Adapting the principles and practices of lesson study as an approach to teacher professional learning in STEM

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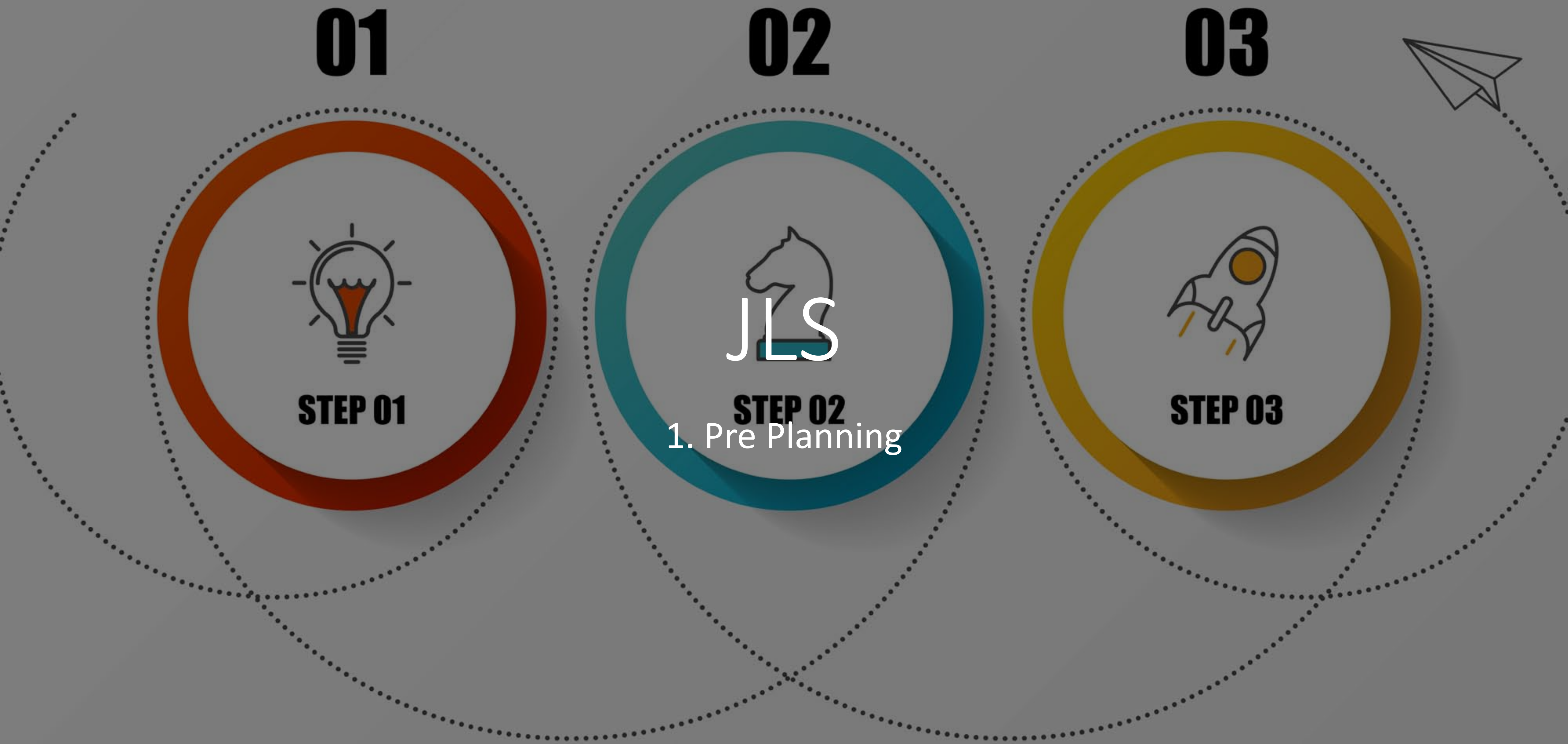
Session Overview

- The Three Phases of Japanese Lesson Study (JLS)
  1. Pre - Planning
  2. During the Lesson
  3. Post Lesson
- Three Big Ideas from JLS
- An example of Adapted JLS within Integrated STEM
  - The model
  - Recommendations/ Implications
- Application for your school setting?

JLS

1. Pre Planning



1. JLS – Pre - Planning

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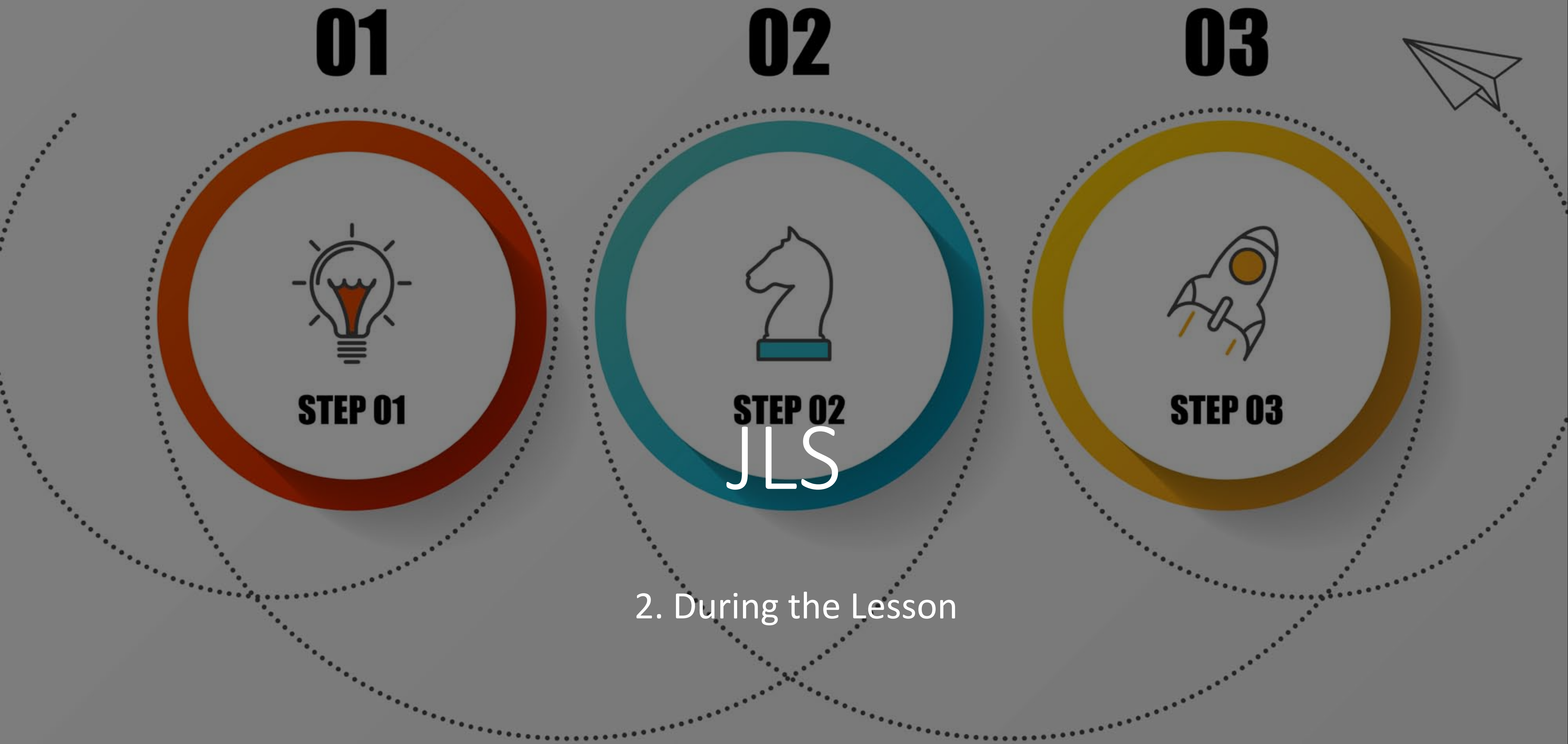
- Focus on curriculum materials and objectives
- Identify key learning outcomes from the curriculum materials and objectives
- Design a problem-solving task with multiple approaches to allow for different kinds of students' thinking

1. JLS – Pre - Planning

- Identify key questions to be asked during the lesson
- Anticipate student responses and difficulties
- Prepare teaching plan

