Faculty of Education
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Reflections and Inspirations on Area B1

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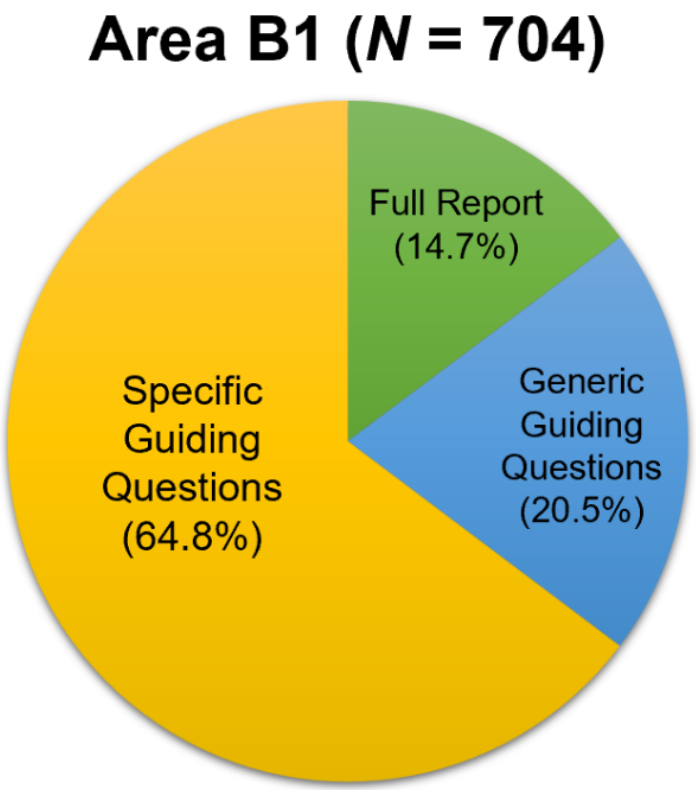
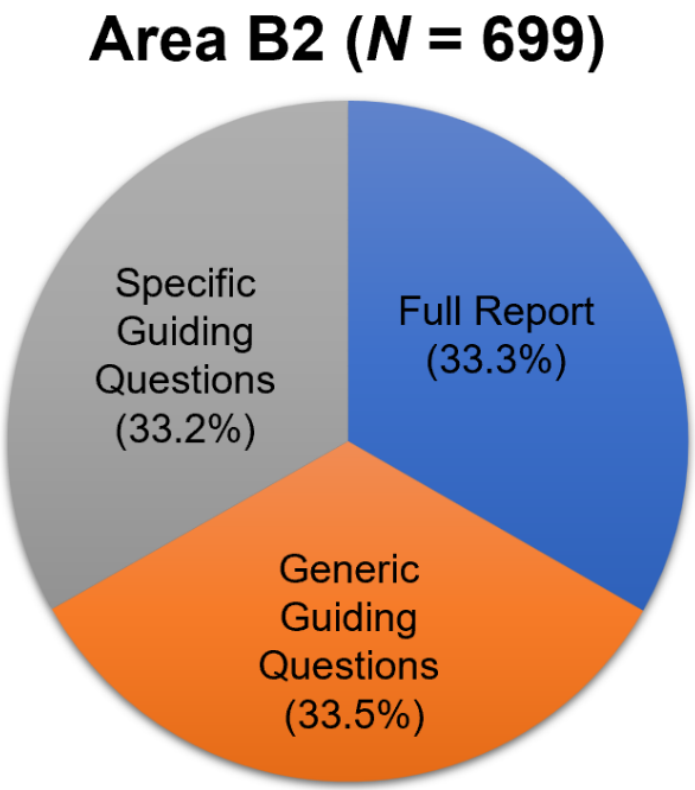
香港考試及評核局
Hong Kong Examinations and Assessment Authority

Review on SBA implementation

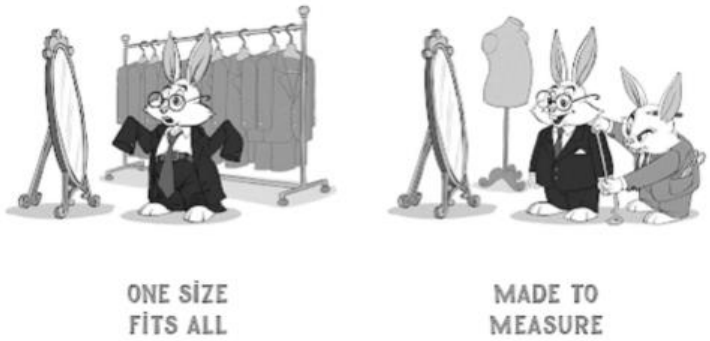
Format of Assessment





Potential benefits of the new SBA format

- Better *alignment* with valued objectives of assessment
- More *flexibility* for teachers in conducting the assessment
- More *targeted* feedback to support student learning



Outline

- Inspirational ideas from practising teachers
- A diagnostic tool to facilitate teachers' SBA task design

Example 1: *Yeast Fermentation*

Scenario:

Respiration is the process by which organisms obtain chemical energy from food through the oxidative breakdown of food. The compound oxidised during respiration is called respiratory substrates. Yeasts are a group of organisms which are capable of using a variety of carbohydrates as their respiration substrates.

There are three unknown solutions which can provide the yeasts with respiratory substrates, namely solutions A, B and C. Solutions A, B and C can be pure water, pure glucose or 1:1 glucose/sucrose solutions at the same concentration. A brewer wants to identify the priority of yeasts in using solutions A, B and C as respiratory substrates, producing carbon dioxide at the highest rate, hence alcohol, for brewery.

Aim of the investigation:

To determine the rate of respiration of yeasts in different substrate solutions and identify the best solution for brewery

Problem-solving Task

Inspirations

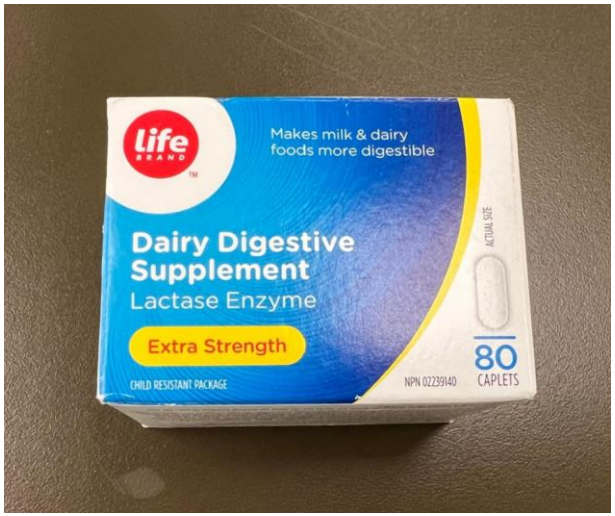
Effect of **Chemical *X*** on the fermentation rate of yeast using different types of sugar

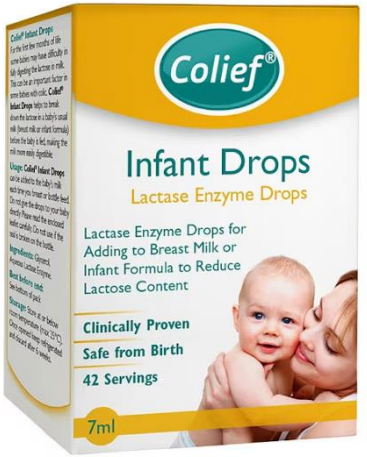
- Sugar A (Lactose), Sugar B (Sucrose), Sugar C (Glucose), Sugar D (Starch)

Chemical *X*

- Lactase
- Invertase

- Infant drops
- Beano enzymes



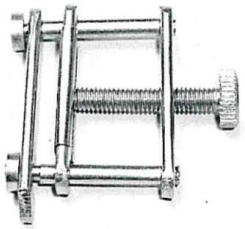


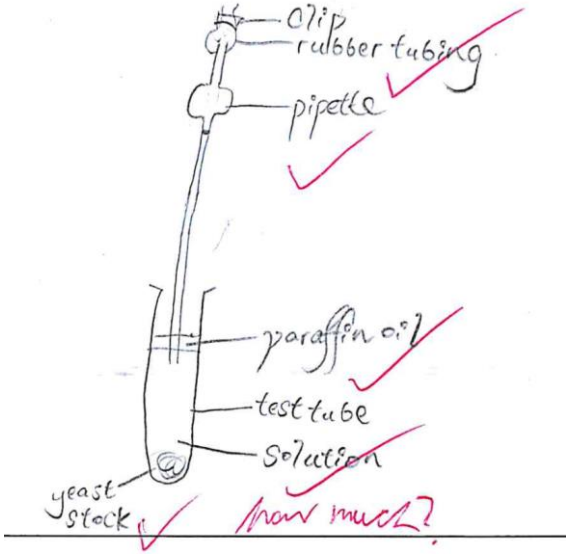
Design of the investigation:

You have been given the following materials and apparatus:

Pipette filler
Measuring cylinders
1mL pipettes
Test tubes
Short rubber tubings
Clips
10% yeast stock
Solution A
Solution B
Solution C
Paraffin oil

A clip





Alcoholic Fermentation in Yeasts

Relation to topics / curriculum link:

- *cellular energetics, fermentation*
- *microbiology*

Prior knowledge and skills needed:

- *the process of alcoholic fermentation*
- *different types of sugars (e.g. glucose, sucrose, fructose) as carbon source for growth of yeasts*
- *alcoholic fermentation is an enzyme-catalysed reaction*

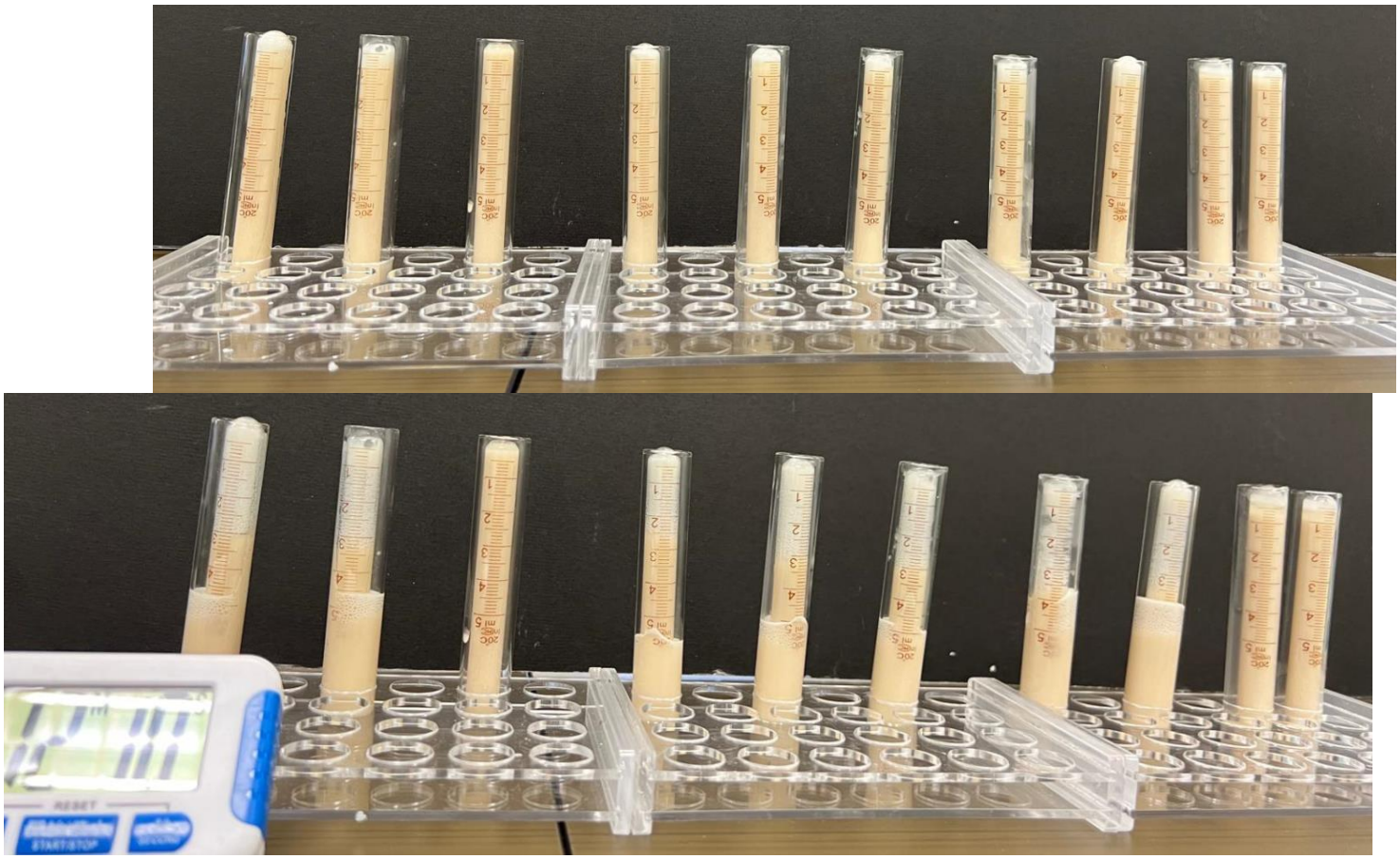
Alcoholic Ferme

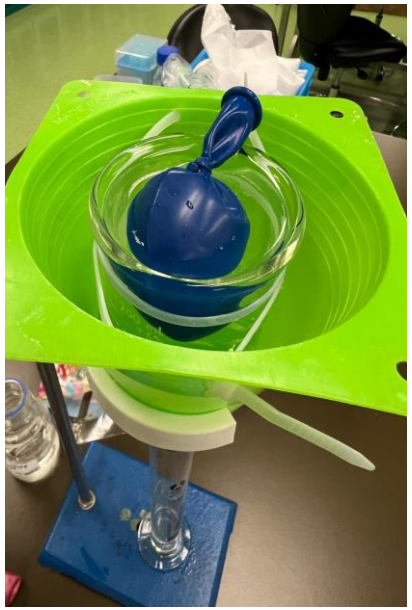
Pre-lab Practice (Setting up a respirometer)

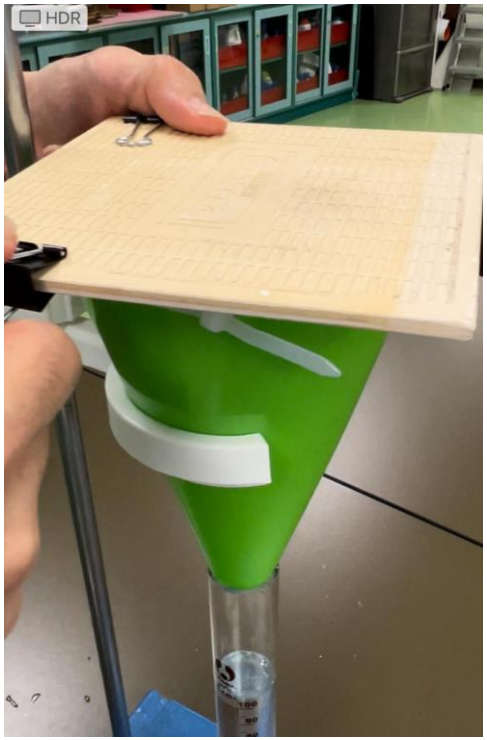
(2a) (2b) (2c) (2d) (2e) (2f)

[Learning and Teaching Resources List (hkedcity.net)]

Sugar A		Sugar B		Sugar C		Sugar D		Water	
-	+	-	+	-	+	-	+	-	+







[Engineering the Efficiency of Alcoholic Fermentation - Activity - TeachEngineering]

Example 2: *Photosynthesis*

Conversations between classmates.

