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

Workshop on the marking of SBA B1 sample

Objectives

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

Outline of the Workshop

❶ Marking student samples

❷ Discussion on the scoring of the student samples

❸ Discussion on possible modifications of the B1 SBA sample task sheet

❹ AOB

❶ Marking student samples

Background of the SBA task

Yeast Bead Invertase Investigation

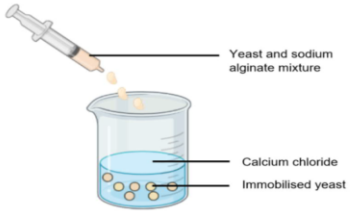
- Effect of pH on invertase activity

Context

- The samples were selected from a S.5 class (medium ability, n=18) in a Band 1 school.

School-based Assessment (SBA)

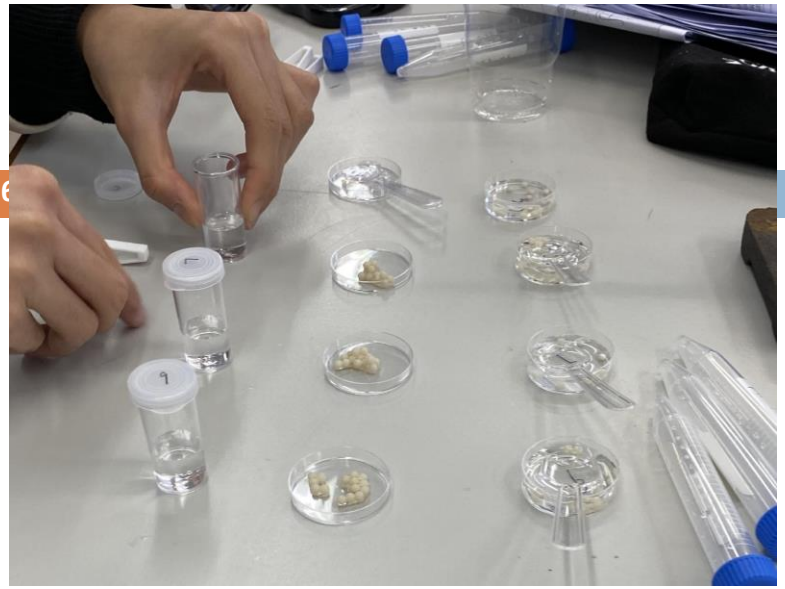
Invertase in yeast beads

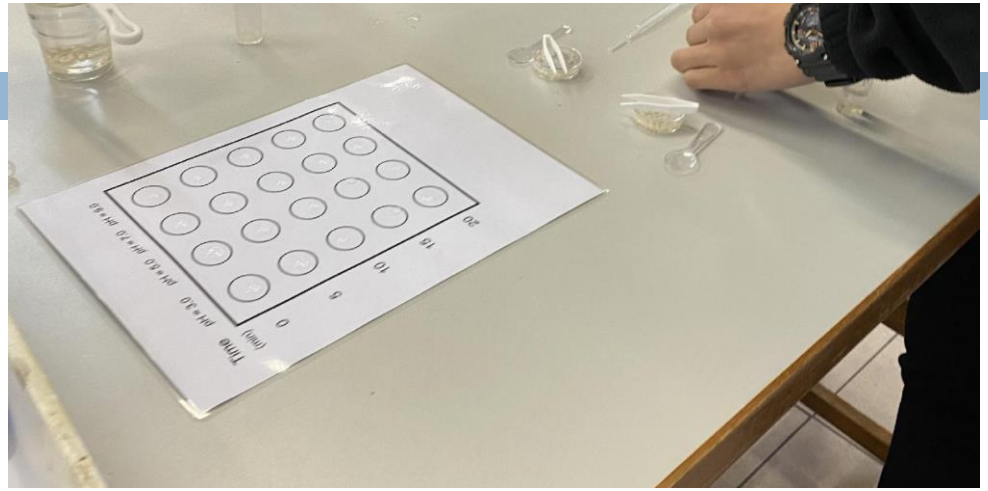


Yeast beads

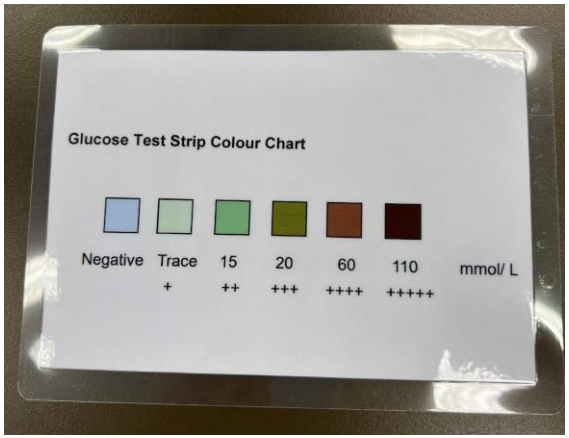
$$\text{sucrose} \xrightarrow{\text{invertase}} \text{fructose} + \text{glucose}$$

