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

香港中學文憑考試

Hong Kong Diploma of Secondary Education Examination

生物

Biology

校本評核會議資料 2024-2025

School-based Assessment Conference Materials 2024-2025

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Notes

- This booklet contains some examples of how to design and implement SBA tasks. These materials are intended to demonstrate the various ways teachers can use the new SBA format to assess and support student learning. It is important to emphasise that there is no one-size-fits-all approach to instructional and assessment materials and methods. Teachers are strongly encouraged to adapt the provided materials based on their specific context.
- It is important to note that the examples included are *not* tasks approved by the HKEAA. Instead, they are intended to inspire teachers to develop their own SBA assessment tasks.
- We would like to thank the teachers for their generosity in allowing us to share their materials.

(1) Summary of Changes in SBA Formats (with updates)

Below is a summary of the changes in School-based Assessment (SBA) formats. Updates are highlighted in grey.

New format of the SBA (from 2024 HKDSE)

- Students are *not* required to write full experimental procedures.
- Students can be guided by *specific* questions on experimental designs.
- B1 and B2 can be assessed using different experiments. Please note that the hands-on component of the investigative practical work should still be conducted, even if the assessment is only done in B1/B2.
- B2 remains unchanged.

Notes

- Teachers should assess student work according to the performance descriptors outlined in the *SBA B1 Assessment Guidelines* (pp. 3–4) and the *SBA B2 Assessment Guidelines* (pp. 5–6) included in the conference materials released for 2023–2024. See this <link>.

New format of the SBA (from 2027 HKDSE)

- B1 remains unchanged (i.e., same as 2024 and 2025 HKDSE).
- The new B2 *Assessment Guidelines* should be used.
- The draft version of the *SBA B2 Assessment Guidelines* can be found on pp. 3–6. Please note that the guidelines may be slightly modified based on student samples collected and consensus marking.

(2) SBA Assessment Guidelines (Area B2 from 2027 HKDSE)

Assessment Guidelines for Results and discussions (B2): (DRAFT VERSION) (From 2027 HKDSE)

Mark range	Quality of work	Performance
9-10	Excellent	The report shows most of the good performances and a few excellent performances.
6-8	Good	The report shows most of basic performances and some good performances.
3-5	Fair	The report shows some basic performances and a few good performances.
1-2	Poor	The report shows a few basic performances.

	Basic Performances	Good Performances	Excellent Performances
Data Recording, Analysis & Interpretation	B1. Record qualitative data using clear descriptions/quantitative data (e.g., corrected to appropriate decimal places/significant figures) properly.	G1. Construct and use appropriate representations (e.g., tables, graphs and/or diagrams) to organise and display data.	
	B2. Carry out basic calculations (e.g., percentages, frequencies, rates, means, ratios) to simplify or summarise data.	G2. Compare data sets based on (semi-)quantitative and/or qualitative data.	E1. Apply concepts of basic statistics (e.g., range, variance, standard deviation, error bar) to compare and explain data sets.
	B3. Identify anomalous data, if any, in the data set.	G3. Explain why the data are considered anomalous.	E2. Suggest possible explanations for anomalous data (e.g., human errors) or ways to confirm if the data are anomalous.
			E3. Interpret the results in the control(s) to evaluate the success of the experiment/the influence of the experimental manipulation.
Constructing & Evaluating Explanations	B4. Describe and interpret the relationships/trends and patterns in the data sets, if any, in relation to the investigative problem.	G4. Explain the relationships/trends and patterns in the data sets in relation to the investigative problem using scientific ideas and principles.	
		G5. Describe and interpret the relationships/trends and patterns in more complex data sets (e.g., with multiple variables), if any, in relation to the investigative problem.	E4. Explain the relationships/trends and patterns in more complex data sets (e.g., with multiple variables) in relation to the investigative problem using scientific ideas and principles.
		G6. Evaluate if the testing hypothesis, if any, is supported, refuted, or remains undetermined according to the data.	E5. Discuss alternative hypothesis, if any.
	B5. Make (a) claim(s) in relation to the investigative problem based on data.	G7. Construct (an) evidence-based claim(s) in relation to the investigative problem using relevant data.	E6. Construct (an) evidence-based claim(s) in relation to the investigative problem using relevant data and reasoning/Evaluate (a) claim(s)/alternative explanations in relation to the investigative problem using relevant data and reasoning.

