**Stage 2 Biology**

**Assessment Type: Investigation Folio**

**Enzyme Design and Deconstruct Investigation**

Student Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

SACE Registration \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Assessment Design Criteria:**

IAE1: Deconstruction of a problem and design of a biological investigation.

IAE2: Obtaining, recording and representation of data, using appropriate conventions and formats

IAE3: Analysis and interpretation of data and other evidence to formulate and justify conclusions.

IAE4: Evaluation of procedures and their effect on data.

KA1: Demonstration of knowledge and understanding of biological concepts.

**Part A: Completion Practical**

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

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

Pectinase is an enzyme that catalyses the breakdown of pectin, a component of the cell wall in fruits, such as apples and oranges. Pectinase is used commercially to aid in extracting juice from fruit. By enzymatically breaking down the cell wall, pectinase releases the juice from within the cells. Pectinase is also used for clarifying the extracted juice.

 Pectin galacturonic acid

 pectinase

The volume of apple juice produced when pectinase breaks down pectin will be used to measure enzyme activity. In this experiment you will investigate the effect of different temperatures on the amount of apple juice produced.

**Materials:**

400g applesauce
60mL 5% pectinase solution

12x 250ml beakers

Electronic weighing scales

1x 10mL measuring cylinder

4x 50mL measuring cylinders

Stirring rod

4x funnels

12x filter paper discs

4x water baths at temperatures 15°C, 30°C, 45°C and 70°C

4x stopwatches

**Method:**

1. Make a filter by folding the filter paper disc into quarters and opening it to fit into the top of a funnel. Sit the filter over a 50mL measuring cylinder. This will be used to filter the apple juice at step 7.
2. Label 4 beakers: 15°C, 30°C, 45°C and 70°C
3. Weigh and distribute 30g of applesauce into each beaker.
4. Add 5mL of pectinase to the applesauce in the beaker labelled 15°C and stir.
5. Place the beaker into the 15°C water bath and start a 10 minute timer on the stopwatch.
6. Repeat steps 4 and 5 for the remaining three beakers (30°C, 45°C and 70°C) and place each beaker into the respective water bath. It is advised to leave a few minutes spacing in between the time each beaker is placed into the water bath to support the flow in the following steps.
7. After 10 minutes in the water bath, pour the applesauce mixture through the filter so that the filtrate passes into the 50ml measuring cylinder.
8. After several minutes, record the amount of juice produced from the applesauce (filtrate).
9. Replicate the experiment twice to obtain three trials for each temperature.
10. Convert the amount of juice obtained into a rate of reaction (ml/minute) using$ \frac{volume mL}{10}$

After conducting the practical, the data collected will be used to write an individual report. The report is to be a maximum of 1500 words.

The practical report should include the sections, outlined below:

* Introduction (with relevant biological concepts explained)
* Aim, hypothesis and list of variables identified
* Materials\*
* Method\*
* Safety and/or ethical risks\* (identification and management of these risks)
* Results (table/s and graph/s)\*
* Analysis (of results, identifying trends and linking results to concepts)
* Evaluation (of procedures and data, and identifying sources of uncertainty)
* Conclusion (with justification and awareness of limitations).

\*Not included in word count

**PART B:**

**Deconstruct and Design (Max 4 pages – min font size 10)**

*“How might plastics be most effectively digested by enzymes?”*

Recent scientific inquiry has led to the discovery of enzymes that have the ability to digest plastics. This has the potential to solve a broad range of issues currently affecting society. Much research is still required to identify a range of optimum conditions that allow the enzymes to digest the plastics best. This task will require you to deconstruct the question posed and then design a hypothetical investigation that could be conducted using laboratory or field work.

**1. Brainstorming**

Think about all of the variables involved when considering how the digestion of plastics might be affected by enzymes. Deconstruct the problem by brainstorming using a lotus diagram, concept map and/or other graphic organiser. This process should break down the main question into smaller, more specific components.



**2. Refining and Prioritising**

After brainstorming, consider which options from your graphic organiser may be suitable for further investigation. Before selecting the focus of your experimental design, further research may be required. Use a table and/or other graphic organiser to document this process.

|  |  |  |
| --- | --- | --- |
|  | **Investigation Option 1:** | **Investigation Option 2:** |
| **Questions to research:** |  |  |
| **Findings from research:** |  |  |
| **Opportunities:** |  |  |
| **Limitations:** |  |  |

**3. Investigation Design**

Working individually, design an investigation for **one** prioritised component from the deconstruction process in Part A. You will need to consider potential solutions that might be found by this investigation.

Aim:

Hypothesis:

Variables:

* Independent variable:
* Dependent variable:
* Variables that cannot be controlled:
* Factors held constant:

|  |  |  |
| --- | --- | --- |
| Factors held constant | Why it needs to be controlled | How it will be controlled |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Materials:

Method:

|  |  |  |
| --- | --- | --- |
|  | Method | Justification |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| … |  |  |

Safety and Ethical Risks:

Identify any safety and/or ethical risks, the harm they can cause and how they will be managed.

|  |  |  |
| --- | --- | --- |
| Identify any safety and/or ethical risks | Harm it can cause | How it will be managed |
|  |  |  |
|  |  |  |
|  |  |  |

Results Table:

Construct a results table that could be used to record the data from this investigation

| - | 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. |