JLS

2. During the Lesson



2. JLS – During the Lesson

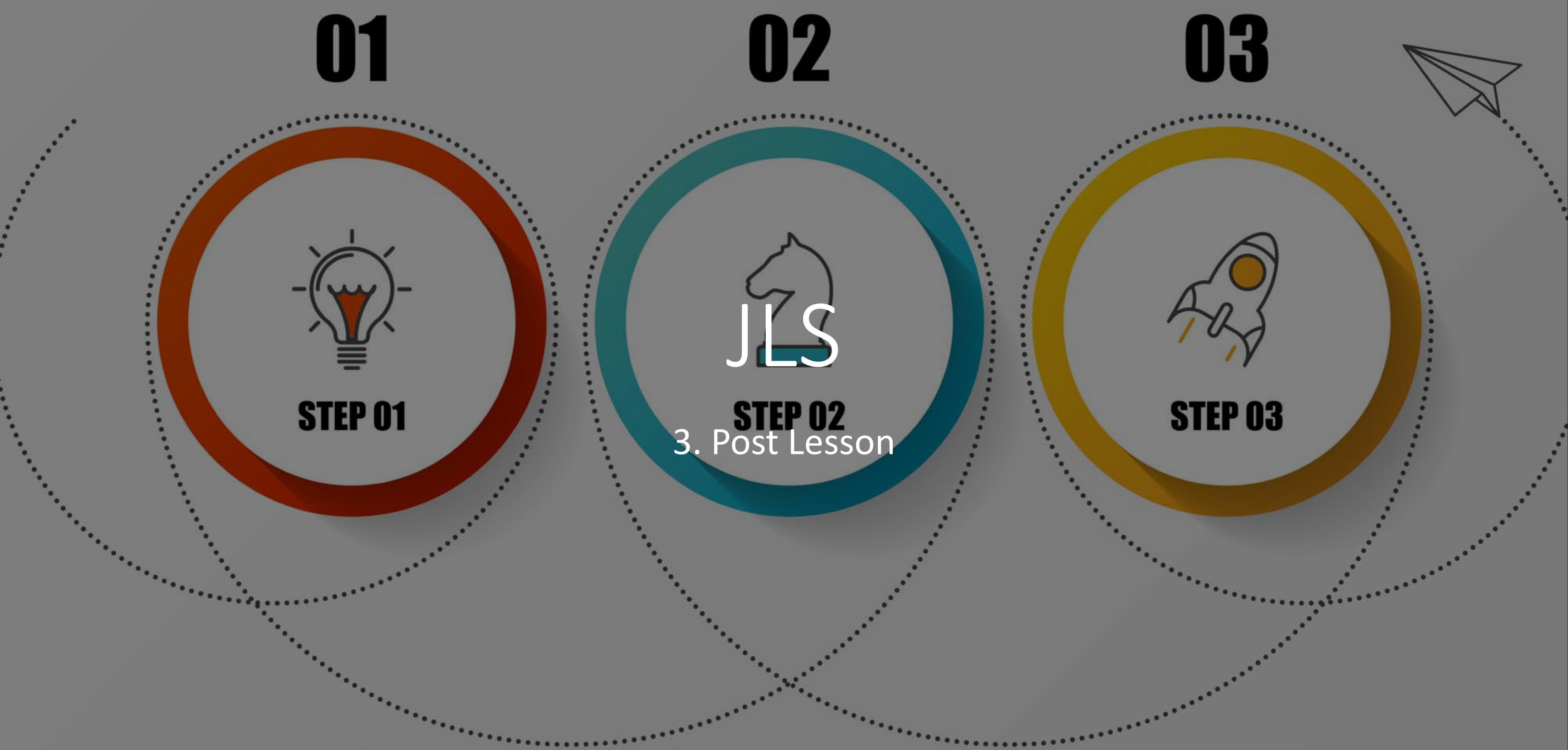
- Organise student groups, functions and questions within the lesson
- Explaining to students about group work and completion of templates for responses
- Presentation of the problem
    - anticipating any difficulties or questions
    - student work
    - monitoring progress
    - identification of work samples
    - whole class sharing
    - wrapping up

2. JLS – During the Lesson

- Observers know what to observe and how to record
- Artefacts to be collected, using a template (pro-forma) for students to record key elements of their problem-solving, including solution process