A study of the advantage of the presence of red pigmen

Introduction

One day, when Peter and Mary walked around the shops that sell tropical fishes, they discovered that some pondweeds had a red pigment. They started the following conversation:

Peter: I've read books about algae. The book says that some algae with red photosynthetic pigment are more adapted to absorb blue light. Thus, they can live deeper down the sea. I think this red pondweed may also have the same adaptation.

Mary: I don't think so. I think the red pigment is used to block strong sunlight, so that the chlorophyll would not be damaged when the sunlight is too bright. Thus, this red pondweed should be more adapted to live in places with strong light.

Task

Help Peter and Mary to solve their problem by designing an experiment using the following materials:

a. pondweeds: *Cabomba caroliniana* (green) and *Cabomba australis* (with red pigment)

b. 100 ml 0.25% sodium hydrogen carbonate solution

c. 2 5 ml pipettes

d. 2 pieces of rubber tubing

e. 2 screw clips

f. 2 boiling tubes

g. 1 thermometer

h. 1 500 mL beaker

i. 2 table lamps

j. 2 stop watch

k. 1 retort stand with 2 clamps

l. 2 pipette fillers

m. 1 meter rule

n. 1 piece of blue filter

j. 1

k. 1

Sufficient hint is given.

Hint: As different plants are used in the experiment, it is very difficult to compare their actual rate of photosynthesis. Design an experiment to compare their change in rate of photosynthesis under different conditions, with reference to the rate under a certain reference light intensity.

Explanatory hypothesis-testing Task

- State the hypotheses suggested by Peter and Mary.

- State the predicted results according to the two hypotheses.

Inspirations

How can a wounded apple affect seedling growth?

Scenario

Andrew heard the following conversation between his classmates:

David: I read on a website that a wounded apple can inhibit seedling growth. Is it possible that a wounded apple releases a gaseous chemical that can inhibit seedling growth?

Vincent: I wonder if a wounded apple can affect the growth of all types of seedlings.

Andrew decided to conduct an experiment to test David's hypothesis that a gaseous chemical is released from a wounded apple that can inhibit the growth of all types of seedlings.

ACTIVITY

What are some **common difficulties students face** in designing this investigation?

READ (1 min)

- Read P.16 of the booklet

TURN & TALK (5 min)

- Talk to the person next to you
- Share your thinking.

What are some **common difficulties students face** in designing this investigation?

HKDSE Practice Paper 1B Q.10(c)

When wheat grains are sown on a piece of farmland which has been frequently sprayed with pesticide X, the germination rate is poor. Design an experiment to investigate whether pesticide X affects germination of the wheat grains.

(4 marks)

(c) Sample size: Soak a sufficiently large number of wheat grains (e.g. 50) in water added with pesticide X. 1

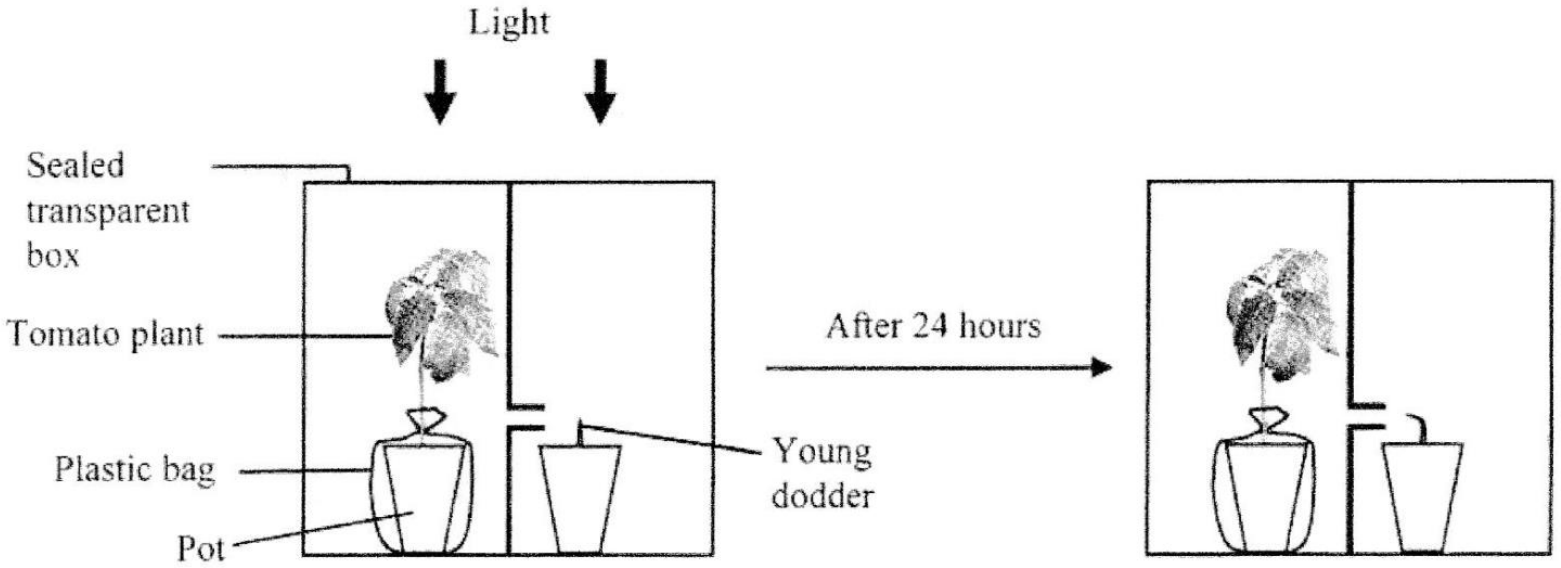
Setting up of the control: Soak equal number of wheat grains in water without pesticide X. 1

Controlled variables: Allow the grains in the 2 set-ups to germinate under identical environmental conditions for the same period of time. 1

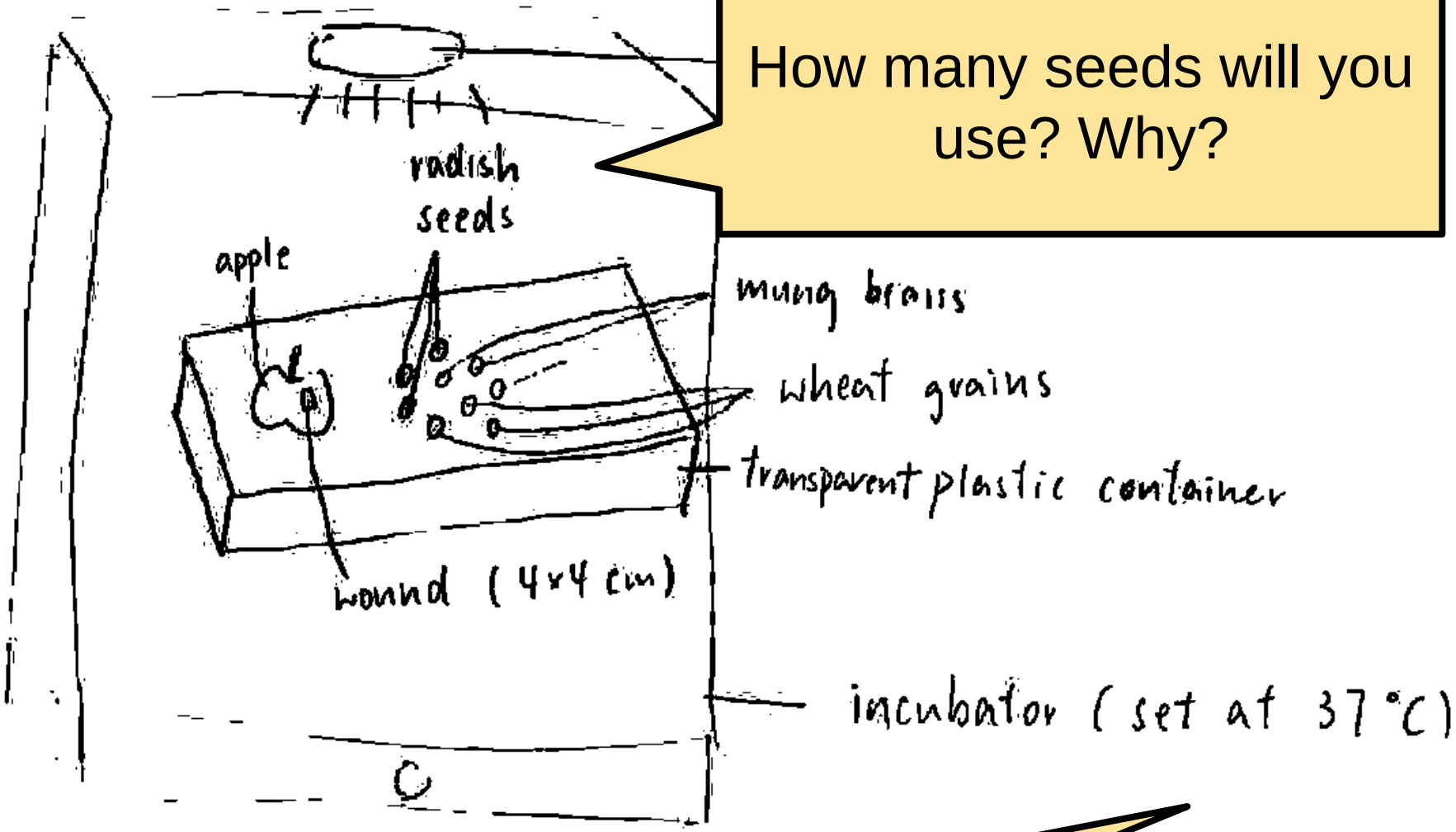
Measurement: Compare the success rate of germination to see if there is any significant difference. 1

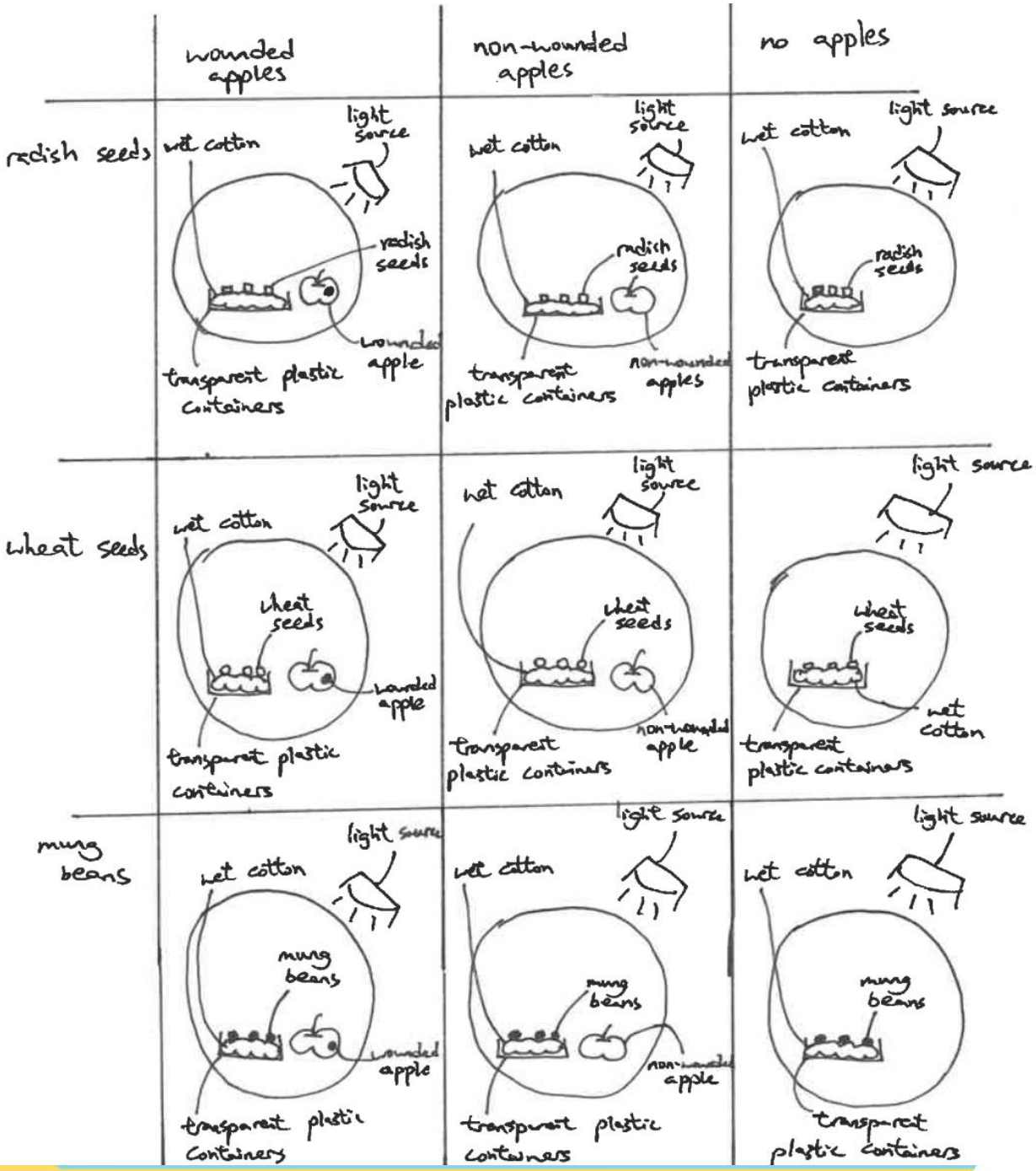
6. Dodder is a parasitic plant. A young dodder plant seems to be able to 'smell' the tomato plants growing nearby. It is hypothesised that the young dodder can detect the volatile chemicals produced by the tomato shoots. This signal detected then causes the young dodder to grow towards and twine around the stem of the tomato plant. The following experiment was conducted to test this hypothesis. The set-up of the experiment and the result are shown in the figure below. In the experiment, the soil used for both plants was the same.