Invertase





Time (min)	pH = 3.0	pH = 5.0	pH = 7.0	pH = ..0
0				
5				
10				
15				
20				



❶ Marking student samples

Sample A

1. **Question (a) (1):** B3. Identify the IV
   - ☐ Unattained
   - ☐ Basic performance
2. **Question (a) (2):** B3. Identify the DV
   - ☐ Unattained
   - ☐ Basic performance
3. **Question (a) (3):** G6. Explain how variables are connected with the measurement(s)
   - ☐ Unattained
   - ☐ Basic performance
   - ☐ Good performance
4. **Question (b):** B1. State briefly the overall experimental design and its underlying biological principles and/or concepts
   - ☐ Unattained
   - ☐ Basic performance
5. **Question (c):** E7. Explain why some procedures can reduce measurement errors
   - ☐ Unattained
   - ☐ Basic performance
   - ☐ Good performance
   - ☐ Excellent performance
6. **Question (d):** G7. Identify important CVs
   - ☐ Unattained
   - ☐ Basic performance
   - ☐ Good performance
7. **Question (e):** E8. Identify the significant assumptions of the design
   - ☐ Unattained
   - ☐ Basic performance
   - ☐ Good performance
   - ☐ Excellent performance
8. **Question (f) (1):** G10. Explain why a specific

10. **Question (g) (1):** G1. Explain how the overall experimental design is related to underlying biological principles and/or concepts
    - ☐ Unattained
    - ☐ Basic performance
    - ☐ Good performance
11. **Question (g) (2):** G11. Suggest alternative designs
    - ☐ Unattained
    - ☐ Basic performance
    - ☐ Good performance

Overall performance:
(number of questions achieved at each level)

____ Unattained
____ Basic performance
____ Good performance
____ Excellent performance

Overall rating of the sample:

☐ 1 ☐ 6
☐ 2 ☐ 7
☐ 3 ☐ 8
☐ 4 ☐ 9
☐ 5 ☐ 10

Record your

- judgment on each question
- overall rating of the sample

❶ Marking student samples

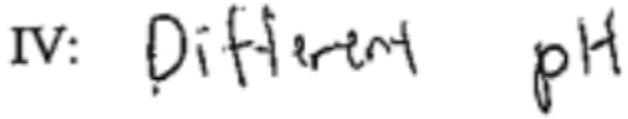
Important note:

- Note that the suggested scoring applies to the samples collected. Such differentiation of the quality of the responses best produces the rank order reflective of students' understanding of the criteria in the assessment guidelines.

❷ Discussion on the scoring

(a) (1) Independent variable

Sample A



(Basic)

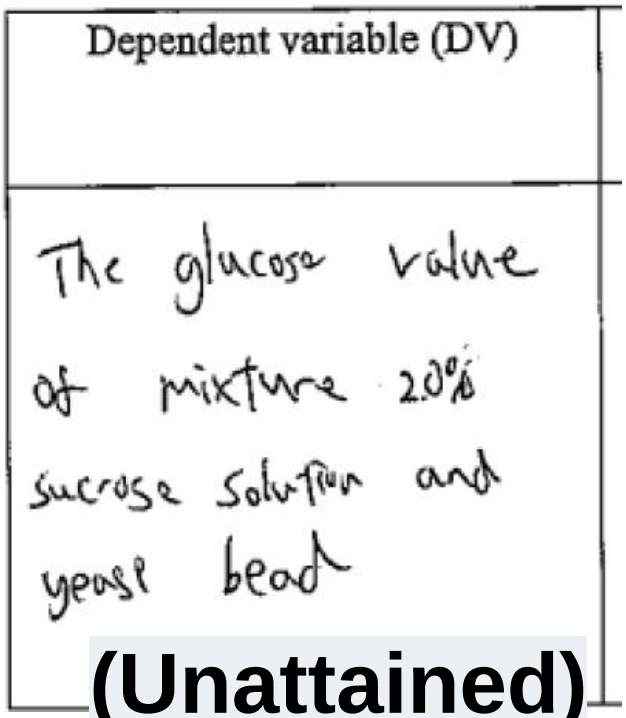
Sample B

(Basic)