JLS

3. Post Lesson

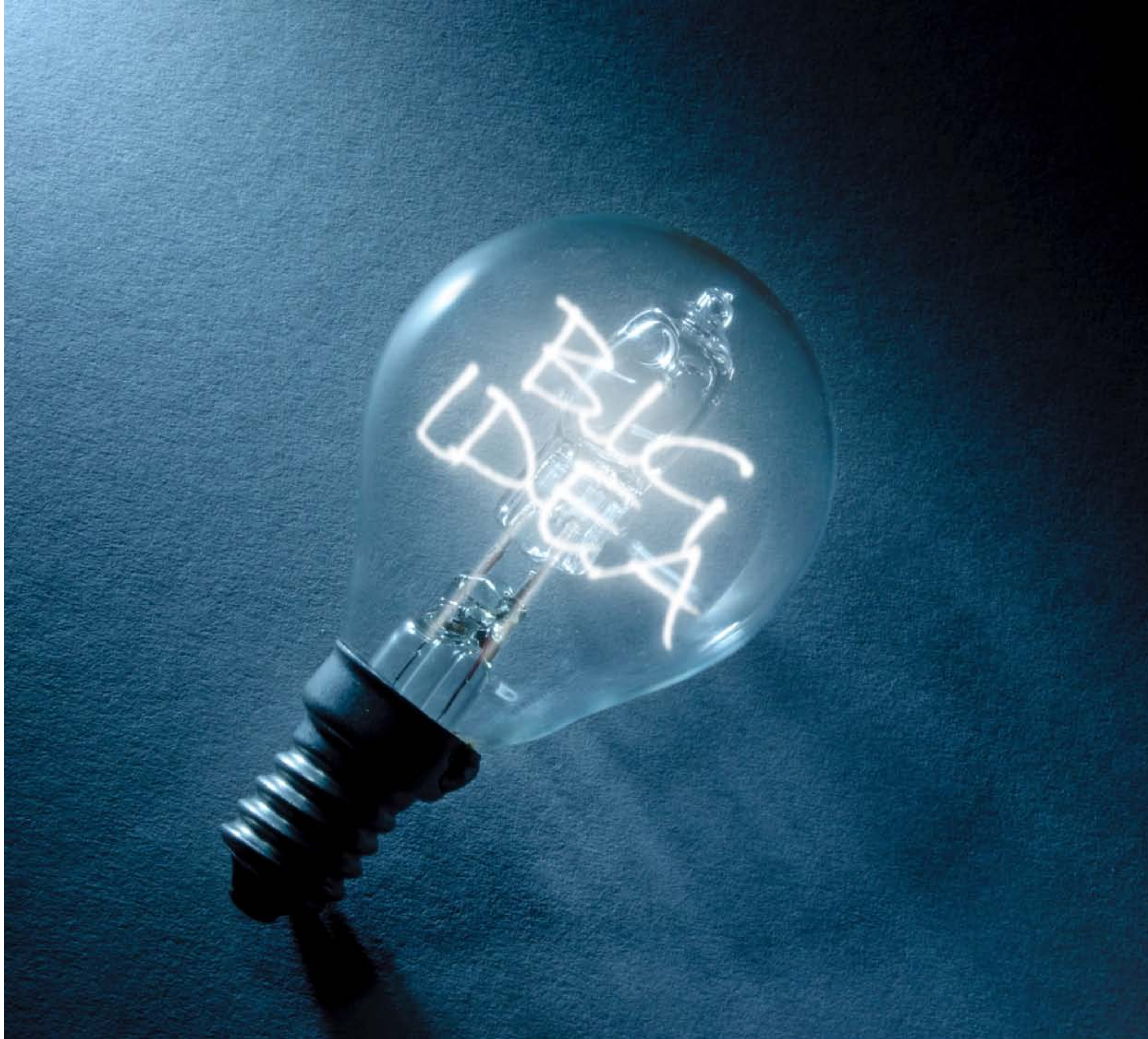


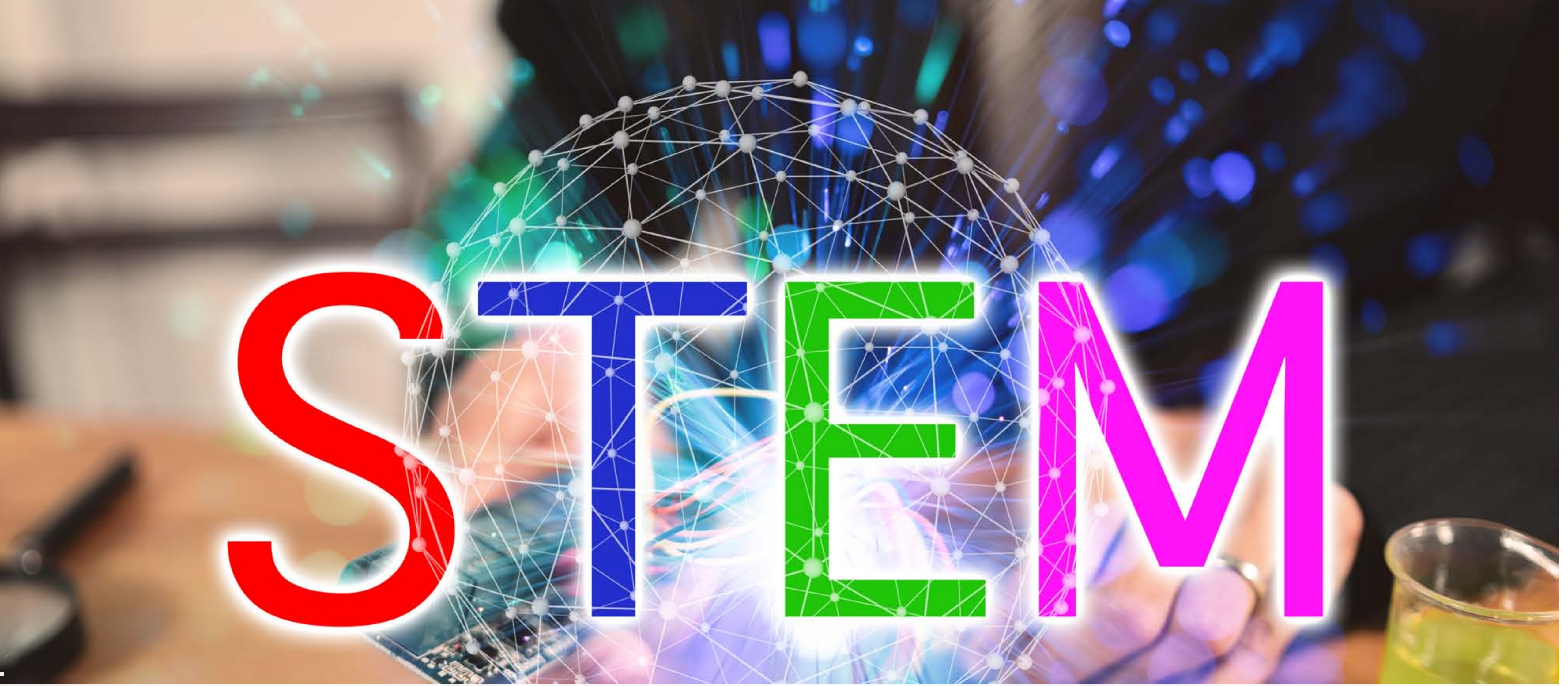
3. JLS – Post Lesson

- Feedback from observers (including expert outsiders)
- Analysis of artefacts against student learning objectives and curriculum goals
- What has been learnt about the lesson design?
- How can it be improved?
- How can students' work/thinking be improved within the lesson and after (as a result of the evaluations of artefacts and observers' comments)?
- Prepare next cycle of teaching and learning

Three Big Ideas Behind these three Phases

1. Focus on students' thinking and learning
2. Instructional Design matched to Curriculum and Theory
3. Deep Teacher Professional Learning





Adapting JLS for Integrated STEM

Context

PSTS participated in **collaborative planning and reviewing their teaching** within a series of **5 weekly lessons** within **upper primary classes** in a Melbourne school.

PSTs observe and respond to each other's teaching, providing real time feedback using 'Padlet'.

They use their mobile phones. The feedback/ observation process is unobtrusive and immediate.

PSTs use the 'Padlet' data later for reflective discussion.

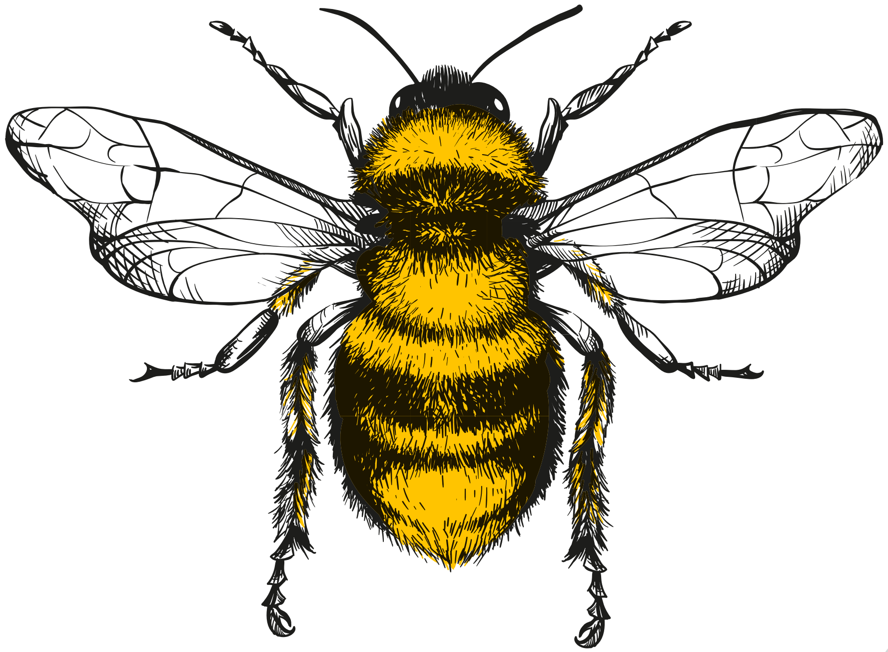
Model for Integrated STEM Professional Learning

CONTENT FOCUSED LEARNING (GTAC & VSSEC)

PROCESS FOCUSED LEARNING (JAPANESE LESSON STUDY)

TEAM BASED PLC PLANNING

5 WEEK TEAM TEACHING SEQUENCE EMBEDDED WITHIN SCHOOL



Content Focused Learning

- Teachers need strong content knowledge in the areas they choose to focus on.
- In 2016 professional learning was sought from the Gene Technology Access Centre (GTAC) when planning a sequence focused on bees, pollination and Colony Collapse Disorder (CCD).
- In 2019 the context for integrated STEM was on potential colonization of Mars.
- We therefore sought professional learning from the Victorian Space Science Education Centre (VSSEC) where content knowledge was provided with regards challenges associated with colonizing Mars and basic coding.

Content Focused Learning

Science Education Partners	University Partners	Scientists	Mathematicians
Royal Melbourne Zoo	Faculty of Science (Physics)	Dr. Frazer Thorpe	Professor Derek Holton
Melbourne Museum	Faculty of Engineering	Dr. Nicole Webster	
The Gene Technology Access Centre (GTAC)		Dr. Ken Walker	
The Victorian Space Science Education Centre (VSSEC)		Dr. Dermott Henry	

Over five years we have collaborated with **scientists, engineers, Science Education Centres** (e.g. GTAC, VSSEC), **MGSE Academics, local schools** and **PSTs**.

Content Focused Learning (Bees, Pollination, and more)

Science	Mathematics
Physical & Behavioral Adaptations	Estimating, reading and comparing angles using a protractor
Negating experimental error when investigating (e.g. sample size, averages etc.)	Negating experimental error when investigating (e.g. sample size, averages etc.)
Exploring variables and fair tests	Measuring and interpreting elapsed time
Symbiotic relationships and how they develop	Interpreting, comparing and creating data representations.
The Importance of Bees (for production of food etc.)	Measuring and comparing lengths with rulers
Domain specific language development	Domain specific language development
Anatomy of Bees	Using scales and rate (e.g. 1cm represents the 1m that bee travels in 1 second)
The roles of Bees in a Colony	

Content Focused Learning (VSSEC)

