How to run an Arm School Program Innovation Day

Arm School Program with support from CBSE

April 26th, 2022

Learning outcomes

- Understand what an Innovation Day is and its purpose
- Understand how to deliver an innovation day activity
- Understand considerations needed for the day to run smoothly
- Understand the pedagogy of the PBL activities being used
- Understand the technology requirements for the activities
- Understand the logistical and safeguarding issues
- Understand how to assess the day
- Understand how to capitalise on the success of the day

Innovation day concept

THE GLOBAL GOALS
For Sustainable Development

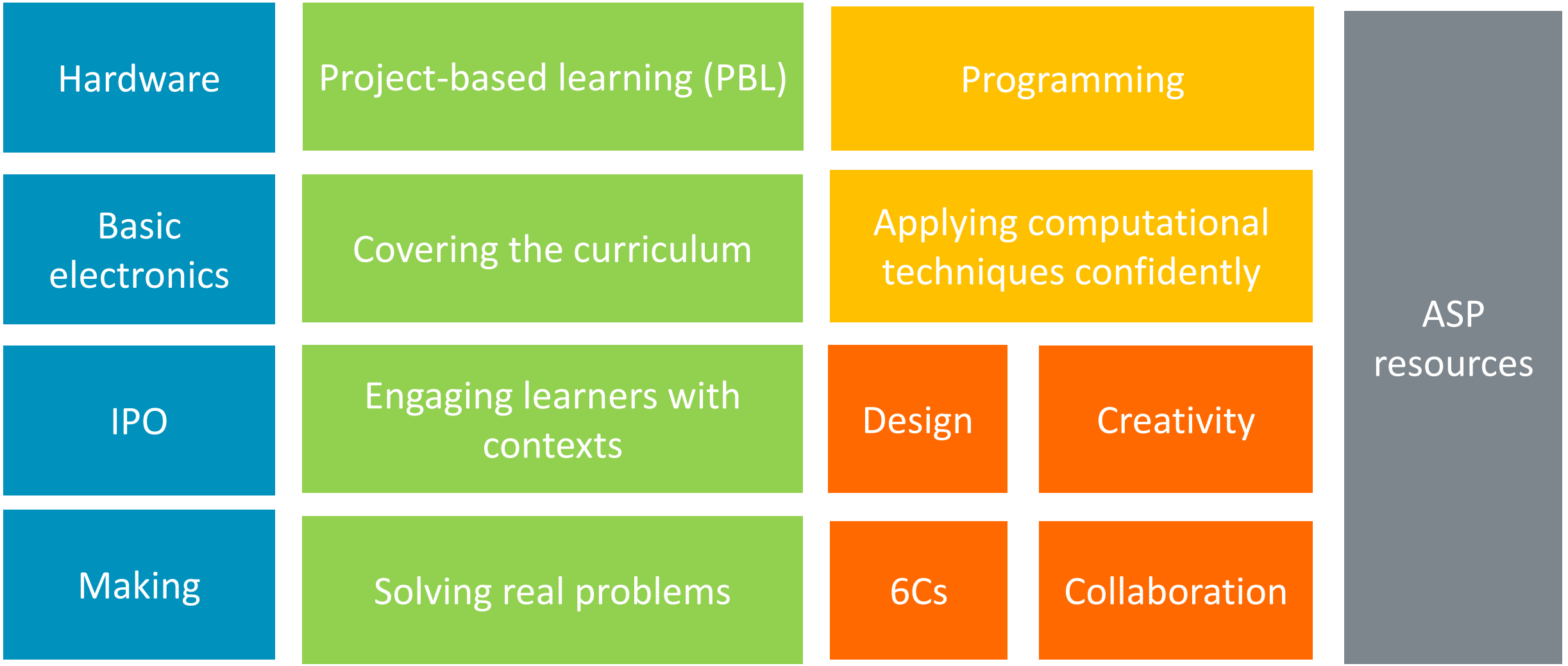
- Full day Project Based Learning competition
- Mix of Computing/Making challenges
- Micro:bit V2
- Build and programme an ‘artefact’ to solve a problem
- Judging of project completion as well as other factors such as:
  - Gracious professionalism
  - Creativity
  - Innovation
- Elevator pitch project presentation
- Global Goals linked context

Project structure and pedagogy

- Arm School Program schema:
  - Setting the scene
  - Success Criteria
  - Scaffolded support material (where needed)
  - Stretch tasks
  - Final thoughts

- Design before build
- Improve iteratively
- Prompt teams to refer to the **success criteria** often
- Collaboration is essential!
- Bonus missions provide additional points

