SMART PLANT SYSTEMS (MICRO:BIT + 3D DESIGN)

STUDENT'S NAME:

Key Concept: Systems

Related Concepts: Development, Function & Innovation

Global context: Scientific and Technical Innovation

STATEMENT OF INQUIRY

Understanding how systems function and develop allows us to design innovative solutions that use technology to monitor and improve environmental conditions.

Factual question: What environmental factors affect plant growth?

Conceptual question: How can data help us make better decisions?

Debatable question: To what extent should we rely on technology to manage natural systems?

ASSIGNMENT SUPPORT

Flower Pots Buying Guide

The Best Types of Pots for Plants

30 Indoor Plants That Like Direct Sunlight

THE CHALLENGE

Unit: Smart Plant Systems (Micro:bit + 3D Design)

Grade Level: Middle/Secondary

Duration: 5 Lessons (60–75 min each)

Subjects: Design, Technology, Science

Unit Overview

Students will design and grow a plant in a custom 3D-printed pot while building a micro:bit-based sensor system to monitor environmental conditions (light, temperature, and soil moisture). They will use data to make informed decisions about plant care.

Learning Objectives: By the end of this unit, students will be able to: Explain how environmental factors affect plant growth
Design a functional, plant-specific pot using CAD software
Program a micro:bit to collect and transmit environmental data
Interpret sensor data to improve plant care
Reflect on the effectiveness of their design and system

Formative Assessment: Research completion - CAD design progress - Coding checkpoints

Summative Assessment: Clear understanding of plant needs: Justification of design decisions - Functional pot (size, drainage, usability) - Micro:bit collects accurate data - Successful radio communication - Uses data to make decisions about plant care - Thoughtful analysis and improvements

3D POT DESIGN

REVIEW

LESSON 1
A // INQUIRING & ANALYZING

Choose a plant (herb, succulent, etc.)
Research

- **Sunlight needs**
- **Ideal temperature range**
- **Soil moisture requirements**
- **Pot size and drainage**

Extra Points: Research at least 2 different plants in order and compare different needs.

Include images, videos & links

KEEP YOUR ANSWERS BRIEF!

B

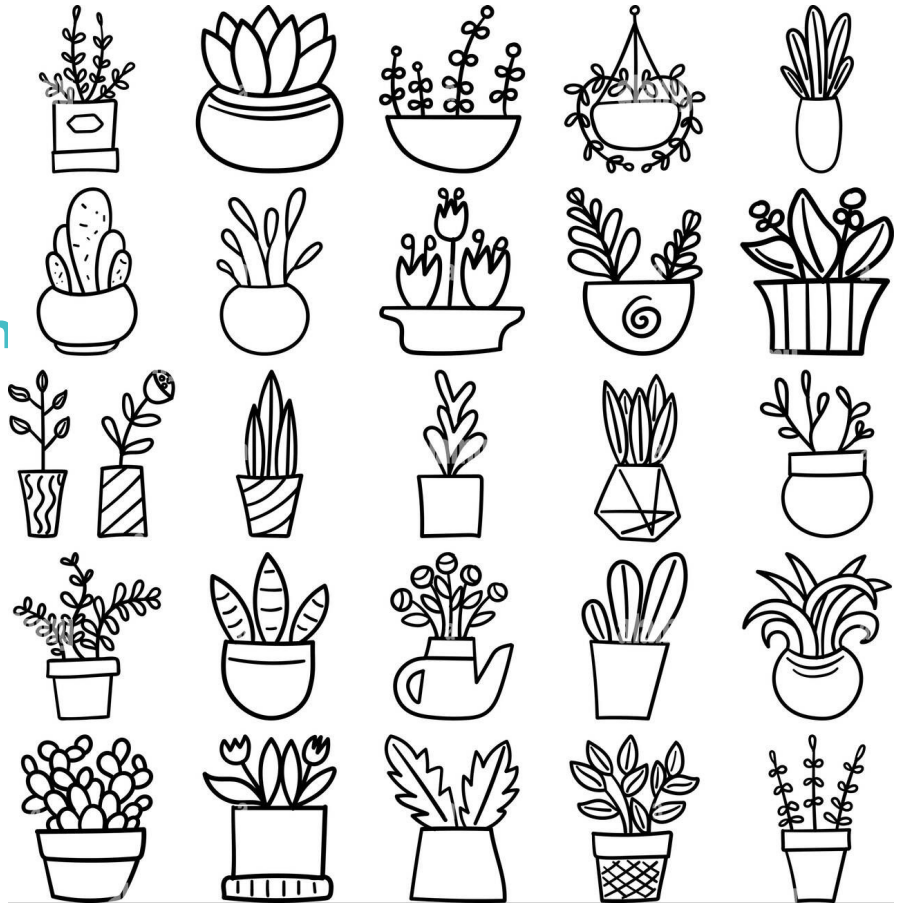
LESSON 2 B // DEVELOPING IDEAS

Sketch out 3 different ideas on what your pot may look like.

Key pot design features:

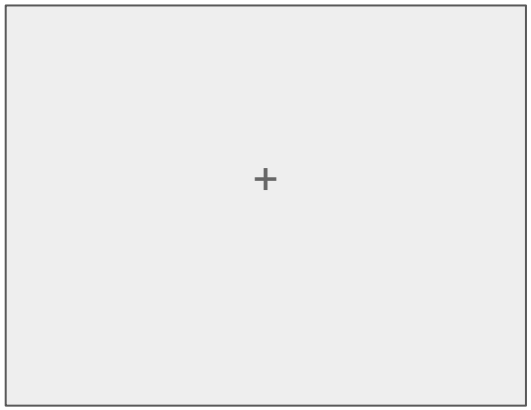
- Drainage holes
- Size and depth
- Stability
- Aesthetic design

Based on your chosen plant, which features do you think will be most important?

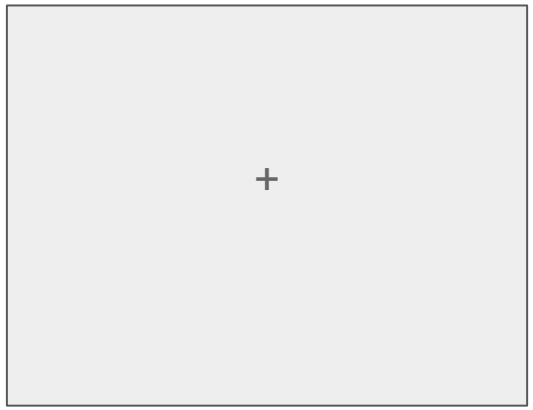


PRESENT

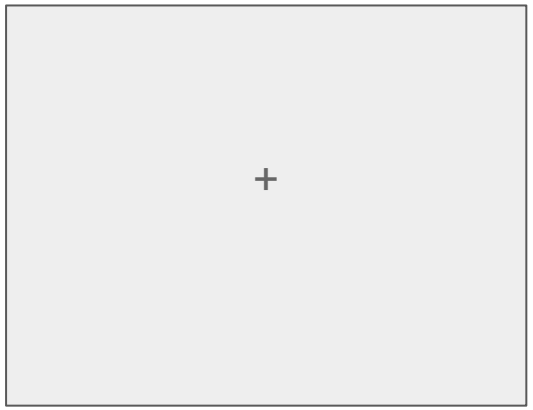
Present a range of feasible design ideas, which can be correctly interpreted by others.



... insert a description of your design.

