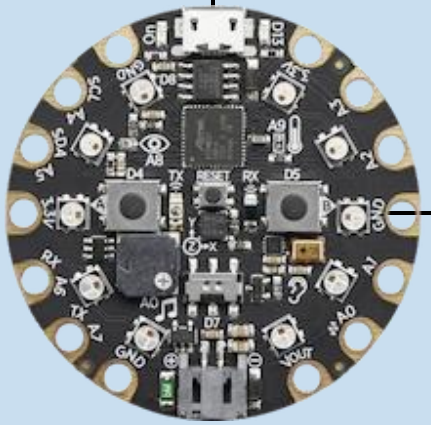
Innovative STEAM Pathways: Centering Mathematics, Supporting Equity, and Leveraging Other Disciplines Primarily as Tools — Through an Electronic Platform



CADGME, Conference on Digital Tools in Mathematics Education,

September 2025

Carole DORDING,

Gilbert BUSANA, Christian MEYERS,

Robert A.P. REUTER, Christina SIRY,

Yves KREIS

UNIVERSITÉ DU LUXEMBOURG

STEAM CONNECT

Co-funded by the Erasmus+ Programme of the European Union

Overview

1. Overview of the ERASMUS+ STEAM-CONNECT Project
2. Key Values of STEAM Education
3. Focus of the Multiplier Event Courses
4. Circuit Playground Express Board
5. Design Thinking Activity
6. Our Chosen Activity
7. Activity Overview & Workshop Motivation

1. Overview of the ERASMUS+ STEAM-CONNECT Project

- Brought together STEAM (**S**cience, **T**echnology, **E**ngineering, **A**rts, and **M**athematics) expert teams from universities and educational organizations, fostering collaboration among teachers, parents, artists, educators, and researchers from diverse disciplines across five countries.

  The expert teams included:

  - University of Luxembourg
  - University of Turin, Italy
  - Experience Workshop ay, Finland
  - University of Linz, Austria
  - Comenius University Bratislava, Slovakia

- Two secondary schools in each country adapted inspirational materials to create fresh ideas and innovative interdisciplinary STEAM approaches, and they organized Multiplier Event Courses.

2. Key Values of STEAM Education

- STEAM education involves high-quality **hands-on activities**, **real-world** problem-solving, and **inter- or transdisciplinary learning**, slightly **differentiated** to reach all students, regardless of their backgrounds.
- STEAM activities emphasize **collaboration, creativity, and practical skills**, making learning more accessible to students with different abilities and learning preferences.
- STEAM education makes STEM subjects more appealing, which may break down barriers to learning.

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STEAM-Centered classroom

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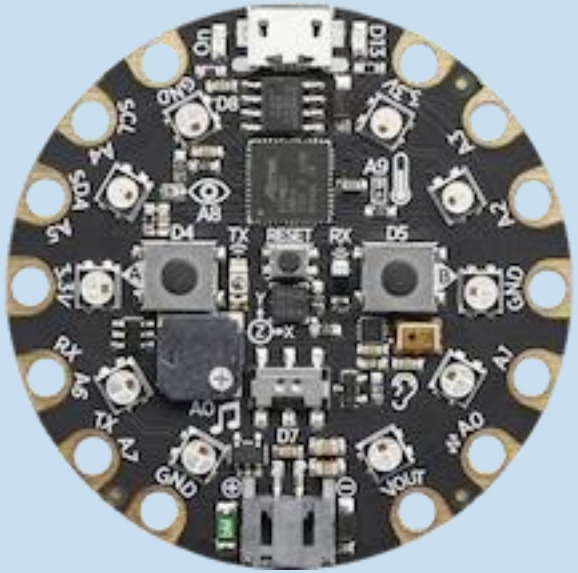
STEAM-Centered classroom

Identify an engaging, authentic topic—such as a specific object—to connect diverse content and the arts to a meaningful question or problem.

→ Clear FOCUS

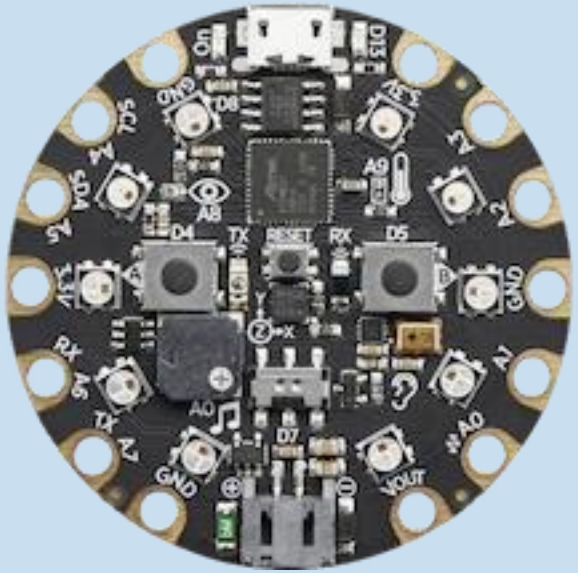
3. Focus of the Multiplier Event Courses



Luxembourgish team:

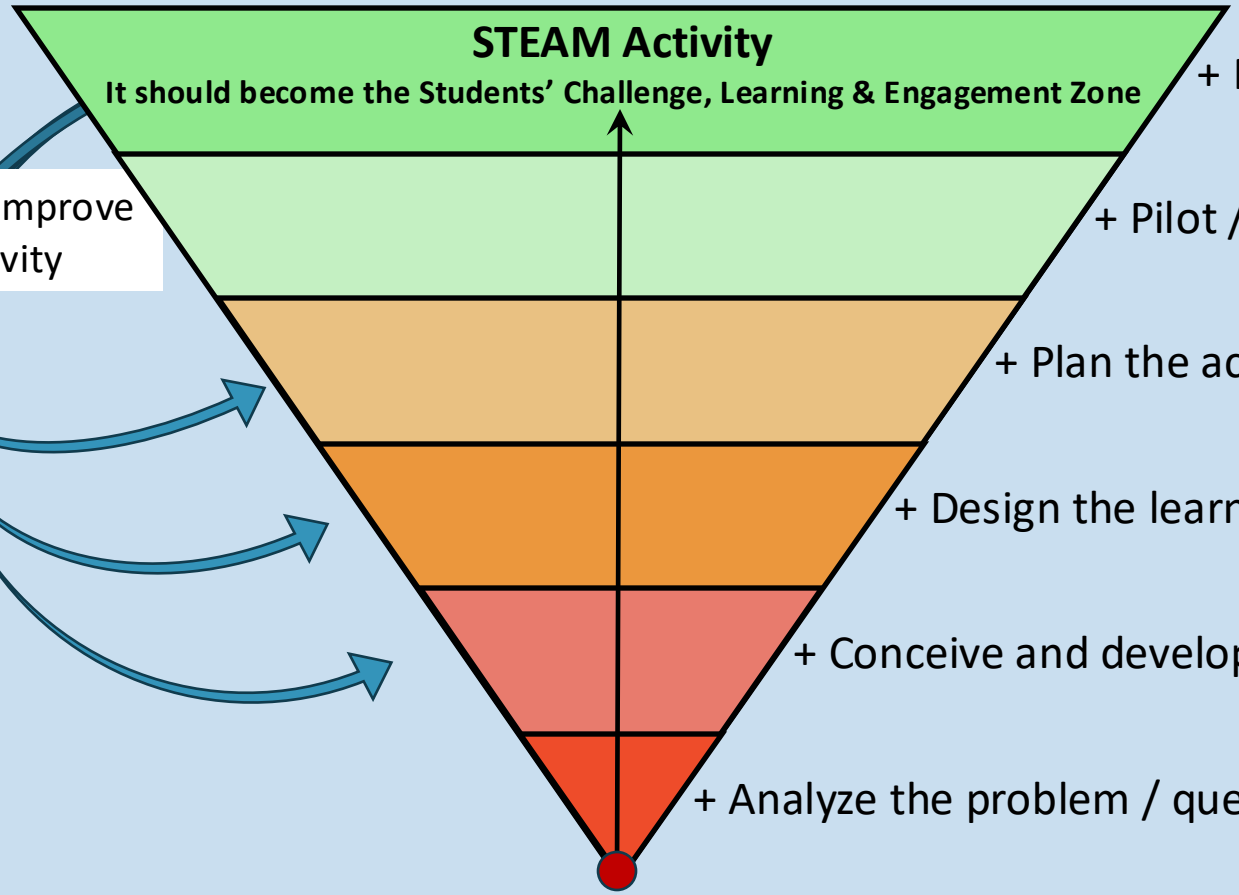
Using the Circuit Playground Express Board, **alone or in combination** with another object, for **hands-on**, **interdisciplinary STEAM learning**.

