Stage 2 Biology

Assessment Type 1: Investigations Folio

Practical Investigation (Completion)

**Introduction**

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

Students have an opportunity to work collaboratively.

**Question: What is the effect of substrate concentration 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 different concentrations of substrate (H2O2) on the rate of catalase activity (mL/s).

Issues of safety have been addressed

  

**Materials:**

18mL catalase extract (spinach, pureed & filtered)

10mL cold hydrogen peroxide (H2O2) solution of each of the following concentrations (0, 1, 2, 3, 4, 5, 6%)

1 x 5mL syringe

7 x 50mL measuring cylinder

7 x 10mL measuring cylinder

1 x stopwatch

**Procedure:**

Clear, step by step instructions for students.

1. Using a 10mL measuring cylinder, measure 6mL of the 0% H2O2 and pour it into a 50mL measuring cylinder.

2. Measure 3mL of the catalase extract with the syringe.

3. Add the 3mL of catalase extract to the H2O2 in the 50mL measuring cylinder and immediately start timing.

4. 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 – 9 mL and record your data in a table.
2. Repeat steps 1 – 5 for the other concentrations of H2O2 (1, 2, 3, 4, 5, 6 %)
3. Calculate the rate of reaction using the following formula:

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

30 seconds

Requirements of the task and timelines are clear to students.

1. Collate class data to provide replicates and average.

Your **individual** report must include the following:

* Introduction – including:
* theory behind the practical
* purpose of the experiment
* hypothesis actually used in Part B to carry out the investigation
* variables
* Method used
* Results Table(s) and Graph(s)
* Discussion- including:
* analysis of the data
* evaluation of the method, and suggests improvements to the method
* Conclusion - relating to the data, providing justification and considering limitations

The report should be a maximum of 1500 words if written, or a maximum of 9 minutes for an oral presentation, or the equivalent in multimodal form.

Only the following sections of the report are included in the word count:

• introduction

• analysis of results

• evaluation of method/procedure

• conclusion.

The report is due a week after the results are collected.

**Assessment Design Criteria**

Investigation, Analysis and Evaluation: IAE: 2, 3, 4

Knowledge and Application: KA1, 4

**Guidelines for how to address the Performance Standards in the report:**

|  |  |  |
| --- | --- | --- |
| **Section of the Report** | **Requirements/Indicators** | **Performance Standards** |
| **Introduction** | **Relevant biological Information presented that relates specifically to the practical being investigated.**  **The information relates to the aim of the experiment.** | **KA1** |
| **Aim** | **Has the correct format**  **Indicates the purpose of the experiment**  **Independent and dependent variables are identifiable.** | **KA1** |
| **Hypothesis** | **Has the correct format- is not in the form of a question**  **Links the independent and dependent variable and is a prediction.** | **KA1** |
| **Method** | **Describes how the independent variable is changed, is detailed and describes how the dependent variable is measured.**  **All variables should be identified.** | **KA1** |
| **Results** | **Table has the correct format**  **Data is represented in an appropriate manner- all data is shown**  **Significant figures are correct**  **Graphs are drawn appropriately- axis are labelled, appropriate scale used, title, size, correct format** | **IAE2** |
| **Discussion** | **Explains all the data obtained. Trends are identified and related to relevant biological concepts.**  **Provides reasoning based on the data for supporting or rejecting the hypothesis**  **Evaluates the experimental method**  **Identifies potential sources of random and systematic error specifically and effect on data**  **Discusses the data’s reliability, precision, accuracy and validity** | **KA1,**  **IAE3**  **IAE4** |
| **Conclusion** | **Indicates whether the aim of the experiment has been met and restates the overall trend of the experiment.**  **Provides justification and discusses any limitations of the experiment and the conclusion drawn.** | **IAE3** |
| **Safety Audit** | **Detailed analysis of the potential risks, hazards and how they are managed and the precautions taken in the classroom** | **KA1** |
| **Communication** | **Use of appropriate biological terms and conventions** | **KA4** |
| **Reference List** | **Harvard Referencing Used**  **Sources correctly cited.**  **Bibliography provided** | **KA4** |

Task meets assessment specification as described in the subject outline:

* At least two practical investigations
* Individual practical report is submitted
* Requirements of the report, including word count, are clearly listed.

**Stage 2 Biology Performance Standards**

| - | Investigation, Analysis, and Evaluation | Knowledge and Application | |
| --- | --- | --- | --- |
| A | Critically deconstructs a problem and designs a logical and coherent biological investigation with detailed justification.  Obtains, records, and represents data, using appropriate conventions and formats accurately and highly effectively.  Systematically analyses and interprets data and evidence to formulate logical conclusions with detailed justification.  Critically and logically evaluates procedures and their effect on data. | | Demonstrates deep and broad knowledge and understanding of a range of biological concepts.  Applies biological concepts highly effectively in new and familiar contexts.  Critically explores and understands in depth the interaction between science and society.  Communicates knowledge and understanding of biology coherently, with highly effective use of appropriate terms, conventions, and representations. | |
| B | Logically deconstructs a problem and designs a well-considered and clear biological investigation with reasonable justification.  Obtains, records, and represents data, using appropriate conventions and formats mostly accurately and effectively.  Logically analyses and interprets data and evidence to formulate suitable conclusions with reasonable justification.  Logically evaluates procedures and their effect on data. | | Demonstrates some depth and breadth of knowledge and understanding of a range of biological concepts.  Applies biological concepts mostly effectively in new and familiar contexts.  Logically explores and understands in some depth the interaction between science and society.  Communicates knowledge and understanding of biology mostly coherently, with effective use of appropriate terms, conventions, and representations. | |
| C | Deconstructs a problem and designs a considered and generally clear biological investigation with some justification.  Obtains, records, and represents data, using generally appropriate conventions and formats, with some errors but generally accurately and effectively.  Undertakes some analysis and interpretation of data and evidence to formulate generally appropriate conclusions with some justification.  Evaluates procedures and some of their effect on data. | | Demonstrates knowledge and understanding of a general range of biological concepts.  Applies biological concepts generally effectively in new or familiar contexts.  Explores and understands aspects of the interaction between science and society.  Communicates knowledge and understanding of biology generally effectively, using some appropriate terms, conventions, and representations. | |
| D | Prepares a basic deconstruction of a problem and an outline of a biological investigation.  Obtains, records, and represents data, using conventions and formats inconsistently, with occasional accuracy and effectiveness.  Describes data and undertakes some basic interpretation to formulate a basic conclusion.  Attempts to evaluate procedures or suggest an effect on data. | | Demonstrates some basic knowledge and partial understanding of biological concepts.  Applies some biological concepts in familiar contexts.  Partially explores and recognises aspects of the interaction between science and society.  Communicates basic biological information, using some appropriate terms, conventions, and/or representations. | |
| E | Attempts a simple deconstruction of a problem and a procedure for a biological investigation.  Attempts to record and represent some data, with limited accuracy or effectiveness.  Attempts to describe results and/or interpret data to formulate a basic conclusion.  Acknowledges that procedures affect data. | | Demonstrates limited recognition and awareness of biological concepts.  Attempts to apply biological concepts in familiar contexts.  Attempts to explore and identify an aspect of the interaction between science and society.  Attempts to communicate information about biology. | |