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

Workshop on the marking of SBA B2 sample

Goals

- To provide teachers with hands-on experience in marking student samples
- To discuss the marking of student samples

Outline

❶ Marking student samples

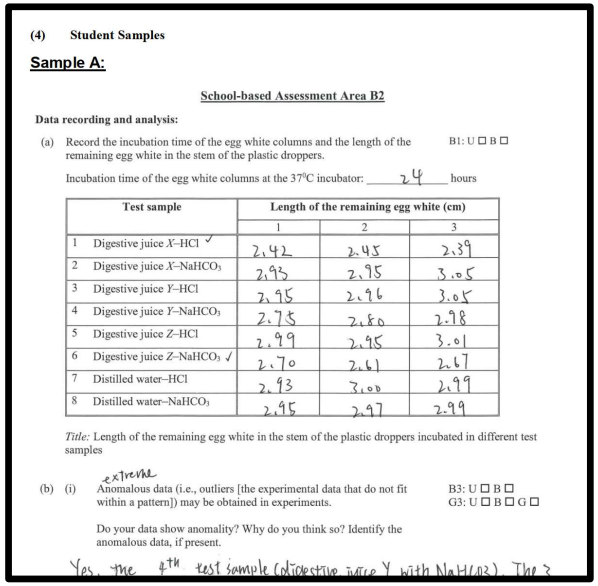
❷ Discussion on the scoring of the student samples

❸ Discussion on possible modifications of the task sheet

1 Marking student samples

You have received

- Two student samples (Sample A, Sample B)
- Area B2 *Assessment Guideline*
- Sample Score Sheet



(4) Student Samples

Sample A:

School-based Assessment Area B2

Data recording and analysis:

(a) Record the incubation time of the egg white columns and the length of the remaining egg white in the stem of the plastic droppers. B1: U ☐ B ☐

Incubation time of the egg white columns at the 37°C incubator: 24 hours

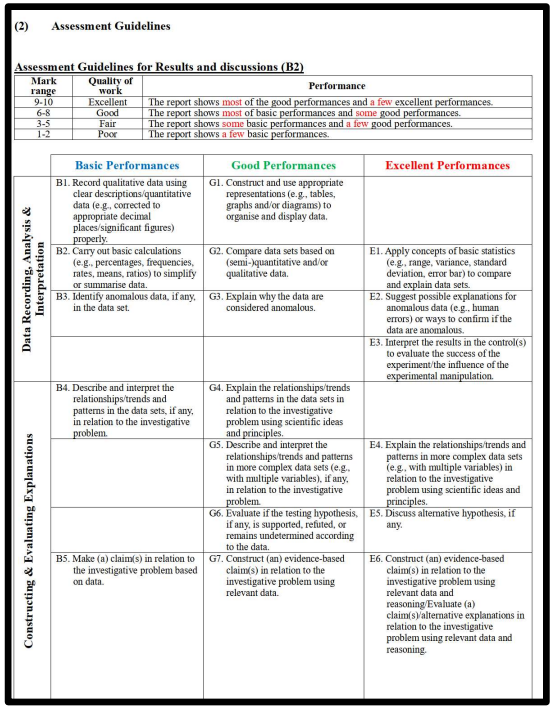
	Test sample	Length of the remaining egg white (cm)		
		1	2	3
1	Digestive juice *X*–HCl ✓	2.42	2.45	2.39
2	Digestive juice *X*–$NaHCO_3$	2.93	2.95	3.05
3	Digestive juice *Y*–HCl	2.95	2.96	3.05
4	Digestive juice *Y*–$NaHCO_3$	2.75	2.80	2.98
5	Digestive juice *Z*–HCl	2.99	2.95	3.01
6	Digestive juice *Z*–$NaHCO_3$ ✓	2.70	2.61	2.67
7	Distilled water–HCl	2.93	3.00	2.99
8	Distilled water–$NaHCO_3$	2.95	2.97	2.99

Title: Length of the remaining egg white in the stem of the plastic droppers incubated in different test samples

(b) (i) extreme Anomalous data (i.e., outliers [the experimental data that do not fit within a pattern]) may be obtained in experiments. B3: U ☐ B ☐ G3: U ☐ B ☐ G ☐

Do your data show anomality? Why do you think so? Identify the anomalous data, if present.

Yes, the 8th test sample (distilled water Y with $NaHCO_3$). The 3

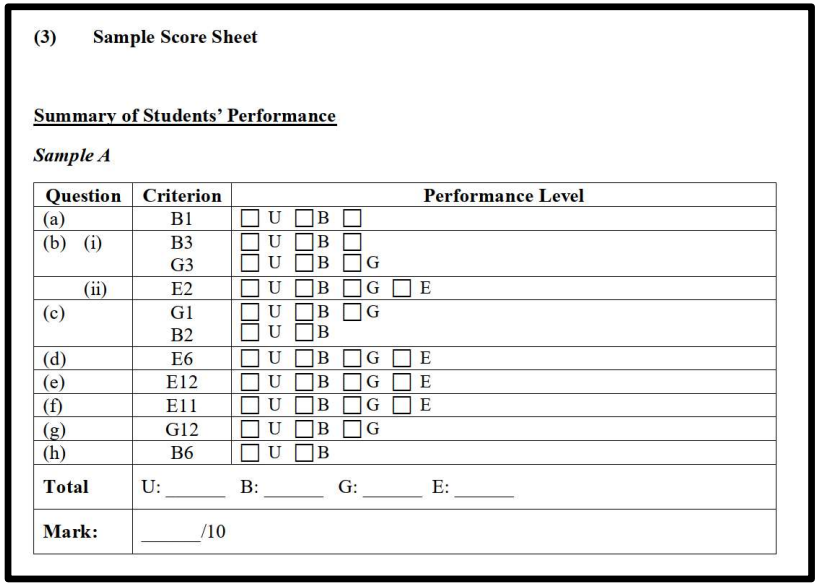


(2) Assessment Guidelines

Assessment Guidelines for Results and discussions (B2)

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.