Errors, Limitations & Improvement		G8. Identify significant measurement errors (e.g., uncertainties/errors in the measurement system, including random and systematic errors).	E7. Explain the impact of measurement error(s) on the validity and reliability of data/conclusion.
		G9. Suggest valid improvements to reduce (the impact of) measurement error(s) (e.g., using better tools, repeating measurements).	E8. Explain why the improvements can reduce (the impact of) measurement error(s).
		G10. Explain the limitations of experimental design in generating data to answer the investigative problem (e.g., sample selection, sample size, range and intervals).	E9. Suggest and explain valid improvements/further data collection to address the limitations of the experimental design in relation to the investigative problem.
Future work & Conclusion		G11. Make informed decisions in relation to the investigative problem based on the relevant data/findings of the investigation.	E10. Make informed decisions in relation to the investigative problem based on relevant data/findings of the investigation with reasoning.
		G12. Suggest *new* investigations to be conducted that are relevant to the findings of the investigation.	E11. Discuss how to modify or extend an investigation to answer a *new* investigation question.
	B6. Make a conclusion in relation to the investigative problem.	G13. Make a conclusion that indicates clearly if the hypothesis is supported, refuted, or remains undetermined according to the results for investigations involving hypothesis-testing.	E12. Discuss the generalisability of the results/conclusion.
Others		G14. Explain how a specific step impacted the validity and reliability of the data collected.	E13. Evaluate the overall validity and reliability of the data/evidence or methods that can influence the validity and reliability of the data/evidence.
			E14. Assess the appropriateness and adequacy of the experimental design (e.g., selection of the range and interval of the independent variable(s), measurement of the dependent variable(s), confounding variables, biases in the data) based on the data.

結果及討論 (B2)的評分準則 (初稿)

分 域	作業水平	相關表現
9-10	優 異	實驗報告顯示大多數的良好表現及少量的優秀表現。
6-8	良 好	實驗報告顯示 大多數的基礎表現 及 部分的良好表現 。
3-5	平 平	實驗報告顯示 部分的基礎表現 及 少量的良好表現 。
1-2	差 劣	實驗報告顯示 少量的基礎表現 。

	基礎表現	良好表現	優秀表現
數據的記錄、分析及闡釋	B1. 以清晰的描述記錄定性 / 定量數據 (例如：正確運用適當的小數點 / 有效數字)	G1. 建構並使用適當的數據展示 (例如：表列、圖表及 / 或圖像) 來組織及表達數據	
	B2. 進行基本運算 (例如：百分比、頻率、速率、平均數、比例) 來簡化 / 撮要數據	G2. 比較(半)定量及/或定性數據組	E1. 應用基礎統計概念比較及解釋數據組 (例如：範圍、方差、標準差、誤差捧)
	B3. 指出數據組中的異常數據 (如有)	G3. 解釋該組數據為什麼屬異常	E2. 就異常數據提出可能解釋(例如:人為誤差) 或確認數據屬異常的方法
			E3. 分析對照組的結果以評鑑實驗是否成功 / 實驗操作對結果的影響
解釋的建構及評鑑	B4. 就著探究問題，描述並分析數據組的關聯/ 趨勢及模式	G4. 就著探究問題，運用科學概念 / 原則來解釋數據組的關聯/ 趨勢及模式如何與探究問題相關	
		G5. 就著探究問題，描述並分析較複雜數據組 (例如:多項變量，如有) 的關聯/ 趨勢及模式	E4. 就著探究問題，運用科學概念 / 原則來解釋較複雜數據組 (例如:多項變量) 的關聯 / 趨勢及模式
		G6. 若有假說，評鑑數據是否能支持、反對假說或未能對假說作出判斷	E5. 討論其他假說的可能性 (如有)
	B5. 就著探究問題，按所得的數據提出主張	G7. 就著探究問題，運用相關的數據作為證據建構主張	E6. 就著探究問題，運用相關的數據作為證據建構主張，並加以論證 / 評鑑主張/ 評鑑對探究問題的不同解釋
誤差、限制及改善		G8. 指出重要的量度誤差 (例如：量度方案中的不確定因素 / 誤差，包括隨機誤差及系統誤差)	E7. 解釋量度誤差對數據 / 結論的效度(有效性) 及信度 (可信性) 的影響
		G9. 提出有效的改善方案以減低量度誤差(的影響) (例如：使用較佳的量度工具、重複量度)	E8. 解釋改善方案如何能減低測量誤差(的影響)
		G10. 解釋實驗設計在產生 / 收集數據以回應探究問題方面有什麼限制 (例如：採樣、樣本大小、範圍及間距)	E9. 就著探究問題，提出並解釋有效改善方案 / 進一步的數據收集方案以改善實驗設計

結論及進一步探究		G11. 按探究所得的數據 / 結果，就探究問題提出合理的決定	E10. 按探究所得的數據 / 結果，就探究問題提出合理的決定並加以論證
		G12. 就探究所得的結果，提出新的探究	E11. 討論如何改良 / 延伸探究以回應新的探究問題
	B6. 就著探究問題提出結論	G13. 若探究涉及假說，按所得的結果提出結論，以說明是否支持假說、推反假說或未能確定	E12. 討論實驗結果 / 結論的概括性 / 通用性
其他		G14. 解釋某特定步驟如何影響所得數據的效度和信度	E13. 評鑑數據 / 證據的整體效度和信度，或其他可影響整體效度和信度的方案
			E14. 按所得數據，評估實驗設計的適當性及充分性 (例如：自變量的範圍 / 間距之選取、因變量的量度方法、干擾變量、偏頗的數據)

(3) Examples of Tasks from Practising Teachers

- The following shows some tasks used by practicing teachers for SBA assessment. It is important to note that these SBA tasks are *not* approved by the HKEAA. Instead, they are intended to inspire teachers to develop their own SBA assessment tasks. Teachers are encouraged to develop their own SBA assessment tasks to assess students comprehensively, incorporating updates as needed over the years.
- It is worth noting that several factors will determine the validity of an SBA assessment task. Even sample tasks released by the HKEAA can be deemed invalid for reasons such as improper usage, including insufficient time allocated for assessments or students being given the mark schemes prior to the assessment.

