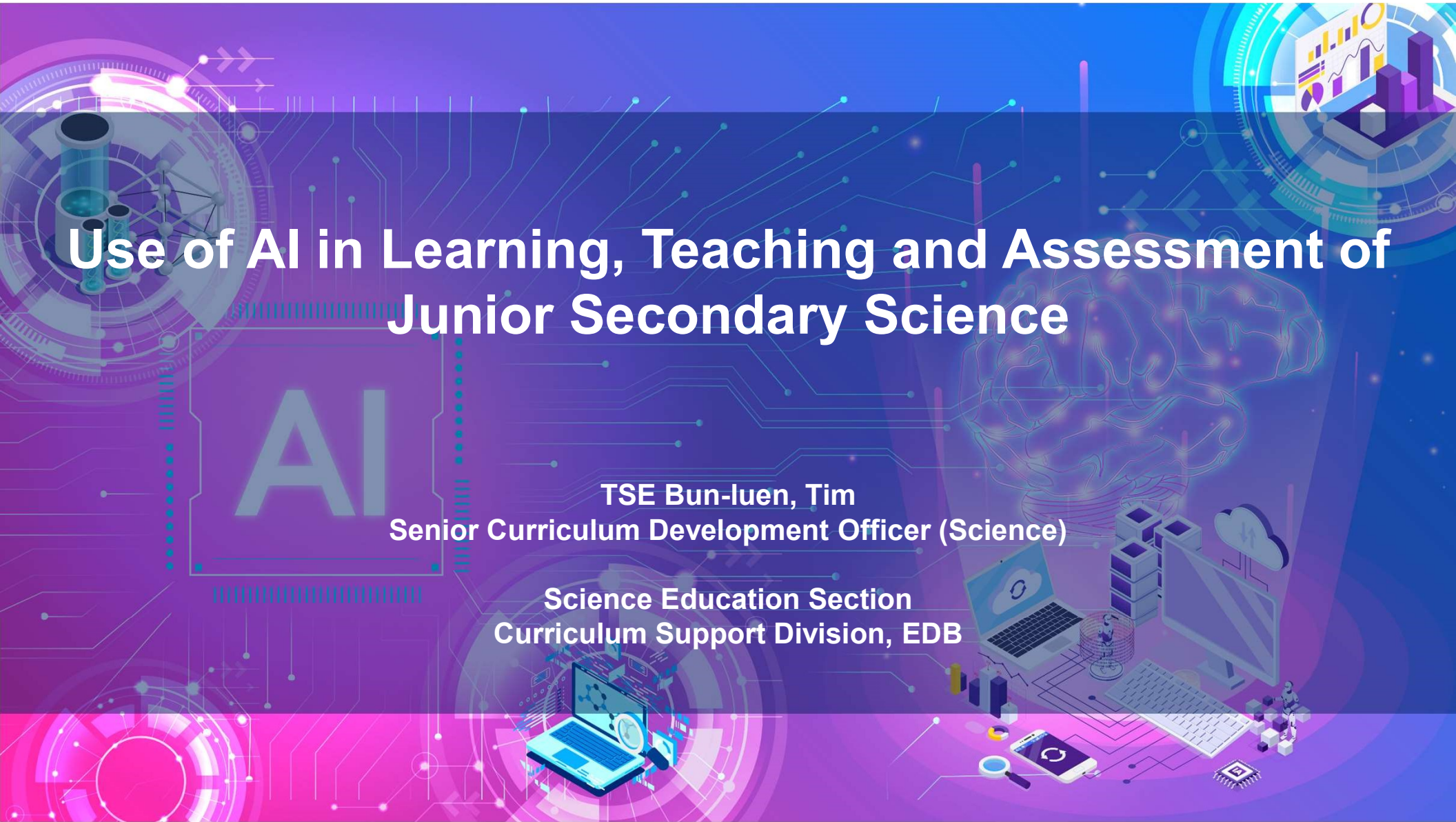


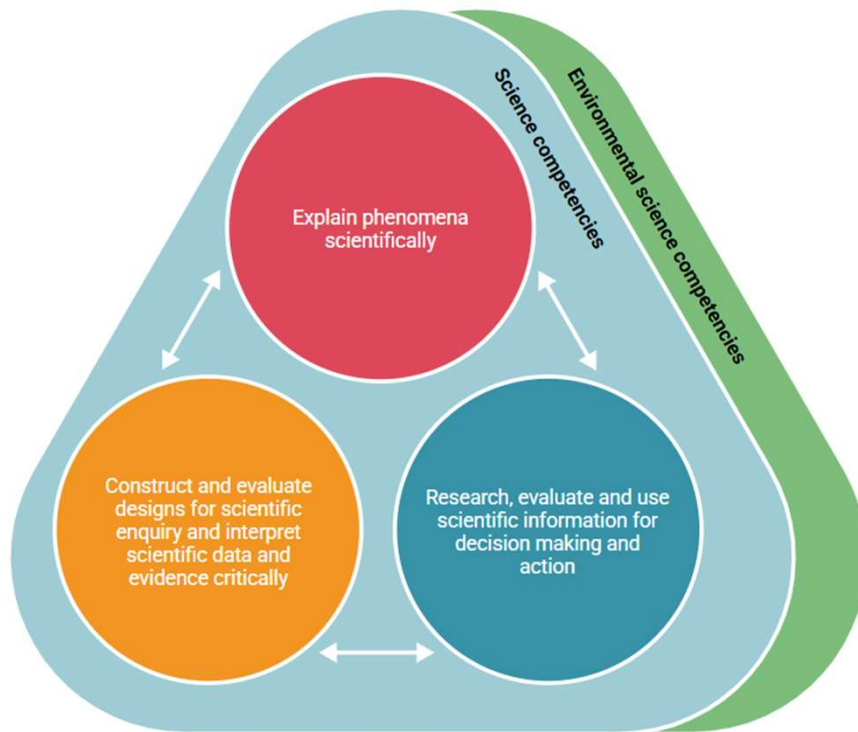
Use of AI in Learning, Teaching and Assessment of Junior Secondary Science

TSE Bun-luen, Tim
Senior Curriculum Development Officer (Science)

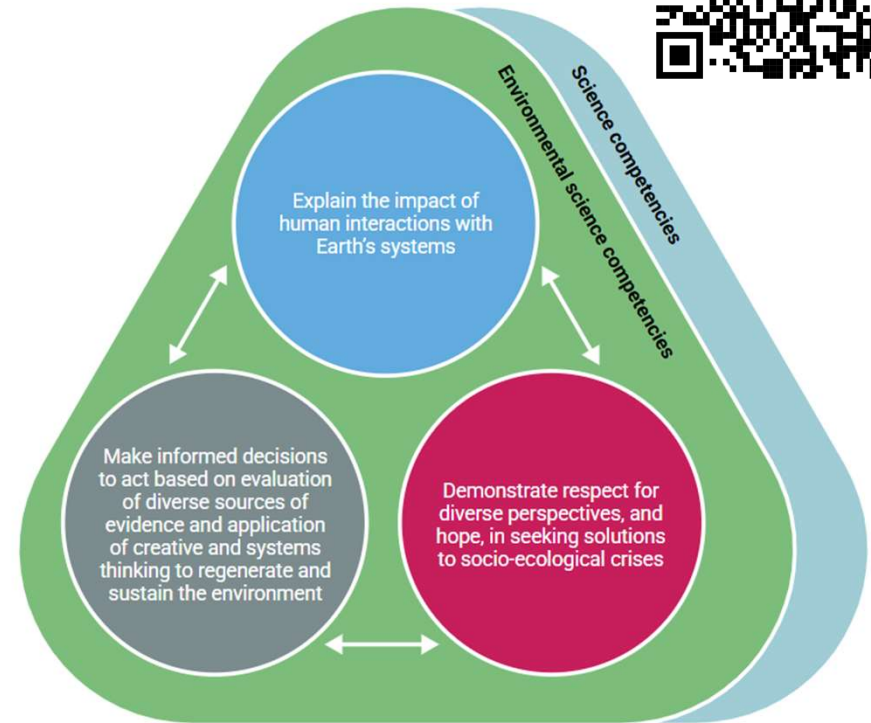
Science Education Section
Curriculum Support Division, EDB