(3) Sample Score Sheet

Summary of Students' Performance

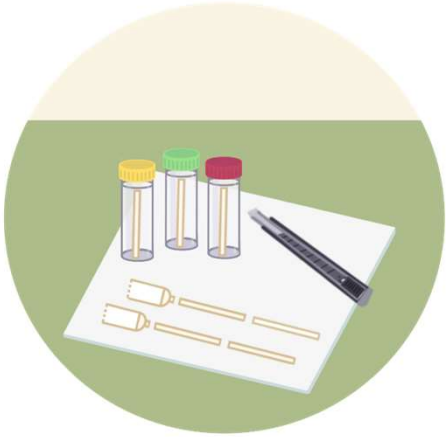
Sample A

Question	Criterion	Performance Level
(a)	B1	☐ U ☐ B ☐
(b) (i)	B3	☐ U ☐ B ☐
	G3	☐ U ☐ B ☐ G
(ii)	E2	☐ U ☐ B ☐ G ☐ E
(c)	G1	☐ U ☐ B ☐ G
	B2	☐ U ☐ B
(d)	E6	☐ U ☐ B ☐ G ☐ E
(e)	E12	☐ U ☐ B ☐ G ☐ E
(f)	E11	☐ U ☐ B ☐ G ☐ E
(g)	G12	☐ U ☐ B ☐ G
(h)	B6	☐ U ☐ B
Total	U: _____ B: _____ G: _____ E: _____	
Mark:	_____/10	

1 Marking student samples

Background of the SBA task

- Egg white investigation is situated in a problem-solving context
- Students collect data and use them as evidence to deduce the locations from which the three digestive juice samples are taken within the alimentary canal



1 Marking student samples

Context of the trial implementation

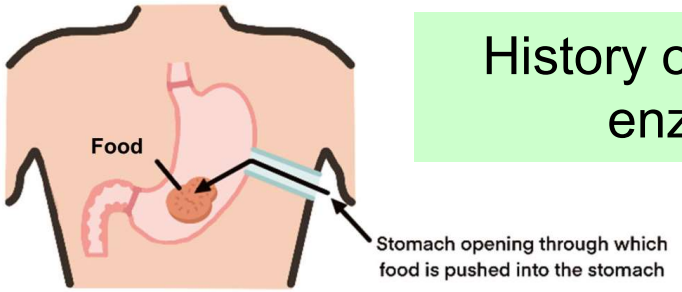
- EMI school
- Secondary 4
- Number of students: 23
- Topics taught: Nutrition in Human
- Prior knowledge about scientific investigations:
  - Recording data and constructing simple tables
  - Identifying and explaining anomalous data
  - Drawing conclusions

1 Marking student samples

- Students read about the history of science related to the function of the stomach and information about different enzyme assays before B1 Assessment.

Source 1: Investigating stomach function

In 1822, William Beaumont, a Canadian army doctor, investigated stomach function by carrying out experiments on his patient Alexis St Martin. Alexis was shot in the abdomen and survived with an opening in his stomach. Dr Beaumont tied food to a string and inserted it into Alexis' stomach.



History of science – enzymes

The following shows the experimental conditions and results:

Experiment	Site	Food	Time for disappearance of food (hours)
1	Alexis' stomach	Bread	No disappearance
2	Alexis' stomach	Beef	2

After Experiments 1 and 2, Dr Beaumont removed some fluids from Alexis' stomach and put it into a test tube for further experiments. He used beef of the same size as that used in Experiment 2.

Experiment	Site	Temperature (°C)	Food	Time for disappearance of food (hours)
3	Test tube	20	Beef	10
4	Test tube	37	Beef	4

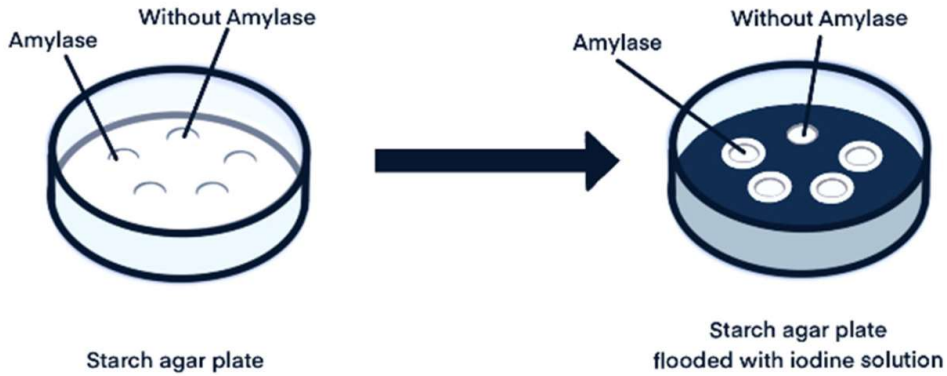
Source 2: Investigating the activity of digestive enzymes

Amylases, lipases, and proteases are digestive enzymes found in the human alimentary canal. Their actions can be studied *in vitro* (i.e., outside the human body).

Methods for studying amylase activity

Using the *starch agar plate*, which contains a mixture of starch and agar, is a method for studying amylase activity. When iodine solution is added to the plate, it reacts with the starch and forms a blue-black complex, and the plate turns blue-black in colour.

When amylase is placed in wells on the starch agar plate and incubated under *appropriate conditions* for 16 hours, the amylase breaks down the starch surrounding the wells. When iodine solution is added to the plate after incubation, a clear zone forms around the well containing amylase. The size of the clear zone indicates the amylase activity.



Methods for studying lipase activity

Lipase activity can be studied using *whole milk with an alkaline solution containing a pH indicator* (blue under alkaline pHs and yellow under acidic pHs). Whole milk contains triglycerides. Lipase catalyses the breakdown of the triglycerides in whole milk into fatty acids and glycerol. The fatty acids lower the pH of the alkaline solution. When the pH falls below 6, the solution changes colour from blue to green and then to yellow. The time it takes for the reaction mixture to change colour from blue to yellow indicates the activity of the lipase.

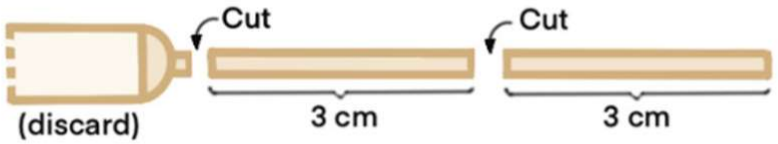
Scan the QR code to watch a video showing the action of lipase on whole milk with an alkaline solution containing a pH indicator.