4. Circuit Playground Express Board



- Key built-in features packed into the Circuit Playground Express Board:
  - ✓ 10 mini NeoPixels, each able to display a full range of colors;
  - ✓ 1 accelerometer, a motion sensor;
  - ✓ 1 temperature sensor;
  - ✓ 1 light sensor that functions as a colour sensor / as a pulse sensor;
  - ✓ 1 sound sensor (MEMS microphone);
  - ✓ 2 push buttons, labeled A and B;
  - ✓ 1 slide switch;
  - ✓ Infrared receiver and transmitter;
  - ✓ MicroUSB port for programming and debugging.
- The same board can be programmed in four different ways.

5. Design Thinking Activity (part 1)



Refine and improve the activity

+ Reflect on and evaluate the activity

+ Pilot / implement the activity, observing its flow

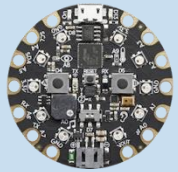
+ Plan the activity implementation

+ Design the learning experience

+ Conceive and develop the activity concept

+ Analyze the problem / question to identify key elements

Choose a creative activity idea with clear topic focus, incorporating



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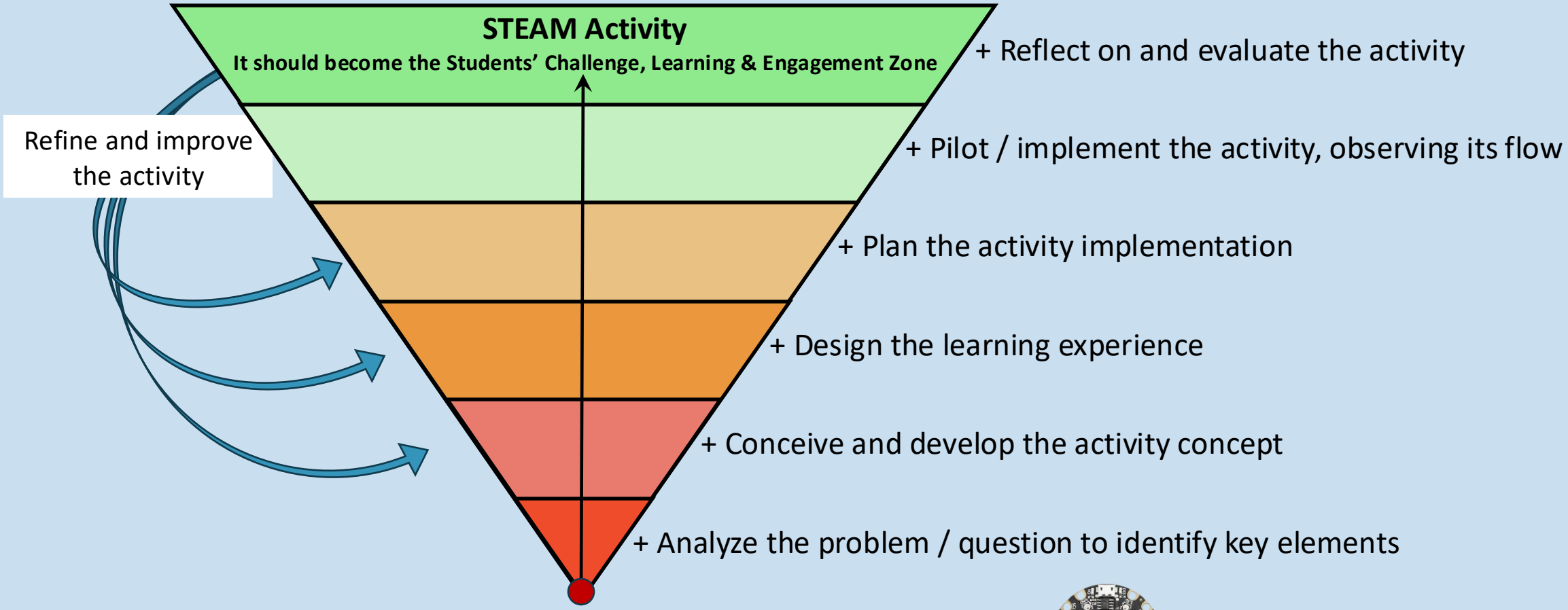

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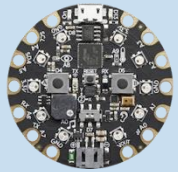

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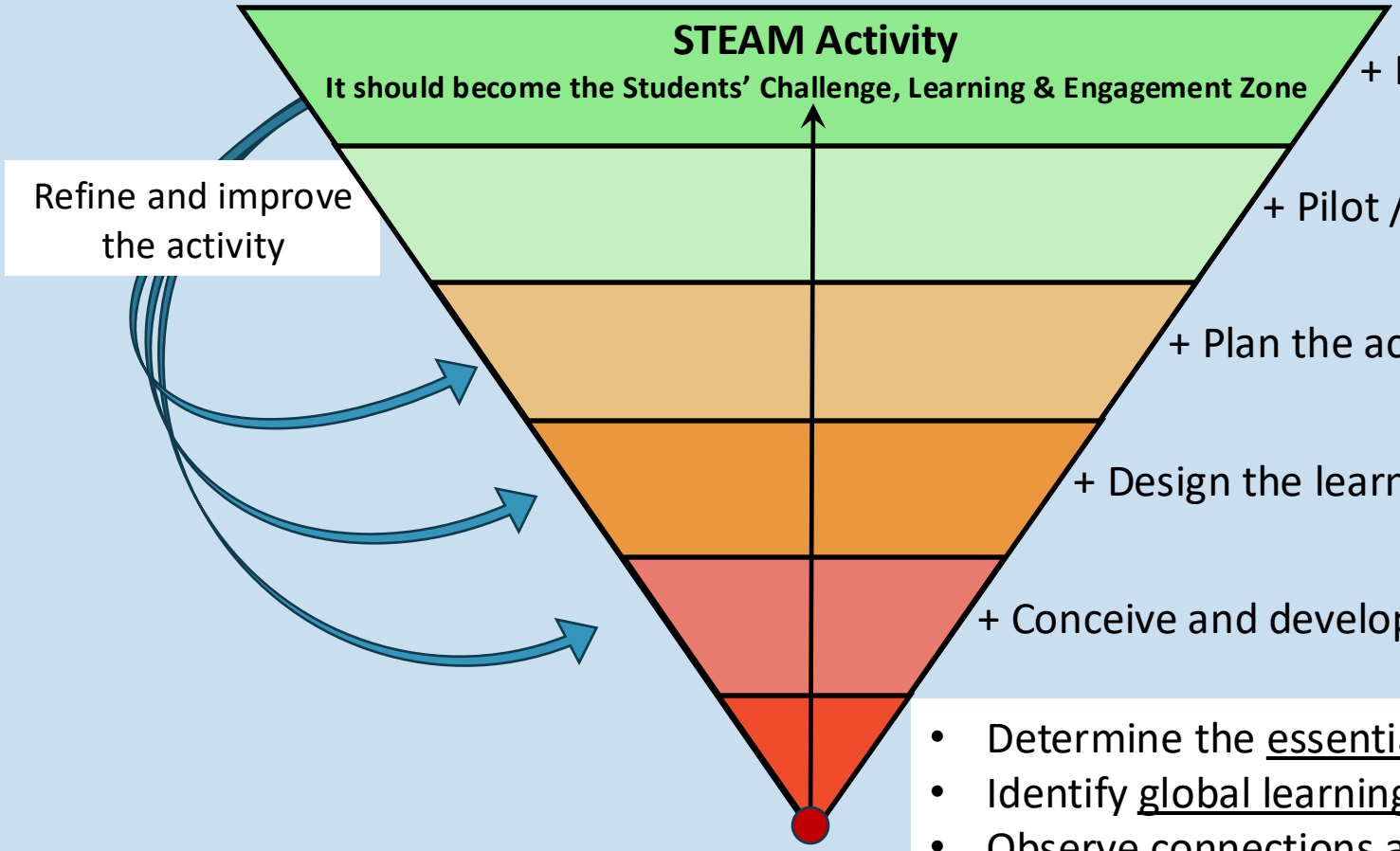
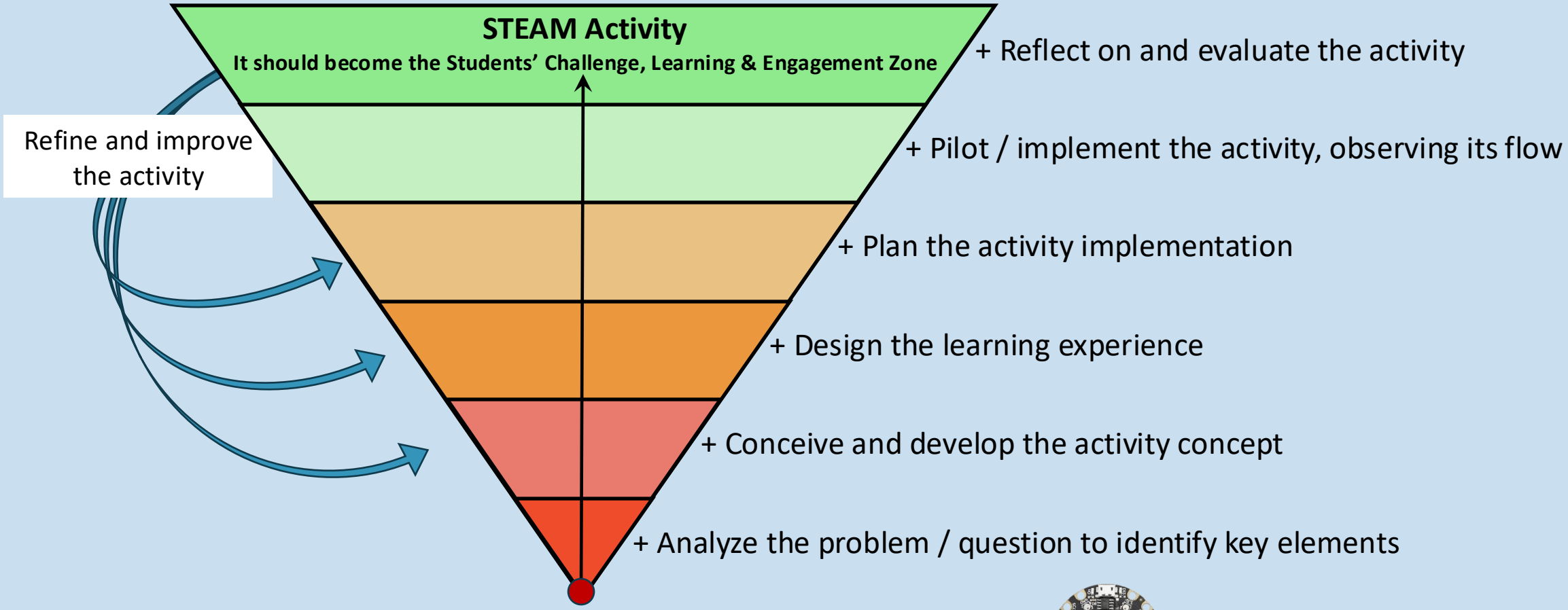