Science Education is facing big changes in view of societal needs

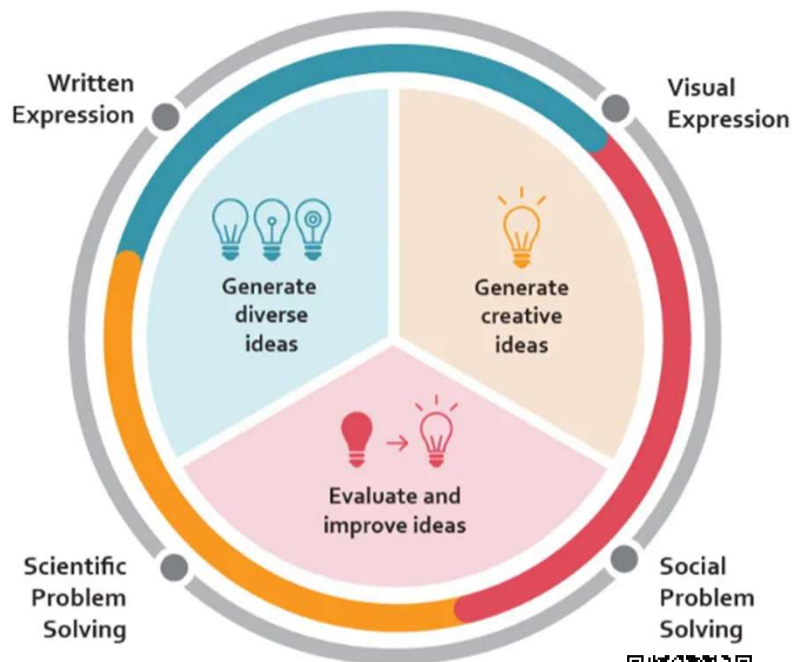


Science Competencies

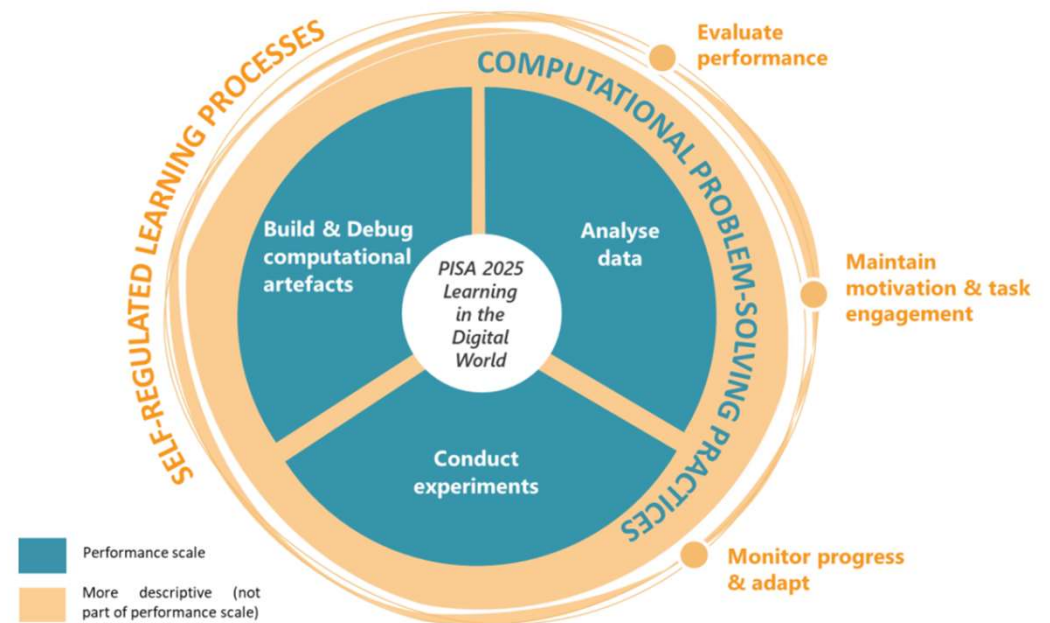


Environmental Science Competencies

Digital competency and creativity are more vital



Creative Thinking



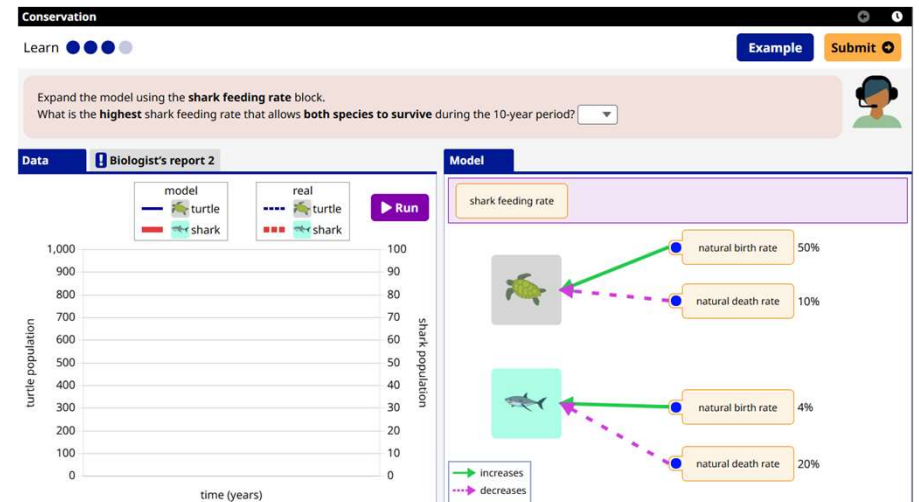
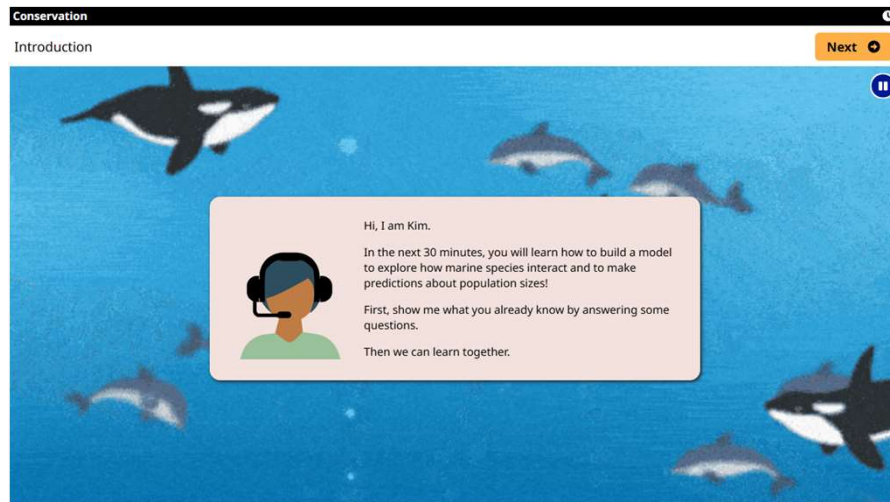
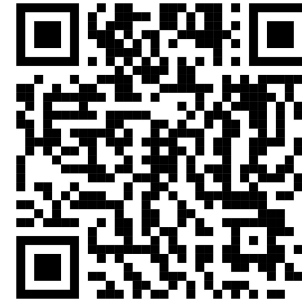
Learning in digital world – Competency model

<https://www.oecd.org/en/topics/sub-issues/creative-thinking/pisa-2022-creative-thinking.html>

<https://www.oecd.org/en/topics/sub-issues/learning-in-the-digital-world/pisa-2025-learning-in-the-digital-world.html>

Digitalised Tasks

- <https://conservation.netlify.app/>



2024 Policy Address – STEAM Education

Renew the curriculum of junior secondary Science and strengthen the interface between the primary and secondary levels for enhancing students' scientific thinking and fostering innovation.