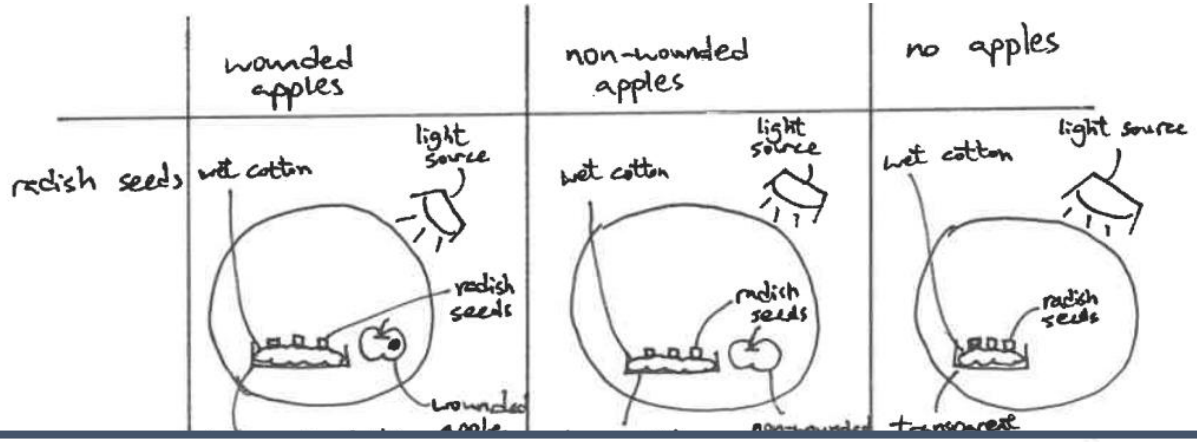
2013 HKALE



(a) Why should the pot containing the tomato plant be wrapped in a plastic bag? (1 mark)


How many seeds will you use? Why?
radish seeds
apple
mung beans
wheat grains
transparent plastic container
wound (4×4 cm)
incubator (set at 37 °C)
Heat stress?


wounded apples
non-wounded apples
no apples
radish seeds
wheat seeds
mung beans
wet cotton
light source
radish seeds
wounded apple
transparent plastic containers
non-wounded apples
wheat seeds
mung beans

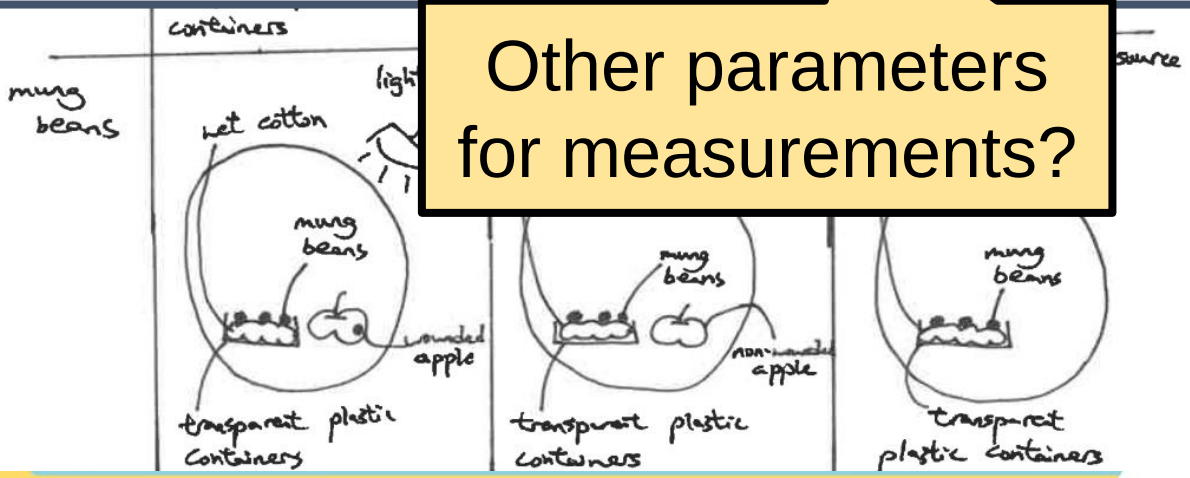


IV: whether the apple is wounded or not + types of seedlings

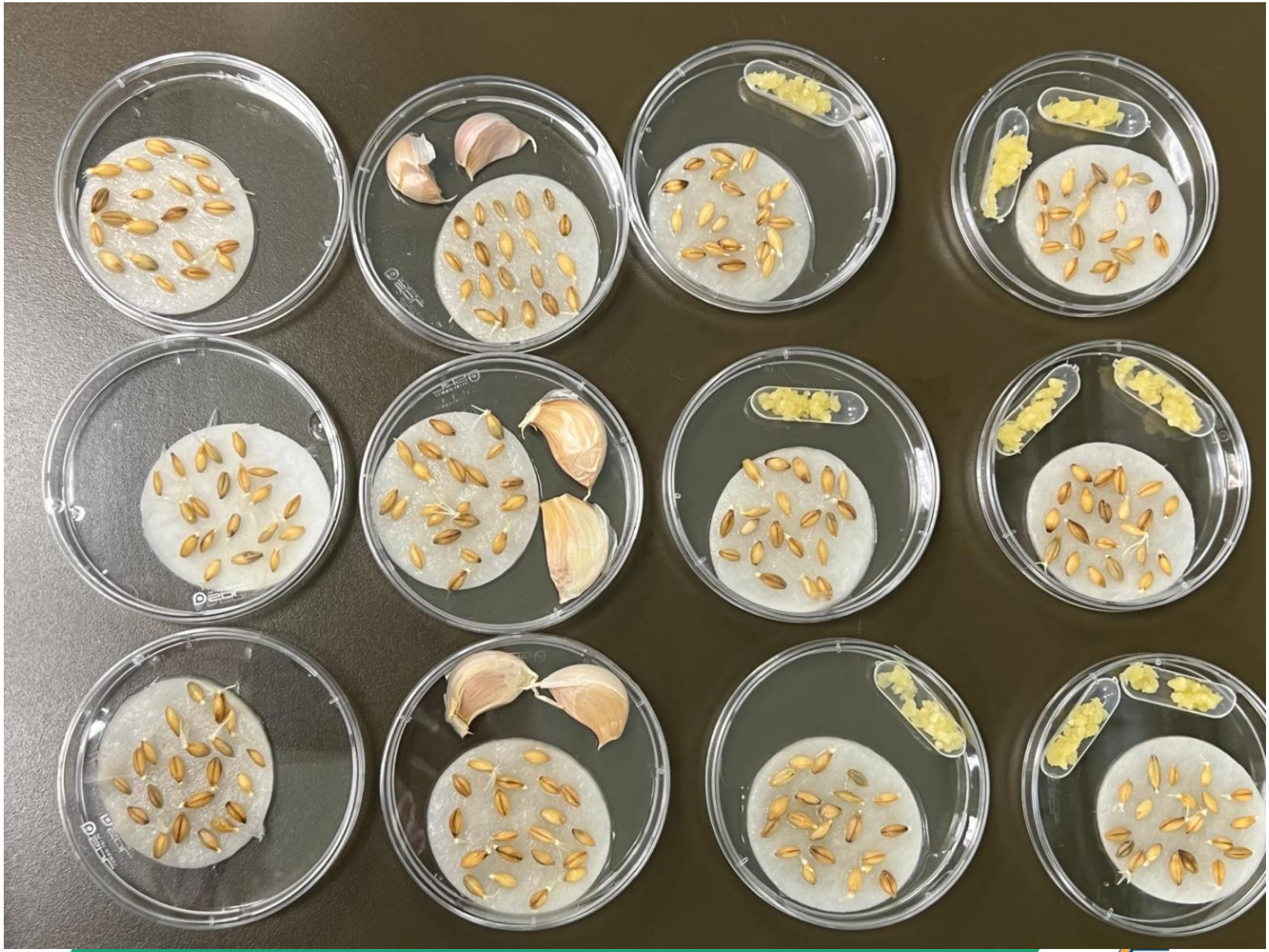
DV: growth of seedlings

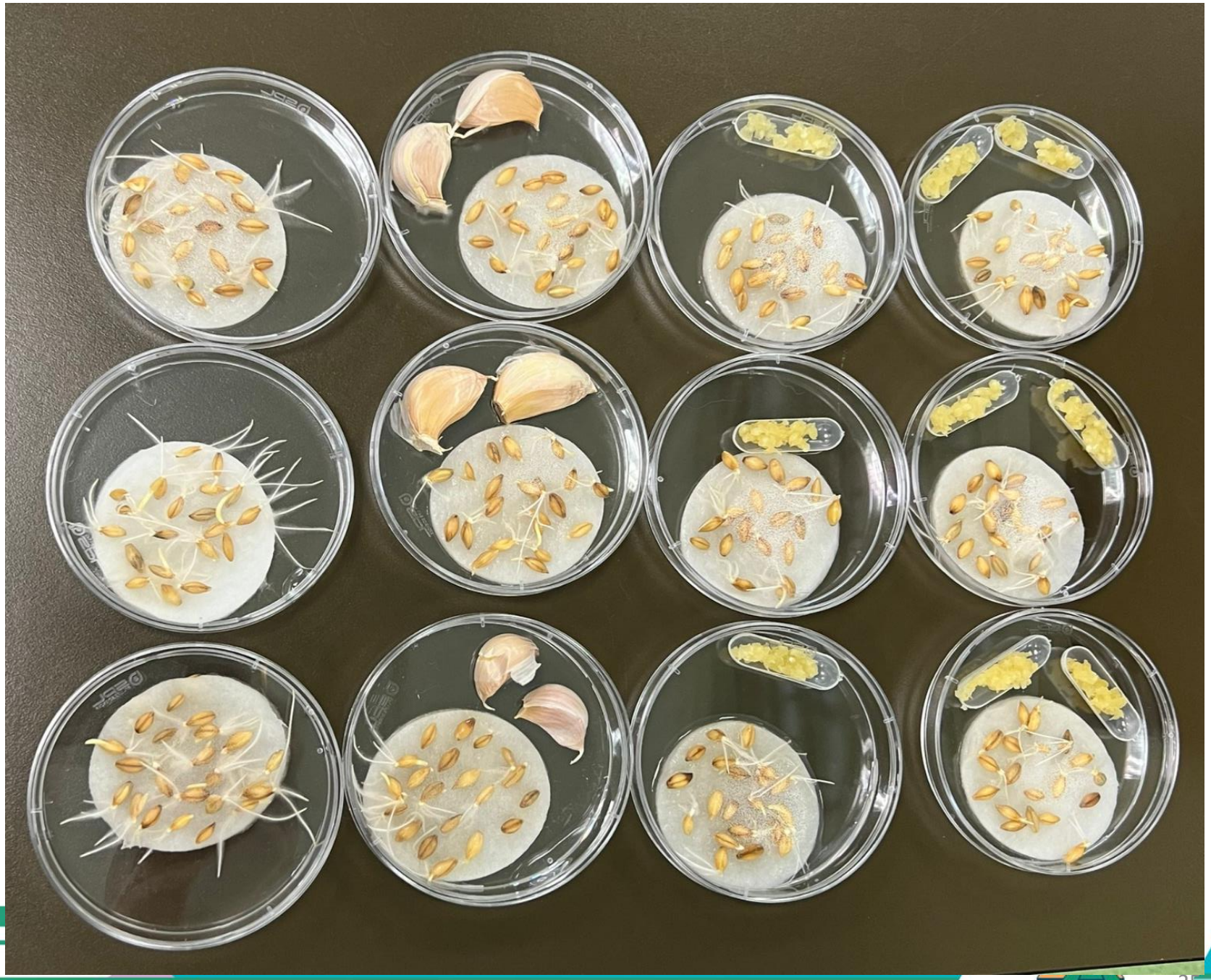
measurement of DV: by increase in height per day

control variables: number of seedlings per set-u surrounding temperature



Other parameters for measurements?





Example 3: *Transpiration*

Investigating transpiration in leafy shoots in the school garden

Some plant physiologists conduct research to understand the relationship between stomatal distribution and plant adaptations to various environmental conditions. They have designed different experimental set-ups to compare the transpiration rates between the upper and lower leaf epidermis of various plant species.

Your biology teacher has provided you with four different leafy shoots taken from different locations of the school garden. He has asked you to design an investigation to compare the transpiration rates between the upper and lower leaf epidermis of these shoots. The data may help the whole class to deduce the locations from which the leafy shoots were taken in the school garden.

Preparing for the investigation (B1) (Individual Task)

Investigation question:

- To compare the transpiration rates be

Instruction:

- Before collecting data on the leafy sh
  at least two set-ups that will enable y
- Draw your set-ups below.

The photograph shows the materials and

Leafy shoot	Water	
25 mL/50 mL measuring cylinder	Electronic balance	
Paraffin oil	Scissors	
Plastic dropper	Capillary tube	
Pipette filler	Rubber bung	
Stand and clamp	Paper towel	
Forceps	Test tube rack	
Stopwatch	Infra-red thermometer	

Notes:

- You may want to look for informatio
- You can request 1-2 additional materials and apparatus. Reasonable requests will be considered. (Remember scientists often work within a limited budget!).