Example 1: Problem-solving task

Students need to use the data from their experiment to determine the identity of the solutions.

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:

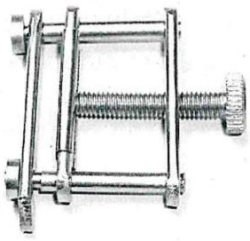
To determine the rate of respiration of yeasts in different substrate solutions and identify the best solution for brewery

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



Example 2: Explanatory hypothesis-testing task

A study of the advantage of the presence of red pigment in the leaves of pond weed

Introduction

The scenario is introduced using the format of a conversation between two classmates. Students are required to test different hypotheses for why some pondweeds have red pigments.

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)	i.	2 table lamps
b.	100 ml 0.25% sodium hydrogen carbonate solution	j.	2 stop watch
c.	2 5 ml pipettes	k.	1 retort stand with 2 clamps
d.	2 pieces of rubber tubing	l.	2 pipette fillers
e.	2 screw clips	m.	1 meter rule
f.	2 boiling tubes	n.	1 piece of blue filter
g.	1 thermometer	j.	1 10 mL pipette
h.	1 500 mL beaker	k.	1 100 mL beaker

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.

Sufficient hints are provided to students. Moreover, the experiment is complex enough to elicit a range of scientific inquiry skills outlined in the *Assessment Guidelines*.

Example 3: Problem-solving task

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 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.

Students prepared for B1 by searching information on-line.

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!).

Appropriate *ideas about science* are highlighted in the task sheet.

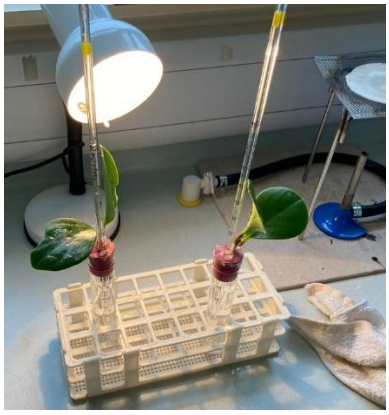
Preparing for the investigation (B1) (Group Task)

Students share design rationales with their peers.

(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.

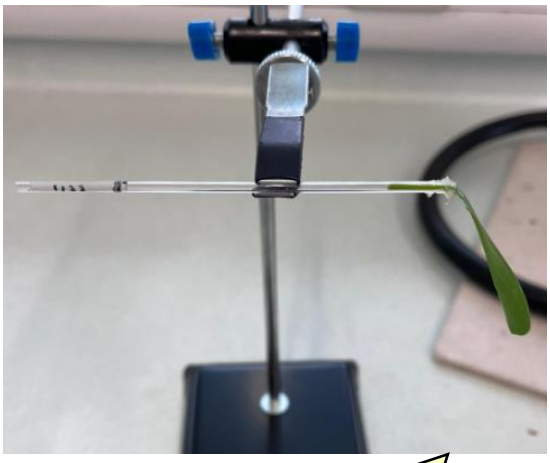
(b) Collect data using *at least* two set-ups to identify which one your group believes would be most suitable for the investigation. Explain the rationales.

Students are allowed to design their own set-ups and conduct a trial run. This process cognitively prepares them to answer questions in B1.



Before Area B1 Assessment

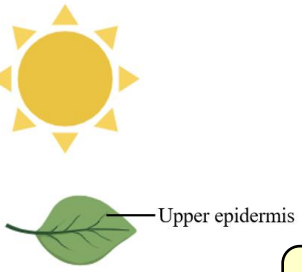
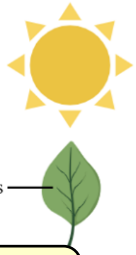
Students were shown the setups they would use in the actual practical work. The set-ups involve attaching a leaf stalk to a narrow glass tube.



Easy-to-assemble microscale set-ups are used to save instructional time.

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 in the form of diagrams are used to reduce linguistic demands.

Which orientation of the leaf (horizontal or vertical) would you choose for the leaf? Explain your answers.

Orientation	**Explanation**
☐ Horizontal ☐ Vertical	

The graphic organiser directs students' attention to providing explanations.

<u>After Area B1 Assessment</u>

- Each group of students was given two leaves and tasked with comparing the transpiration rates between the upper and lower leaf epidermis of the leaves.
- The class data were pooled.
- Students completed Area B2 reports at home.
- The B2 questions include asking students to: (1) compare the differences in stomata distribution among the four types of leaves; (2) assess the generalisability of measuring the transpiration rate of a leaf in relation to the results from a leafy shoot and a whole plant; (3) provide additional evidence that may support their data regarding the differences in transpiration rates and stomatal distribution between the lower and upper epidermis (e.g., using stomatal imprints to count the number of stomata); and (4) consider other factors (e.g., maturity of the leaves, type of leaf) that may be relevant, apart from stomatal distribution in the upper and lower epidermis, for deducing the location from which the leaves were taken.