Project Based Learning and Practical Computing



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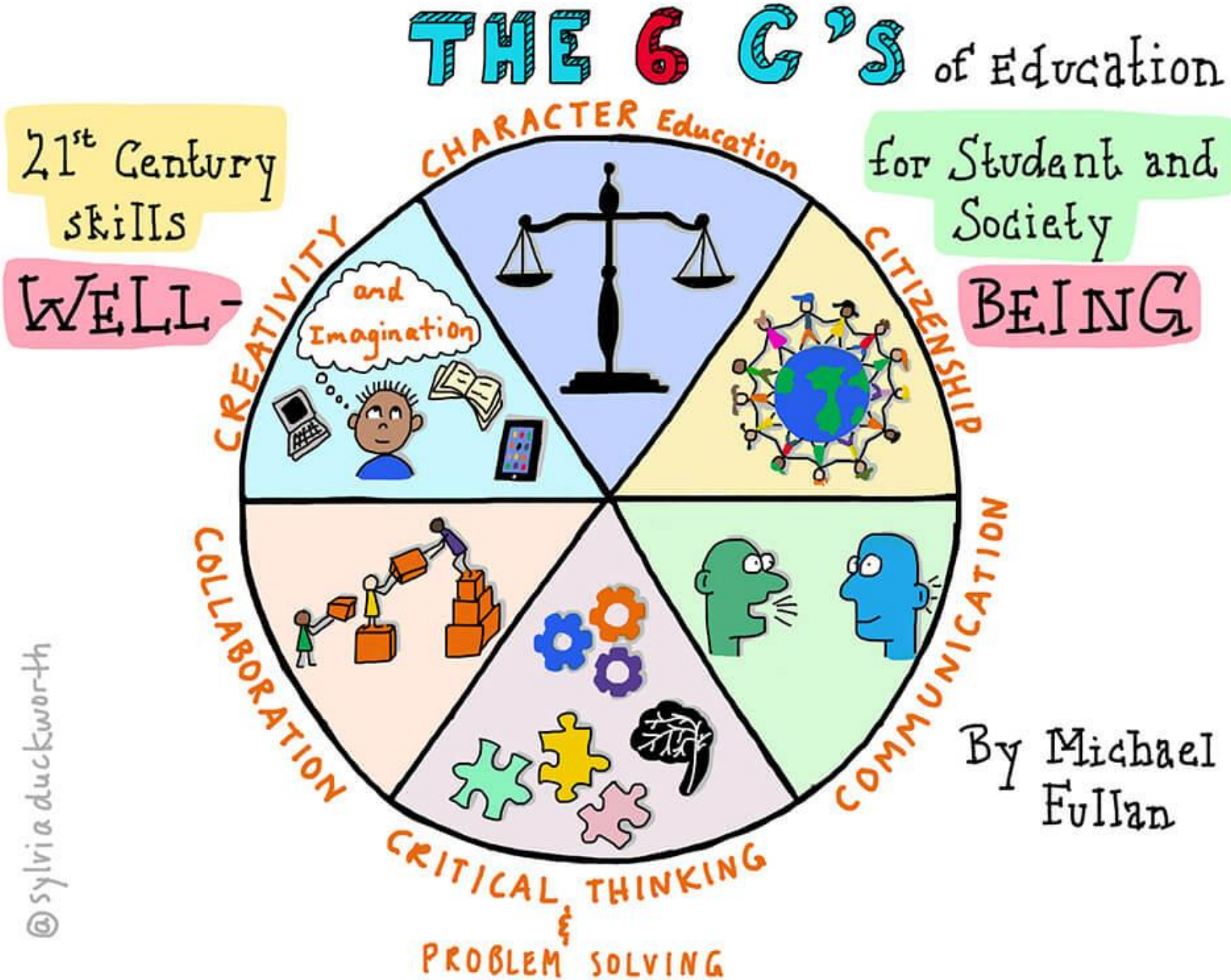
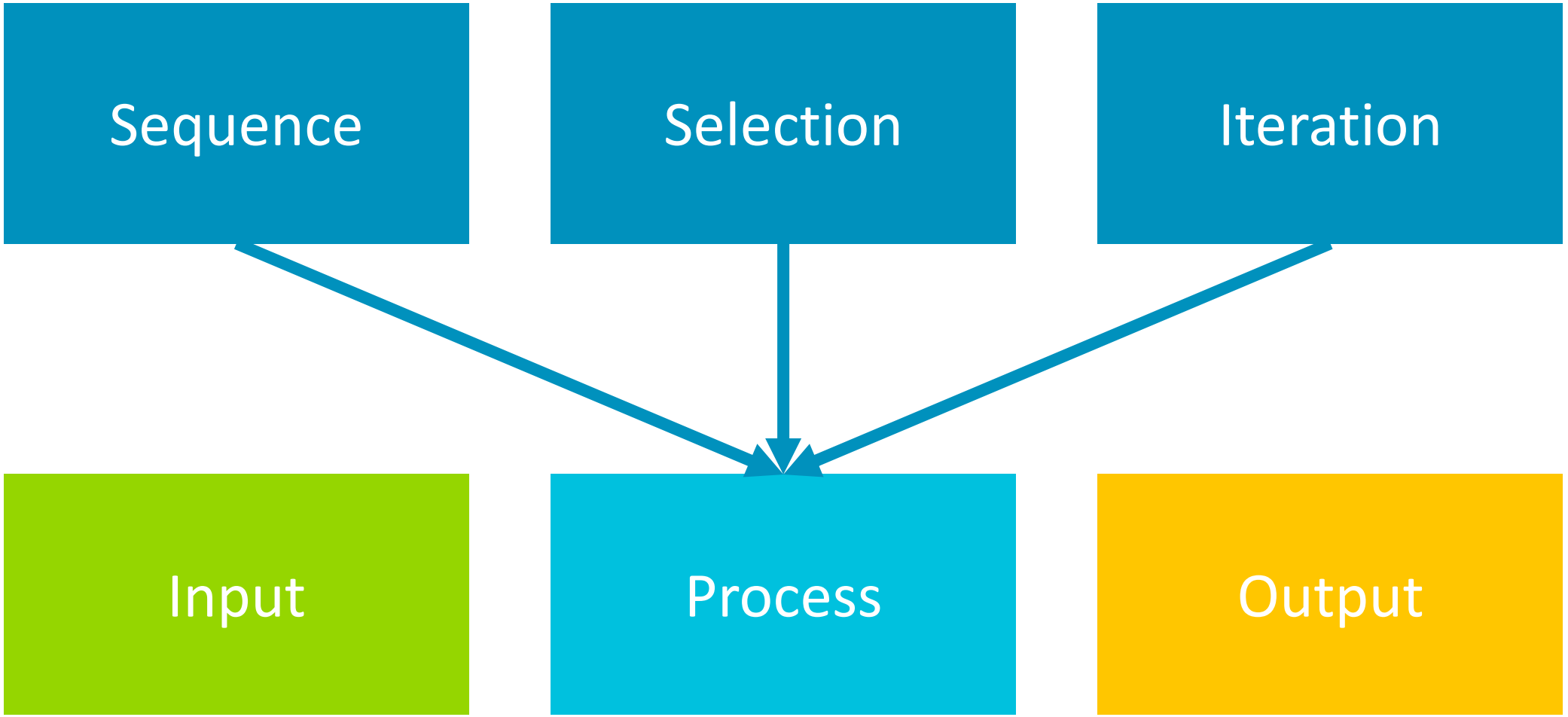

THE 6 C'S of Education
21st Century skills
WELL-
for Student and Society
BEING
CHARACTER Education
CITIZENSHIP
COMMUNICATION
CRITICAL THINKING & PROBLEM SOLVING
COLLABORATION
CREATIVITY and Imagination
By Michael Fullan
@sylvia duckworth

Basic Programming Constructs

- There are three main programming constructs:



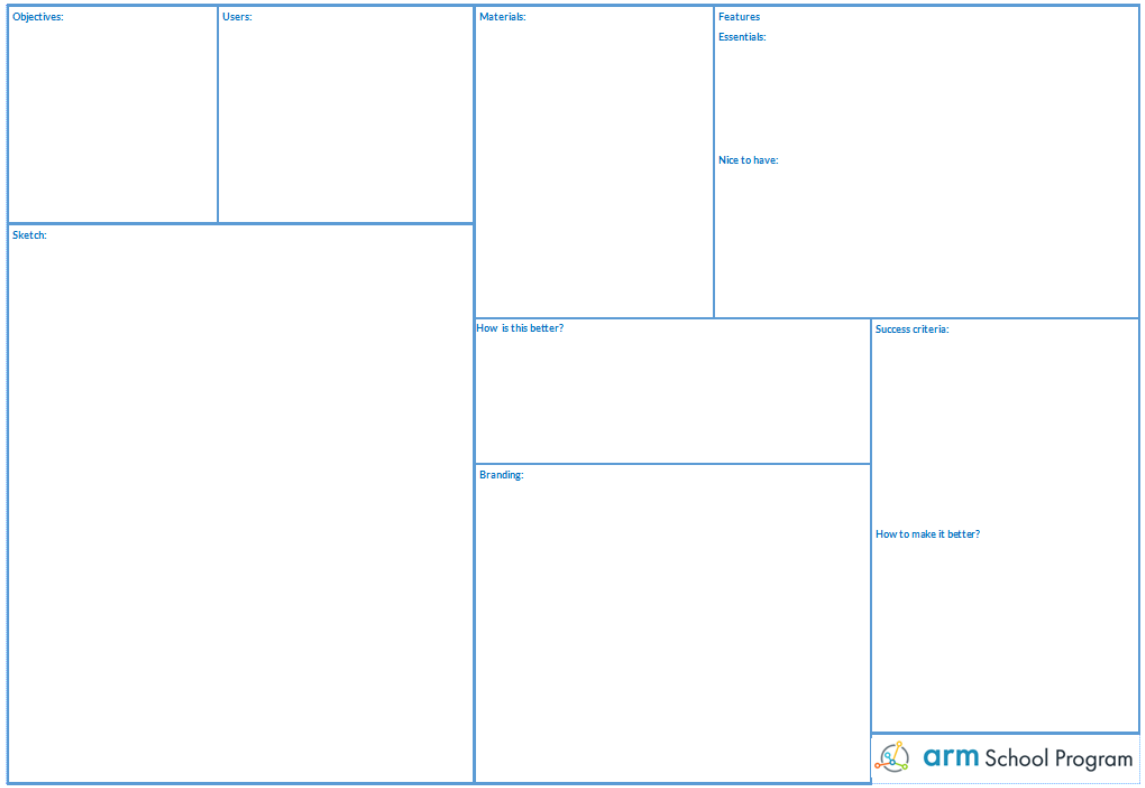
The Input Process Output (IPO) Model

- All computer systems take data into a system using ‘Inputs’, carry out processes on the inputs and then display the result of that processing using ‘Outputs’
- Using the **Input, Process, Output** worksheet try to identify what the outputs will be