A comparison of the stomatal density of upper and lower epidermis of leaves using leaf temperature

Background of the experiment

Stomata are small holes on the leaf surface that allow gases to enter or leave the leaf. Loss of water vapor through stomata is a major way of transpiration in plants. In this experiment, you are going to compare the stomatal density of the upper and lower leaf epidermis by measuring the surface temperatures with an infrared thermometer.

Design of the experiment

a) The temperature of the **upper surface** of a leaf is first measured with a thermometer.
b) The **lower surface** of the leaf is then smeared with Vaseline to block the transpiration from lower surface.
c) After **10 minutes**, the temperature of the **upper surface** of the leaf is measured again.
d) The difference in the temperature of the upper surface of a leaf before and after application of Vaseline can show the relative **stomatal density of the lower surface.**
e) The above processes are repeated on many leaves.
f) a)-e) are repeated by measuring the temperature of **lower surface** and application of Vaseline on **upper surface.**
g) By comparing the temperature changes of the upper and lower surface of leaves, we can compare the stomatal density of the upper and lower surfaces.

Preparing for the investigation (B1) (Individual Task)

Investigation question:

- To compare the transpiration rates between upper and lower leaf epidermis of different leafy shoots

Instruction:

- Before collecting data on the leafy shoots, you should use the materials and apparatus listed below to design *at least* two set-ups that will enable you to measure the transpiration rate of a leafy shoot accurately.
- Draw your set-ups below.

The photograph shows the materials and apparatuses available in the laboratory:

Leafy shoot	Water	Vaseline
25 mL/50 mL measuring cylinder	Electronic balance	Dry cobalt (II) chloride paper
Paraffin oil	Scissors	Adhesive tape
Plastic dropper	Capillary tube	1mL graduated pipette
Pipette filler	Rubber bung	Boiling tube
Stand and clamp	Paper towel	Spatula
Forceps	Test tube rack	Table lamp
Stopwatch	Infra-red thermometer	

Notes:

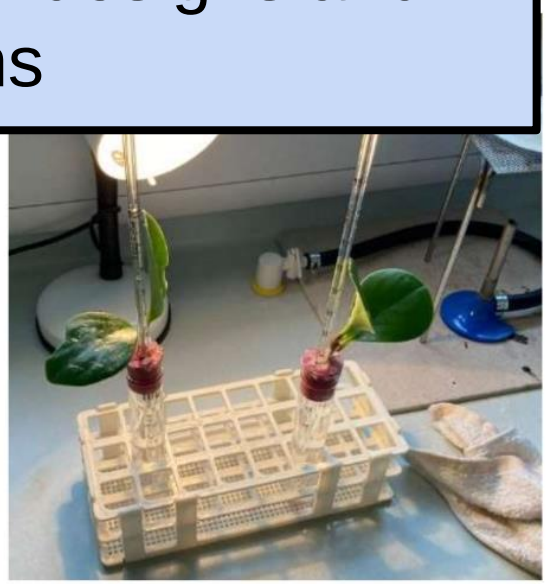
- You may want to look for information about possible set-ups and identify their common principles.
- You can request 1-2 additional materials and apparatus. Reasonable requests will be considered. (Remember scientists often work within a limited budget!).

Preparing for the investigation (B1) (Group Task)

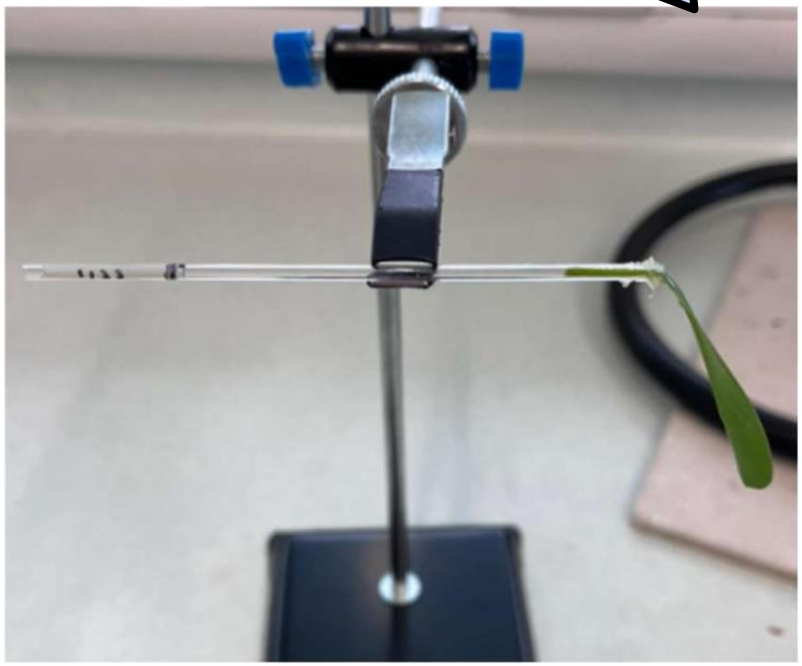
(a) Share your experimental designs and rationales with your peers. After discussing with them and conducting further research online using the iPad, identify *at least* two set-ups that your group think would be suitable for collecting data.

(b) Collect data using *at least* two set-ups to identify which one your group believes would be most suitable for the investigation. Explain the rationales.

Students share their designs and trial run their designs



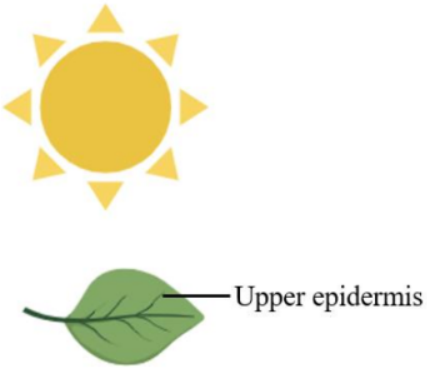
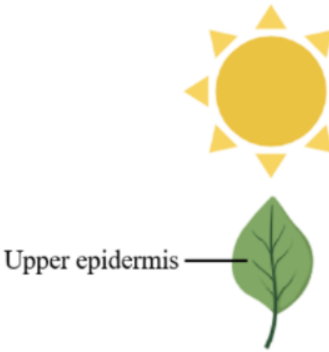
Students were shown the set-ups they would use in the actual practical work.



[A Transpiration Experiment Requiring Critical Thinking Skills | The American Biology Teacher | University of California Press (ucpress.edu)]

Examples of items in the B1 task sheet

(c) Student A suggested placing the leaf horizontally while Student B suggested placing it vertically.

Horizontal (proposed by student A)	**Vertical** (proposed by student B)
	

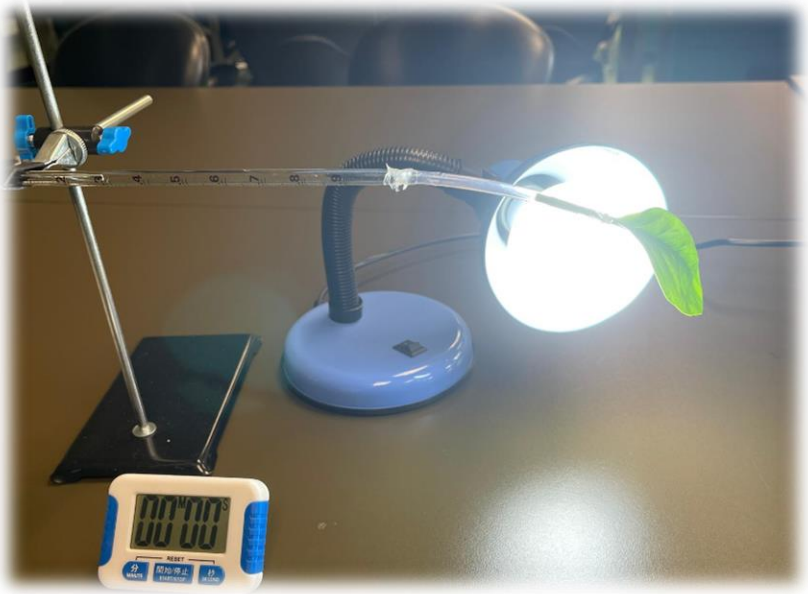
Visual scaffolds

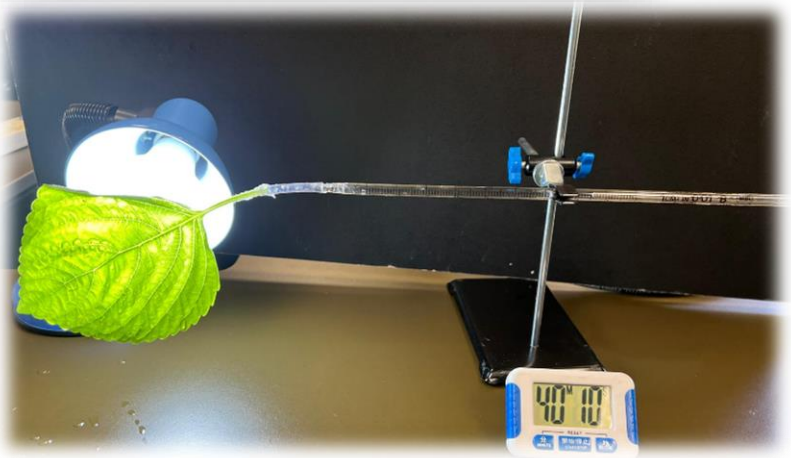
Which orientation of the leaf (horizontal or vertical) would y
answers.

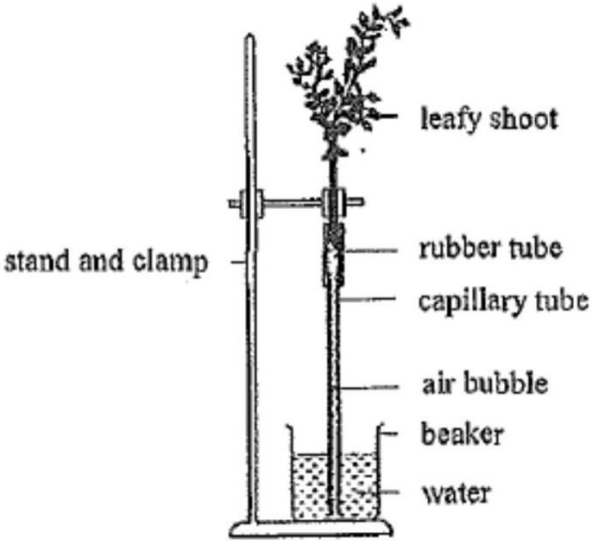
Orientation	**Explanation**
☐ Horizontal ☐ Vertical	

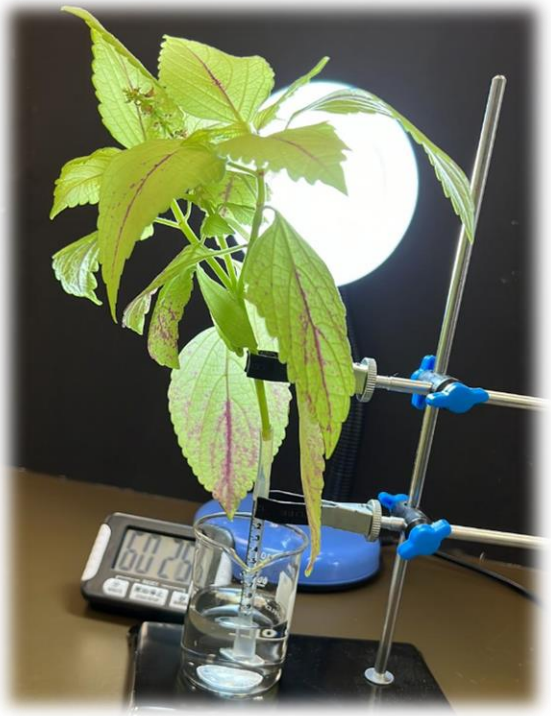
Visual organiser provides structure to elicit student reasoning