(4) Recommendations for SBA Task Design (Area B1)

Important information related to SBA task design in the SBA Handbook

The following summarises some important information in the SBA handbook. Please refer to the handbook for more information <link>.

- According to the SBA handbook, teachers can design their own tasks and/or modify the sample SBA tasks provided by HKEAA to suit the needs of their students.
- The tasks devised should: (1) help students develop science process skills (or called scientific inquiry skills) and other generic skills outlined in the curriculum; (2) enable a balanced integration between theory and practice; (3) be appropriate to the topic taught and suited to the strengths and abilities of the students and (4) allow for differentiation among students in their demonstration of the assessed abilities.
- In the new format, teachers may use the experiment for the assessment of B1 only, B2 only, or both B1 and B2, depending on the suitability of the experiment.
- The design and planning of the investigation (B1) has to be completed within the classroom time under the supervision of the teacher.
- The estimated in-class time per task for Area B is 60 minutes while the estimated out-of-school time per task is 60 minutes.
- The final SBA Area B marks of a candidate include: (i) the best TWO marks obtained from different topics in Area B1; (ii) the best TWO marks obtained from different topics in Area B2.

Recommendations for SBA task design

- Multiple factors can impact on the validity of an SBA assessment task.
- Teachers can enhance the validity of their assessments by paying attention to task selection, design of guiding questions and many other aspects (e.g., scoring the reports).
- The following shows some recommendations for task selection and question setting.

Recommendations for task selection

- Teachers are encouraged to explore diverse investigative tasks for SBA assessment, particularly those that are engaging, involve live animals, exhibit a certain level of complexity, and require novel experimental designs. For ideas and resources, please refer to p. 33 of the 2023–2024 SBA conference materials, which includes a list of resources from trustworthy sources <link>.
- Teachers should avoid using experiments that merely demonstrate a phenomenon or overly simple investigations for assessment (e.g., "Is light/chlorophyll/chlorophyll required for photosynthesis?"). If such tasks are chosen, the maximum mark should not exceed 5 out of 10.
- Teachers should select tasks that provide opportunities for students to demonstrate their understanding of scientific inquiry skills at all performance levels, as outlined in the *Assessment Guidelines*.
- Teachers should refrain from using tasks that students can easily replicate from textbooks or other teaching materials, as this shifts the focus from assessing students' understanding of the scientific inquiry skills outlined in the *Assessment Guidelines* to rote memorisation. Suggestions for developing and modifying existing tasks can be found in previous SBA conference materials. For example, see the following links: <link 1> <link 2>.

Notes

- *Please note that "standard" investigation may still be suitable. In fact, a simple, standard investigation can still engage students in a wide range of scientific inquiry skills, as outlined in the *Assessment Guidelines*, provided it allows for a higher degree of openness and includes well-formulated guiding questions.

Recommendations for question setting

For full reports

- Teachers may consider using the new set of generic guiding questions. See p. 30 of 2023–2024 SBA conference materials <link>.
- Teachers are encouraged to clearly indicate to students which generic guiding questions they are using do not carry marks (e.g., aims of the investigation, procedures, safety precautions), although responses to these questions may be an integral part of a full report.

For reports using specific guiding questions

- Teachers should avoid setting questions that ask for discrete biology content knowledge without sufficient linkage to experimental design (e.g., "What is the function of carbon dioxide in photosynthesis?") and those that assess scientific inquiry skills *not* included in the *Assessment Guidelines* (e.g., "What is the aim of this investigation?").
- Teachers are encouraged to set questions that reflect the particular context/scenario of the investigation, allowing students to apply their scientific inquiry skills in contexts.
- Teachers should avoid setting multiple questions on one criterion*.
- Teachers are encouraged to annotate the relevant criterion/criteria from the *Assessment Guidelines* in the task sheets/marked student reports/scoring guides.
- Teachers should include a balanced number of questions addressing different levels of performance (i.e., basic, good, excellent performances) to effectively elicit a range of students' understanding*.

Notes

- Teachers are encouraged *not* to water down the cognitive demands of the questions. Instead, they can embed sufficient scaffolds and structures to help students express their understanding of the scientific inquiry skills outlined in the *Assessment Guidelines*. Moreover, teachers can strengthen the integration of these skills into their daily instruction to support students' learning of scientific inquiry, which is a key emphasis of the senior biology curriculum (see the link for *Biology Curriculum and Assessment Guide (Secondary 4 - 6)*)
- Teachers can use multiple questions to assess the same criterion. However, they should *not* assign multiple scores to the student responses.

(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>。

Scan the QR code to obtain the Self-Assessment Tool	**掃描二維碼以獲取自我評估工具**

Examples for exemplifying the ideas in the self-assessment tool

Example 1

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 (e.g., "Is heat released during seed germination?"), which require a limited variety of scientific skills in designing the experiment.

Task Sheet 2

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.

He found the following materials in the laboratory.

