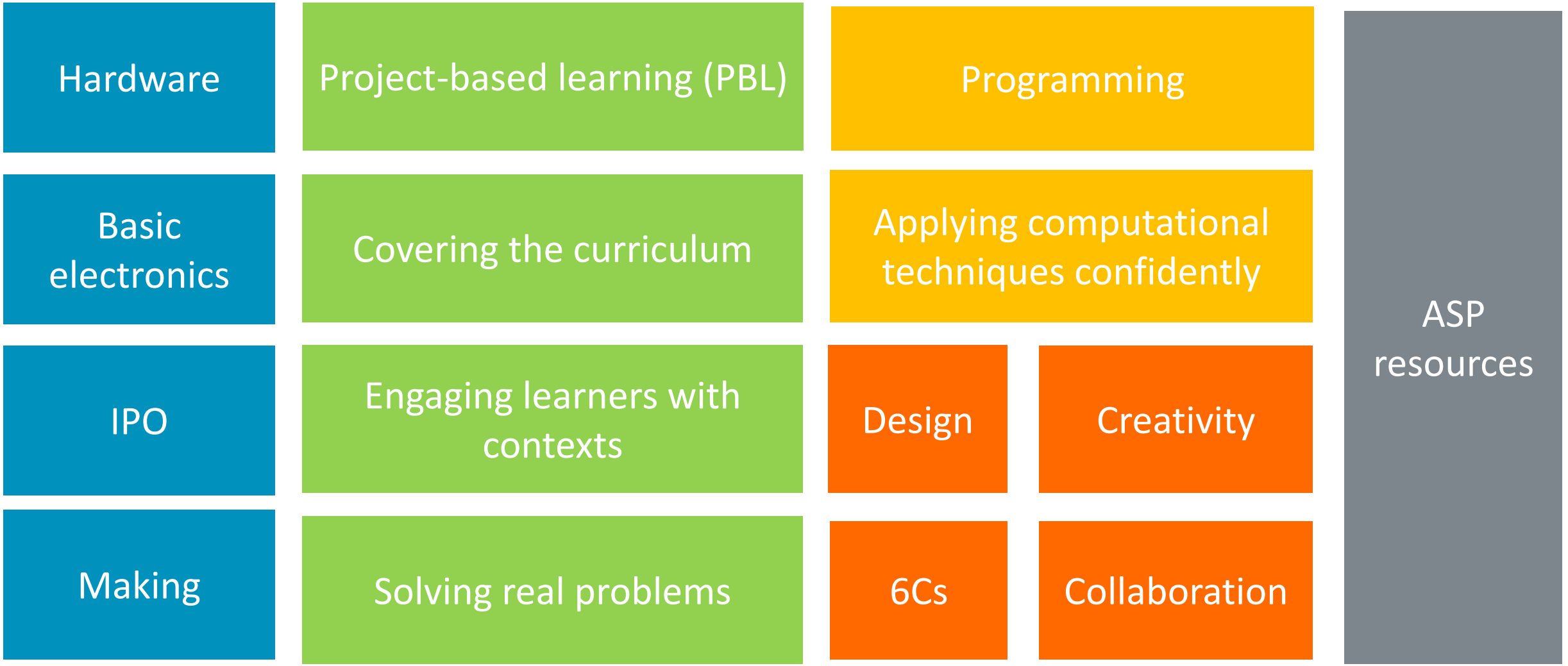
Contexts are key Contextualizing PBL projects effectively

Arm School Program with support from CBSE

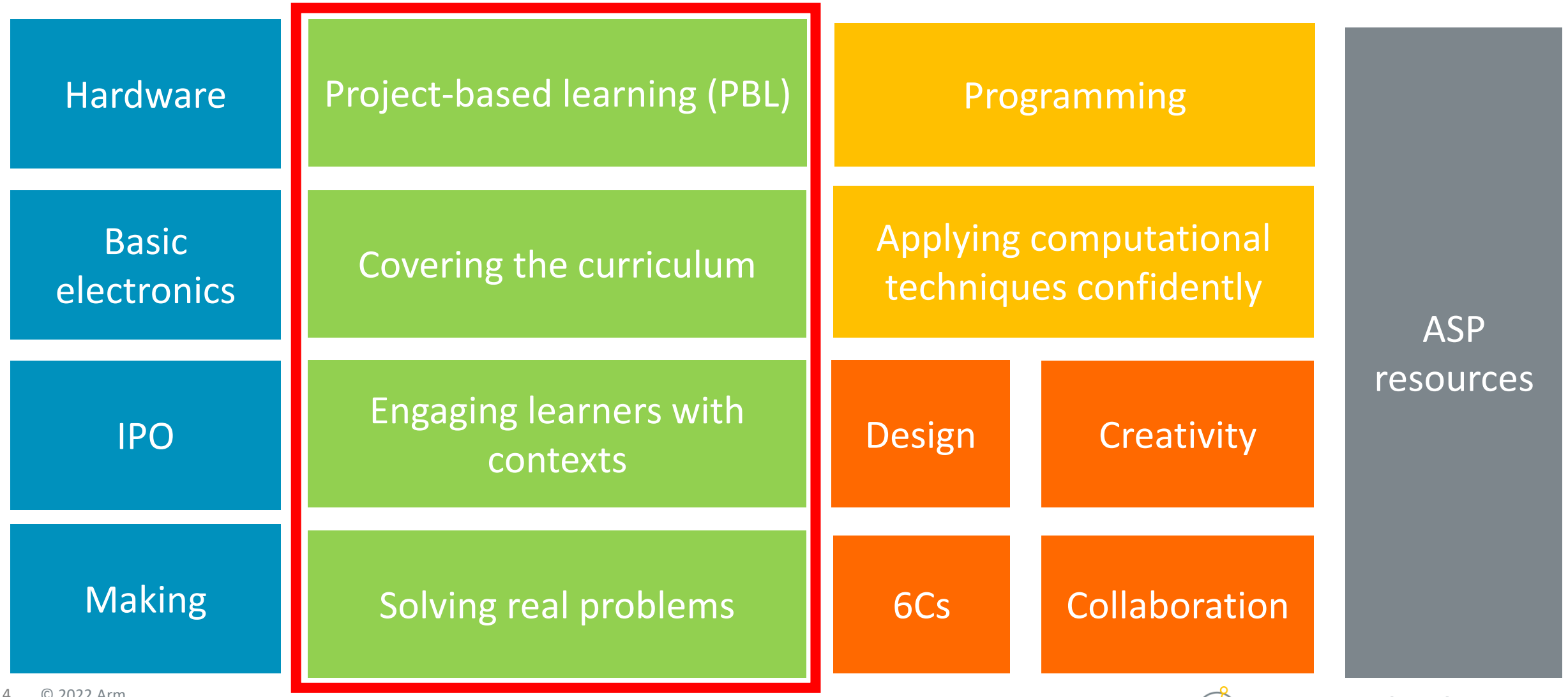
Learning outcomes:

- Understand the ASP schema
- Understand how to apply a context to the ASP schema
- Understand how to develop a problem set and create effective success criteria
- Understand how to scaffold and differentiate a Physical Computing project idea effectively
- Understand the hardware and delivery considerations for new Physical Computing projects
- Develop a new Physical Computing project on a novel context/theme
- Confidently iterate a new project after first delivery

