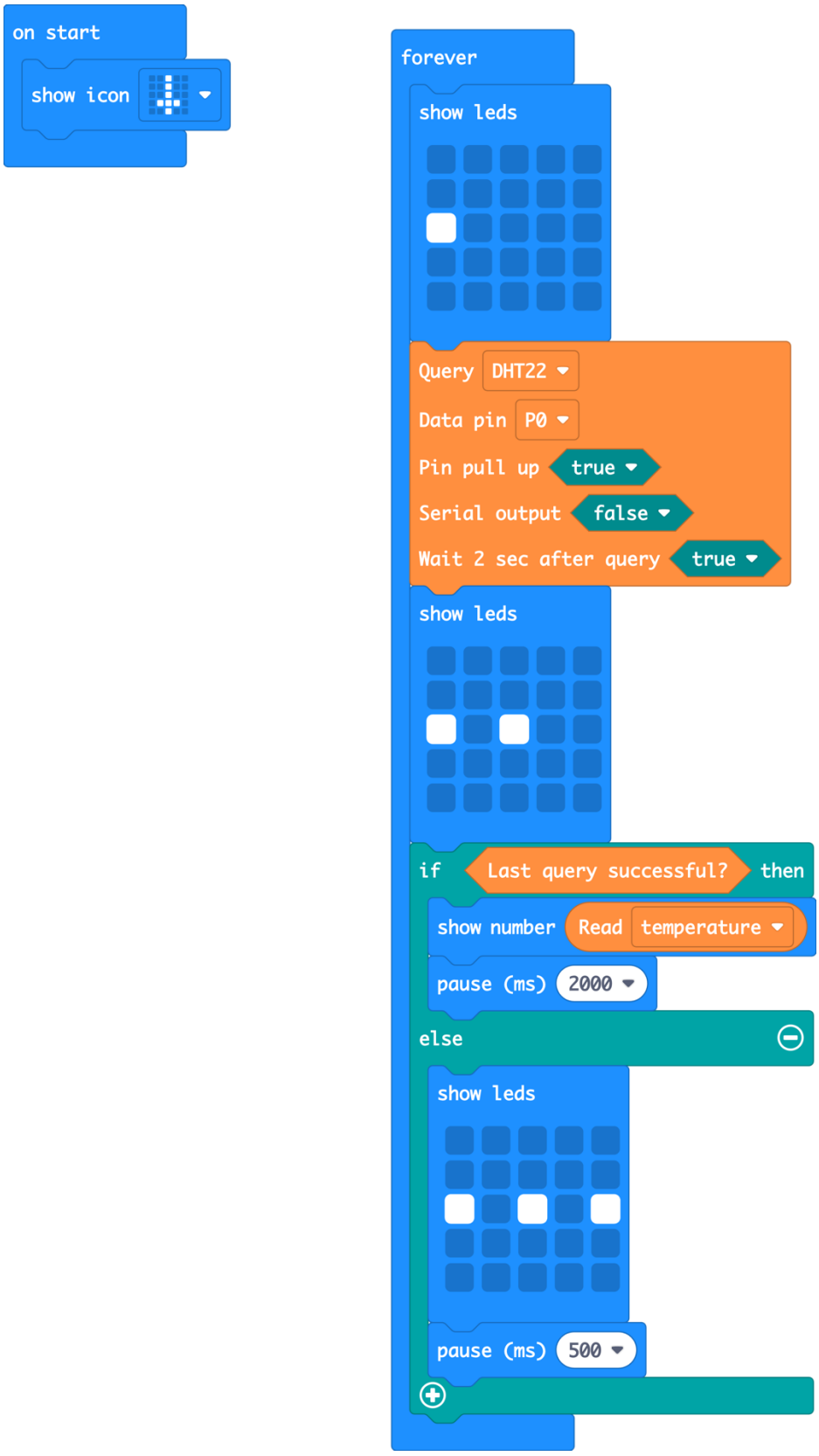


Date	Sensor readings			
	Pot 1	Pot 2	Pot 3	Pot 4
20/02/2024				
21/02/2024				
…				

Program for microbit:
Requires extension "DHT11_DHT22", you will need to search for this:



Alternatively can use LM35 Temperature sensor from 37 in 1 Starter Kit, with a simple analog read program.



Also read the Humidity value and record these results for each pot.