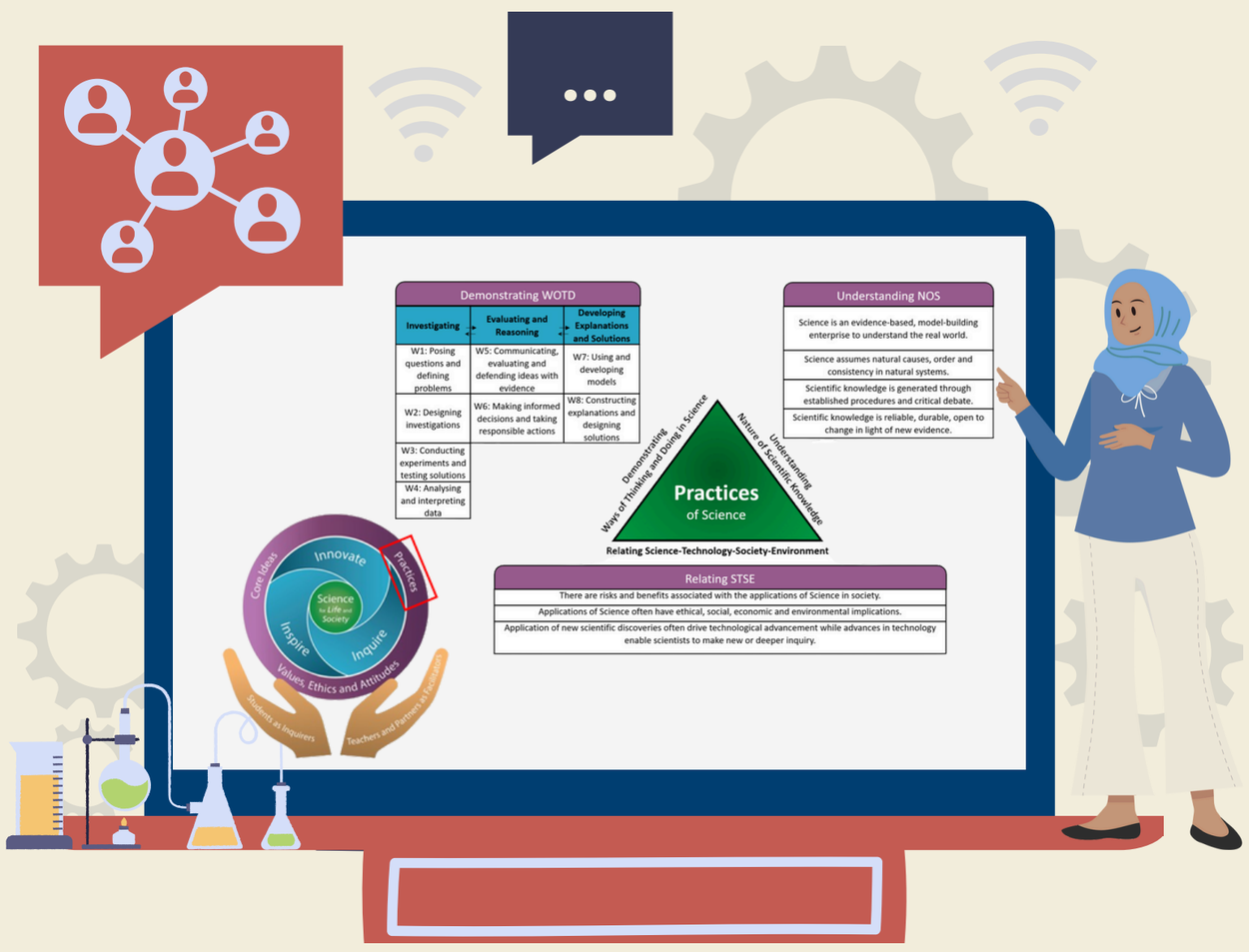
SINGAPORE
Student Learning Space

Educational Technology Division
Ministry of Education

SLS Guide for Science

Leveraging SLS to Enhance Teaching and Learning of Science



Features primary and secondary level learning activities

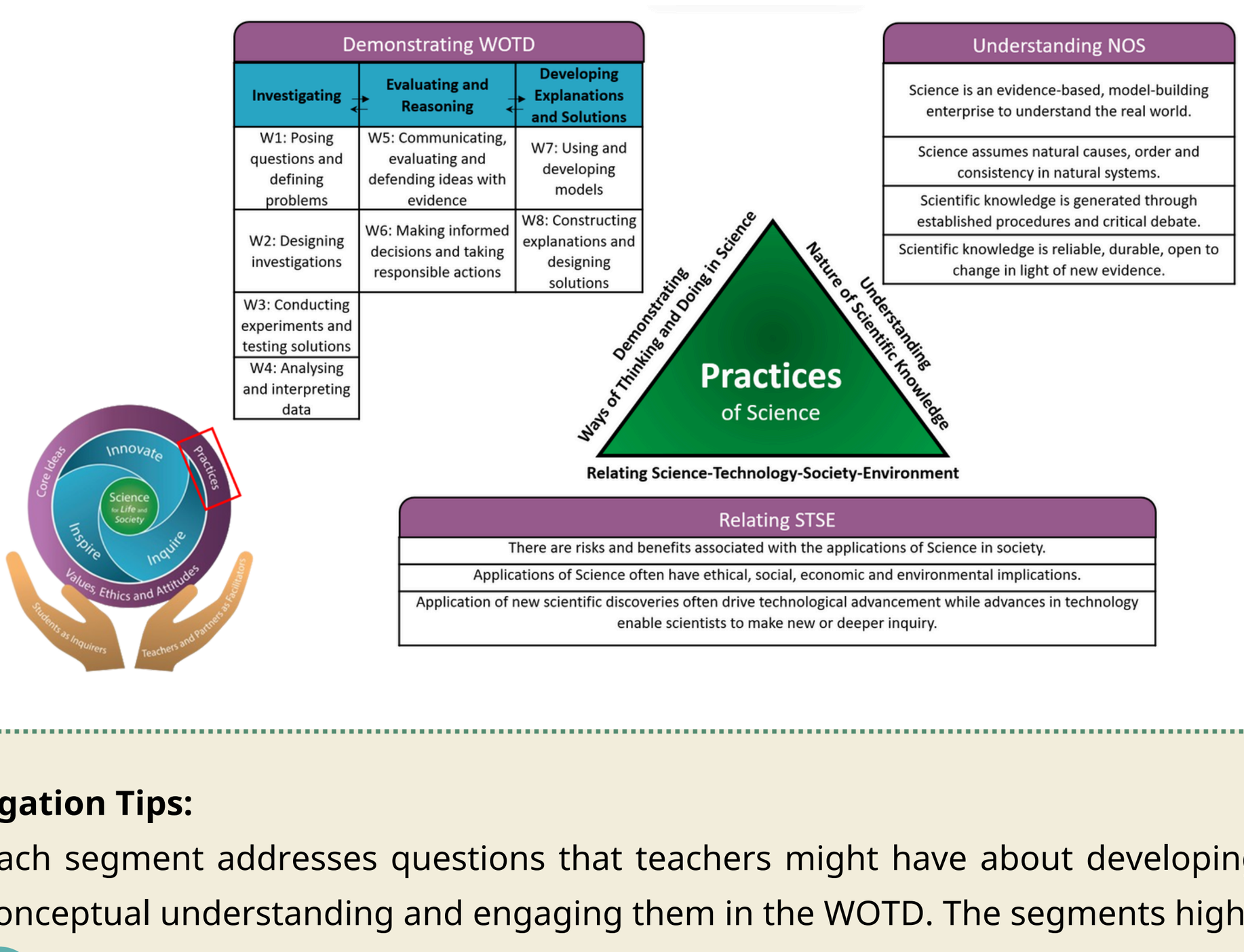
Updated as of 28 March 2025

SLS Guide for Science
Leveraging SLS to Enhance Teaching and Learning of Science

- The guide is developed by Educational Technology Division (ETD) with input from Academy of Singapore Teachers (AST) and Curriculum Planning and Development Division (CPDD).

- The examples in the guide incorporate key actions and considerations in the EdTech Pedagogical Scaffold (EdTech PS).

- The guide demonstrates the potential of the Singapore Student Learning Space (SLS) to enhance the teaching and learning of Science, featuring learning activities utilising SLS that are derived from different Science lesson examples. These activities foster and support students' scientific conceptual understanding and the Ways of Thinking and Doing (WOTD) in the Science Curriculum Framework. Teachers can also leverage available resources on Community Gallery and MOE Library to complement lessons and reinforce key or challenging concepts.



Navigation Tips:

- Each segment addresses questions that teachers might have about developing students' conceptual understanding and engaging them in the WOTD. The segments highlight:
  - how teachers can harness the affordances of SLS to enhance their teaching approach,
  - the interactions among students, teacher and students and/or students and content that foster engagement and learning, and
  - the pedagogical affordances of SLS features.
- Please note that the SLS features mentioned in the guide serve as suggestions to inspire teachers to explore possibilities and they are not exhaustive.
- For detailed technical information on each SLS feature, simply click on the embedded link. You will be directed to the relevant page in the SLS User Guide.

Content outline

Click on the page number to access the page

Investigating (W1 - W4)

- **How can I design activities to facilitate posing questions, designing investigations, conducting experiments/testing solutions and analysing data?** **Pg 4**

NEW! **How can I support my students in developing self-regulation in practical lessons?** **Pg 7**

Evaluating and Reasoning (W5 - W6)

- **How can I help my students effectively communicate their ideas, substantiate their arguments with evidence, and evaluate their peers' explanations, so as to provide constructive feedback?** **Pg 9**

NEW! **How can I support my students in mathematical reasoning in science, enabling them to provide arguments that are well-substantiated?** **Pg 12**

Developing Explanations and Solutions (W7 - W8)

- **How can I use models to help my students describe and explain natural phenomena?** **Pg 14**

NEW! **How can I help my students use metacognitive principles—awareness, monitoring, and evaluation—to enhance their critical thinking for constructing explanations and designing solutions to scientific issues?** **Pg 16**



Investigating (W1 - W4)



How can I **design activities** to facilitate posing questions, designing investigations, conducting experiments/testing solutions and analysing data?

Teachers can engage students and **activate their learning** using Resources such as simulations (Fig. 1.1) that allow them to **conduct scientific investigations** to understand and explore concepts (e.g., varying the independent variable and observing trends and patterns when exploring factors that affect photosynthesis). To **facilitate collaborative learning**, teachers can organise students into Subgroups (Fig. 1.2) and assign Team Activities (Fig. 1.3). Google Meet links can be created for each Team within the Assignment to enable synchronous discussions outside of class or during Home-Based Learning (HBL), **enabling students to collaboratively investigate, experiment, and analyse data**. Additionally, teachers can provide Differentiated Access (Fig. 1.3) to students in various subgroups based on their readiness levels.

Students can join their assigned Google Meet Video Conference to **work together** to record their data in a Google-Attached file pre-populated in a Free-Response Question (FRQ) (Fig. 1.4) and **analyse the data** obtained.

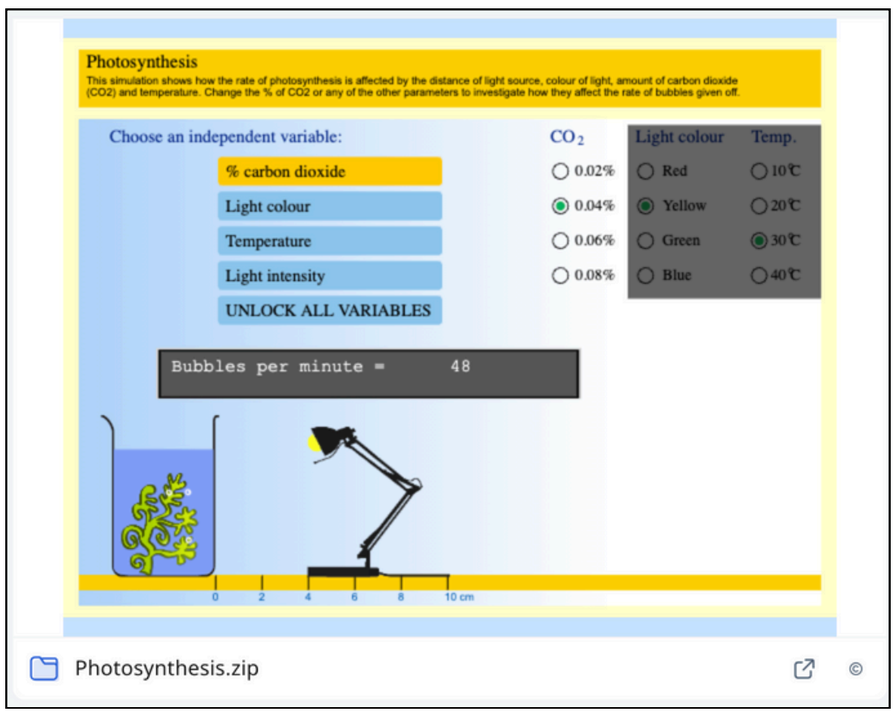


Fig. 1.1

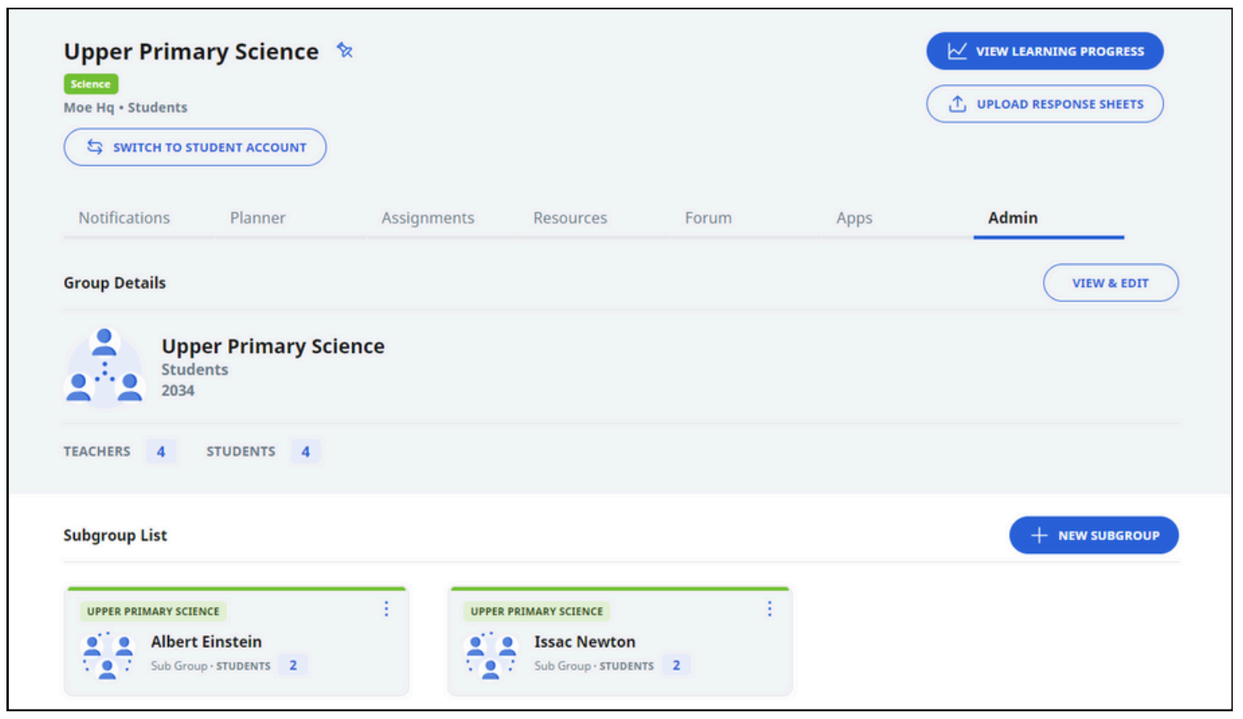


Fig. 1.2

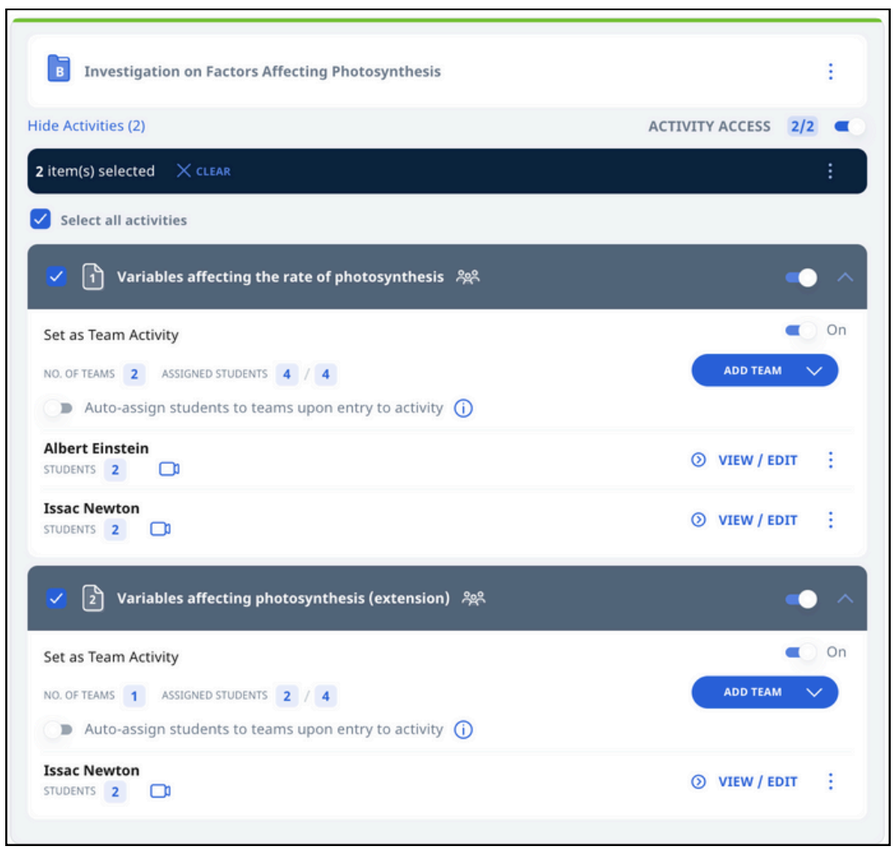


Fig. 1.3

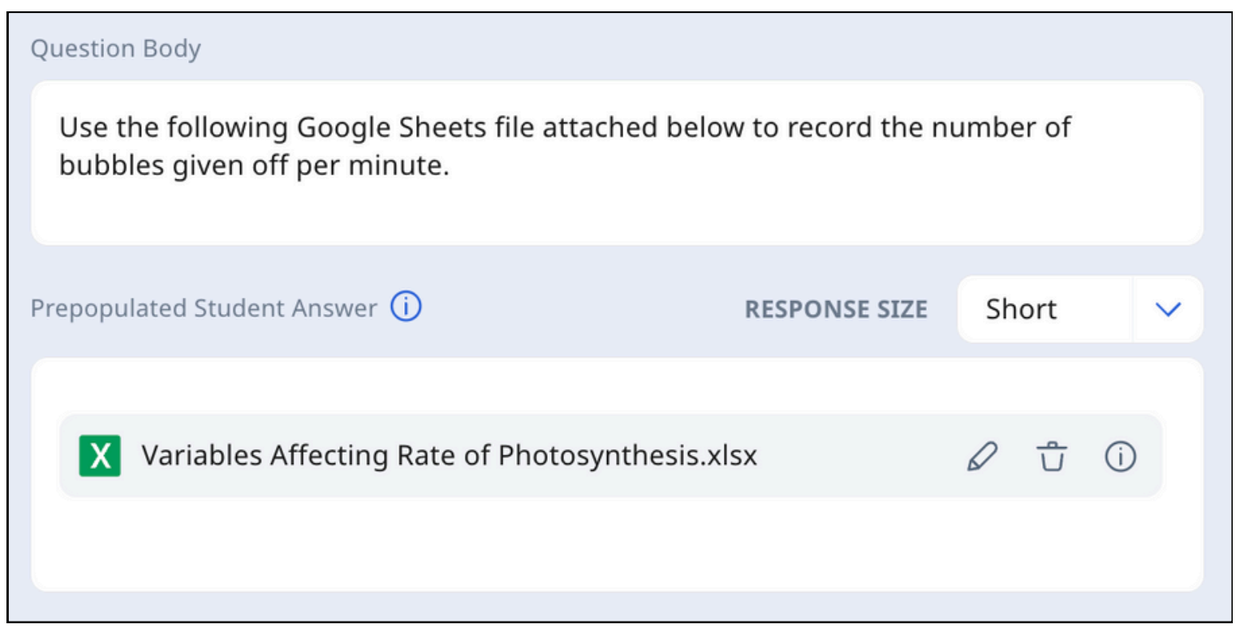


Fig. 1.4

Click on the pictures for a larger view.