Project Based Learning and Practical Computing

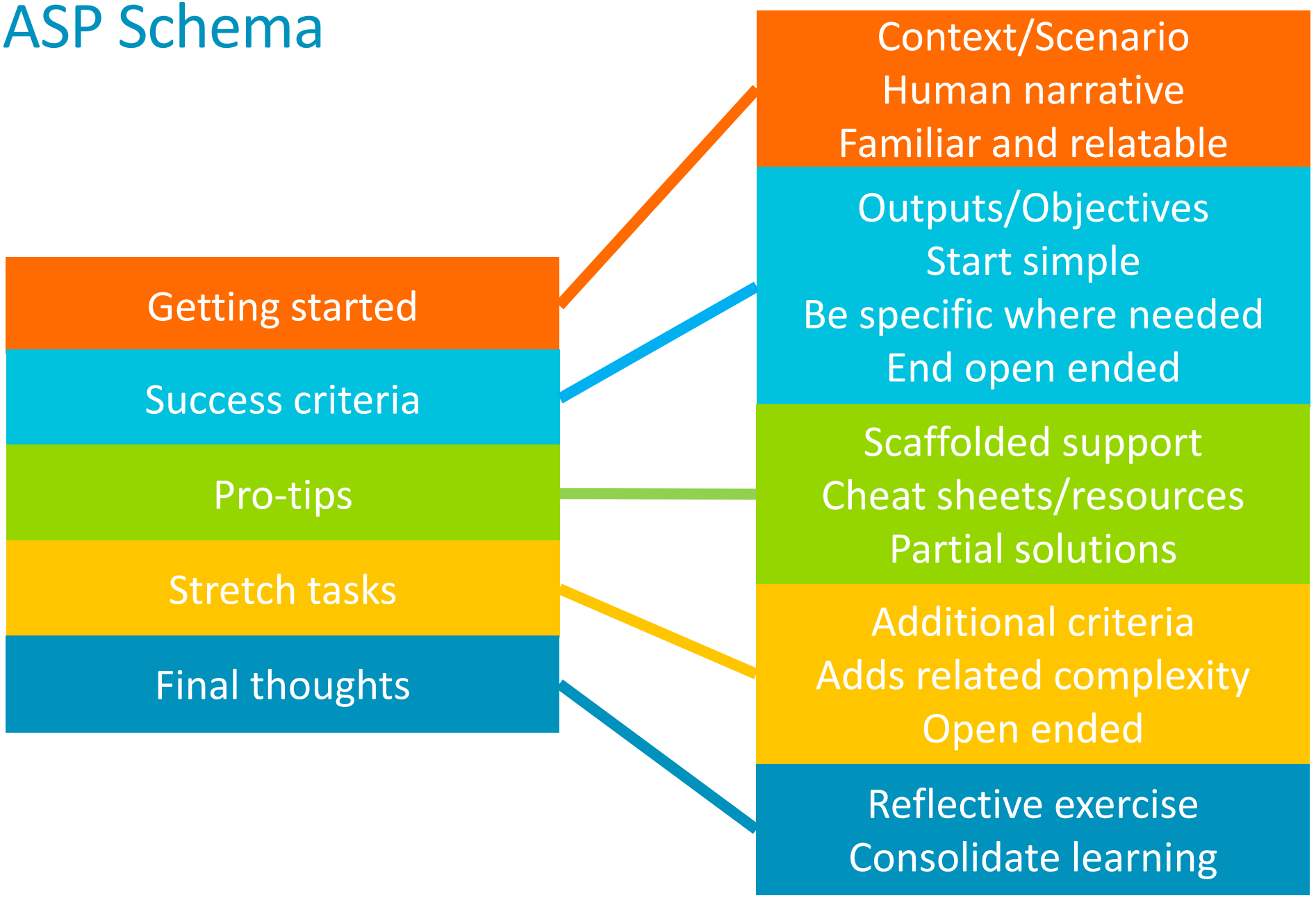


Project Based Learning and Practical Computing

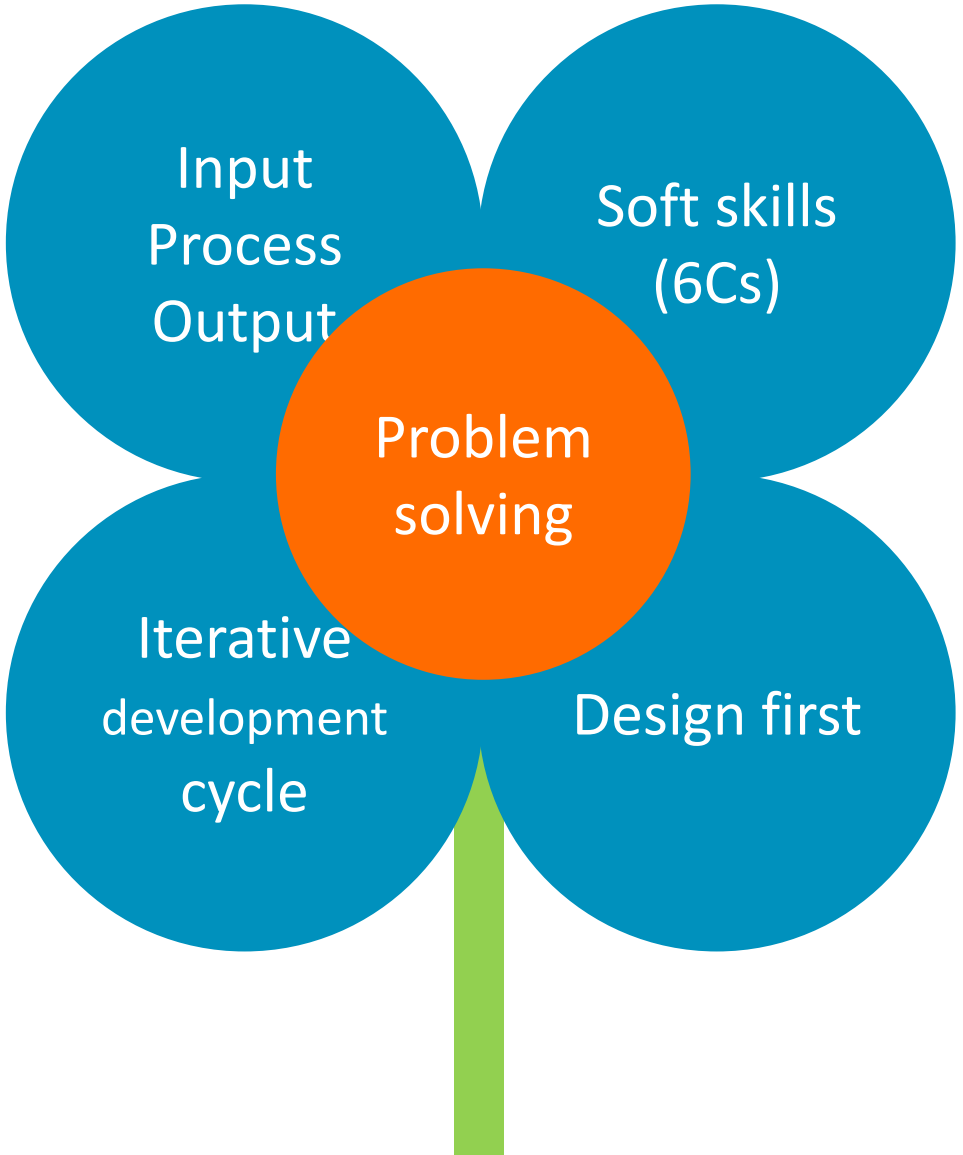


arm School Program

The ASP Schema



Core elements of the approach



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

IPO table

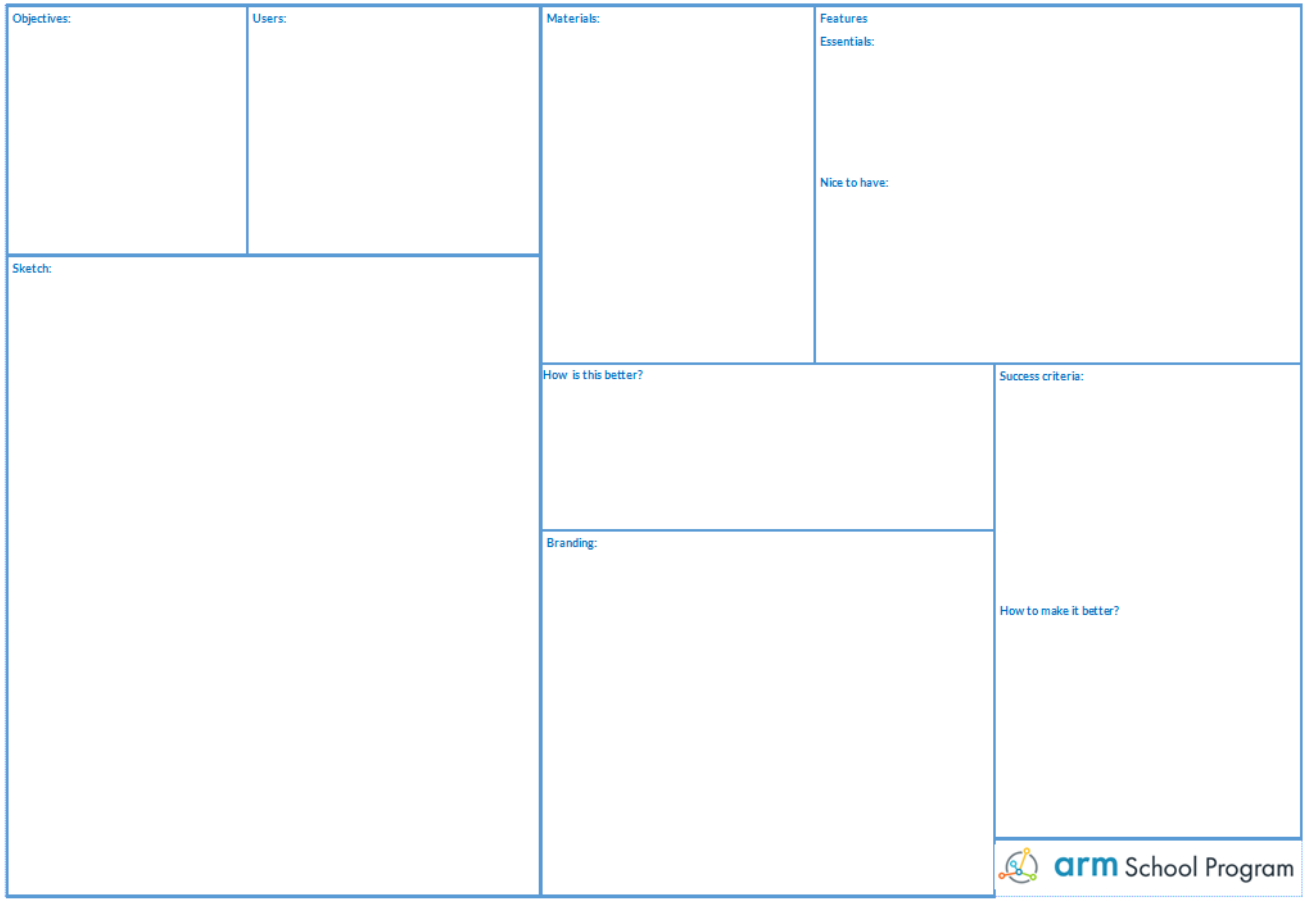