Inspirations






leafy shoot
stand and clamp
rubber tube
capillary tube
air bubble
beaker
water



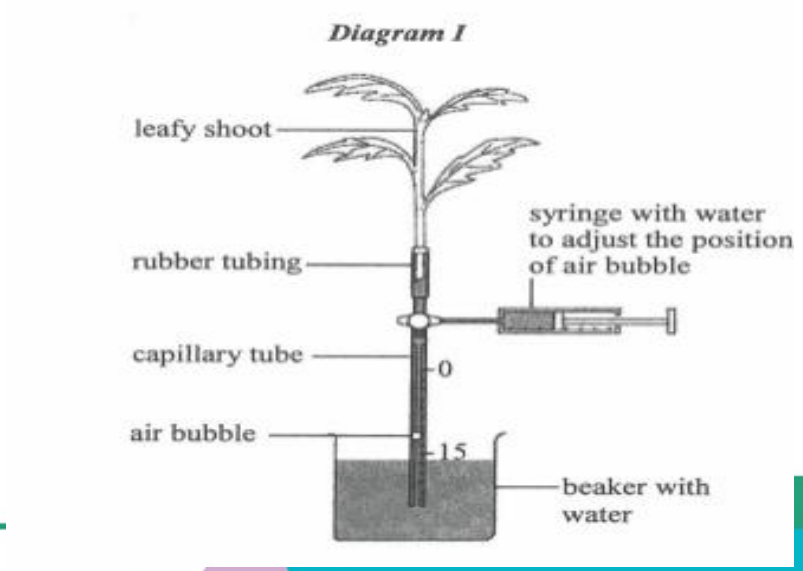
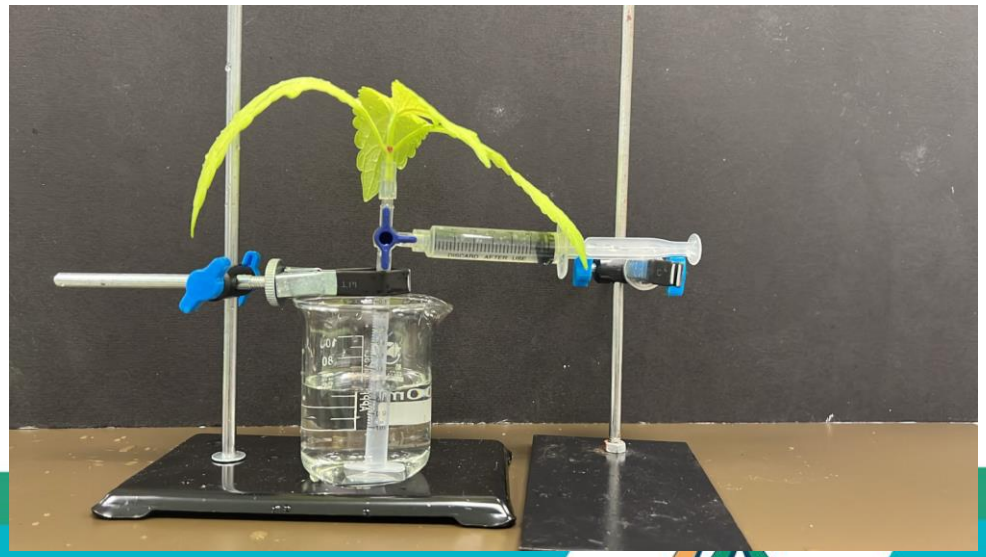
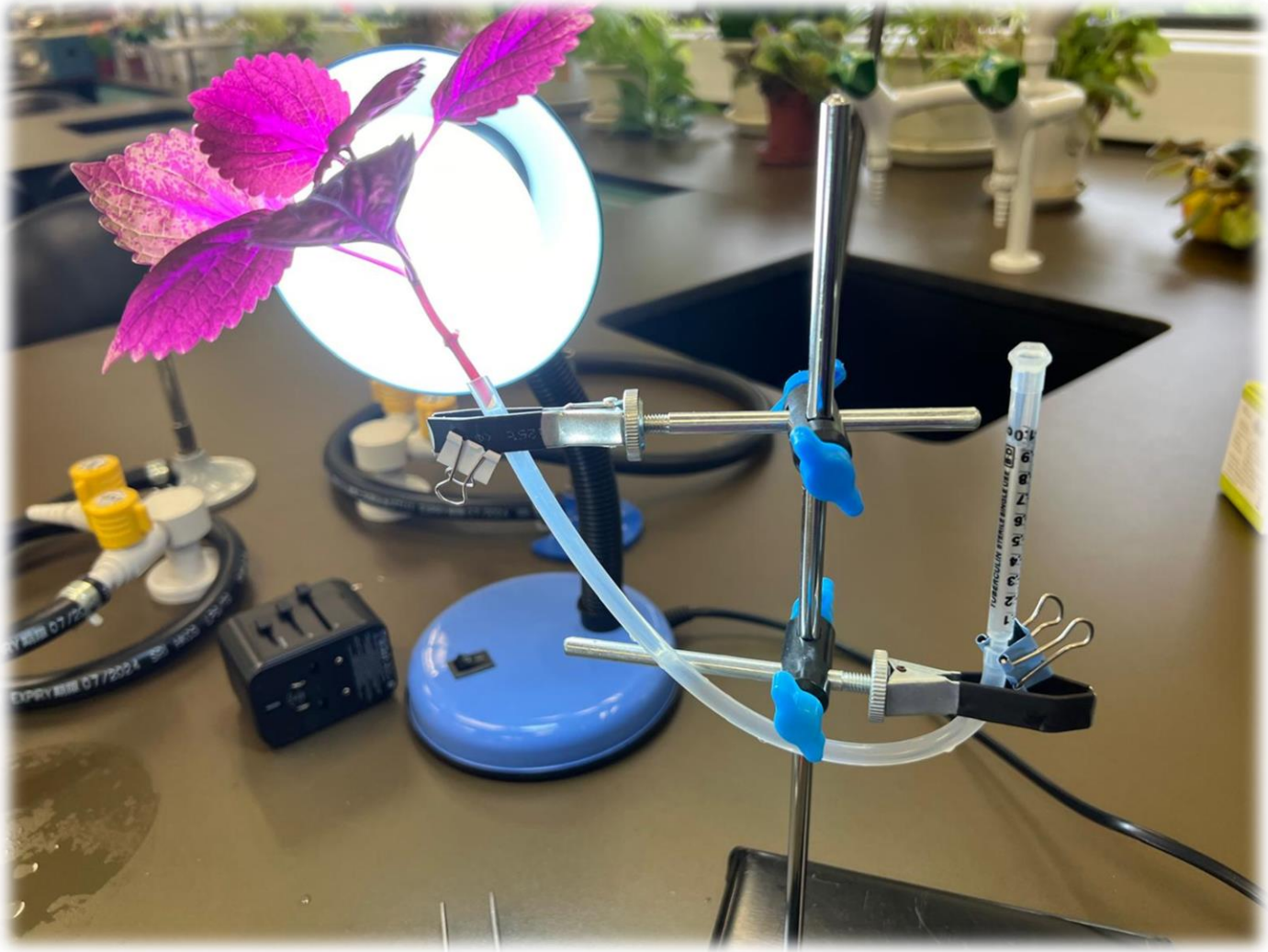


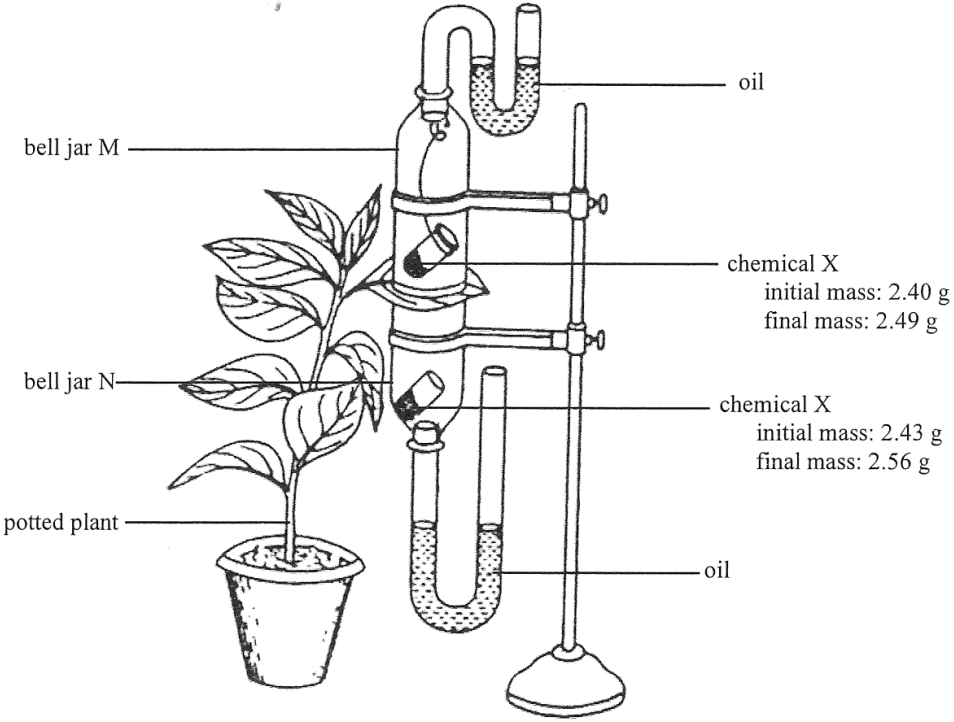
Diagram I
leafy shoot
rubber tubing
syringe with water
to adjust the position
of air bubble
capillary tube
0
air bubble
15
beaker with
water





What is in B2?

- Compare the differences in stomata distribution among the four types of leaves based on the data
- Assess the generalisability of measuring the transpiration rate of a leaf in relation to the results from a leafy shoot and a whole plant;
- Provide additional evidence that may support their data regarding the differences in transpiration rates as well as stomata distribution between the lower and upper epidermis
- Consider limitations of data by considering other factors (e.g., maturity of the leaves, type of leaf) that may be relevant for determining the location



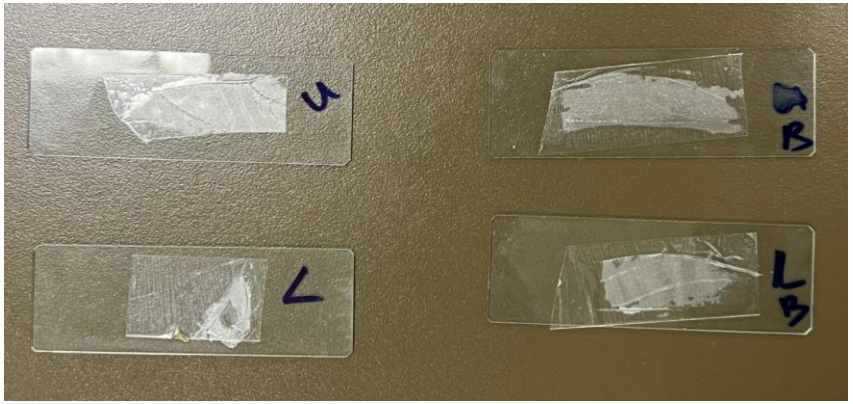
(ii) this is probably due to: (any ***one*** of the following)

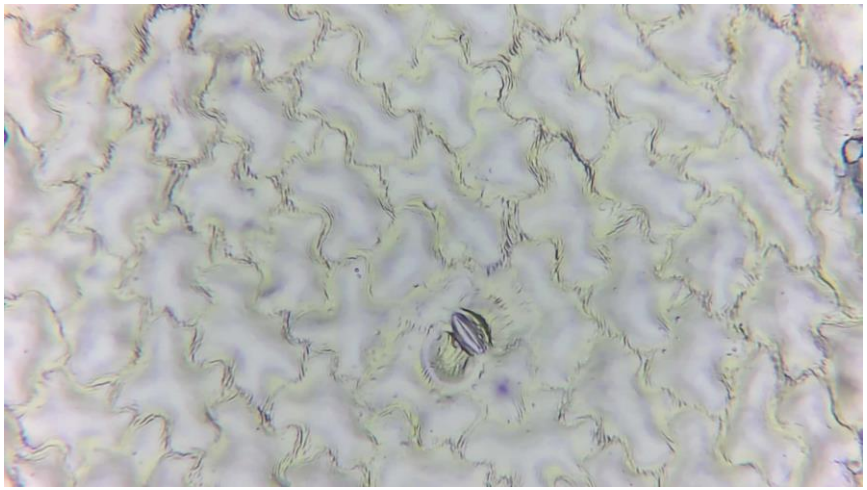
- different number of stomata in the upper and lower epidermises (1)
- different stomatal density of the upper and lower epidermises (1)
- different stomatal structures of the upper and lower epidermises (1)
- different thicknesses of the cuticles of the upper and lower epidermises (1)

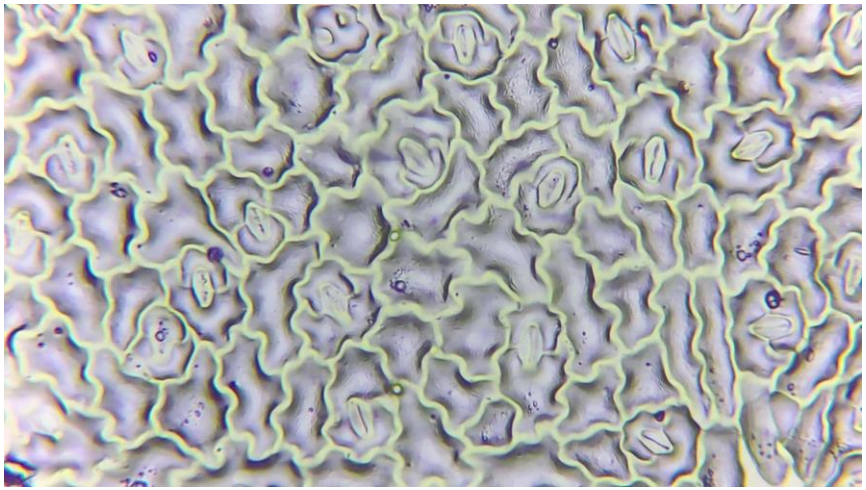
(iii) number of stomata / stomatal density: (any **one** set)

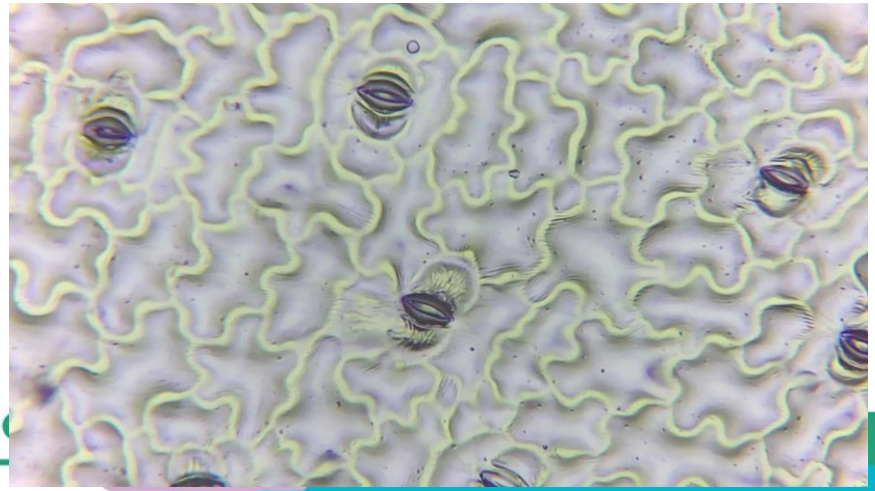
- microscopic examination of epidermal peel (1), count the number of stomata per unit area in the upper and lower epidermis (1)
- use nail polish to obtain a mold of the epidermis for microscopic examination (1), count the number of stomata per unit area in the upper and lower epidermis (1)
- immersion of the leaf in hot water (1), count the number of bubbles appearing on each surface per unit area of the upper and lower epidermis (1)