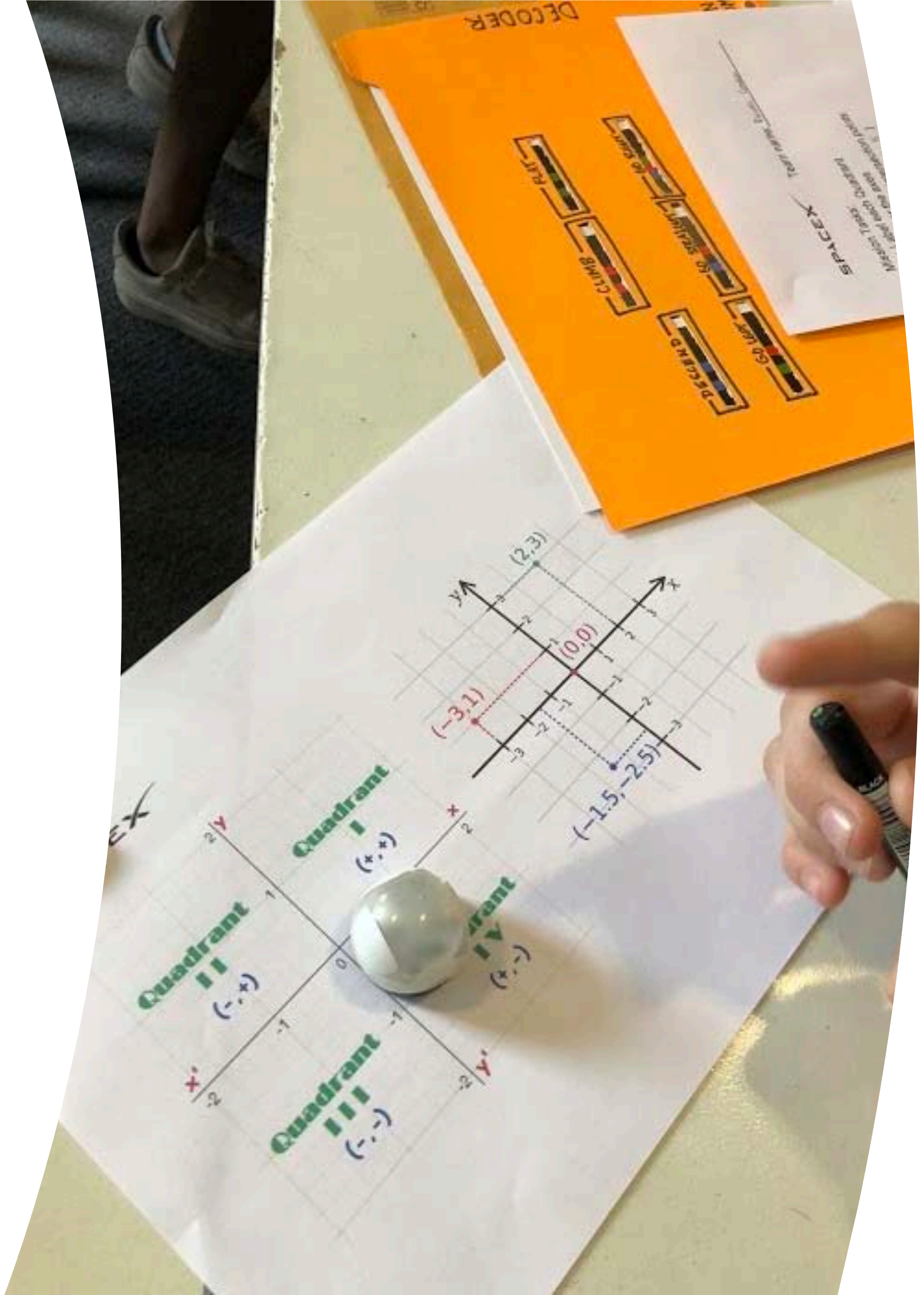
Process Focused Learning (JLS)

PRE-PLANNING

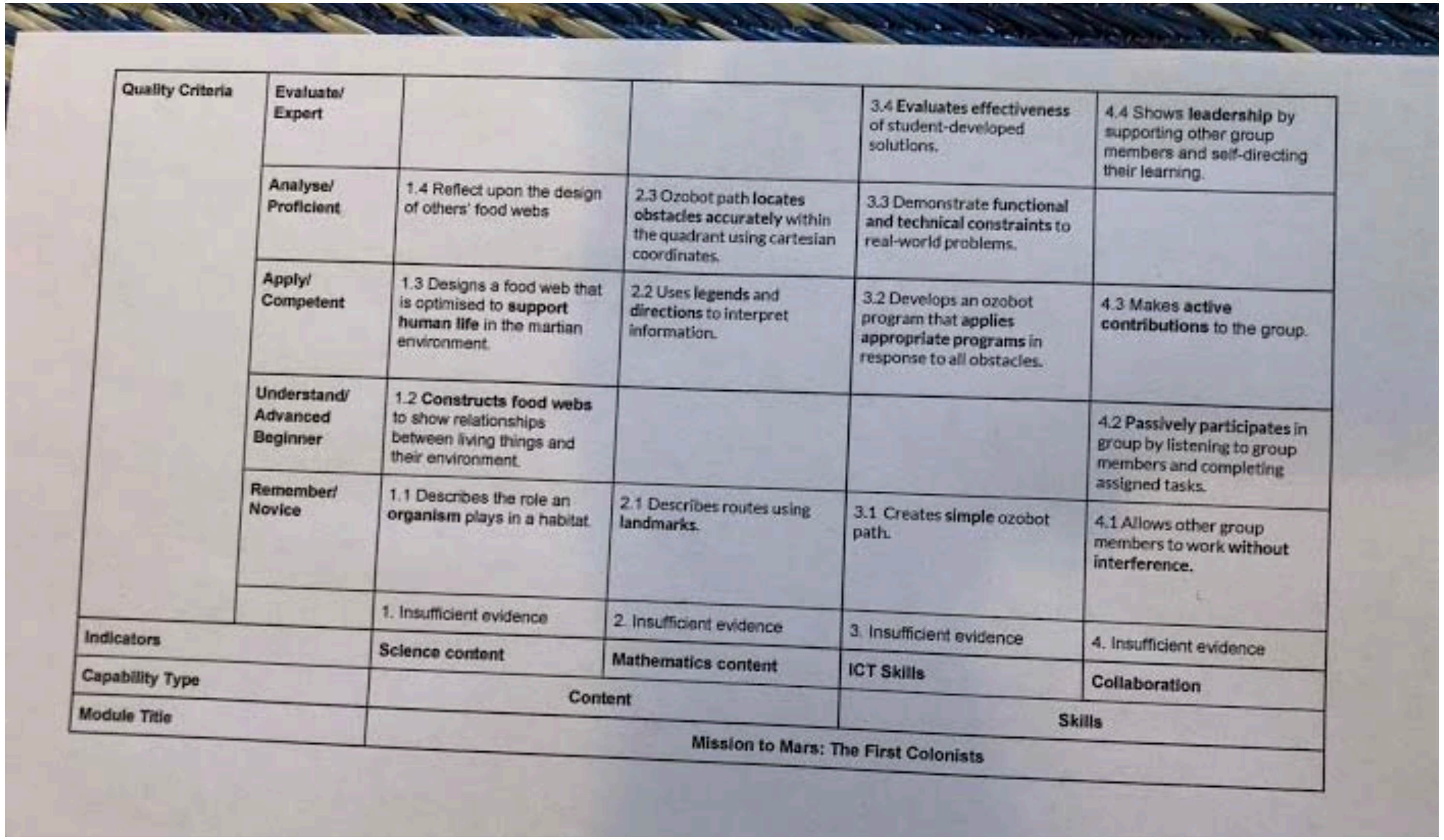
DURING THE LESSON

POST LESSON

Team Based Planning – Pre-Planning (PLC)



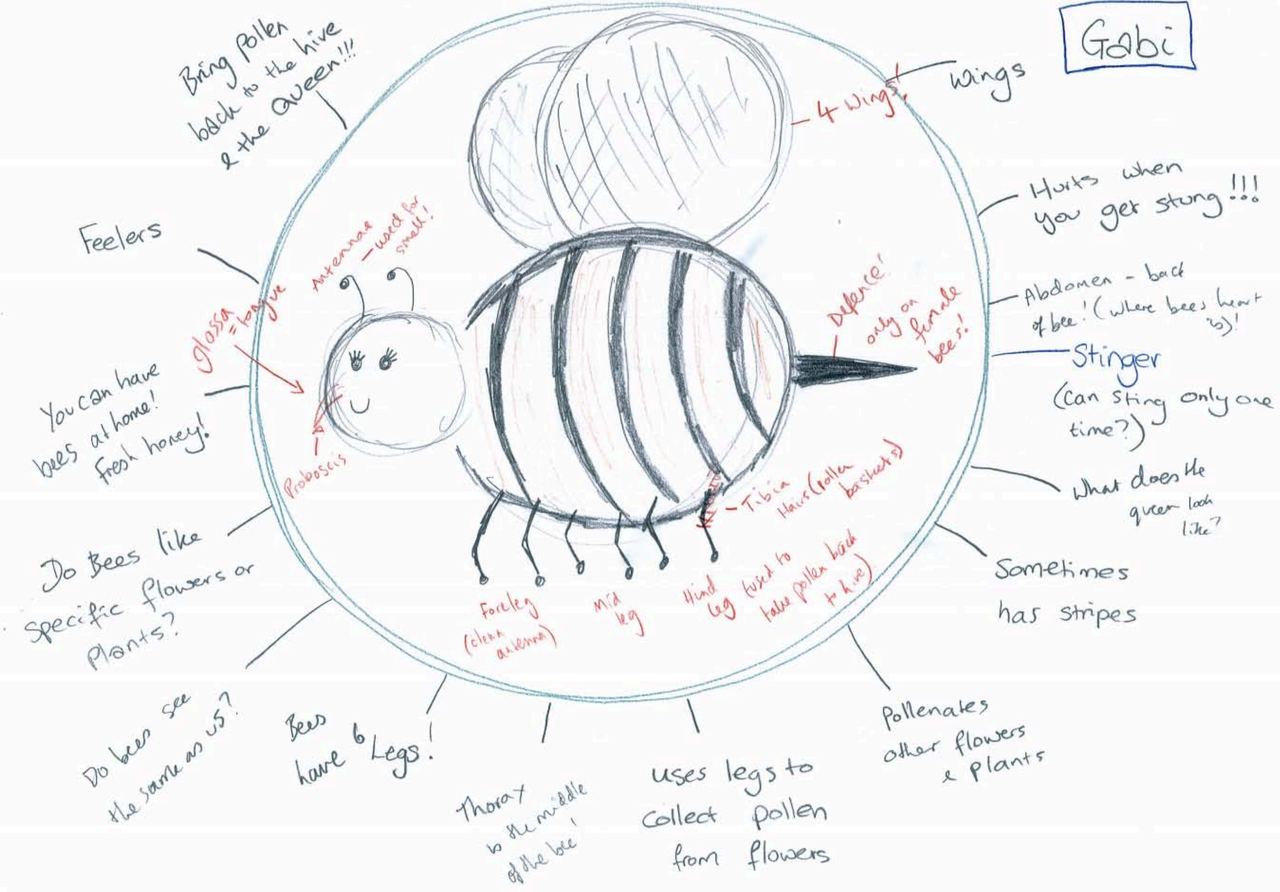
- This team teaching group planned the use of Ozobots to explore sites for investigation on Mars.
- They planned for students to navigate through cartesian co-ordinates across all 4 quadrants.