Input
Process
Output

Input	Process	Output
Button press	Records data	Graph on LEDs

Design thinking

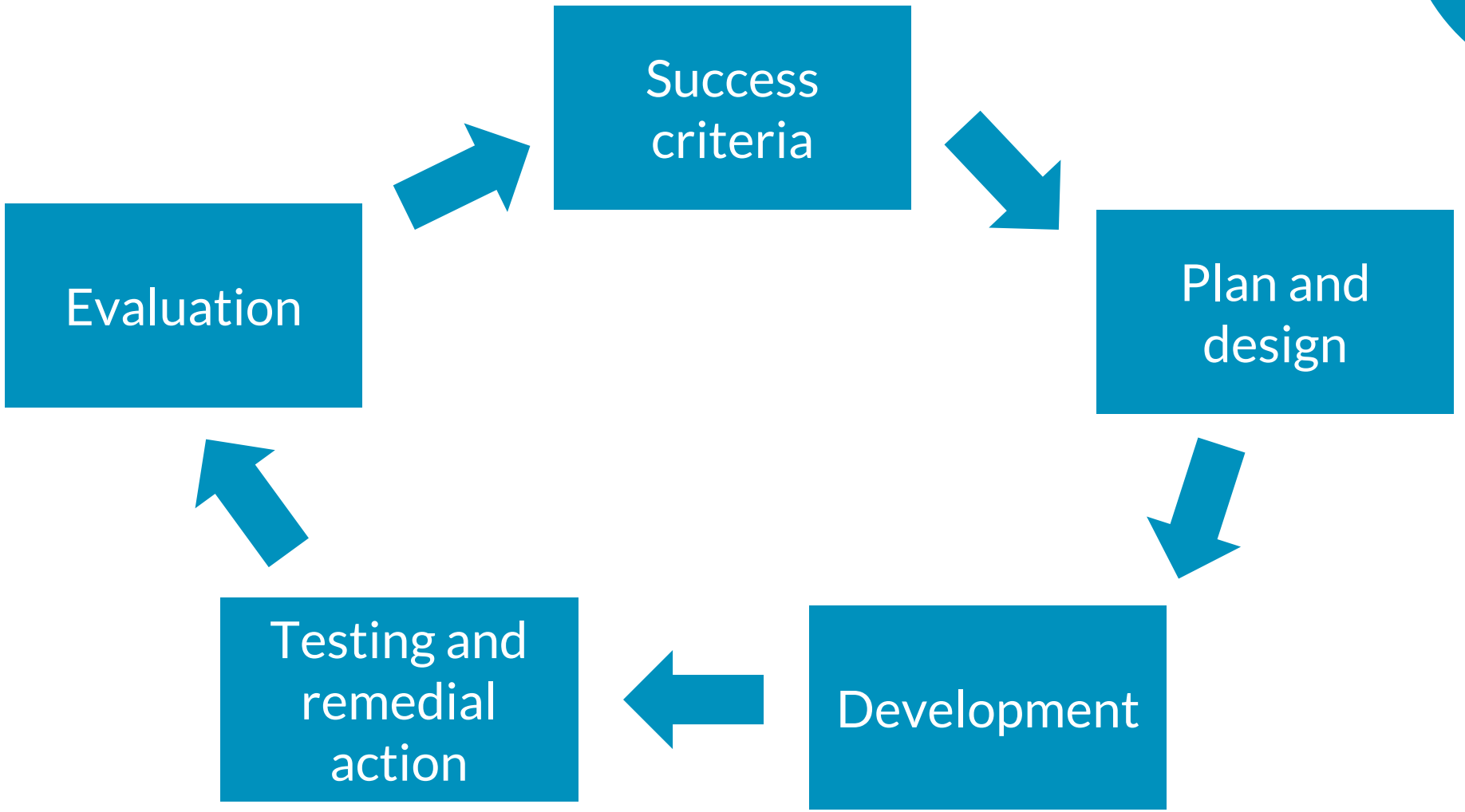
Design first

- Concept designs and rapid prototyping
- Iterating on designs
- Objectives
- Users
- Sketching
- Materials
- Features and prioritisation
- Analysis, why is this better?
- Brand
- What could be improved?



