

Internal Assessment

■ How can students meet the internal assessment criteria?



Internal Assessment-Design

- Aspect 1-
 - Formulate a focussed Research Question
 - Includes both dependent and independent variables
 - Quantitative if appropriate
 - Organism or tissue investigated
 - How would you write the RQ for a photosynthesis experiment involving pond weed?



Internal Assessment-Design

■ Design- aspect 1

– Formulate a focussed Research Question

■ Includes both **dependent** and **independent** variables

■ **Quantitative** if appropriate

■ **Organism or tissue investigated**

– Example: How does **increasing light intensity** affect the **production of oxygen** by *Elodea canadensis* (Pond weed)?



Internal Assessment-Design

■ Design-aspect 1

– Identify the relevant variables

■ Independent

■ Dependent

■ Other Controlled variables

– List the relevant variables for the
Photosynthesis experiment



Internal Assessment-Design

■ Design-aspect 1

– Variables

- Independent- light intensity/ watts or other LI units
- Dependent- number of bubbles / volume of gas produced in unit time
- Other Controlled variables- and why!
 - Temperature- affects rate of reactions
 - pH- affects enzymatic function
 - CO₂ concentration- needed for photosynthesis
 - Size of plant / surface area of leaves- determines amount of chloroplasts/chlorophyll
 - Time for plant to adjust to light intensity



Internal Assessment-Design

■ Design-aspect 2

- Method should include materials
 - All the necessary equipment and materials to control and measure the variables listed in Design aspect 1
 - Indicates the precision of measurements
- What is needed for the photosynthesis experiment with *Elodea*?



Internal Assessment-Design

■ Design-aspect 2

– All the necessary equipment and materials to control and measure the variables listed in Design aspect 1

■ Indicates the precision of measurements

- a 10 cm piece of *Elodea*
- 60 W lamp or other specified sources of light
- Stopwatch ($\pm 0.01s$) or stopclock (± 1 sec)
- Boiling tube
- Thermometer ($0-100^{\circ}$ C, $\pm 0.5^{\circ}$ C)
- Meter stick (1m, $\pm 0.5cm$)
- pH indicator paper ($\pm 1pH$) or pH meter ($\pm 0.5pH$)



Internal Assessment-Design

■ Design-aspect 2

– Control of variables

- Specifies how the measurements will be collected
- Specifies how the other variables will be controlled
- Each variable in list needs to be mentioned



Internal Assessment-Design

■ Design-aspect 2

– Control of variables

- Each variable in list needs to be mentioned
- Specifies how the measurements will be collected
 - **Light intensity** by distance of lamp to plant- $LI = 1/d^2$ or varying the power of lamp (10W, 40W, 60W, 100W)
 - **Number of bubbles counted per 15 sec intervals**
- Specifies how the other variables will be controlled
 - Thermometer to ensure temperature is constant
 - pH measured before and after
 - Fresh water used for each test so CO_2 is the same
 - Same plant used for all tests
 - Plant at specific light intensity for 5 minutes before collecting data



Internal Assessment-Design

■ Design-aspect 3

– Sufficient and relevant data

■ RANGE of intervals or measurements

■ SIZE of intervals or measurements

■ Number of REPLICATES of experiment



Internal Assessment-Design

■ Design-aspect 3

– Sufficient and relevant data

■ RANGE of intervals or measurements

- What light intensities should be considered?

■ SIZE of intervals or measurements

- What unit of time should be considered?
- For how long should the test run?

■ Number of REPLICATES of experiment

- How many times should the experiment be carried out?
Use of class data?

■ Will relevant data be able to be collected?



Internal Assessment-DCP

■ Data Logging

- Students should learn to...
 - choose which probes to use- Design aspect 1 + 2
 - calibrate by choosing intervals + number of samples- Design aspect 3
 - label data tables- DCP
 - do data analysis- select data appropriately- DCP
 - export data
- How to use for assessing DCP?
- Use of data logging equipment- experience



Internal Assessment-DCP

- Recording raw data- aspect 1 -pg 26-28 Biology Guide
 - Rules for data table construction
 - Descriptive title
 - Headings with units/ no units in body of table
 - BCWD
 - Uncertainties in all measurements, shown in data table
 - in headings with units, ie. Temp / ° C ($\pm 0.5^{\circ}$ C)
 - $\pm \frac{1}{2}$ of the smallest unit measurable by the instrument
 - ± 1 unit of length ($\frac{1}{2} * 2$ measurements)



Internal Assessment-DCP

- DCP- What is raw data?
 - Actual values of measurements
 - Readings before and after a treatment
 - Readings of measurements over time
 - Countings made by the student



Internal Assessment-DCP

■ DCP- Processing raw data- aspect 2

– Data processing- show the formula!

- Combining raw data values
- Means (average)
- Standard deviations
- % differences
- Statistical tests- t-test, X^2 test

- See [Topic 1 Statistical Analysis](#)



Internal Assessment-DCP

- DCP- Presenting processed data- aspect 3
 - BCWD in data tables
 - Graphs, if appropriate
 - Students need to learn to know which graph to use for various types of data
 - Rules for graph construction-
 - Title, correct scales, labels + units, data points
 - Uncertainties
 - Best fit lines, smooth curves



Internal Assessment-CE

- Conclusion- aspect 1- pg 28 Biology Guide
 - Refers back to the RQ and hypothesis
 - Explains with reference to data analysis and literature values
 - Give quantitative relationship between variables where appropriate- linear, exponential, inverse, positive or negative
 - Compare the results with text book or other literature values- correct citation of sources!



Internal Assessment-CE

■ Evaluation- aspect 2

– Evaluation- most difficult part for students!

■ Critical look at the design and method

■ Identify sources of error in method and measurement and their significance to the results

■ Limitations in method, materials and data collection



Internal Assessment-CE

■ Improvements- aspect 3

- Specifically addressing the weaknesses and limitations identified
- Realistic changes to design of data collection, choice of materials, method of analysis
- I should do the experiment again 😞
- I should be more careful 😞
- I should use my time more wisely 😞



Internal Assessment-CE

■ Evaluation-

- Sources of error in method and measurement
 - Light intensity not really quantitative
 - Too many bubbles to count / no bubbles made
 - No real control of CO₂
 - Temperature changed
- Limitations in method and data collection
 - Too small of range of light intensities- not bright enough
 - Different sizes of plants between groups so class data can't be used
- Realistic improvements on cited limitations or sources of error.
 - Use light meter to measure actual light intensity
 - Use water bath to block heat from lamp
 - For greater accuracy, collect volume of gas produced not count bubbles
 - Increase number of replicates to get more data to find averages and standard deviation



Internal Assessment-CE

■ Evaluation

Eg “*Could have done it more times*” is trivial

“*Given the high standard deviation of the data a larger sample size is recommended*” is significantly better.

General sources of error quoted that could have been easily avoided through correctly following the protocol e.g. “*We could have incorrectly read the thermometer*”.

However, “*The outlier in the data at 30 ° C could have resulted from an inaccurate temperature measurement*” is a valid criticism and could lead to a similar recommended improvement (from P Hoeben)