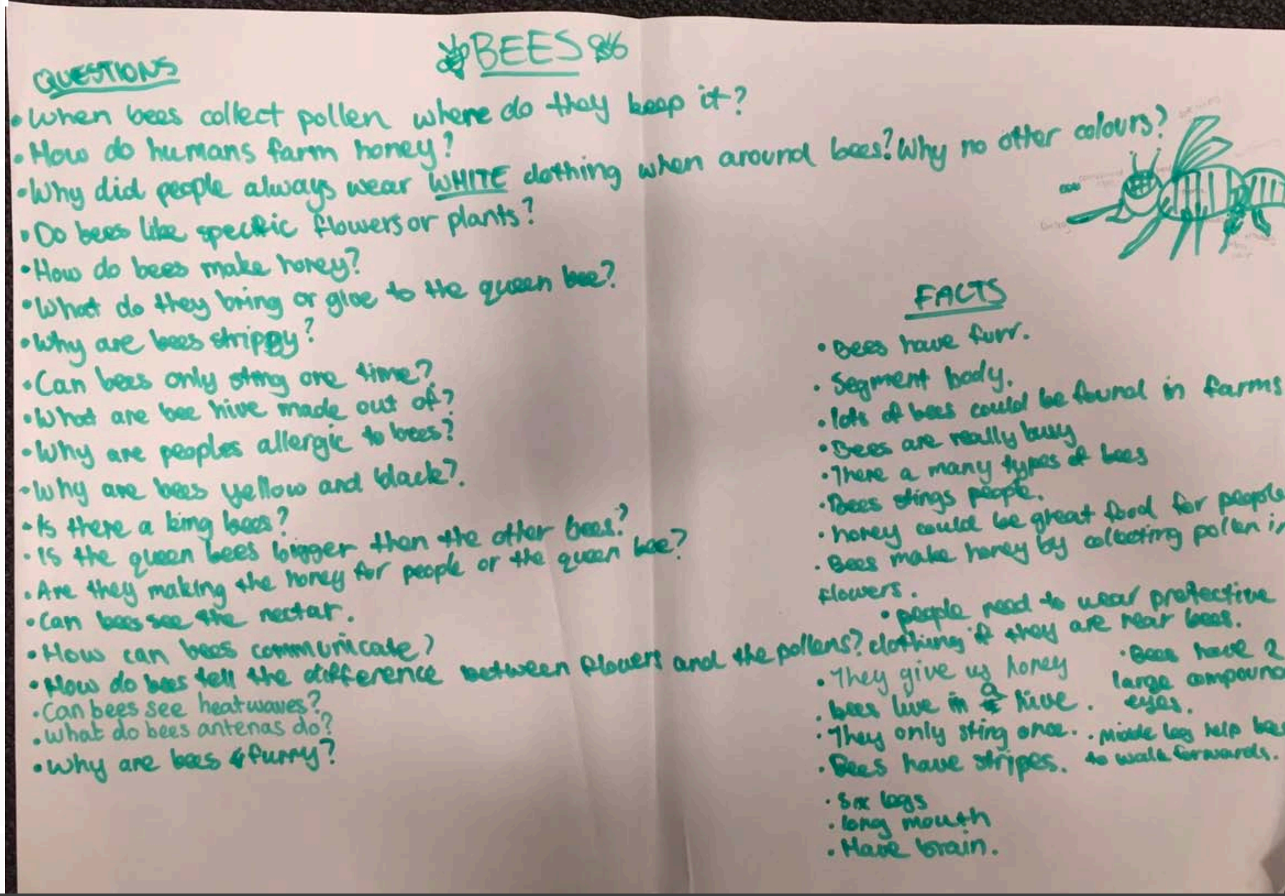


Quality Criteria					
	Evaluate/ Expert			3.4 Evaluates effectiveness of student-developed solutions.	4.4 Shows leadership by supporting other group members and self-directing their learning.
	Analyse/ Proficient	1.4 Reflect upon the design of others' food webs	2.3 Ozobot path locates obstacles accurately within the quadrant using cartesian coordinates.	3.3 Demonstrate functional and technical constraints to real-world problems.	
	Apply/ Competent	1.3 Designs a food web that is optimised to support human life in the martian environment.	2.2 Uses legends and directions to interpret information.	3.2 Develops an ozobot program that applies appropriate programs in response to all obstacles.	4.3 Makes active contributions to the group.
	Understand/ Advanced Beginner	1.2 Constructs food webs to show relationships between living things and their environment.			4.2 Passively participates in group by listening to group members and completing assigned tasks.
	Remember/ Novice	1.1 Describes the role an organism plays in a habitat.	2.1 Describes routes using landmarks.	3.1 Creates simple ozobot path.	4.1 Allows other group members to work without interference.
		1. Insufficient evidence	2. Insufficient evidence	3. Insufficient evidence	4. Insufficient evidence
Indicators		Science content	Mathematics content	ICT Skills	Collaboration
Capability Type		Content		Skills	
Module Title		Mission to Mars: The First Colonists			

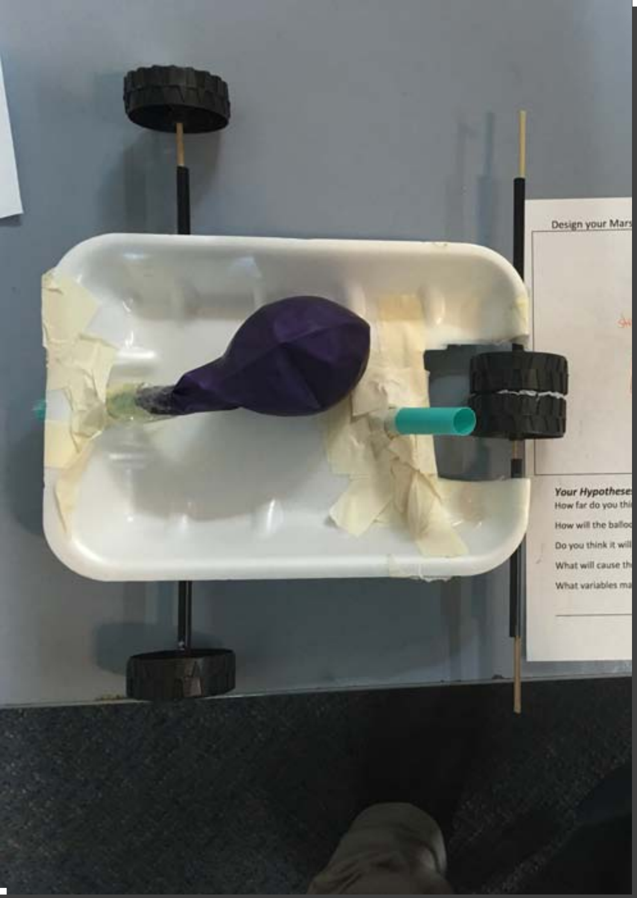
Formative Assessment Matrix

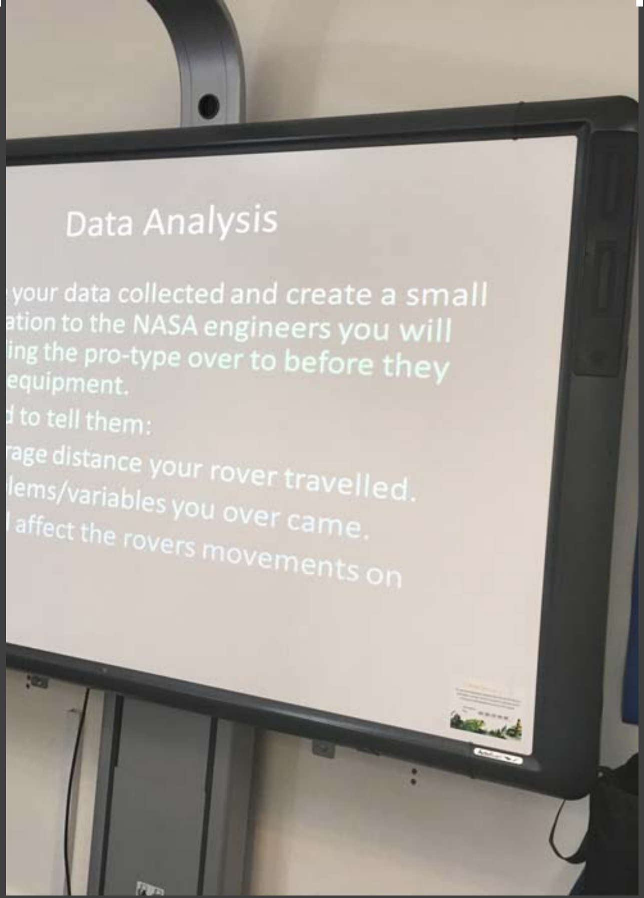
- This team teaching group planned and constructed a formative assessment Matrix.
- This instrument required the planning of a continuum on understanding in each area.
- The Matrix was planned to assess both content and skills:
  - Science & Maths Content and
  - Digital Technologies and Collaboration