Iterative development cycle

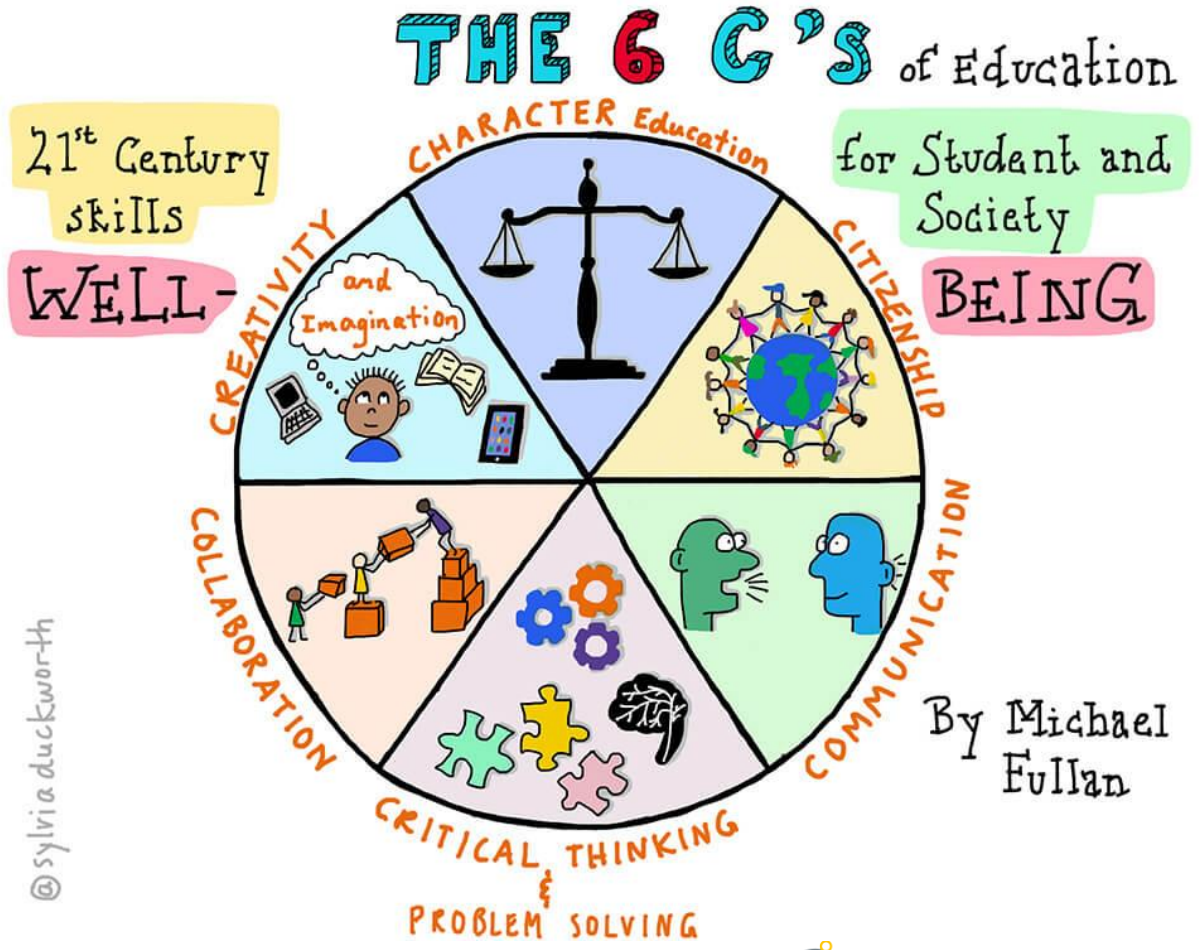
Iterative development cycle



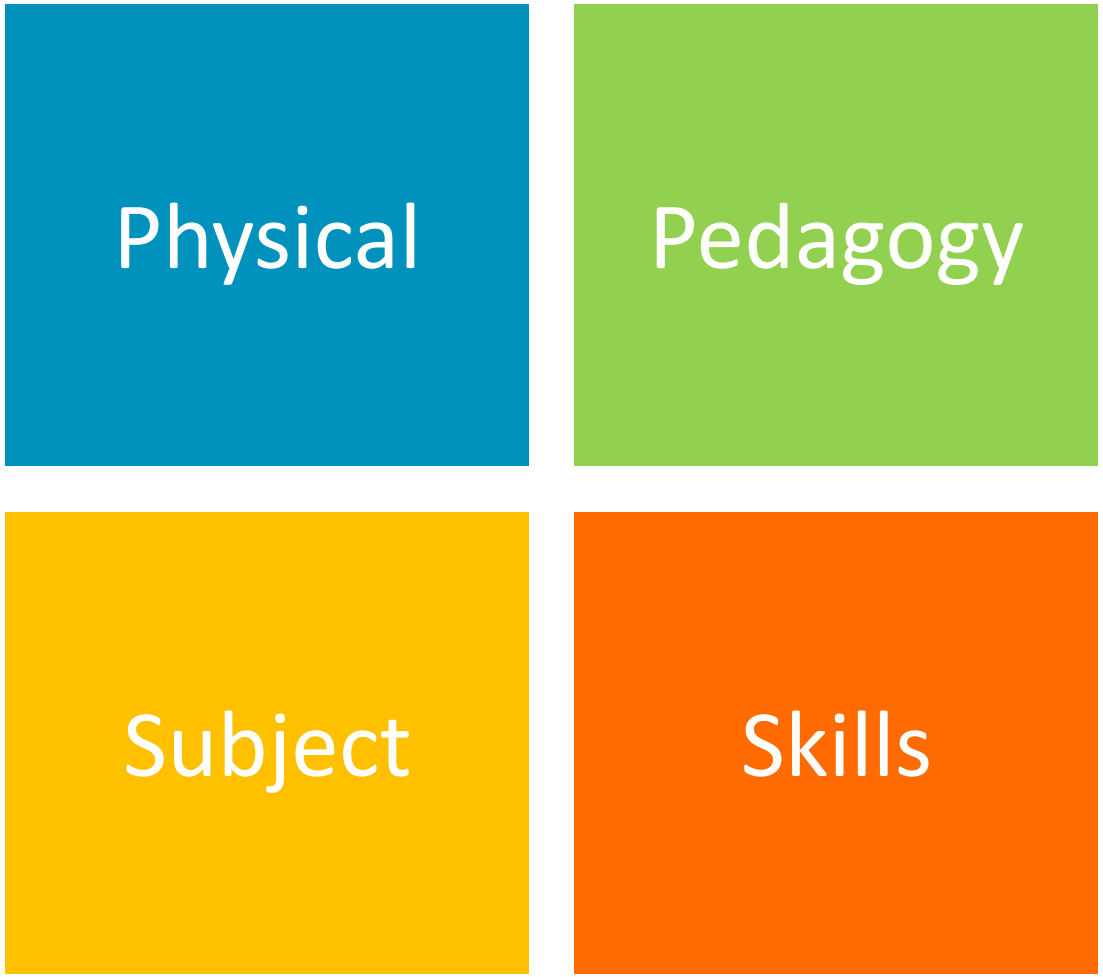
Soft skills

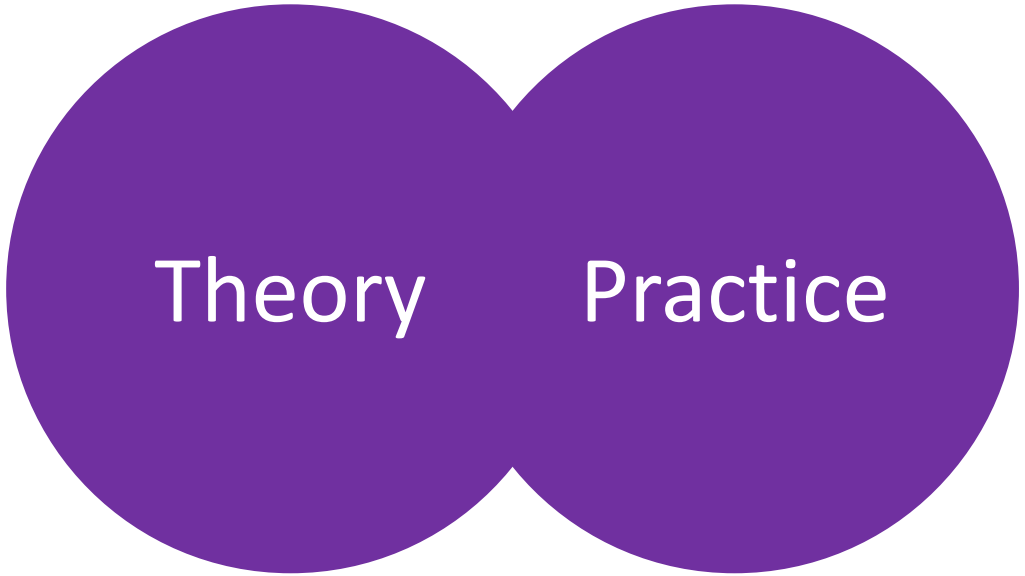
Soft skills (6Cs)

- Teamwork
- Collaboration
- Creative ideation
- Applied Computational thinking
- Communication
- Planning
- Iterative development
- Problem solving



arm School Program





arm School Program

Why do contexts matter?