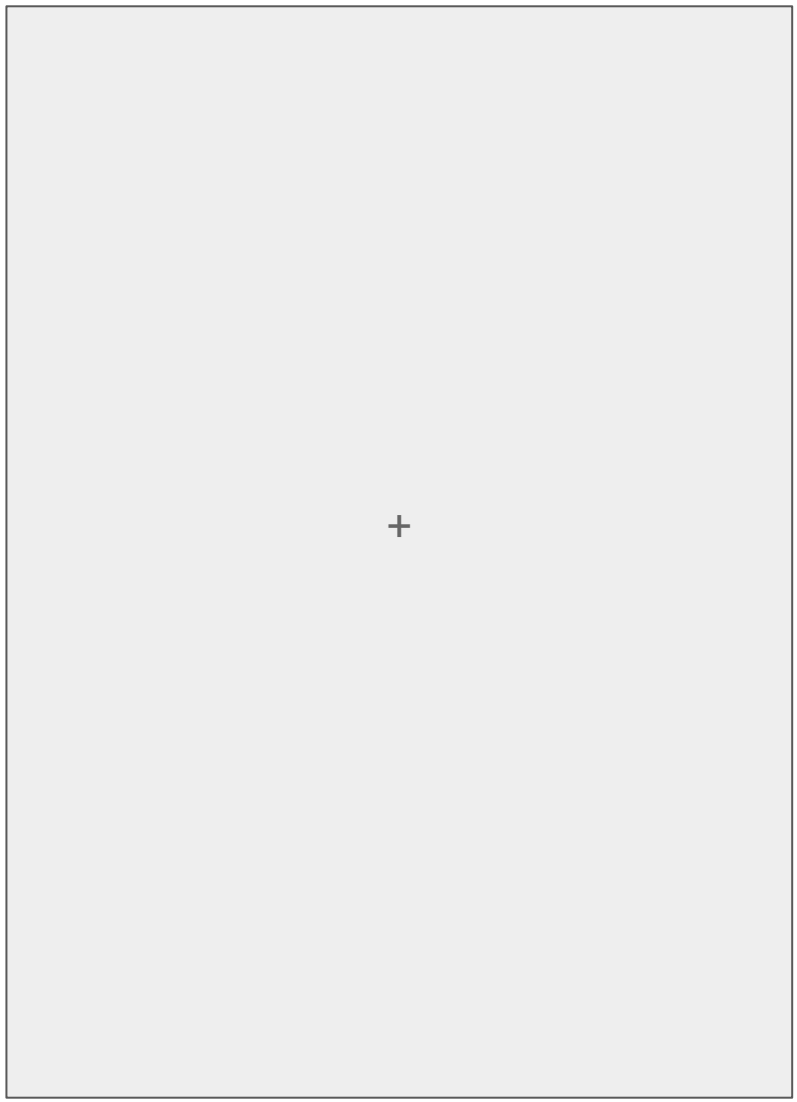


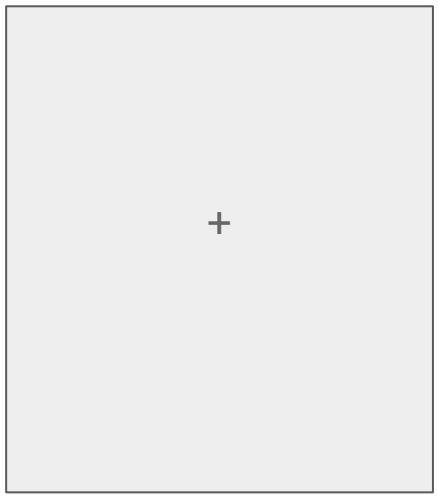
... insert a description of your design.

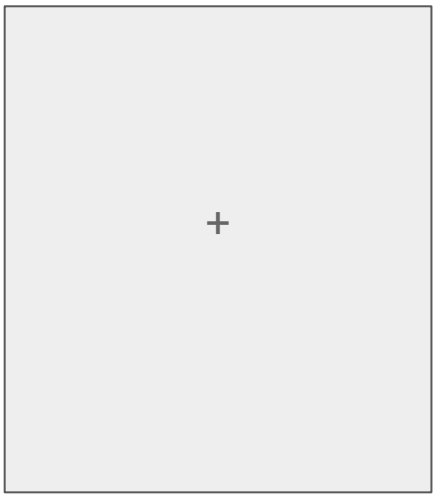


... insert a description of your design.

Present the chosen design and outline the reasons for its selection

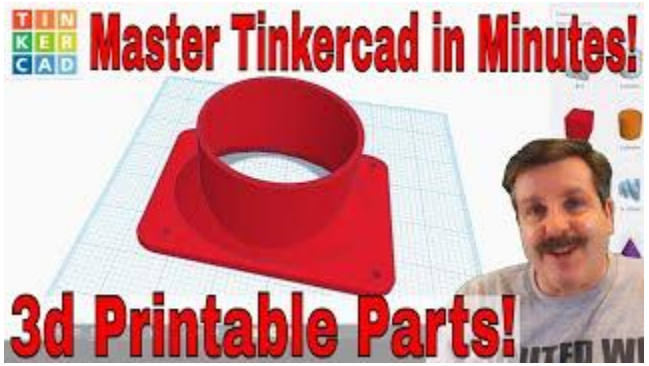






... describe why your group chose this design.

HELPFUL TINKERCAD LINKS



HELPFUL FUSION 360 LINKS

FUSION 360 // 2D Drawings & Schematics
- ➢ https://www.youtube.com/watch?v=L0IwfH-9Fss&authuser=0
- ➢ https://www.youtube.com/watch?v=wpdH0uoidxI&authuser=0

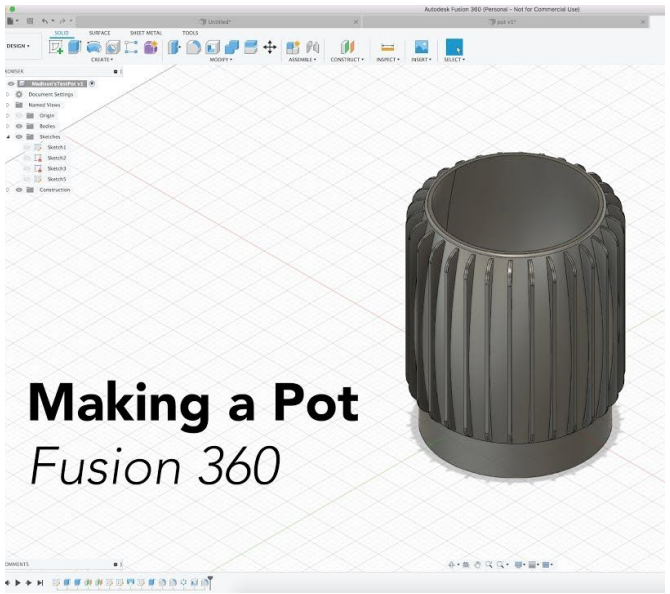
FUSION 360 // Holes
- ➢ https://www.youtube.com/watch?v=4bDNXpWQaW4&authuser=0

FUSION 360 // Align
- ➢ https://www.youtube.com/watch?v=tn4rSyvvk5Y&authuser=0

FUSION 360 // Interface
- ➢ https://www.youtube.com/watch?v=WKb3mRkgTwg&authuser=0
- ➢ https://www.youtube.com/watch?v=TeGNe9TYt-k&authuser=0
- ➢ https://www.youtube.com/watch?v=61Z78PpLidU&authuser=0

FUSION 360 // Beginner Tips
- ➢ https://www.youtube.com/watch?v=F6_Wy4SvhSY&authuser=0
- ➢ https://www.youtube.com/watch?v=tN6ItcyWtzI&authuser=0

FUSION 360 // Sketching
- ➢ https://www.youtube.com/watch?v=zxnIBdMTD9Q&authuser=0
- ➢ https://www.youtube.com/watch?v=gf7-80Yymr0&authuser=0
- ➢ https://www.youtube.com/watch?v=_MpL9fPAUG4&authuser=0
- ➢ https://www.youtube.com/watch?v=zWMqWVXG1QU&authuser=0
- ➢ https://www.youtube.com/watch?v=zgJNtKn9wfY&authuser=0



CLICK ON ME!

CREATING THE SOLUTION

STEP 1

- Create a CAD model of their pot
- Add annotations explaining:
  - Why size/shape suits plant
  - How drainage is addressed