Teachers can also use the Interactive Thinking Tool (ITT) to **guide students to formulate and share** their hypothesis and the Comments feature (Fig. 1.5) to allow students to comment on their peers' hypotheses. Teachers can encourage students to reflect on their understanding through their peer's comments, supporting the co-construction of meaning and enhancing the development of their metacognitive skills.

Students can sketch a graph of their data using the ITT with pre-populated axes (Fig. 1.6) and they can **discuss on the trend observed** from the graph.

Alternatives

Use a Free-Response Question to prepopulate the hypothesis structure and guide students in formulating their hypotheses.

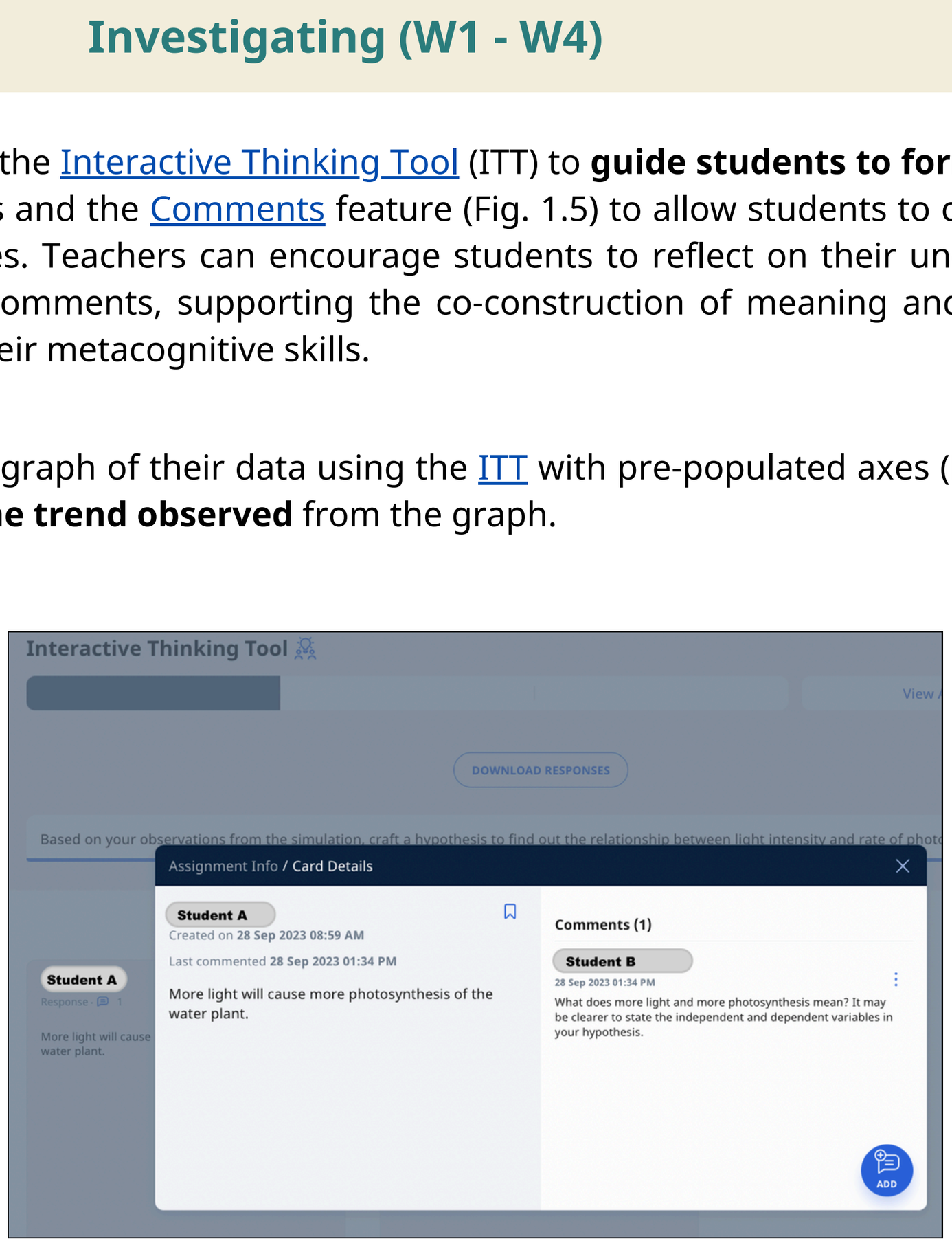


Fig. 1.5

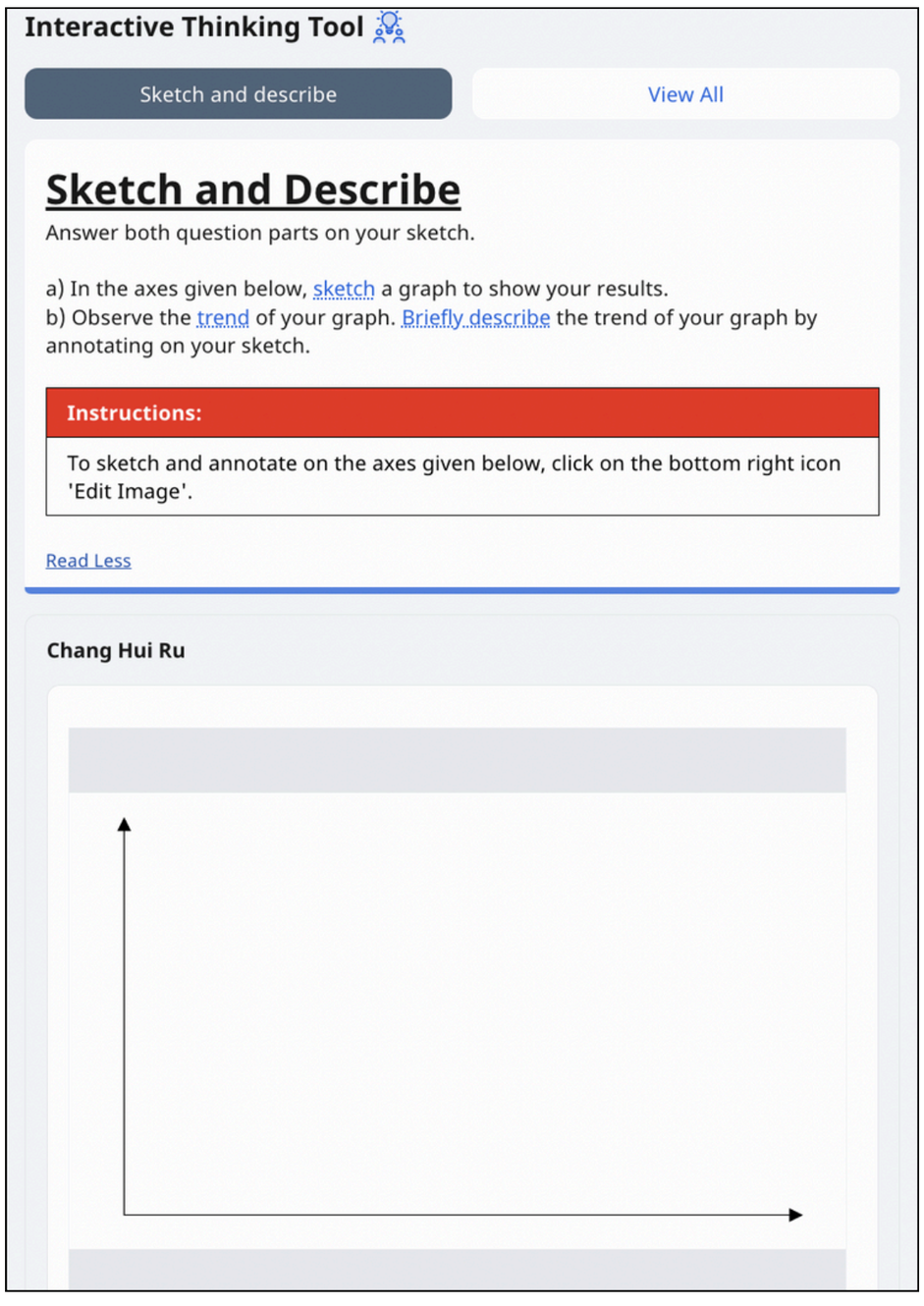


Fig. 1.6

Click on the pictures for a larger view.

Alternatively, teachers can also use the Short Answer Feedback Assistant (ShortAnsFA) in a Teacher-Marked Quiz to **guide students to formulate** and share their hypotheses. The ShortAnsFA generates the first draft of comments for students' responses based on the suggested mark scheme. Teachers can edit and build on the AI-generated comments before either Unsubmitting the Quiz for students to improve their answers or Releasing the Quiz to return the feedback to students if no major edits are needed.

Upon receiving feedback from the ShortAnsFA (Fig. 1.7), students whose quiz were unsubmitted can **reflect on their understanding** and resubmit a refined hypothesis.

Additional tips for using ShortAnsFA

Did you know that you can use a slash to indicate alternative answers for the same point? Be sure to leave a space before and after the slash.

Click this link to find more tips on writing suggested answers for ShortAnsFA.

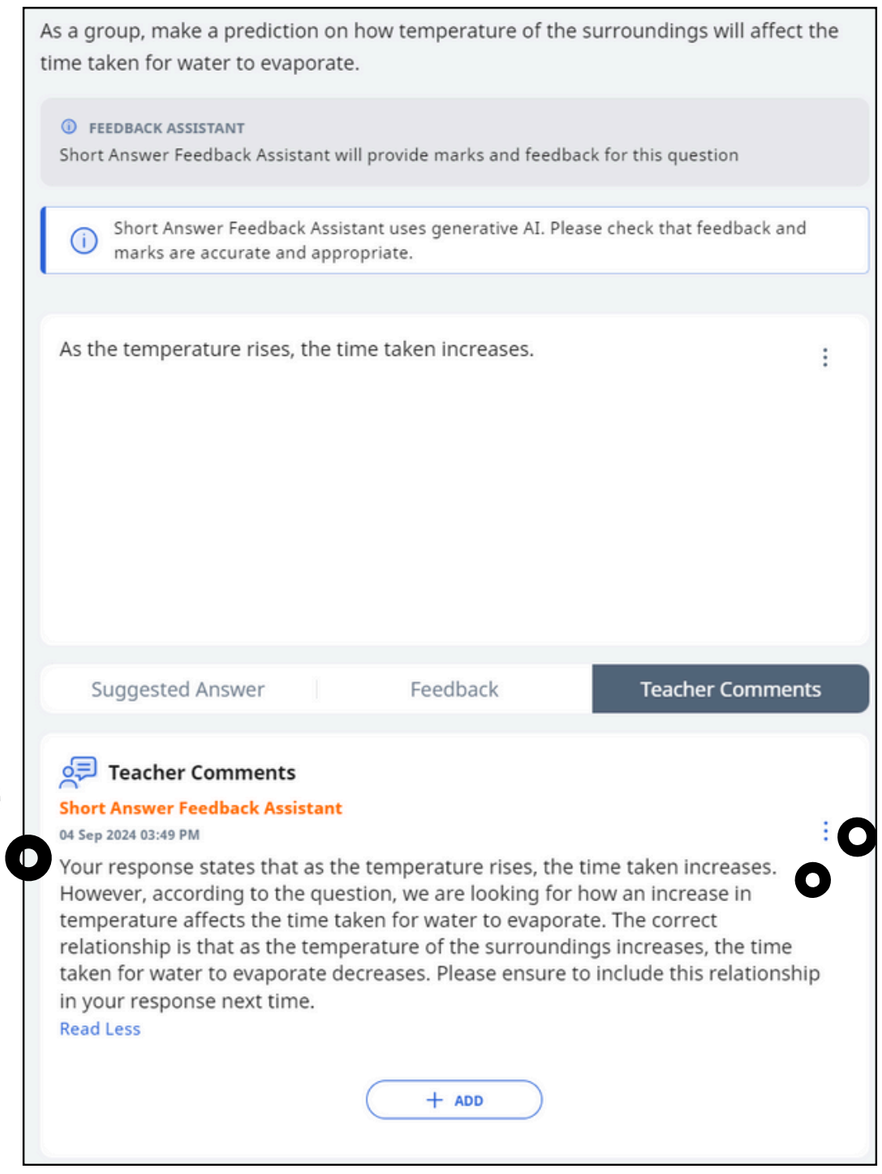


Fig. 1.7

Click on the picture for a larger view.

Did you know?

If the ShortAnsFA is set up outside a Teacher-Marked Quiz, feedback will be automatically generated and immediately available to students.

PEDAGOGICAL AFFORDANCES:

- Simulation software / Virtual labs **provide a controlled digital environment for students to plan and design investigations** that might not be practical or possible given constraints of the school science laboratory.
- Subgroups and Differentiated Access can be used to **meet the diverse needs of students**. Subgroups afford teachers the flexibility to organise students based on their interests, readiness, or learning profiles. By offering differentiated access for each Subgroup, students **stay focused and motivated on their assigned tasks**, helping them **review learning and co-construct ideas**.
- Team Activities and Google Meet links enable **meaningful peer interactions and enhance collaboration** among students, seamlessly integrating synchronous and asynchronous learning, facilitating learning together.
- The ITT allows students to document their learning, **make their thinking visible** and comment on their peers' responses. It also allows students to collaborate with one another.
- Populating axes and tables helps students to **organise and represent their data**.
- Providing students with immediate and personalised feedback using the ShortAnsFA can also **shorten the feedback loop**, enabling students to quickly identify mistakes, strengthen understanding and apply the concepts to scientific investigations.

Investigating (W1 - W4)

How can I support my students in **developing self-regulation in practical lessons**?



Teachers can use SLS functions to **promote student autonomy**, developing self-regulated learning in practical lessons. Teachers can first add Split-page Media (Fig. 2.1) to **break down practical demonstrations into images or bite-sized videos** distributed across paginated activities (Fig. 2.2). Transcript for videos (Fig. 2.3) can be generated to assist students in following practical demonstrations more effectively. This approach **supports inclusivity and accessibility**, allowing students to reinforce learning with written text, benefiting diverse learners. To **scaffold learning**, teachers can add videos or images alongside text or SLS components using 2-Column Display (Fig. 2.4). Teachers can provide further scaffolds by inserting Tooltips or placing optional hints in the Accordion Display.

Teachers can add Multiple-Choice Questions (MCQ) to encourage students to **self-assess their learning progress** (e.g., using success criteria or "Traffic Light" system). These questions can be set such that they do not require correct answers, as they are intended to gather students' sentiments. This allows teachers to gauge their students' level of confidence (Fig. 2.5).