- Determine the <u>essential concepts and skills</u> to be taught
- Identify <u>global learning objectives</u> for the different disciplines
- Observe <u>connections</u> and key contributing factors to the central challenge

5. Design Thinking Activity (part 2)



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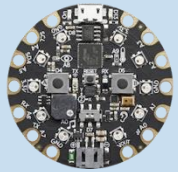

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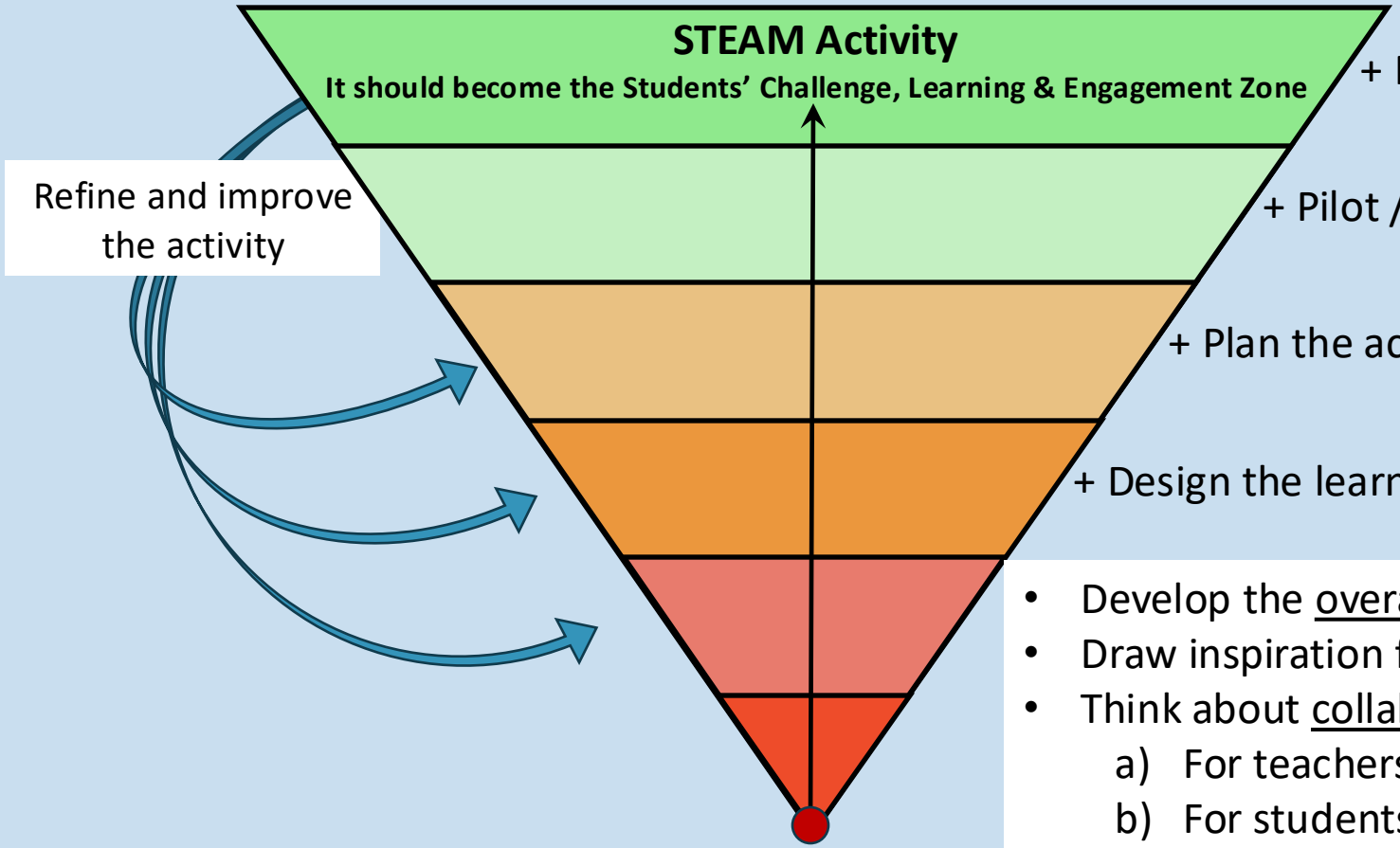