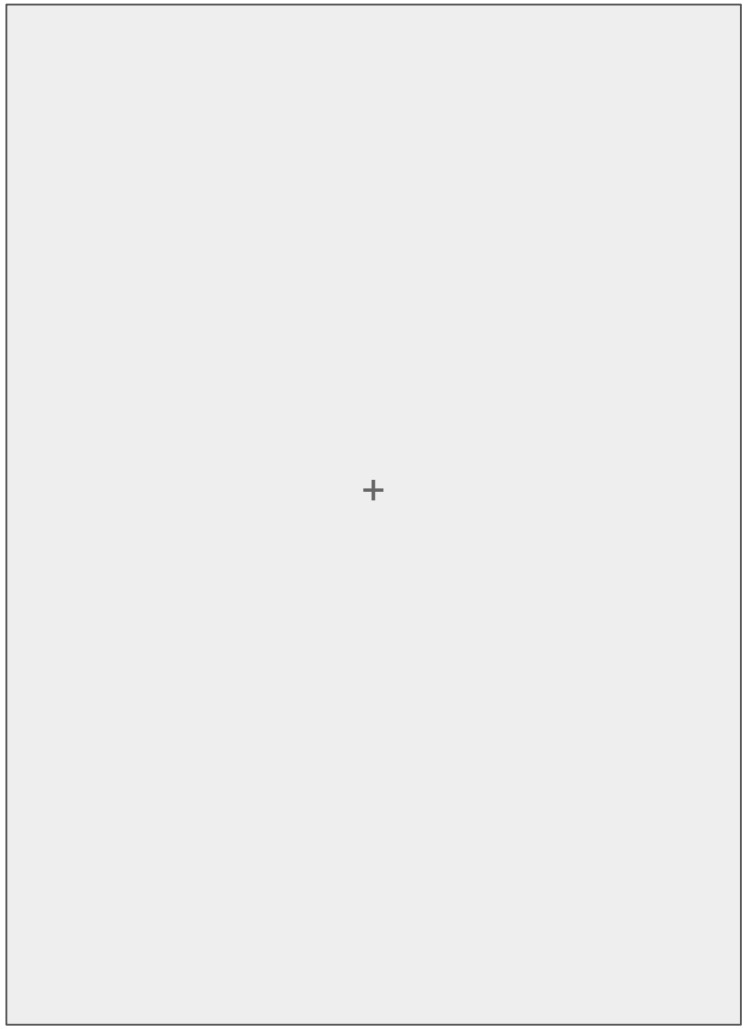
STEP 2

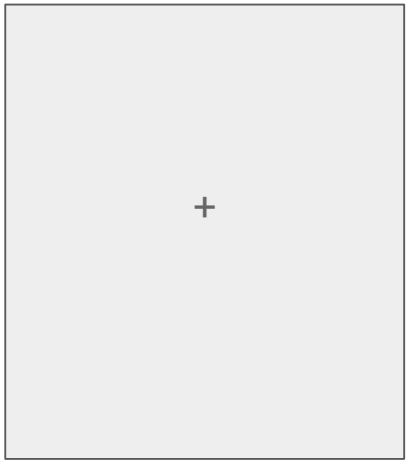
  - Finalize CAD designs
  - Export and prepare files for printing
  - Begin 3D printing (teacher may manage print queue)

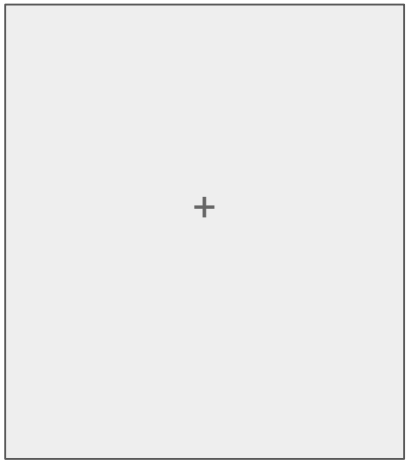
CREATING THE SOLUTION

Demonstrate excellent technical skills when making the solution

Document your process of building your physical prototype. Show me some of the steps you take while building your design.



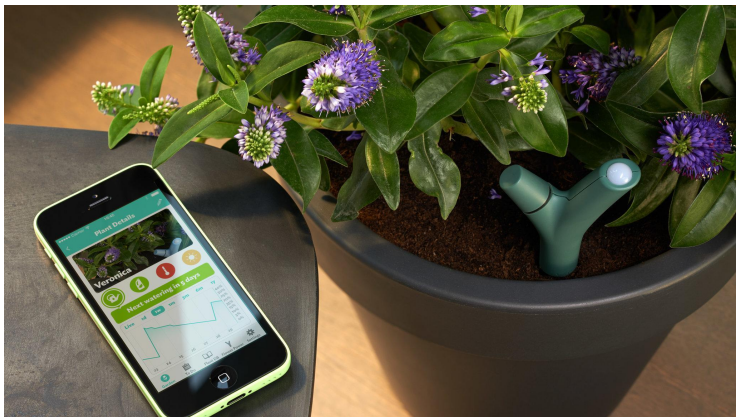




... describe what is being depicted.
(Add annotations and arrows to your pictures, too!)

PLANT MONITORING WITH MICRO:BIT SENSORS

A // INQUIRING & ANALYZING



Based on the plant you researched above, what are its most important needs (moisture, temperature, amount of light, etc.)?

Make a list of the most important things that you should be *monitoring* to keep your plant happy and healthy.

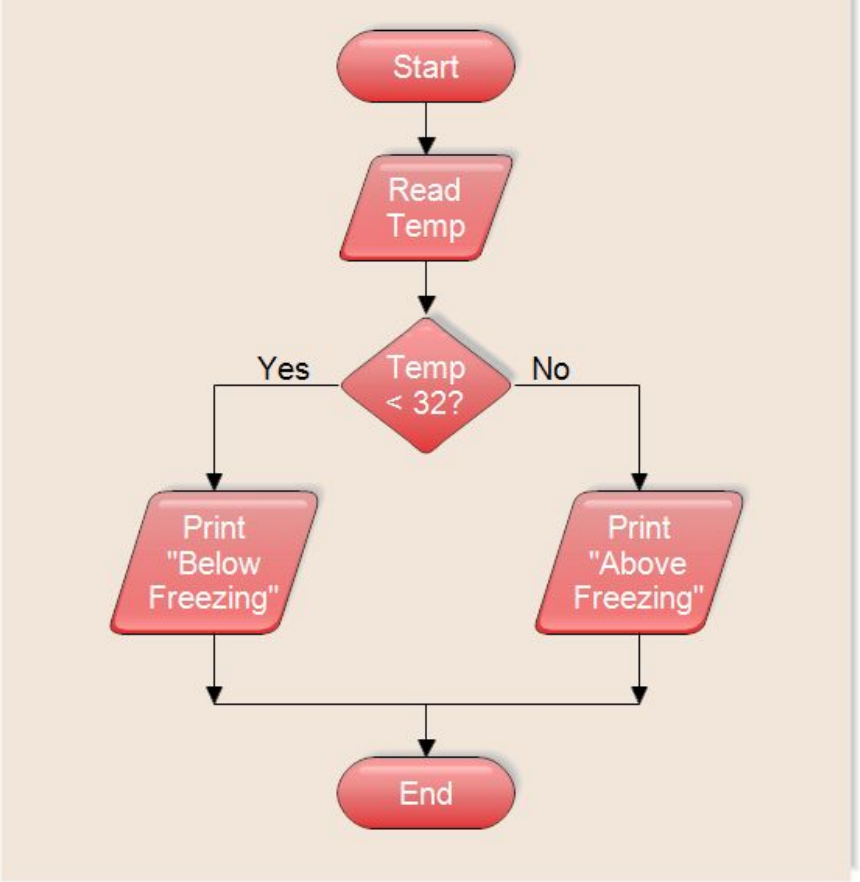
Write out a brief description of how you would want to get that information from your plant.

KEEP YOUR ANSWERS BRIEF!

A

LESSON 2 B // DEVELOPING IDEAS

For each group member, write or draw, step by step, a process for how you can take information from a LIGHT SENSOR, a THERMOMETER, and/or a SOIL MOISTURE SENSOR, and send it to another device.