更新初中科學科課程，做好中小學階段銜接，強化科學思維，培育創新精神。

Launch a pilot scheme to promote artificial intelligence-assisted teaching in junior secondary Science with a view to enhancing the effectiveness of learning.

開展先導計劃，於初中科學科推動人工智能輔助教學，強化學習效能。

The draft of the renewed JS Science Curriculum is released



Updated Science (Secondary 1-3) Curriculum Consultation

● Background

"The Chief Executive's 2024 Policy Address" highlighted the promotion of STEAM (Science, Technology, Engineering, the Arts, and Mathematics) education in primary and secondary schools. The policy measures include the renewal of the junior secondary Science curriculum, strengthening the interface between the primary and secondary levels for enhancing students' scientific thinking and fostering innovation. The updated curriculum will be implemented from the 2027/28 school year and schools may start piloting from the 2025/26 school year.

The Curriculum Development Council Committee on Science Education established the Ad Hoc Committee for the Revision of Science (Secondary 1 – 3) Curriculum (the Ad Hoc Committee) last year. This Committee has undertaken the curriculum review and updating task, incorporating views from various stakeholders, including experienced secondary school principals, teachers, and academics from tertiary institutions. In December 2024, the CDC Committee on Science Education submitted the "Updated Science (Secondary 1 – 3) Curriculum Framework" (Consultation Draft) and the proposed arrangements for the curriculum consultation to CDC, which were accepted.

For details, please refer to [Education Bureau Circular No. 32/2024](#).

● Curriculum document

["Updated Science \(Secondary 1-3\) Curriculum Framework" \(Consultation Draft\)](#) [PDF](#)

e-Learning Tools	Applications
Animation	<ul style="list-style-type: none">watching animations to help visualise natural phenomena and processes, and grasp abstract concepts (e.g. the motion of particles in a liquid as temperature changes).
Virtual experiment	<ul style="list-style-type: none">using interactive simulations which students could manipulate different simulated objects through self-directed learning.
Science Online Platform	<ul style="list-style-type: none">using online platform to provide students with different learning experiences, such as online science seminars, e-quizzes, and online reading activities.
Data-logger	<ul style="list-style-type: none">using a data-logger to conduct experiments, e.g. a data-logger with a position sensor can be used to investigate the motion of a ball falling under the action of gravity.
Mobile device	<ul style="list-style-type: none">using mobile devices installed with apps for interactive learning inside and outside the classroom, e.g. using "location-based" applications to extend science learning beyond the classroom.using a VR and AR technology to create immersive learning experiences that can make abstract scientific concepts more tangible (e.g. exploring human system or ecological system).
Artificial intelligence (AI)	<ul style="list-style-type: none">using visual recognition technology for pattern seeking.using machine learning system to make scientific predictions.Using AI chatbot in adaptive science learning.

The use of Artificial Intelligence (AI) in education is an emerging trend



“AI for Science Education” Funding Programme

● Background

To tie in with the Chief Executive's proposal in the 2024 Policy Address for continuously promoting STEAM education in primary and secondary schools, including supporting teachers in the use of artificial intelligence (AI) in teaching, the Education Bureau (EDB) continues to enhance information technology education and promote the close integration of innovation and technology (including AI) with education. We are now launching a pilot programme in junior secondary Science, to support schools in integrating AI into learning and teaching, thereby strengthening AI education.

The “AI for Science Education” Funding Programme is supported by the Quality Education Fund. For the details of the programme, please refer to [EDBCM No. 227/2024](#).

● Programme Objectives

Enhance science teachers' capacity in AI-assisted teaching, encourage schools to arrange for teachers to participate in professional development programmes and conduct trial lessons, thereby promoting pedagogical innovations and enhancing students' learning effectiveness.

Good practices and drive innovative applications of AI in L&T of JS Science

Adopt new L&T Strategy for using AI in JS Science

Use digitalised planning and evaluating tools in JS Science

Use AI in probing students' learning in JS Science

Facilitate students to explore into AI-infused scientific investigation

Question 1

How could / should AI be used in Learning and Teaching in JS Science?

Point of consideration:

- The L&T strategies / pedagogies (e.g. ICAP, 5E, POE.....)
- Use of AI as teaching assistance to promote science classroom interactions
- The use of AI to lessen teachers' burden for quality lesson planning
- Examples of AI-oriented student task

Example : ICAP Framework



	What students do	The nature of learning activity
P assive (Receiving)	The student does not create anything that is not already present in the learning materials. If a procedure is involved, the procedure is rigid (固有的) and will result in a predetermined outcome (預設結果) .	The activity or lesson requires the student to watch a teacher led demonstration or listen to a lecture about the activity. There is no selection of materials or creative production.
A ctive (Manipulating)	The student may engage in a selection (作選擇) process, whereby they choose from multiple content, for example, among various procedures, data, or ways of presentation.	The activity or lesson involves the student performing physical manipulations (操作) , usually following a fixed procedure (固定過程) .
C onstructive (Self-constructing)	The student must generate something new (創建新意念) , that is, something that extends beyond what was provided in the learning materials (在所提供的學習資料以外) . This could include, for example, a new idea, procedure, or way of representing data.	The activity or lesson requires the student to generate new ideas beyond what the materials provide. For example, if the learning activity involves generating a way of representing data and no examples (不提供例子) of representing data are present in the learning materials, the student is engaging in a generative process.
I nteractive (Dialoguing)	Two or more students (多名學生) engage in an intrinsically co-constructive activity (共建活動) , including substantial dialoguing (深入討論) rather than parallel monologues (不是單向表達), to generate knowledge (創建知識) based on students' interaction.	The activity or lesson requires more than one student to generate new ideas beyond what the learning materials provide.

Chen, Y. C. (2021), Development and validation of an observation-based protocol to measure the eight scientific practices of the next generation science standards in K-12 science classrooms. *Journal of Research in Science Teaching*, 58-10. <https://doi.org/10.1002/tea.21716>

Example : Learning events in Science lessons

Science learning events	P assive Receiving (Individual)	A ctive Manipulating (individual)	C onstructive constructing (individual)	I nteractive Dialoguing (group)
Asking scientific questions	Listen to the teacher posing scientific questions	Select scientific questions from provided materials.	Ask genuine scientific questions	Discuss with peers to create genuine scientific questions
Creating scientific models	Read textbooks to understand some scientific models	Follow given instructions to build models step-by-step	Find patterns from scientific data and construct models accordingly.	Collaboratively build scientific models in groups to explain phenomena.
Planning and conducting investigations	Read provided procedures for scientific experiments or investigations.	Follow fixed steps to conduct experiments or investigations.	Design investigations or write experimental steps	Collaboratively design investigations or write experimental steps in groups.