❷ Discussion on the scoring

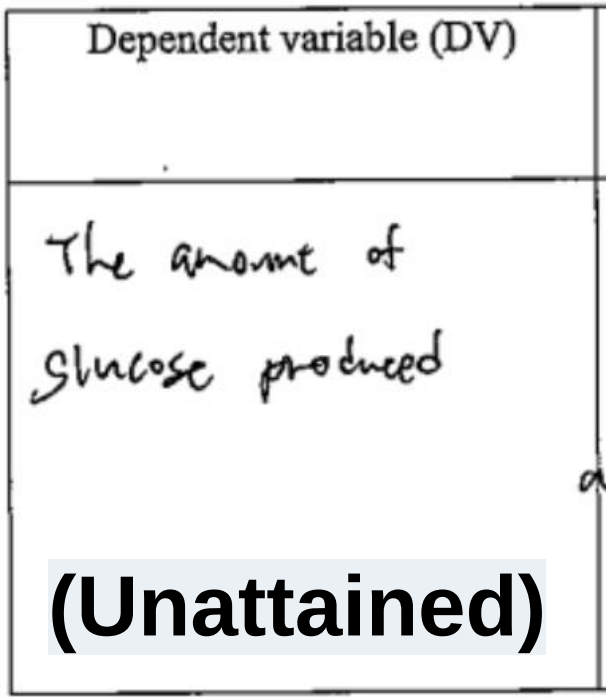
(a) (2) Dependent variable

Sample A



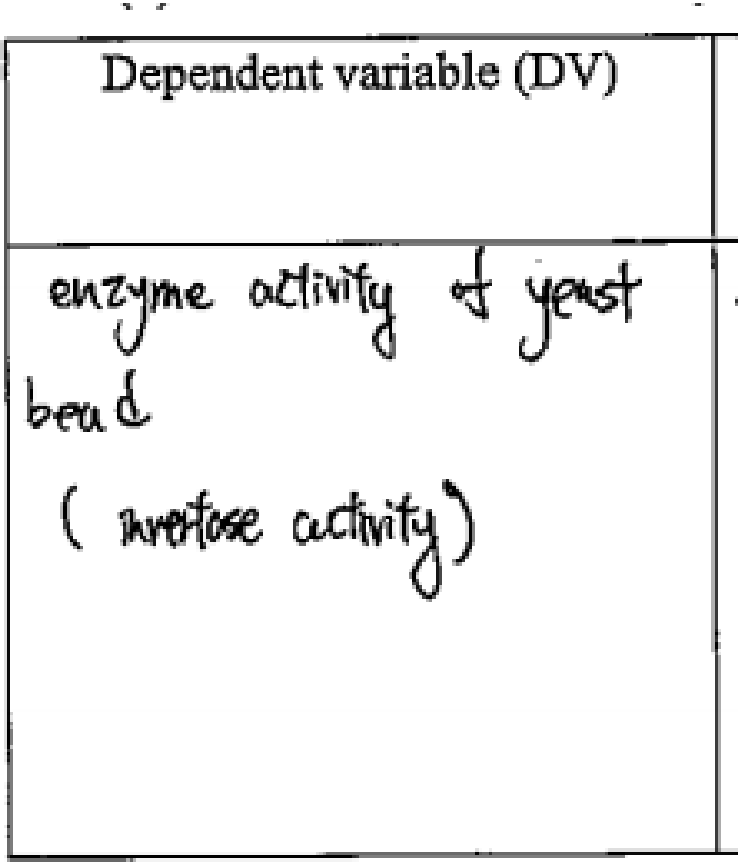
(Unattained)