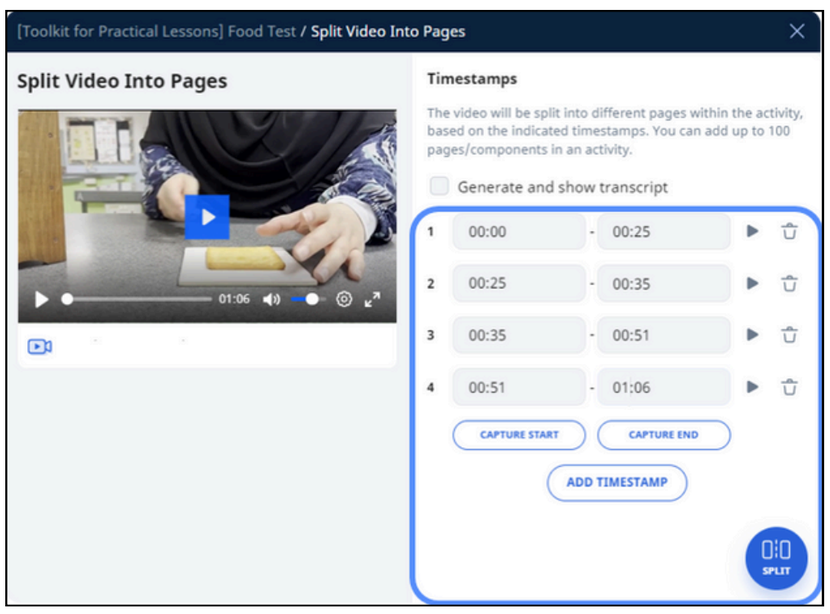


Fig. 2.1

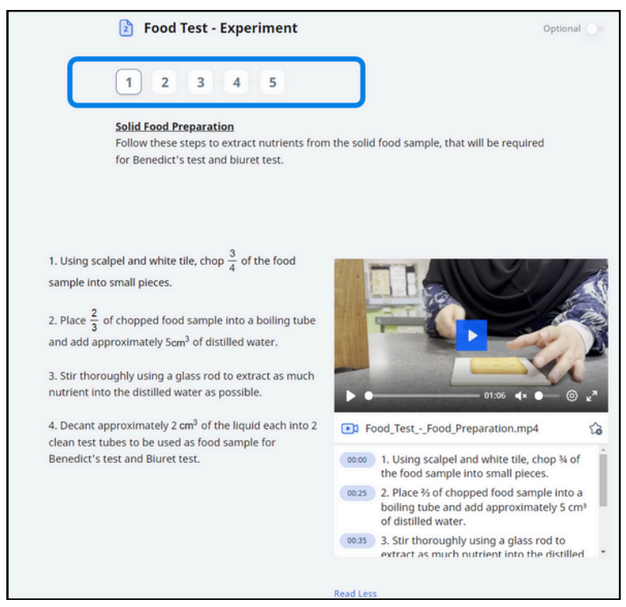


Fig. 2.2

Alternatives

The SLS module can be assigned as a pre-lesson activity to familiarise students with the practical tasks and as a post-lesson activity for reviewing and revising the tasks.

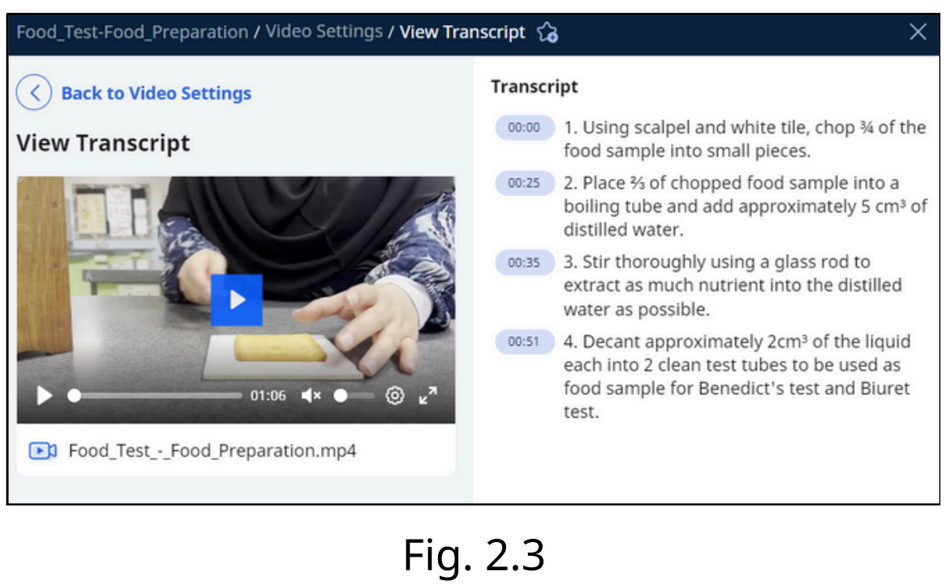


Fig. 2.3

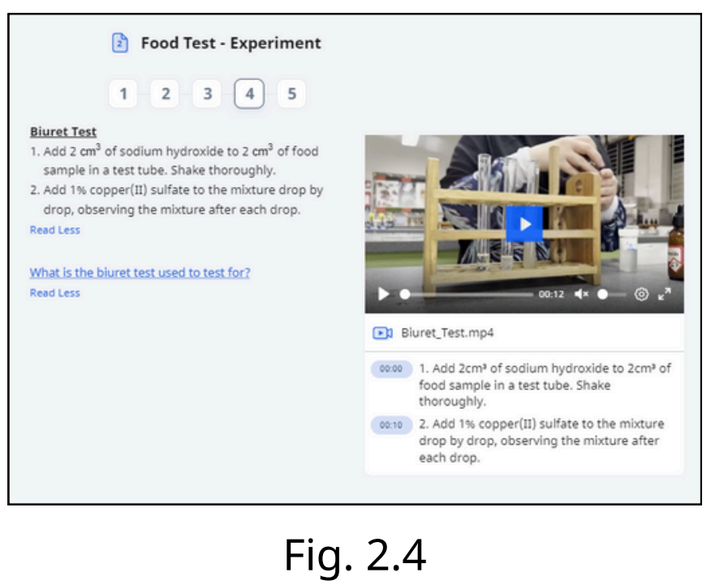


Fig. 2.4

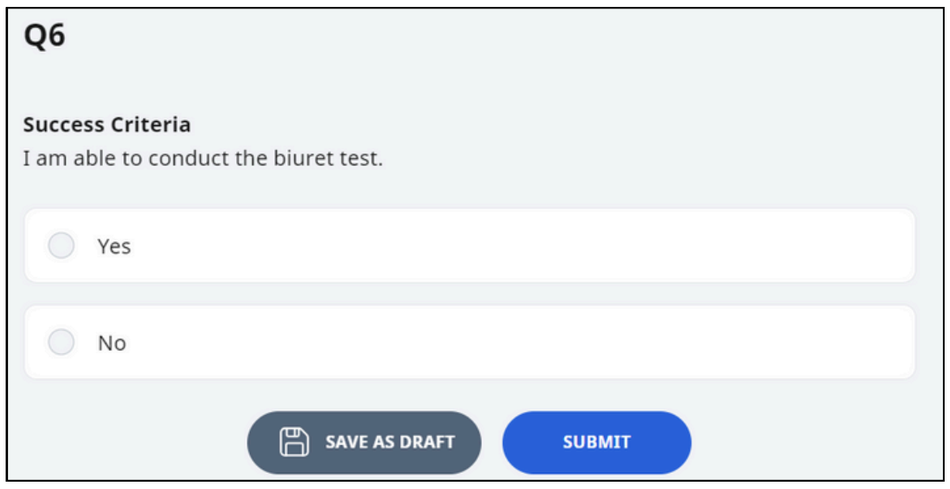


Fig. 2.5

Click on the pictures for a larger view.

Investigating (W1 - W4)

Bite-sized, replayable videos provide visual references that help students **follow instructions more easily** and **maintain engagement during tasks**. Students can Add Notes to Video at specific timestamps (Fig. 2.6) to either ask a question or add notes for future reference. These annotations can then be viewed and commented on by teachers. These resources allow students to **learn at their own pace** and revisit demonstrations as needed.

Students can be encouraged to cultivate active thinking with step-specific questions within the experimental procedure. Students can **access additional information or guidance** by hovering over the Tooltip to better understand the purpose behind each practical step. Additional hints using Accordion Display (Fig. 2.7) **facilitate self-regulated learning** and help familiarise students with the experimental task. Students can keep a record of key experimental observations by Uploading Media (Fig. 2.8), which supports them in their review of the experimental tasks and results during and after the practical lesson. In addition, students can refer to the images of expected visual observations via suggested answers (Fig. 2.9) to **self-monitor, provide assurance, and guide corrective actions** during the practical lesson.

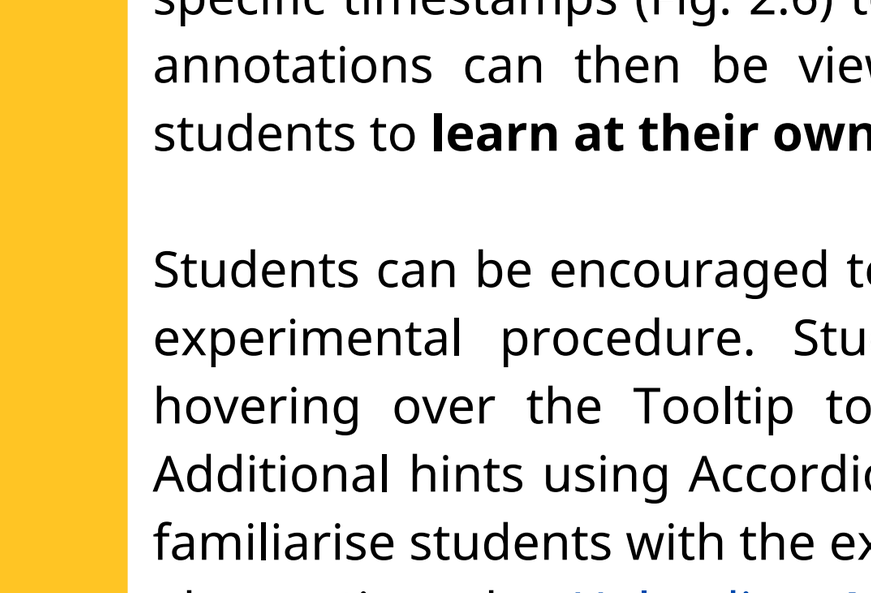


Fig. 2.6

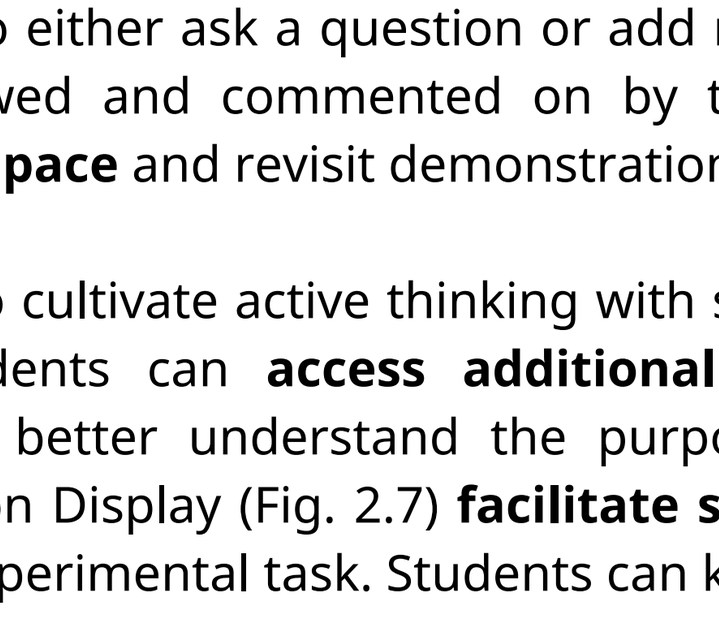


Fig. 2.7

Additional tips on the use of SLS to support students in practical lessons

Want to learn about other strategies to help students develop self-regulation skills for practical work?

To explore resources and sample lessons in the Community Gallery, click here for Chemistry resources and here for Biology resources.

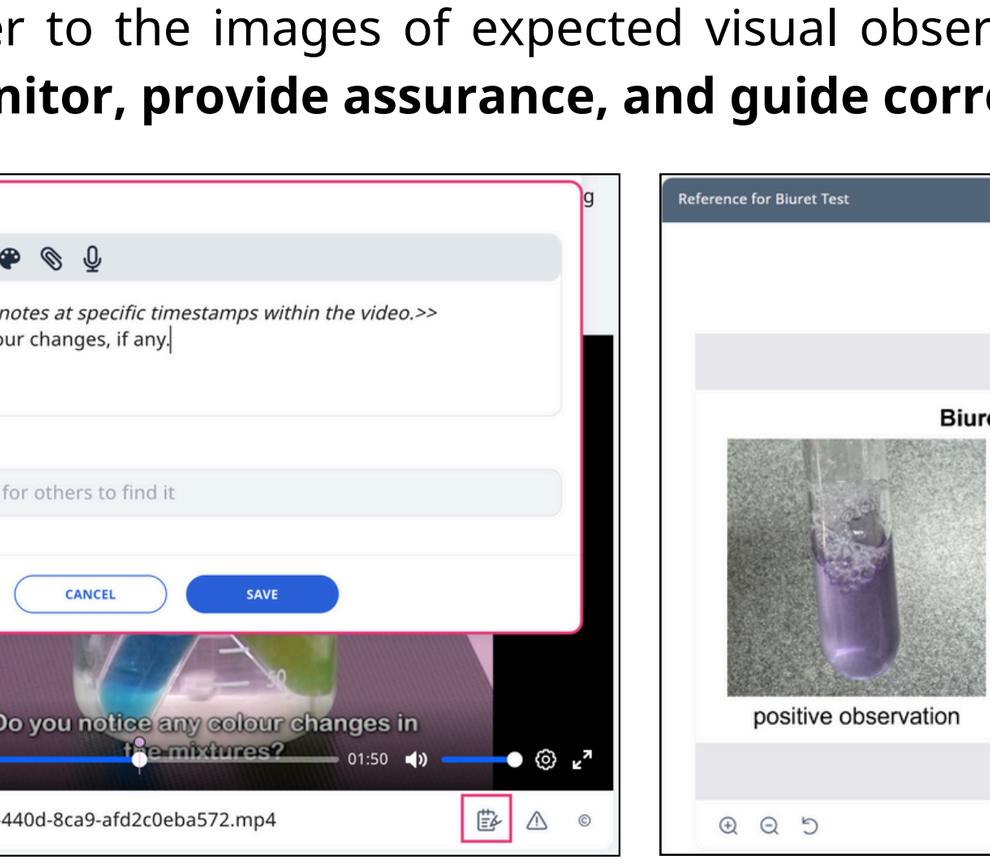


Fig. 2.8



Fig. 2.9

Click on the pictures for a larger view.

PEDAGOGICAL AFFORDANCES:

- Splitting practical demonstration videos into bite-sized snippets can help students **follow instructions better** and **enhance engagement** by providing timely guidance as they perform tasks. Encouraging students to add notes to videos helps them **monitor their own learning**.
- The 2-Column Display **presents complementary content simultaneously**, allowing students to see the videos and instructions side-by-side, which **provides greater clarity** to students as they carry out their tasks.

Evaluating and Reasoning (W5 - W6)



How can I help my students **effectively communicate their ideas**, **substantiate their arguments with evidence**, and evaluate their peers' explanations, so as to **provide constructive feedback**?

Teachers can start the lesson using a Poll to **activate students' prior knowledge** followed by an Interactive Thinking Tool (ITT) with pre-populated prompts to guide students in **substantiating their claim with evidence and reasoning** (Fig. 3.1).

A Video can be included to help students observe a chemical reaction at the macroscopic level, and a Multiple-Choice Question (MCQ) can be added to assess their understanding (Fig. 3.2).

Students express their choice in the Poll and articulate their reasoning supported with evidence in the ITT. This helps to **facilitate idea exchange among peers** and develop a deeper understanding of the topic.

Students can replay the videos as needed before responding to the MCQ, which then **offers them instantaneous automated feedback**.

