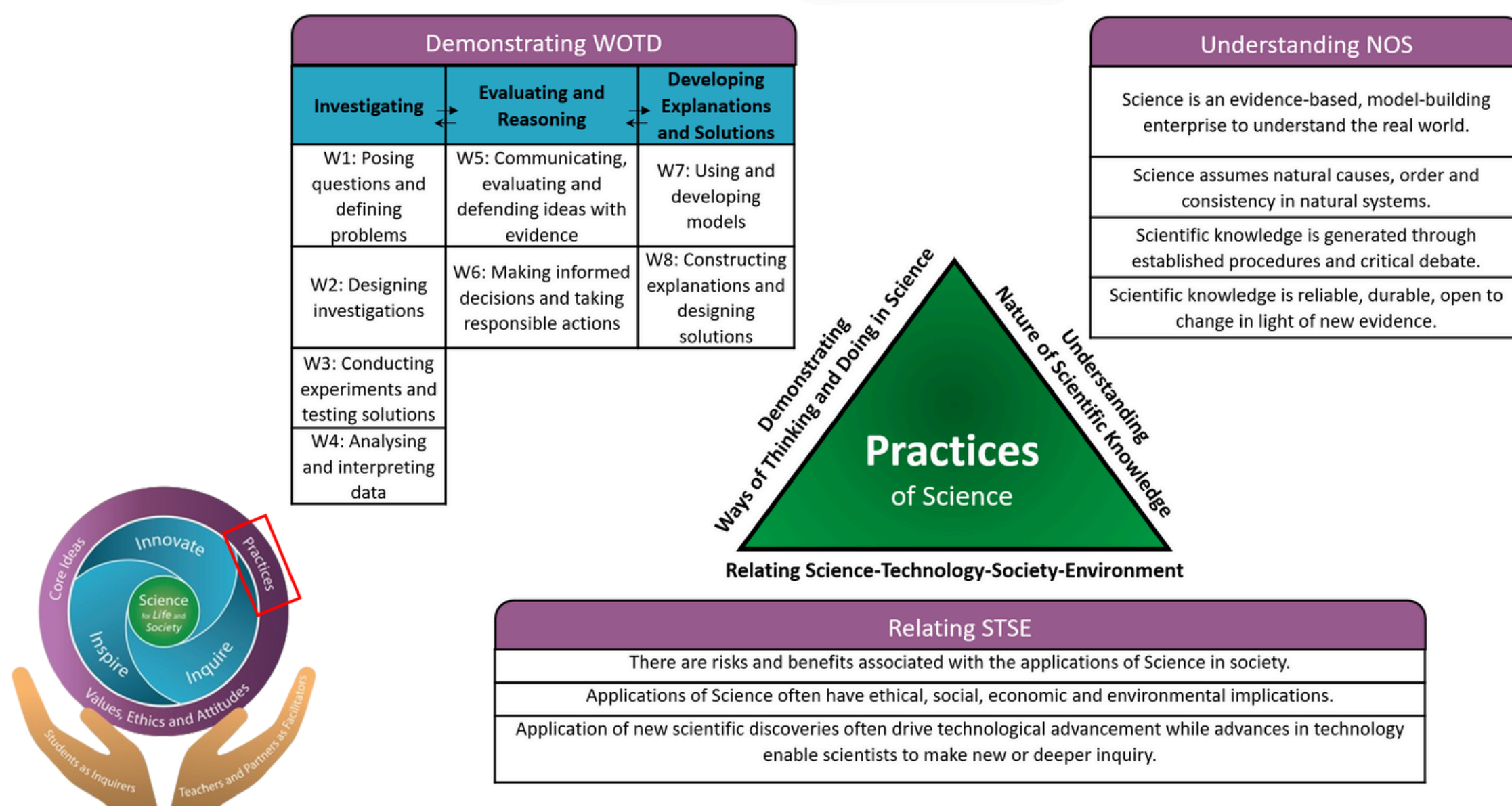





SLS Guide for Science

Leveraging SLS to Enhance Teaching and Learning of Science

- The guide is developed by Educational Technology Division with input from Academy of Singapore Teachers and Curriculum Planning and Development Division.
- This guide demonstrates the potential of the Singapore Student Learning Space (SLS) to enhance the teaching and learning of Science, using different SLS features and different 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.

Investigating (W1 - W4)



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



Teachers can engage students and **activate their learning** using [Resources](#) such as simulations 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) (Fig. 1.1).



Students can record their data in a table (included in a [Free-Response Question](#)) (Fig 1.2) and **work collaboratively** with one another in pairs or in groups to **analyse the data** obtained. They can further **discuss and comment** on the results obtained by other pairs or groups.