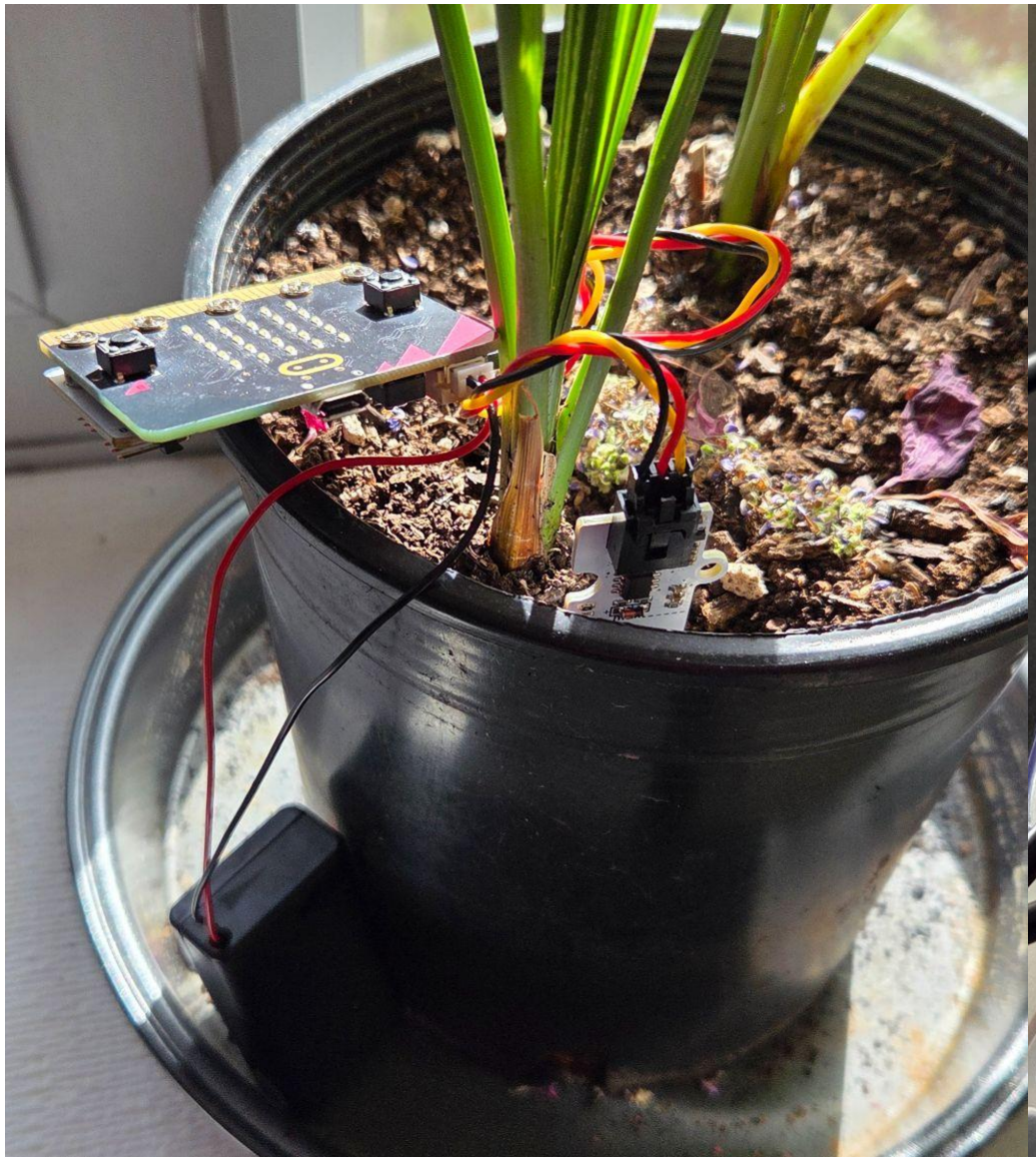


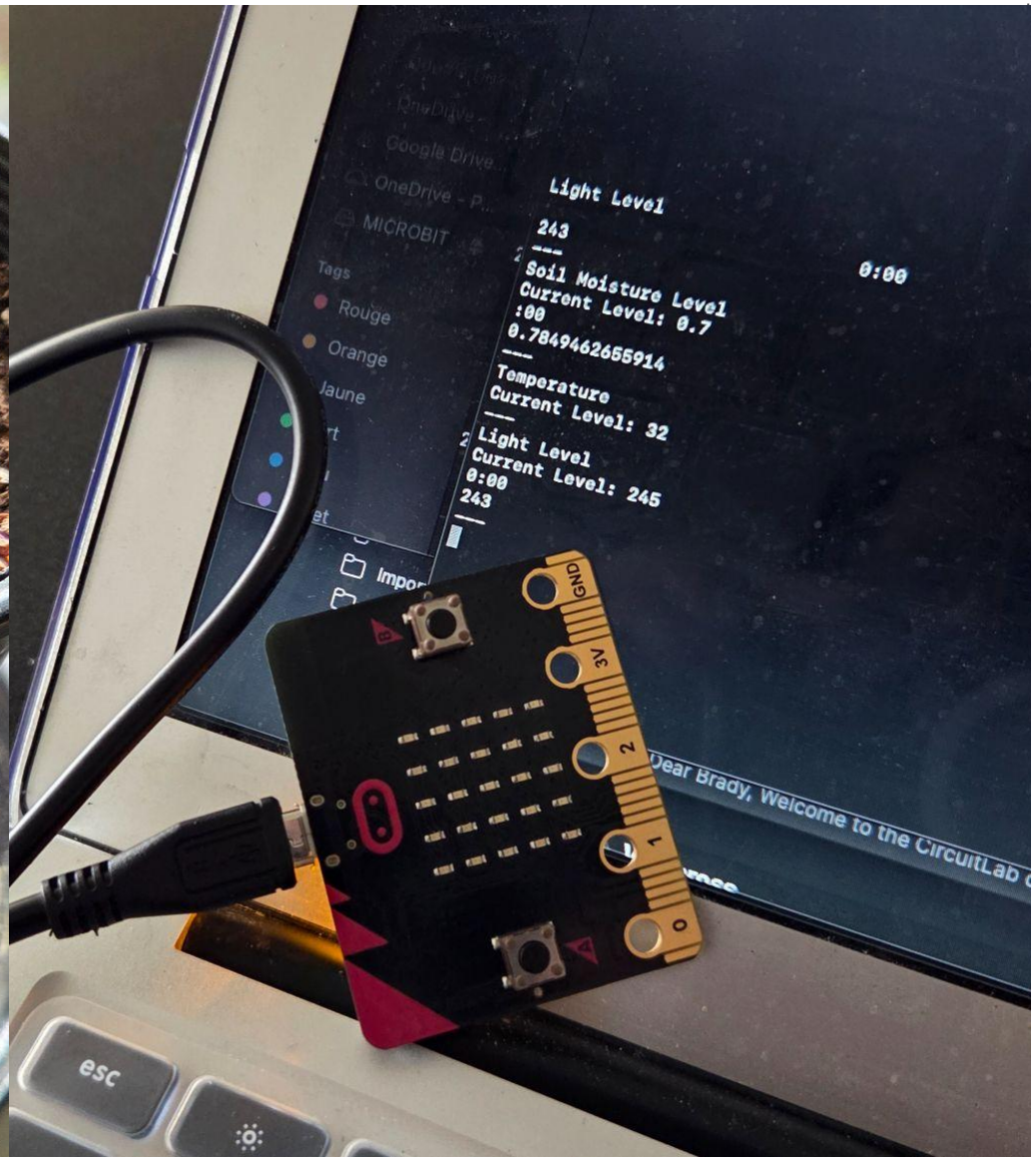
Don't just think about collecting the information — how would you want it *presented* to you? What would make it clear what you're reading? How often will you need to collect data? How often will you be able to read it?

Share your instructions with your partners. Can they follow along? Are you missing any steps?