Sample B

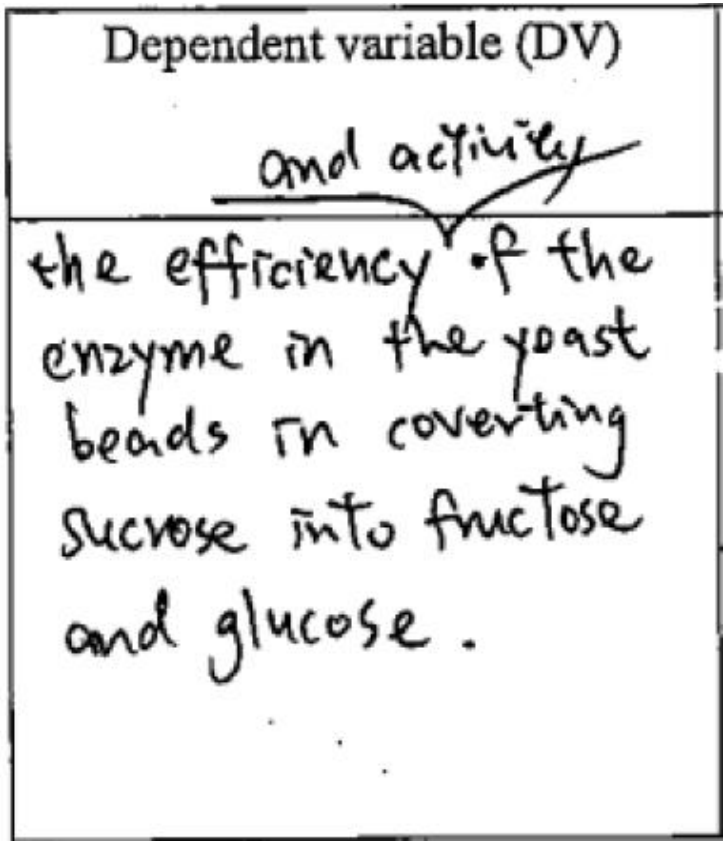


(Unattained)

❷ Discussion on the scoring



(Basic)

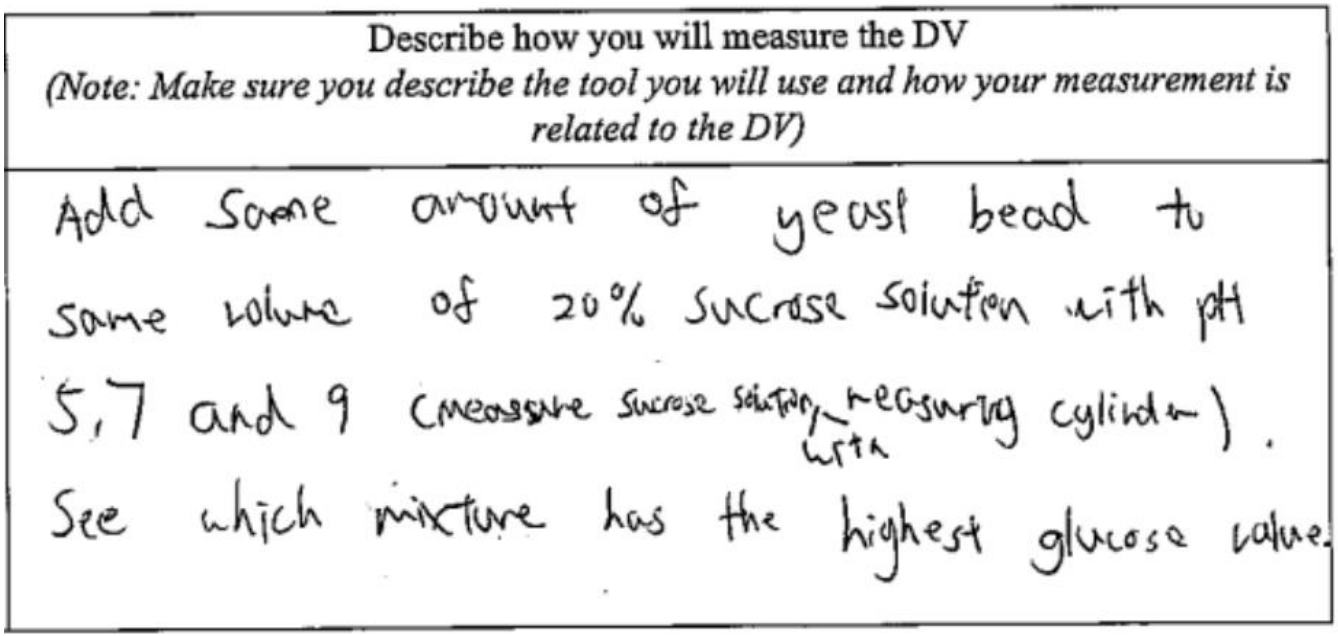


(Basic)

❷ Discussion on the scoring

(a) (3) Dependent variable and its measurement

Sample A



Describe how you will measure the DV

(Note: Make sure you describe the tool you will use and how your measurement is related to the DV)

Add same amount of yeast bead to same volume of 20% sucrose solution with pH 5, 7 and 9 (measure sucrose solution with measuring cylinder). See which mixture has the highest glucose value.

(Unattained)

❷ Discussion on the scoring

(a) (3) Dependent variable and its measurement

Sample B

Describe how you will measure the DV *(Note: Make sure you describe the tool you will use and how your measurement is related to the DV)*
Glucose test strips are used. After the yeast beads are added to the solution, a drop of solution will be picked up with a dropper every 2 minutes, and dropped onto a spotting plate, which the test strip will be dipped in. The difference in glucose levels will present itself as different colours of the test strips, which shows the different amounts of glucose produced.