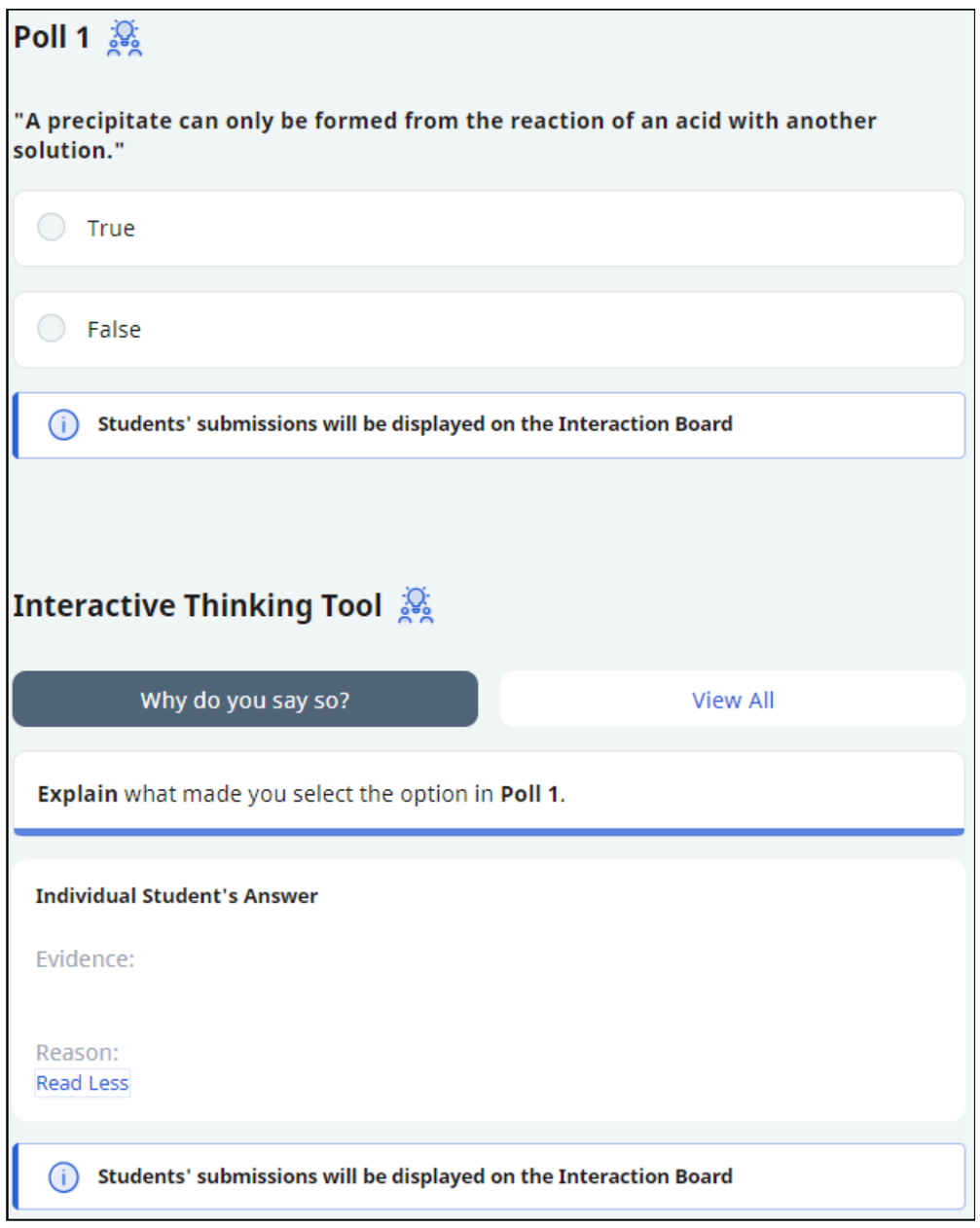


Fig. 3.1

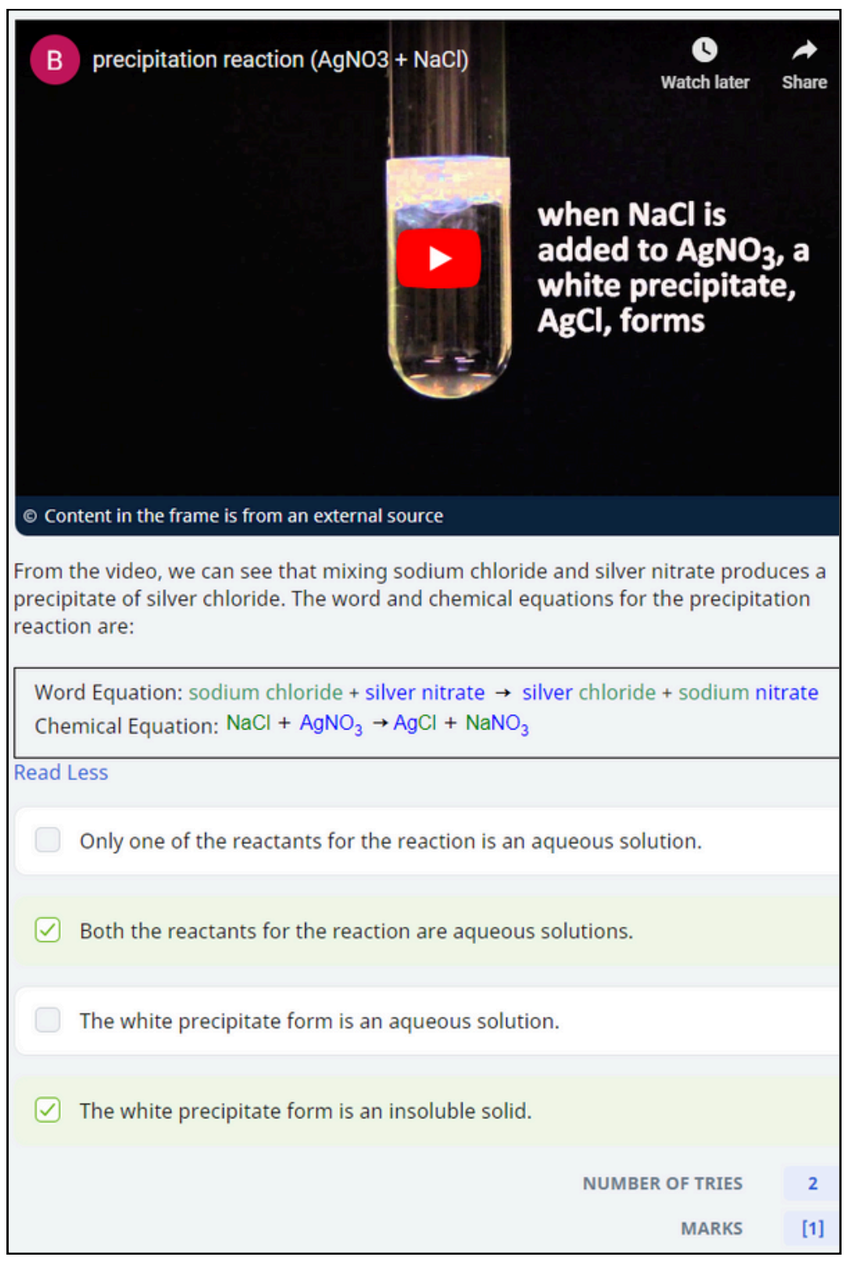


Fig. 3.2

Click on the pictures for a larger view.

Evaluating and Reasoning (W5 - W6)

A simulation can be embedded in SLS to enable students to visualise the interactions at the sub-microscopic level during a chemical reaction (Fig. 3.3). This representation of abstract concept helps students to refine their own understanding.

To help students **think more critically**, teachers can include a table within the pre-populated response in a Free-Response Question (FRQ) to structure students' reflections and guide them to describe/record their observations, translating what they see at the sub-microscopic level into symbolic representation (Fig. 3.4).

Teachers and students can use symbols and conventions to create chemical notations and write chemical equations to **communicate their ideas, solutions and justification** using ChemType (Fig. 3.5). ChemType supports handwritten input which are auto-translated to computer notations.

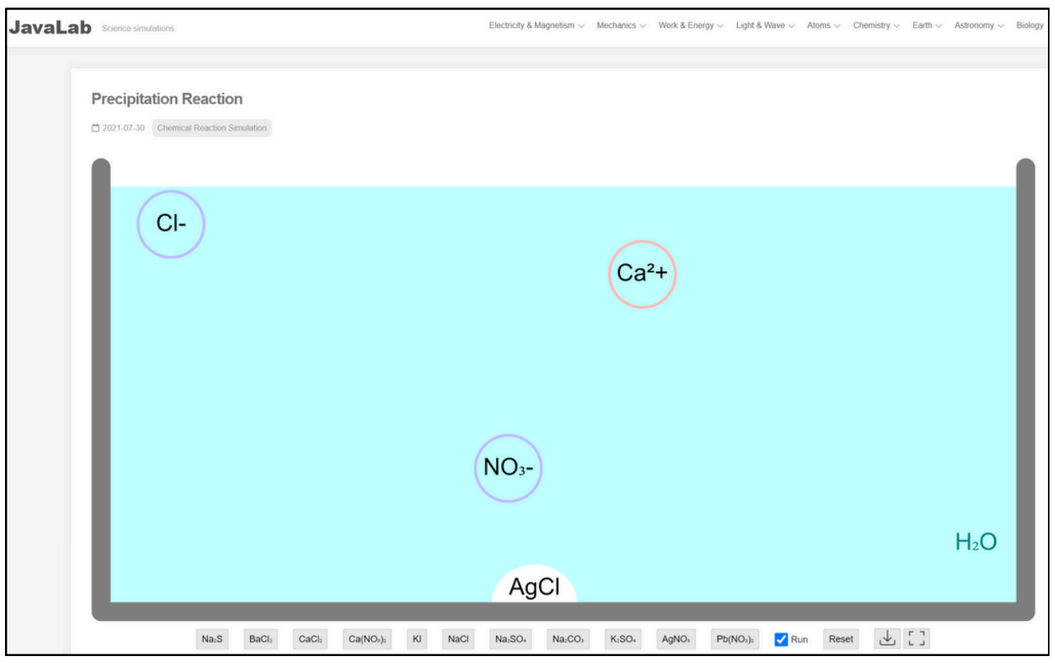
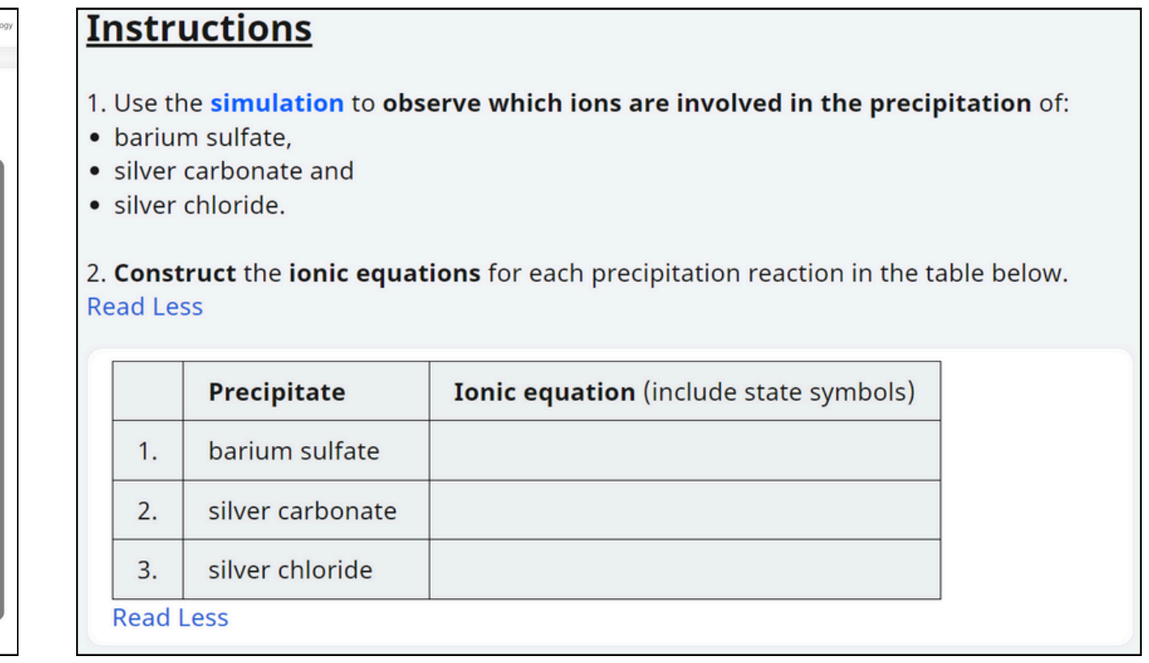


Fig. 3.3



Instructions

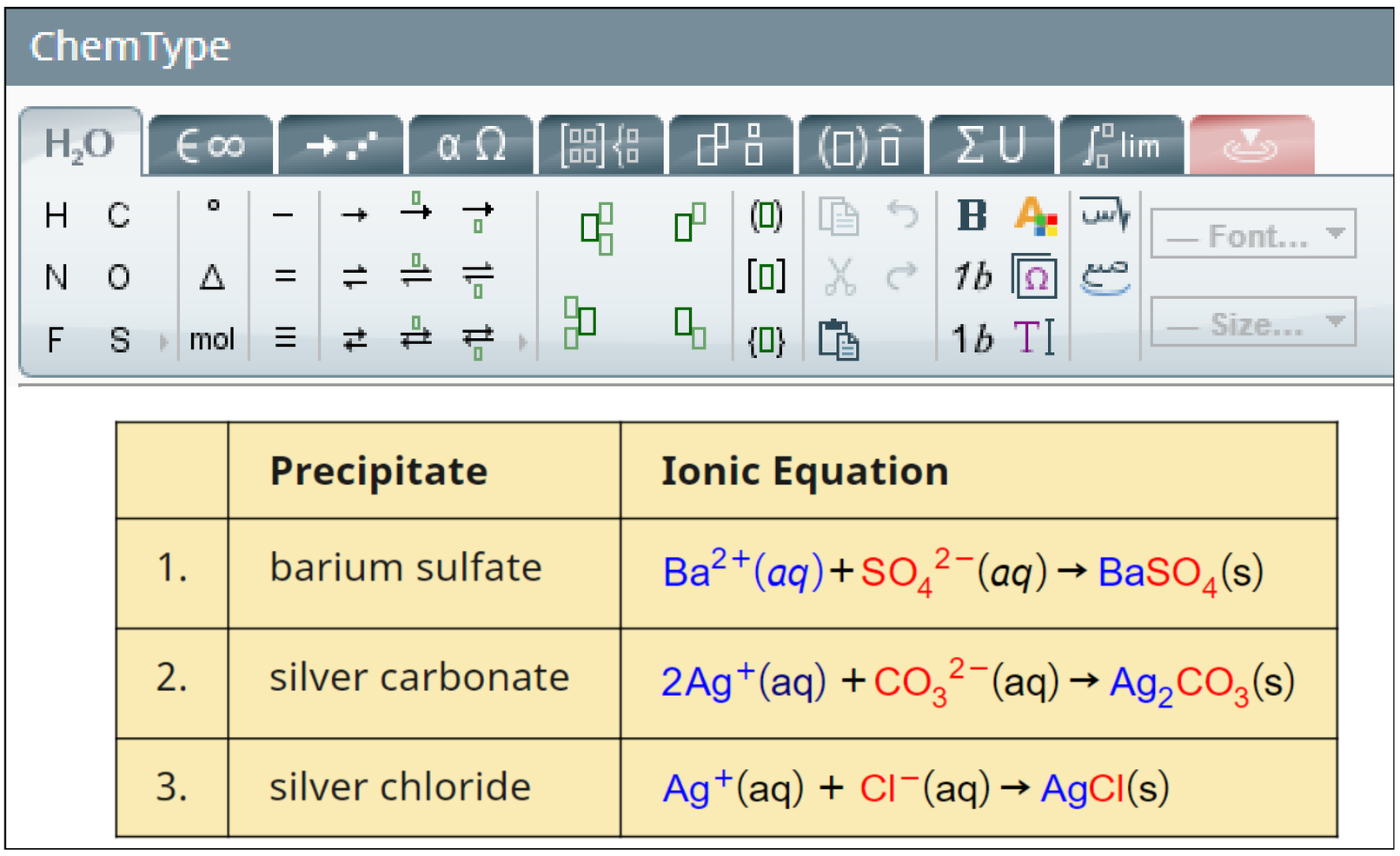
1. Use the **simulation** to **observe which ions are involved in the precipitation** of:
- barium sulfate,
- silver carbonate and
- silver chloride.

2. **Construct** the **ionic equations** for each precipitation reaction in the table below.
Read Less

	Precipitate	**Ionic equation** (include state symbols)
1.	barium sulfate	
2.	silver carbonate	
3.	silver chloride	

Read Less

Fig. 3.4



	Precipitate	Ionic Equation
1.	barium sulfate	$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$
2.	silver carbonate	$2Ag^{+}(aq) + CO_3^{2-}(aq) \rightarrow Ag_2CO_3(s)$
3.	silver chloride	$Ag^{+}(aq) + Cl^{-}(aq) \rightarrow AgCl(s)$

Fig. 3.5

Click on the pictures for a larger view.

Evaluating and Reasoning (W5 - W6)

Using a 2-Column ITT with pre-populated prompts (Fig. 3.6a), students record their explanations and substantiate them with evidence (Fig. 3.6b). Teachers can **guide students in providing constructive peer feedback** (e.g., sentence starters), which can in turn help students refine their explanations (Fig. 3.6c).

Students have a choice to type, draw or upload images/videos to **articulate their ideas, understanding and explanations** (Fig. 3.7) when responding to the ITT. They can review their peers' explanations and provide Comments. This enables students to refine their knowledge, drawing on scientific concepts and evidence to evaluate their claims (Fig. 3.8). By collectively improving their ideas through respectful discussions, students synthesise these ideas and learn together.

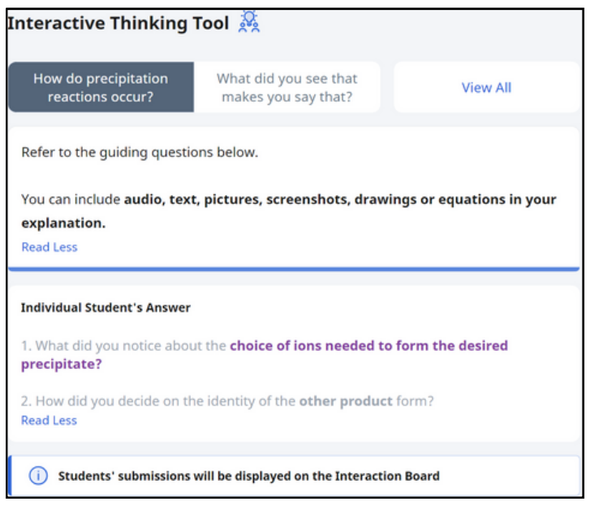


Fig. 3.6a

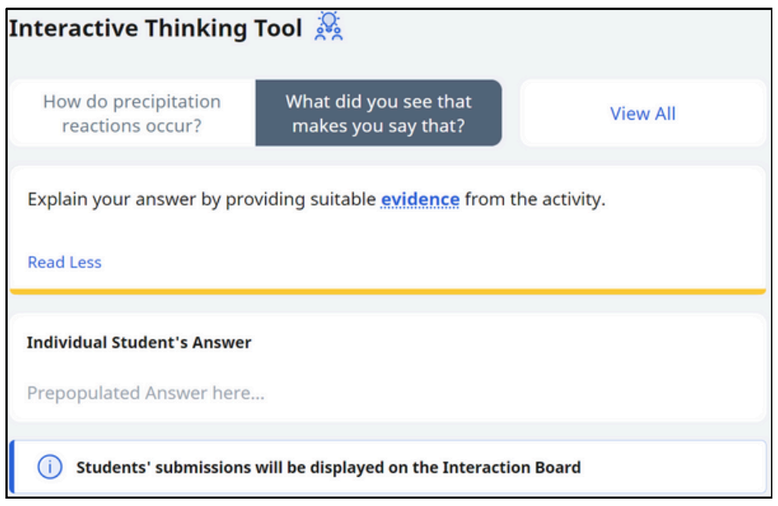


Fig. 3.6b

Alternatives

Using Forum and Discussion promotes the sharing and exchange of perspectives.

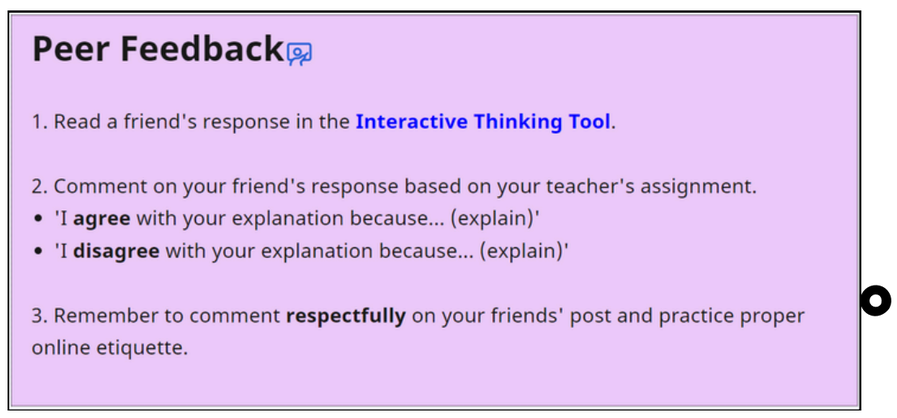


Fig. 3.6c

DI by Product

Do you know
apart from text responses, students can express their views in different modes, e.g., Drawings, Uploading files or even Audio recording?