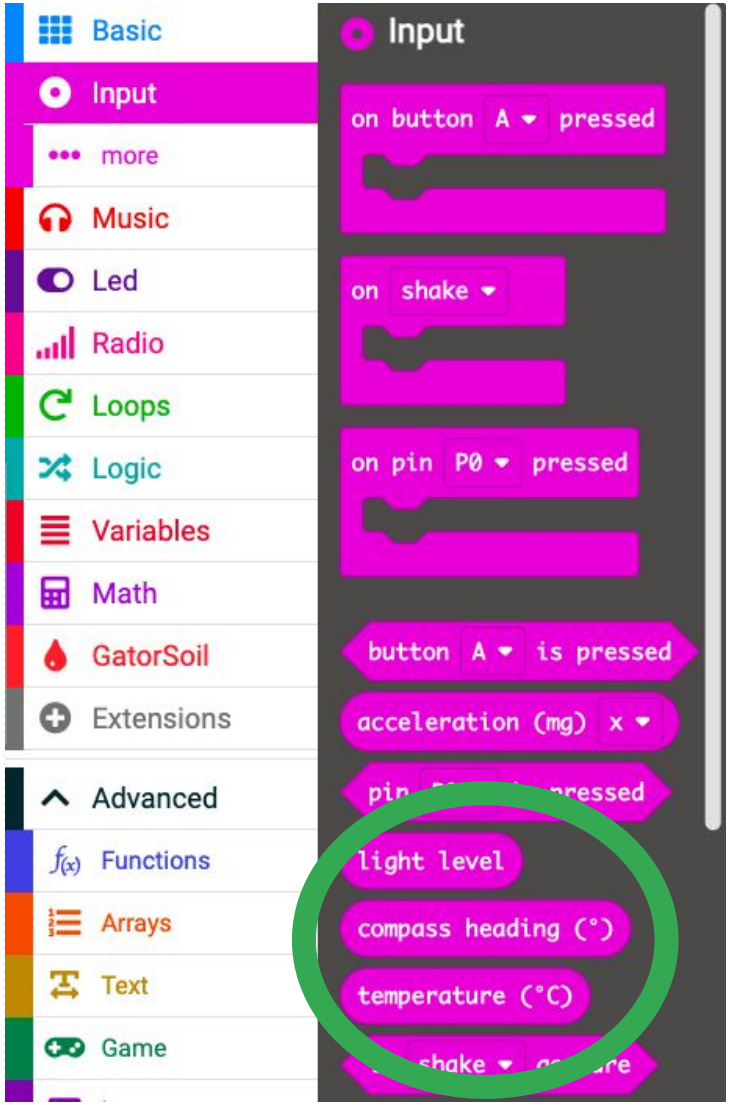
B

micro:bit sensors





micro:bit sensors



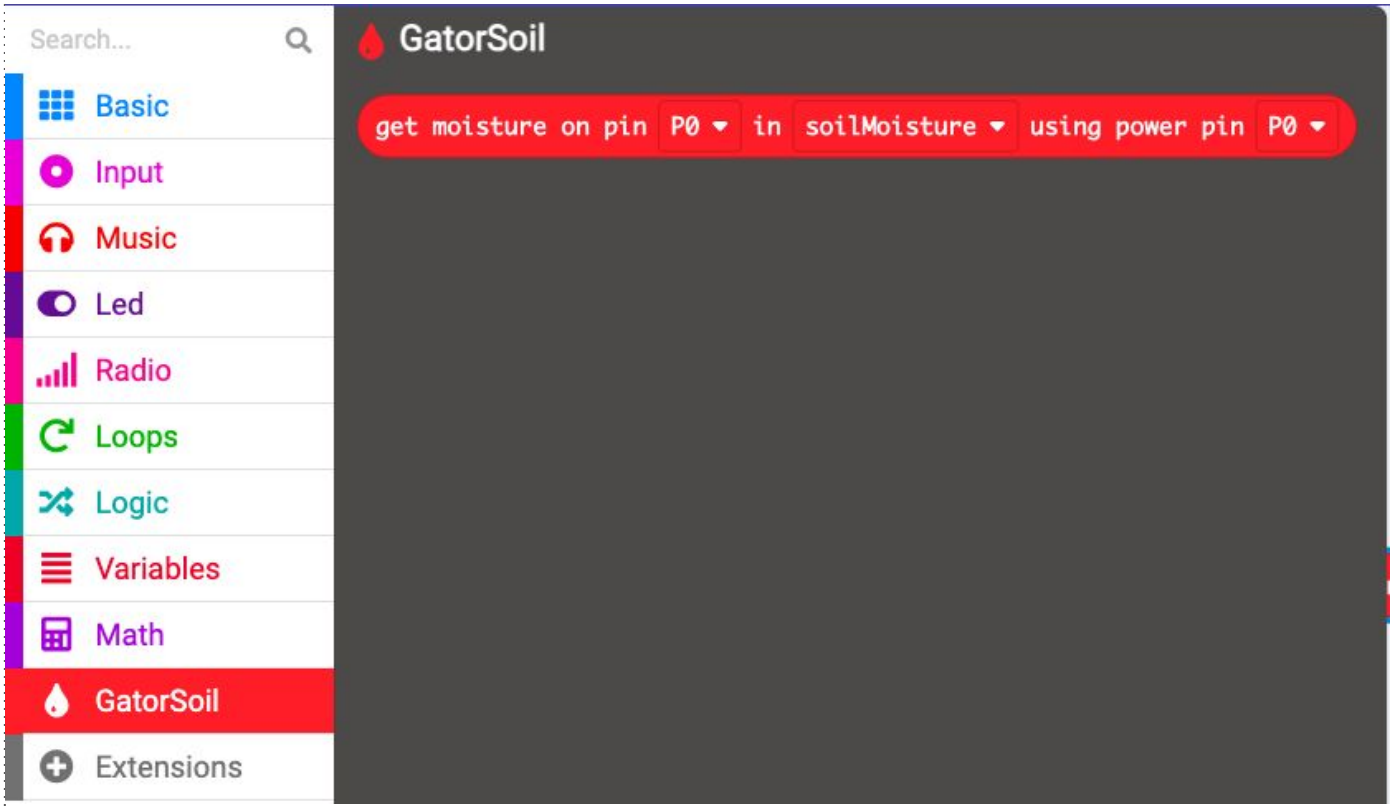
micro:bits have **sensors** that can gather data on a wide range of information.

some of these sensors are **built in** to the micro:bit, and some can be **connected** to it via **pins**.

some internal sensors you might find useful are the **led light sensor**, which can determine the amount of ambient light in the room, and the **thermometer**, which measures temperature.

micro:bit sensors

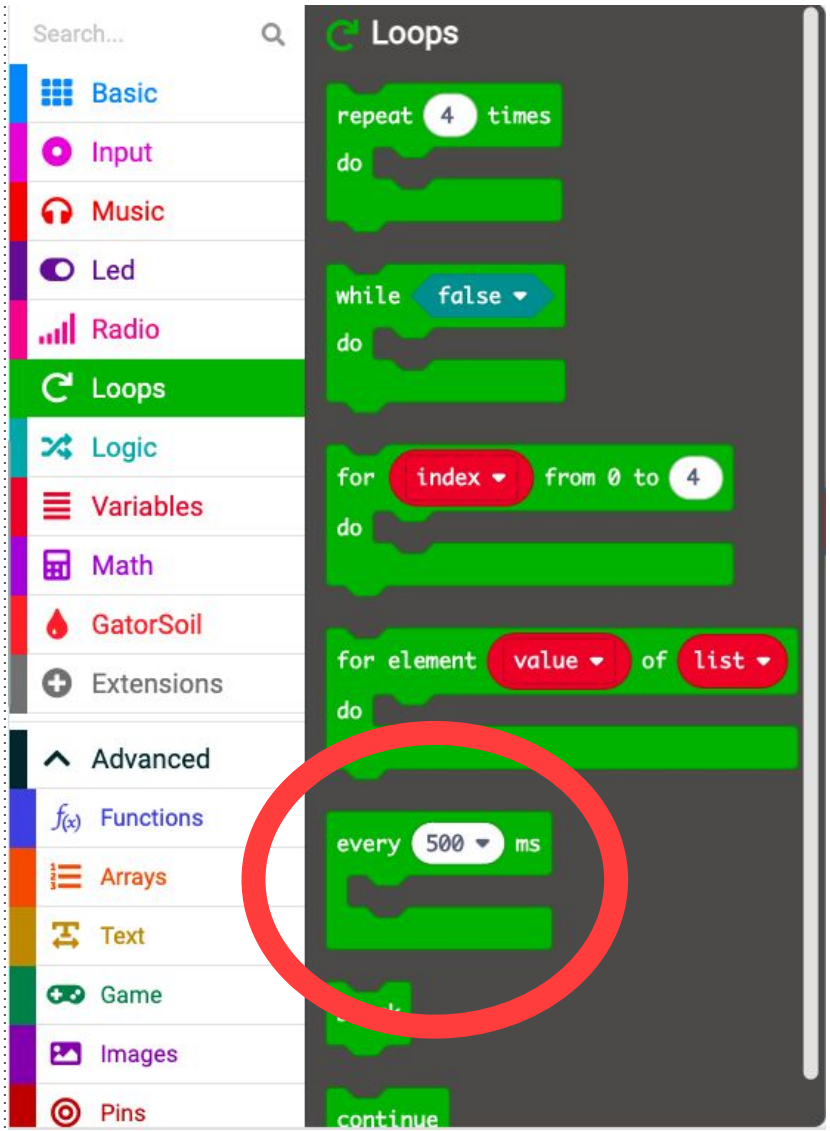
you might also use a separate **soil moisture sensor**, which requires a separate **extension** called **gatorsoil**.



to install extensions, click on **“extensions”** and type in what you’re looking for.

this will add its functions to your **library**!

loops



you'll probably need to check levels at regular intervals to make sure your plant stays healthy for as long as possible.

we can use **loops** to do the same thing over and over.

makecode gives you a lot of options for looping, like choosing a number of times, a true/false statement, or a time interval.

you'll probably want to use a **time interval** for your data, but what could you use the other options for?

remember: there are **1000 ms** in a second!

sample code

here's some (incomplete) code for the sensor. what does each line do?

how could you improve it?

what is it missing?

what could you do to make the data easier to access or easier to read?