Design thinking

- IPO tables
- Concept designs and rapid prototyping
- Iterating on designs

Input	Process	Output



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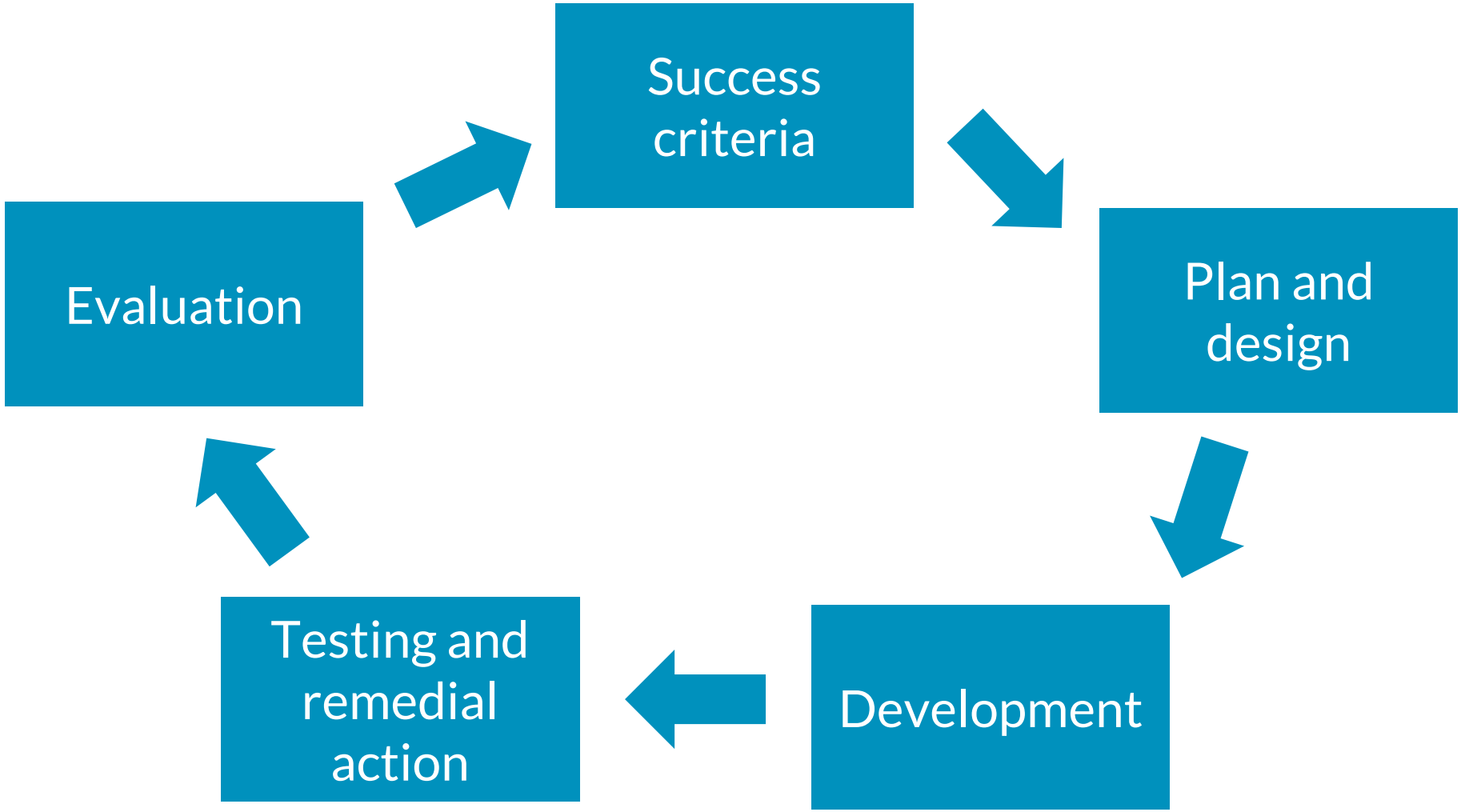
Iterative development cycle



Why making matters – thinking in systems

'Engineers use a unique mode of thinking based on seeing everything as a system. They see structures that aren't apparent to the layperson, they know how to design under constraints, and they understand trade-offs. Adopting an engineering mindset can help you in any field.'

Engineering mindset:

- The ability to see a structure where there's nothing apparent
- Designing under constraints
- Understanding trade-offs

Preparing them for the day

Logistics

- Arrange a suitable space with IT facilities
- Ensure MakeCode is unblocked
- Ensure USB are functional
- Ensure all hardware is sourced
- Gather spare parts/batteries
- Gathering making materials
- Brief colleagues on the plan
- Plan timings for the day
- Power for laptops – access/extensions
- Tables
- Space for each team
- Access to WiFi
- PC log in accounts