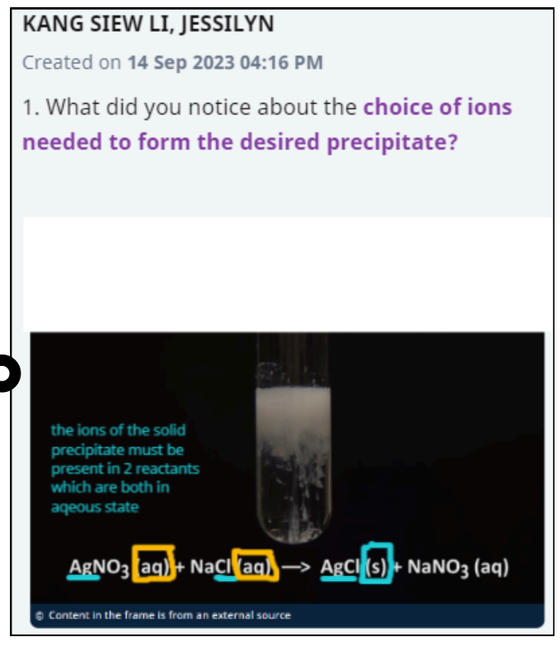


Fig. 3.7

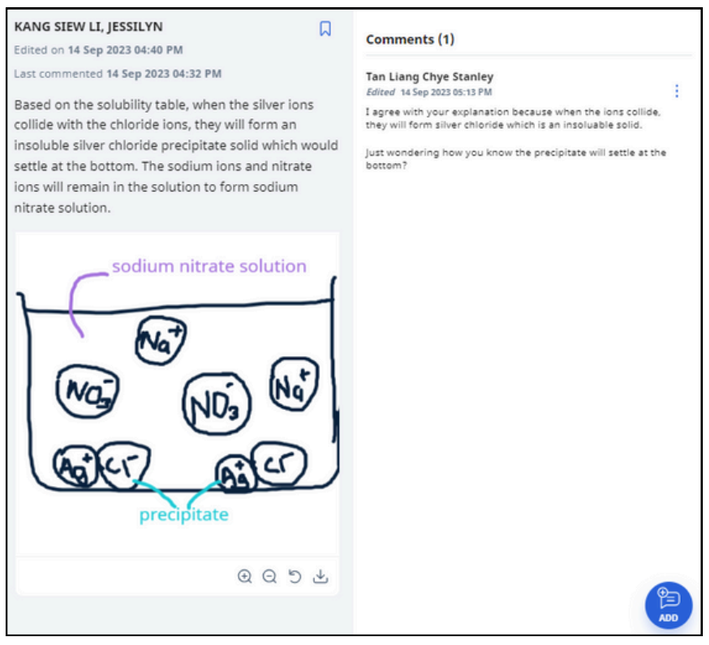


Fig. 3.8

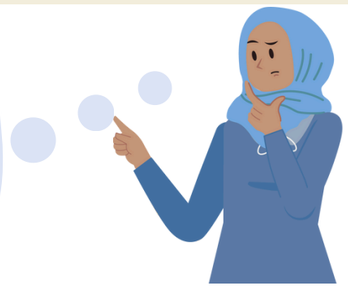
Click on the pictures for a larger view.

PEDAGOGICAL AFFORDANCES:

- Integrating various forms of media, such as images, videos, and interactive elements enhances the learning materials. Each mode/representation highlights different aspects of a concept, **bringing clarity** to the student.
- Using tools like ChemType to input chemical notations, allows students to **express their observations more precisely and with the appropriate representation**.
- Allowing students to choose their preferred mode to express their ideas and reasoning within scientific contexts is an important process to **enable them to take ownership of their learning** and to **communicate effectively**.

Evaluating and Reasoning (W5 - W6)

How can I support my students in **mathematical reasoning** in science, enabling them to **provide arguments that are well-substantiated**?



Teachers can Add Multi-Part Questions (Fig. 4.1) to guide students to substantiate their arguments with clear justification using mathematical calculations. Feedback Assistant - Mathematics (FA-Math) can be added to the Free-Response Question (FRQ) (Fig. 4.2) to provide automated line-by-line feedback, and teachers can customise hints and feedback to **offer varying degrees of scaffolding** for students. This approach ensures that students demonstrate their understanding through step-by-step problem-solving before moving on to evaluate and reason their conclusions.

FA-Math can **generate randomised questions** based on the same stem, exposing students to a variety of questions on the same concept. Teachers can leverage a wide variety of Mathematical question types within FA-Math. For example, questions involving graphs (Fig. 4.3) enable students to communicate their reasoning visually, which is particularly effective for explaining specific science concepts. Through **reviewing the errors made by the students**, teachers can identify misconceptions that students may have and **provide targeted feedback** to help them progress in their learning.

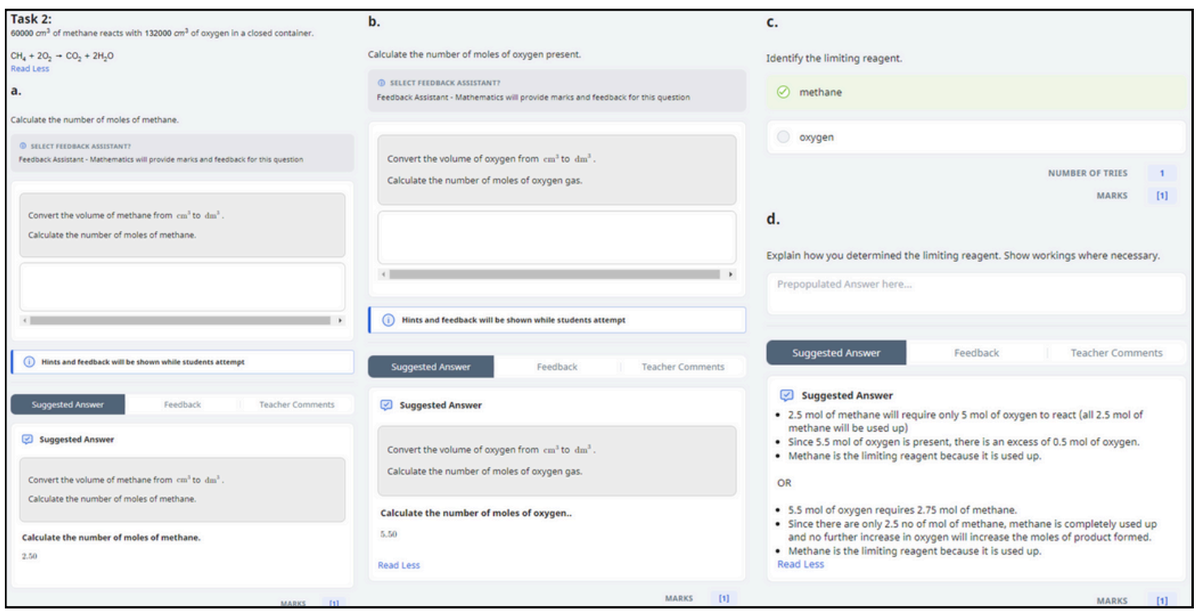
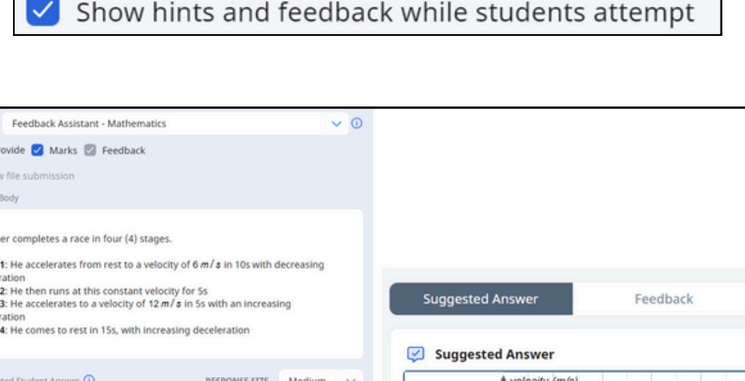


Fig. 4.1

DI by Process

Did you know that you can set FA-Math to provide immediate or delayed feedback based on students' answers by checking and unchecking this option?



Additional tips when setting science questions in FA-Math

You can break tasks into smaller parts and set accuracy or units as needed when setting up science questions in FA-Math.

You can learn more in this FA-Math resource link.

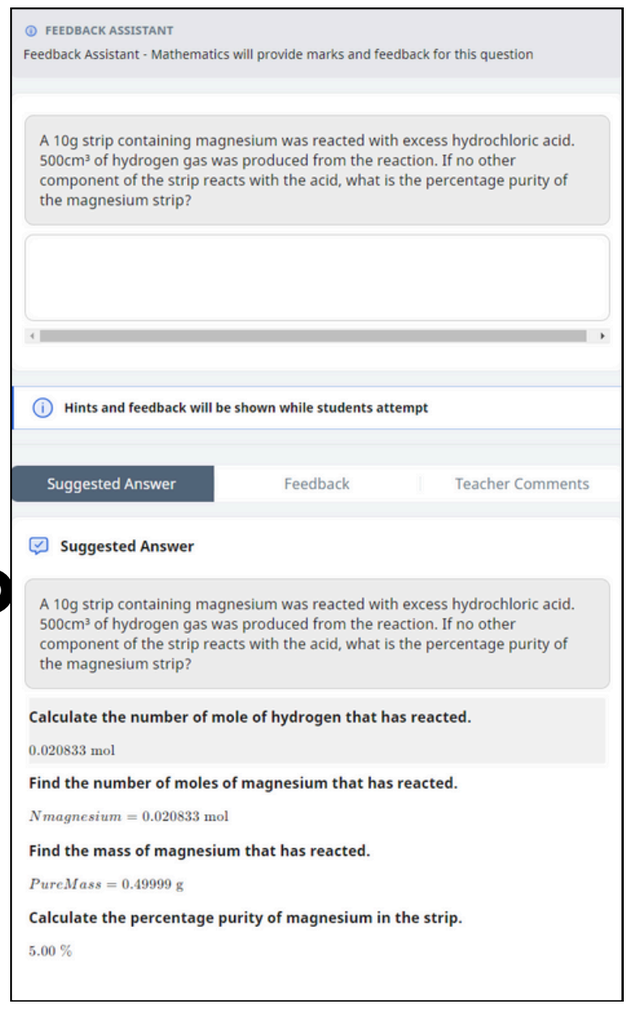


Fig. 4.2

Fig. 4.3

Click on the pictures for a larger view.

Evaluating and Reasoning (W5 - W6)

When facing difficulties, students can access the hints (Fig. 4.4) which will assist them in progressing through problems. FA-Math provides line-by-line feedback (Fig. 4.5), enabling students to **promptly correct mistakes and improve the accuracy in their answers**. Students can use the Handwriting function for diagrams and workings when solving science calculation questions for Multi-Step problems in FA-Math (Fig. 4.6 and Fig. 4.7). After solving the calculation questions, students can proceed to evaluate their results and **provide arguments that are well-substantiated by accurate calculations and clear reasoning** in the subsequent questions (Fig. 4.8).

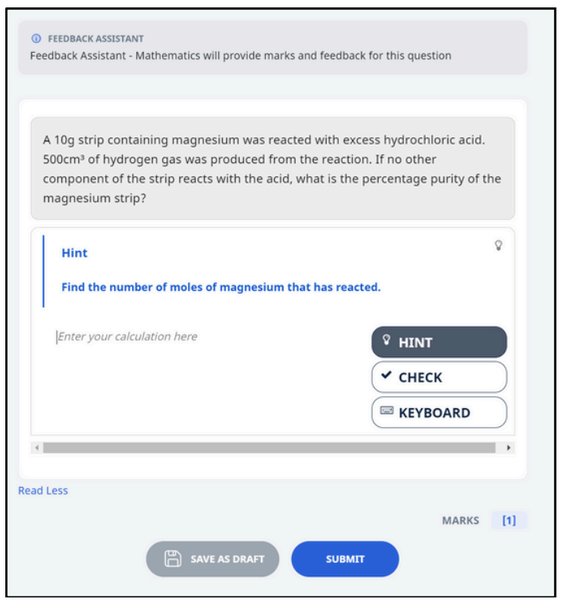


Fig. 4.4

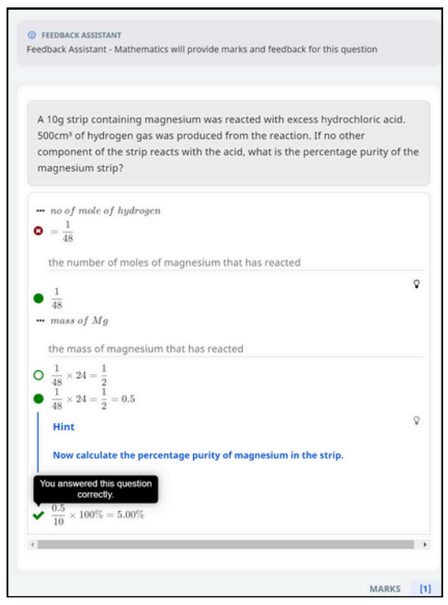


Fig. 4.5

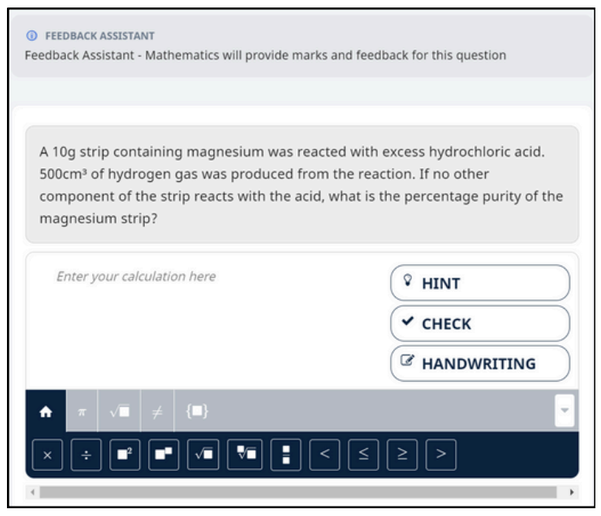


Fig. 4.6

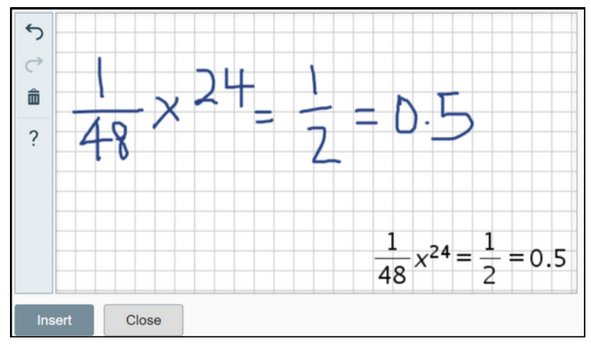


Fig. 4.7

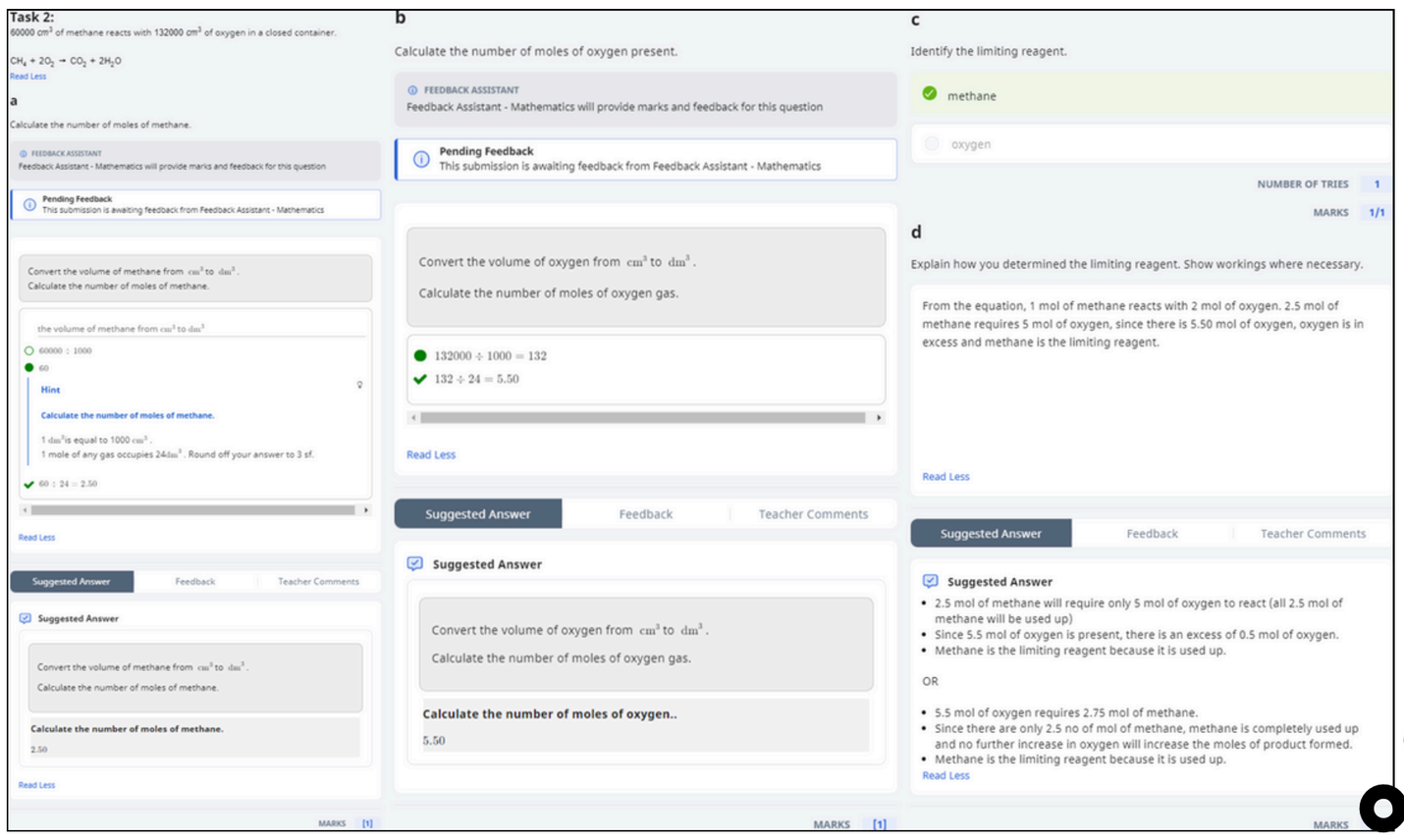


Fig. 4.8

Resources on SLS

You can click here to find this Chemistry module on mole concept that uses FA-Math, on the SLS Community Gallery (CG).