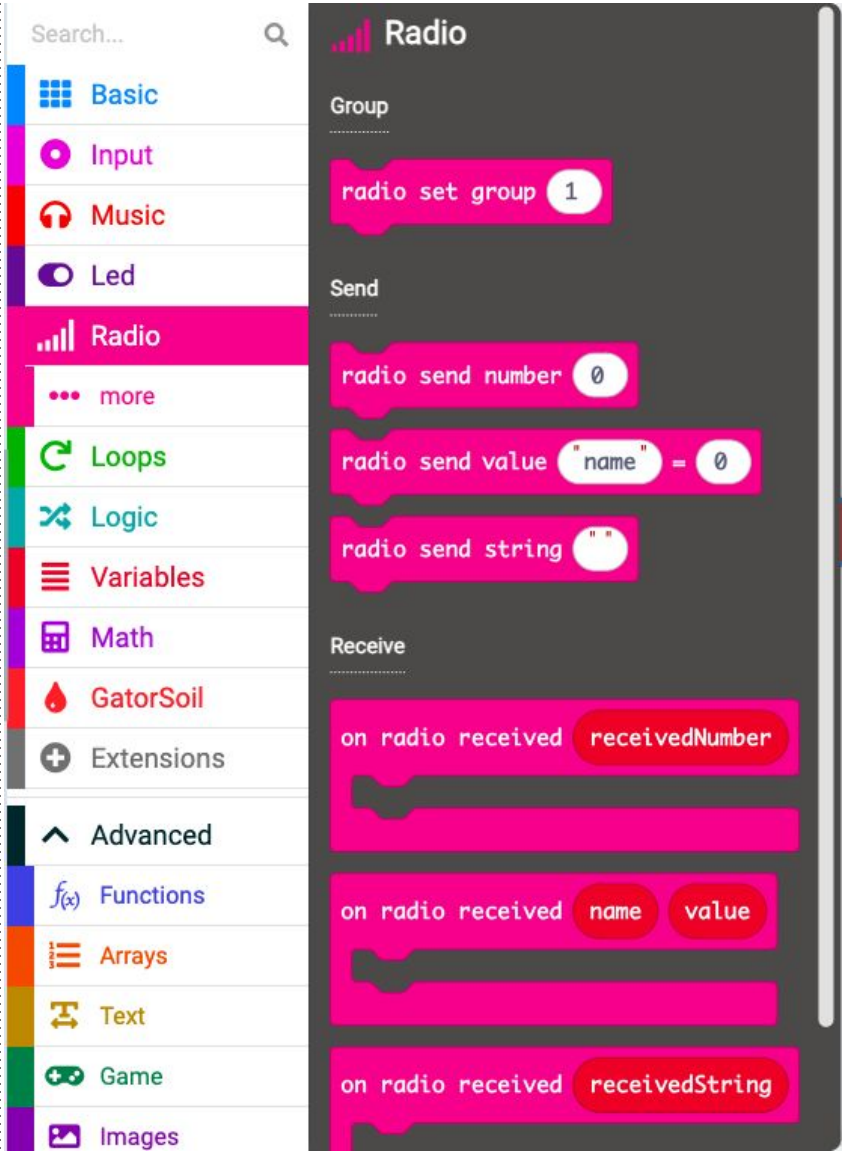
advanced micro:bit techniques

all of the techniques on the following six slides are **optional** for this assignment.

but if you want to **challenge yourself** to make something that really works as a sensor, i recommend giving them a try!

radio

micro:bit advanced



you've been given **two** micro:bits. micro:bits are able to communicate with one another, which allows you to send information from one to another.

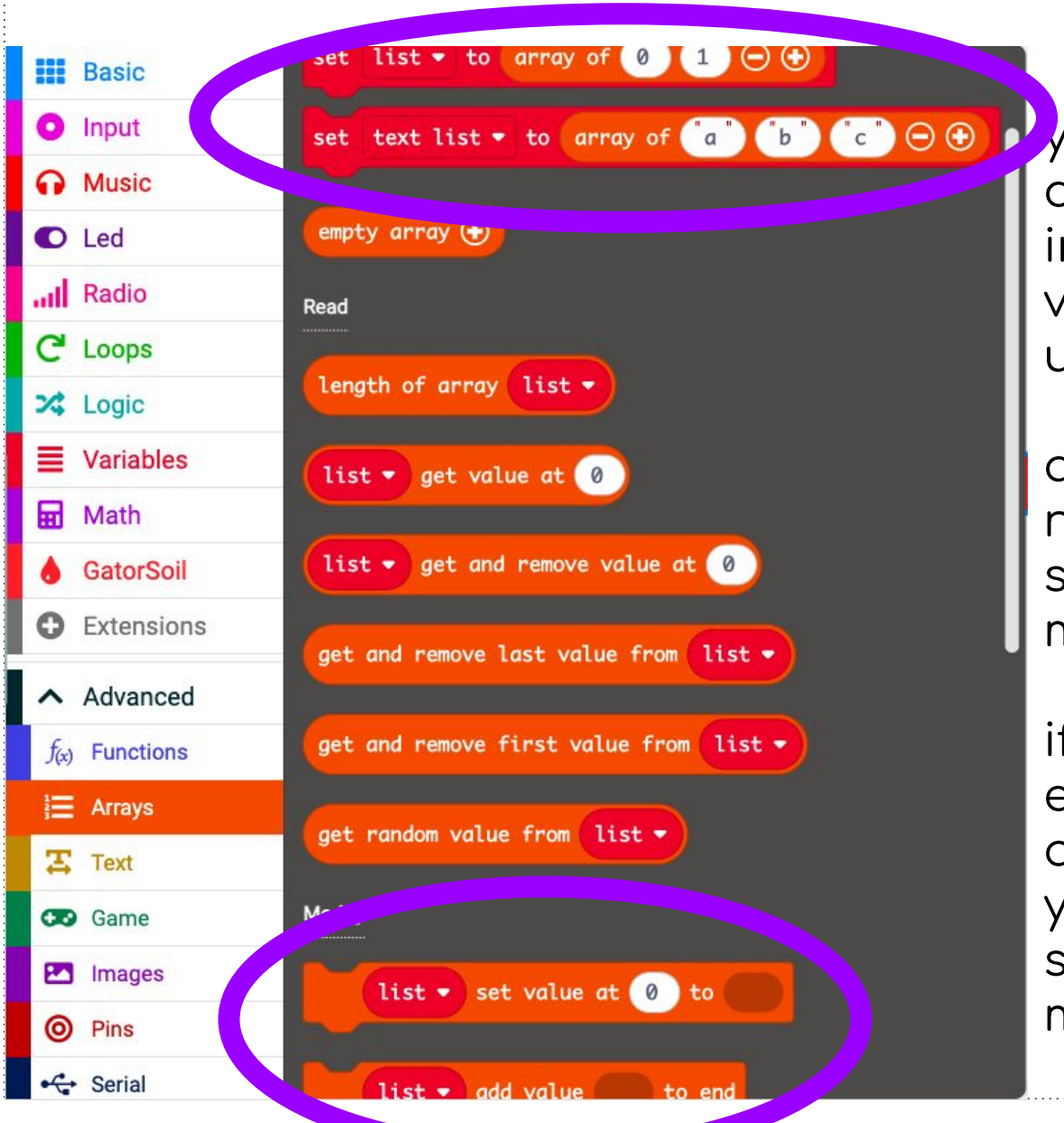
this means that you can set up one micro:bit in your pot, and use the other one to send data to your ipad or laptop through usb or bluetooth.

consider: are you going to always be able to connect to the sensor? how often are you going to be able to collect data?

one important note if you want to use **radio** functions: make sure you set both micro:bits to the same **group**!

arrays: writing

micro:bit advanced



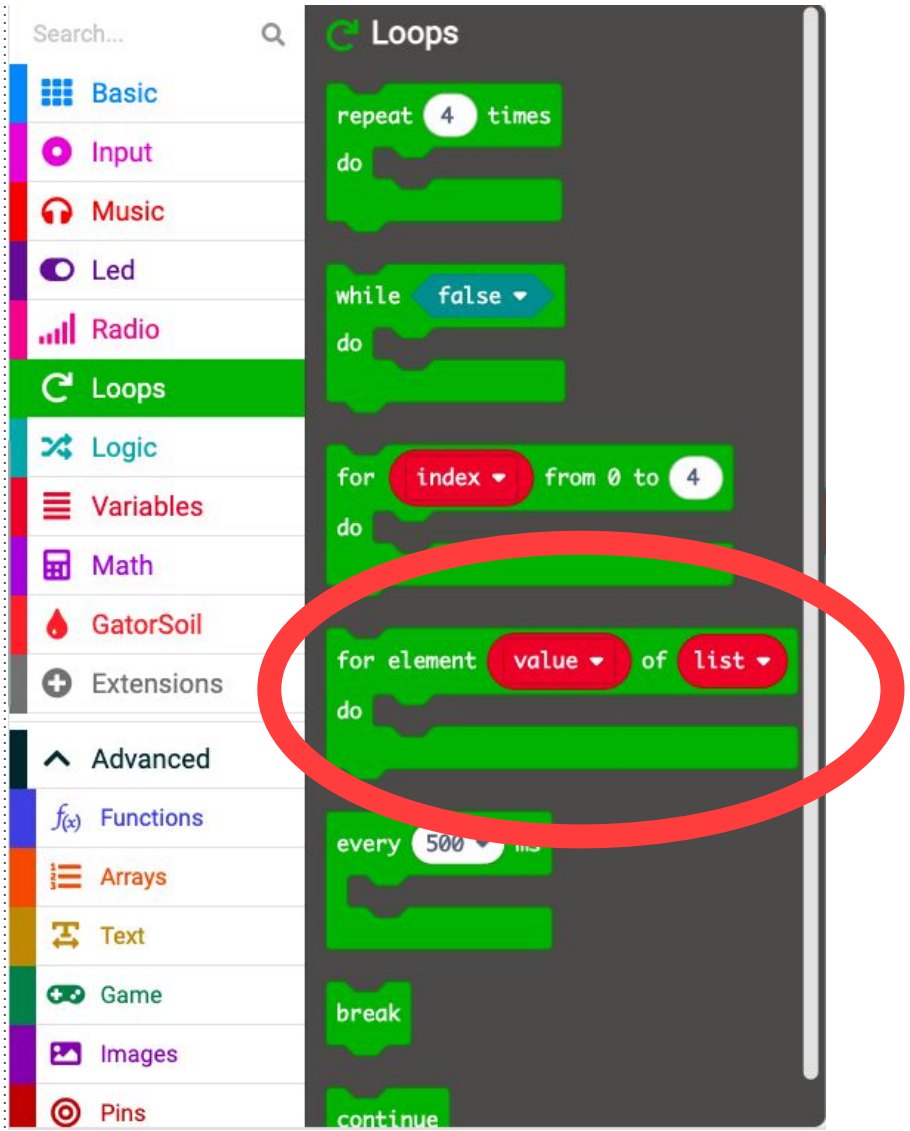
you might want to collect a lot of data and send it all at once. instead of making a new variable for each point, we can use **arrays**.