Plastic bags	Apples	Knife	Incubator (set at 37^0C)
Transparent plastic containers	Paper towel/cotton	Measuring cylinder	Petri dish
Black plastic containers	Light source	Distilled water	Forceps
Radish seeds	Mung beans	Wheat grains	Others*

Notes:

- You should try to restrict yourself to using the materials listed above. You may request specific materials commonly found in the laboratory if you can clearly justify why you need them.
- You may not need to use all of the materials.
- You need to start with seeds as seedlings are not available in the laboratory.

Design an experiment to test the above hypothesis.

The scenario is introduced using the format of using the format of a conversation between two classmates. Students are required to test a hypothesis. The scenario provides opportunities for students to demonstrate their understanding of a wide range of scientific inquiry skills. A variety of guiding questions can be formulated (e.g., "How many seeds will you use in each treatment?").

Additional materials are provided that may elicit students' misconceptions (e.g., light must be present for seeds to germinate, 37^0C is the optimal temperature for seed germination/growth) when designing the experiment. These concepts may be incorporated into the guiding questions in Area B1 Assessment (e.g., "Ryan said that Andrew must place all his setups under the light source to test David's hypothesis. Do you agree?

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?

Q.1 to Q.3 focus on discrete content knowledge that is not integrated with scientific inquiry skills.

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

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*).

Questions are specific enough to elicit students' understanding of scientific investigation skills that reflect the particular context/scenario of the investigation.

The number of questions addressing different levels of performance (i.e., basic, good, excellent performances) is balanced to effectively elicit a range of students' understanding.

Student-friendly definitions are provided to help students understand key terms related to scientific inquiry.

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 surface area discs with water 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

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

Example 4

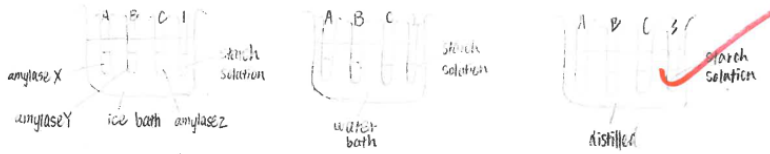
The relevant criterion is annotated.

Task Sheet 6 (with student response)

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

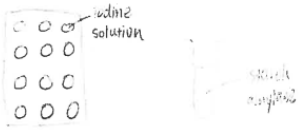
① Add 1 cm^3 of amylase solution to X, Y, Z to test tube A to C and add 5 cm^3 of starch solution to test tubes A to C, 1 to 3

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



E

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



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

Marking conventions are not easily understood by a professional colleague.

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

(6) Sharing of SBA implementation by

The Chinese Foundation Secondary School

- Cold pressor test is clinical test used to evaluate patients' cardiac function. This scenario is related to the daily life application of the topic "Coordination & Response". The school (i.e., CFSS) has utilised this scenario for SBA for many years.
- In the past, full reports were used as the assessment format. Last year, the task sheets were updated to align with the new SBA formats. Rather than assessing all ability areas, assessments were conducted only in Area A and Area B2.
- A discussion was held with students to help them understand the experimental design and procedures. See *Task Sheet 1* and the *Laboratory Manual* below:

Task Sheet 1

Investigating Cardiovascular Responses and Factors Related to the Responses in Cold Pressor Test

Task 1:

Read the following scenario. Be prepared to discuss the questions with the whole class:

Scenario:

The scenario is related to the daily life application of the topic "*Coordination and response*".

Sudden temperature stress can trigger physiological responses in the human body by activating the autonomic nervous system.

The **Cold Pressor Test** is used clinically as a stress test to evaluate cardiac autonomic function. The procedures in the test assess an individual's *responses in the cardiovascular system* and *pain tolerance level* in response to exposure to cold stress on a hand. The test involves immersing a person's hand in ice-cold water for a specified duration (e.g., 5 minutes) while monitoring the individual's pain tolerance level and cardiovascular responses.

In this investigation, you will investigate your own *cardiovascular responses* and *pain tolerance level* to cold stress on your hand in the cold pressor test. You will also examine factors that may influence an individual's pain tolerance in response to cold stress on the hand using class data.

Cold Pressor Test

Assessment of Area B1 was not conducted. However, a class discussion was held to help students understand the experimental design and procedures of the investigation.

Questions to consider before the investigation:

- What parameters will you measure to assess your cardiovascular responses during the cold pressor test? How will you measure these parameters?
- How will you determine your pain tolerance level?
- What factors may affect an individual's pain tolerance level in response to cold stress on the hand? What data will you measure and collect to examine their relationship?

Teachers can follow the guidelines for risk assessment issued by the Education Bureau <link>. They may also want to read the journal article about the use of the cold pressor test for teaching purposes (e.g., Silverthorn & Michael, 2013) <link>.

La

Safety Precautions:

Please inform the teacher

- if you have any known health problems (e.g., cardiovascular disease, neurological disorders) or recent caffeine consumption;
- if you experience any signs of stress during the experiment, such as excessive shivering, discomfort or dizziness.