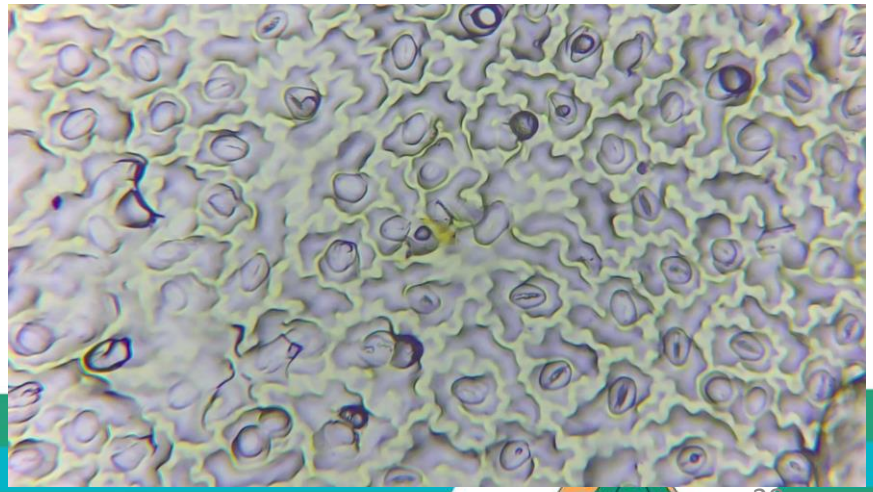
Inspirations

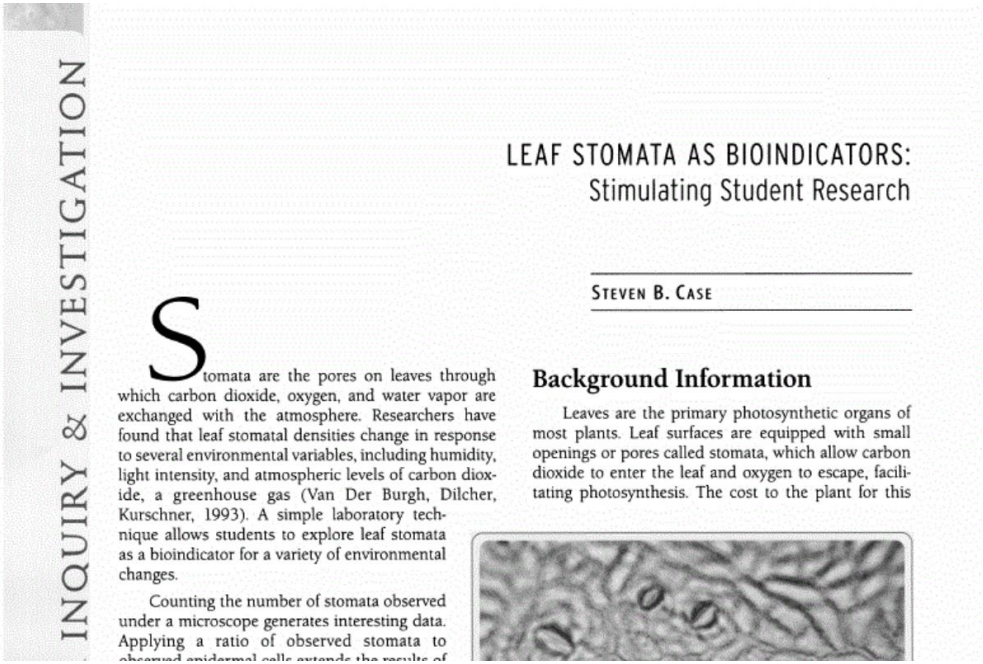












INQUIRY & INVESTIGATION

LEAF STOMATA AS BIOINDICATORS:
Stimulating Student Research

STEVEN B. CASE

Stomata are the pores on leaves through which carbon dioxide, oxygen, and water vapor are exchanged with the atmosphere. Researchers have found that leaf stomatal densities change in response to several environmental variables, including humidity, light intensity, and atmospheric levels of carbon dioxide, a greenhouse gas (Van Der Burgh, Dilcher, Kurschner, 1993). A simple laboratory technique allows students to explore leaf stomata as a bioindicator for a variety of environmental changes.

Counting the number of stomata observed under a microscope generates interesting data. Applying a ratio of observed stomata to

Background Information

Leaves are the primary photosynthetic organs of most plants. Leaf surfaces are equipped with small openings or pores called stomata, which allow carbon dioxide to enter the leaf and oxygen to escape, facilitating photosynthesis. The cost to the plant for this

[ERIC - EJ745303 - Leaf Stomata as Bioindicators: Stimulating Student Research, American Biology Teacher, 2006-Feb (ed.gov)]

[Environmental Correlates of Leaf Stomata Density (Description Guidelines) (esa.org)]

Scenario:

Respiration is the process by which organisms obtain chemical energy from food through the oxidative breakdown of food. The compound oxidised during respiration is called respiratory substrates. Yeasts are a group of organisms which are capable of using a variety of carbohydrates as their respiration substrates.

There are three unknown solutions which can provide the yeasts with respiratory substrates, namely solutions A, B and C. Solutions A, B and C can be pure water, pure glucose or 1:1 glucose/sucrose solutions at the same concentration. A brewer wants to identify the priority of yeasts in using solutions A, B and C as respiratory substrates, producing carbon dioxide at the highest rate, hence alcohol, for brewery.

Aim of the investigation:

To determine the rate of respiration of yeasts in different substrate solutions and identify the best solution for brewery

A study of the advantage of the prese

Introduction

One day, when Peter a
pondweeds had a red pig

Peter: I've read books ab
adapted to absorb
also have the same

Mary: I don't think so. I think the red pigm
not be damaged when the sunlight is too
in places with strong light.

What makes these tasks worthy of appreciation?

Investigating transpiration in leafy shoots in the school garden

Some plant physiologists conduct research to understand the relationship between stomatal distribution and plant adaptations to various environmental conditions. They have designed different experimental set-ups to compare the transpiration rates between the upper and lower leaf epidermis of various plant species.

Your biology teacher has provided you with four different leafy shoots taken from different locations of the school garden. He has asked you to design an investigation to compare the transpiration rates between the upper and lower leaf epidermis of these shoots. The data may help the whole class to deduce the locations from which the leafy shoots were taken in the school garden.

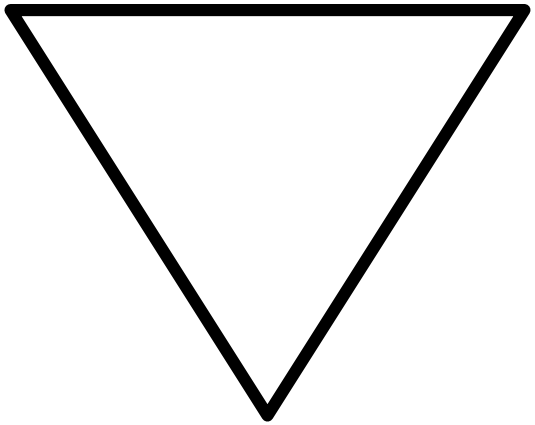
National Research Council. (2001). *Knowing what students know: The science and design of educational assessment*. National Academies Press.

Assessment Triangle

Observation

SBA Task

Interpretation



Cognition

(e.g., knowledge, skills, attitudes)

Scientific inquiry skills in B1 and B2

Validity refers to “what is assessed and how well this corresponds with the behaviour or construct that it is intended to test or assess.” (Harlen, 2005, p. 247).

Harlen, W. (2005). Trusting teachers’ judgement: research evidence of the reliability and validity of teachers’ assessment used for summative purposes. *Research Papers in Education*, *20*(3), 245–270.

What should be assessed in B1 and B2?

Memorisation of procedures

VS

Scientific inquiry skills related to designing investigation

Memorisation of results and findings

VS

Scientific inquiry skills related to data analysis and interpretation

Outline

- Inspirational ideas from practising teachers

- A diagnostic tool to facilitate teachers' SBA task design

Factors affecting the validity of assessment

Task selection

+

Task design

+

Administration of task

+

Scoring the responses

+

…….

pp.14-15 of the booklet

(5) Self-Assessment Tool for SBA Task Design

Introduction

- The following diagnostic self-assessment tool comprises a series of self-reflection questions designed to assist teachers in selecting appropriate tasks for the SBA and in designing specific guiding questions to meet the requirements of the new Area B1 format for the SBA.
- Please note that these self-reflection questions will be updated later to align with the new requirements of Area B2 for HKDSE 2027.
- Another tool to assist teachers in scoring SBA reports will be released during the Area B2 Scoring Workshop.

Self-Assessment Tool for SBA Task Design

- Answer the following questions to identify key red flags (🚩) in your SBA task, which indicate areas requiring attention.
- The greater the number of red flags you identify, the more likely you will need to consider using a different SBA task or modifying your current task for the Area B1 assessment.

		Yes	No
	Task Selection		
1.	Does the task involve practical work that merely demonstrates a phenomenon or a simple investigation addressing a yes/no question (e.g., "Is heat released during seed germination?")?	☐ 🚩	☐
2.	Does the task provide opportunities for students to demonstrate their understanding of scientific inquiry skills at all the performance levels (i.e., basic, good, excellent performances) outlined in the *Assessment Guidelines*?	☐	☐ 🚩
	Designing Guiding Questions		
	For Full Reports (if applicable)		
3.	Are the students aware that their responses in the full reports should address the relevant criteria in the *Assessment Guidelines*?*	☐	☐ 🚩
4.	Are the students aware that some parts of the full reports not addressing the *Assessment Guidelines* will not be awarded marks (e.g., aim of the investigation, procedures, safety precautions)?	☐	☐ 🚩
	Reports Using Specific Guiding Questions (if applicable)		
5.	Are questions that ask for discrete biology content knowledge without sufficient linkage to experimental design included (e.g., "What is the function of water in seed germination?")?	☐ 🚩	☐
6.	Are questions assessing scientific inquiry skills not with the *Assessment Guidelines* (e.g., safety precautions) included?	☐ 🚩	☐
7.	Are the questions specific enough to elicit students' understanding of scientific investigation skills that reflect the particular context/scenario of the investigation?	☐	☐ 🚩
8.	Are questions targeting the same criterion included to yield scores more than once?	☐ 🚩	☐
9.	Is each question annotated with the relevant criterion/criteria from the *Assessment Guidelines* in the task sheets/marked student reports/scoring guides?	☐	☐ 🚩
10.	Is the number of questions addressing different levels of performance (i.e., basic, good, excellent performances) balanced to effectively elicit a range of students' understanding?	☐	☐ 🚩

Notes: Teachers may consider using the new set of generic guiding questions for full reports <link>.

設計校本評核作業自我評估工具

- 回答下列問題以辨識你的校本評核作業，需要注意的地方(紅色警示旗 🚩)。
- 如你在校本評核作業識別出多項警示旗,代表你可能需要考慮使用另一項校本評核作業，或者對目前的作業做出修改以有效地作出 B1 評核。

		是	否
	評核作業選擇		
1.	作業所包括的實驗是否只用作演示現象，或者回答是/否探索問題的簡單探究 (例如，"探究萌發種子會否產生熱?")?	☐ 🚩	☐
2.	作業能否提供足夠機會，讓學生能展示他們在評分準則中，不同表現等級的科學探究技能(即基礎、良好、優秀表現) ?	☐	☐ 🚩
	設計指導性問題		
	完整探究報告 (如適用)		
3.	學生是否知道完整探究報告的內容，應符合*評分準則*的標準?	☐	☐ 🚩
4.	學生是否知道完整探究報告中，不涉及*評分準則*的部份(例如: 探究目標、實驗步驟、安全預防措施) 不會被評分?	☐	☐ 🚩
	使用具針對性及指導性問題的報告 (如適用)		
5.	題目涉及的生物知識，是否與實驗設計沒有足夠聯繫 (例如 "水在種子萌發過程的作用是什麼?")?	☐ 🚩	☐
6.	題目是否涉及不在*評分準則*中的科學探究技能 (例如: 安全預防措施)?	☐ 🚩	☐
7.	題目是否能針對特定背景/情景，以誘發學生表現出相應科學探究技能的理解?	☐	☐ 🚩
8.	不同題目是否涉及同一準則，令分數重複計算?	☐ 🚩	☐
9.	在工作紙/已批改的學生報告/評分標準中的每條題目，是否都標誌了在*評分準則*中的相關準則?	☐	☐ 🚩
10.	針對不同表現等級 (即基礎、良好、優秀表現) 的題目數量是否平衡，以有效誘發學生的各種理解?	☐	☐ 🚩

注意: 如老師要求學生撰寫完整探究報告，可以考慮使用新的通用指導性討論問題 <連結>。

Purpose of the tool

- To assist teachers in selecting appropriate tasks for the SBA and in designing specific guiding questions to meet the requirements of the new Area B1 format for the SBA

Task Sheet 1

設計實驗以探究萌發種子會否產生熱

完成實驗 22.4 後，小明知道活鼠(動物)的呼吸作用會產生熱。他想知道植物的呼吸作用是否也會生熱。

假如你是小明。設計並進行實驗，探究種子會否產生熱。

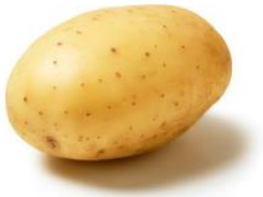
The investigation addresses a yes/no question which require a limited variety of scientific skills in designing the experiment.

完 植物的呼吸作用是否也
會

		Yes	No
Task Selection			
1.	Does the task involve practical work that merely demonstrates a phenomenon or a simple investigation addressing a yes/no question (e.g., "Is heat released during seed germination?")?	✔	☐
2.	Does the task provide opportunities for students to demonstrate their understanding of scientific inquiry skills at all the performance levels (i.e., basic, good, excellent performances) outlined in the *Assessment Guidelines*?	☐	✔

探究溫度對澱粉酶活性的影響

小明喜歡吃馬鈴薯。他希望探究溫度對澱粉酶活性的影響。



1. 實驗的目的是什麼?
2. 馬鈴薯主要的成分是什麼?
3. 寫出分泌到口腔唾液中用於消化馬鈴薯的名稱?
4. 寫出一文字方程式以顯示唾液對馬鈴薯主要營養成分的消化。
5. 寫出以下各項變量

自變量	因變量	控制變量

6. 寫出實驗兩項安全預防措施。
7. 寫出實驗主要主步驟。

探究溫度對澱粉酶活性的影響

小明喜歡吃馬鈴薯

Q.2 to Q.4 focus on discrete content knowledge that is not integrated with scientific inquiry skills.

1. 實驗的目的是什麼?

2. 馬鈴薯主要的成分是什麼?