(Good)

❷ Discussion on the scoring

(a) (3) Dependent variable and its measurement

Describe how you will measure the DV *(Note: Make sure you describe the tool you will use and how your measurement is related to the DV)*
Use a glucose test strip to test the colour change, if there is colour change, the sample contains invertase, and it is active for reaction.

(Basic)

❷ Discussion on the scoring

(b) Underlying biological concept

Sample A

(b) Suggest another method to measure the DV if other materials are available.

(Unattained)

Sample B

(b) Suggest another method to measure the DV if other materials are available.

Benedict's test.

(Basic)

❷ Discussion on the scoring

(c) Reducing measurement errors

Sample A

Which brand, A or B, will you use in this investigation? Why?

I will use brand A for this investigation, because three pH value (5, 7, 9) may not have a very big diffrence. If we use brand B, the results of glucose test paper may be very similar, so we should use brand A cause it has a wider colour chart.

(Basic)

❷ Discussion on the scoring

(c) Reducing measurement errors

Sample B

Which brand. A or B, will you use in this investigation? Why?

A, the intervals between different concentrations are smaller, which means it is more sensitive to sucrose concentration, making the experiment more accurate.

(Good)

❷ Discussion on the scoring

(c) Reducing measurement errors

Which brand, A or B, will you use in this investigation? Why?

I would choose brand A, since it has more intervals or the difference between each colour change is smaller. Therefore, it can help provide a more accurate results company with B. It is because when the glucose level is around 200, 400 or other levels, brand A provides us with more graduations so that we can know that which level is the actual glucose level closer to, and hence can minimize the error. For brand B, the glucose level provided is more dispersed and thus when the actual glucose level lies between the gaps, it will ropriate boxes. provide us with less accurate results.

(Excellent)

❷ Discussion on the scoring

(d) Control variables

Sample A

(d) Which of the following factors should be kept constant during the investigation? Put a "✓" into the appropriate boxes.

		Yes	No
(1)	The temperature of the sucrose solution	☑	☐
(2)	The number of yeast beads in each plastic vial containing sucrose solution	☑	☐
(3)	The concentration of the sucrose solution	☑	☐
(4)	The size of the spoon used to transfer the yeast beads	☐	☑

(Good)

❷ Discussion on the scoring

(d) Control variables

Sample B

(d) Which of the following factors should be kept constant during the investigation? Put a "✓" into the appropriate boxes.

		Yes	No
(1)	The temperature of the sucrose solution	☑	☐
(2)	The number of yeast beads in each plastic vial containing sucrose solution	☑	☐
(3)	The concentration of the sucrose solution	☑	☐
(4)	The size of the spoon used to transfer the yeast beads	☐	☑

(Good)

❷ Discussion on the scoring

(d) Control variables

(d) Which of the following factors should be kept constant during the investigation? Put a "✓" into the appropriate boxes.

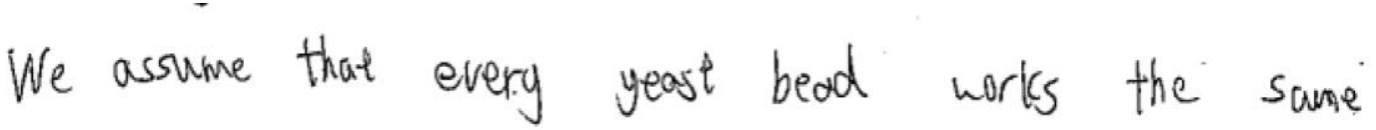
		Yes	No
(1)	The temperature of the sucrose solution	☑	☐
(2)	The number of yeast beads in each plastic vial containing sucrose solution	☑	☐
(3)	The concentration of the sucrose solution	☐	☑
(4)	The size of the spoon used to transfer the yeast beads	☐	☑

(Unattained)

❷ Discussion on the scoring

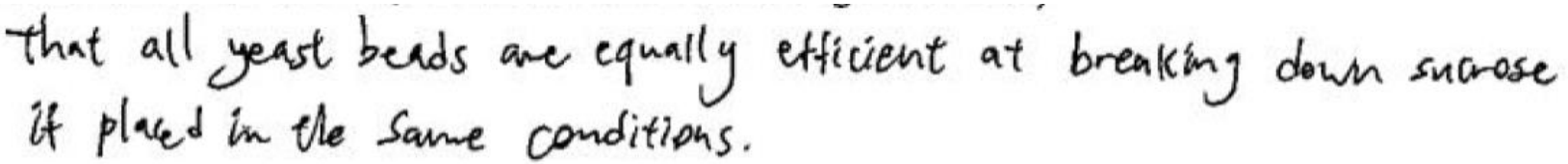
(e) Assumption

Sample A



(Basic)

Sample B



(Good)

❷ Discussion on the scoring

Unattained:
❑ Environmental conditions are the same. ❑ Yeast beads have the same size and shape.
Basic:
❑ All yeast beads work the same [under same conditions].
Good:
❑ Amount of invertase in each yeast bead is the same.
Excellent:
❑ Glucose is only contributed by the activity of invertase in the yeast beads.