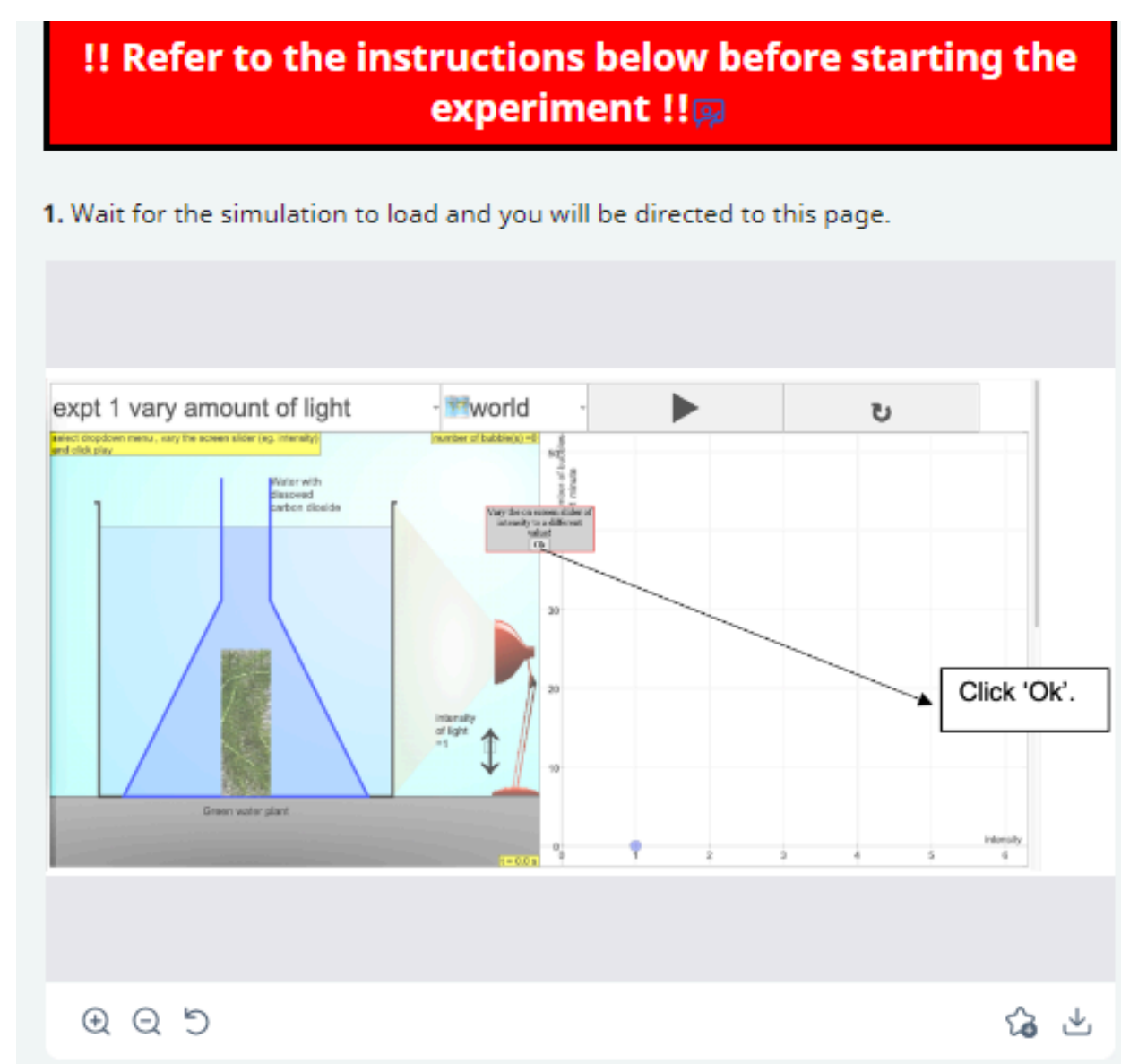


Fig 1.1

Q2

Results

Record your results from the virtual lab simulation in a [table](#) below.

[Read More](#)

Experiment No.	Light intensity	No. of bubbles produced in a minute
1	1	20
2	2	22
3	3	28

[Read Less](#)



Alternatives

Use [Click-and-Drop](#) to help in sequencing their steps when designing an investigation.

Fig 1.2



Click on the pictures for a larger view.