3. 寫出分泌到口腔唾液中用於消化馬鈴薯的名稱?

4. 寫出一文字方程式以顯示唾液對馬鈴薯主要營養成分的消化。

5. 寫出以下各項變量

自變量	因變量	控制變量

6. 寫出實驗兩項安全預防措施。

7. 寫出實驗主要主步驟。

探究溫度對澱粉酶活性的影響

小明喜歡吃馬鈴薯

Q1, Q6, Q7 assess scientific inquiry skills ***NOT*** in the Assessment Guidelines.

1. 實驗的目的是什麼?

Reports Using Specific Guiding Questions (if applicable)			
5.	Are questions that ask for discrete biology content knowledge without sufficient linkage to experimental design included (e.g., "What is the function of water in seed germination?")?	✔	☐
6.	Are questions assessing scientific inquiry skills not with the *Assessment Guidelines* (e.g., safety precautions) included?	✔	☐
7.	Are the questions specific enough to elicit students' understanding of scientific investigation skills that reflect the particular context/scenario of the investigation?	☐	✔

6. 寫出實驗兩項安全預防措施。

7. 寫出實驗主要主步驟。

探究溫度對澱粉酶活性的影響

小明喜歡吃馬鈴薯。

Most questions only elicit scientific inquiry skills at the basic performance levels.

1. 實驗的目的是什麼?

10.	Is the number of questions addressing different levels of performance (i.e., basic, good, excellent performances) balanced to effectively elicit a range of students' understanding?	☐	✔

5. 寫出以下各項變量

自變量	因變量	控制變量

6. 寫出實驗兩項安全預防措施。

7. 寫出實驗主要主步驟。

Example 2

Task Sheet 3
Experimental question *How does the concentration of ethanol affect the membrane permeability of beetroot?* ***Design*** 1. What are the major components of a cell membrane? 2. Which component will be dissolved by the ethanol? Explain your answer. 3. What will happen if cells of beetroot are immersed in ethanol? 4. What is the independent variable in this experiment? 5. What is the dependent variable of this experiment? How do you measure it? 6. State *at least* two control variables of this experiment to make it a fair test. 7. What are the major assumptions underlying the whole experimental design?

Task Sheet 4

Experimental question

How does the concentration of ethanol affect the membrane permeability of beetroot?

Design

1. In this experiment, we are investigating how a factor (independent variable, IV) affects another factor (dependent variable, DV). What are the DV and IV of this experiment?
2. Explain how the membrane permeability of the beetroot cells can be measured based on the above information. Suggest an accurate and reliable method for the measurement.
3. What do you predict the results when beetroot tissues are put into different concentrations of ethanol?
4. Will you (1) put the same beetroot into different concentrations of ethanol one after one, or (2) put different beetroot into different concentrations of ethanol? Discuss the strengths and drawbacks of each design.
5. Your teacher stresses that the beetroot has to be cut into same size and shape in each concentration of ethanol. Explain why it is needed.
6. One student proposes putting a 3 cm cylinder of beetroot into each concentration of ethanol. Another student thinks the cylinder should be cut into three 1-cm discs to be put into each concentration of ethanol. Which one do you think is better? Explain why.
7. Apart from ethanol and the shape and size of beetroot, are there other factors that may affect the leakage of pigment from beetroot cells? Explain your answers. How can these factors be controlled?
8. Do you think the volume of ethanol (not the concentration) bathing the beetroot needs to be kept the same for each treatment? Explain your answer.
9. What is the major assumption underlying the whole experimental design? (*An assumption is something we think it is true, though we cannot be sure. A major assumption is the one that the experiment cannot make any conclusion without assuming it to be true*).

Example 3

Task Sheet 5 (with student response)

6. Which of the following are the variables that **must** be kept the same? Put a "✓" in the corresponding box(es). Explain how these variables will affect the result if they are not kept the same.

U☐ B☐ G☐ E☐
U☐ B☐ G☐ E☐
U☐ B☐ G☐ E☐
U☐ B☐ G☐ E☐

☑ volume of ethanol	☑ temperature of ethanol	☐ concentration of ethanol
☑ size and shape of beetroot discs	☑ time for rinsing the beetroot discs	☐ time for shaking the test tubes

As the more the volume of ethanol added to the discs the more of ethanol particles increase which more membrane will be cells damaged

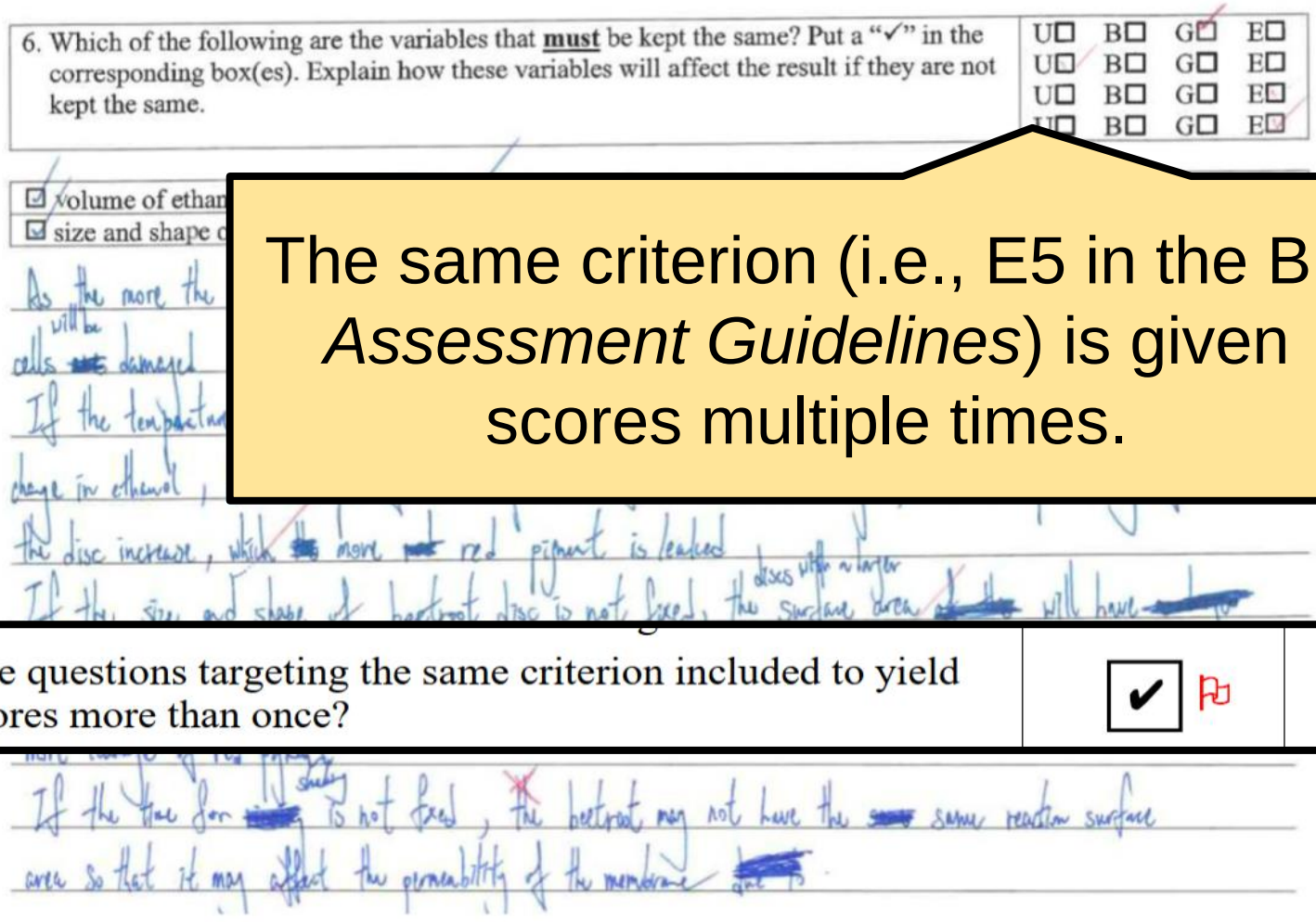
If the temperature of ethanol is not fixed, the permeability of the disc may change due to the temperature change in ethanol, for example if the temperature of the ethanol is higher, then the permeability of the disc increase, which more red pigment is leaked

If the size and shape of beetroot disc is not fixed, the discs with a larger surface area will have more leakage of red pigment

If the time for shaking is not fixed, the beetroot may not have the same reaction surface area so that it may affect the permeability of the membrane

Example 3

Task Sheet 5 (with student response)



6. Which of the following are the variables that **must** be kept the same? Put a "✓" in the corresponding box(es). Explain how these variables will affect the result if they are not kept the same.

U☐ B☐ G☐ E☐
U☐ B☐ G☐ E☐
U☐ B☐ G☐ E☐
U☐ B☐ G☐ E☐

☑ volume of ethan
☑ size and shape

As the more the
will be
cells damaged
If the temperature
change in ethanol,
the disc increase, which more red pigment is leaked
If the size and shape of beetroot disc is not fixed, the surface area will have
discs with a larger
If the time for soaking is not fixed, the beetroot may not have the same reaction surface
area so that it may affect the permeability of the membrane

The same criterion (i.e., E5 in the B1 *Assessment Guidelines*) is given scores multiple times.

8.	Are questions targeting the same criterion included to yield scores more than once?	✔	☐

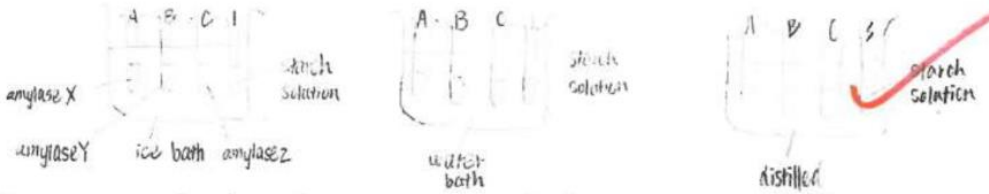
Example 4

Task Sheet 6 (with student response)

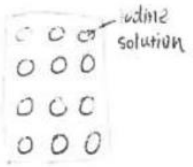
(d) Describe the procedures. Include any precaution. (4 marks) G10 Marks_____

① Add 1 cm^3 of amylase solution to X, Y, Z to test tube A to C and add 5 cm^3 of starch solution to test tubes A to C, 1 to 3

② Put the test tubes into beakers of water at the set temperatures (ice bath, water bath and distilled water). Leave the tubes into the beakers for 10 minutes.



③ Add two drops of iodine solution into each of the wells of a spot plate



④ For each beaker, pour the starch solution into the test tube containing amylase solution. Keep the mixture in the water bath at the set temperatures throughout the investigation after mixing.

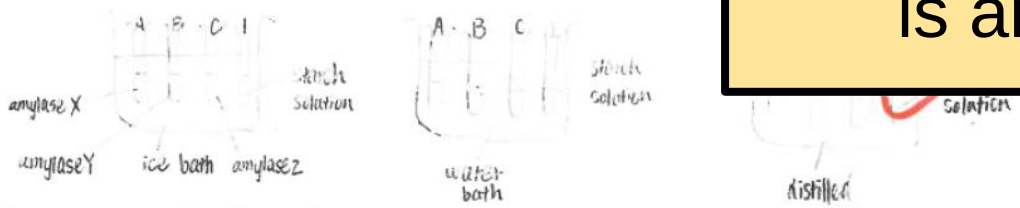
Example 4

Task Sheet 6 (with student response)

(d) Describe the procedures. Include any precaution. (4 marks) G10

① Add 1 cm^3 of amylase solution to X, Y, Z to test tube A to C and add 5 cm^3 of starch solution to test tubes A to C, 1 to 3

② Put the test tubes into beakers of water at the set temperature. Leave the tubes into the beakers for 10 minutes.



③ Add two drops of iodine solution into each of the wells of a spot plate

The relevant criterion is annotated.

9.	Is each question annotated with the relevant criterion/criteria from the *Assessment Guidelines* in the task sheets/marked student reports/scoring guides?	✔	☐

④ For each beaker, pour the starch solution into the test tube containing amylase solution. Keep the mixture in the water bath at the set temperatures throughout the investigation after mixing.

P.

4

Example 4

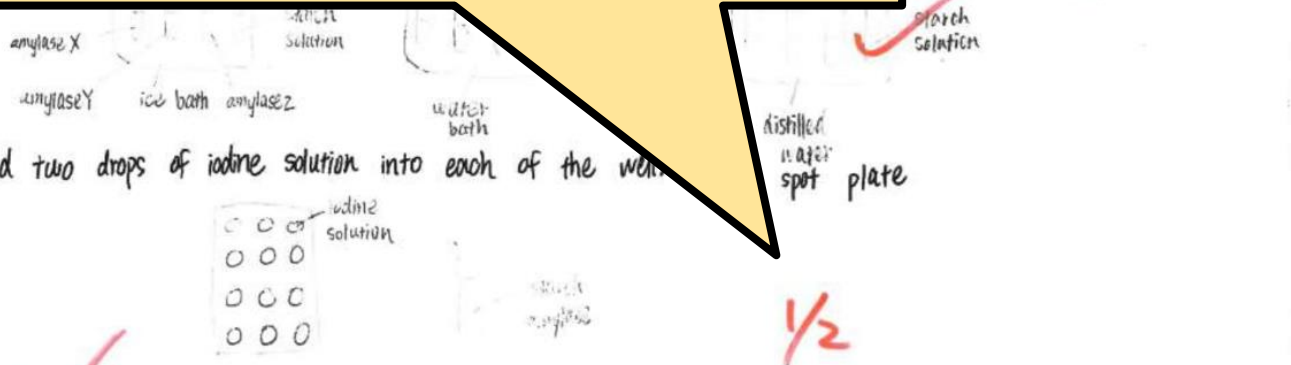
Student responses **not** related to the criteria in the *Assessment Guidelines* were awarded marks (i.e., procedures).

sponse)

G10 Marks_____

^{3} of starch solution

ath, water bath and distilled



③ Add two drops of iodine solution into each of the wel

④ For each beaker, pour the starch solution into the test tube containing amylase solution. Keep the mixture in the water bath at the set temperatures throughout the investigation after mixing.