Enzyme Assays

1 Marking student samples

Methods for studying protease activity

Egg white columns can be used to study protease activity. A plastic dropper filled with egg white is placed in a hot water bath. The stem of the plastic dropper filled with hardened egg white is then cut into 3-cm-long egg white columns. Each egg white column is placed in a plastic tube containing protease and incubated under *appropriate conditions* for 24 hours. The protein in the egg white is broken down into soluble substances. The length of the remaining egg white in the stem of the plastic dropper can be measured to determine protease activity.



Scan the QR code to watch a video showing how to prepare a protein column and the action of protease on egg white columns.

Area B1

Scenario

Your biology teacher, Mr. Ho, has given you three types of digestive juices: *X*, *Y*, and *Z*. These juices come from different parts of the human alimentary canal: the mouth, the stomach, and the pancreatic duct.

You will now need to design an investigation *to identify where the digestive juices (X, Y, and Z) were taken from*. You can use the following materials and apparatuses for your experiment:

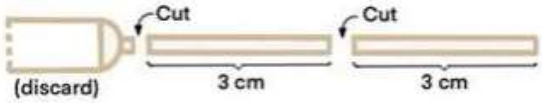
Digestive juice *X*	Water bath (95°C)	Hydrochloric acid	Knife
Digestive juice *Y*	Water bath (40°C)	Sodium hydrogencarbonate solution	White tile
Digestive juice *Z*	Incubator (37°C)	Sodium chloride solution	Plastic tubes
Egg white column (plastic dropper containing hardened egg white)	Ice bath	Sodium hydroxide solution	Electronic caliper

Hint: You may *not* need to use all the materials listed above.

- The students performed the practical work in which they made egg white columns that were **3 cm long**.

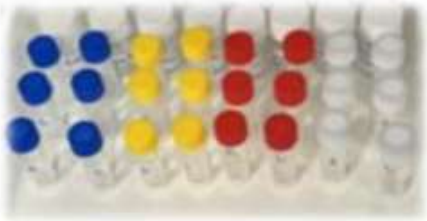
1. A plastic dropper filled with egg white is placed in a hot water bath.

2. The stem of the plastic dropper filled with hardened egg white is then cut into segments of 3-cm long egg white columns.



3. The egg white column is placed in a plastic tube containing protease and incubated at appropriate conditions for 24 hours.

- Different types of digestive juices (*X*, *Y*, and *Z*)
- Different pH condition (HCl and $NaHCO_3$)
- Control set-ups



4. The length of the remaining egg white in the stem of the plastic dropper can be measured for protease activity.

❶ Marking student samples

Sample A:

School-based Assessment Area B2

Data recording and analysis:

(a) Record the incubation time of the egg white columns and the length of the remaining egg white in the stem of the plastic droppers. B1: U ☐ B ☐

Incubation time of the egg white columns at the 37°C incubator: 24 hours

Test sample	Length of the remaining egg white (cm)		
	1	2	3
1 Digestive juice *X*–HCl ✓	2.42	2.45	2.39
2 Digestive juice *X*–$NaHCO_3$	2.93	2.95	3.05
3 Digestive juice *Y*–HCl	2.95	2.96	3.05
4 Digestive juice *Y*–$NaHCO_3$	2.75	2.80	2.98
5 Digestive juice *Z*–HCl	2.99	2.95	3.01
6 Digestive juice *Z*–$NaHCO_3$ ✓	2.70	2.61	2.67
7 Distilled water–HCl	2.93	3.00	2.99
8 Distilled water–$NaHCO_3$	2.95	2.97	2.99

Title: Length of the remaining egg white in the stem of the plastic droppers incubated in different test samples

(b) (i) Anomalous data (i.e., outliers [the experimental data that do not fit within a pattern]) may be obtained in experiments. B3: U ☐ B ☐ G3: U ☐ B ☐ G ☐

Do your data show anomality? Why do you think so? Identify the anomalous data, if present.

Yes, the 4th test sample (digestive juice Y with $NaHCO_3$). The 3 datas have large difference (2.98 cm^3 & 2.75 cm^3)

(ii) Tim found that an outlier was present in one of the replicates of one test sample. Suggest ***one*** possible reason for the occurrence. E2: U ☐ B ☐ G ☐ E ☐

there are other substance in one of the replicates of test sample and affect the result

Area B2 Task Sheet (done at home)

- 9 questions (including sub-questions)
- Targeted 11 criteria within the revised B2 *SBA Assessment Guidelines*
- 4X Excellence, 3X Good, 4X Basic

1 Marking student samples

(3) Sample Score Sheet

Summary of Students' Performance

Sample A

Question	Criterion	Performance Level
(a)	B1	☐ U ☐ B ☐
(b) (i)	B3 G3	☐ U ☐ B ☐ ☐ U ☐ B ☐ G
(ii)	E2	☐ U ☐ B ☐ G ☐ E
(c)	G1 B2	☐ U ☐ B ☐ G ☐ U ☐ B
(d)	E6	☐ U ☐ B ☐ G ☐ E
(e)	E12	☐ U ☐ B ☐ G ☐ E
(f)	E11	☐ U ☐ B ☐ G ☐ E
(g)	G12	☐ U ☐ B ☐ G
(h)	B6	☐ U ☐ B
Total	U: _____ B: _____ G: _____ E: _____	
Mark:	_____/10	

Record your

- judgment on each question
- overall rating of the sample

Outline

❶ Marking student samples

❷ Discussion on the scoring of the student samples

❸ Discussion on possible modifications of the task sheet

❷ Discussion on the scoring

Data recording and analysis:

(a) Record the incubation time of the egg white columns and the length of the remaining egg white in the stem of the plastic droppers. B1: U ☐ B ☐

Incubation time of the egg white columns at the 37^0C incubator: _____ hours

Test sample	Length of the remaining egg white (cm)		
	1	2	3
1 Digestive juice *X*–HCl			
2 Digestive juice *X*–$NaHCO_3$			
3 Digestive juice *Y*–HCl			
4 Digestive juice *Y*–$NaHCO_3$			
5 Digestive juice *Z*–HCl			
6 Digestive juice *Z*–$NaHCO_3$			
7 Distilled water–HCl			
8 Distilled water–$NaHCO_3$			

Title: Length of the remaining egg white in the stem of the plastic droppers incubated in different test samples

❷ Discussion on the scoring

B1. Record qualitative data using clear descriptions/quantitative data (e.g., corrected to appropriate decimal places/significant figures) properly.