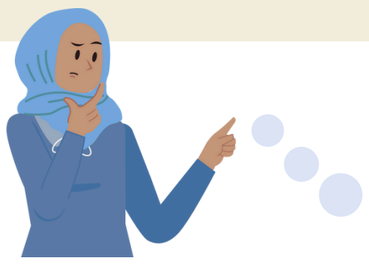
Did you know there are other Science modules available with FA-Math enabled in the CG? Click here to find out how to search for them effectively.

Click on the pictures for a larger view.

PEDAGOGICAL AFFORDANCES:

- FA-Math provides **immediate feedback**, **scaffolding students' understanding** during multi-step problem solving and ensuring they remain on the correct path as they progress through questions. This timely feedback enables students to **promptly address misconceptions or errors in their reasoning** and thus enhance their mathematical and scientific reasoning skills. In addition, this process fosters the **development of more reflective and independent learners**.

Developing Explanations and Solutions (W7 - W8)



How can I **use models** to help my students **describe and explain** natural phenomena?

Teachers can **spark curiosity** by embedding YouTube Videos of an interesting natural phenomenon (e.g., floating city video) and providing a scientific explanation for the occurrence.

By using the "See-Think-Wonder" template from the Interactive Thinking Tool (ITT) (Fig. 5.1), teachers can encourage students to **observe, interpret, and ask questions** about the phenomenon. Students' metacognitive skills are enhanced when they connect their observations with personal experiences and prior conceptions. By interpreting these connections and generating thoughtful questions, students develop deeper insights, allowing them to **generate well-supported explanations** for the natural phenomenon.

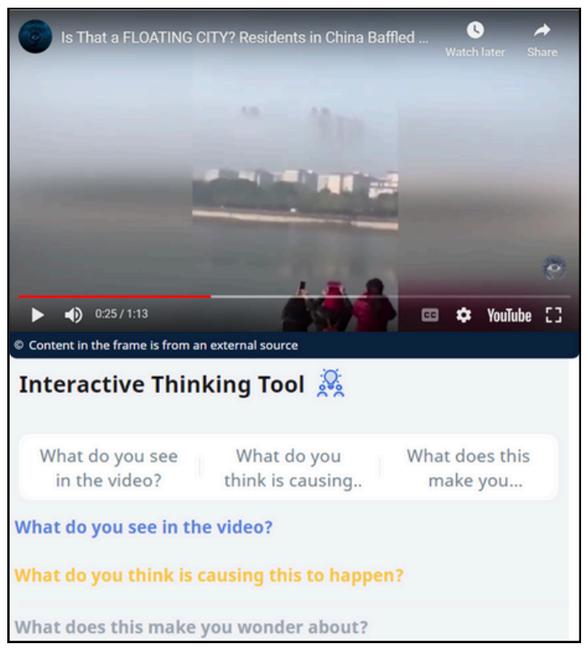


Fig. 5.1

Chunking - as a scaffold

Did you know that you can set the preferred start and end times for video playback? Visual chunking helps students understand and process information quickly and clearly.

Click on the picture for a larger view.

Teachers can Search for Resources and Star Resources from MOE Library or Community Gallery, Insert Media Objects like pictures and videos, or embed simulations from Whitelisted Websites. These resources, accompanied by guiding questions in the Accordion Displays (Fig. 5.2), can be used to teach students about models (e.g., the Ray Model of Light).

Using the Accordion Display feature (Fig. 5.3), students can view the ray model information one section at a time, preventing them from feeling overwhelmed and aiding concentration.

Accordions Display feature

The Accordion Display can be used to present key concepts, helping students focus and reducing cognitive load.

Did you know that the MOE Library offers many useful simulations and interactive tools that you can use when designing your lessons?

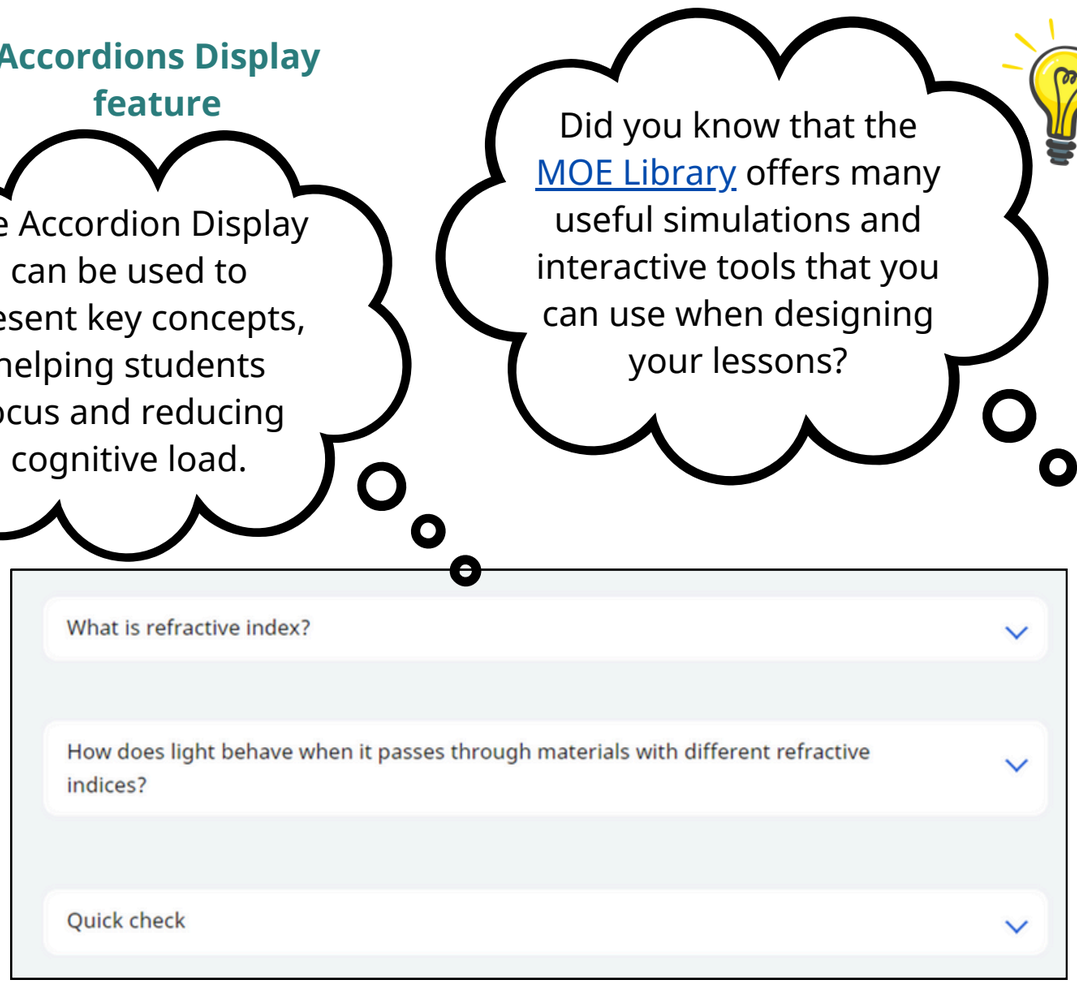


Fig. 5.2

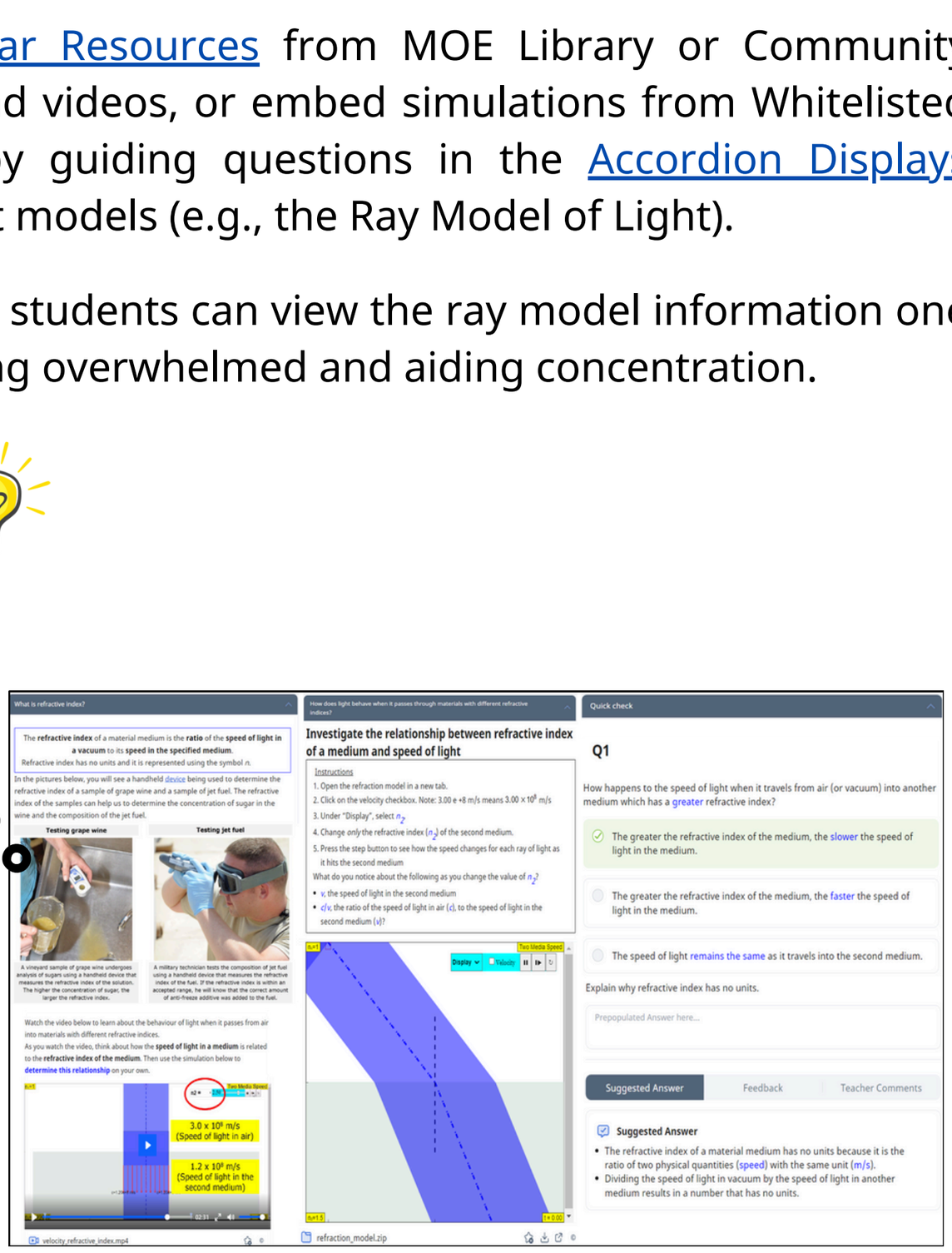


Fig. 5.3

Click on the pictures for a larger view.

Developing Explanations and Solutions (W7 - W8)

Teachers can use the ITT to **engage students collaboratively** to formulate an explanation for the observed phenomena (Fig. 5.4). Answering frames (e.g., "Premise-Reasoning-Outcome, P-R-O" frame) can be included to **help students formulate their explanation** (Fig. 5.5).

Students can **negotiate diverse ideas and refine their understanding** as they work towards a collective understanding.

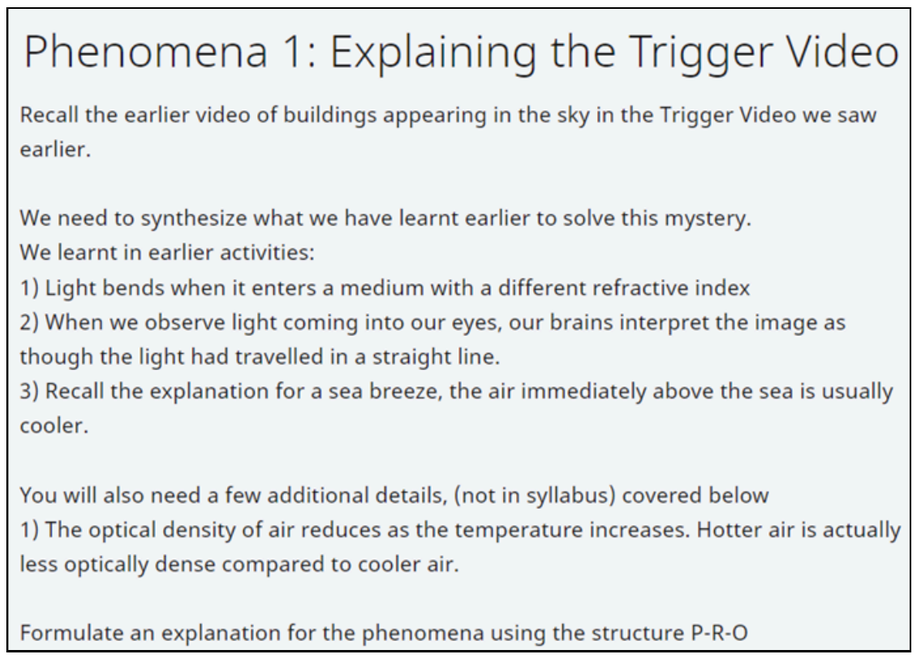


Fig. 5.4

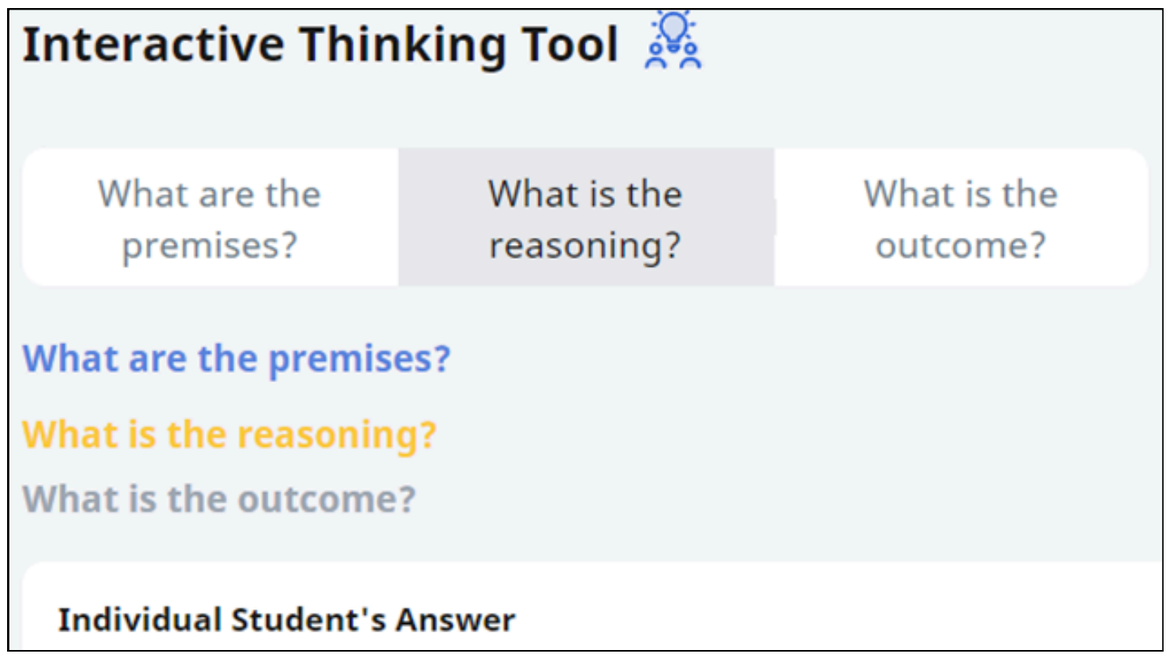


Fig. 5.5

Click on the pictures for a larger view.

Teachers can introduce another scientific phenomenon (e.g., a mirage on the road) for students to **apply their understanding** of the model to explain this phenomenon. This can be done using Free-Response Questions (FRQ) (Fig. 5.6) with minimal scaffolds provided.

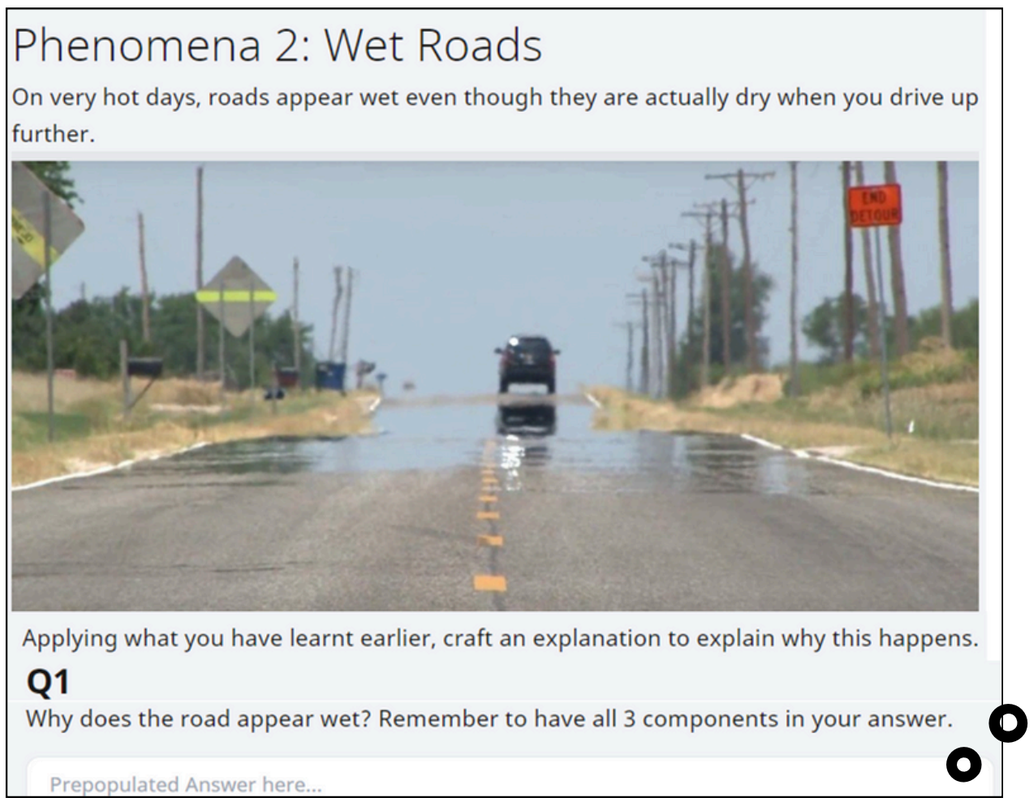


Fig. 5.6

Additional tips when using Free-Response Questions

Did you know that for Free-Response Questions, you can include the recommended time and response size best suited for the question?