❷ Discussion on the scoring

(f) (1) Precaution

Hints: Be sure to include the following parts in your answers:

- the effect on the data being collected
- explanation for the effect

Sample A

	Impact on experimental results
(1)	The pH value of sucrose solution will be affected, because if yeast beads didn't put into buffer solution, the pH value of yeast beads and sucrose solution will be diffrent. So the result won't be the pH you want.

(Basic)

❷ Discussion on the scoring

(f) (1) Precaution

Hints: Be sure to include the following parts in your answers:

- the effect on the data being collected
- explanation for the effect

Sample B

	Impact on experimental results
(1)	The amount of glucose may be higher initially for the set-ups with lower pH. The buffer solution ensures that the yeast beads are already at the pH of the sucrose solution. In this case, the yeast beads will only change its pH once in contact with the sucrose solution, meaning that it will not be denatured beforehand and more of the enzymes will be able to break down sucrose into glucose.

(Basic)

❷ Discussion on the scoring

(f) (1) Precaution

Hints: Be sure to include the following parts in your answers:

- the effect on the data being collected
- explanation for the effect

	Impact on experimental results
(1)	Since ~~it is not~~ ~~at~~ yeast beads were not added into their respective buffer solutions, pH of yeast beads are not the same ~~as~~ with sucrose solutions, that the pH of solution obtained after the expiriment is different from the initial pH of the sucrose solution, resulting in either higher or lower glucose concentration ~~in~~ in the solution obtained.

(Good)

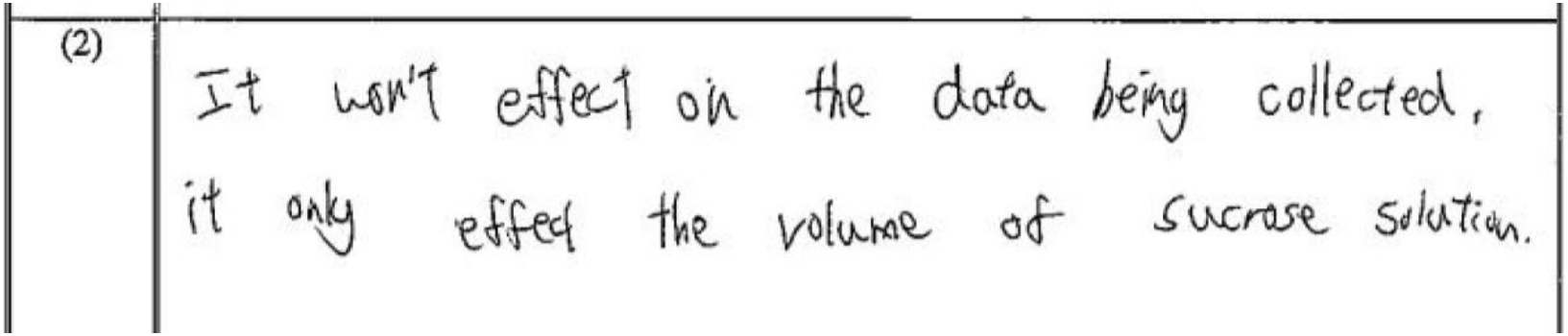
❷ Discussion on the scoring

(f) (2) Precaution

Hints: Be sure to include the following parts in your answers:

- the effect on the data being collected
- explanation for the effect

Sample A



(Unattained)

❷ Discussion on the scoring

(f) (2) Precaution

Hints: Be sure to include the following parts in your answers:

- the effect on the data being collected
- explanation for the effect

Sample B

(2)

The volume of the sucrose solution decreases, becoming that there is a difference in volume across set-ups. The spilled solution could have had more or less glucose compared to the rest of the solution, meaning that the total amount of glucose at the end will be affected.

Note that the investigation measures the concentration of glucose which reflects the invertase activity. As some students within the samples collected could clearly indicate this relationship, this sample was rated as unattained. The rating could be adjusted to attain basic performance if majority cannot clearly indicate the effect on the data collected which allows better differentiation.