Unattained **Basic**

Criteria:

- Fill in *all the information* in the table
- Record the raw data to a number of decimal places appropriate to the resolution of the equipment
- Record all the raw data of the same type to the same number of decimal places.

Sample A

- All information recorded
- Appropriate decimal places for all data

(a) Record the incubation time of the egg white columns and the length of the remaining egg white in the stem of the plastic droppers. B1: U ☐ B ☐

Incubation time of the egg white columns at the 37^{0}C incubator: 24 hours ✓

Test sample		Length of the remaining egg white (cm)		
		1	2	3
1	Digestive juice *X*–HCl ✓	2.42	2.45	2.39
2	Digestive juice *X*–$NaHCO_3$	2.93	2.95	3.05
3	Digestive juice *Y*–HCl	2.95	2.96	3.05
4	Digestive juice *Y*–$NaHCO_3$	2.75	2.80	2.98
5	Digestive juice *Z*–HCl	2.99	2.95	3.01
6	Digestive juice *Z*–$NaHCO_3$ ✓	2.70	2.61	2.67
7	Distilled water–HCl	2.93	3.00	2.99
8	Distilled water–$NaHCO_3$	2.95	2.97	2.99

Basic

Title: Length of the remaining egg white in the stem of the plastic droppers incubated in different test samples

Sample B

- All information recorded
- Appropriate decimal places for all data

(a) Record the incubation time of the egg white columns and the length of the remaining egg white in the stem of the plastic droppers. B1: U ☐ B ☐

Incubation time of the egg white columns at the 37^{0}C incubator: 24 hours ✓

Test sample		Length of the remaining egg white (cm)		
		1	2	3
1	Digestive juice *X*–HCl	2.42	2.45	2.39
2	Digestive juice *X*–$NaHCO_3$	2.93	2.95	3.05
3	Digestive juice *Y*–HCl	2.95	2.96	3.05
4	Digestive juice *Y*–$NaHCO_3$	2.75	2.80	2.98
5	Digestive juice *Z*–HCl	2.99	2.95	3.01
6	Digestive juice *Z*–$NaHCO_3$	2.70	2.61	2.67
7	Distilled water–HCl	2.93	3.00	2.99
8	Distilled water–$NaHCO_3$	2.95	2.97	2.99

Basic

Title: Length of the remaining egg white in the stem of the plastic droppers incubated in different test samples

Unattained

- Not all information recorded
- Not appropriate decimal places for all data

Incubation time of the egg white columns at the 37^0C incubator: _____ hours

Test sample	Length of the remaining egg white (cm)		
	1	2	3
1 Digestive juice *X*–HCl	2.4	2.7	255
2 Digestive juice *X*–$NaHCO_3$	3.2	3.1	X
3 Digestive juice *Y*–HCl	3.0	3.1	2.95
4 Digestive juice *Y*–$NaHCO_3$	3.0	3.0	3.0
5 Digestive juice *Z*–HCl	3.0	3.0	3.0
6 Digestive juice *Z*–$NaHCO_3$	2.7	2.6	2.7
7 Distilled water–HCl	3.0	3.0	3.0
8 Distilled water–$NaHCO_3$	3.0	3.0	3.0

❷ Discussion on the scoring

(b) (i) Anomalous data (i.e., outliers [the experimental data that do not fit within a pattern]) may be obtained in experiments.

B3: U ☐ B ☐
G3: U ☐ B ☐ G ☐

Do your data show anomality? Why do you think so? Identify the anomalous data, if present.

.....

.....

.....

B3. Identify anomalous data, if any, in the data set.

Unattained **Basic**

G3. Explain why the data are considered anomalous.

Unattained **Basic** **Good**

❷ Discussion on the scoring

Outlier	A value in a set of results that differ significantly from the observed trends.

P.85 (Junior science curriculum)

- Identify the data point(s) showing anomality
- Describe the general trends of other data sets
- Explain why a particular set of data represent deviations

OR

- No anomalous data
- Describe the general trends (e.g., only slight fluctuations among data sets)
- Use data to substantiate the claim

❷ Discussion on the scoring

Sample A

(b) (i) Anomalous data (i.e., outliers [the experimental data that do not fit within a pattern]) may be obtained in experiments.

extreme

B3: U ☐ B ☐
G3: U ☐ B ☐ G ☐

Do your data show anomality? Why do you think so? Identify the anomalous data, if present.

Yes, the 4th test sample (digestive juice Y with $NaHCO_3$). The 3 datas have large difference (2.98 cm^3 & 2.75 cm^3)

✓ ✓

General trend of other data sets *not* described

Basic

Basic

❷ Discussion on the scoring

Sample B

extreme data

(b) (i) Anomalous data (i.e., outliers [the experimental data that do not fit within a pattern]) may be obtained in experiments.

B3: U ☐ B ☐
G3: U ☐ B ☐ G ☐

Do your data show anomality? Why do you think so? Identify the anomalous data, if present.

Yes, in test sample 4, the first test and second test is 2.75cm and 2.80cm respectively that present there is digestion. but the third test is 2.98 cm that show there is no digestion.

Basic

- **General trend described:** shows digestion (other data sets)
- **Deviation:** no digestion (outlier)

Good

❷ Discussion on the scoring

(ii) Tim found that an outlier was present in one of the replicates of one test sample. Suggest ***one*** possible reason for the occurrence. E2: U ☐ B ☐ G ☐ E ☐

.....

.....

E2. Suggest possible explanations for anomalous data (e.g., human errors) or ways to confirm if the data are anomalous.

Unattained **Basic** **Good** **Excellent**

❷ Discussion on the scoring

Concepts for marking:

- Provide reasonable explanations for the occurrence of the anomalous data (e.g., potential cross-contamination between samples or insufficient immersion of the egg white column in the solutions)
- Provide elaboration related to some biological principles (e.g., inhibition of enzyme/protease activity, reducing the initial amount of substrate)

❷ Discussion on the scoring

Sample A

(ii) Tim found that an outlier was present in one of the replicates of one test sample. Suggest ***one*** possible reason for the occurrence. E2: U ☐ B ☐ G ☐ E ☐

There are other substance in one of the replicates of test sample and affect the result

Explanation is possible but not very elaborative and clear.