- Engagement (if done well)
- Relatability/familiarity
- Roots the problem in the learner's world
- Sense of ownership over the problem set
- Makes a complex problem accessible
- Relates to subject domain
- Defines the constraints of the problem/project
- Provides the 'big picture', the WHY?
- Adds a narrative construct

What do we mean by ‘context’?

- The context is the circumstances that form the setting for the learning in terms of which it can be fully understood
- The theme or information relating to the challenges being set
- Ideally:
  - relevant to the learner
  - recognisable or familiar to the learner
  - thematically linked to their surroundings/educational setting
- Contexts can be *almost* anything

THE GLOBAL GOALS
For Sustainable Development

arm School Program

micro:bit

Project Constraints

- Time
- Hardware (digital)
- Access to PCs/internet
- Making resources
- Space
- Tools
- Storage
- Budget/costs

Constraints for the project vs constraints for the learners

Introducing constraints to learners

- Part of the ‘engineering mindset’ is dealing with constrained resources
- Limited making materials
- Limited functionality of dev boards
- Only prescribed hardware
- Limited time
- Constraints on storage/physicality
- Specify in success criteria

Project context ideation

- What hardware is available?
- Big or small project?
- Focus on output or data gathering?
- Computational skill focus?
- How can a context be digitised or manipulated using computational techniques?
- Automation or smart X?
- **Can the problem actually be solved given the constraints?**

What engages your learners?

Subject or topic area of curriculum

Current affairs

Global Goals

Local issues

Open ended problems

- Allows creativity and interpretation to flourish
- Allows upwards differentiation
- Needs to be carefully crafted/constrained
- Can be applied in success criteria or stretch tasks
- Examples:
  - Make the artefact interactive, develop 3 distinct interactions
  - Make the artefact follow a pattern
  - Make the artefact store or transmit the data in a suitable format and structure
  - Make the artefact take input from a user and output appropriate noises

PBL project design considerations

- What will motivate my learners?
- Is the context relatable?
- Does the context need to ‘pop’?
- Is everything new or just the problem set?
- Am I overburdening the learning?
- How can I ensure sufficient progress is made?
- Is there enough scaffolding to support learning?
- Are my learners resilient enough to succeed?
- How can I assess my learners progress?

Where to start?

- Start with one of these areas
- Ideate the other areas to ‘gap fill’
- Ensure the project is realistically achievable
- Write a simple narrative for the context
- Create some success criteria
- Refine
- **Build the artefact yourself!**
- Develop appropriate scaffolding

Example project 1 – Drama (cross curricula/feature/subject)

Context setting:

Your school is putting on a production that requires the lights and sound or set to be automatically controlled by the performer's gestures. You can combine any gesture with any lights/sound/set sequence or action that will enhance the performance.

The theme of the production is <**insert relevant local context**>.

Success criteria:

- Create a device that recognises when a gesture is performed and then transmits a signal to another device that triggers the light/sound/set action.
- Design 3 different pairs of gesture/action that combine sound/light/set actions to enhance the performance.

Hardware:

- 2x micro:bits
- Lights or models of
- Sound generation/or model of
- Set automation/animatronics

Subject focus:

- Automation
- Interaction
- Set interaction/design
- Sound triggering/design
- Light triggering/design

IPO table

Input

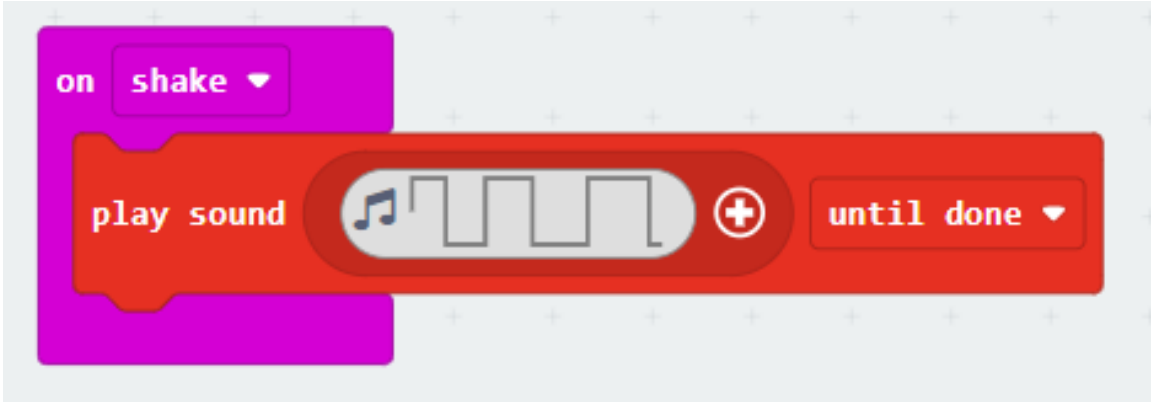
- Gesture 1 (Shake)
- Gesture 2 (Freefall)
- Gesture 3 (6G)

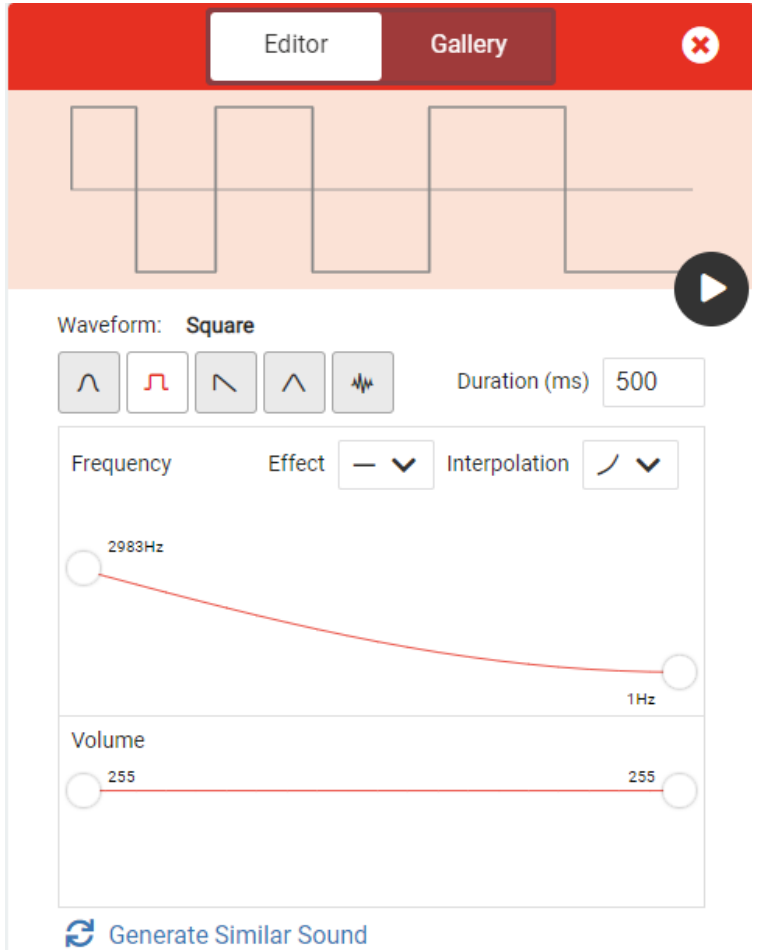
Process

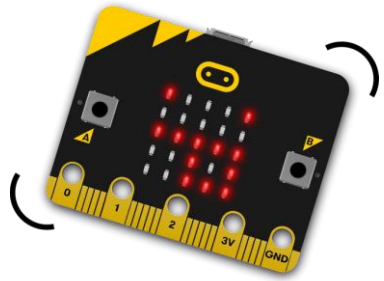
- Transmit to other micro:bit then trigger a light action
- Transmit to other micro:bit then trigger a sound
- Transmit to other micro:bit then trigger a set action

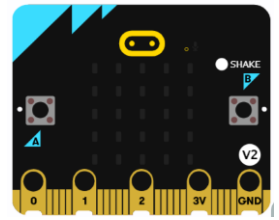
Output

- Light sequence triggered (DMX or modelled with LEDs)
- Sound on micro:bit or trigger a sample on PC/Sampler/instrument
- Animatronic process, set movement, pyro, balloon release, smoke, motor/servo, curtain release etc.