+ Reflect on and evaluate the activity

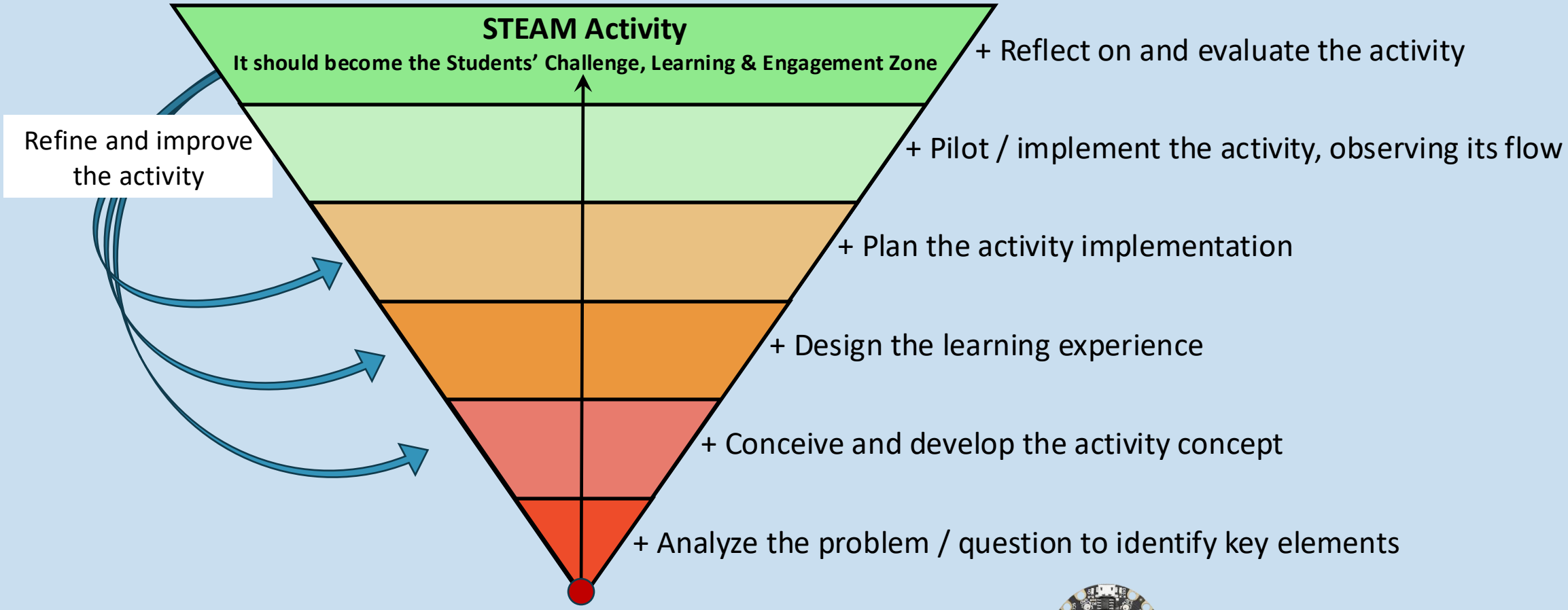
+ Pilot / implement the activity, observing its flow

+ Plan the activity implementation

+ Design the learning experience

- Develop the overall concept of the activity
- Draw inspiration from existing projects and research
- Think about collaboration opportunities and teamwork:
  a) For teachers
  b) For students
  c) Between teachers and students

5. Design Thinking Activity (part 2)



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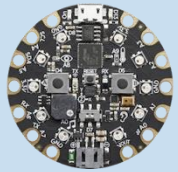

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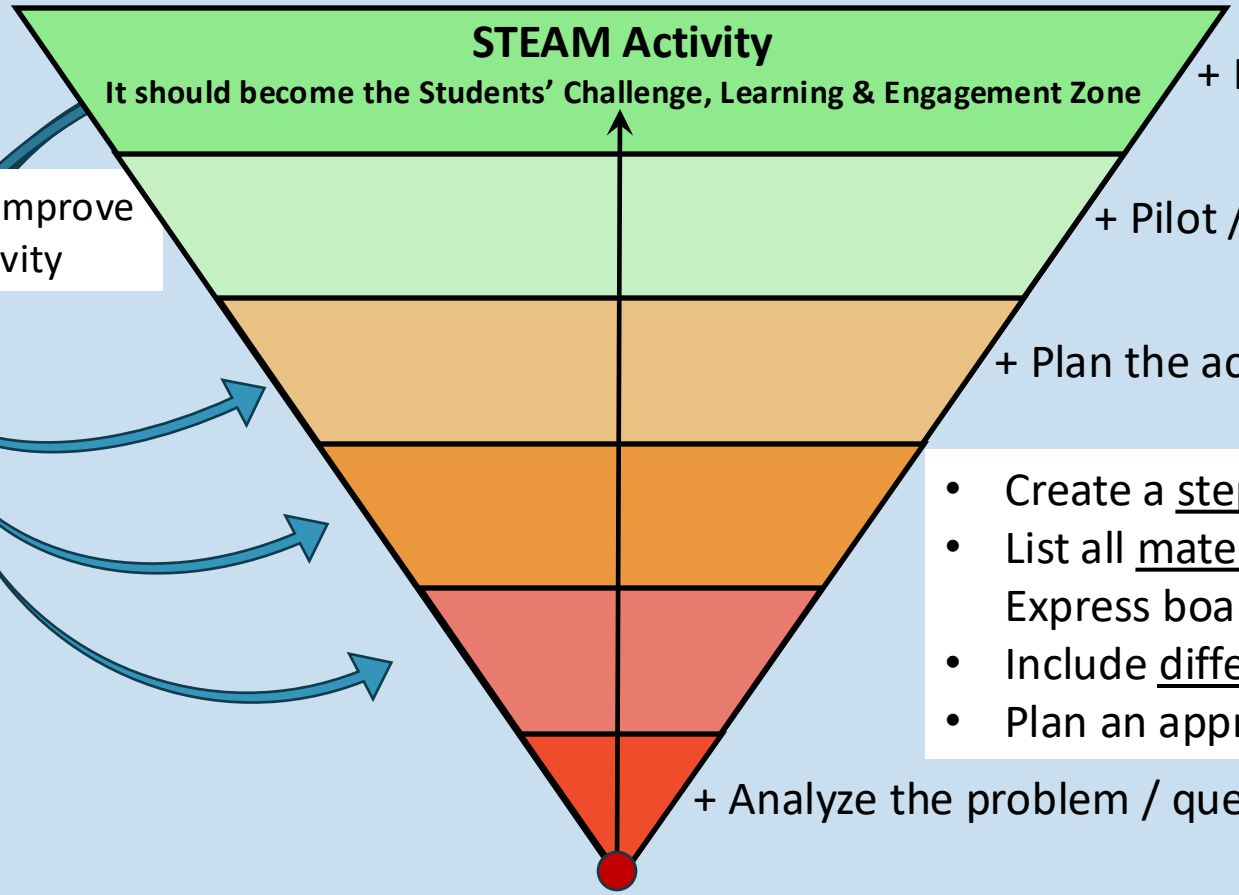


+ Reflect on and evaluate the activity

+ Pilot / implement the activity, observing its flow

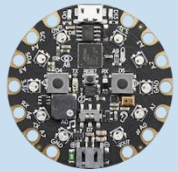
+ Plan the activity implementation

- Create a step-by-step activity outline
- List all materials and technology (e.g., Circuit Playground Express board, balance board, heat/cooling sources)
- Include differentiation ideas by ability and school level
- Plan an approach to collect feedback (e.g., Multiplier Event)

+ Analyze the problem / question to identify key elements

Refine and improve the activity

Choose a creative activity idea with clear topic focus, incorporating



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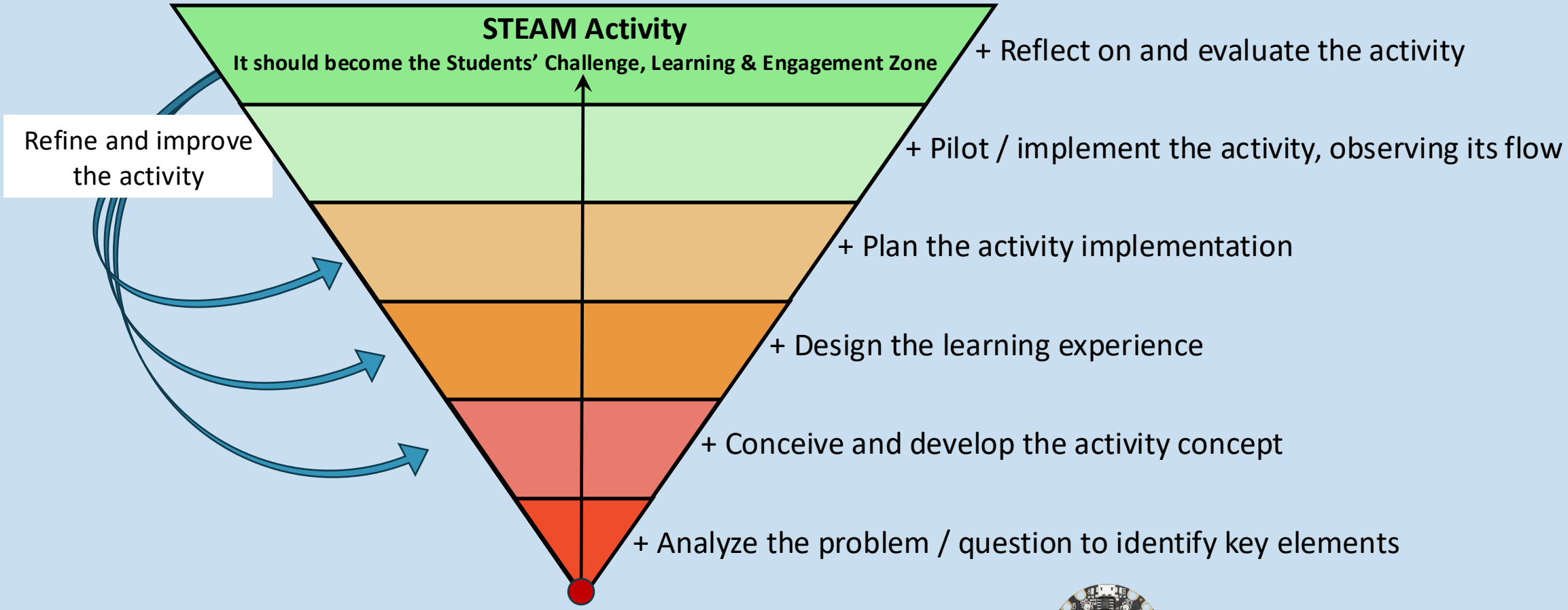

