Stage 2 Biology Completion Practical and Deconstruct & Design

Temperature Affecting

Enzyme Activity

**TASK A – Completion Practical:**

**Temperature Affecting Catalase Activity**

**Instructions:**  Refer to Lab background and instruction sheet (attached)

**Assessment Conditions:** Supervised 90 minute lesson

Collaborative groups of 2-3

Performance Standards: **IAE 2,3,4; KA 1, 4**

**Submission:** Max 1500 word report (or 10 min oral presentation);

Word count includes: *Introduction; Hypothesis; Variables; Analysis; Evaluation; Conclusion*

Draft – *due 1 week before final due date.*

**TASK B – Deconstruct & Design:**

**Factors Affecting Enzymes in Laundry Detergents**

**Instructions:**  See instructions below

**Assessment Conditions:** Supervised 45 minute lesson

Performance Standards: **IAE 1**

**Refer to supplement materials for guidelines for Deconstruct**

**Submission:** 2x double sided A4 sheet which demonstrates thinking

Draft – *due 1 week before final due date.*

**Problem Background – Enzymes in Laundry Detergents:**

Enzymes are often added to laundry detergents to help remove stains by breaking down the macromolecules that cause them. There are different kinds of enzymes which may be used depending on the type of macromolecule. When manufacturers are considering which enzyme(s) to add, they need to take into account cost, safety, and the various conditions under which they may be used.

You will consider and explore the following question:

**What factors affect enzyme activities in washing detergents?**

* Research which enzymes can assist in the washing process and how they work. Consider the factors can affect their activity.
* Explore the various factors that would be involved in selecting an enzyme to use in laundry detergent.
* Make informed decisions about a method that could be used to determine experimentally how one factor might affect enzyme activity and how this could be measured in the context of stain removal.
* Explore the risk factors involved in the process.
* Show clear evidence of your thinking and justification for method, materials, and proposed data collection method.
* Select one enzyme and develop a method to investigate one factor that might influence a manufacturer’s decision about adding that enzyme to their laundry detergent.
* Show your work and summarise your exploration on 2x A4 double sided pages
* You should include:
  + Key questions you asked in your deconstruct and experiment design
  + Fully annotated design with all parts of an experiment – annotations explaining your thinking, rationale for decisions, justification for choices, etc.

Attachment: **Completion Practical**

**Summative Completion Practical:**

**Factors Affecting Catalase Activity (Temperature)**



**Completion Practical – Effect of Temperature on Catalase**

**Introduction**

Enzymes have specific functions and are affected by different environmental factors.

**Question:** What is the effect of temperature on enzyme activity?

**Complete the Experiment (Collaborative work)**

Hydrogen peroxide (H2O2) is a very reactive chemical which is formed as a by-product in cellular reactions. It is highly toxic and must be removed or it will disrupt chemical reactions in the cell. Catalase, which is found in most tissue from living organisms, breaks the compound down into two harmless substances, water and oxygen according to this equation:

2H2O2 2H2O + O2

catalase

The volume of oxygen produced when catalase is added to hydrogen peroxide will be used as a measure of enzyme activity. The volume of foam produced in a given time will be measured, and this approximates the quantity of oxygen released. The rate of enzyme activity can then be calculated using the following formula:

*Rate of reaction (mL/second)* = Volume of foam produced (mL)

30 seconds

In this experiment you will investigate the effect of temperature on the rate of catalase activity on H2O2 (mL/s).

**Materials per group:**

40mL catalase extract (spinach, pureed & filtered)

* 125ml distilled water + 50-60g of baby spinach leaves smoothie style
* Filter over beaker using paper towel
* Place 50-60ml of extract in 100ml beaker and place in temp bath at front of lab

10mL 6% hydrogen peroxide (H2O2) solution of each of the following temperatures: **5oC; 21 oC (or room temp); 35 oC; 55 oC**

4 x thermometer

3x 1000ml beakers for water baths

4 x 100mL measuring cylinder

2 x 10mL measuring cylinder

1 x stopwatch

2x 5ml syringes for water transferring

1 kettle for hot water source

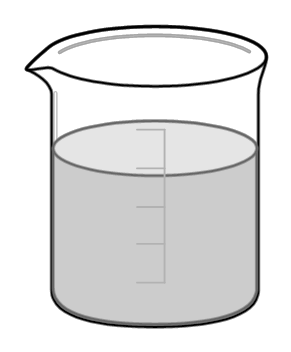
**Procedure:**

1. Prepare four water baths filling 1000ml beakers 1/3 full of water:
   1. 5oC water bath – use ice from freezer in the water
   2. 21 oC (room temp) – use water from the tap in the lab
   3. 35 oC – warm to this temperature with kettle water + thermometer monitoring
   4. 55 oC – warm to this temperature with kettle water + thermometer monitoring

1. Using a clean 10mL measuring cylinder, measure 10mL of the 6% H2O2 and pour it into a 100mL measuring cylinder. Do this for all four 100ml measuring cylinders.
2. Place the measuring cylinders into their water baths – and leave for 5 min to allow the solution to reach the water bath temperature.