arrays are **lists** of text or numbers that are all saved and sorted together in the micro:bit's memory.

if you add a new value to the end of an **array**, it doesn't erase anything you added before; now you can have all of your data saved forever (or until the micro:bit runs out of memory)!

arrays: reading

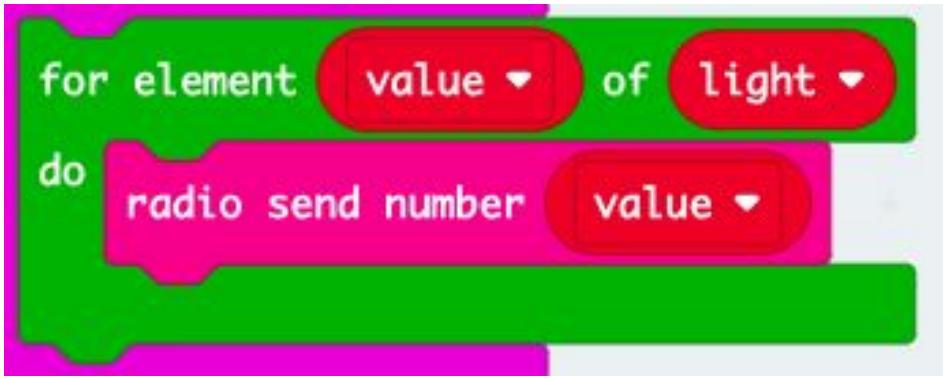
micro:bit advanced



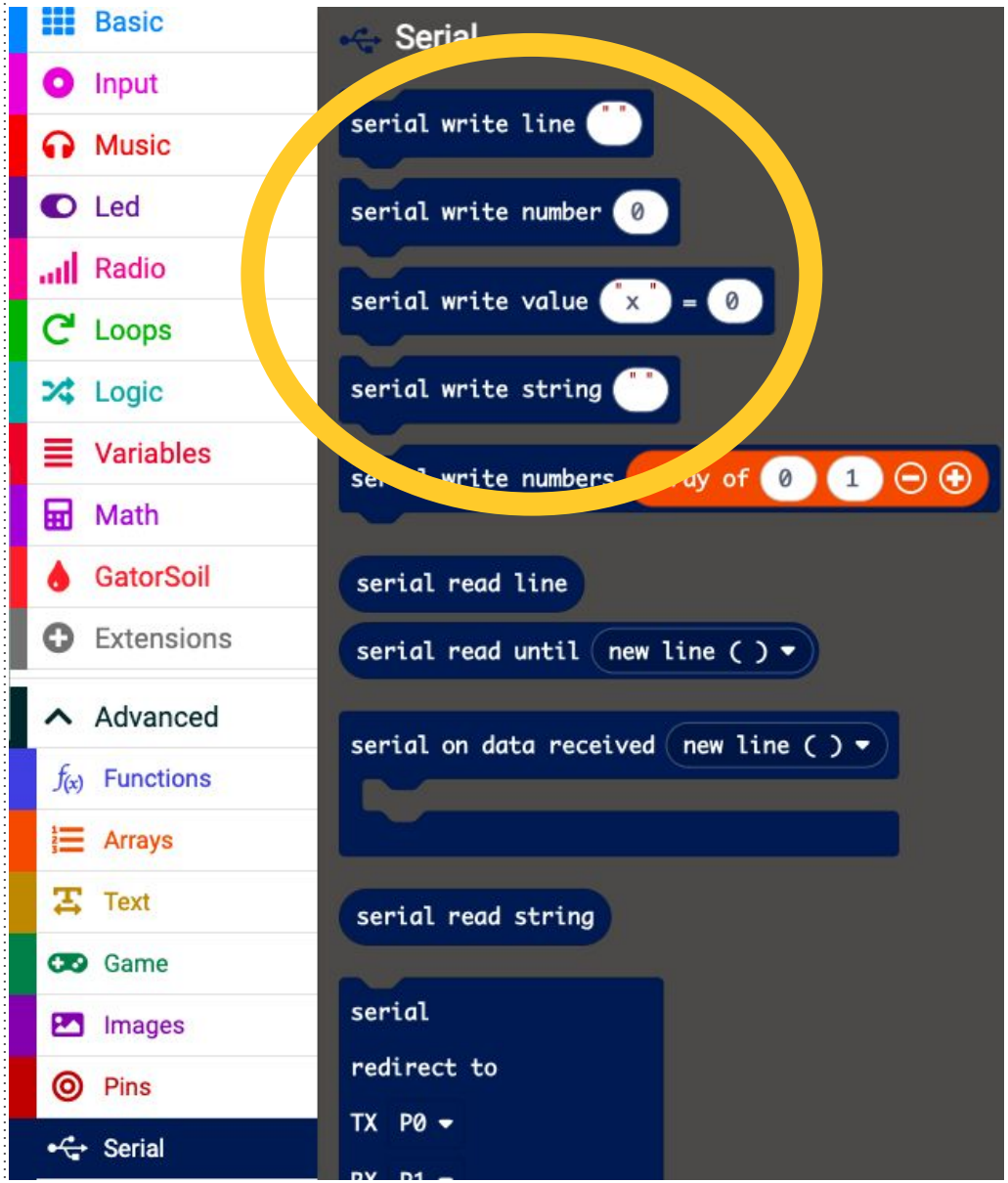
now that you've got all of your data neatly sorted in order in an **array**, how can you get it back out again?

let's look at that list of **loops** again.

"for element 'value' of 'list'" means that the loop is going to read everything in the list in order and call it 'value.' this means you can now do things with each 'value' in the list!



serial

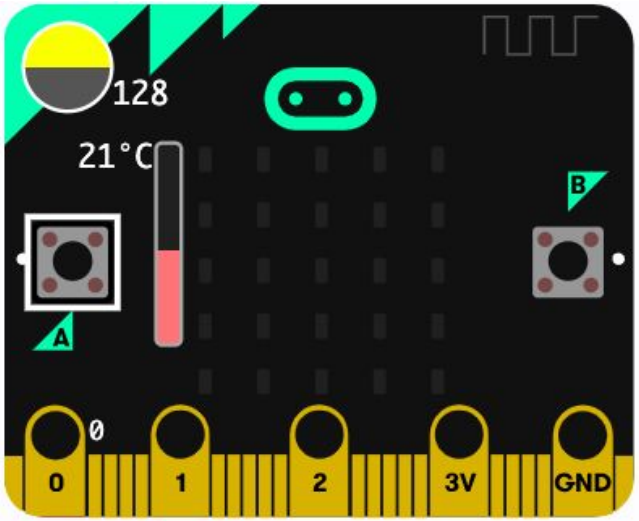


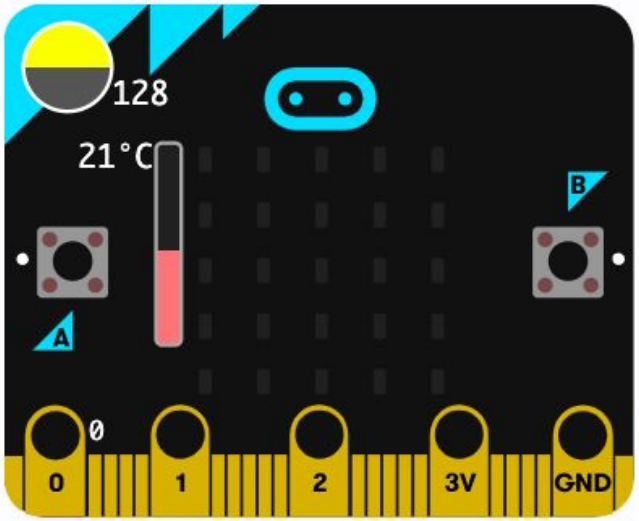
micro:bit advanced

you can also send information from your micro:bit to a computer or an ipad using a **serial** connection.

this lets you read and save a whole array in makecode, rather than the micro:bit led screen

serial





Show data Simulator

Your data: 128

micro:bit advanced

you can also send information from your micro:bit to a computer or an ipad using a **serial** connection.