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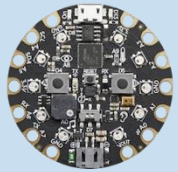

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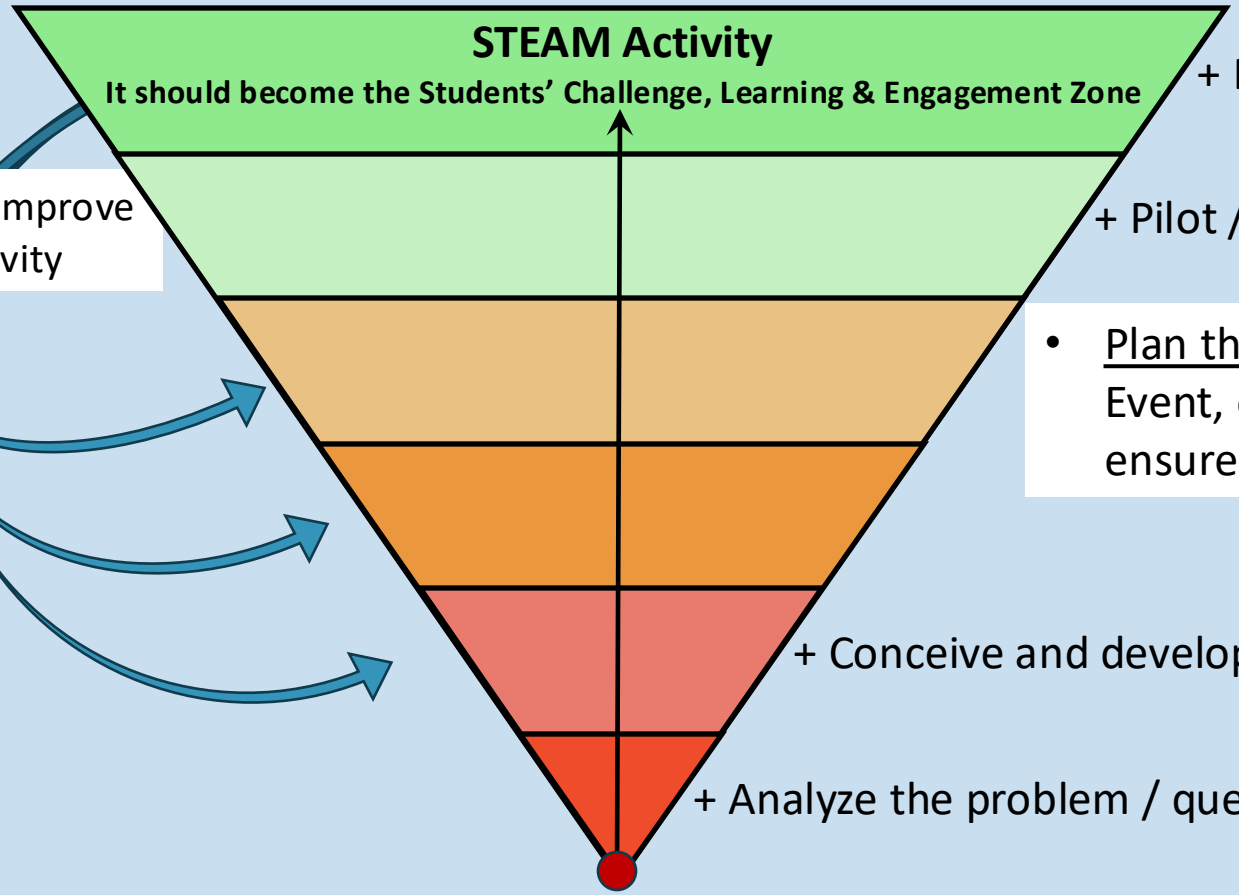


Refine and improve the activity

+ Reflect on and evaluate the activity

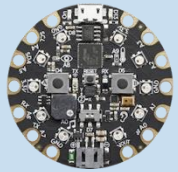
+ Pilot / implement the activity, observing its flow

- Plan the activity implementation for the Multiplier Event, organizing tasks, materials, and roles to ensure smooth and effective execution

+ Conceive and develop the activity concept

+ Analyze the problem / question to identify key elements

Choose a creative activity idea with clear topic focus, incorporating



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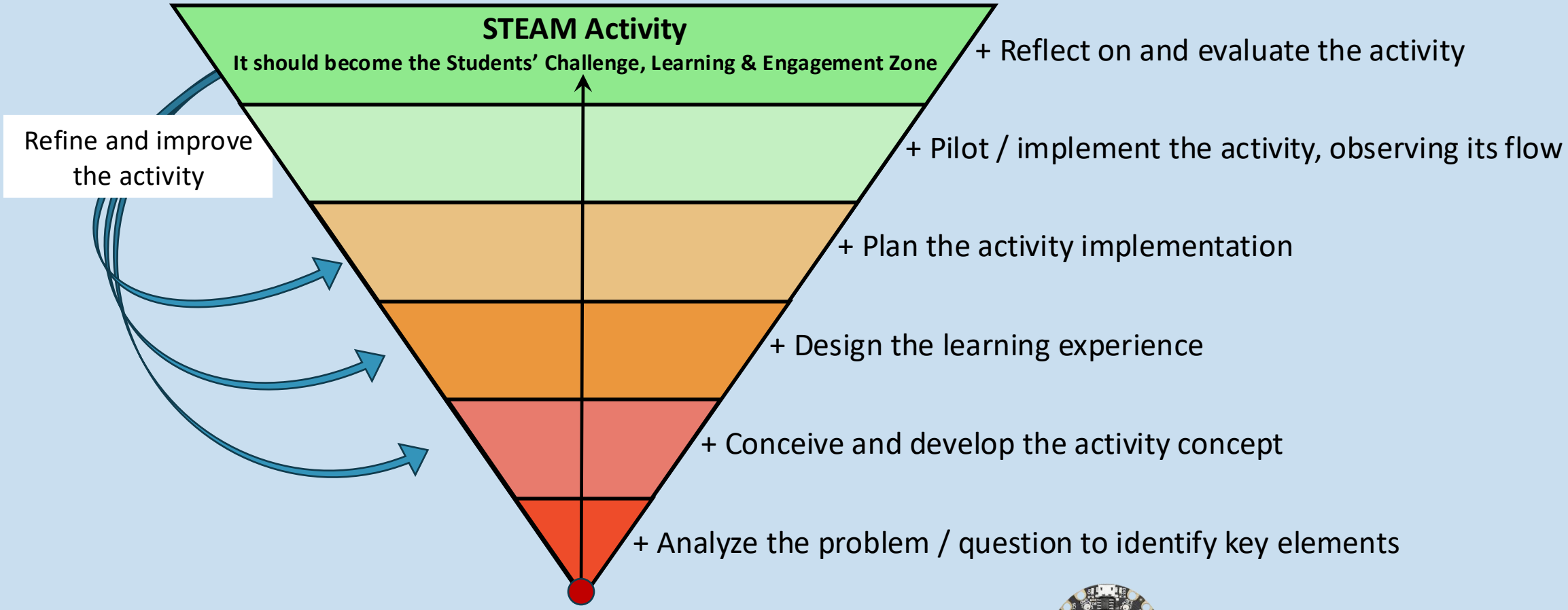

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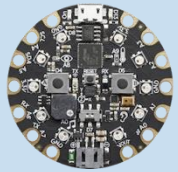