Example 4

Task Sheet 6 (with student response)

(d) Describe the procedures. Include any precaution. (4 marks) G10 Marks_____

① Add 1 cm^3 of amylase solution to X, Y, 2 to test tube A to C and add 5 cm^3 of starch solution to test tubes 1 to 3

, water bath and distilled

E

Marking conventions are **not** easily understood by a professional colleague.

½

④ For each beaker, pour the starch solution into the test tube containing amylase solution. Keep the mixture in the water bath at the set temperatures throughout the investigation after mixing.

P.

4

Summary

- Many teachers have updated their SBA tasks in line with the requirements of the new formats
- Teachers are encouraged to explore more diverse investigative tasks for SBA assessment, particularly those that are engaging, exhibit a certain level of complexity, and require novel experimental designs that students cannot easily replicate from textbooks

Summary

- Some modifications can make the tasks more meaningful and valid.

- These include
  - changing verification-type practical to problem solving/hypothesis-testing tasks/use of data for decision-making purposes.
  - changing a bit the content of the practical (e.g., chemicals, use of different set-ups).
  - use of specific guiding questions.

Summary

- The S*elf-Assessment Tool* for SBA Task Design consists of reflection questions that serve as important reminders for assessing suitability of SBA tasks

Look forward to sharing more tasks from the biology teacher community!

A website with ideas for teaching scientific inquiry skills in biology

Aims of the website

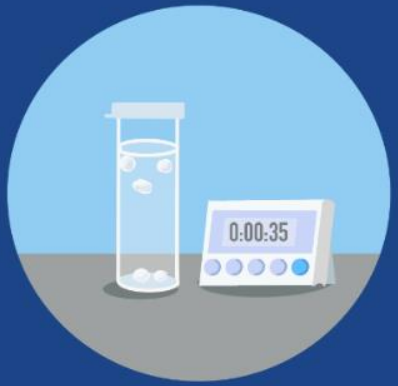
- To share teaching and learning resources for designing and implementing scientific investigations
- To encourage professional exchange amongst teachers

Notes:

- The tasks were not designed for SBA and they are **NOT** approved by the HKEAA
- However, the tasks provide ideas for scenario setting and ***some*** may be modified for SBA purposes

Some package is developed based on and extended from the sample tasks released.

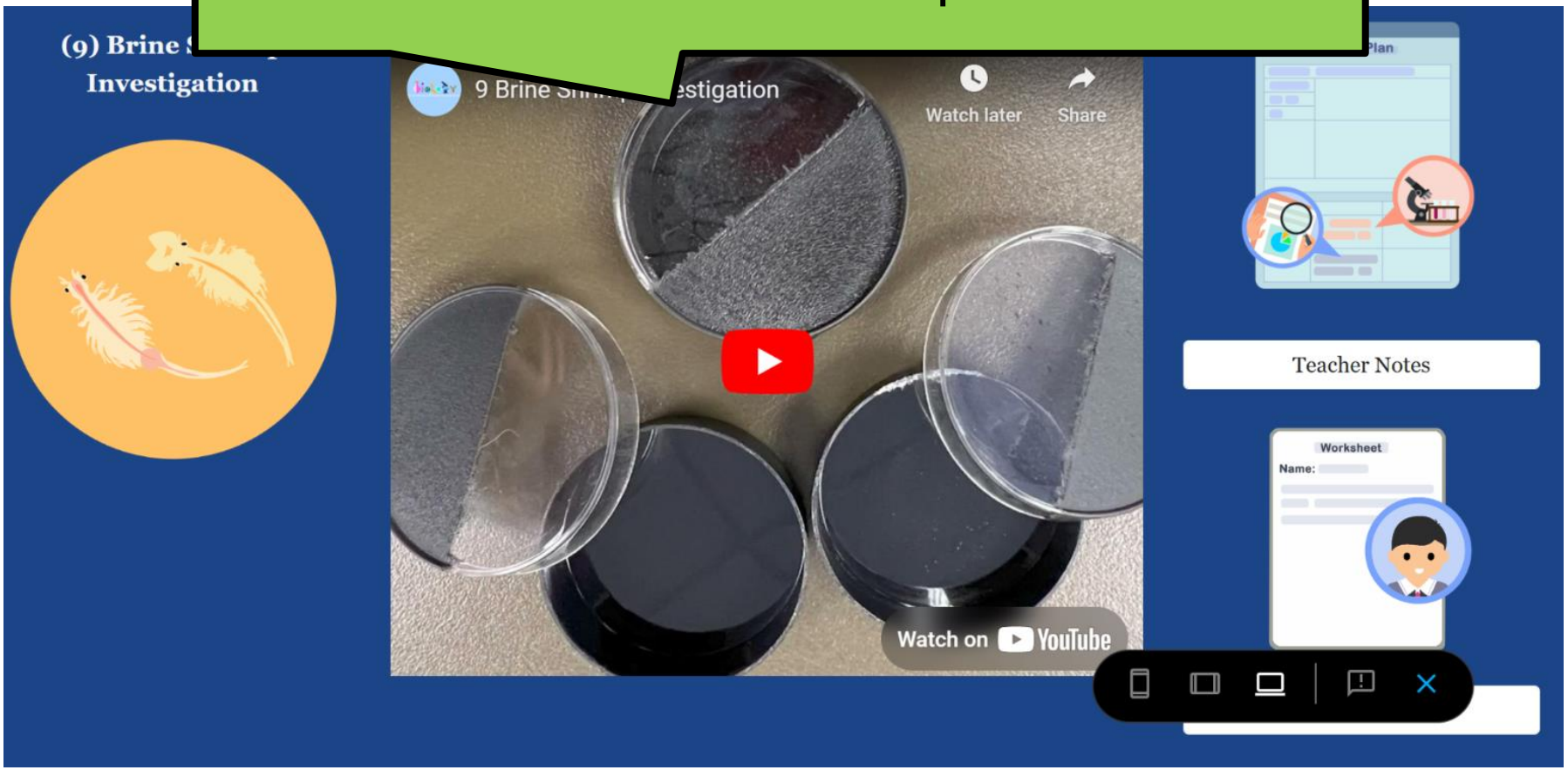
(3) Yeast Bead Catalase Investigation



Teacher Notes

Student Worksheets

Some package comprises more open-ended scientific inquiries.

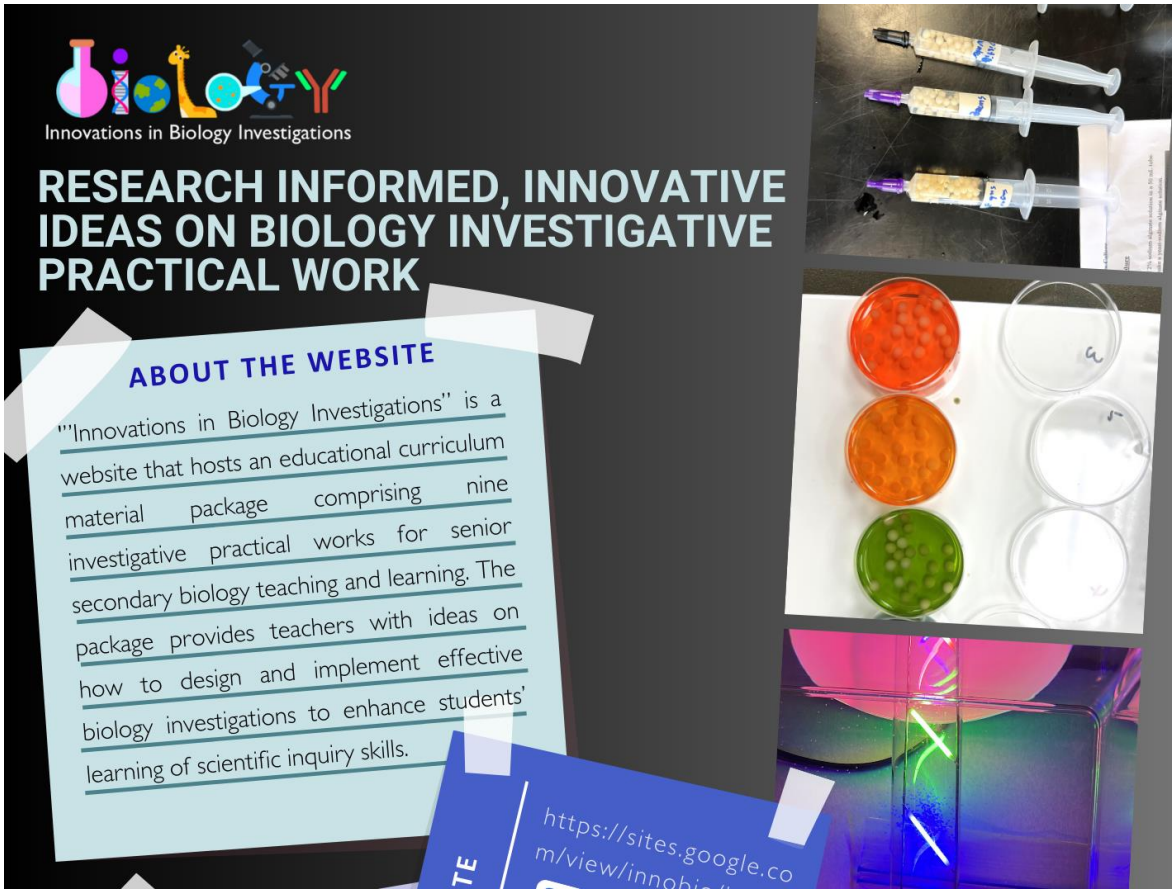


Stage	Design principles	Implementation strategies
❶ Preparing for the investigation	▪ Situate the investigations in meaningful scenarios/contexts relevant to students (**Contextualisation**) ▪ Provide sufficient background information for students to comprehend the context of the investigation ▪ Assess students' background knowledge related to the investigation ▪ Allow students to raise questions about the investigation or the context	• Reading Materials • Diagnostic Assessment • *See-Think-Wonder* Chart • Driving Question Board
❷ Planning and designing the investigation	▪ Allow students to design their own set-ups ▪ Show students the materials and apparatuses to facilitate their design ▪ Allow students to trial run their designs and set-ups	• Investigation Planning Template • Annotated Diagrams • Virtual Laboratory
	▪ [illegible] in collecting a large set of data (e.g., repeating their measurements, setting up replicates) (**Complex Data Set**) ▪ Perform a demonstration of difficult procedures ▪ Provide support for data collection (e.g., data collection sheet, guidance on procedures [e.g., video]) ▪ Allow students to use digital tools to collect and record data	• Data Collection Sheet • Digital Tool (e.g., camera for recoding (time-lapse) videos/data)
❹ Analysing, interpreting, evaluating and explaining data	▪ Allow students to use digital tools to visualise, represent and analyse data ▪ Engage students in analysing and interpreting complex data sets ▪ Allow students to compare their data sets with those of other groups ▪ Involve students in assessing the quality of their data by critically evaluating their own and their peers' data (or class data) ▪ Have students use data to make or evaluate claims and scientific explanations/make decisions/solve problems (**Explanation Construction/Decision-making/Problem-solving Task**) ▪ Promote student reflection on the process of the investigation (e.g., learning from errors, improving the experimental designs)	• Digital Tool (e.g., *Google Sheet* for recording and manipulating data) • Data-sharing Web Platform • Inquiry Display Board • Reflection Card or Journal

Embedding **scaffolds and structures** for students to express their thinking
Orchestrating **meaningful dialogues** around important scientific thinking
Providing substantive **feedback** to advance student thinking

Design principles and implementation strategies for effective scientific investigations.

If you wish, you can take ***a leaflet*** that has a QR code linking to the website.




Innovations in Biology Investigat...
Introduction
Investigations
More
Edit logo
Conclusion
Future Initiatives
Resources
Getting Involved
We are actively developing new resources, and we encourage you to contribute to our initiatives.

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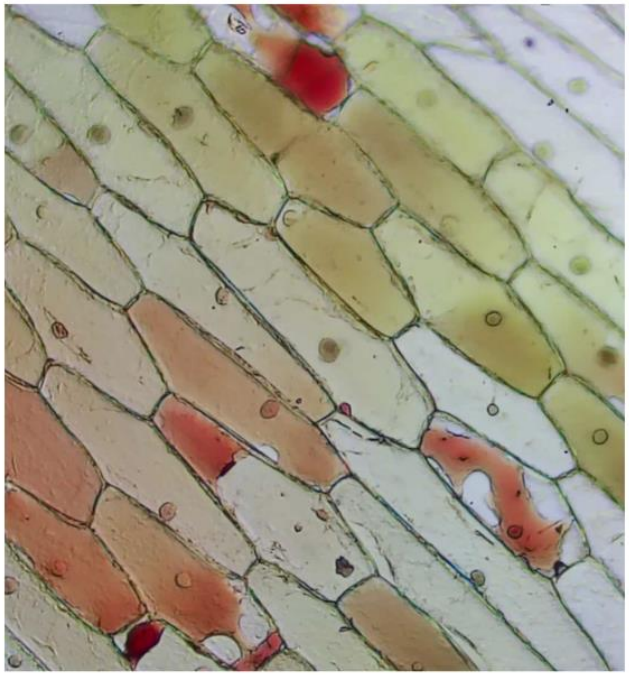
- Our team is developing the following educative curriculum materials to enhance the teaching and learning of biology/science. Watch out for new updates:
  - Biology investigations that can enhance students' ability to analyse and interpret more complex scientific data and evidence critically (using digital tools).
  - Integrating scientific inquiry skills into day-to-day biology/science teaching.
  - Infusing engineering practices into biology investigations using engineering design cycle.
  - Enhancing the authenticity of biology investigations using a model-based inquiry approach/scientific modelling.
- There are three ways you can get involved: (1) submitting instructional materials for modification; (2) becoming a task reviewer; and (3) trying out some of the units and co-designing them.



- Click the relevant button below to fill out the relevant *Google Form* if you're interested.

Contributing Materials | Reviewing Units | Implementing Units

Innovations in Biology Investigations

Innovations in Biology Investigations

Thank you for your interest in co-designing and/or enacting some of the unit in-the-making. The project will contact you when appropriate.

kennedyckh@gmail.com Switch account

Not shared

* Indicates required question

Name: *

Your answer

Contact information

Kennedy Chan

(kennedyckh@hku.hk)