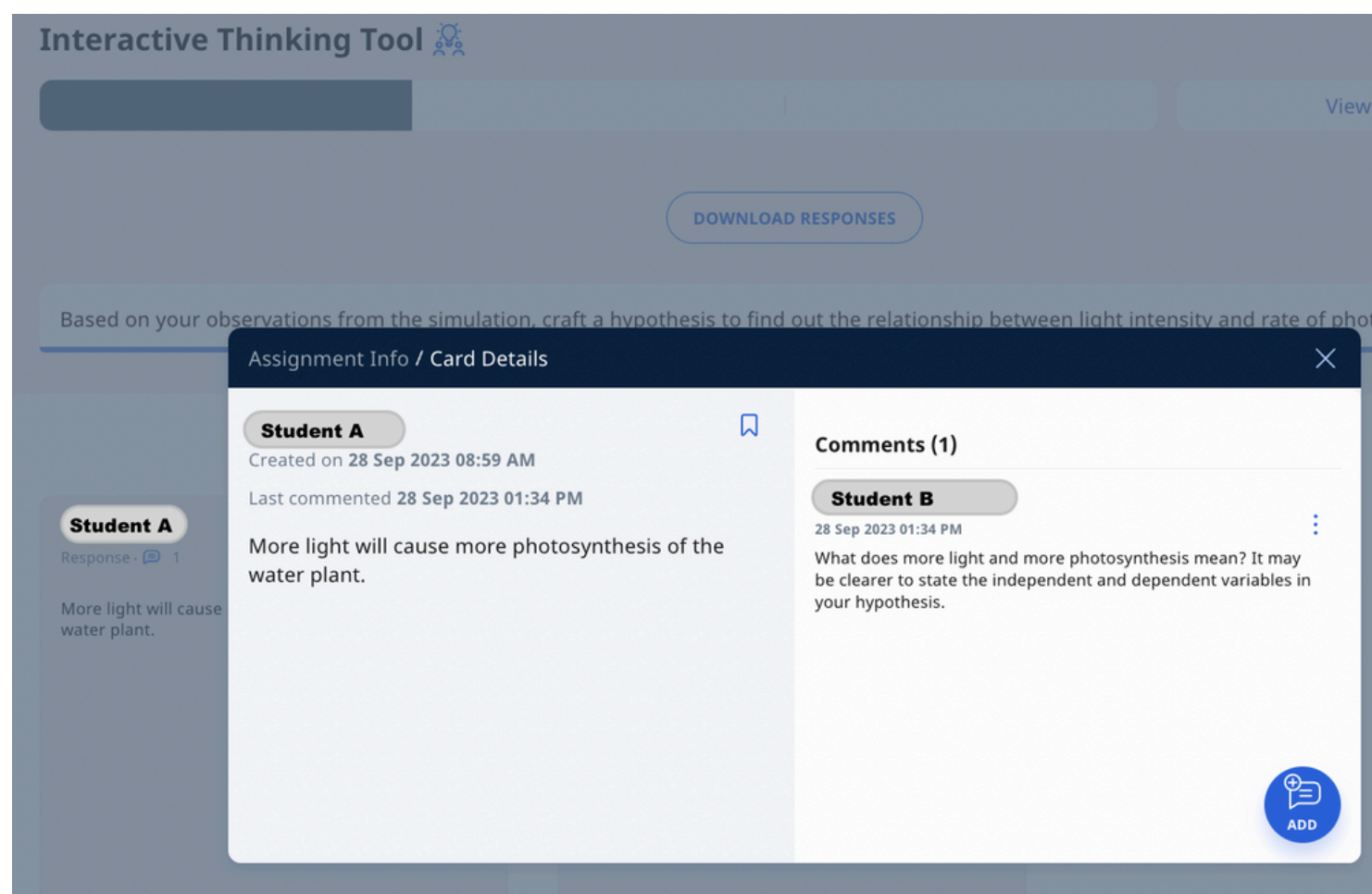
Investigating (W1 - W4)



Teachers can also use the [Interactive Thinking Tool](#) to guide students to formulate and share their hypothesis while the [Comments](#) feature allows students to comment on their peers' hypotheses (Fig 1.3).



Students can sketch a graph of their data using the [Interactive Thinking Tool](#) with pre-populated axes (Fig 1.4) and they can **discuss on the trend observed** from the graph.



Alternatives



Use [Free-Response Question](#) type to prepopulate hypothesis structure to guide students in formulating their hypotheses.