(Unattained/ Basic)

❷ Discussion on the scoring

(f) (2) Precaution

(Good)

(2)	enzyme activity recorded may be higher than normal state. explanation: If sucrose solution is spilled, there will be a decrease in sucrose solution volume, there will be less sucrose present in the mixture and less time is needed for invertase to catalyse all sucrose in mixture, therefore time taken recorded will be shorter, and we will mistakenly calculate the enzyme activity higher than usual. Also a fixed volume of solution can not be maintained. (controlled variable) absent.

❷ Discussion on the scoring

Sample A

The student showed understanding that the alternative design is workable.

(1) Based on the properties of the enzyme, explain whether Adam's design is workable.

Adam's design won't be workable, because enzyme may degenerate in high pH. The enzyme may already degenerate when he put in a new buffer solution

(Basic)

The student shows understanding of the carryover effect in within subject design. The student should not be doubled penalized for assuming that enzymes would be denatured in low pH (refer to (f)(1)).

Sample B

(1) Based on the properties of the enzyme, explain whether Adam's design is workable.

No, as enzymes become denatured at low pH, if the yeast beads are placed first into a low pH solution, they will remain denatured even when placed subsequently in a neutral solution. Hence making the results of the later set-ups meaningless.

(Good)

❷ Discussion on the scoring

Sample A

(2) Suggest an alternative method to minimise the experimental error due to the individual differences between the yeast beads.

Do few more experiment and take the mean results

Sample B (Basic)

(2) Suggest an alternative method to minimise the experimental error due to the individual differences between the yeast beads.

Repeat the experiment with multiples of each set-up.
Place four yeast beads into 15 mL (each) of 20% sucrose solution,
two set-ups are at a pH of 5, two at pH 7 and two at pH 9.
Then a dropper is used to pick up the solution at 2 minute intervals
and dropped onto a piece of glucose test strip. The process is repeated
until there is no observable change between two tests. The number of
drops are then recorded and compared
needed

(Good)

❷ Discussion on the scoring

Assessment Guidelines for Experimental Design (B1)

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 the 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.

	(a) (1)	(a) (2)	(a) (3)	(b)	(c)	(d)	(e)	(f) (1)	(f) (2)	(g)	(h)
A	Basic	Unattained	Unattained	Unattained	Basic	Good	Basic	Basic	Unattained	Basic	Basic
B	Basic	Unattained	Good	Basic	Good	Good	Good	Basic	Unattained	Good	Good

Sample	**A**	**B**
Excellent	0	0
Good	1	6
Basic	6	3
Unattained	4	2
Mark	3-5	6-8

❸ Possible modifications

Brainstorm 2 modifications of the sample task/questions to better assess your students' understanding of experimental design.

(You can want to read the B1 Assessment Guidelines for ideas)

	Basic Performance	Good Performance	Excellent Performance
Biological principle/ knowledge	B1. State briefly the overall experimental design and its underlying biological principles and/or concepts	G1. Explain how the overall experimental design is related to underlying biological principles and/or concepts	
Hypothesis & Prediction (if any)	B2. Identify the hypothesis tested	G2. State the predicted results based on the hypothesis	E1. Elaborate how the predicted results give/does not give support to the hypothesis
Sampling (if any)		G3. Identify errors/issues related to the sampling method(s) and a small sample size	E2. Suggest and explain ways to reduce sampling errors (e.g., random sampling) and average out effect of variations within a sample (e.g., increasing sample size)
Dependent variable (DV) & Independent variable (IV)	B3. Identify the DV and IV	G4. Explain why the variables are DV and IV in the investigation	
		G5. Identify multiple IV/DVs	
	B4. State the methods of measurement(s)/manipulation(s)	G6. Explain how variables are connected with the manipulation(s) and measurement(s)	E3. Explain the limitations related to the manipulation/measurement method(s)/ instrument(s) for the variable(s)
			E4. Discuss the strengths and limitations of the alternative measurement method(s)
	B5. State the predicted results based on the relationship(s) between the variables		
Control variables (CV)	B6. Identify some CVs	G7. Identify important CVs	E5. Explain why some important CVs need to be controlled
	B7. Identify the control set-up(s)	G8. Explain why the control set-up(s) (e.g., multiple control set-ups in some investigations) is/are needed	E6. Discuss the limitations of the control set-up(s)
Measurement	B8. Identify important measurement errors	G9. Suggest ways to reduce measurement errors (e.g., using an instrument with a higher sensitivity)/enhance reliability (e.g., repeated measurements, using different measurement methods/instruments)	E7. Explain why some procedures can reduce measurement errors (e.g., repeated/averaging measurements for reducing random errors; calibration for reducing systematic errors; involving multiple observers to minimize individual bias; choosing an instrument that has a higher sensitivity to reduce measurement errors)
Assumption (if any)			E8. Identify the significant assumptions of the design
Others		G10. Explain why a specific step is conducted and its impact on the validity and reliability of the experimental design	E9. Discuss design decision(s) related to/ evaluate the overall validity and reliability of the experimental design
		G11. Suggest alternative designs	E10. Discuss the limitations and strengths of alternative designs (e.g., achieving the same investigation aim using different designs, within subject and between subject design)