this lets you read and save a whole array in makecode, rather than the micro:bit led screen

sample code

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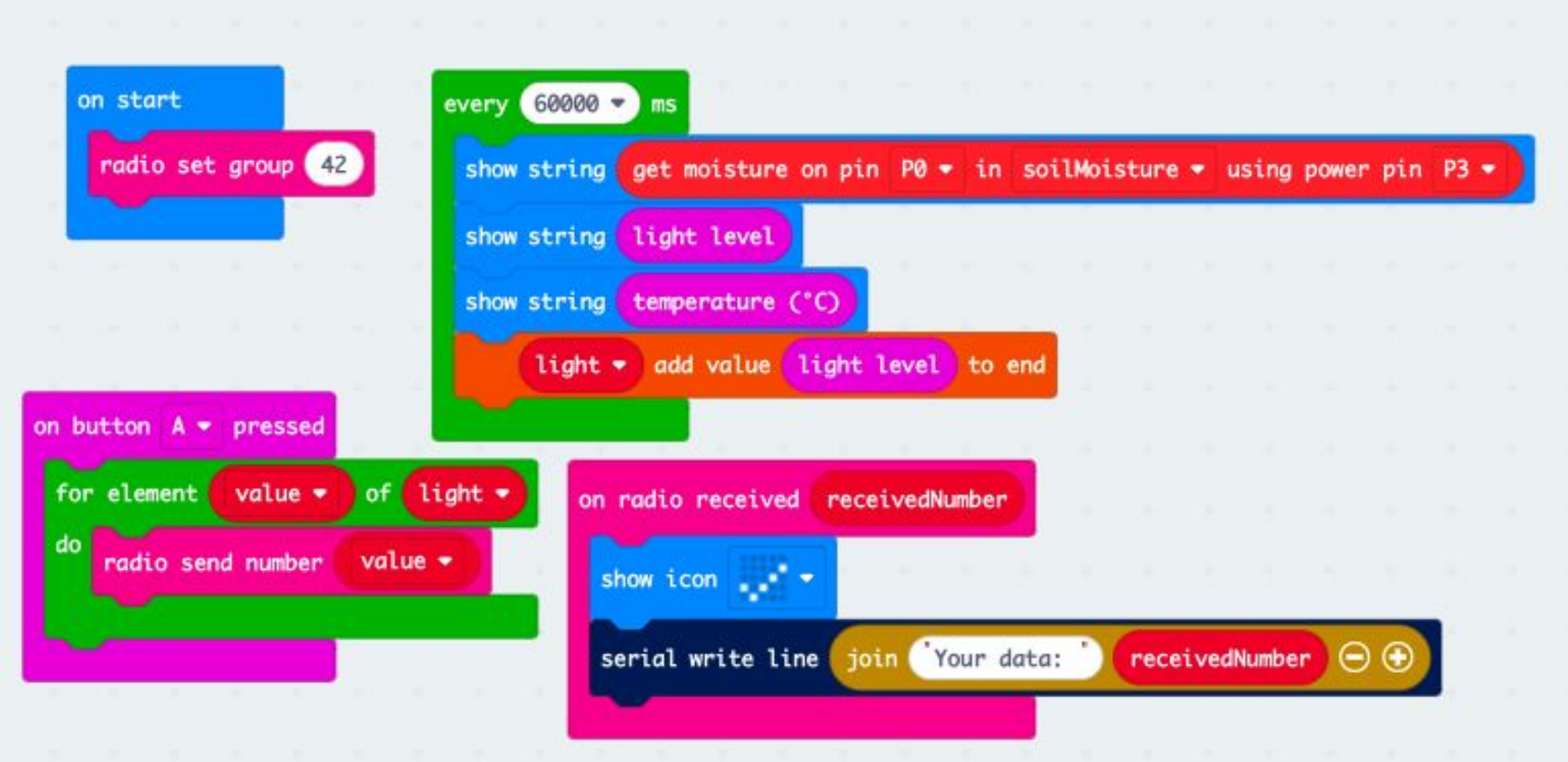
how could you improve it? what is it missing?

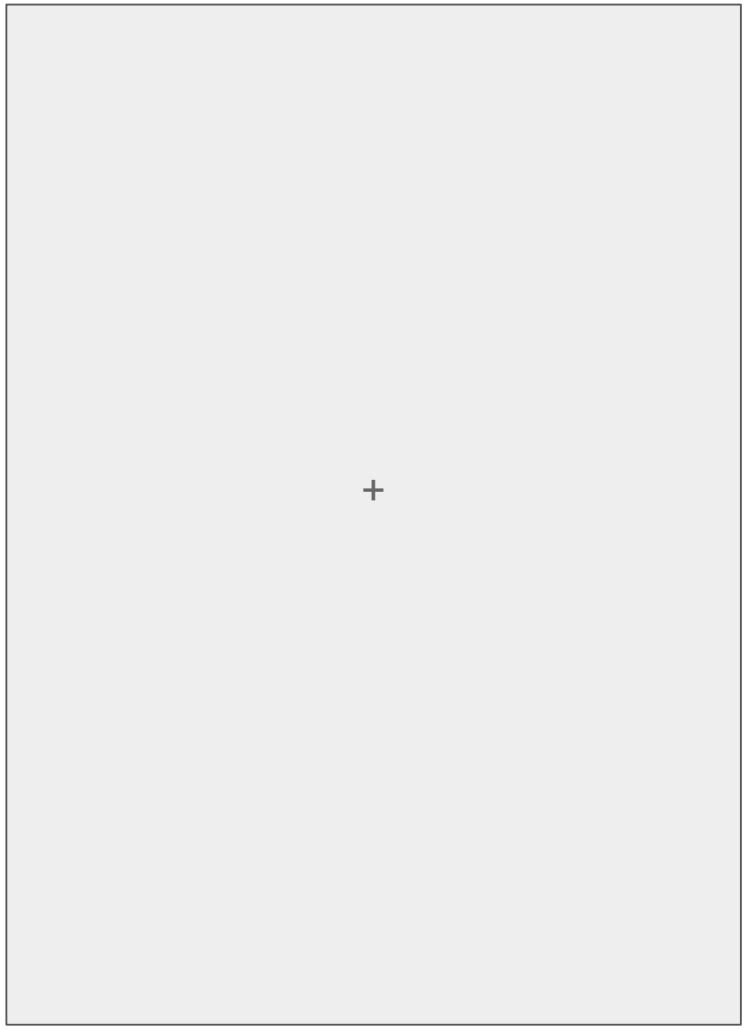
micro:bit advanced

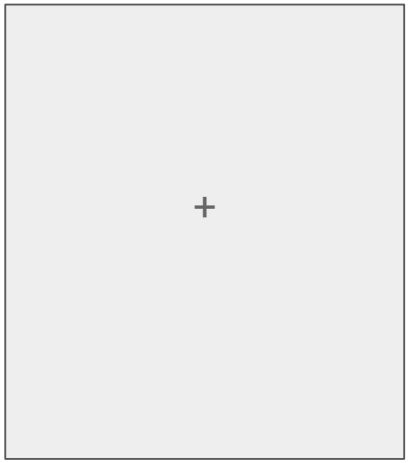


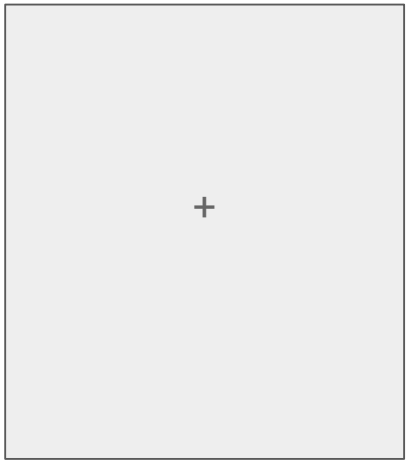
CREATING THE SOLUTION — micro:bit

Demonstrate excellent technical skills when making the solution

Document your process of writing your code. Show me some of the steps you take while building your design.







... describe what is being depicted. (Add annotations and arrows to your pictures, too!)

REVIEW

D // EVALUATING YOUR IDEAS

For this section your journal must provide evidence that:

Diii // DESCRIBE

describe how the solution could be improved

Diii // DESCRIBE

describe how the solution could be improved

Once your system is fully assembled and your plant is placed in its pot, begin testing and collecting data.

Analyze the following:

1. **Is the plant positioned in an optimal location?**
2. **Do the environmental conditions align with your initial research?**
3. **What adjustments are necessary (e.g., repositioning the plant, modifying watering levels, adjusting light exposure)?**

Final Reflection Questions:

A. **To what extent did your design meet the needs of your plant?**
B. **What insights did the collected data reveal?**
C. **What improvements would you implement in a future iteration?**

KEEP YOUR REFLECTION BRIEF! ONE OR TWO SENTENCES SHOULD BE ENOUGH.