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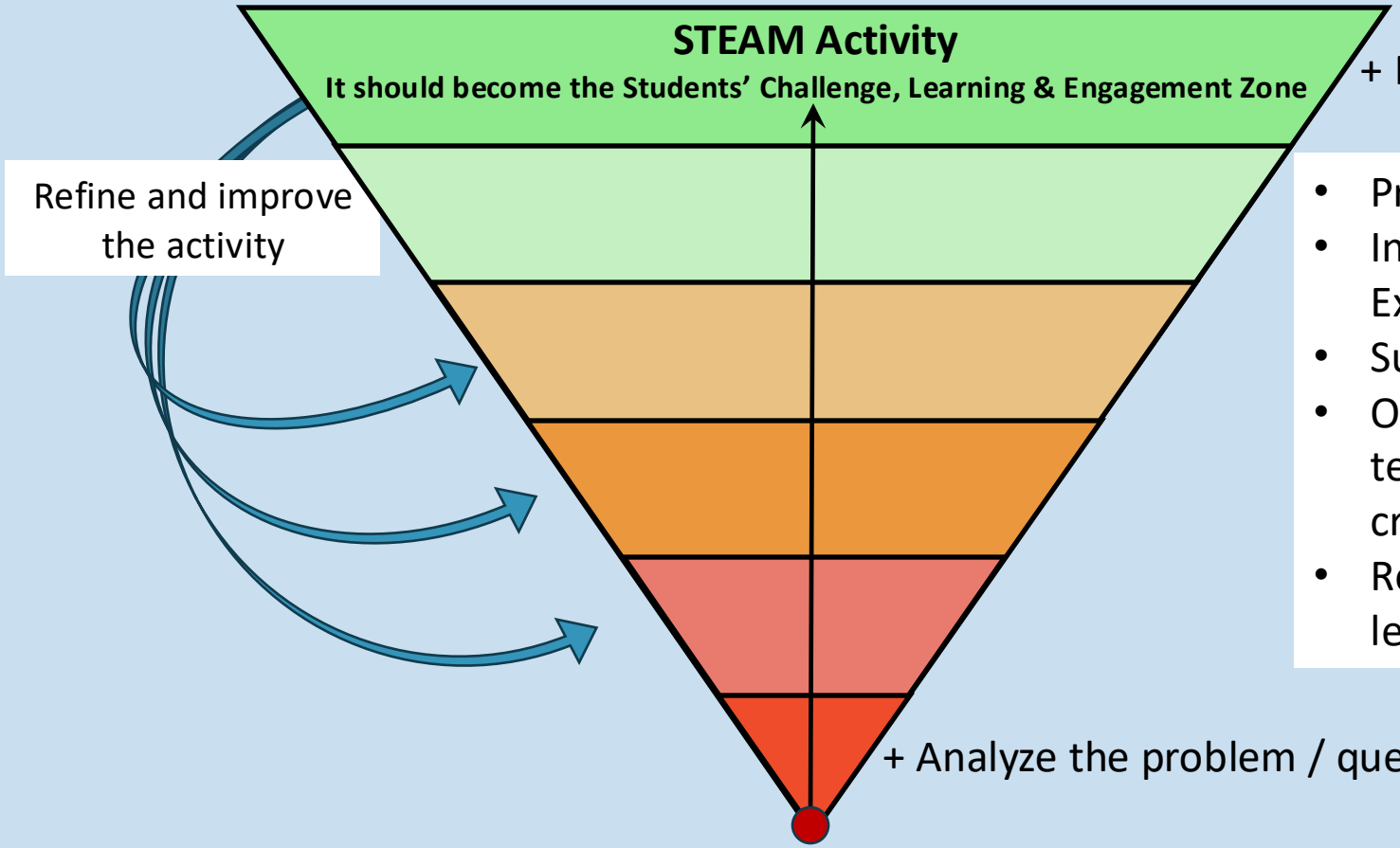

+ Reflect on and evaluate the activity

- Prepare materials and resources
- Introduce the concept and the Circuit Playground Express board
- Support hands-on, interdisciplinary learning
- Observe engagement and participation, support teachers, provide feedback, and encourage creative exploration
- Reflect and capture insights, challenges, and lessons for classroom implementation

+ Analyze the problem / question to identify key elements

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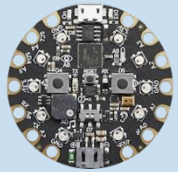

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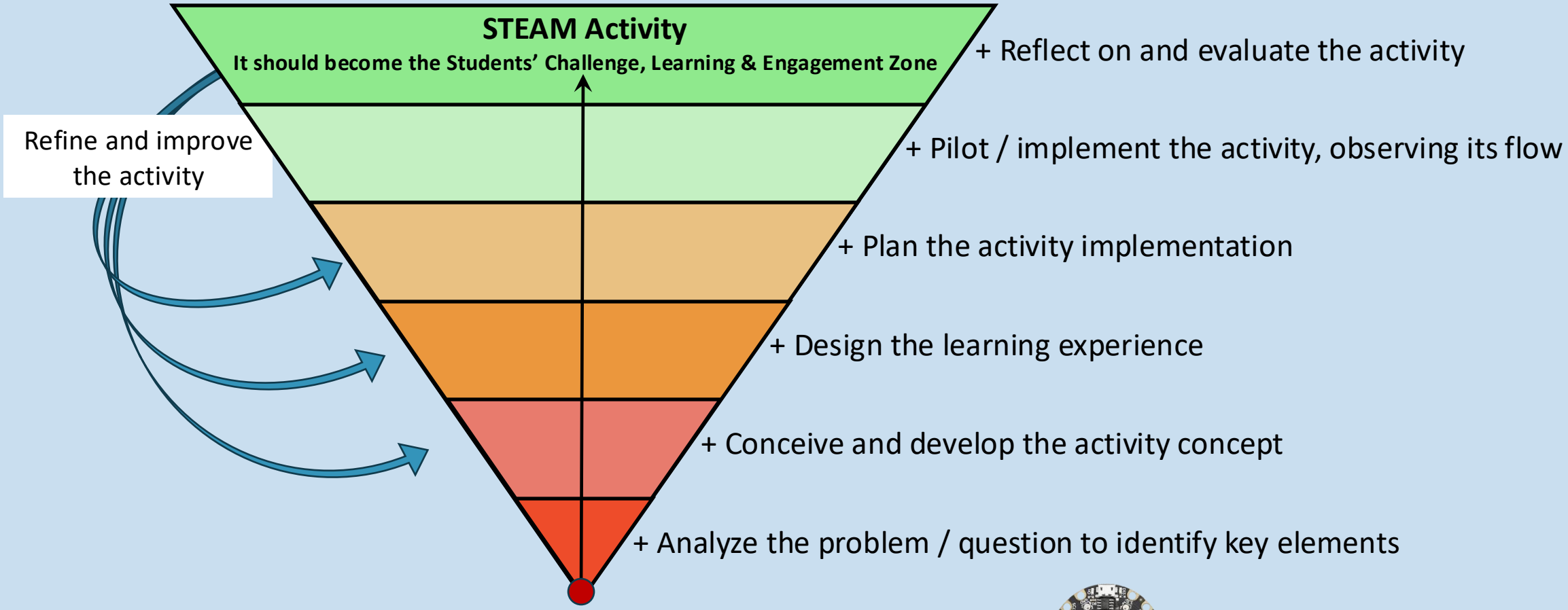

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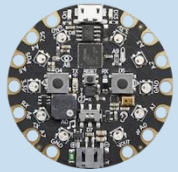