Fig 1.3

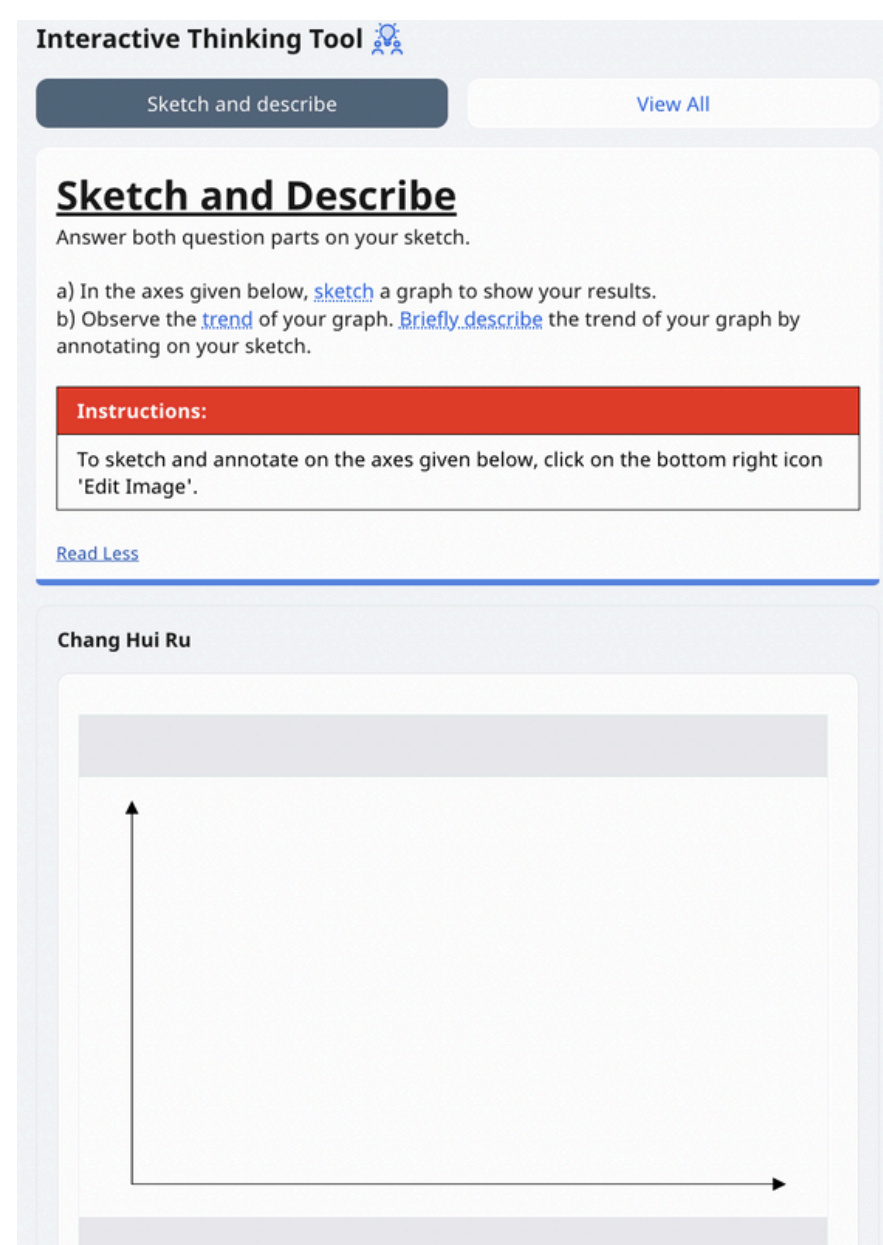


Fig 1.4



Click on the pictures for a larger view.



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 lab.
- The Interactive Thinking Tool 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**.

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](#) with pre-populated prompts to guide students in **substantiating their claim with evidence and reasoning**. (Fig 2.1).

A [Video](#) can be included to help students observe a chemical reaction at the macroscopic level, and an [Multiple-Choice Question](#) included to assess their understanding (Fig 2.2).



Students express their choice in the [Poll](#) and articulate their reasoning supported with evidence in the [Interactive Thinking Tool](#). This helps to facilitate idea exchange among peers.

Students can replay the videos as needed before responding to the [Multiple-Choice Question](#), which then **offers them instantaneous automated feedback**.

Poll 1

"A precipitate can only be formed from the reaction of an acid with another solution."

☐ True

☐ False

Students' submissions will be displayed on the Interaction Board

Interactive Thinking Tool

Why do you say so? [View All](#)

Explain what made you select the option in **Poll 1**.

Individual Student's Answer

Evidence:

Reason:

[Read Less](#)

Students' submissions will be displayed on the Interaction Board

Fig 2.1

B precipitation reaction ($\text{AgNO}_3 + \text{NaCl}$) Watch later Share

when NaCl is added to AgNO_3 , a white precipitate, AgCl, forms

© Content in the frame is from an external source

From the video, we can see that mixing sodium chloride and silver nitrate produces a precipitate of silver chloride. The word and chemical equations for the precipitation reaction are:

Word Equation: sodium chloride + silver nitrate → silver chloride + sodium nitrate
Chemical Equation: $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$

[Read Less](#)

☐ Only one of the reactants for the reaction is an aqueous solution.

☒ Both the reactants for the reaction are aqueous solutions.

☐ The white precipitate form is an aqueous solution.

☒ The white precipitate form is an insoluble solid.

NUMBER OF TRIES **2**

MARKS **[1]**

Fig 2.2



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 2.3).

To help students **think more critically**, teachers can include a table within a [Free-Response Question](#) 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 2.4).



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 2.5). ChemType supports handwritten input which are auto-translated to computer notations.