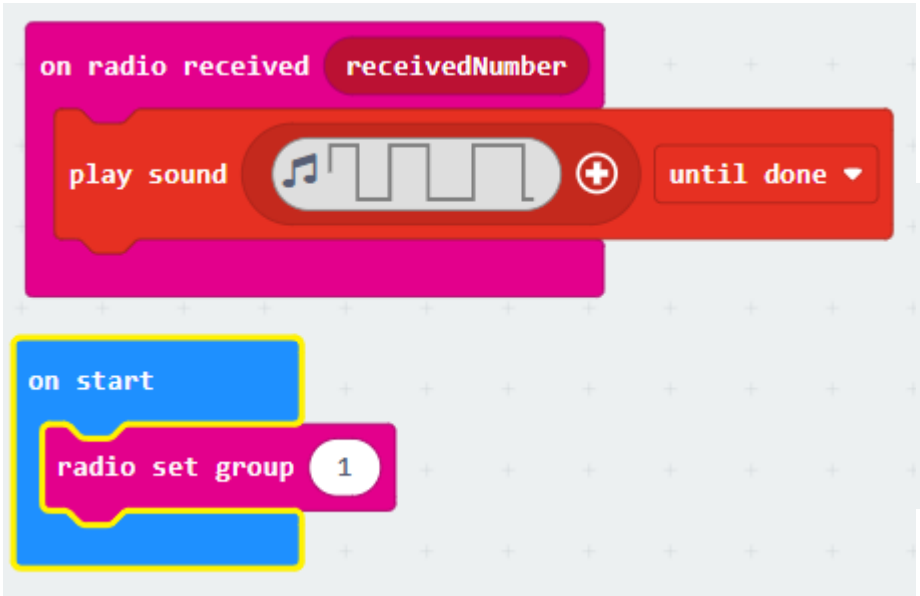


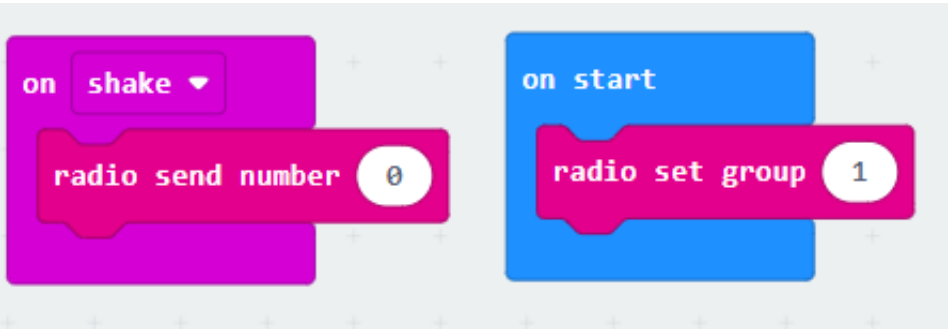






- Square wave used to create a ‘laser’ type sound
- Triggered by a shake





arm School Program

Example project 2 – Geography (from a school context)

Context setting:

The headteacher is concerned about air pollution levels in the school pick up point due to the amount of vehicles. They have asked you to create a device to monitor the air quality in your school at various times of the day to see when air quality is best/worst during a normal school day.

Success criteria:

- Build a device that can measure air quality over a typical school day
- The device should either store the data locally or transmit the data to another device/PC for analysis
- Analyse the data and create a report on what factors impact air quality as well as making recommendations to improve air quality where appropriate

Hardware:

- Micro:bit/Arduino/Rpi 4/PicoW
- Air quality sensor

Subject focus:

- Fieldwork
- Data collection and sampling
- Quantitative data analysis - percentiles

IPO table

Input

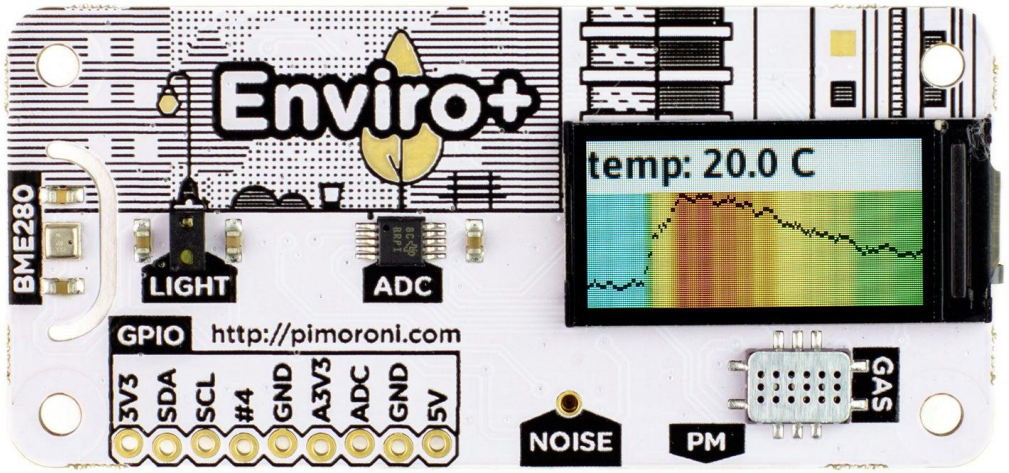
- Temperature sensor
- Air pressure sensor
- Light sensor
- Gas sensor
- Microphone
- Particulate matter sensor

Process

- Threshold for output trigger
- Data capture/storage in tables/variables/lists
- Create graphs