Basic

❷ Discussion on the scoring

Sample B

(ii) Tim found that an outlier was present in one of the replicates of one test sample. Suggest ***one*** possible reason for the occurrence. E2: U ☐ B ☐ G ☐ E ☐

Maybe there is time error and measuring.

Not specific reason

Unattained

Unattained

The $NaHCO_3$ corrode the egg white.

human error.

The error at measuration.

Basic

sample. Suggest ***one*** possible reason for the occurrence.

There are other substance in one of the replicates of test sample and affect the result.

Good

The egg white in that egg white column is not completely boiled, same unboiled egg white flow out.

The solution may not completely covered the egg white columns.

Excellent

It can be a contaminant in the tube that inhibit the activity of ensyme.

❷ Discussion on the scoring

(c) Construct a table to show the average length of the remaining egg white in the stem of the plastic droppers and protease activity of each test sample.

B2: U ☐ B ☐
G1: U ☐ B ☐ G ☐

B2. Carry out basic calculations (e.g., percentages, frequencies, rates, means, ratios) to simplify or summarise data.

G1. Construct and use appropriate representations (e.g., tables, graphs and/or diagrams) to organise and display data.

Unattained **Basic**

Unattained **Basic** **Good**

❷ Discussion on the scoring

Criteria to meet:

Record **all** the data required in the table

+

Any *two* of the following to meet the basic requirement (basic)/ all of the following (good):

- Place the independent variable in the first column and the dependent variable in the subsequent columns.
- Contain one column listing the average length of remaining egg white and one column showing the protease activity
- For each column, include a heading with the appropriate unit in brackets (e.g., enzyme activity [cm hr^{-1}]).
- Record processed data up to one significant figure more than the raw data.

❷ Discussion on the scoring

- Enzyme activity = change in length of egg white column / time (cm hr^{-1})

- Initial length of the egg white column = 3 cm

Sample A

(3-2.42)
(24) (60)

(c) Construct a table to show the average length of the remaining egg white in the stem of the plastic droppers and protease activity of each test sample. G1: U ☐ B ☐ G ☐

(***Hint:*** Refer to the checklist on how to construct a table properly)

Test sample	Length of remaing egg white(cm) 1	2	3	Average length of remaing egg white (cm)	Enzyme activity(1/min)
1. X-HCl	2.42	2.45	2.39	2.420	0.00004038
2. X-NaHCO3	2.93	2.95	3.05	2.977	0.00001620
3. Y-HCl	2.95	2.96	2.98	2.963	0.00002546
4. Y-NaHCO3	2.95	2.80	3.01	2.920	0.00005556
5. Z-HCl	2.99	2.95	3.01	2.983	0.00001157
6. Z-NaHCO3				2.660	0.00023 6 ✓
7.					

Missing data

Unattained

Basic

Sample B

B2 : U ___ B ____

G1: U ☐ B ☐ G ☐

(c) Construct a table to show the average length of the remaining egg white in the stem of the plastic droppers and protease activity of each test sample.

Unattained

(***Hint:*** Refer to the checklist on how to construct a table properly)

Test sample (digestive juice)	Average length of the remaining egg white	Protease Activity (the protein is digested cm/24hr)
X + HCl	2.420 cm	0.58 cm ①
Z + HCl	2.983 cm	0.017 cm
Z + NaHCO3	2.600 cm	0.4 cm ②
H2O + HCl	2.973 cm	0.027 cm
H2O + NaHCO3	2.970 cm	0.03 cm

3-2.42 = 0.58

- Place the independent variable in the first column and the dependent variable in the subsequent columns.
- Contain one column listing the average length of remaining egg white and one column showing the protease activity

Basic

Discussion and conclusion:

Discussion and conclusion:

(d) From which part of the alimentary canal were the digestive juice samples taken? Explain your deduction based on your data. E6: U ☐ B ☐ G ☐ E ☐

Digestive juice	**Part of the alimentary canal** (Put a "✓" into the appropriate box.)	**Explanation for your deduction**
X	☐ Mouth cavity ☐ Stomach ☐ Pancreatic duct	
Y	☐ Mouth cavity ☐ Stomach ☐ Pancreatic duct	
Z	☐ Mouth cavity ☐ Stomach ☐ Pancreatic duct	

Unattained **Basic** **Good** **Excellent**

E6. Construct (an) evidence-based claim(s) in relation to the investigative problem using relevant data and reasoning/Evaluate (a) claim(s)/alternative explanations relation to the investigative problem using relevant data and reasoning.

❷ Discussion on the scoring

Scientific Argumentation	
Scientific argumentation is a systematic process to analyse and explain natural phenomena. Scientists share and express scientific observations and conclusions through scientific argumentation in scientific communities, which is very important for constructing and communicating scientific knowledge. A scientific argument usually consists of the following three main parts:	
Claim:	A statement that answer a scientific question
Evidence:	Qualitative observations or quantitation data that supports a claim
Reasoning:	A justification curated based on scientific knowledge or principles to describe why the evidence supports the claim

- P.22 (Junior science curriculum)

❷ Discussion on the scoring

Concepts for marking:

- Select the *appropriate claims* about the correct locations of the digestive juice samples. (i.e., *X*: Stomach; *Y*: Mouth cavity; *Z*: Pancreatic duct)
- Provide evidence in terms of *whether protein digestion occurred* in the respective samples *based on the data* about the length of the remaining egg white column.
- Connect the claim and evidence with reasoning by referring to *relevant biological knowledge about the occurrence of protein digestion* in different parts of the alimentary canal.

Sample A

Basic

(d) From which part of the alimentary canal were the digestive juice samples taken? Explain your deduction based on your data. E6: U ☐ B ☐ G ☐ E ☐

Digestive juice	Part of the alimentary canal (Put a "✓" into the appropriate box.)	Explanation for your deduction
X	☐ Mouth cavity ☑ Stomach ☐ Pancreatic duct	It can digest protein under acidic environment which is HCl that simulate the stomach gastric acid
Y	☑ Mouth cavity ☐ Stomach ☐ Pancreatic duct	It cannot digest protein. Thus, the juice do not contain protease
Z	☐ Mouth cavity ☐ Stomach ☑ Pancreatic duct ✓	It can digest protein under alkaline environment

No data (e.g., length of egg white remaining)

Sample B

Basic

(d) From which part of the alimentary canal were the digestive juice samples taken? Explain your deduction based on your data.