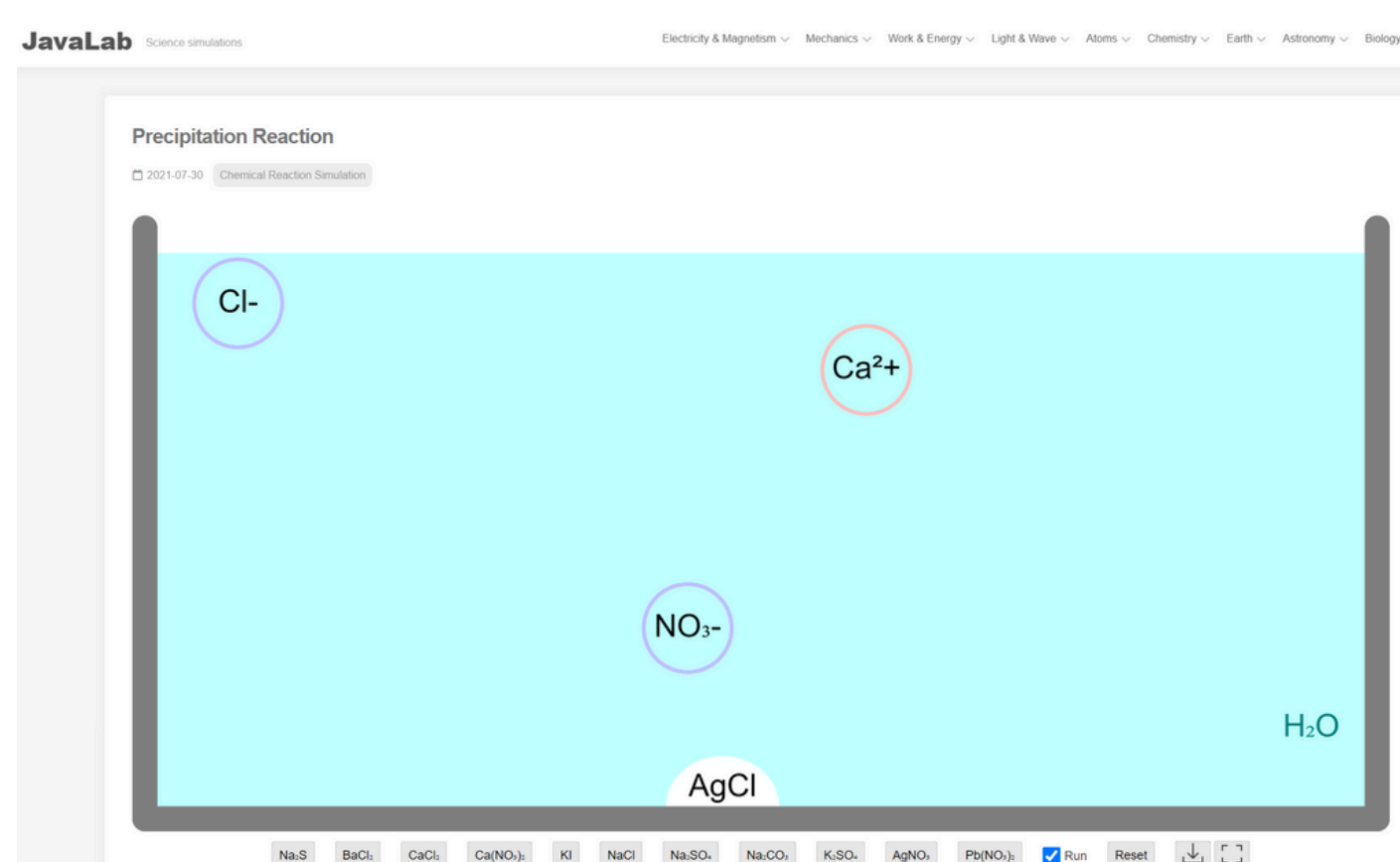


Fig 2.3

Instructions

1. Use the [simulation](#) to **observe which ions are involved in the precipitation of**:

- barium sulfate,
- silver carbonate and
- silver chloride.

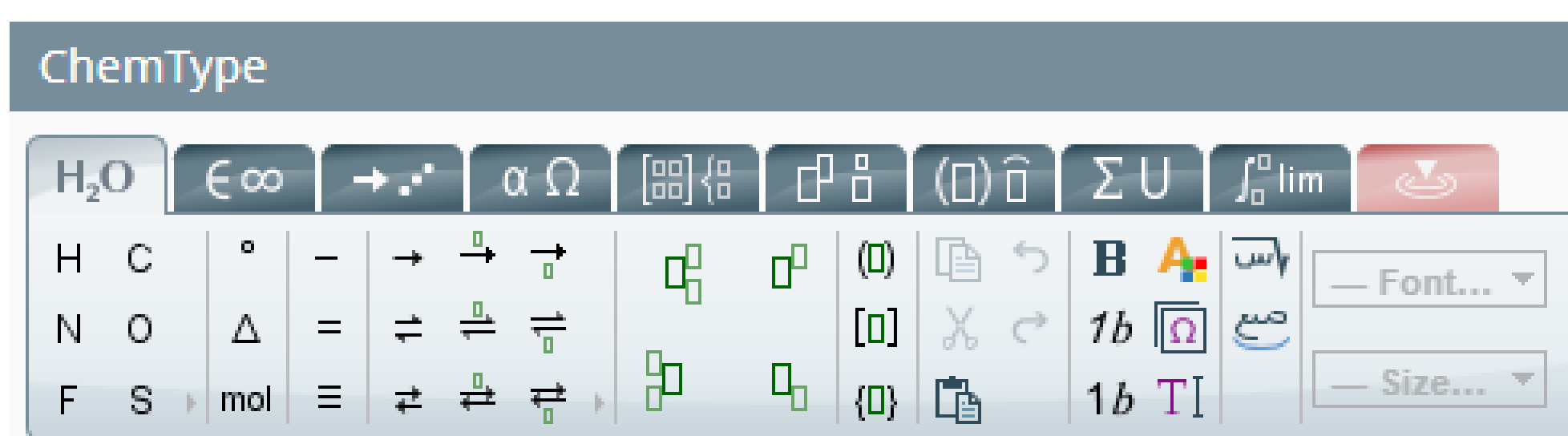
2. **Construct the ionic equations** for each precipitation reaction in the table below.

[Read Less](#)

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

[Read Less](#)

Fig 2.4



	Precipitate	Ionic Equation
1.	barium sulfate	$\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$
2.	silver carbonate	$2\text{Ag}^{+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{Ag}_2\text{CO}_3(\text{s})$
3.	silver chloride	$\text{Ag}^{+}(\text{aq}) + \text{Cl}^{-}(\text{aq}) \rightarrow \text{AgCl}(\text{s})$

Fig 2.5



[Click on the pictures for a larger view.](#)

Evaluating and Reasoning (W5 - W6)



Using a 2-Column [Interactive Thinking Tool](#) with pre-populated prompts (Fig 2.6a), students record their explanations and substantiate them with evidence (Fig 2.6b). Teachers can **guide students in providing constructive peer feedback** (e.g., sentence starters), which can in turn help students refine their explanations (Fig 2.6c).



Students have a choice to type, draw or upload images/videos to **articulate their ideas, understanding and explanations** (Fig 2.7) when responding to the Interactive Thinking Tool. 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 2.8).

Alternatives



Using [Forum](#) and [Discussion](#) promotes the sharing and exchange of perspectives.

Fig 2.6a

Fig 2.6b

Fig 2.6c

Fig 2.7

Fig 2.8

DI by Product



Do you know you can allow students to provide their input by typing, [recording](#) of audio or even [drawing](#)?



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**.