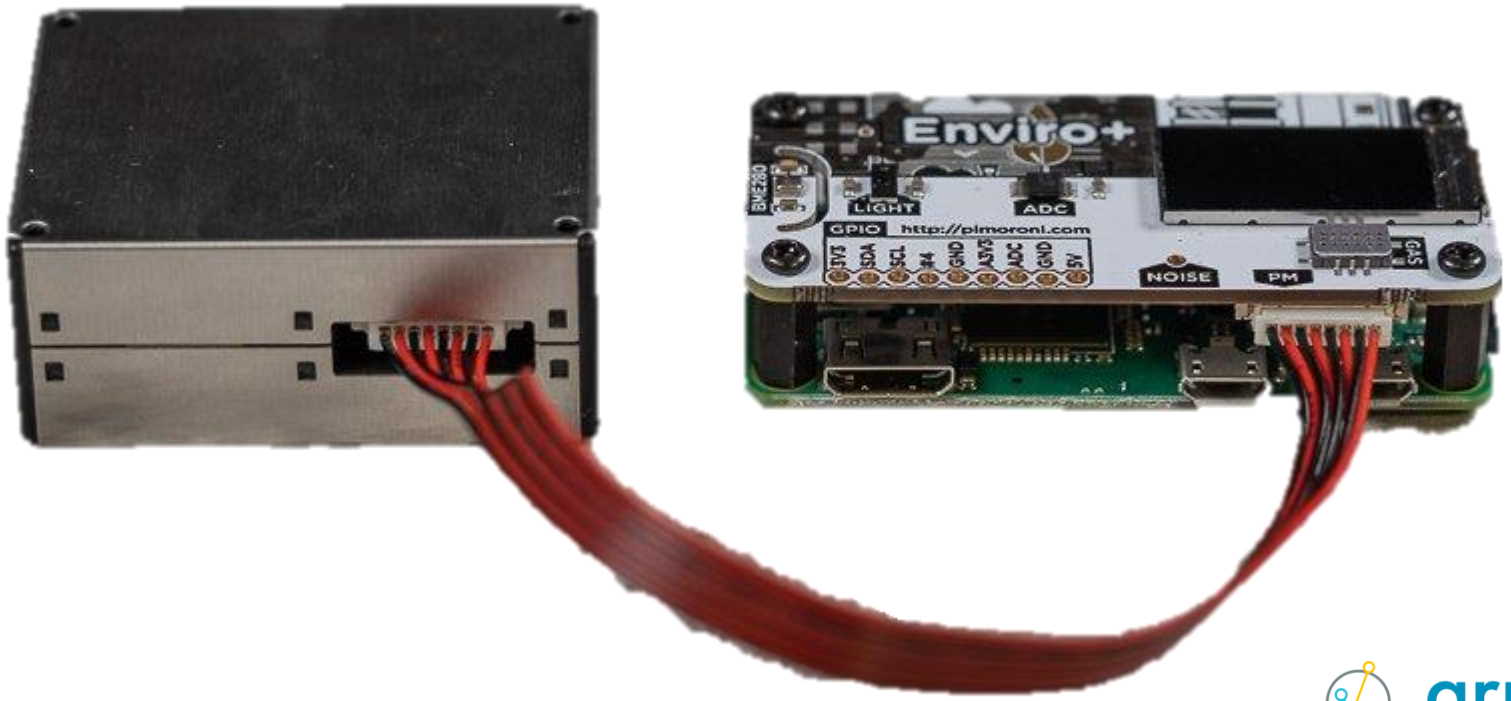
Output

- Data mapped to .csv
- Graphs onscreen/dashboard
- Warning light/sound
- Transmit data over Wifi/radio



Luftdaten

- https://devices.sensor.community/



Example project 3 – Music (from the device features)

Context setting:

You have been asked to create an autonomous digital band that play a random tune in the key of C. The band should have a bass, mid and treble element. The band need to be triggered by a button press from the conductor. The conductor needs to be able to change the movement of the song being played by using gestures. These should be short pre-programmed arrangements in another key.

Success criteria:

- Program 4 micro:bits to form a digital band
- Have 1 conductor:bit to control the band
- Have 3 band:bits (bass, mid, treble) all randomly playing melodies in the key of C
- The conductor:bit should be able to trigger short pre-programmed arrangements (in another key) using gestures

Hardware:

- 4 micro:bits (V2) with battery packs

Subject focus:

- Bass mid treble
- Harmony
- Key of C
- Automation of note composition
- Gestures and movements

IPO table

Input

- Button press
- Gesture detection

Process

- Random music algorithm in C
- Music arrangement in E

Output

- Radio transmission
- Music from speakers
- Music direct to PA via jack

Micro:bit orchestra

- https://www.captaincredible.com/microbit-orchestra/
- https://www.youtube.com/watch?v=gLZGRN_SYJs
- https://youtu.be/hsJHWqQpvHA

Example project 4 – Physics (from the curriculum)

Context setting:

Your Physics teacher has asked you to create a device that can accurately measure the acceleration of a trolley down a ramp.

Success criteria:

- Create a device that can accurately and consistently measure acceleration
- The device must be able to control independent and dependant variables to mitigate human error
- The data gathered needs to in a .csv format
- You must analyse the data to determine which variables increase acceleration

Hardware:

- 1 micro:bits (V2) with battery pack
- Trolley
- Ramp

Subject focus:

- Acceleration
- Independent, dependent and control variables
- Human error and scale (digitisation of measurement)
- Anomalous and average data