E6: U ☐ B ☐ G ☐ E ☐

- No data (e.g., length of egg white remaining)
- Wrong concepts (e.g. enzymes are reactive)

Digestive juice	Part of the alimentary canal (Put a "✓" into the appropriate box.)	Explanation for your
X	☐ Mouth cavity ☑ Stomach ☐ Pancreatic duct	gastric juice contain [illegible] HCl that pepsin is the most reactive to break down protein in acidic medium.
Y	☑ Mouth cavity ☐ Stomach ☐ Pancreatic duct	Saliva doesn't contain any acidic and alkaline substance, the pH is maintained near neutrality. Amylase in saliva is denatured by extreme pH so it couldn't break down any things.
Z	☐ Mouth cavity ☐ Stomach ☑ Pancreatic duct	Pancreatic juice contain $NaHCO_3$ to provides an alkaline medium for enzyme to break down substances. So enzymes in alkaline medium is reactive for action.

And Amylase can't break down protein.

Excellent

Digestive juice	Part of the alimentary canal (Put a "✓" into the appropriate box.)	Explanation for your deduction
X	☐ Mouth cavity ☑ Stomach ☐ Pancreatic duct	The data showed egg white in tube contained X & HCl have a change in length, while others not Protease in stomach work in pH2 efficiently due to the gastric juice which contain HCl While other enzyme (protease) will denature in this environment
Y	☑ Mouth cavity ☐ Stomach ☐ Pancreatic duct	The data showed egg white in tube contained Y & HCl or $NaHCO_3$ both have no change in length (or slightly in change) Since mouth cavity does not contain protease, and protein is unable to be broken down
Z	☐ Mouth cavity ☐ Stomach ☑ Pancreatic duct	The data showed egg white in tube contained Z & $NaHCO_3$ have a change in length. while others not Pancreatic duct can find pancreatic juice which contain protease (pepsin) and $NaHCO_3$. It work best in pH environment of $NaHCO_3$ others don't. So there is a change in length of egg white.

- With data
- Interpret the data using biological knowledge

❷ Discussion on the scoring

(e) Vincent claims that the protease activity of digestive juice *X* would remain the same if the same amount/volume of digestive juice *X* is introduced into the human body for the digestion of the same amount of egg white.

E12: U ☐ B ☐ G ☐ E ☐

Discuss whether you agree with his claim. (Put a "✓" into the appropriate box.)

☐ Agree
☐ Disagree

Explanation:

E12. Discuss the generalisability of the results/conclusion.

Unattained **Basic** **Good** **Excellent**

❷ Discussion on the scoring

Concepts for marking:

- Make a correct judgment about the validity of the claim.
- State the limitations of the experimental set-up in generalising the findings to *in vivo* conditions/ Point out the difference between the *in vitro* and *in vivo* conditions.
- Discuss the limitations by describing the differences between *in vivo* and *in vitro* conditions, connecting them to biological knowledge (e.g., the physical digestion/churning action of the stomach, the continued secretion of gastric juice, and the presence of other materials in the stomach that can influence the digestive process).

Sample A

(e) Vincent claims that the protease activity of digestive juice *X* would remain the same if the same amount/volume of digestive juice *X* is introduced into the human body for the digestion of the same amount of egg white.

E11: U ☐ B ☐ G ☐ E ☐

Discuss whether you agree with his claim. (Put a "✓" into the appropriate box.)

☐ Agree
☑ Disagree

- Point out experimental design (i.e., *in vitro* vs *in vivo*) which influences generalisability
- No biological knowledge

Explanation:

The environment of stomach and in the experiment may not be entirely the same due to errors. It pH value may be changed a little bit.

Good

Sample B

- Point out experimental design (i.e., *in vitro* vs *in vivo*) which influences generalisability
- Biological knowledge about the difference in conditions

(e) Vincent claims that the protease
same if the same amount/volum
human body for the digestion o

Discuss whether you agree with his claim. (Put a "✓" into the appropriate box.)

☐ Agree
☑ Disagree ✓

Excellent

Explanation:

In the stomach, the concentration of HCl of gastric juice may be different ✓ from HCl in the test that may affect the activity of enzyme. And there is physical digestion in body, muscles in the stomach wall contract to churn the food become smaller to increase the surface area for digestion. ✓

(f) The design of this experiment does not allow you to determine the optimal pH of the enzyme in the digestive juice *X*. E11: U ☐ B ☐ G ☐ E ☐

Describe how you would modify this experiment to get a more accurate estimate of the optimum pH of the enzyme in digestive juice *X*.

E11. Discuss how to modify or extend an investigation to answer a *new* investigation question.

Unattained **Basic** **Good** **Excellent**

Concepts for marking:

- Describe the modifications (i.e., smaller pH range) in the experimental design
- State *at least* one control variable (e.g., initial length of the egg white column) in the modified experimental designs
- State how to interpret the data to **estimate** the optimal pH more accurately (Notes: The use of graphing should be theoretically the most appropriate method)

❷ Discussion on the scoring

Sample A

(f) The design of this experiment does not allow you to determine the optimal pH of the enzyme in the digestive juice *X*. E10: U ☐ B ☐ G ☐ E ☐

Describe how you would modify this experiment to get a more accurate estimate of the optimum pH of the enzyme in digestive juice *X*.

Put digestive juice X into test tubes with pH 1-7 ✓ enviroment and see which egg white column has the shortest egg white remained. ✓

- Describing the modification of the design
- No mention of control variable
- Estimation of optimum pH "relatively" more accurately

Good

❷ Discussion on the scoring

Sample B

- Describing the modification of the design
- Mentioning the control variables
- Estimation of optimum pH “relatively” more accurately

(f) The design of this experiment does n
of the enzyme in the digestive juice *X*

Describe how you would modify this experiment to get a more accurate estimate of the optimum pH of the enzyme in digestive juice *X*.

Same amount of
Set three more setups that adding HCl of different pH value in three test tubes and adding same amount of digestive juice X and egg white of same length in them. After same time the shortest remaining egg white in the test tube will show the optimum pH value of the enzym

(g) rengthen your
h digestive juice

G12: U ☐ B ☐ G ☐

- Suggest teachers to further discuss with students how to make the estimation more accurate by graph plotting and interpolation

Excellent

❷ Discussion on the scoring

(g) Mr Ho suggests that you can collect additional evidence to strengthen your claim in (d) about the part of the alimentary canal from which digestive juice samples *Z* is taken by conducting further enzyme assays. G12: U ☐ B ☐ G ☐

Suggest ***one*** enzyme assay that you can perform to collect additional data to strengthen your claim. Briefly explain your answer.