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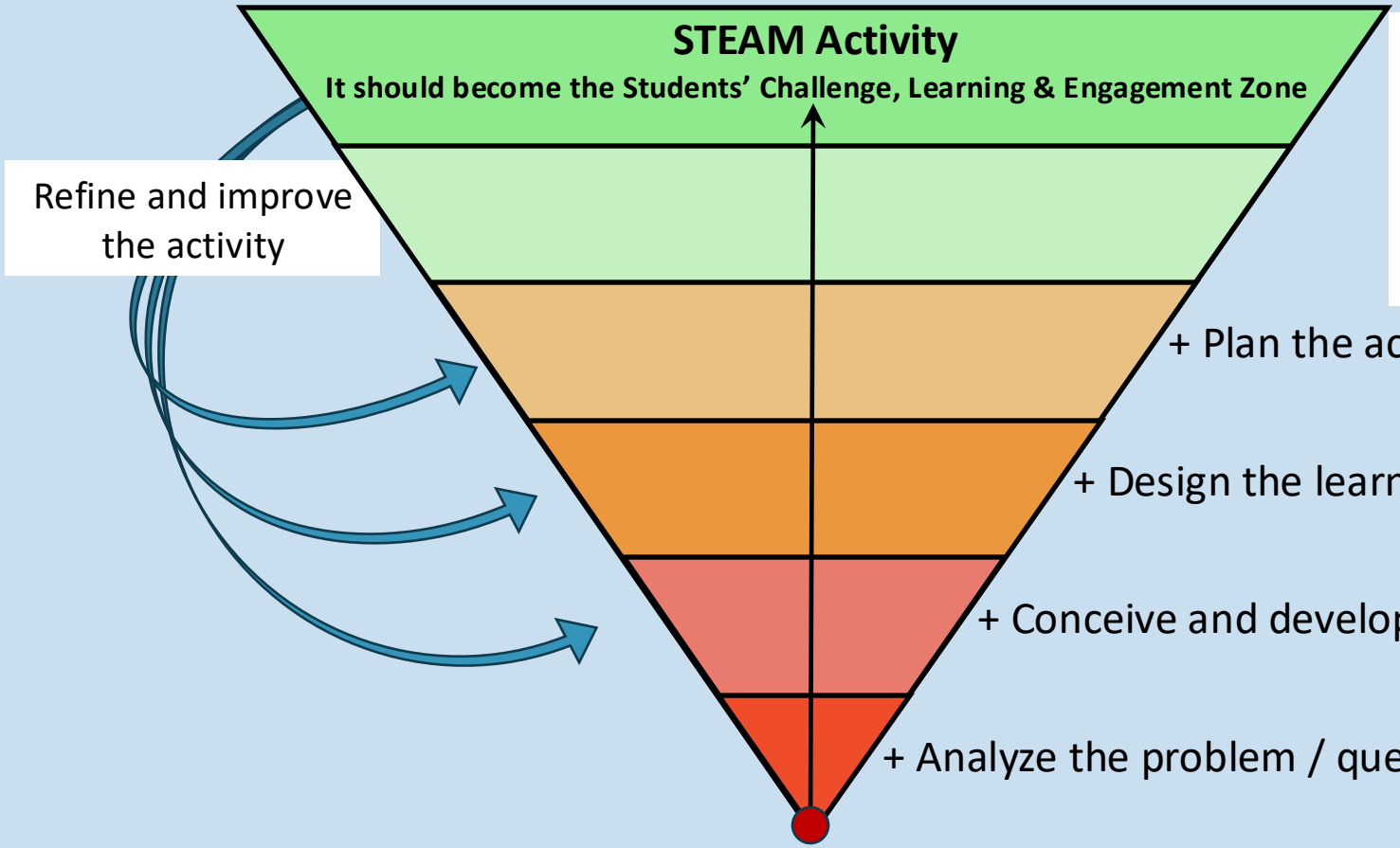

- Analyze feedback from teachers and later from students
- Consider how activities could be scaled or adapted for different groups and learning contexts

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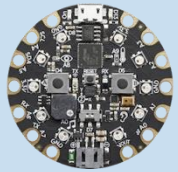

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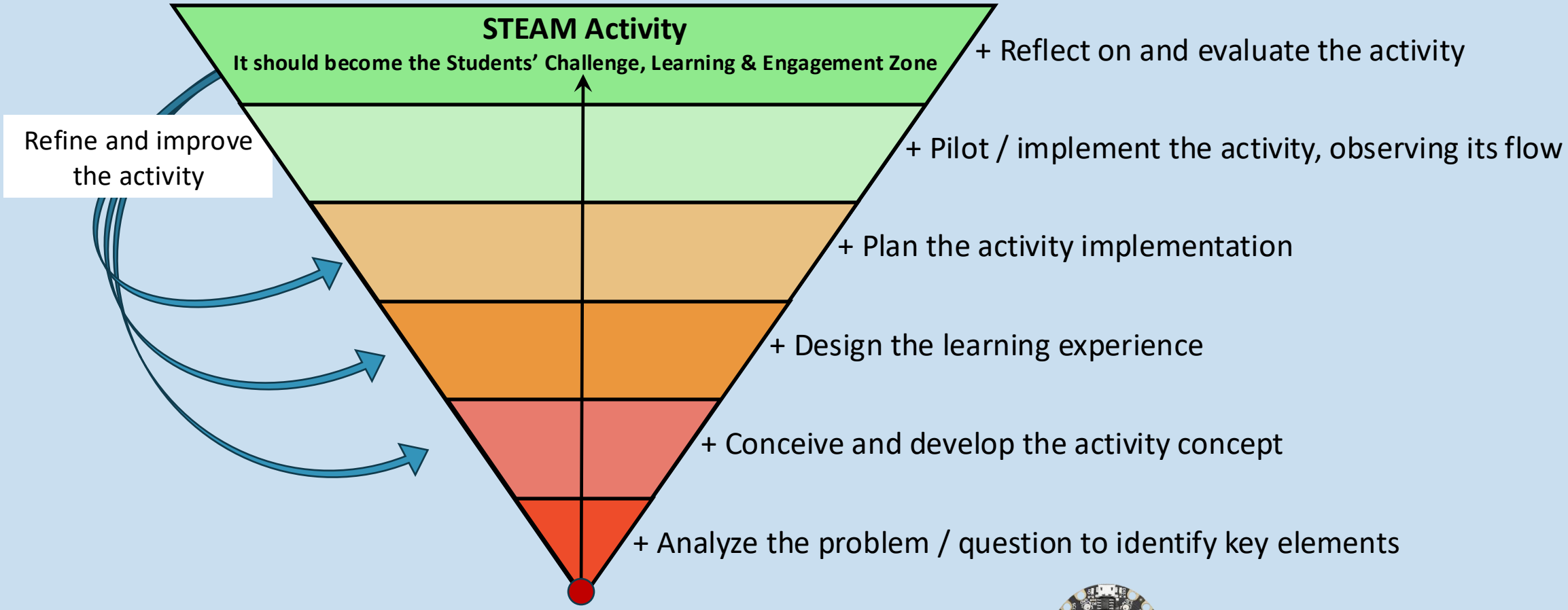

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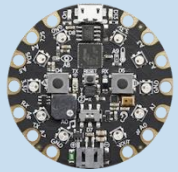
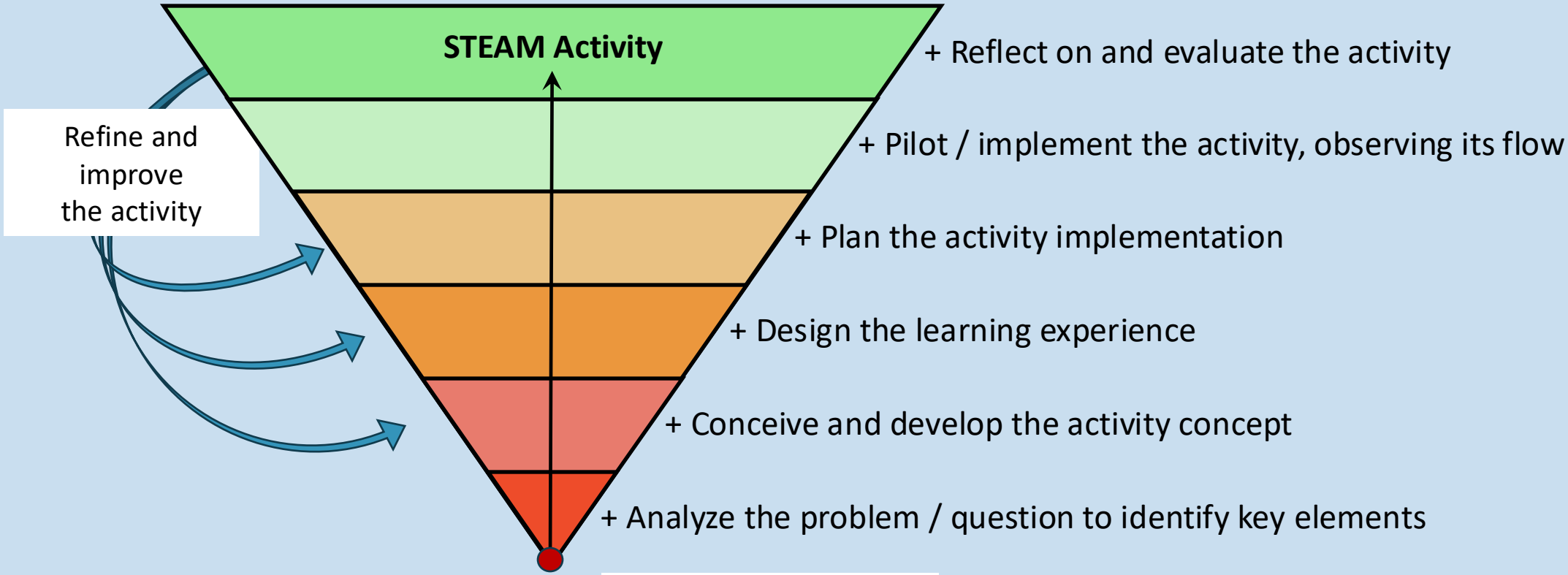
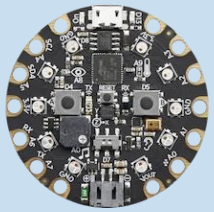


6. Our Chosen Activity



Topic :  **+** 

7. Activity Overview (part 1)

a. Introduction

Exploring the sense of balance at school through an innovative STEAM activity that combines a balance board, resembling a skateboard, with the Circuit Playground Express Board.

b. Questions

- Why is it both engaging and meaningful to stand or sit on a surface that is inherently unstable?
- How does the Circuit Playground Express Board help students explore balance, and which sensor(s) is/are used?
- Does this challenge involve only physical control, or can it also go further and foster learning across and connections to other subjects, such as **mathematics**?
- Can the sense of balance be used as a tool to explore and understand concepts, such as **mathematical** ones like the **fundamentals of a function** — minimum and maximum, increasing and decreasing, or concavity and convexity — or even for **estimating angles**?