Click on the picture for a larger view.

PEDAGOGICAL AFFORDANCES:

- Technologies such as video can engage students by providing **visual and dynamic representations** of scientific phenomena **making abstract ideas more concrete and cohesive**.
- Teachers have access to a wide variety of resources in SLS including videos, simulations, interactive models, and explanatory texts that can **meet various learning needs**.
- Technology enables students to **visualise scientific models** through simulations, **increasing their understanding of the concept**.

Developing Explanations and Solutions (W7 - W8)

How can I help my students apply metacognitive principles—awareness, monitoring, and evaluation—to **enhance their critical thinking** when **developing explanations and solutions** for scientific issues?



Teachers can effectively use the Short Answer Feedback Assistant (ShortAnsFA) with rubrics to guide students in developing critical thinking skills. Populating ShortAnsFA with criteria and band descriptors (Fig. 6.1) enables it to **gauge students' levels of proficiency** and **provide meaningful feedback** to support students in progressing along levels of achievements.

After students submit their responses, ShortAnsFA evaluates them based on the rubrics, providing targeted feedback that **raises students' awareness** by outlining what their responses include and/or lack, helping them understand key strengths and/or gaps in their answers. This also **supports students in monitoring** by providing suggestions to extend their explanations and encouraging them to analyse and deepen their thinking.

Teachers can also leverage the Data Assistant (DAT) to analyse student responses by identifying patterns to group students by their proficiency in meeting rubric criteria (Fig. 6.2). Teachers can **provide more personalised comments** to address specific needs, such as constructing evidence-based explanations. This approach ensures feedback is actionable, **helping students refine their critical thinking and problem-solving skills** in scientific contexts.

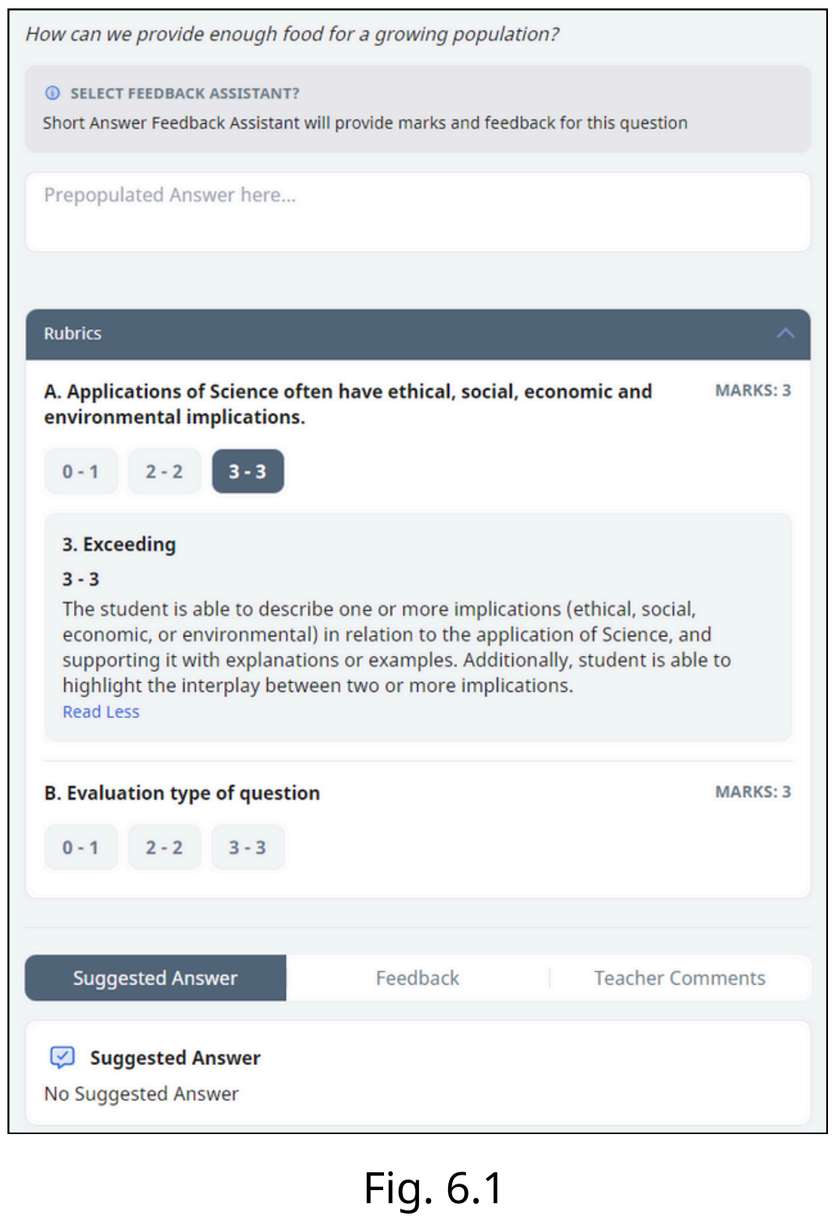


Fig. 6.1

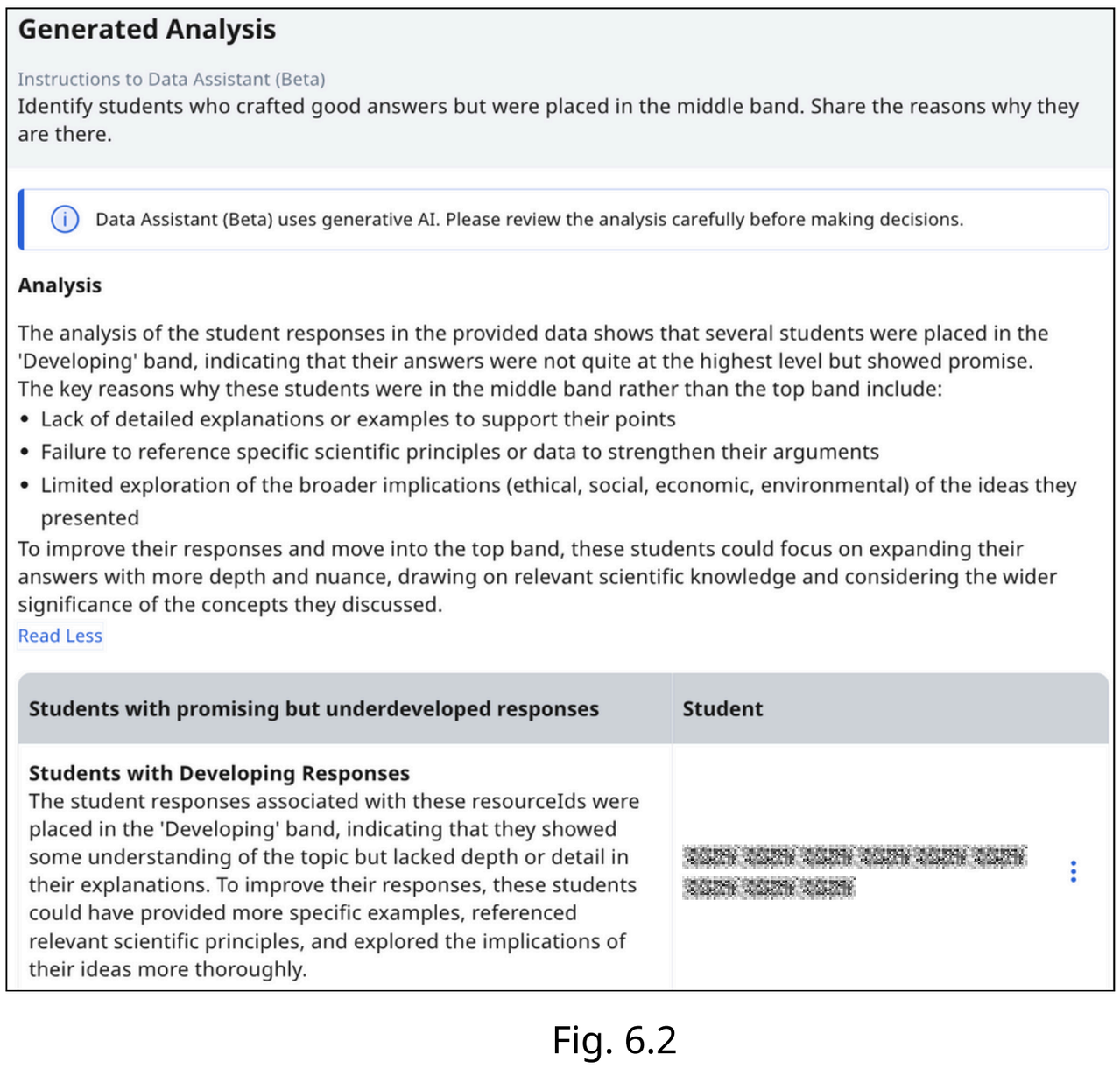


Fig. 6.2

Click on the pictures for a larger view.

Resources on SLS

You can click here to find this module on Using SLS to develop Critical Thinking through Issues in Science (Sec) [Toolkit for CAIT]).

Developing Explanations and Solutions (W7 - W8)

Subsequently, teachers can prompt students to **evaluate their responses based on the feedback.** This encourages them to reflect on and assess the quality of their reasoning before submitting refined responses in a separate Free-Response Question (FRQ) (Fig. 6.3). Teachers can choose to hide the rubrics in this FRQ to **draw students' attention to understand, then act on the feedback** provided in their previous attempt.

Teachers can include a metacognitive reflection question (Fig. 6.4) to help students **be more aware of their gaps in learning**, and help teachers track and evaluate their learning.

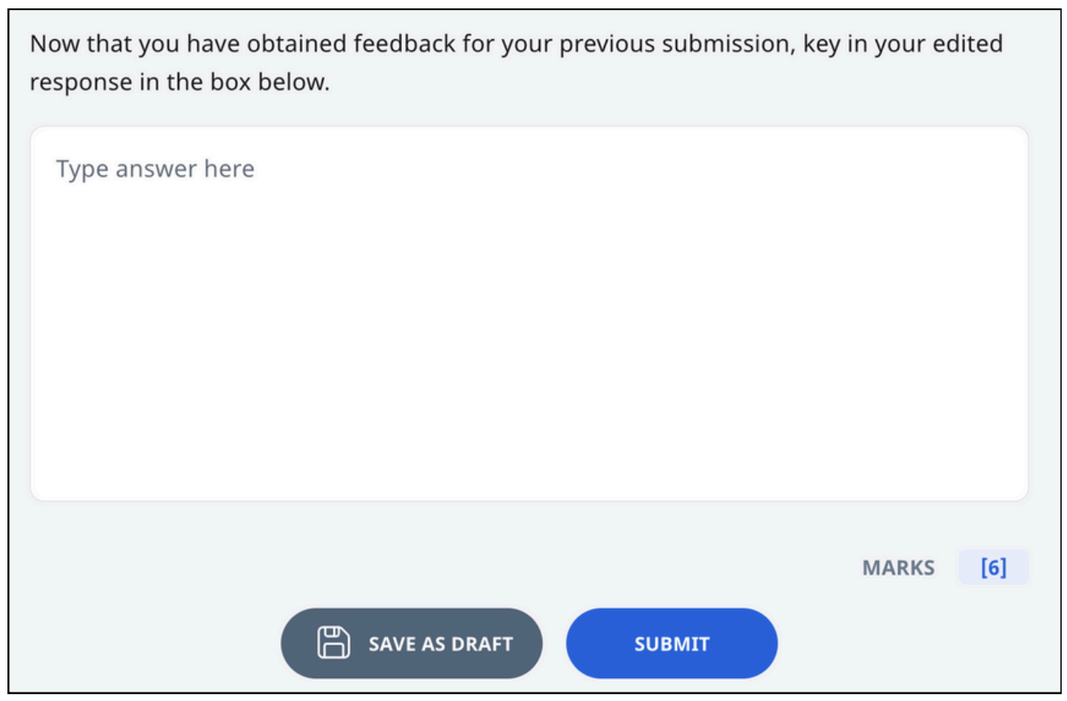


Fig. 6.3

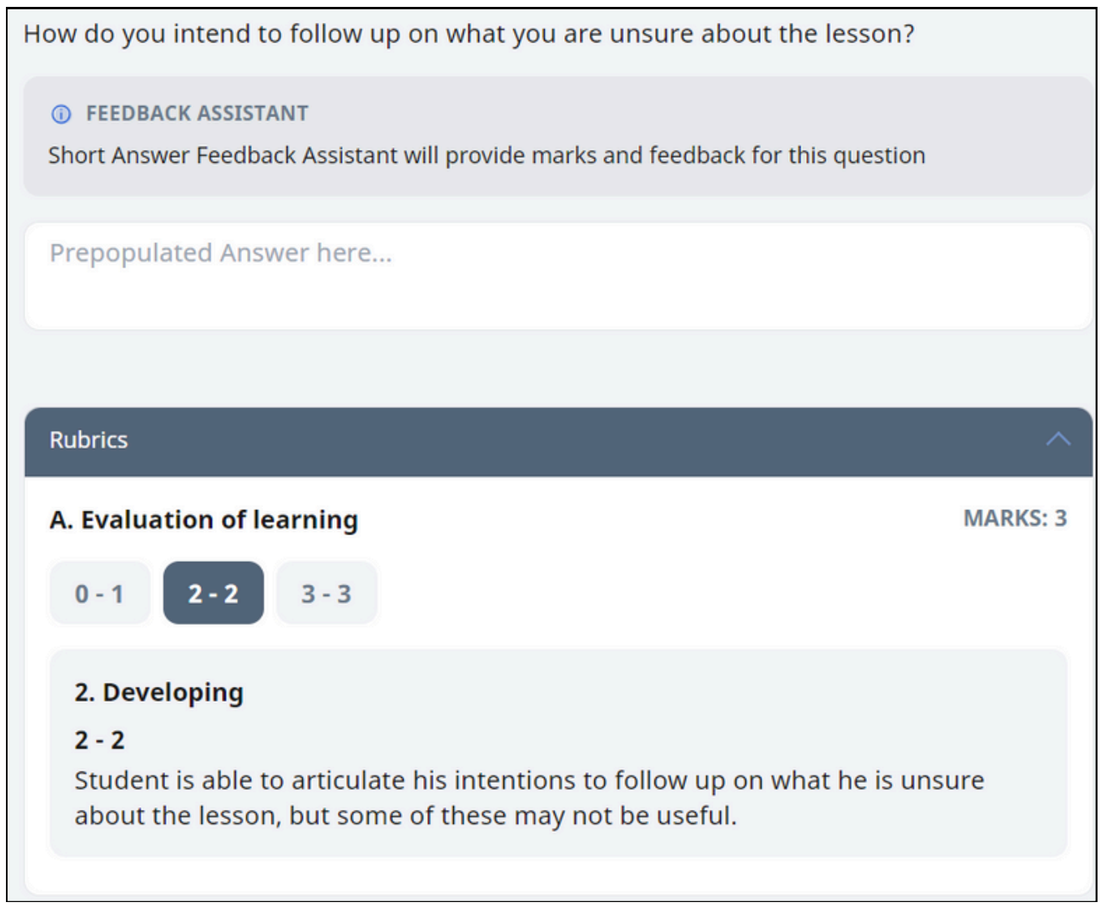
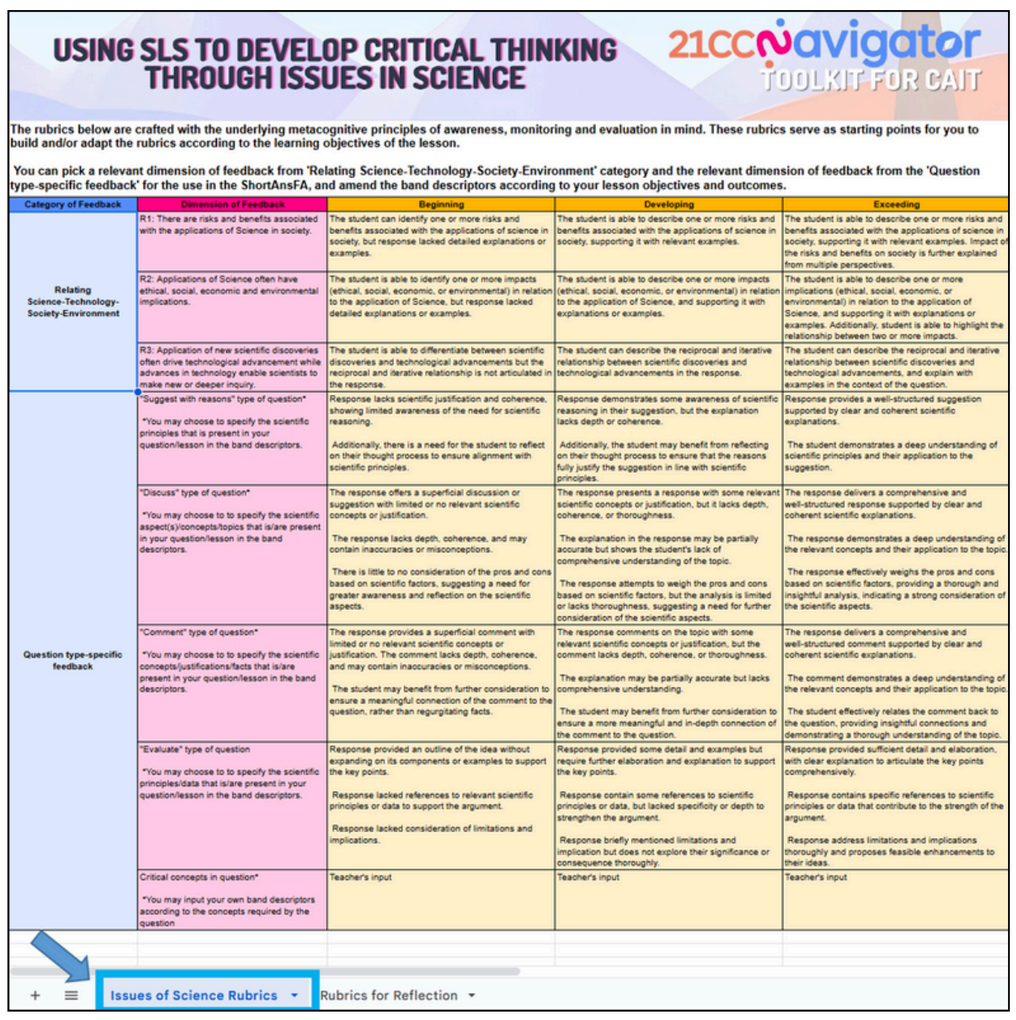


Fig. 6.4

Resource for rubrics template

Did you know there are rubrics aligned to learning goals and developmental milestone for emerging 21CC that can serve as starting points for you to build and/or adapt according to the learning objectives of the lesson?