G12. Suggest *new* investigations to be conducted that are relevant to the findings of the investigation.

Unattained **Basic** **Good**

❷ Discussion on the scoring

Concepts for marking:

- State the appropriate additional enzyme assay to be conducted.
- Explain how the data can be used to verify the claims.

❷ Discussion on the scoring

Sample A

(g) Mr Ho suggests that you can collect additional evidence to strengthen your claim in (b) about the part of the alimentary canal from which digestive juice samples *Z* is taken by conducting further enzyme assays. G12: U ☐ B ☐ G ☐

Suggest ***one*** enzyme assay that you can perform to collect additional data to strengthen your claim. Briefly explain your answer.

lipase, because digestive juice X only contain protease and lipase in digestive juice 2 may affect the experiment result

Unattained

❷ Discussion on the scoring

Sample B

(g) Mr Ho suggests that you can collect additional evidence to strengthen your claim in (b) about the part of the alimentary canal from which digestive juice samples *Z* is taken by conducting further enzyme assays. G12: U ☐ B ☐ G ☐

pH value of the enzym

Suggest ***one*** enzyme assay that you can perform to collect additional data to strengthen your claim. Briefly explain your answer.

Using fat instead of egg white in columns and put it into test tubes which contain digestive juice X, Yz. As only pancreatic juice contain lipase to digest fat so the test tube with the shortest remaining fat must contain digestive juice z.

(h) State the conclusion of this investigation based its aim. G6: U ☐ B ☐

- Enzyme assay described
- Explanation how to interpret data collected in the enzyme assay

Good

❷ Discussion on the scoring

Basic

Add 2 digestive juice Z ✓ contains lipid sample and starch sample.
If it is pancreatic duct, it can digested lipid sample and starch sample

Use starch agar plate ✓ to test the amylase in samples Z,
the starch will turn into colourless from milky since the amylase digest it.

Good

There is lipease in digestive juice from pancreatic duct. Add lipid into three digestive juice. Digestive juice that contain lipease can catalyse ✓ the breakdown of lipid. Lipid will be broken down into fatty acid and glcerol and decrease the pH of digestive juice. Therefore use pH meter to test each sample. ✓

❷ Discussion on the scoring

(h) State the conclusion of this investigation based its aim. B6: U ☐ B ☐

B6. Make a conclusion in relation to the investigative problem.

Unattained **Basic**

❷ Discussion on the scoring

Sample A

(h) State the conclusion of this investigation based its aim. B6: U ☐ B ☐

Digestive juice X is from stomach, digestive juice Y is from mouth cavity and digestive juice Z is from pancreatic duct.

✓

Basic

❷ Discussion on the scoring

Sample B

(h) State the conclusion of this investigation based its aim. remaining fat must contain digestive juice z. B6: U ☐ B ☐

Digestive juice x is gastric juice in stomach which optimal pH of protease is acidic.

END OF B2 TASK SHEET

U:	G:
B:	E:

Digestive juice y is saliva in mouth cavity which pH is maintained near neutral, the amylase is denatured in extreme pH medium. It can't digest protein.

Digestive juice z is pancreatic juic in pancreatic duct which optimal pH of enzymes is alkaline

- Suggest teachers to advise students to be concise in their conclusions.

Basic

❷ Discussion on the scoring

Unattained

In experiment setup contains juice Z, the starch will be converted to ~~[illegible]~~ disaccharides and ~~[illegible]~~ cannot be detect by ~~[illegible]~~ iodine test.
Starch

Why protease from X & Z (Stomach & pancreatic duct) can digest egg white.

Irrelevant conclusions

❷ Discussion on the scoring

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.

Sample A

2 U 7 B 2 G 0 E

Basic performance (most)
Good performance (some)
6 /10

Sample B

2 U 5 B 2 G 2 E

Basic performance (most)
Good performance (a few)
Excellent performance (a few)
8 /10

Outline

❶ Marking student samples

❷ Discussion on the scoring of the student samples

❸ Discussion on possible modifications of the task sheet

❸ Possible modifications

Area B2 Task Sheet

- Aspects assessed
  - Data Recording, Analysis & Interpretation
  - Constructing & Evaluating Explanations
  - Future Work & Conclusion
- Aspects *not* assessed
  - Errors, Limitations & Improvement
  - Others

❸ Possible modifications

Other possible modifications:

- Add one column to record the average change in length of the egg white columns

B2 : U ___ B ___

G1: U ☐ B ☐ G ☐

(c) Construct a table to show the average length of the remaining egg white in the stem of the plastic droppers and protease activity of each test sample.

(***Hint:*** Refer to the checklist on how to construct a table properly)

Test sample (digestive juice)	Average length of the remaining egg white	Protease (the protein is digested cm/24h) Activity
X + HCl	2.420 cm	0.58 cm ①
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Y + HCl	2.987 cm	0.013 cm
Y + $NaHCO_3$	2.843 cm	0.157 cm ③
Z + HCl	2.983 cm	0.017 cm
Z + $NaHCO_3$	2.600 cm	0.4 cm ②
H_2O + HCl	2.973 cm	0.027 cm
H_2O + $NaHCO_3$	2.970 cm	0.03 cm

Discussion and conclusion:

Calculation was proven to be difficult to students

❸ Possible modifications

- May specify the results in the outliers (e.g., no change in length) so the reasoning of the students can be more easily distinguished

(ii) Tim found that an outlier was present in one of the replicates of one test sample. Suggest ***one*** possible reason for the occurrence. E2: U ☐ B ☐ G ☐ E ☐

.....

.....

Summary

- The scoring of two samples were discussed.
- Teachers should assess the student responses according to the *SBA B2 Assessment Guidelines*.