Example : Learning events in Science lessons

Science learning events	P assive Receiving (Individual)	A ctive Manipulating (individual)	C onstructive constructing (individual)	I nteractive Dialoguing (group)
Using creative thinking	Read textbooks to understand different methods of solving scientific problems	Write different methods to solve problems based on teacher's questions and related data	Propose genuine methods or improve existing methods to solve problems	Discuss with peers to propose multiple genuine methods or improve existing methods to solve problems.
Analyzing data	Listen to the teacher explaining data patterns and results	Analyse data step-by-step	Search for additional data to further analyse	Collaborate in groups to search for additional data and further analyse
Constructing scientific explanations	Read textbooks or listen to teachers explaining scientific concepts	Explain phenomena based on given assignments after listening to teachers	Apply learned concepts and data to create explanations in unfamiliar situations	Discuss with peers and apply learned concepts and data to create explanations in unfamiliar situations

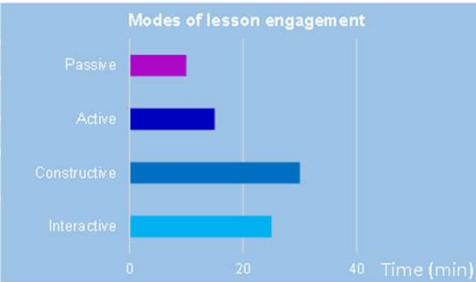
Example : Learning events in Science lessons

Science learning events	P assive Receiving (Individual)	A ctive Manipulating (individual)	C onstructive constructing (individual)	I nteractive Dialoguing (group)
Conducting evidence-based scientific arguments	Read textbooks to learn about scientific arguments and evidence related to certain issues	Write scientific arguments based on provided data within a fixed framework (Claim-Evidence-Reasoning)	Analyse data, summarise evidence and write scientific arguments	Analyse data, summarize evidence, write different scientific arguments, and engage in scientific debates in groups
Communicating and evaluating science	Listen to the teacher presenting scientific conclusions	Express scientific ideas following fixed steps and formats	Creatively express scientific ideas such as reflection articles and science posters.	Discuss with peers to creatively express scientific ideas, such as reflection articles and science posters

	Learning activity examples 學習活動例子	Action verb 學習活動指令 - 重點詞彙
P assive 被動學習 (個人)	<ul style="list-style-type: none"> Read textbook 閱讀科學文章 / 教科書 Listen to lecture 聆聽教師講解 View science demonstration 觀看教師實驗示範 / 科學影片 	<ul style="list-style-type: none"> Listen (聆聽), Look (觀看), Read (閱讀), Observe (觀察)
A ctive 主動學習 (個人)	<ul style="list-style-type: none"> Conduct a practical according to steps 根據步驟進行實驗 Complete a worksheet 完成工作紙 	<ul style="list-style-type: none"> Annotate (註解), Calculate (計算), Categorise (分類), Choose (選擇), Circle (圈出), Complete (完成), Cross out (刪去), Describe (描述), Fill in (填寫), Find (找出), Follow the procedures (按步驟...), Identify (辨識), Label (標示), List (列出), Match (配對), Measure (量度), Record (記錄)
C onstructive 構建學習 (個人)	<ul style="list-style-type: none"> Construct science model 提出科學模型 Explain phenomenon 解釋現象 Design an experiment 設計實驗步驟 Design an invention 製作發明品 	<ul style="list-style-type: none"> Ask Questions (提出問題), Build (建構), Comment (評論), Compare (比較), Connect (連繫), Construct (建構), Create (創作), Decide (決定), Determine (求出), Draw (繪出), Explain (解釋), Generate (創出), Justify (解釋), Predict (估計), Sketch (草繪), Solve (解), Suggest (建議), Summarise (解釋)
I nteractive 互動學習 (小組)	<ul style="list-style-type: none"> Discuss with peers about different science ideas and views 就不同科學觀點與同儕或教師討論 Evaluate students' experimental design 就學生設計的實驗裝置進行評鑑 	<ul style="list-style-type: none"> Build upon (建基於...), Discuss (討論), Elaborate (闡述), Evaluate (評鑑), Revise (修訂), Work in groups (以小組方式工作.....)

Digitalised Lesson Design & Evaluation Tool (Trial version)

Science (S1-3) - Lesson Design & Evaluation Tool (Trial version)

School :	ABC college	Modes of lesson engagement 
Level :	S2	
Class :	2A	
Expected time :	80 minutes	
Unit :	Scientific_Practices_II	
Content Area :	4.2. Scientific reasoning - scientific models - ways of scientific reasoning - uses and limitations of scientific reasoning	
Learning Outcome 1 :	- give examples of different types of scientific models	
Learning Outcome 2 :	- be aware of the limitations of the scientific reasoning for establishing science knowledge and making inference (S)	
Learning Outcome 3 :	---	

	Characteristics of engagement mode	L&T Activity to be Conducted	Time (min)
Passive	<p>The activity requires the student to watch a teacher led demonstration or listen to a lecture about the activity. There is no selection of materials or creative production.</p> <p>Individual student does not create anything that is not already present in the learning materials. If a procedure is involved, the procedure is rigid and will result in a predetermined outcome.</p> <p>Examples of action verb of the task: <u>Listen, Look, Read, Observe</u></p>	<input type="checkbox"/> Ask students listen to teacher explains new science content <input type="checkbox"/> Ask students watch teacher demonstrates an experiment or investigation <input type="checkbox"/> Ask students read science textbooks or other resource materials <input type="checkbox"/> Other: _____	10
Active	<p>The activity involves the student performing physical manipulations, usually following a fixed procedure.</p> <p>Individual student may engage in a selection process, whereby they choose from multiple content, for example, among various procedures, data, or ways of presentation.</p> <p>Examples of action verb of the task: <u>Annotate, Calculate, Categorise, Choose, Circle, Complete, Cross out, Describe, Fill in, Find, Follow the procedures, Identify, Label, List, Match, Measure, Record</u></p>	<input type="checkbox"/> Ask students describe the natural phenomena observed <input type="checkbox"/> Ask students use scientific formulas and laws to calculate routine problems under guidance <input type="checkbox"/> Ask students conduct experiments (hands-on or virtually) according to step-by-step instructions <input type="checkbox"/> Ask students use computational models, simulations and other tools to generate data according to step-by-step instructions <input type="checkbox"/> Other: _____	15
Constructive	<p>The activity requires the student to generate new ideas beyond what the materials provide. For example, if the learning activity involves generating a way of representing data and no examples of representing data are presented in the learning materials.</p> <p>Individual student would generate something new, that is something beyond what was provided in the learning materials. This could include, for example, a new idea, procedure, or way of representing data.</p> <p>Examples of action verb of the task: <u>Ask questions, Build, Comment, Compare, Connect, Construct, Create, Decide, Determine, Draw, Explain, Generate, Justify, Predict, Sketch, Solve, Suggest, Summarise</u></p>	<input type="checkbox"/> Ask students ask authentic questions about scientific phenomena <input type="checkbox"/> Ask students predict the outcomes of experiments or investigations <input type="checkbox"/> Ask students formulate hypotheses based on observed phenomenon or provided information <input type="checkbox"/> Ask students use multiple sources of evidence / scientific concepts to explain scientific phenomena <input type="checkbox"/> Ask students create representations (e.g., models, graphs) to explain scientific phenomena <input type="checkbox"/> Ask students propose multiple / different / original solution to a scientific problem <input type="checkbox"/> Ask students draw conclusions from data to support or refute the hypothesis set <input type="checkbox"/> Other: _____	30
Interactive	<p>The activity requires more than one student to generate new ideas beyond what the learning materials provide.</p> <p>Two or more students engage in an intrinsically co-constructive activity, including substantial dialoguing rather than parallel monologues, to generate knowledge based on students' interaction.</p> <p>Examples of action verb of the task: <u>Build upon, Discuss, Elaborate, Evaluate, Revise, Work in groups</u></p>	<input type="checkbox"/> Ask students discuss and propose an original improvement to an experiment or investigation <input type="checkbox"/> Ask students argue about science questions and summarise by providing supporting and refuting arguments <input type="checkbox"/> Ask students evaluate the quality of the output from computational models, simulations and other tools and suggest further revisions, if any <input type="checkbox"/> Other: _____	25

Example 1: AI-assisted science reading



P_{assive}

A_{ctive}

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MARCH 2025

How do storms impact coastal ecosystems?