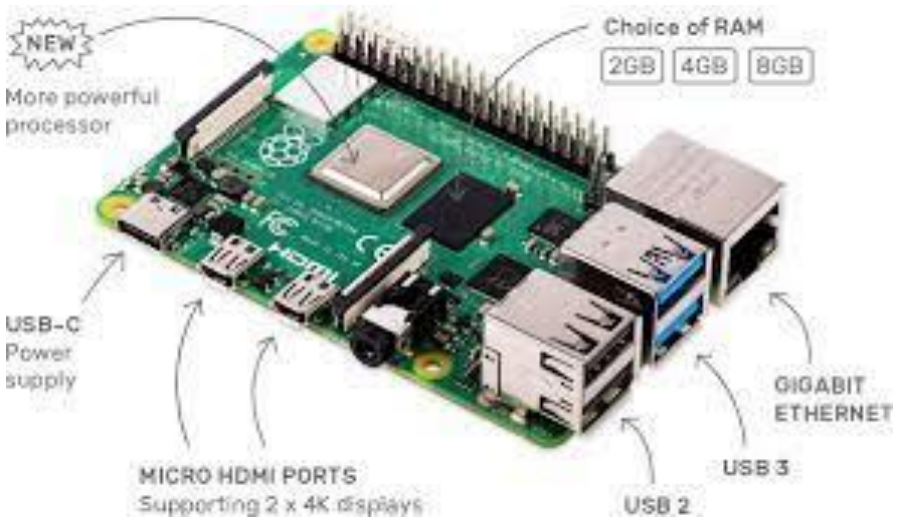
Colleague preparation

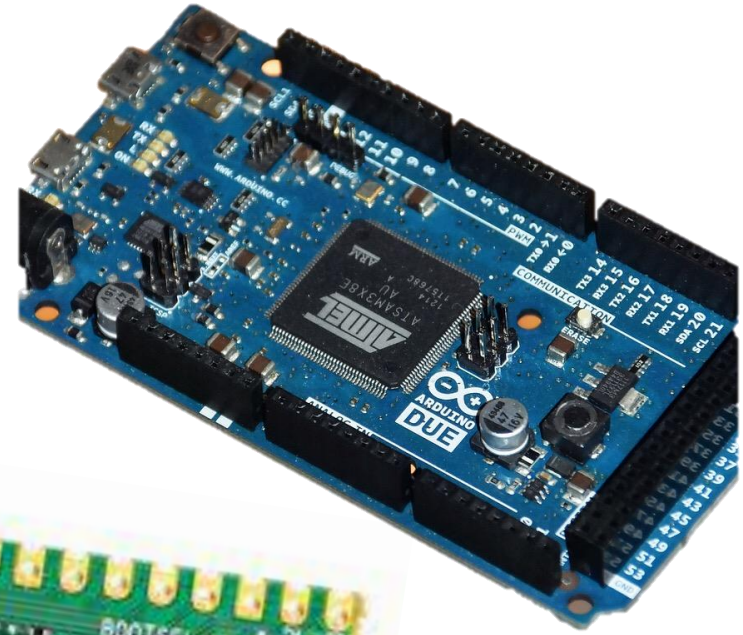
- A familiarity with:
  - Micro:bit V2 features
  - Flashing process
  - Control:bit blocks
  - Data capture on micro:bit
  - Visualising data from a .csv
  - Simple encryption concepts
  - Use of Radio blocks
  - Error codes

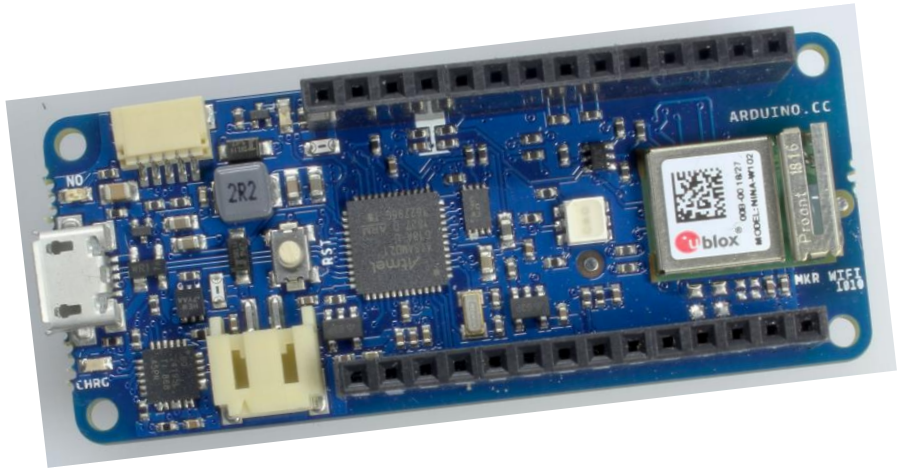
Running order for the day

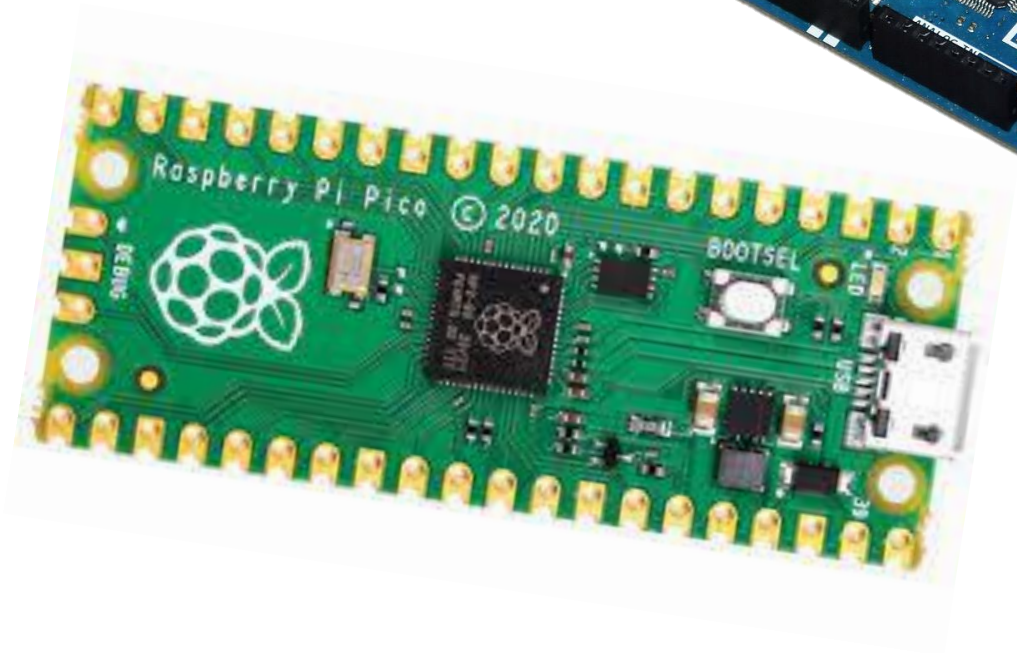
- Intro session
  - Micro:bit features
  - How to flash the micro:bit
  - How the other hardware works
- The challenge
  - Success criteria
  - Tips
  - Making resources
- Design build and iterate
  - Templates
- Lunch
- Build and iterate
- Presenting to the judges (elevator pitch)
- Judge’s rounds (artifact assessment)
- Wrap up

Other devices









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Briefing colleagues

- The structure of the day
- The pedagogy – not intervening unless necessary
- Troubleshooting the micro:bit
- Open questioning
- The focus on the success criteria
- How to support learners effectively
- Keeping up the pace

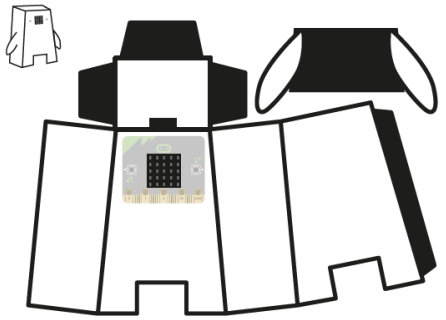
Involving external partners

- Speak to local business about sponsoring prizes or even hardware
- Speak to local press about covering the event
- Speak to companies related to the context to come and present something
- Build in a careers style session

Gracious professionalism

- Fierce competition and mutual gain are not separate notions
- Gracious professionals learn and compete like crazy but treat one another with respect and kindness in the process
- Avoid treating anyone like losers
- No chest thumping tough talk
- No sticky-sweet platitudes either
- Knowledge, competition, and empathy are comfortably blended

Setting the context and problem set



Setting the scene

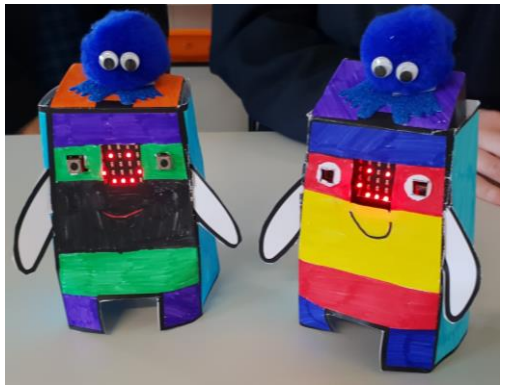
Loneliness and isolation are a real problem for children and the elderly staying in hospitals for long periods of time, especially in rural areas.