Materials and apparatus (per group of 4):

Water tray	Thermometer	Height measuring scale	Electric arm sphygmomanometer
Ice water	Stopwatch	Weighing scale	

Procedures:

1. Measure and record your height and weight with a scale.
2. Use an electric arm sphygmomanometer to measure your initial blood pressure and heart rate.
3. Immerse your hand up to the wrist into the tray of ice water (*Figure 1*). Start the stopwatch immediately after immersion.
4. Measure your blood pressure and heart rate at 1-minute intervals using the electric arm sphygmomanometer (*Figure 2*).
5. Withdraw your hand from the water after 5 minutes or when you feel physiological discomfort, whichever occurs first. Record the duration of immersion immediately after the withdrawal of hand. (Try to tolerate the cold water for **at least 1 minute**.)
6. Measure your blood pressure and heart rate 2 minutes after the withdrawal of your hand, at 1-minute intervals using the electric arm sphygmomanometer.
7. Rate your perceived level of pain on a scale from 0 to 5 (0 = no pain, 1-2 = mild pain, 3-4 = moderate pain 5 = severe pain).

Key experimental procedures are illustrated using both text and diagrams to facilitate students' understanding of the experiment.

Figure 1. Immersing a hand in ice-cold water covering the palm and wrist

Figure 2. Measuring the blood pressure and heart rate using an electric arm sphygmomanometer

- Students not only collected quantitative data (e.g., blood pressure, heart rates, perceived pain levels), but they also collected variables that could not be manipulated but may be related to their cardiovascular responses (e.g., height, weight).
- Students completed Part 1 of the *B2 Assessment Task Sheet* during the class period.

B2 Assessment Task Sheet Part 1

School-based Assessment Area B2

Data recording:

(a) Record your personal information in the space provided below.

- Age: _____
- Sex: ☐ Male ☐ Female
- Height (cm): _____
- Weight (kg): _____

Students recorded data that cannot be manipulated during the investigation. These variables may also be related to their cardiovascular responses in the investigation.

(b) Record the data collected from the cold pressor test and calculate the mean arterial pressure based on the collected data:

[B1] ☐ U ☐ B

(1) Perceived level of pain (0-5): _____

(0 = no pain, 1-2 = mild pain, 3-4 = moderate pain, 5 = severe pain).

(2) Duration of immersion of the hand (min: sec): _____

Cardiovascular responses	**Time after immersing the hand in ice-cold water (min)**						**Time after withdrawing hand (min)**	
	0	1	2	3	4	5	1	2
Systolic blood pressure (mmHg)								
Diastolic blood pressure (mmHg)								
Mean arterial pressure (mmHg)								
Heart rate (beats per min)								

Students collected quantitative data on the changes in various parameters related to their cardiovascular responses at different time points during the immersion of their hands in ice-cold water.

Title: Changes in systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate during the cold pressor test

(c) Please also input your individual data collected in part (a) and (b) by scanning this QR code.

Your teacher would provide you with the class data later.

https://forms.gle/q74umJ33vpKVGs9H6

Students input their data in a *Google Form* so that the data could be shared with their class

Reading materials were provided to support students' understanding of different graphical representations and to facilitate their selection of the appropriate graph type for this investigation.

Data analysis and interpretation:

(d) Scientists construct graphs to observe trends and patterns in the data.

Scan this QR code to learn about different types of graphical representations.

(1) Construct **a suitable graph** to show the changes in your cardiovascular responses (i.e., mean arterial pressure and heart rate) during the cold pressor test (i.e. just before your hand immersion in the ice-cold water to 2 minutes after withdrawing your hand)

[G1] ☐ U ☐ B ☐ G

Annotating the question with the relevant criteria facilitates students' reflection on their responses after they receive their marked reports back.

- After the students had submitted their individual data, the data were pooled and shared with the class.
- Students completed *Part 2 of the B2 Assessment Task Sheet* at home.
- Students were guided to seek and discern patterns in the class data, perform manipulations on the data (e.g., calculations), and evaluate claims using relevant data and reasoning in addition to employing common scientific inquiry skills (e.g., identifying errors and suggesting improvements).
- Specifically, guiding questions were designed to engage them in carrying out basic calculations to summarise data, comparing data sets based on quantitative data (i.e., mean), , comparing the variability of data sets, and evaluating claims related to the investigation question using relevant data and reasoning within the given contexts (see the extract of the task sheet below).

B2 Assessment Task Sheet Part 2 (extract)

(g) To make sense of the class data provided in the *Google Spreadsheet*, you have conducted additional online research to gather more information.

All you need to know about the Cold Pressor Test!

Individuals can be grouped into two groups, the *tolerant group* and the *non-tolerant group* based on the results in the cold pressor test. Tolerant group can tolerate hand immersion in ice-cold water for more than 1.5 minutes while non-tolerant group cannot tolerate hand immersion in ice-cold water for more than 1.5 minutes and would withdraw their hands.

1. The two groups would perceive different levels of pain during the cold pressor test.
2. The two groups show different changes in *Mean Arterial Pressure* (MAP). The changes can be seen at 1 minute during the cold pressor test.