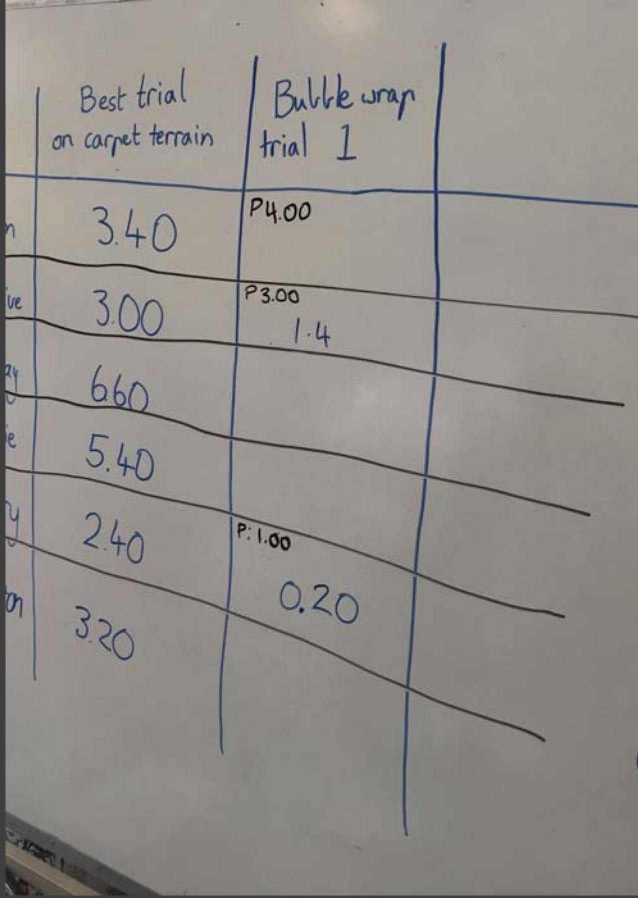




More formative assessment (Bees, Pollination, and more)

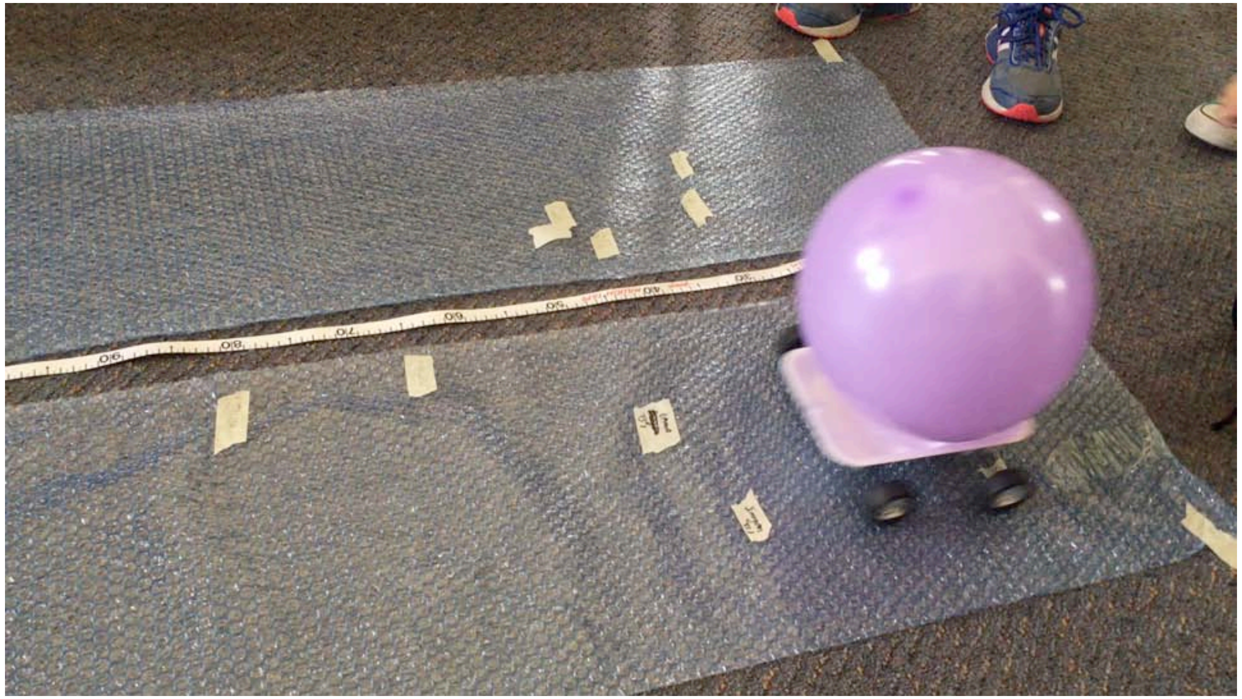


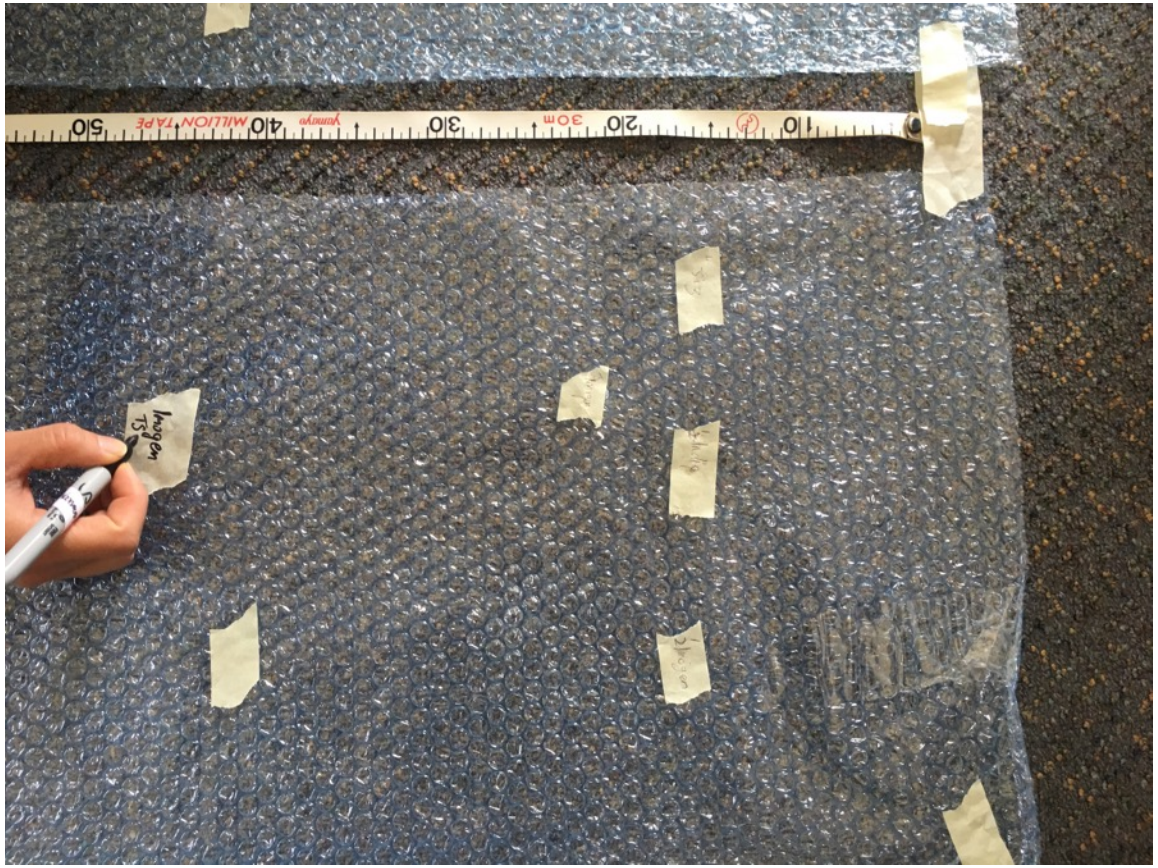




Team Teaching (Designing, Building and Analysing Mars Rovers)

Researching Integrated STEM
(Designing, Building and Analysing Mars Rovers)





Team Teaching (Coding and Colonisation of Mars)

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(On the prepared template students justify choice of supplies and the path the Mars Buggy took to collect them.)