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7. Activity Overview (part 2)

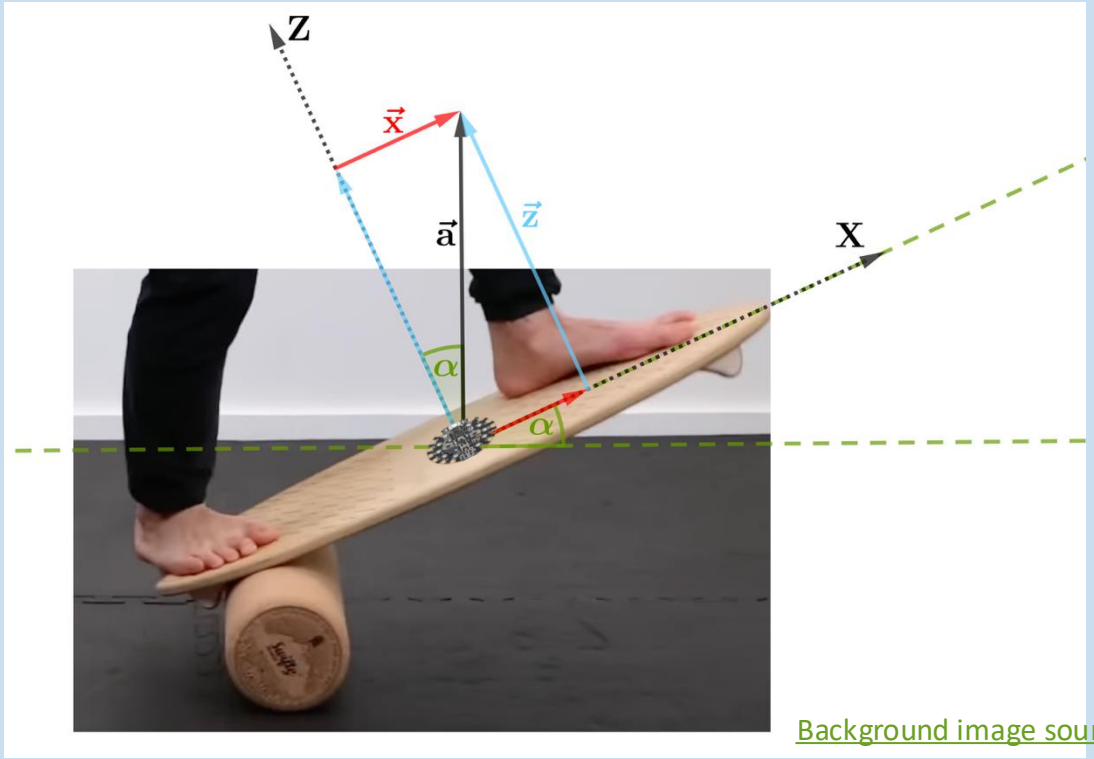
c. Calculations

The Circuit Playground Express Board lies on the balance board, at a slight tilt angle (α) relative to the horizontal, aligned with the coordinate system and directly integrated into a real-life balancing situation.

https://www.strong-tek.com/

https://www.familyoffive.co.uk/

https://ie-littlehelper.glopalstore.com/

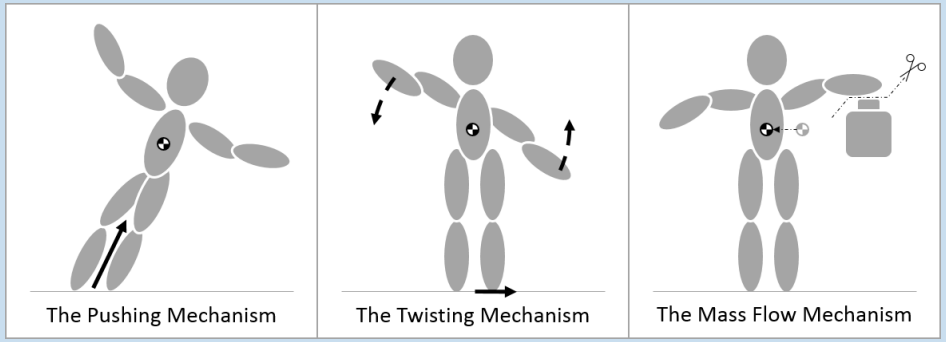


Background image source

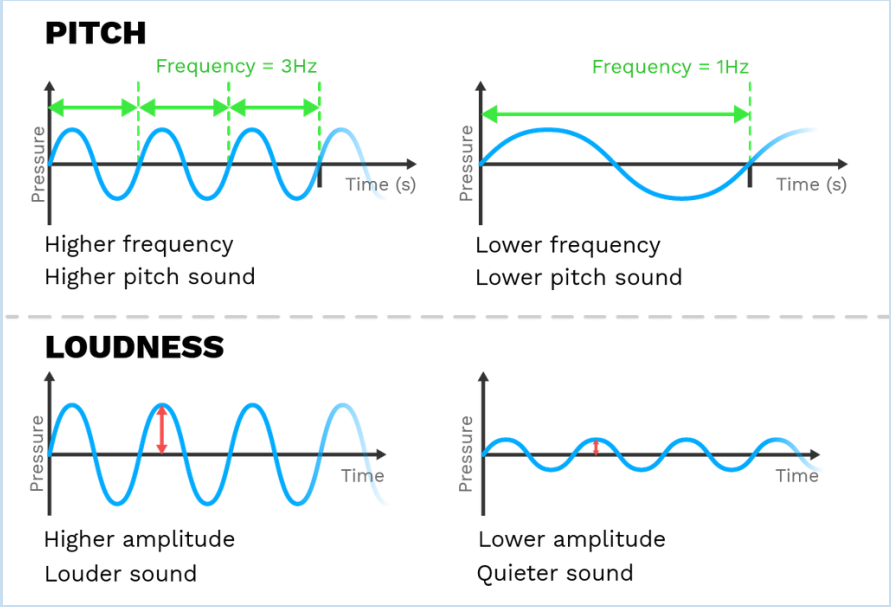
7. Activity Overview (part 3)

d. Interdisciplinary Connections

Only a few pictures are shown here, as the activity will be explored in greater depth during tomorrow's workshop.



Conceptually Understanding Balance



Sound Properties

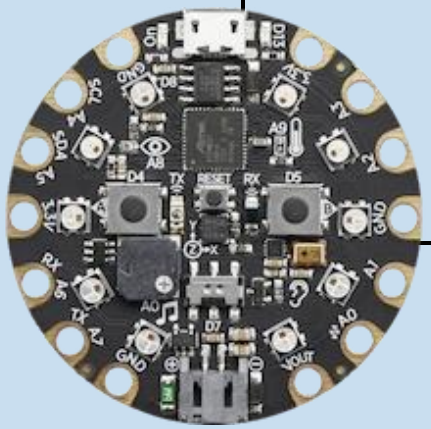
Balance Board Math: *"Being the graph"* through the sense of balance for embodied self-regulation and learning

-> Inspiration & Motivation for Our Workshop

This concludes our presentation.

We would like to sincerely thank all the teachers who participated in the Multiplier Event Courses, as well as our colleagues from the partner countries.

We also greatly appreciate your attention and interest.
We now look forward to your questions.



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Appendix: References

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- https://learn.adafruit.com/sensor-plotting-with-mu-and-circuitpython/light

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- https://theory.labster.com/sound-properties-dbs/