Developing Explanations and Solutions (W7 - W8)



How can I help my students to **generate explanations** for natural phenomena **using models**?



Teachers can **spark curiosity** by [embedding YouTube Videos](#) of an interesting natural phenomenon (e.g., floating city video).



By using the "See-Think-Wonder" template from the [Interactive Thinking Tool](#), teachers can encourage students to **observe, interpret, and ask questions** (Fig 3.1).

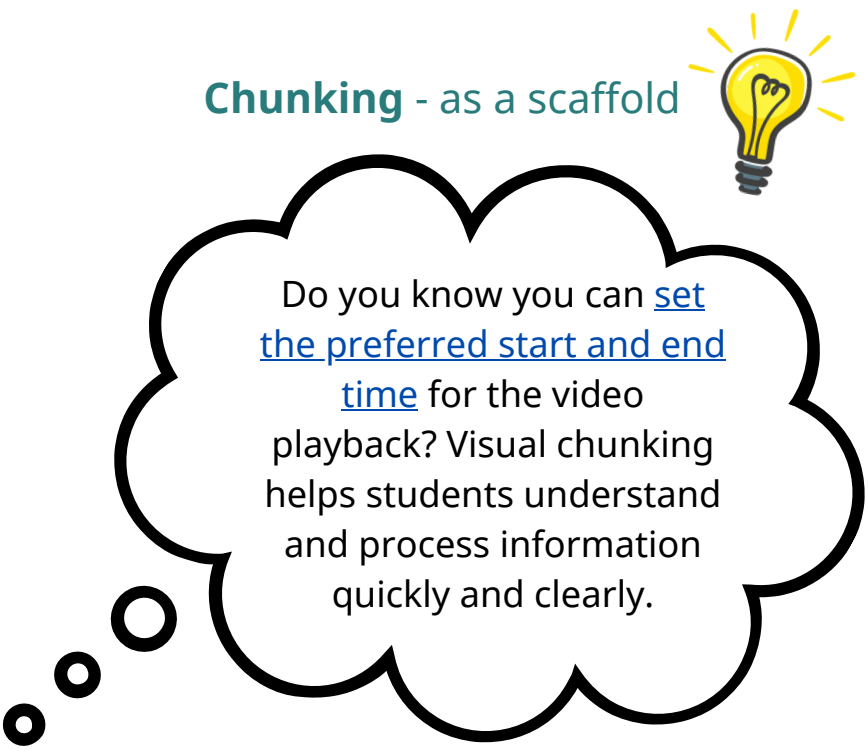
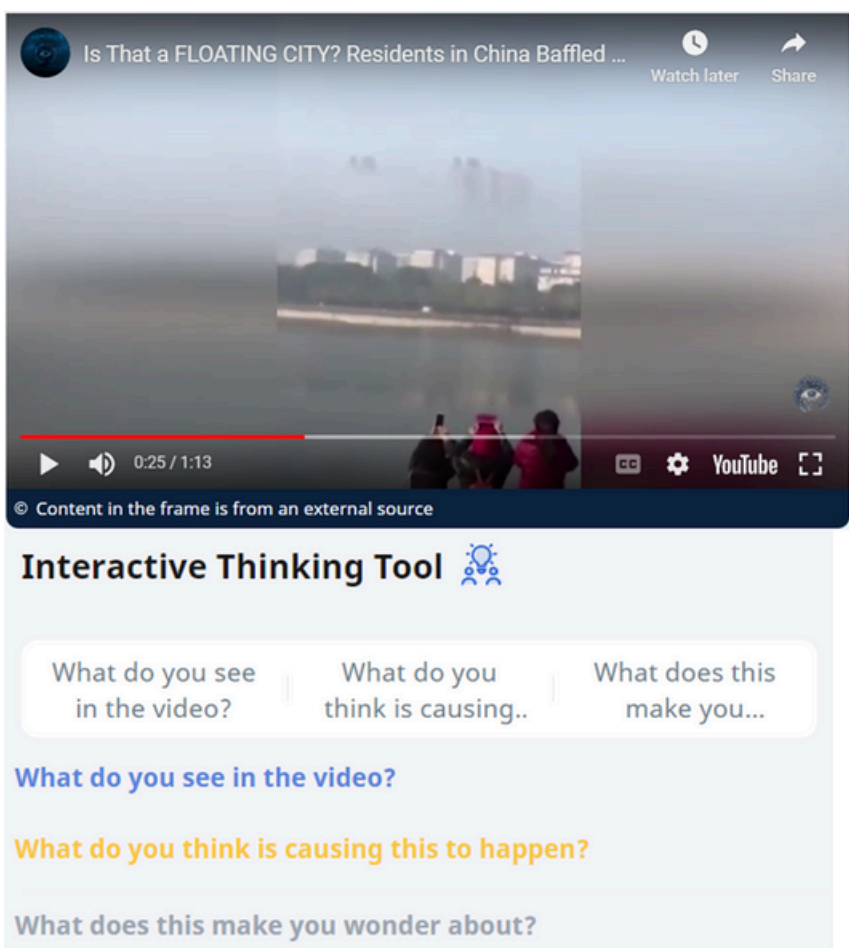


Fig 3.1



Click on the picture for a larger view.



Teachers can [Upload Files](#) such as pictures and videos, and/or embed simulations from [Whitelisted Websites](#), with guiding questions in the [Accordions](#) display to **teach students about models** (e.g., the Ray Model of Light) (Fig. 3.2).



