CONSENSUS MARKING

FOR THE NEW MODE OF SBA BIOLOGY

- Experiment: How does the concentration of ethanal affect the membrane permeability of beetroot?
- Task sheet with specific questions to guide the design of the investigation
- Five sample B1 reports from two school trials
- S4 students new to SBA
- Marked by DCs and 138 teachers

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?

Sample K

DV: shade of red of solution after experiment
IV: amount of solution added, mass of beetroot pieces added, temperature of solution

H 2%
M 9%
L 89%

Sample G

The dependent variable is the effectiveness of concentration of ethanol to the membrane permeability of beetroot. The independent variable is the different concentration of ethanol.

H 29%
M 56%
L 15%

Good 11. Explain how variables are connected with the manipulation and measurements

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.

Sample B

Observe the experiment after half hour and 1 hour. For example, put 3 beetroot in different test tub, inside the test tube have different ethanol with different concentration, but one is filled with water which is control setup. If more fast the pigment release, then the membrane is more permeable.

H 3%
M 41%
L 56%

Sample F

We can try to look at the diffusion of the beetroot cells. If the red colour of red pigment is diffuse out by diffusion, that means the cell membrane is permeable. If not, the cell membrane of the beetroot cell is impermeable.

H 0%
M 23%
L 77%

Sample K

Compare and contrast the shade of red of each boiling tubes, the more red the solution is, the greater effect the ethanol had. By measuring how deep the red colour is in each tube.

H 14%
M 62%
L 24%

Basic 3. Predict the results

3. What do you predict the results when beetroot tissues are put into different concentrations of ethanol?

Sample B

The highest concentration of ethanol will damage the membrane more faster, that means the pigment can do diffusion before others beetroot tissue. So the membrane is more permeable.

H 9%
M 59%
L 32%

Sample K

Different tubes would result in a different intensity of the shade of red in the solution i.e. the higher the concentration of ethanol, the more red that solution would be.

H 40%
M 50%
L 10%

Excellent 28. Discuss the limitations and strengths of the alternative designs (e.g. within subject and between subject design)

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.

Sample B

(1), because of you put different beetroot into different concentration, then the test become unfair. The beetroot inside is different, means there are two independent variables.

H 2%
M 30%
L 68%

Sample K

Put different beetroot because less pigments is obtained if the same beetroot is used, and it is better for a fair experiment since the same amount of starting pigment is obtained.

H 7%
M 45%
L 48%

Sample G

The same beetroot. We can sure that the size and shape of the beetroot should be the same during the experiment, but that beetroot may be sticked by other ethanol and affect the result. In different beetroots, we can sure that ethanol won't mix together, but the size and shape of the beetroots may not be same …

H 28%
M 34%
L 38%

Sample L

Put different beetroots into different concentration of ethanol. Strengths is that the experiment can be finished in shorter time.

H 1%
M 12%
L 87%

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.

Sample B

Because the ratio of volume and surface area in different size is different.

H 6%
M 50%
L 44%

Sample K

Different size and shape will change the total surface area of beetroot exposed to the solution, creating another dependent variable we don't want. To maintain a fair test, same size and shape of beetroot has to be used i.e. control the experiment to only have one dependent variable which is the shade of red of resulting solutions.

H 36%
M 52%
L 12%

Sample G

It is because if the beetroot has same size and shape, this test can be a fair test and the results will be more accurate and reliable.

H 5%
M 45%
L 50%

Good 17. Explain why a specific step is conducted.

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.

H 59%
M 37%
L 4%

Sample K

Three 1 cm discs because it has more total surface area, which can speed up the experiment. Therefore, the results will be more different i.e. the difference in different concentration of ethanol will be more obvious to observe so experiments can tell the difference better.

Good 12. Identify important CVs

Excellent 22. Explain why some important CVs need to be controlled

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?

H 12%

M 64%

L 24%

Sample B

The temperature of the environment, because higher T will make particles move faster, means can finish diffusion in shorter time. But we need to do fair test. So we can put these test tubes in same place, such as freezer. Although it takes lot of time but it must be fair.

Sample F

H 3%
M 52%
L 45%

The volume of ethanol should be the same.

The room T because it will affect the T of ethanol, which will affect the results

H 46%
M 47%
L 7%

Sample K

T of the solutions since a high T can also damage the cell membrane and cause pigment leakage. This can be controlled by using solutions at room T.

The freshness of beetroot can also affect the leakage of pigment. To control this, we should extract beetroot from the same beetroot sample.

H 19%

M 51%

L 30%

Sample G

If the beetroot aren't taken from the same beetroot, the results will be affected because in different beetroots, their cells may contain different amount of pigment… not a fair test… not accurate and reliable.

H 8%

M 49%

L 43%

Sample L

Temperature. The higher the T, the higher rate of evaporation of ethanol. The volume of each tube become different, affect the measurement of colour. The test becomes unfair. The experiment can be put in a water bath to keep the same T.

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.

H 12%
M 39%
L 49%

Sample K

Yes, if the volume of ethanol cannot cover the beetroot, become unfair because some parts of beetroot cells are not leaking pigments..

H 39%
M 39%
L 22%

Sample G

Yes, same volume ensure it is fair test.. For example, the lowest conc of ethanol has more volume than the highest, the colour of the lowest may darker than the highest, the results may be affected.

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).

H 0%
M 10%
L 90%

Sample B

The water potential of the cells is the same.

Sample F

The red pigment will dissolve out from high to low conc gradient.

H 1%
M 8%
L 91%

Sample K

The more red pigment the solution is, the more pigments were leaked during the experiment, which therefore shows the impact of the conc of ethanol has on the membrane permeability of beetroot.

H 21%
M 42%
L 37%

Sample G

The higher conc of ethanol, a larger damage of the membrane, and more red pigments can be captured.

H 25%
M 26%
L 49%

10. Your teacher suggest you to replicate the experiment if time is allowed. Explain the underlying reason(s).

H 27%
M 55%
L 17%

Sample K

It can eliminate error as more results obtained. We can compare different results and find a reasonable average as conclusion, which is better than using just a single result

H 10%
M 47%
L 43%

Sample G

More experiment, more results, more data, more accurate and reliable

From items to overall score

Item	Basic/good/excellent	B	F	K	G	L
1	B1	L	L	L	H/M	M
2	G11	M/L	M/L	M	H	L
3	B3	M/L	L	H/M	H	H/M
4	E28	M/L	L	M/L	H/M	L
5	E22	M/L	L	M	L	M
6	G17	M/L	M/L	H	M	L
7	E22	M	M/L	H/M	M	M
8	E22			M/L	H/M	H/M
9	E27	L	L	H/M	M/L	L
10	E24			M	L	L
Total	Average (SD)	4.6 (1.6)	2.8 (1.3)	6.5 (1.4)	6.8 (1.5)	4.8 (1.5)
	Performance	fair	poor	good	good	fair

What is the right kind of assessment for SBA ?

- Impression vs semi-quantitative vs marking scheme
- Relative vs absolute fairness
- Open vs closed questions
- Authentic assessment
- Formative vs summative
- School-based vs public assessment