1. Measure 5mL of the catalase extract from the 5oC catalase bath. *\*Note: swirl before pouring to ensure even concentration.*
2. Add the 5mL of catalase extract to the H2O2 in the 5oC measuring cylinder and immediately start timing.
3. After 30 seconds record the level of foam (mL) in the measuring cylinder and record your data in a table.





hydrogen peroxide

&

catalase extract

1. Calculate the volume of foam produced by the following formula:

= final volume – 15 mL

…and record your data in a table.

1. Repeat **steps 4 – 7** for 21 oC (room temp), 35 oC, and 55 oC
2. Calculate the rate of reaction for each temperature using the following formula:

*Rate of catalase activity (mL/second)* = Volume of foam produced (mL)

30 seconds

1. Collate class data to provide replicates and average

**Stage 2 Summative Lab Report Guide - Enzymes**

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| --- | --- |
| **Section of the Report** | **Requirements/Indicators** |
| **Introduction** | * Relevant biological Information presented that relates specifically to the practical being investigated. The information relates to the aim of the experiment. * Own words; refer to lab to get ideas * May include the following terms/ideas in the intro (as a guide):   + Denature   + Active site   + Specificity   + Factors that affect enzymes   + Rate of reaction   + Secondary/tertiary structure   + Substrate / reactants   + Kinetic energy (of molecules)   + Structure / function of enzymes |
| **Aim** | * Indicates the purpose of the experiment |
| **Hypothesis** | * Has the correct format- is not in the form of a question. * Links the independent and dependent variable and is a prediction. |
| **Materials &**  **Method** | * Copy from lab handout * List materials used (dot point form) |
| **Variables** | List each type of variable (with units) with brief explanation – use a subheading for each type:  **Independent** (the thing you change; what is on the x-axis)  **Dependent** (the thing you measure as results; what is on the y-axis)  **Controlled** (the things you keep the same to make it fair; should have 3-4)  **Uncontrolled** (the things you could not really control that may have impacted results; should have 2-3) |
| **Safety/Ethical Audit** | * Detailed analysis of the potential risks, hazards and how they are managed, and the precautions taken in the classroom. Any relevant ethical considerations. |
| **Results** | * Include all data tables from lab * **Tables** have the correct format (title; units at top of column; etc.) * **Table 1: \_\_\_\_\_\_\_\_\_\_\_\_\_** * Data is represented in an appropriate manner- all data is shown * Significant figures are correct * **Graph** is drawn appropriately- axis are labelled, appropriate scale used, title, size, correct format; lines/curves of best fit * X axis = independent variable * Y axis = dependent variable   Average of Class Results compared to results from your group |
| **Discussion**  **Analysis**  **Evaluation** | * Explains all the data obtained – why are you getting these results based on your bio knowledge * Provides reasoning based on the data for supporting or rejecting the hypothesis * Identify any trends and discuss; if none – say so; explain * Explain various parts of the curve/line of best fit * Link/discuss results to biological concepts/background * Any overall comparisons to the class average curve/line; with any explanations * Identifies potential sources of random and systematic error specifically & their impact on data **(to what degree and justify!)**; sources of uncertainty * States and justifies to what degree the data is reliable, etc. * Discusses the data’s reliability, precision, accuracy and validity with justification!!! \*(explain your thinking) * Evaluates the experimental method and suggests possible relevant improvements to the design and how it would impact data accuracy or reliability.   **Further Help for Critical Evaluation of Data**   * Compare your group to the class average in relation to accuracy, reliably, precision, etc.; to what degree are they similar/different? Why – justify your thinking and reasoning.   Critical evaluation of procedures and data can determine the meaningfulness of the results.   * Identify sources of **uncertainty**, including: * **random** and **systematic** errors * **uncontrolled factors.** * Evaluate **reliability**, **accuracy**, and **validity** of results, by discussing factors including: * sample size * precision (are results all close the best fit? Why or why not?; to what degree? * random error * systematic error * uncontrolled factors.   KEY: determine ‘TO WHAT DEGREE’ the data is reliable, accurate, or valid – AND GIVE JUSTIFCATION FOR WHY YOU THINK SO.  Example sentence stems:  “…this would impact the results by causing…”  “… this would affect the validity of the data because…”  “This is a valid result because…”  “Changing this would increase the accuracy of the data by…”  “This reveals the precision of the data is low because…”  “This must have had a major impact on the reliability of the data, because…”  “This would have had negligible or no impact on the validity of the data because…” |
| Conclusion | * Indicates whether the aim of the experiment has been met with justification; * Briefly restates the overall trend of the experiment. * Any overall limitations of the study pointed out with justification |
| Communication | * Use of appropriate biological terms and conventions; **3rd person** |

**Stage 2 Biology**

**Summative Lab Report & Deconstruct and Design**

**Temperature Affecting Enzyme Activity**

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| **Specific features** | | **Grade** | **Comments** |
| IAE1 | *Deconstruct and design of a biological investigation* |  | *Deconstruct and design* |
| IAE2 | *Obtaining, recording, and representing data* |  |  |
| IAE3 | *Analysis and interpretation of data and other evidence;*  *formulate and justify conclusions* |  |  |
| IAE4 | *Evaluation of procedures and their effect on data* |  |  |
| KA1 | *Demonstration of knowledge and understanding of biological concepts* |  |  |
| KA4 | *Communication of knowledge and understanding of biological concepts and information using appropriate terms conventions and representations* |  |  |