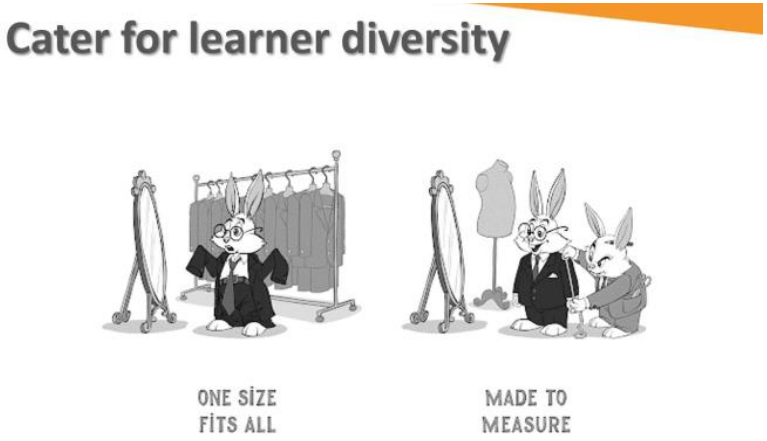
❸ Possible modifications

Possible modifications include:

(a) Varying question formats

(b) Modifying the questions

(c) Changing the factor(s) under investigation



❸ Possible modifications

(a) Varying question formats

Which of the following is the dependent variable of this investigation?

- ☐ pH of the sucrose solution
- ☐ Invertase activity
- ☐ Glucose concentration
- ☐ Amount of yeast beads

❸ Possible modifications

(2) State the DV and briefly describe how you will measure the DV with the given materials.

Dependent variable (DV):

Description of how you will measure the DV: *Notes:* • *You may support your description with a drawing* • *Make sure you describe the tool you will use and how your measurement is related to the DV*

❸ Possible modifications

(b) Modifying the questions

Tom performed a trial run for you. He tested the glucose concentration of the samples at pH 5 and 7 at 15 minutes of the experiment. He found that the glucose test strips showed the same colour (i.e. the darkest colour on the colour chart).

Suggest *one* possible change in the experimental design that would allow you to see if there is a difference in invertase activity at these two pH values.

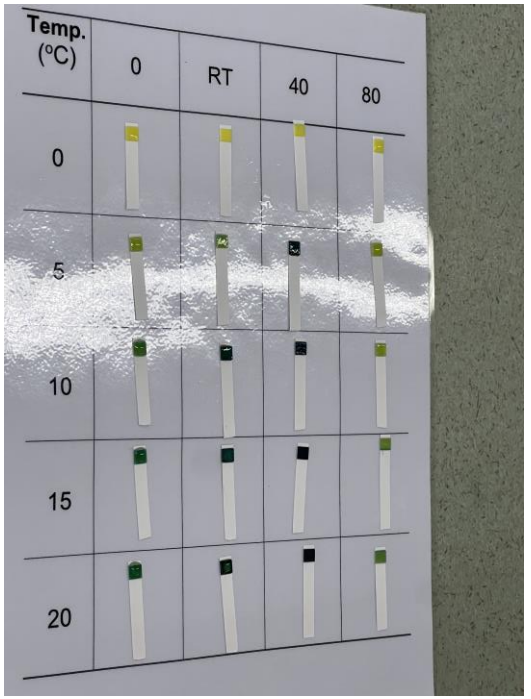
G11. Suggest alternative designs

- Will you test the glucose concentration of the samples taken at a particular time immediately with the glucose test strip or only when all the samples have been collected? Explain your reason.

G10. Explain why a specific step is conducted and its impact on the validity and reliability of the experimental design

(c) Changing the factor(s) under investigation

Effect of temperature on invertase activity



Summary

- Discussed the marking of two samples (fair, good performance)
- Brainstormed some modifications of the sample task (e.g., varying question formats, modifying the questions, changing the factor(s) under investigation)

Resources

- Task sheet (*Effect of temperature on yeast bead invertase*)
- More samples for practising marking
- FAQ