Authors:
Collette J. Feehan, Karen Filbee-Dexter,
and others
Associate Editors:
Miranda Wilson and Alexandra Appleton

Abstract

Climate change is making tropical cyclones stronger. It is also making them more common. We know tropical cyclones can cause a lot of damage to houses and buildings. But what about coastal ecosystems? We depend on coastal ecosystems for protection and food. It's important to understand how increasing storms could impact them.

We collected data from the literature on 97 storm landfalls. We looked at things like death and diversity. Then we

calculated the impact on five different coastal ecosystems. We also looked at what caused the impact; for example, wind or waves. We found that tropical cyclones harmed all five ecosystems. But they harmed mangrove forests the most. Mangrove forests were most often harmed by wind. We need to know more about what storm traits can cause impacts. Only then can we manage and preserve these ecosystems better.

Introduction

Have you ever had to evacuate your home because of a storm? The storm was likely a **tropical cyclone**. You might know them as **hurricanes**, **typhoons**, or just **cyclones** based on where you live. **Tropical cyclones are rotating storms that form over the ocean. We classify them based on their wind speed** (categories 1-5). Categories 4 and 5 are very intense. They can have wind speeds of more than 130 miles per hour (209 km per hour).

Tropical cyclones can cause billions of dollars in damage to property. But we don't always think about the damage

Coastal ecosystems provide food, coastline protection, and beauty for people. Some coastal ecosystems are (a) oyster reefs, (b) coral reefs, (c) salt marshes, (d) seagrass meadows, and (e) mangrove forests. Images: (a), (b): Florida Museum; (c), (d), (e): Zach Franklin, Steven Lutz/GRID-Arendal, and David Unger, CC BY-NC 2.0

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MARCH 2025

HOW DO STORMS IMPACT COASTAL ECOSYSTEMS?

they can do to coastal **ecosystems**. **Tropical cyclones can hurt organisms and habitats**. For example, big storms can break coral or uproot mangrove trees. Tropical cyclones can also cause sediment to move. They can even change the water quality. We depend on many coastal ecosystems. They give us food and protect coastlines from storms. They also give us beautiful places to explore!

Researchers know that **climate change** can make tropical cyclones stronger and more common. Unfortunately, it

is hard to predict their impacts on ecosystems. Coastal ecosystems are very complex. In the past, researchers have used wind speed to predict damage. But that may not work for every type of coastal ecosystem. **We wanted to find out what impact tropical cyclones have on different types of coastal ecosystems**. With this information we can start to predict the impact of storms on our coasts. This will help us manage those areas better.

Methods

Impacts on Ecosystems:

We searched existing studies for North Atlantic tropical cyclones that made landfall. They also needed to have information about their impact on coastal ecosystems. We found records for 97 landfalls. These had 891 separate data points about impacts. We explored data from five different ecosystems. **They were mangrove forests, seagrass meadows, salt marshes, oyster reefs, and coral reefs.** We looked at data like animal growth and

death. We also focused on things like diversity and food web complexity. Then we calculated the **effect size**. We used pre- and post-storm data from the research to do this.

Causes of Impacts:

We looked at the research studies to see what was causing impacts. This included wind, waves, sediment movement, changes in **salinity**, and **storm surge**. We also looked at how often they occurred.

Results

We found that tropical cyclones harmed all the ecosystems (Fig. 1). **The largest impact was on mangrove forests.** Impacts in each ecosystem had different causes (Fig. 2). For example, damage in mangrove forests related to wind speed. But damage to coral reefs was because of waves.

Figure 1:
Effect sizes in the five coastal ecosystems. Negative effect sizes show harmful impacts from tropical cyclones.

2

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HOW DO STORMS IMPACT COASTAL ECOSYSTEMS?

Wind speed defines the strength of tropical cyclones. How many coastal ecosystems suffer damage mainly from the wind? Which one(s)?

Figure 2:
Causes of damage to each of the different ecosystems. The size of the icon represents the amount of damage.

Discussion

Our results show that tropical cyclones cause damage in all the ecosystems we looked at. But different things cause damage in the different ecosystems.

For example, mangrove trees have exposed roots and branches. **Our data showed that mangrove forests were most affected by wind speed.** Winds damaged branches and uprooted trees. **In contrast, seagrasses and salt marsh plants are flexible.** They can bend in the wind and waves. We found instead that **they were most affected by sediment moving and storm surge.** In fact, we found wind caused most of the damage in only one of the five ecosystems.

Wind speed defines the strength of tropical cyclones. Our results show we cannot rely only on wind speed to predict

damage to coastal ecosystems. We need to know more about things like wave action and sediment movement. We also need to know more about water quality and storm surge.

Many coastal ecosystems are quick to recover from storms (**resilience**). Others can resist damage in the first place (**resistance**). **Climate change will cause more intense and frequent tropical cyclones.** This could decrease the resilience and resistance of coastal ecosystems. But people depend on these ecosystems. So, **better management of these areas is essential to help them weather the coming storms.**

Conclusion

Coastal ecosystems provide us with food, as well as protection from storms. They are also beautiful. As storm impacts increase, there are still things we can do to protect them.

- Reduce pollution by reusing and recycling things.
- Write letters to your local council or representative.

Explain why we need to protect coastal areas from development.

- Support or volunteer with local habitat conservation efforts.
- Decrease your contribution to climate change. Ride your bike or take the bus instead of driving.

3

Example 1: AI-assisted science reading



tropical-cyclones_article.pdf
PDF

I am a science educator I want to help my students (age of 11-16) to engage in reading the journal and test them the scientific skills in the context of the experiment described in the journal. Moreover, students might be in need of some assistances to understand the content of the journal, such as translating into Chinese; simplify the content; explaining terminologies in simple English or Chinese.

Can you provide the supporting materials and testing items for me?

Provide requirements of scaffolding measures



Storms Ecosystems Chinese

以下是文章的中文翻譯版本：

熱帶風暴如何影響沿海生態系統？

氣候變化導致熱帶氣旋變得更強也更頻繁。我們知道熱帶氣旋可以對房屋和建築造成極大破壞，但它們對沿海生態系統有什麼影響呢？我們依賴沿海生態系統獲取食物和提供保護，因此了解風暴增加對這些生態系統的影響十分重要。

我們從相關文獻中收集了97個風暴登陸的數據，檢視生物的死亡與多樣性，計算了五種不同沿海生態系統所受的影響。我們還分析了造成這些影響的原因，例如風或海浪。我們發現熱帶氣旋損害了全部五種生態系統，其中紅樹林受到的傷害最大，主要是受到強風影響。我們必須更清楚了

Translated science journal



Supporting Materials (支援材料)

A. Simplified Summary of the Article (文章簡化摘要):

熱帶氣旋（亦稱颶風或颱風）是在海洋形成的強烈風暴。氣候變化使這些風暴變得更強且更頻繁。科學家研究了這些風暴如何影響五種沿海生態系統：紅樹林、海草床、鹽沼、牡蠣礁和珊瑚礁。他們發現所有這些生態系統都受到風暴的損害，但紅樹林受害最嚴重，特別是受到強風影響。