   *MAP is a measure of the average pressure exerted on the arterial walls throughout the cardiac cycle and can be calculated using the following formula:

$$MAP = DBP + \frac{SBP - DBP}{3}$$

3. Female with a height of less than 150 cm show more variations in the change in *cardiac output* during the immersion period than males with a height of 150 cm or above.

Additional information and specific guiding questions are included to guide students to analyse and interpret the more complex data set (i.e., class data).

(1) If the class is divided into two groups based on the above criterion (i.e., the **tolerant group** and the **non-tolerant group**), compare the average weight of individuals in these two groups.

[G2] ☐ U ☐ B ☐ G

_____

(2) Explain whether the class data **supports** or **does not support** each of the statements about the differences in the two groups as mentioned in the above online research.

[G7] ☐ U ☐ B ☐ G [B2] ☐ U ☐ B
[E6] ☐ U ☐ B ☐ G ☐ E [E1] ☐ U ☐ B ☐ G ☐ E

Statement	**Put a "✓" into the appropriate boxes**	**Explanation based on evidence from the class data** (*Note*: Include quantitative data whenever appropriate)
1	☐ Support ☐ Do NOT support	
2	☐ Support ☐ Do NOT support	
3	☐ Support ☐ Do NOT support	Guiding questions are included to guide students to evaluate claims using relevant data and reasoning.

(7) Frequently Asked Questions

- The following shows a list of frequently asked questions (FAQs). FAQs that are new or with updates are highlighted for teachers' easy reference (*** new/updated this year**).
- Please note that the question numbers of FAQs released last year (see p. 31–32 of 2023–2024 SBA conference materials <link>) may have changed in this version to facilitate the grouping of related FAQs for easier reading by teachers.

Q 1 Could students be asked to write a full report on the investigation instead of finishing worksheets when assessing B1 and B2?

A 1 Yes. Teachers should mark the full report according to the *Assessment Guidelines*, i.e., categorising students' answers to the descriptors stated in the *Assessment Guidelines* and scoring the work according to the *10–point scale*.

Please be reminded that the new *Assessment Guidelines* for B1 should be adopted. In this case, teachers should initiate a class discussion on design decisions such as alternative measurement methods, sampling strategies, validity and reliability of the data collected, etc so that students are aware of the expectation that they will need to include these aspects in their full reports in order to sufficiently demonstrate their understanding of experimental design (i.e., good and excellent performances in the *Assessment Guidelines*). Otherwise, their full reports may focus only on the basic performances listed in the *Assessment Guidelines*, with the poor and fair quality of work demonstrated. Teachers may consider using the new set of generic guiding questions. See p. 30 of 2023–2024 SBA conference materials <link>.

***Q 2 Can similar scientific inquiry skills be assessed in both Area B1 and B2?**

A 2 It may seem that some criteria overlap between Areas B1 and B2 (e.g., G9 and E7 in B1, G8 and E7 in B2). For instance, in B1, students may be asked to identify and explain how to reduce (the impact of) measurement errors when considering certain experimental designs. In B2, students may be asked similar questions in the context of their own investigations. Although the questions may appear similar, they actually require different skills as the questions are posed in different contexts. As Area B2 focuses on assessing students' ability to analyse and interpret data, students should use the data from their investigations to support their answers when appropriate.

***Q 3 Can we use a task sheet that consists mostly of basic and good performances to help students achieve higher marks?**

A 3 According to the mark scale in the SBA handbook, the quality of a student's work should reflect a certain level of performance. For example, reports receiving 9–10 marks should demonstrate mostly good performances, with a few excellent performances. A task sheet that includes primarily basic and good performances may limit students' opportunities to achieve higher marks in the SBA. Therefore, teachers should include a balanced number of questions that address different levels of performance (i.e., basic, good, and excellent) to effectively elicit a range of students' understanding.

Q 4 Can we modify existing investigations for the new SBA formats?

A 4 Yes. Teachers are encouraged to set any questions targeting specific criterion/criteria outlined in the B1 and B2 *Assessment Guidelines* based on existing laboratory protocols. Some current sample tasks are also modified from existing laboratory protocols.

Q 5 Should teachers use the sample task "as is"?

A 5 Teachers are strongly encouraged to adapt and modify the sample tasks to meet the learning needs of their students. However, the focus of the assessment should always be related to the performance descriptors in the assessment guidelines.

Q 6 Could teachers grade only B1 or only B2 of an investigation and leave the rest ungraded?

A 6 Yes. Teachers have the discretion to adopt the scheme flexibly. For example, if the design of an investigation is too complicated for assessing B1, teachers may consider giving students the details of the design to teach essential elements of B1 and conduct B2 only. On the other hand, if teachers find a task with little assessment opportunities for B2, they may choose to assess students on B1 only.

Q 7 If there are no suggested answers for the sample SBA assessment(s), how can teachers know the standard of assessment?

A 7 Teachers should assess the student work according to the performance descriptors in the *a Assessment Guidelines* rather than looking for the "model answers", especially when some questions are actually open-ended.

Q 8 Can teachers use a tailor-made marking scheme to assess students' performance in an investigation?