BEE BOT LIMITATIONS

Cargo bay doors are at the front of the BeeBot so the front of your BeeBot must face the supply drop-zone

Fuel capacity = 100L

- Travel 500m = 2L fuel use
- Turn left or right = 2L fuel use

SUPPLY ZONES

A = Water purification system

B = Perchlorate filter

C = Insulated human habitat

D = Solar Panels to make fuel

E = Greenhouse to grow food in

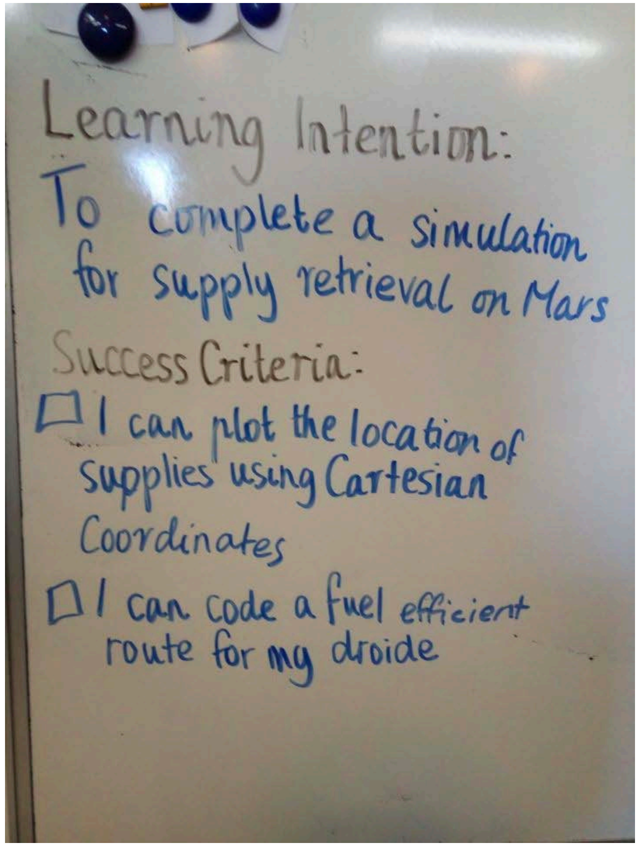
F = Radiation suits

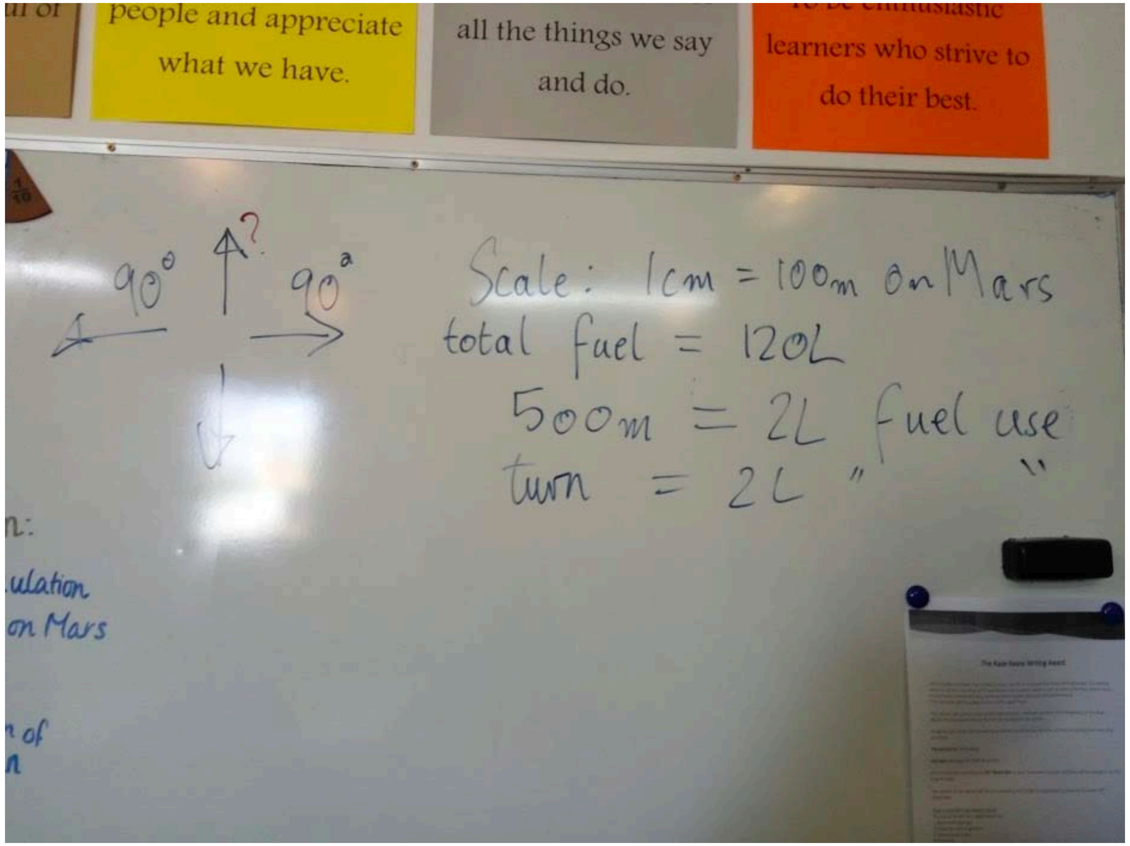
SCALE : 1cm on the map = 100m on Mars

WRITE YOUR ALGORITHM TO COLLECT AND BRING BACK YOUR SUPPLIES

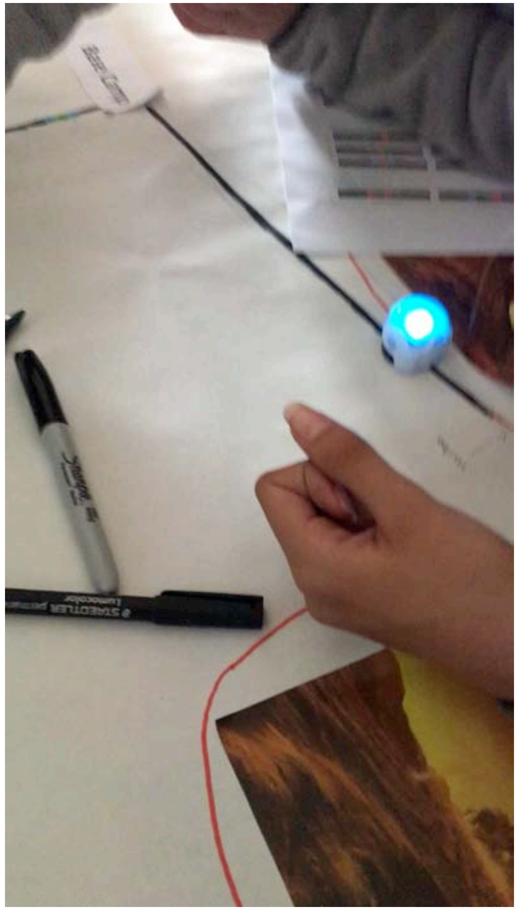
Command	Fuel used by command	Total fuel used	Cartesian coordinate reached

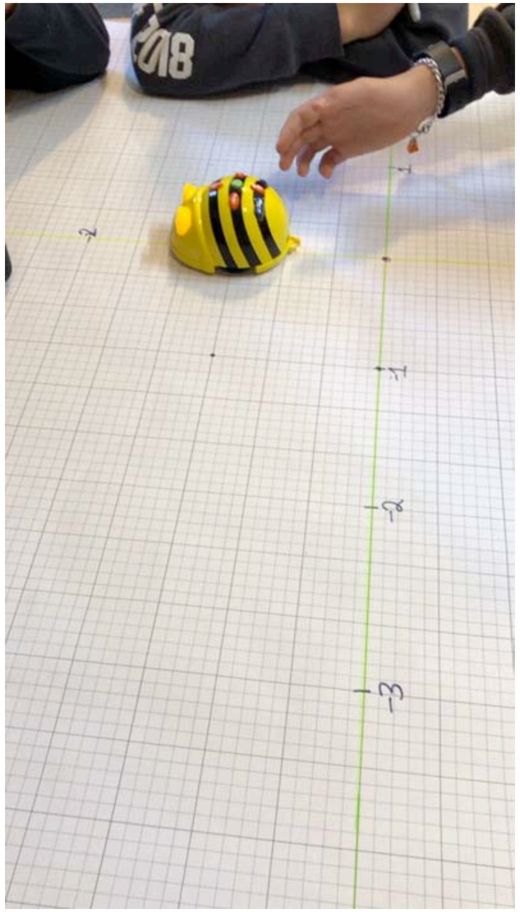
Team Teaching (Coding and Colonisation of Mars)