IPO table

Input

- Button press

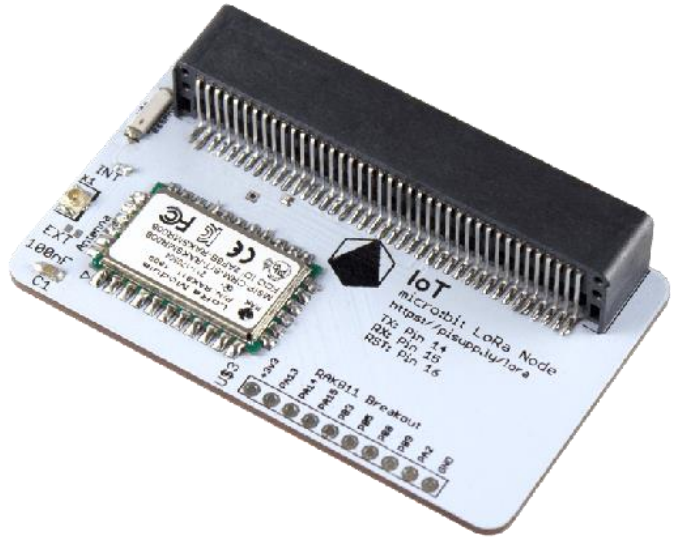
Process

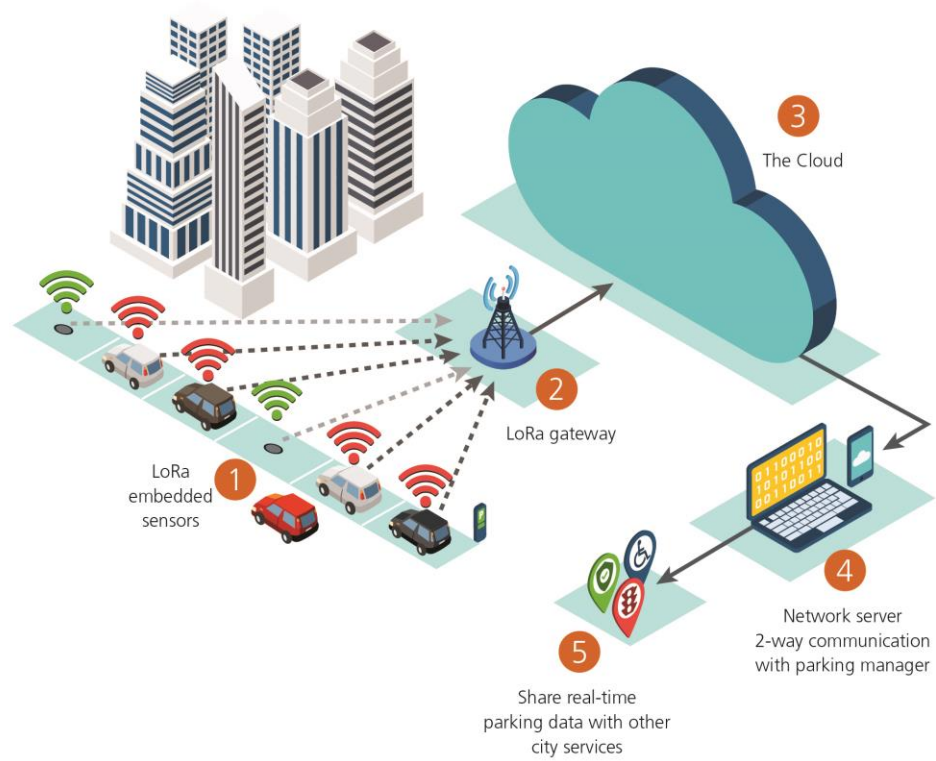
- Data logging of movement

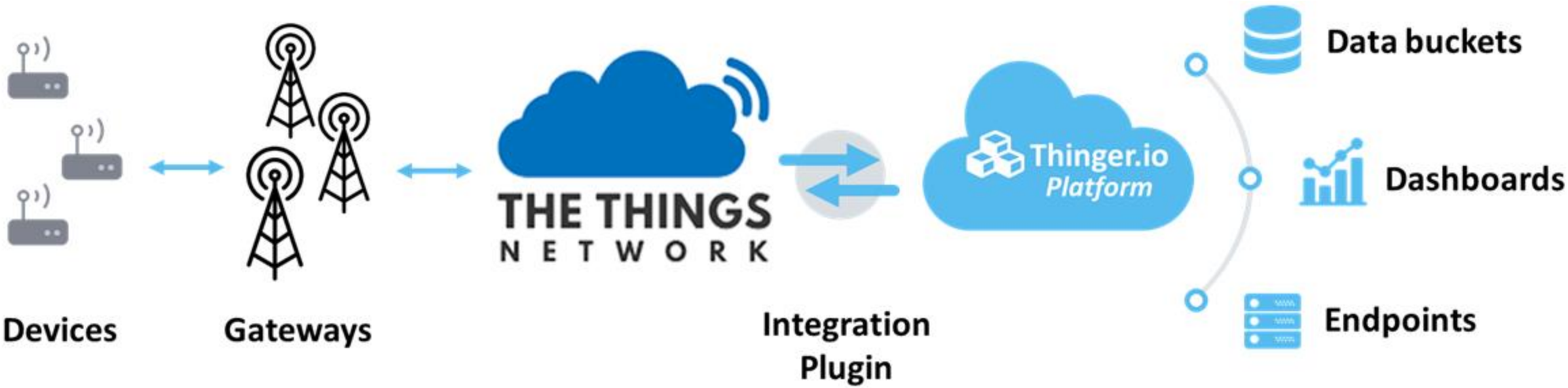
Output

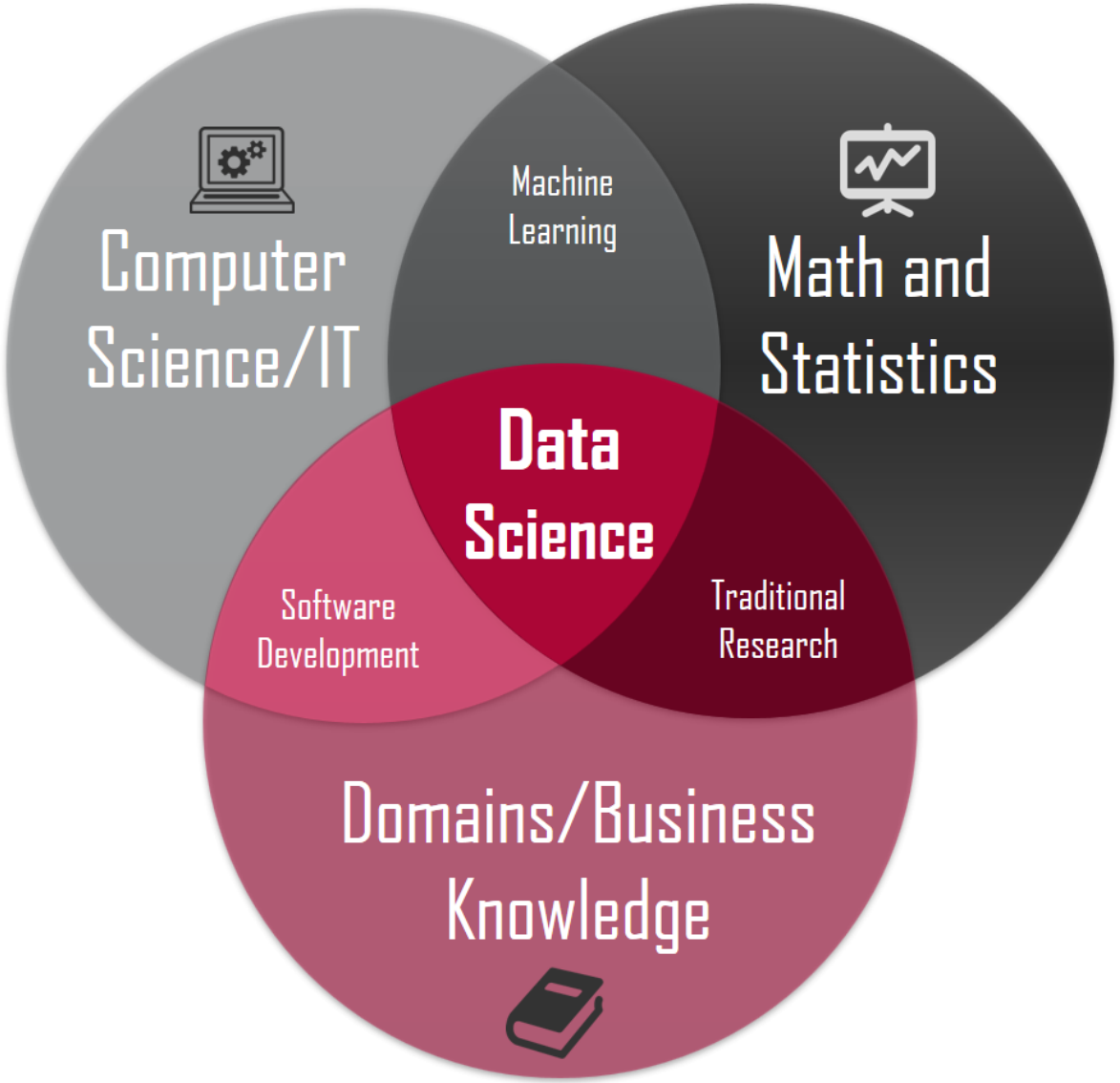
- Radio transmission of data
- .csv via USB
- Graphing to LEDs

LoRaWAN®


IoT
microbit: LoRa Node
https://pisupply/lora
TX: Pin 14
RX: Pin 15
RST: Pin 16
RAK811 Breakout


3
The Cloud
2
LoRa gateway
LoRa
embedded
sensors
1
4
Network server
2-way communication
with parking manager
5
Share real-time
parking data with other
city services

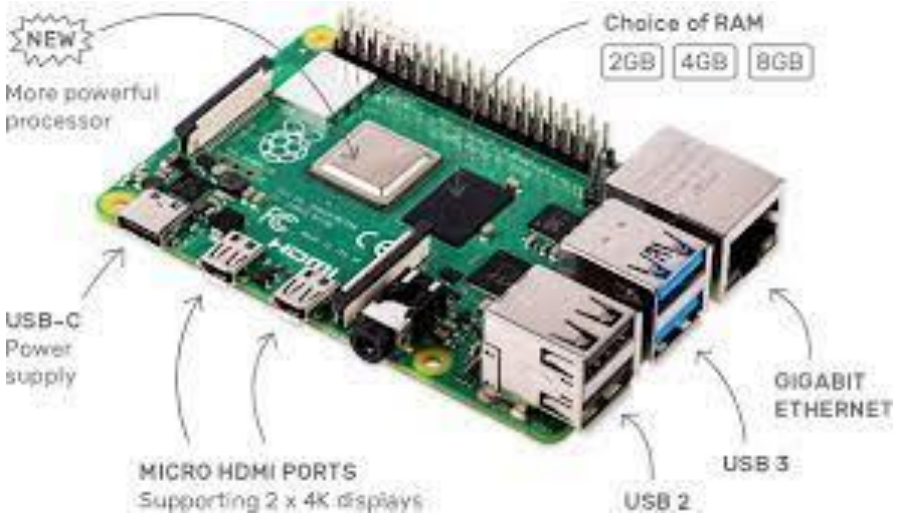

Devices
Gateways
THE THINGS
NETWORK
Integration
Plugin
Thinger.io
Platform
Data buckets
Dashboards
Endpoints



Data Science

- The next tech wave
- A new subject?
- Where would it live in the curriculum?

Other devices



Over to you!

- Using the templates demonstrated above create your own PBL projects
- Try them with a class
- Iterate on it to improve delivery
- Share them with colleagues and peers online
- Share them with the 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

Q & A

Robert Leeman, Educational Solutions Manager, Arm

Nick Sample, Senior Manager, Arm School Program

arm

Thank You
Danke
Gracias
Grazie
谢谢
ありがとう
Asante
Merci
감사합니다
धन्यवाद
Kiitos
شكرًا
ধন্যবাদ
תודה