Using the Accordions display feature, students can view the ray model information one section at a time, preventing them from feeling overwhelmed and **aiding concentration** (Fig 3.3).

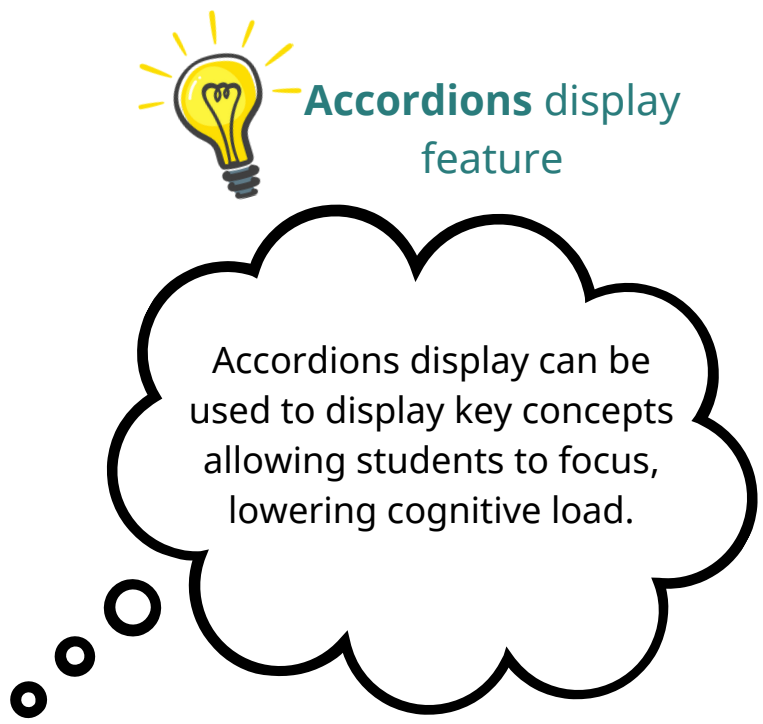
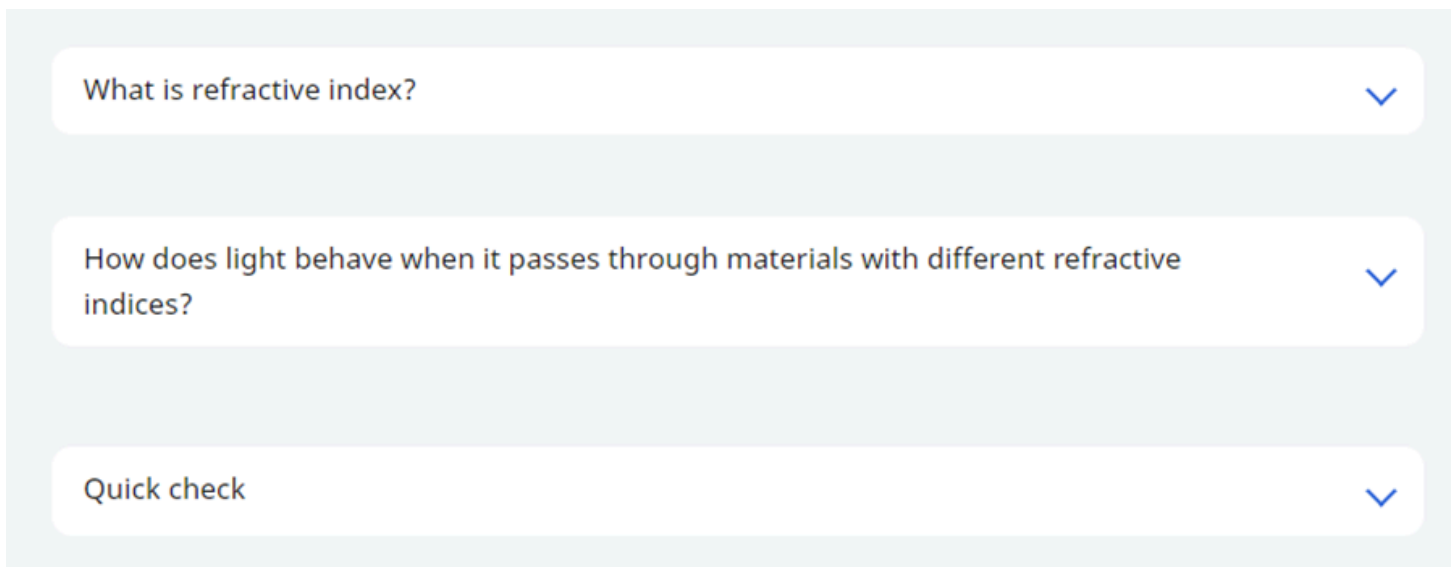



Fig 3.2



Click on the picture for a larger view.



Resources on SLS


Do you know there are many useful simulations and interactives in the [MOE Library](#) that you can use when designing your lessons?

What is refractive index?

The refractive index of a material medium is the ratio of the speed of light in a vacuum to its speed in the specified medium. Refractive index has no units and it is represented using the symbol n .


In the pictures below, you will see a handheld device being used to determine the refractive index of a sample of grape wine and a sample of jet fuel. The refractive index of the samples can help us to determine the concentration of sugar in the wine and the composition of the jet fuel.