You have been tasked with creating a digital pet that can be played with and that can keep people company whilst they stay in hospital.

The pet must be interactive.

Success criteria

- The product must be suitable for one of the users listed below and the pet must:
- Look like a friendly pet (be creative)
- Be robust enough to be played with
- Contain a micro:bit that users can interact with
- Have a face to express emotions when interacted with
- Have one or more interactions programmed so it behaves like a pet to keep the user company

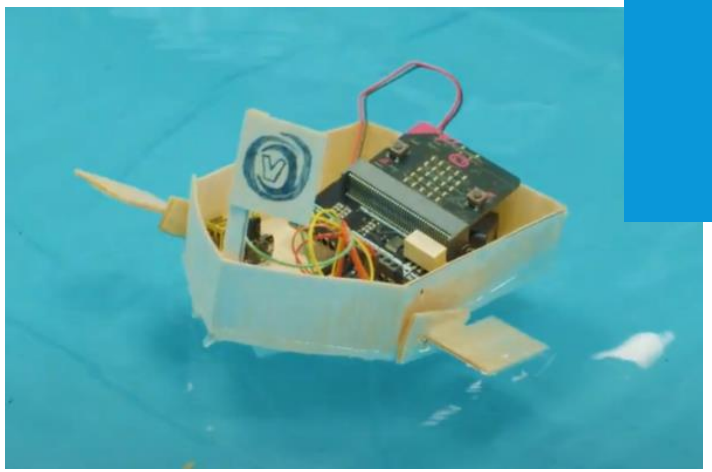


micro:pet feature ideas

- Reacting to playing/shaking (accelerometer)
- Emotions that are effected by interaction or noise
- Feeding (every few seconds/minutes)
- Needing attention (gets lonely if not interacted with frequently) and tells you!
- Sleeping and waking (light sensor) - think snoring
- Reacting to temperature (temperature sensor)
- Communication/interaction between micro:pets (advanced)
- Use the new speaker and mic to make your pet come alive

THE GLOBAL GOALS
For Sustainable Development

Oil spill cleaner-upper



Setting the scene

A group of marine scientists have asked you to develop an algorithm that could be used on a boat drone to drag around a sheet of this smart material to clean up an oil spill.

14 LIFE BELOW WATER

Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

Goal 14 in Action Explore the Targets

Success criteria:

- Build a floating oil spill cleaner upper boat drone that starts with a button press
- The product should be able to autonomously navigate over an area
- The product should be made to clean up an oil spill by dragging a ‘smart material’

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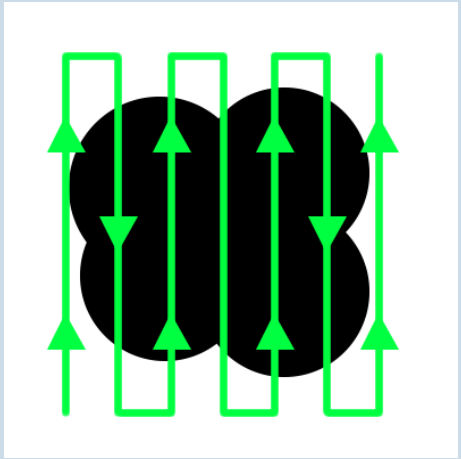
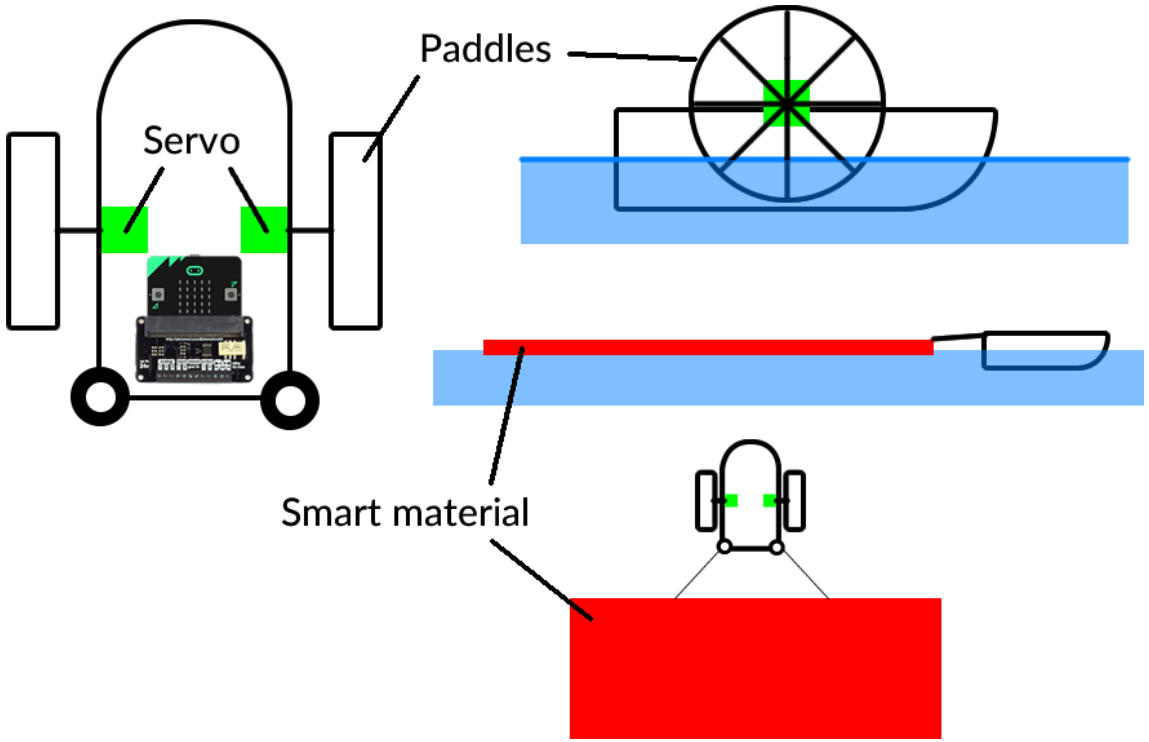
Input Process Output

Input	Process	Output
Button press	Algorithm to control the movement of the boat drone in a path to clean up oil: 	Servo motor control