Resources

HKDSE School Based Assessment (Biology)
Assessment Guidelines & Sample Tasks

Assessment guidelines

SBA Assessment guideline	English version	Chinese version
1. Area B1	<link>	<link>
2. Area B2	<link>	<link>
3. Area B2 (from 2027 HKDSE)	<link>	<link>

Area B1 Sample tasks

Sample task	English version	Chinese version
1. Effect of concentration of ethanol on membrane permeability 乙醇濃度對膜通透性的影響	<link>	<link>
2. A comparison of the stomatal density of upper and lower epidermis of leaves using leaf temperature 利用葉溫比較葉片上、下表皮的氣孔密度	<link>	<link>
3. Investigating enzymatic activities of biological washing powders 探究生物洗衣粉的酶活性	<link>	<link>
4. Investigating the effect of heavy metal ions on catalase activity of yeast beads 探究重金屬離子對酵母凝膠珠中過氧化氫酶活性的影響	<link>	<link>
5. Investigating the effect of pH on invertase activity of yeast beads 探究pH值對酵母珠的轉化酶活性的影響	<link>	<link>

Area B2 Sample tasks

Sample task	English version	Chinese version
1. Investigating cardiovascular responses and factors affecting the responses in Cold Pressor Test 研究心血管反應和影響冷加壓試驗反應的因素	<link>	<link>
2. Investigating the enzyme activities of digestive juices from different parts of the alimentary canal using egg white columns 利用蛋白柱探究來自消化道不同部分的消化液酶活性	<link>	<link>

- Please note that these sample tasks are intended to support teachers when planning their SBA. **Teachers are *strongly* encouraged to adapt and modify these sample tasks** to better support the learning needs of their students.
- Teachers can modify other existing investigations for the new SBA formats.
- Please refer to the previous SBA conference documents <link> <link> for guidance on how to design SBA tasks.

- Area B2 Sample Tasks will be emailed to group members shortly
- Teachers are encouraged to modify the tasks

Resources

How to improve simple experiments

HKDSE School Based Assessment (Biology)
Assessment Guidelines & Sample Tasks

Assessment guidelines

SBA Assessment guideline	English version	Chinese version
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SBA for HKDSE - Elective Subjects: Biology - Other Resources

Documents at SBA Conference 2024/25	16/10/2024
Documents at SBA Conference 2023/24	6/11/2023
PowerPoint Presentation at SBA Seminar and Workshop (April 2023)	4/5/2023
Documents at SBA Conference 2022/23	7/11/2022
Documents at SBA Conference 2021/22	4/11/2021
Documents at SBA Conference 2020/21	14/12/2020
Documents at SBA Conference 2019/20	15/11/2019
PowerPoint Presentation at Teachers' Professional Development Program on School-based Assessment	21/8/2009

Resources

- New junior science curriculum

  https://www.edb.gov.hk/en/curriculum-development/kla/science-edu/js-sci.html

Updated Science (Secondary 1-3) Curriculum Consultation

Background

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

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

For details, please refer to Education Bureau Circular No. 32/2024.

Curriculum document

"Updated Science (Secondary 1-3) Curriculum Framework" (Consultation Draft) PDF

Glossary

Part I : Scientific Investigation

Term	Description
Control experiment	An experiment which compares two setups (i.e., experimental setup and control setup) that have all the influencing factors identical except one.
Control variable	Variable to be kept constant between the experimental and control groups.
Dependent variable	Variable which is being measured or observed in an experiment.
lypothesis	A statement testable by scientific investigation that describes or explains an observed phenomenon.
ndependent variable	Variable which is being changed in an experiment.
ignificant figure	For representing the accuracy of a measurement.
Source of error	Some examples include: (i.e. systematic error / random error) (a) Reading error – Taking measurements with quantities smaller than half of the limit of reading (b) Zero error – The measurement error incurred when adjusting of zero reading is not performed (c) Human error – Caused by flaws or mistakes in the investigation (e.g. parallax error)

4 Data Analysis and Pattern Seeking

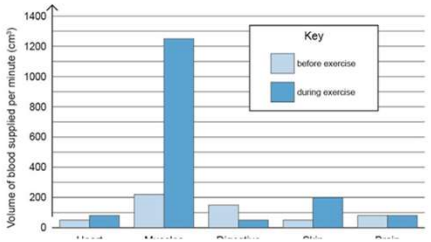
Data refers to the facts and measurements collected in experiments. To present data in an appropriate manner, we have to identify the variables in the scientific investigation into two categories :

Discrete variables (不連續數據)	Variables that can only have certain values. Examples : gender, eye colour
Continuous variables (連續數據)	Variables that can take any value and may not be a whole number. Examples : height, mass, hand span, arm span

Tables can be used to present discrete or continuous variables in an organised manner for a fair comparison.

	Food substance contained (in g)		
	Carbohydrate	Fat	Protein
100 cm^3 of human milk	7.2	4.1	1.0
100 cm^3 of cow milk	4.8	3.5	3.6

Bar charts can be used to show discrete variables.



Resources

Junior science tasks

Example 2

Perform practical work to investigate effervescence
(Suggested Learning and Teaching Activity)

Curriculum Link Unit 8 Atomic World (2024)
[Unit 9 Common Acids and Alkalis (2017)]

Major Content Area 8.4 Acids and Alkalis

Effervescent tablets contain both acidic and alkaline chemicals. When the tablet is placed in water, the two chemicals in the tablet react with each other. A "hissing" sound could be heard during the course of the reaction. A stop watch could be used to measure the duration of sound produced to find out whether the reaction has completed. In this experiment, students will be divided into 5 groups to investigate the effervescence under different conditions :

Student Group	1	2	3	4	5
Effervescent Tablets					
Water Temperature	25 ºC	25 ºC	25 ºC	10 ºC	60 ºC
Time required for the effervescence					

Complete the following task:

Statement	Whether the statement is supported by experimental data
1. Using hot water to perform the experiment can speed up the production of bubbles.	☐ Yes. Data collected by Group(s) ____ are relevant. ☐ No.
2. Increasing the surface area of the effervescent tablet can speed up the production of bubbles in the experiment.	☐ Yes. Data collected by Group(s) ____ are relevant. ☐ No.
3. The bubbles released in the experiment are found to be CO_2.	☐ Yes. Data collected by Group(s) ____ are relevant. ☐ No.

Discuss with your classmates, and check appropriate box(es) below for the best combination to produce the shortest duration of effervescence in the experiment.

Forms of Tablets	☐ Whole piece	☐ Crushed into 5-10 pieces	☐ Crushed into granular form
Water Temperature	☐ 10°C	☐ 25°C	☐ 60 °C