Testing grape wine



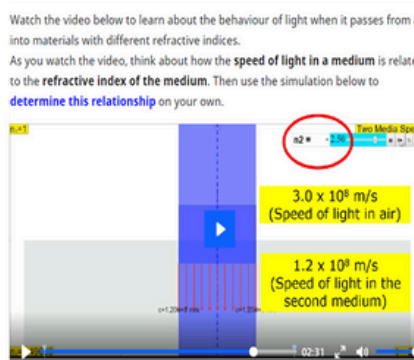
A vineyard sample of grape wine undergoes analysis of sugars using a handheld device that measures the refractive index of the solution. The higher the concentration of sugar, the larger the refractive index.

Testing jet fuel



A military technician tests the composition of jet fuel using a handheld device that measures the refractive index of the fuel. If the refractive index is within an accepted range, he will know that the correct amount of anti-freeze additive was added to the fuel.

Watch the video below to learn about the behaviour of light when it passes from air into materials with different refractive indices. As you watch the video, think about how the speed of light in a medium is related to the refractive index of the medium. Then use the simulation below to determine this relationship on your own.



velocity_refractive_index.mp4

How does light behave when it passes through materials with different refractive indices?

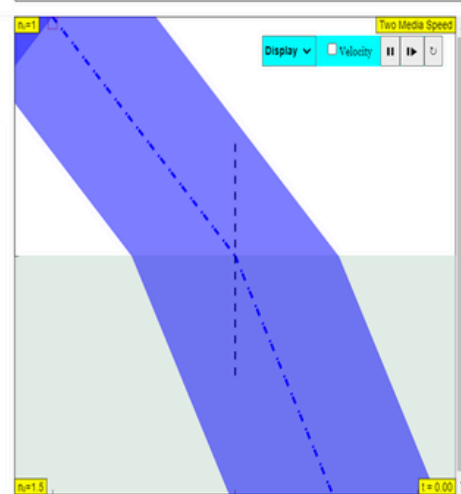
Investigate the relationship between refractive index of a medium and speed of light

Instructions

1. Open the refraction model in a new tab.
2. Click on the velocity checkbox. Note: 3.00×10^8 m/s means 3.00×10^8 m/s
3. Under "Display", select n_2 .
4. Change only the refractive index (n_2) of the second medium.
5. Press the step button to see how the speed changes for each ray of light as it hits the second medium

What do you notice about the following as you change the value of n_2 ?

- v : the speed of light in the second medium
- d/v : the ratio of the speed of light in air (d), to the speed of light in the second medium (v)?



refraction_model.zip

Quick check

Q1

How happens to the speed of light when it travels from air (or vacuum) into another medium which has a greater refractive index?

☒ The greater the refractive index of the medium, the slower the speed of light in the medium.

☐ The greater the refractive index of the medium, the faster the speed of light in the medium.

☐ The speed of light remains the same as it travels into the second medium.

Explain why refractive index has no units.

Prepopulated Answer here...

Suggested Answer

Feedback

Teacher Comments

☒ Suggested Answer

- The refractive index of a material medium has no units because it is the ratio of two physical quantities (speed) with the same unit (m/s).
- Dividing the speed of light in vacuum by the speed of light in another medium results in a number that has no units.

Fig 3.3

Click on the picture for a larger view.

Teachers can use the [Interactive Thinking Tool](#) to **engage students collaboratively** to formulate an explanation for the observed phenomena (Fig 3.4).

Answering frames (e.g., “Premise-Reasoning-Outcome P-R-O” frame) can be included to **help students formulate their explanation** (Fig 3.5).

Phenomena 1: Explaining the Trigger Video

Recall the earlier video of buildings appearing in the sky in the Trigger Video we saw earlier.

We need to synthesize what we have learnt earlier to solve this mystery.

We learnt in earlier activities:


- 1) Light bends when it enters a medium with a different refractive index
- 2) When we observe light coming into our eyes, our brains interpret the image as though the light had travelled in a straight line.
- 3) Recall the explanation for a sea breeze, the air immediately above the sea is usually cooler.

You will also need a few additional details, (not in syllabus) covered below

- 1) The optical density of air reduces as the temperature increases. Hotter air is actually less optically dense compared to cooler air.

Formulate an explanation for the phenomena using the structure P-R-O

Fig 3.4

Interactive Thinking Tool 

What are the premises?

What is the reasoning?

What is the outcome?

What are the premises?

What is the reasoning?

What is the outcome?

Individual Student's Answer

Fig 3.5

Click on the pictures for a larger view.


Developing Explanations and Solutions (W7 - W8)



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 using [Free-Response Questions](#) (Fig 3.6) with minimal scaffolds provided.

Phenomena 2: Wet Roads

On very hot days, roads appear wet even though they are actually dry when you drive up further.



Applying what you have learnt earlier, craft an explanation to explain why this happens.

Q1

Why does the road appear wet? Remember to have all 3 components in your answer.

Prepopulated Answer here...

Additional tips when using
Free-Response Questions



Do you know that for [Free-Response Questions](#), you can include the recommended time as well as response size that best suited for the question.

Fig 3.6



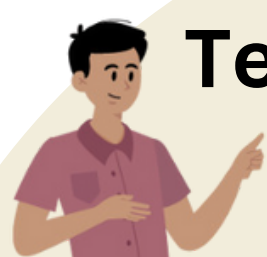
Click on the picture for a larger view.



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.

Tell us your feedback!



<https://go.gov.sg/guidefeedback>