B. Glossary (Simple Definitions) 簡易詞彙表:

- **Ecosystem 生態系統:** 生物互相影響並與環境互動的地方。
- **Mangrove forests 紅樹林:** 生長在鹹水中的沿海森林。
- **Coral reefs 珊瑚礁:** 由稱為珊瑚的微小動物構成的五顏六色的水下結構。
- **Storm surge 風暴潮:** 由強風暴引起的海平面上升。
- **Sediment 沉積物:** 如沙或泥一樣被水搬運的物質。
- **Resilience 回復力:** 快速從損害中復原的能力。
- **Resistance 抵抗力:** 避免受到損害的能力。

Supporting materials

Example 2: Building predictive model using AI

P_{assive}

Background

Mars rovers rely on solar panels to convert solar energy into electrical energy for continuous operation. However, dust storms frequently occur on Mars, which can block sunlight and prevent the rover from charging. During a dust storm, leaving the solar panels open may also risk damage. Your task is to find a method to predict when it is most suitable to open the solar panels to collect energy and when to close them to avoid damage.



Dust storm on Mars



Mars Rover

Using Artificial Intelligence (AI)

Before we begin, let's understand artificial intelligence. Artificial intelligence (AI) is like a very smart computer program that can use scientific models and learn from data to make scientific predictions.

Scientific Models

Scientific models are representations used to explain how nature works. Scientists conduct scientific inquiries, using the data obtained to construct, revise, and evaluate scientific models, which help explore and understand scientific phenomena. Scientific models can be expressed in various forms, including diagrams (such as particle models and food webs), equations, and computer models. AI is widely used for applications such as weather forecasting, where it can analyse vast amounts of data from satellites, sensors, and past data to predict temperature, rainfall, and extreme weather events. It can also be applied in agriculture activities, disaster management to track hurricanes and floods.

The Mission

In this activity, you will look into an AI predictive model to estimate when solar radiation intensity is high or low. You will consider using different data (such as Martian weather data, including temperature and humidity) to train and revise your predictive model, making its forecasts more accurate.

A_{ctive}

1. A student said that temperature is a variable that can be used to predict whether solar radiation on Mars will be high or low. The data below show some sample environmental data collected on Mars. Rearrange the data from high to low and complete the table on the right.

Temperature (°C)	Radiation (High/Low)
-42	Low
-36	High
30	High
105	High
-111	Low
9	High
-8	Low
-60	High
4	Low
0	Low
-143	High
-144	Low
57	High
-2	High
70	High
88	High



Temperature (°C)	Radiation (High/Low)
105	High
88	High

2. According to the table, describe the relationship between the intensity of solar radiation at different temperatures.

C

Constructive

Investigative Task

C

Extension

By using other variables to build the predictive model, would the percentage (%) of correct predictions be increased? How about using multiple sets of variables or a larger set of data?

1. Use the available data and work with your classmates to build, test and evaluate at least two additional models using other variables (e.g., humidity, temperature, or both). Compare the performance of these models and select the best one for predicting solar radiation on Mars.

You may use a separate sheet to test and evaluate your models.

Name of the predictive model	"Model ____"
The variable(s) used for building the predictive model	For example: Humidity and solar radiation
The total number of data used for training the predictive model	
The total number of data remaining for testing the predictive model	
The percentage (%) of correct predictions = $\frac{\text{number of matched test results}}{\text{total number of test results}} \times 100 (\%)$ (The results are subject to the student's modifications to the model)	The percentage (%) of correct predictions = ____ / ____ $\times 100$ = ____

Name of the predictive model	"Model ____"
The variable(s) used for building the predictive model	For example: Temperature, Humidity and solar radiation
The total number of data used for training the predictive model	
The total number of data remaining for testing the predictive model	
The percentage (%) of correct predictions = $\frac{\text{number of matched test results}}{\text{total number of test results}} \times 100 (\%)$ (The results are subject to the student's modifications to the model)	The percentage (%) of correct predictions = ____ / ____ $\times 100$ = ____

Note: Teachers can emphasise the importance of managing control variables in this section. For example, the number of training data, testing data and the variables used should not be changed at the same time when comparing different models.

I

Interactive

Discussion Task

I

3. i) Write down two questions that you would like to explore based on the project you have completed.

Question 1:

Question 2:

Note: Teachers may use online platform to collect the questions from students, and use AI to find out the most popular three questions among the class for further discussions.

The discussion should focus on facilitating students to think about –

- (1) whether the questions selected are investigable using scientific methods;
- (2) what information is needed to further investigate the project.

- ii) Choose one of the most popular three questions in your class and design a plan with your classmates to further investigate on this question.

Other optional questions (AI aspects)

4. Which of the following statements do you think describes a characteristic of artificial intelligence (AI) predictive models?

<input type="checkbox"/>	AI is a technology that can train computers to perform tasks without the need for explicit step-by-step instructions.
<input type="checkbox"/>	AI prediction is like a crystal ball, capable of foreseeing the future.
<input type="checkbox"/>	AI means we no longer need to solve problems because AI will solve them for us.
<input type="checkbox"/>	AI models can only run on large supercomputers.

Point of thoughts

- Is a classroom with only interactive learning (Interactive) a “good” lesson?
- Is it essential to include all four I-C-A-P learning processes in teaching?
- For the I-C-A-P processes, what teaching sequence is more effective? (e.g., $P \rightarrow A$? $P \rightarrow C$?)
- How to apply the ICAP theory in practical sessions?

Question 2

How should teachers re-shape the assessment in JS Science?

Point of consideration:

- Shifting from assessing rote learning to scientific skills (e.g. creativity, problem-solving, scientific inquiry)
- Constructing competency based assessment in Science
- Curating suitable assessment tasks which could couple the use of AI –
 - Multiple alternative answers are accepted;
 - The scientific reasoning for the answer is customised;
 - The answers expected from students are original (i.e. not a simple recall of textbook knowledge)

Example 3: AI-assisted marking

Select a science question to facilitate students providing alternative answers (多樣答案)

Example:
Brass, Bronze, Magnesium
Odd one out : _____
Reasons : _____

1 Ask AI to propose answers under set criteria

這條題目是一道初中科學科的題目，做的規則是，選擇一個項目，指出這個項目為何與另外兩項不同。答案的形式，需要指出另外兩項共同特點，而與所選的項目的特點不同。例如：

Option : Magnesium.
Reason: Magnesium is an element while both bronze and brass are alloy

假設你是科學教育者，請提供另外四個答案。你可選擇不同的選項，但必須要根據上述的回答方式作答。

2 Checking

答案1

Option : Magnesium

Reason : Magnesium 是元素 (金屬元素)，而 Brass (黃銅) 和 Bronze (青銅) 都是銅與其他金屬所組成的合金。

答案2

Option : Magnesium

Reason : Magnesium 在空氣中受熱後極易燃燒並釋放強光，常用於煙火、信號彈；而 Brass 和 Bronze 不易燃燒，主要用於樂器、雕塑或機械零件。

答案3

Option : Brass (黃銅)

Reason : Brass 主要由銅與鋅構成，而 Bronze 主要由銅與錫構成，Magnesium 則是純金屬元素。也就是說，只有 Brass 的合金元素以「鋅」為主，而 Bronze 和 Magnesium 都不含鋅。

答案4

Option : Bronze (青銅)

Reason : Bronze 主要由銅與錫合成，而 Brass 主要為銅與鋅合金，Magnesium 是不含銅的純元素。因此，只有 Bronze 同時含有「錫」成分，而 Brass 和 Magnesium 都沒有錫。