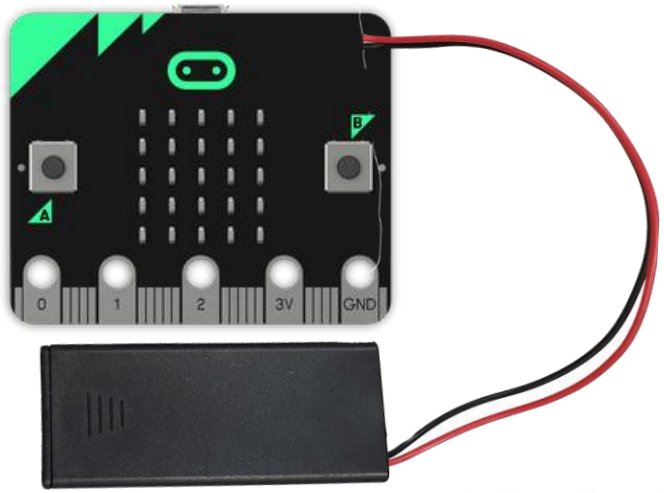
The paddle wheel

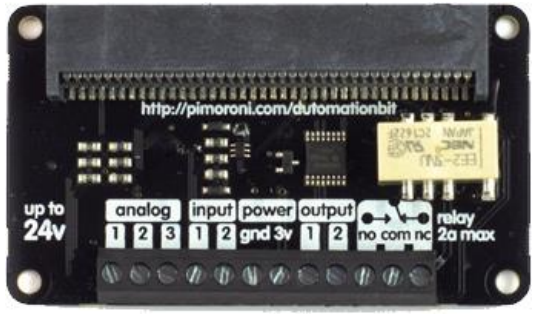


Preparing for the day (organisers)

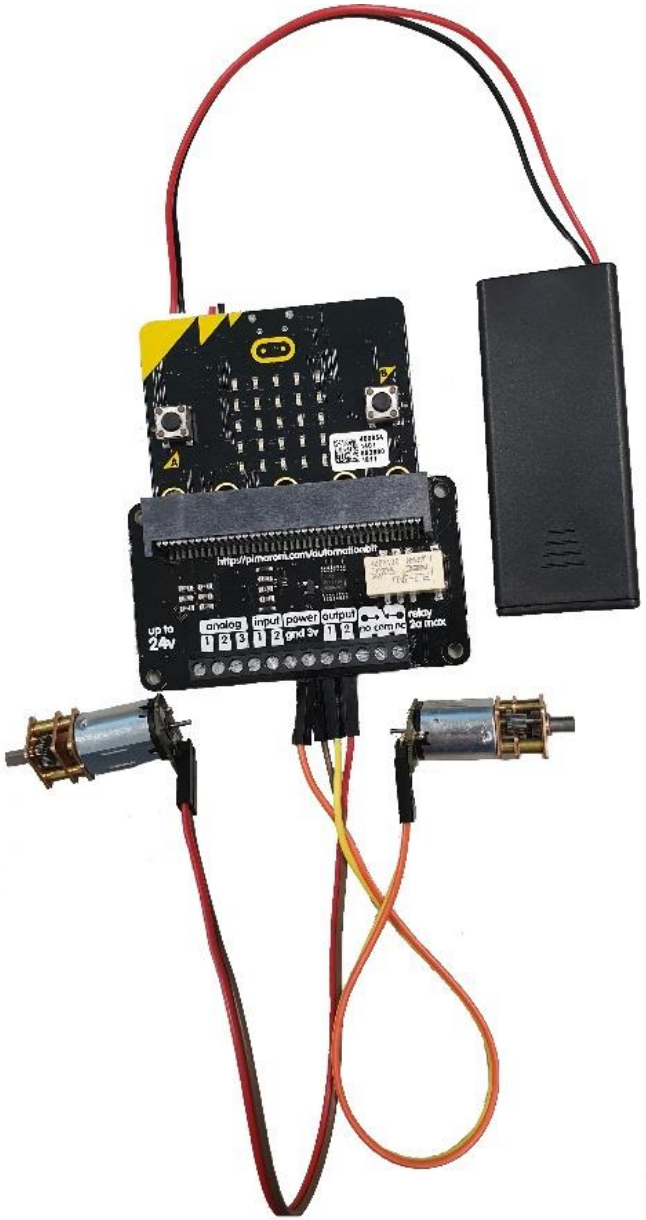
Parts list

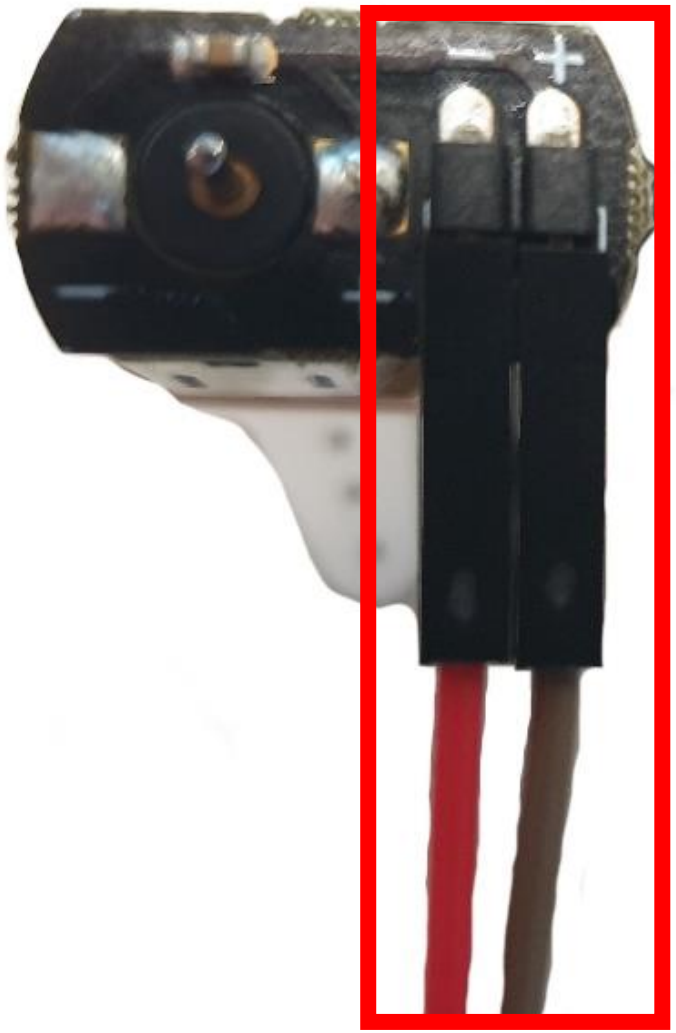
- Micro:bit (1 per team minimum)
- Automation:bit (1 per team minimum)
- Battery pack + AAA batteries
- USB cable
- 2 x motors (with headers shims)
- 10 x header wires
- A sponge
- Making materials
- 1 x laptop per team
  - with Wifi
  - power source