Sample rubrics are provided to develop critical thinking through **issues in science**. The feedback categories include Relating Science-Technology-Society-Environment, Question-type-specific Feedback, and Metacognition for Reflection.



USING SLS TO DEVELOP CRITICAL THINKING THROUGH ISSUES IN SCIENCE — 21CCnavigator TOOLKIT FOR CAIT

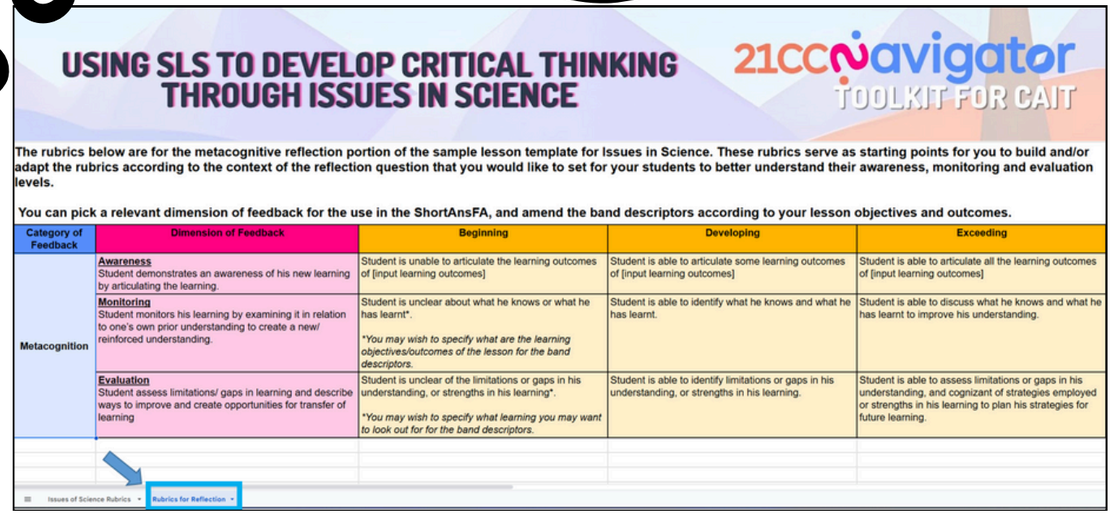
The rubrics below are crafted with the underlying metacognitive principles of awareness, monitoring and evaluation in mind. These rubrics serve as starting points for you to build and/or adapt the rubrics according to the learning objectives of the lesson.

You can pick a relevant dimension of feedback from 'Relating Science-Technology-Society-Environment' category and the relevant dimension of feedback from the 'Question type-specific feedback' for the use in the ShortAnsFA, and amend the band descriptors according to your lesson objectives and outcomes.

Category of Feedback	Dimension of Feedback	Beginning	Developing	Exceeding
Relating Science-Technology-Society-Environment	R1: There are risks and benefits associated with the applications of Science in society.	The student can identify one or more risks and benefits associated with the applications of science in society, but response lacked detailed explanations or examples.	The student is able to describe one or more risks and benefits associated with the applications of science in society, supporting it with relevant examples.	The student is able to describe one or more risks and benefits associated with the applications of science in society, supporting it with relevant examples. Impact of the risks and benefits on society is further explained from multiple perspectives.
	R2: Applications of Science often have ethical, social, economic and environmental implications.	The student is able to identify one or more impacts (ethical, social, economic, or environmental) in relation to the application of Science, but response lacked detailed explanations or examples.	The student is able to describe one or more impacts (ethical, social, economic, or environmental) in relation to the application of Science, and supporting it with explanations or examples.	The student is able to describe one or more implications (ethical, social, economic, or environmental) in relation to the application of Science, and supporting it with explanations or examples. Additionally, student is able to highlight the relationship between two or more impacts.
	R3: Application of new scientific discoveries often drive technological advancement while advances in technology enable scientists to make new or deeper inquiry.	The student is able to differentiate between scientific discoveries and technological advancements but the reciprocal and iterative relationship is not articulated in the response.	The student can describe the reciprocal and iterative relationship between scientific discoveries and technological advancements in the response.	The student can describe the reciprocal and iterative relationship between scientific discoveries and technological advancements, and explain with examples in the context of the question.
Question type-specific feedback	"Suggest with reasons" type of question* *You may choose to specify the scientific principles that is present in your question/lesson in the band descriptors.	Response lacks scientific justification and coherence, showing limited awareness of the need for scientific reasoning. Additionally, there is a need for the student to reflect on their thought process to ensure alignment with scientific principles.	Response demonstrates some awareness of scientific reasoning in their suggestion, but the explanation lacks depth or coherence. Additionally, the student may benefit from reflecting on their thought process to ensure that the reasons fully justify the suggestion in line with scientific principles.	Response provides a well-structured suggestion supported by clear and coherent scientific explanations. The student demonstrates a deep understanding of scientific principles and their application to the suggestion.
	"Discuss" type of question* *You may choose to to specify the scientific aspect(s)/concepts/topics that is/are present in your question/lesson in the band descriptors.	The response offers a superficial discussion or suggestion with limited or no relevant scientific concepts or justification. The response lacks depth, coherence, and may contain inaccuracies or misconceptions. There is little to no consideration of the pros and cons based on scientific factors, suggesting a need for greater awareness and reflection on the scientific aspects.	The response presents a response with some relevant scientific concepts or justification, but it lacks depth, coherence, or thoroughness. The explanation in the response may be partially accurate but shows the student's lack of comprehensive understanding of the topic. The response attempts to weigh the pros and cons based on scientific factors, but the analysis is limited or lacks thoroughness, suggesting a need for further consideration of the scientific aspects.	The response delivers a comprehensive and well-structured response supported by clear and coherent scientific explanations. The response demonstrates a deep understanding of the relevant concepts and their application to the topic. The response effectively weighs the pros and cons based on scientific factors, providing a thorough and insightful analysis, indicating a strong consideration of the scientific aspects.
	"Comment" type of question* *You may choose to to specify the scientific concepts/justifications/facts that is/are present in your question/lesson in the band descriptors.	The response provides a superficial comment with limited or no relevant scientific concepts or justification. The comment lacks depth, coherence, and may contain inaccuracies or misconceptions. The student may benefit from further consideration to ensure a meaningful connection of the comment to the question, rather than regurgitating facts.	The response comments on the topic with some relevant scientific concepts or justification, but the comment lacks depth, coherence, or thoroughness. The explanation may be partially accurate but lacks comprehensive understanding. The student may benefit from further consideration to ensure a more meaningful and in-depth connection of the comment to the question.	The response delivers a comprehensive and well-structured comment supported by clear and coherent scientific explanations. The comment demonstrates a deep understanding of the relevant concepts and their application to the topic. The student effectively relates the comment back to the question, providing insightful connections and demonstrating a thorough understanding of the topic.
	"Evaluate" type of question *You may choose to to specify the scientific principles/data that is/are present in your question/lesson in the band descriptors.	Response provided an outline of the idea without expanding on its components or examples to support the key points. Response lacked references to relevant scientific principles or data to support the argument. Response lacked consideration of limitations and implications.	Response provided some detail and examples but require further elaboration and explanation to support the key points. Response contain some references to scientific principles or data, but lacked specificity or depth to strengthen the argument. Response briefly mentioned limitations and implication but does not explore their significance or consequence thoroughly.	Response provided sufficient detail and elaboration, with clear explanation to articulate the key points comprehensively. Response contains specific references to scientific principles or data that contribute to the strength of the argument. Response address limitations and implications thoroughly and proposes feasible enhancements to their ideas.
	Critical concepts in question* *You may input your own band descriptors according to the concepts required by the question	Teacher's input	Teacher's input	Teacher's input

Issues of Science Rubrics | Rubrics for Reflection

Issues in Science rubrics



USING SLS TO DEVELOP CRITICAL THINKING THROUGH ISSUES IN SCIENCE — 21CCnavigator TOOLKIT FOR CAIT

The rubrics below are for the metacognitive reflection portion of the sample lesson template for Issues in Science. These rubrics serve as starting points for you to build and/or adapt the rubrics according to the context of the reflection question that you would like to set for your students to better understand their awareness, monitoring and evaluation levels.

You can pick a relevant dimension of feedback for the use in the ShortAnsFA, and amend the band descriptors according to your lesson objectives and outcomes.

Category of Feedback	Dimension of Feedback	Beginning	Developing	Exceeding
Metacognition	Awareness Student demonstrates an awareness of his new learning by articulating the learning.	Student is unable to articulate the learning outcomes of [input learning outcomes]	Student is able to articulate some learning outcomes of [input learning outcomes]	Student is able to articulate all the learning outcomes of [input learning outcomes]
	Monitoring Student monitors his learning by examining it in relation to one's own prior understanding to create a new/ reinforced understanding.	Student is unclear about what he knows or what he has learnt*. *You may wish to specify what are the learning objectives/outcomes of the lesson for the band descriptors.*	Student is able to identify what he knows and what he has learnt.	Student is able to discuss what he knows and what he has learnt to improve his understanding.
	Evaluation Student assess limitations/ gaps in learning and describe ways to improve and create opportunities for transfer of learning	Student is unclear of the limitations or gaps in his understanding, or strengths in his learning*. *You may wish to specify what learning you may want to look out for for the band descriptors.*	Student is able to identify limitations or gaps in his understanding, or strengths in his learning.	Student is able to assess limitations or gaps in his understanding, and cognizant of strategies employed or strengths in his learning to plan his strategies for future learning.

Issues of Science Rubrics | Rubrics for Reflection

Reflection rubrics

Click on the pictures for a larger view.

Developing Explanations and Solutions (W7 - W8)

The criteria and band descriptors (Fig. 6.5) in the rubrics provided guide students to think critically when constructing explanations and designing solutions to solve issues in science.

Students are encouraged **to reflect on the feedback provided** (Fig. 6.6) for their responses by the Short Answer Feedback Assistant (ShortAnsFA) to identify areas for improvement. If further clarification of the feedback is needed, they are then encouraged to discuss the feedback with their peers and teachers. Allowing students to revise their answers based on feedback enables them to demonstrate their learning through self-evaluation and make measurable improvements in their work.

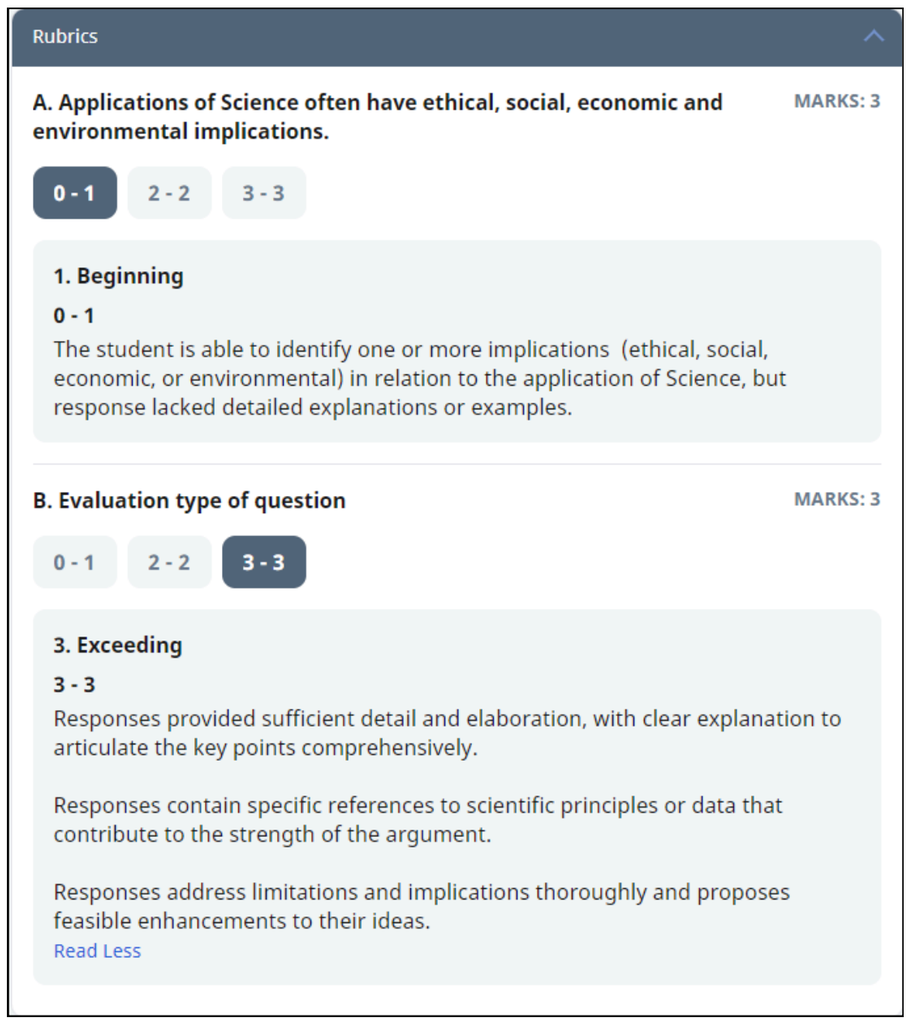


Fig. 6.5

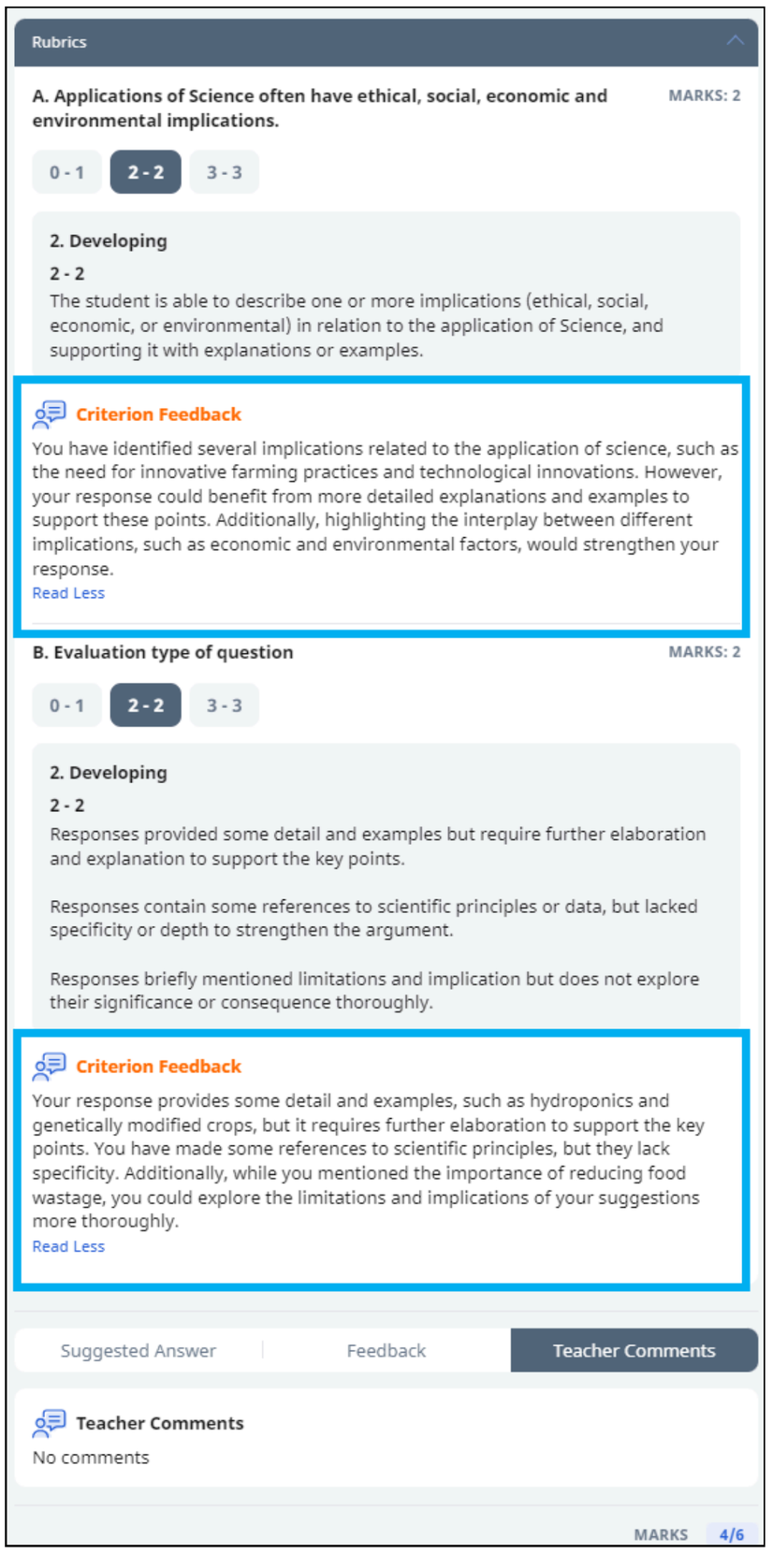


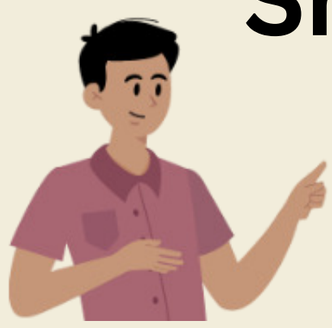
Fig. 6.6

Click on the pictures for a larger view.

PEDAGOGICAL AFFORDANCES:

- Embedding rubrics (e.g., the 21CC-aligned rubrics) in ShortAnsFA enhances students' metacognitive skills and critical thinking by providing customised feedback. DAT complements ShortAnsFA by providing teachers with quick insights into students' responses, enabling timely and targeted feedback. The feedback prompts students to **consider alternative models and explanations**, reflect on their thought processes, and refine their explanations and solutions.
- This process **promotes deeper thinking** and helps students become **more self-directed in refining their answers**.

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