Example 3: AI-assisted marking

3 Ask AI to generate marking rubric

我想做一個評分表
零分：所提出的原因未能分辨選項和另外兩個項目的不同之處，或者邏輯有誤。
1分：所提出的原因不清楚，或不完整，但是仍能夠區別選項和另外兩項的不同之處
2分：所提出嘅原因清晰，又能指出另外兩者共同特徵或用途與第三者不同。
請用表列形式為我提供評分表

4 Checking

以下是一個以表格形式呈現的簡易評分表範例，根據您提供的標準進行編寫：

分數	評分標準
0	- 所提出的原因未能清楚分辨該選項與其他兩項的不同之處。 - 邏輯不清或有明顯錯誤。
1	- 原因敘述不夠清楚或不夠完整。 - 仍能辨別該選項與其他兩項的基本差異，但需進一步闡述。
2	- 理由清晰、完整，能明確指出另外兩項的共同特徵或用途。 - 清楚對比第三者的不同之處，無重大錯誤。

Example 3: AI-assisted marking

⑤ Ask AI to mark the script(s) according to the rubric

8. Brass, bronze, magnesium

Odd one out:

bronze

Reason:

It is brown

請使用評分表，為我批改這條題目，
並說明給分原因。

學生答案

- **Odd one out:** Bronze
- **Reason:** It is brown

依據評分表之評分

給分：1分

• 0分標準：

- 完全未能指出該選項與另外兩個選項的差異，或內容/邏輯明顯錯誤。

• 1分標準：

- 所提出原因不夠清楚或不夠完整，但仍能部分區別該選項與其他兩者的不同。

• 2分標準：


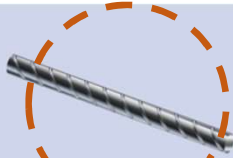

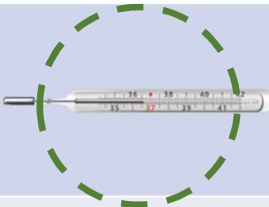


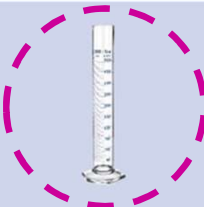
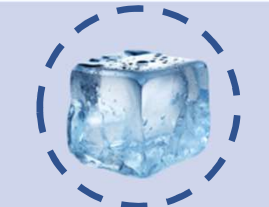
- 所提出的原因清楚、完整，能同時指出另外兩者的共同特徵或用途，並說明與第三者不同之處。

根據上述標準，學生的答案雖然僅以「顏色」作為理由，且沒有進一步闡述另外兩者的特徵，但至少表明了「Bronze 具有與另外兩種金屬不同的顏色」，可以勉強視為「指出了差異」。因此，該答案達到「1分」的條件。



Sample Question 1 “Pair up”

- For the objects below, **pair up the objects** in Row A with the objects in Row B. Give your reason.

Row A				
	Water	Iron rod	Beaker	Thermometer
Row B				
	Stop watch	Mercury	Measuring cylinder	Ice

Both are elements..?

Both are measuring devices?

Both are H₂O?

.....

.....

Sample Question 2 “Odd One Out”

- For the elements below, **select the one which is different** from the others and give your reason.
- *Helium, Hydrogen, Carbon dioxide*

Sample Question 3 “Form Groups”

- **Group the below into two groups** and give your reason.
- *Whale, shark, shrimp, elephant*

Mammal	Non-mammal
<i>Whale</i>	<i>Shark</i>
<i>Elephant</i>	<i>Shrimp</i>

Vertebrates	Invertebrates
<i>Whale</i>	<i>Shrimp</i>
<i>Shark</i>	
<i>Elephant</i>	

Sample Question 4 “Which is better”

- A student proposes the following two methods to find out the volume of the balloon.

Method 1

Pump air into the balloon using a marked syringe. Count the number of pumps.



Method 2

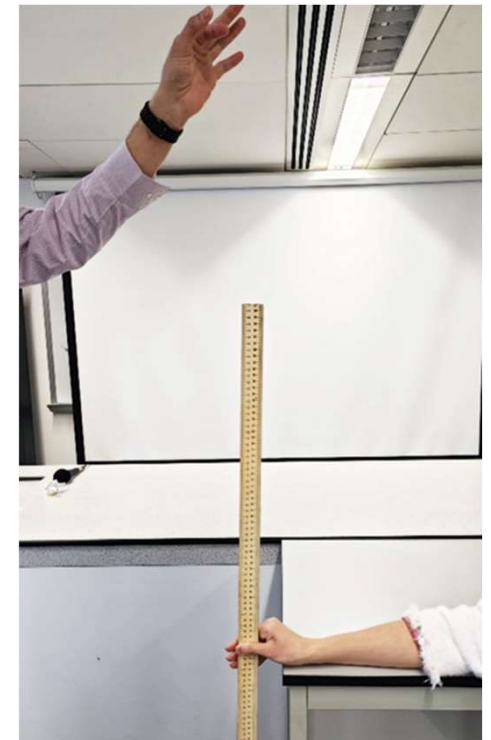
Immerse the inflated balloon into a bucket fully filled with water. Measure the volume of the overflowed water.



- For each method above, explain how you can find out the volume of the balloon. Which method you think is a better method? Could you modify the above methods or propose another better method?

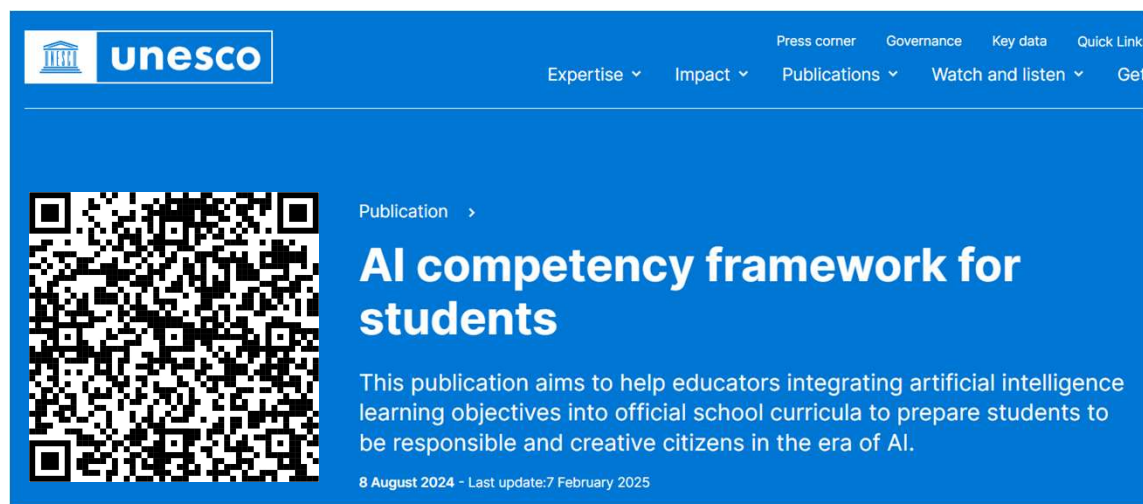
Example 5 “Write as many as possible”

- Two students are investigating reaction time.
- Student A drops a half-meter ruler. Student B catches the ruler between her thumb and fingers. The distance the ruler fell before being caught is recorded.
- **Write as many as you can** the factors that need to be kept constant when carrying out the experiment.