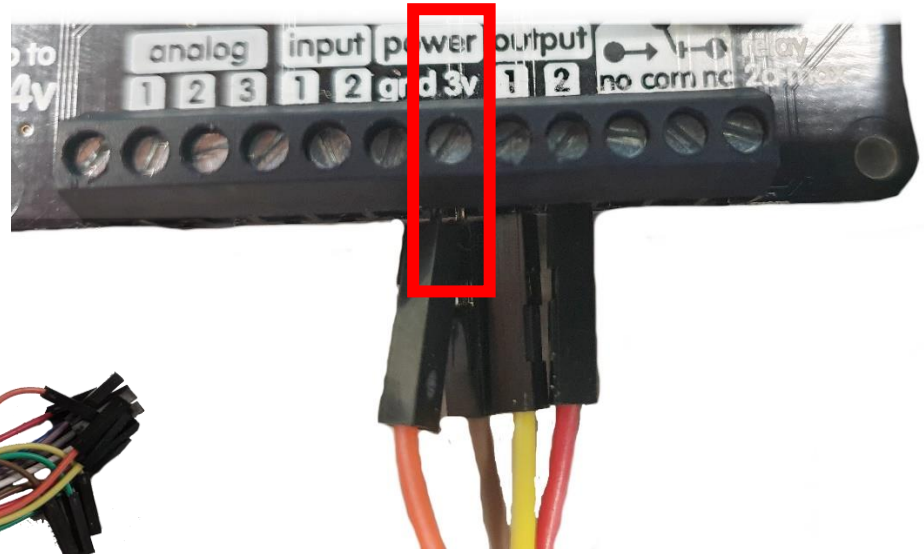
- 1 x body of water (paddling pool)
- Some way to fill and empty safely





Note:

- The motors need power from the batteries
- The + wires from both servos go into the 3v terminal
- Output one is right
- Output two is left
- Ground (GND) wires got to the GND terminal



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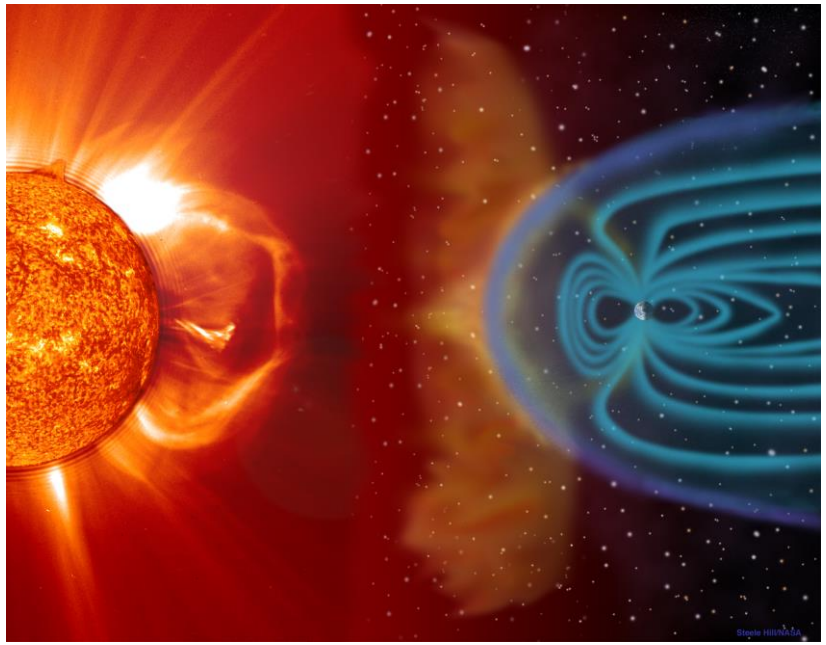
The micro:sat

- You and your team have been drafted into the UK Space Agency to work on a micro:sat project.
- Recently there has been a Coronal Mass Ejection which has affected many satellites in orbit.
- Your mission is to design and develop a prototype **micro-satellite** to meet several objectives including re-establishing communication with a damaged satellite.



The missions

Mission 1	Mission 2
Micro:sat telemetry • Parachute • Data capture and analysis	**TOP SECRET** • **Encryption**
Mission 3	**Mission 4**
Space debris • Robotics • Engineering	**Collision detection system** • Collaboration/communication • Standards and protocols

Bonus missions:

- Elevator pitch
- Open source your code
- TikTok/YouTube shorts
- Website

Mission 1

Context

- The first mission is to collect satellite telemetry upon re-entry and be able to visualise the data. This will be modelled by your satellite being dropped from a height, once with a parachute and once without. Your satellite should be ruggedised to avoid damage to the system. The satellite should be able to capture appropriate data locally for both falls. This data should then be taken off the micro:bit and turned into a visualisation to compare the drop vs the parachute drop.

Success criteria

- Design and build a rugged micro:sat body no bigger than 30cm x 30cm that can hold 4 x micro:bits, batteries and control:bit, motors and wires
- Create a team brand and ensure this brand is shown on your micro:sat. The branding should include:
- A name and logo
- Design and build a suitable parachute for the micro:sat, the micro:sat needs to be able to survive a drop from a height
- Program a micro:bit to collect appropriate data during the 2 drops
- Create a visualisation to compare the 2 drops
- Write a short report comparing the data you gathered that describes how the parachute changed the way the micro:sat fell (this needs to be presented later!)

Mission 2

Context

- The UKSA has a damaged satellite that it needs your micro:sat to investigate. This mission is TOP SECRET and cannot be discussed with other teams. The satellite is known to be transmitting some sort of encrypted data. Your mission is to find out what is being transmitted and what it means. This satellite will be modelled by a micro:bit in a model UKSA satellite that you can access to test your solution. Part of the cipher has already been worked out, these are the special characters (:,/,!,?) all other characters are still encrypted.

Success criteria

- Design and program a micro:sat to receive the input signals from the damaged satellite
- Decipher the encrypted signal
- Report your findings as part of your team's presentation to the UKSA
- Do not discuss this mission with other teams

Mission 3

Context

- A common risk for space travellers is space debris. This can be whole satellites that are now defunct all the way to tiny shards of plastic, rock and metal travelling at high speeds orbiting Earth. These debris that can cause damage to satellites and space travellers alike. Your mission is to design and build a working prototype of a system that can capture space debris.
- The system will need to be deployed once the satellite is in space and so needs to be stored on the micro:sat in as small a space as possible during launch.

Success criteria

- The system must ‘deployable’ (you will need to demonstrate the ‘stored’ and ‘deployed’ states to the judges)
- The deployment must be trigged remotely and not involve any help from the team
- The solution must involve the control:bit and at least one motor

Mission 4

Context

- Your team's micro:sat will be one amongst many other micro:sats being developed by the other teams. You need to develop a **collision detection system** that all the teams can use. To do this you will need to work collaboratively with the other teams to design and use a system that meets the success criteria.
- A representative from each team will need to meet to agree a common method for the micro:sats to communicate with each other and know whether they are too close together (<1m). If the micro:sats sense they are too near to another micro:sat they need to play a warning sound from the speaker.