A 8 Teachers may wish to provide a "marking scheme" for their worksheets. However, some questions are open-ended with many possible answers. Instead of providing a 'marking scheme', teachers may consider using the students' answers to initiate a class discussion and show the range of performance demonstrated by the answers to explain why some achieved an excellent performance while others only a basic performance.

Teachers may also share with students the assessment guidelines for students to self-assess their understanding of specific aspects related to experimental design. However, teachers should *not* encourage rote memorisation of the *Assessment Guidelines*.

Q 9 Can teachers adapt the *Assessment Guidelines* differently for lower ability students? (The new *Assessment guidelines* assess the quality of students' work. How could it be fit into a marking system of 10-point scales without teachers' prejudice?)

A 9 Teachers may adjust their marking standards according to their students' ability, e.g., using a lenient standard for students with lower ability or using a strict standard for students with high ability. This, in fact, will allow a better differentiation of students' performance. The different marking standard will be dealt with during the moderation. For more information, refer to https://www.hkeaa.edu.hk/DocLibrary/Media/Leaflets/HKDSE_SBA_A4booklet_Mar2018.pdf However, it is advisable to communicate with the students whether you might have used a lenient/strict standard to mark their work. Otherwise, it may create confusion to students, and they might have false hope/wrong expectation for their final SBA marks/public exam results.

***Q 10** **How should a student's response be scored if it is a partially correct answer to a question assessing excellent performance?**

A 10 The student's response should *not* be scored on an "all-or-nothing" basis but rather on a relative scale. For example, if a student provides partially correct answers to questions assessing E5 (explain why some important control variables need to be controlled) or E8 (identify the significant assumptions of the design) in B1, the teacher can choose to grade the student as "basic" or "good" based on the accuracy of their explanations and identifications.

***Q 11** **What mark should be awarded to a student's report if it demonstrates a few basic performances and some good performances?**

A 11 The quality of the report can be considered "Fair" as it reflects a performance level between "Good" and "Poor" according to the mark scale in the SBA Handbook.

***Q 12** **Could teachers just assess B1 without conducting the hands-on component of the investigative practical work??**

A 12 No. Teachers should conduct the hands-on component of the investigative practical work with students for any B1 assessment.

Q 13 **Could students finish B1 at home?**

A 13 No. B1 must be completed at school under the teachers' supervision.

Q 14 **Could teachers give students the procedure of investigation (before assessing B1)?**

A 14 Yes. For methods used in the investigation that are novel to the students, the working principles or the outlines of the method should be provided in the task sheet. Teachers may provide the procedure before assessing B1. However, teachers should consider how much detail to provide, as providing certain steps may limit the chance of assessment. For instance, if the details of measurement of the dependent variable have already been provided, then the assessment of B4, G6 and E3 might be affected. In this case, teachers may leave the measurement method as a question and let the class discuss the other possible measurement methods and ask them to explain and evaluate the methods.

Q 15 **What should be assessed in B2?**

A 15 For 2025 HKDSE and 2026 HKDSE, please refer to the assessment guidelines released at the 2021–2022 SBA Conference. See the <link>.

For 2027 HKDSE, teachers should assess the student's work according to the revised SBA B2 *Assessment Guidelines* on pp. 3-5 of this booklet. Please note that the guidelines may be slightly modified later based on student samples collected and consensus marking.

Q 16 Should students finish B2 in school under the teacher's supervision?

A 16 Students may complete B2 at school or at home. Teachers should weigh the pros and cons and decide which is the best way to differentiate their students' performance. In general, it leads to a better differentiation of performance for higher achievers if students have to complete the task within a limited time at school while it leads to a better differentiation for lower achievers if they are allowed to complete the task at home.

In case of suspected plagiarism or inappropriate use of A.I. software, teachers may ask them to explain/demonstrate how they arrived at their answers verbally to verify if the answers are of their own work.

Q 17 If students cannot successfully complete an investigation in class, could they complete B2 using other students' results?

A 17 If this is the case, teachers may allow the sharing of experimental results from other groups (or collected as class data) so that all students can complete B2. Secondary data from other sources may be provided only if the data are directly related to the investigation conducted by the students.

Q 18 Could descriptive observation instead of quantitative measurement be accepted as the results of an investigation in B2?

A 18 Yes. However, teachers should check if the results allow for rich discussions such that students have a chance to achieve sufficient good/excellent performance.

Moreover, teachers should check if the results allow for setting a balanced number of questions addressing different levels of performance (i.e., basic, good, excellent performances) to effectively elicit a range of students' understanding Teachers should ensure that the data, whether descriptive or quantitative, are used to address the investigation problem.

***Q 19 Is it necessary to use graph paper for plotting graphs? Can digital tools be used instead?**

A 19 Students should use graph paper when plotting graphs by hand. Teachers are encouraged to ask students to use digital tools (such as Excel spreadsheets or other online applications) to create appropriate representations (e.g., tables, graphs, and diagrams) for organising and displaying data. Students can leverage the affordances of digital tools to conduct simple statistical analyses (e.g., calculating means and standard deviations) to compare and explain data sets.