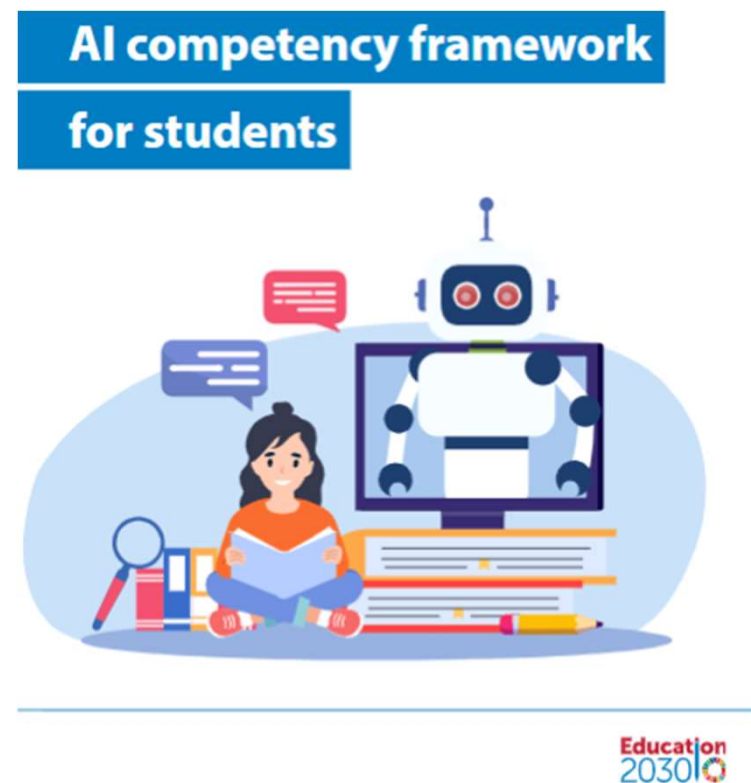


Question 3

What are the key aspects about AI rendering teachers' attention in the L&T of JS Science?



<https://www.unesco.org/en/articles/ai-competency-framework-students>



Further elaboration in the context of science education :

(a) Human-centred mindset on socio-scientific issues (SSIs) and sustainability (example)

Progression Levels		
Understand	Apply	Create
Can AI be used in supporting human decisions on values and socio-scientific issues?	Evaluate whether some selected media / science reports of AI go beyond the genuine capabilities of AI technologies.	Will AI eventually help humans alleviate climate change and protect the planet's well-being?
State advantages and limitations of current AI technologies in supporting decisions in relation to values, socio-scientific issues.	Do students in the future still need to learn how to learn conducting science experiment and draft report?	Should human societies mobilise all resources to unlimitedly train AI models?
Will machine agency become stronger than human agency? Explain.	Assess whether a particular problem in life or science learning can and / or should be solved with AI methods.	Do you think the training of AI models generated irreversible impacts on climate change?

(b) AI techniques and applications in science

For reference

Progression Levels		
Understand	Apply	Create
Explain how machine-learning models are trained, tested and optimized.	Give examples of how AI could be used in science : image recognition, autonomous agent systems, data-based prediction or generative AI.	Explain how sensors, crawling software, and other tools can be used by science researchers
Explain why data play an important role in the training and development of an AI model.	Give examples of open-source datasets which could be used for training AI system.	Draft a design plan on a task-based AI tool to address real-world needs in and beyond the local context. (analysis of AI tools, demonstrate how to collect open-source data, data processing, etc)

(c) Ethics of using AI in science

Progression Levels		
Understand	Apply	Create
State the main points of “Ethical principles” of using AI in science.	Explain the main points of responsible and safe use of AI in science.	Create ethical guidance for yourself and your classmates on the use of GenAI systems in science project.

Good practices and drive innovative applications of AI in L&T of JS Science

Adopt new L&T Strategy for using AI in JS Science

Use digitalised planning and evaluating tools in JS Science

Use AI in probing students' learning in JS Science

Facilitate students to explore into AI-infused scientific investigation

Thank you

For enquiry, please contact

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例子：科學課堂的學習過程

科學學習過程	P assive 被動學習（個人）	A ctive 主動學習（個人）	C onstructive 構建學習（個人）	I nteractive 互動學習（小組）
提出科學問題	<ul style="list-style-type: none"> 學生聆聽教師提出的科學問題 	<ul style="list-style-type: none"> 學生就所提供的資料中選擇科學問題 	<ul style="list-style-type: none"> 學生提出原創科學問題 	<ul style="list-style-type: none"> 學生與同儕討論，提出原創科學問題
創建科學模型	<ul style="list-style-type: none"> 學生閱讀課本，認識一些科學模型 	<ul style="list-style-type: none"> 學生就所提供的指示下按步驟進行建模 	<ul style="list-style-type: none"> 學生因應所得的科學數據，尋找規律並進行建模 	<ul style="list-style-type: none"> 學生以小組方式共建科學模型以解釋科學現象
計劃和進行探究	<ul style="list-style-type: none"> 學生閱讀所提供的科學實驗或探究步驟 	<ul style="list-style-type: none"> 學生按固定步驟進行科學實驗或探究 	<ul style="list-style-type: none"> 學生設計探究或寫出實驗步驟 	<ul style="list-style-type: none"> 學生以小組方式共同設計探究或寫出實驗步驟

例子：科學課堂的學習過程

科學學習過程	P assive 被動學習（個人）	A ctive 主動學習（個人）	C onstructive 構建學習（個人）	I nteractive 互動學習（小組）
運用 創意思維	<ul style="list-style-type: none"> 學生閱讀課本，認識解決科學問題的不同方法 	<ul style="list-style-type: none"> 學生按教師所提出的科學問題和相關資料，寫出不同的解難方法 	<ul style="list-style-type: none"> 學生就科學問題，提出原創的解難方法或改良現有方法 	<ul style="list-style-type: none"> 學生就科學問題與同儕討論，提出多個原創的解難方法或改良現有方法
分析數據	<ul style="list-style-type: none"> 學生聆聽教師講解數據的規律和結果 	<ul style="list-style-type: none"> 學生按固定步驟分析數據 	<ul style="list-style-type: none"> 學生尋找其他資料並與所得數據作進一步分析 	<ul style="list-style-type: none"> 學生以小組方式合作尋找其他資料並與所得數據作進一步分析
建構 科學解釋	<ul style="list-style-type: none"> 學生閱讀課本或聆聽教師講授科學解釋 	<ul style="list-style-type: none"> 學生在聆聽教師講授後，按課業要求解釋科學現象 	<ul style="list-style-type: none"> 學生在於各種不熟悉的情境中，應用所學的科學概念和所得數據創建解釋 	<ul style="list-style-type: none"> 學生與同儕討論，在於各種不熟悉的情境中應用所學的科學概念和所得數據創建解釋

例子：科學課堂的學習過程

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進行證據為本的科學論証	<ul style="list-style-type: none"> 學生閱讀課本，了解某些議題的科學論述，並得知相關科學証據 	<ul style="list-style-type: none"> 學生按照固定框架（說法—證據—推理），引用所提供的資料按指示寫出科學論証 	<ul style="list-style-type: none"> 學生就資料進行數據分析，歸納證據並寫出科學論述 	<ul style="list-style-type: none"> 學生分成小組進行數據分析，歸納證據並寫出不同的科學論述，然後進行科學辯論
科學傳意和評鑑	<ul style="list-style-type: none"> 學生聆聽教師講授科學結論 	<ul style="list-style-type: none"> 學生按固定步驟和格式表達科學意念 	<ul style="list-style-type: none"> 學生進行創作表達科學意念，例如科學反思文章、科學海報 	<ul style="list-style-type: none"> 學生與同儕討論進行創作表達科學意念，例如科學反思文章、科學海報