Success criteria

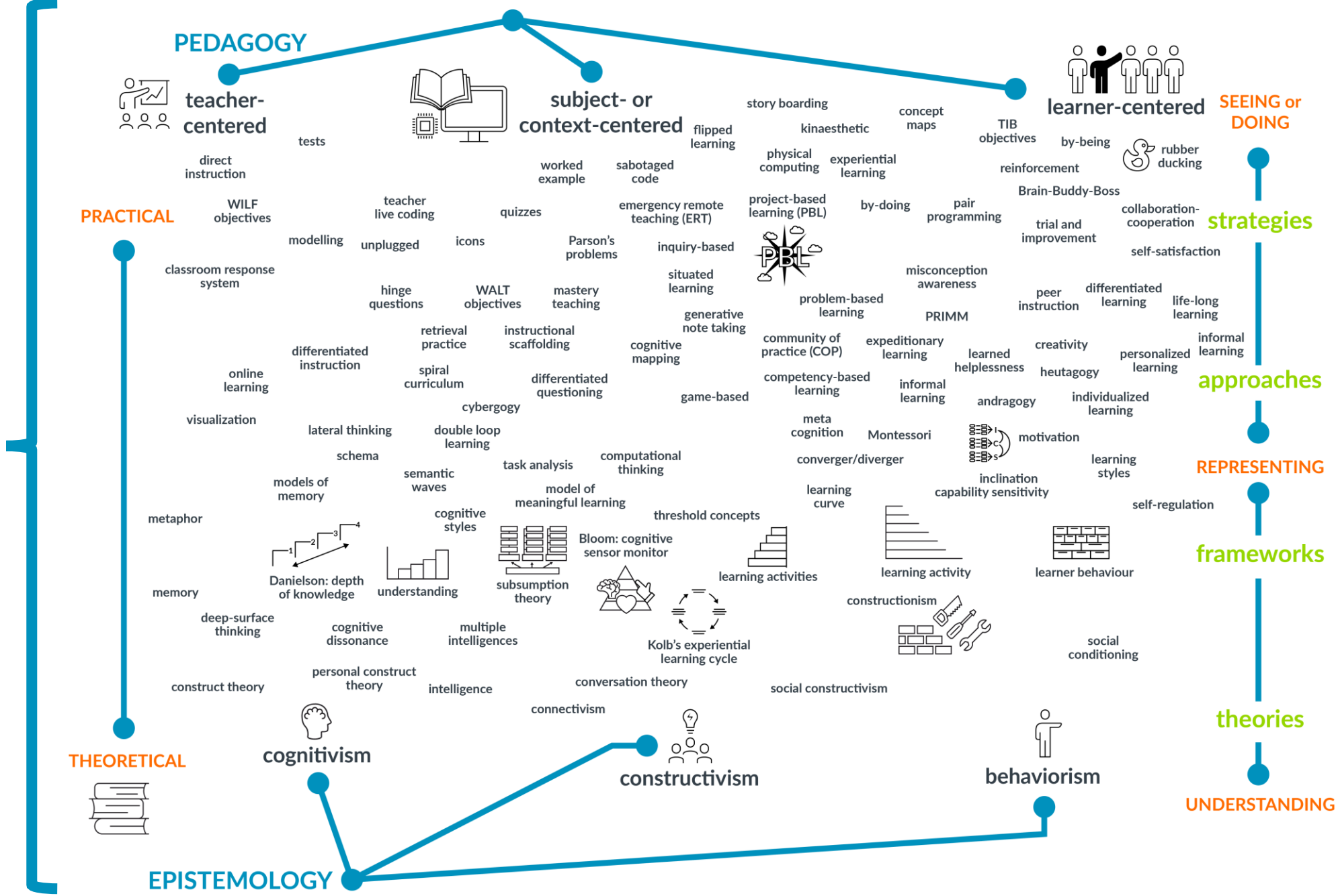
- Collaborate with the other teams to agree a common way to send/receive collision warnings
- The micro:sat must sense whether other micro:sats are within 1m
- The micro:sat must play a warning sound when another satellite is within 1m
- The micro:sat should have some way to know which other satellite is too close
- The system must use as little power as possible and not interfere with other systems
- The code for this solution must be hosted on GitHub under an open-source licence

Bonus missions

1. You will be required to present your solution to a panel of experts. The presentation should be <2 minutes and there will be time for questions from the panel.
2. You are required to ‘open source’ your code (sharing is caring), create a GitHub repository for your missions. Ensure your code is commented appropriately for easy re-use.
3. You have been asked to promote STEM as part of the UKSA education programme. Recent research suggests that TikTok and YouTube are the most effective social platform to share content. Create some content about your project. Ensure you use your teams branding appropriately.
4. Create a website for your team’s project (use a Google Site). Add links or embed your social media content as well as links to your GitHub code base. Add profiles for each of your team. Ensure it is branded using your team’s brand.

Creating your own Innovation day

- Use the ASP schema as the building blocks to shape the activity
- Choose a suitable context that will engage your learners
- Structure the success criteria to build in complexity tailored to your learners ability
- Remember to stretch your learners, don’t make the project trivial
- Remember to blend the making and the programming
- Consider cross-curricular tasks, use data science to measure something useful to another subject



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ASP resources

https://school.arm.com

Teaching and learning resources

- **Introduction to Computing Using micro:bit**
- **Robotics and Internet of Things Course**
- **Introduction to Programming Using MicroPython**
- **Computational Thinking Tasks**
- **Micro:course (book)**

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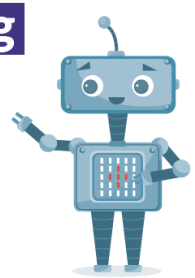
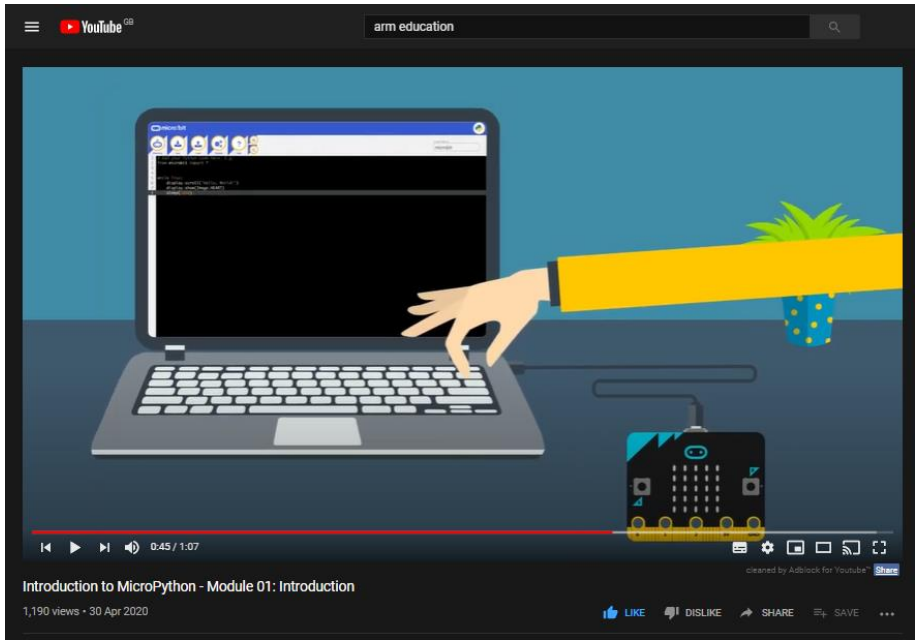
micro:course

learn computing with the micro:bit



YouTube – search for Arm Education

- Intro to Computing with micro:bit
- Intro Programming with MicroPython



arm School Program

Teaching with Physical Computing

A new series of PD courses from the Arm School Program

A course for teachers on Physical Computing and how to apply it through Project-Based Learning in the classroom.

Teaching with Physical Computing

Search for “Project-Based Learning” on edX.org

Course 1 Introduction to Project-Based Learning

Course 2 Practical application and classroom strategies for PBL

Course 3 Assessment of Project-Based Learning

Course 4 Soft skills, teamwork and the wider curriculum