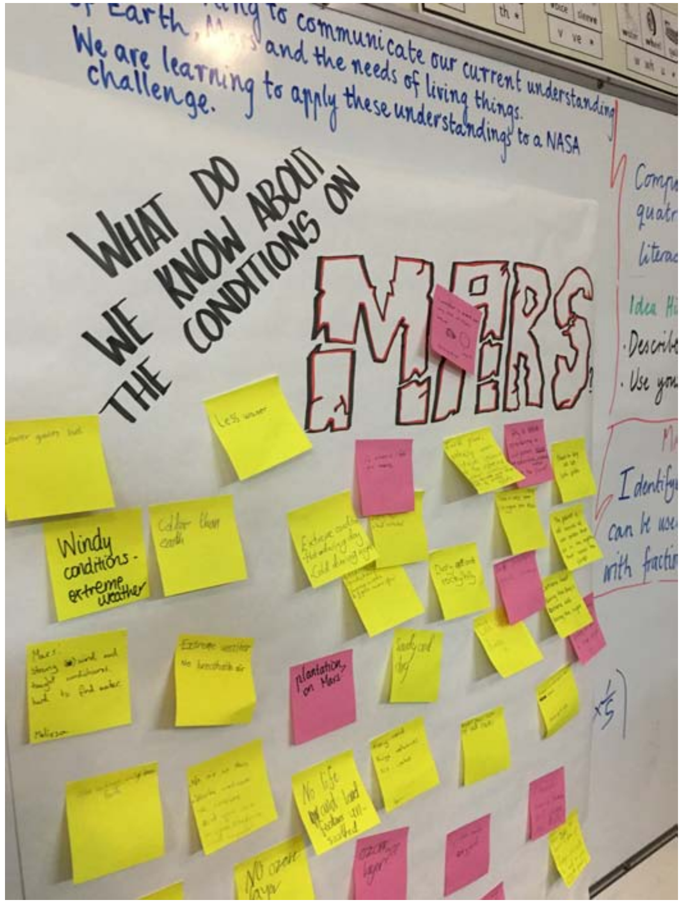




Team Teaching (Coding and Colonisation of Mars)







Reflections – Post the Lesson - Padlet

Reflection

A student referred to the simplicity of Ozobot codes compared to other coding software.

Add comment

"Why did you choose that code?"

Josh asking student to justify their thinking.

Add comment

Engagement with the lesson is high

All students are on task and collaborating well (except fo the one girl who is working by herself haha)

Add comment

Loved the explanation of mountains

2 comments

Emmanuel Giannopoulos 8mo
Using technical language

Reflection

All students enjoyed the lesson, showing that they were engaged with the learning goals.

Add comment

Students are able to plan and design their solar panels, intersections and infrastructure; but struggling to apply i using Ozobots

Add comment

Are the students just making inclines, or creating communities? Needs to link to previous lessons

Add comment

Taking specific expert roles is a good way of sharing the aching; allowed for students to get super immersed in ... e following activity

Add comment

Good extension of student thinking Tyson, showing students how much they have learner and how it all connected (terrains, Cartesian coordinates, and coding)

Add comment

"It goes rogue" - Girl in Ulrich's group

Add comment

A common error throughout the lessons were the use of zobots. Students are finding it really hard to draw ppropriate lines, use distinct colours, be neat. A odelling would have been really good

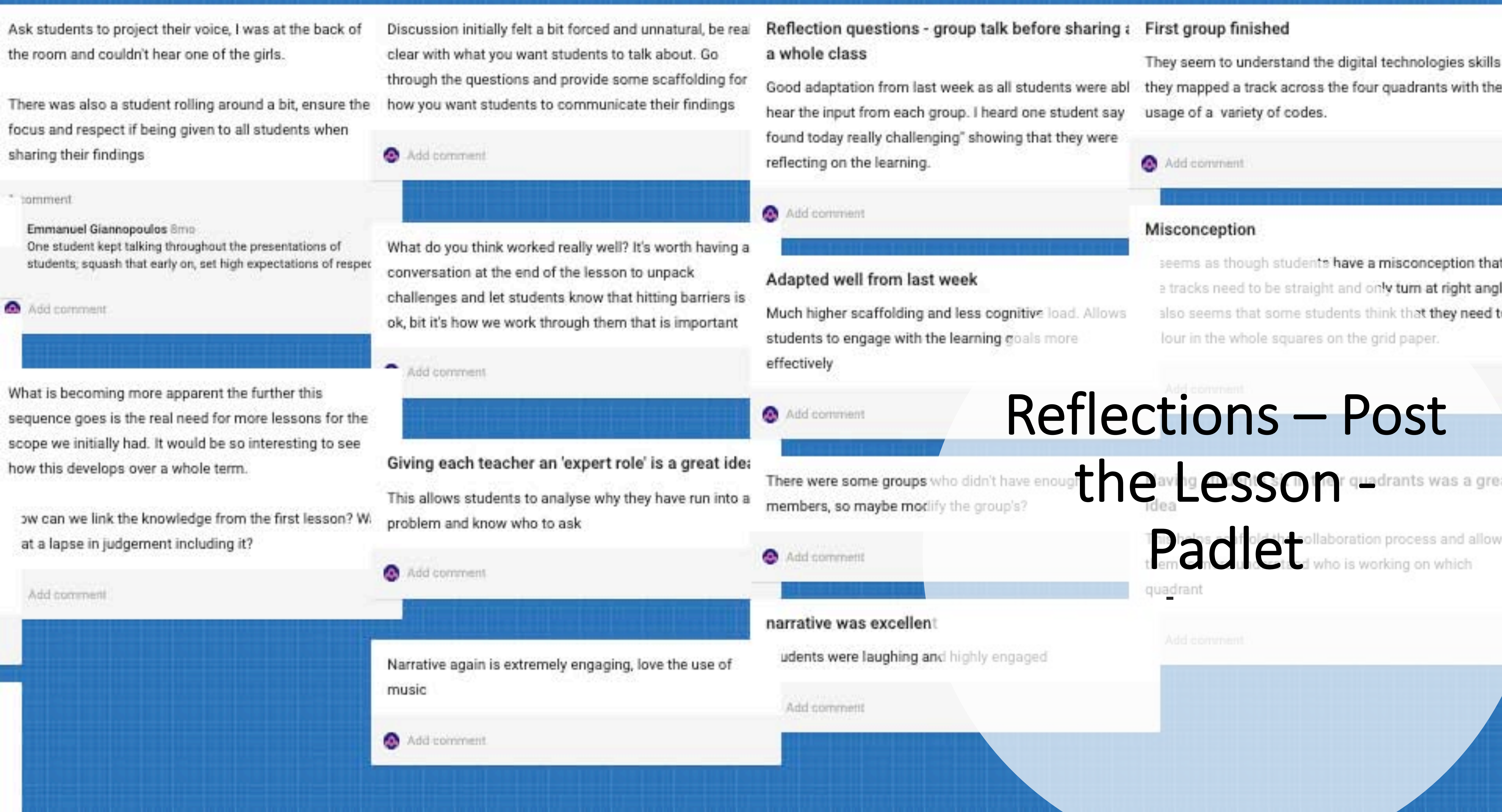
Add comment

Questioning

Effective ... to get students to discuss the coordinates.

Add comment

Reflections – Post the Lesson - Padlet



Applications for your School Setting

- Undertaking this approach requires serious resourcing (teacher time and money)
- The pedagogical demands for this approach to teaching are also high
- We recommend the rigorous and collaborative approach taken in the context provided in this session.
- Planning occurred collaboratively with 6 PSTs – three responsible for leading a given lesson and three undertaking observation.
- These roles were flipped throughout the process.
- Observing participants utilised ‘padlet’ to create a community for feedback.
- Clearly planned and documented approaches to formative assessment are essential.

Big Ideas for starting Collaborative Integrated STEM

- Your Learning Specialist (mathematics, science or STEM) should lead this work and provide both passion and inspiration.
- Leaders will probably need to support them to gain further professional learning in the area
- A driving narrative based on the curriculum that genuinely allows for STEM is required for each sequence.
- Plan for non-tenuous (synergistic) links between disciplines and within disciplines.
- A team of committed teachers prepared to work and learn over the long term is necessary
- Foster a culture of continual professional learning and risk taking in STEM
- Focus on student STEM learning through formative assessment

An Offer…

If your school seriously wants to pursue these ideas contact us…

- Dr Duncan Symons
  - duncan.Symons@unimelb.edu.au
- Dr Max Stephens
  - m.stephens@ unimelb.edu.au