## Stage 2 Biology: Investigation Folio Task

## Topic 2: Cells as the Basis of Life

## Deconstruct and Design Task: Effect of a factor on respiration.

What makes an organism respire faster?

## Introduction and Purpose of Task:

Each individual cell is responsible for the energy transformations that are required to sustain its ordered structure.  Cells accomplish this task by breaking down nutrient molecules (such as glucose) to generate ATP (adenosine triphosphate), in coupled reactions, which can then be used to enable cellular processes that require energy to occur.  This process is called cellular respiration. Respiration may occur in the absence (anaerobic) or presence (aerobic) of oxygen.

Measuring the rate of cellular respiration can either rely on measuring the volume/amount of oxygen taken in, or the volume/amount of carbon dioxide being released.   There are numerous techniques, types of equipment or methods that can be used to measure respiration.

Your task is to design an investigation to test the effect of a factor on the rate of respiration in an organism, to investigate the question, what makes an organism respire faster? You will need to do research and determine what type of organism could be used (consider safety, the ethics, ease of working with the organism) and what method of measurement will be used to test your hypothesis.

To deconstruct this problem, you may need to consider the various aspects of this question including but not limited to: type of organism (e.g. seeds, meal worms, yeast), what factors effect respiration, how to measure respiration, equipment that could be used, anaerobic or aerobic respiration, other variables.

After the experiment has been completed (you may use a different method to the one you designed), you will need to justify your conclusions based on the data obtained. You will also need to consider the limitations of the experiment and consider ways of improving the outcome of your experiment.

Part A: Research, Deconstruct the problem and Design your own experiment

1. *Research:*

Using numerous sources research the factors that affect respiration, possible methods for measuring respiration and other relevant considerations. Keep a list of references used.

1. *Deconstruct a problem:*

Brainstorm the various aspects of the question: *What makes an organism respire faster?*

A table may be an appropriate way to organise your thinking and ideas.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Considerations | Aspects of the Question: What makes an organism respire faster? | | | | |
| type of organism | type of respiration | Method options | Measurement of respiration | Other variables |
| Options |  |  |  |  |  |
| Questions to research |  |  |  |  |  |
| Findings: |  |  |  |  |  |
| Possible Limitations |  |  |  |  |  |

1. *Design*:

Design an experiment to test the effect of one factor on the rate of respiration. You will need to determine your independent and dependent variable to do this effectively.

Design your experiment individually.

In your design include all details required to undertake a reliable and valid experiment. You must also consider the ethical and safety aspects of this experiment. Reference your information appropriately.

* 1. Variables, measurement of the dependent variable, one independent variable, constant variables
  2. Hypothesis
  3. Materials and Equipment required
  4. Method suitable to test the hypothesis
  5. Blank data table

Annotate your deconstruction and design to justify the decisions you have made about such things as the organism you have chosen, the independent and dependent variables, how and why you will control other variables, number of trials, measurements.

Evidence of deconstruction, the method/procedure chosen as most appropriate, and a justification of the plan of action must be a maximum of 4 sides of an A4 page (minimum font size 10).

Submit this for assessment on: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Part B: Complete the experiment

1. Your teacher will allocate you into groups to undertake one experiment designed by one of your groups’ members or provide another appropriate method. This design will be chosen with your teacher, based on equipment availability and feasibility.
2. You will complete the experiment and record the data in an appropriate results table.

Part C: Write an individual report

You will write the report, with the discussion component focused on the data collected.

The Investigation Report must include:

* Introduction – including:
* theory behind the practical
* purpose of the experiment
* hypothesis actually used in Part B to carry out the investigation
* variables
* Materials and method used in Part B
* 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 evidence of the deconstruction and design component (Part A) must be attached to the practical report.

Assessment Conditions for this task:

Class time will be given for students to individually deconstruct the problem and design the method for the experiment.

A double lesson will be provided to collaboratively undertake the practical in a small group. Each student will submit an individual practical report. Appropriate amounts of time will be allocated to enable students to collect data.

Students may submit one draft for feedback for Part A and Part B. Part B will be due one week after the experiment is completed.

Final copy is due 2 weeks after the experiment is completed.

Assessment Design Criteria

Investigation, Analysis and Evaluation: IAE 1, 2, 3, 4 Knowledge and Application: KA1, 4

Links between the report components and the Performance Standards:

|  |  |  |
| --- | --- | --- |
| **Section of the Report** | **Requirements/Indicators** | **Performance Standards** |
| **Deconstruction** | **Explores the various aspects of the problem and this links to the aim, hypothesis and method. Justifies decisions made for design.** | **IAE1** |
| **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.** | **IAE1** |
| **Method** | **Describes how the independent variable is changed, is detailed and describes how the dependent variable is measured.**  **All variables should be identified.** | **IAE1** |
| **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** | **IAE1** |
| **Communication** | **Use of appropriate biological terms and conventions** | **KA4** |
| **Reference List** | **Harvard Referencing Used**  **Sources correctly cited.**  **Bibliography provided** | **KA4** |

**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. | |

Notes for Teachers:

Please note that the table in this task has been partially filled in with some of the aspects of the question provided for you, the teacher, to assist with how you might discuss deconstruct with your students. However, it would be appropriate **not** to give these to the students to enable them to explore the problem and develop their own ideas about the factors that could be considered.

Some useful references for methods that may be suitable for this task:

unknown. 2017. Exploring Yeast Respiration. [ONLINE] Available at: <https://www.uaf.edu/case/lessons-1/Cellular-respiration-in-yeast.docx>. [Accessed 2 March 2017].

unknown. 2017. Lab 5 Cellular Respiration. [ONLINE] Available at: <http://www.biologyjunction.com/lab_5_cellular_respiration_by_kr.htm>. [Accessed 2 March 2017].

unknown. 2017. Investigation - What Factors Affect Cellular Respiration? . [ONLINE] Available at: <https://www.biologycorner.com/worksheets/cellular_respiration_AP_Lab5.html>. [Accessed 2 March 2017].

Lynn Vaccaro. 2017. What Makes a Seed Breathe Faster?. [ONLINE] Available at: <http://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwjug9_S7LPSAhVLJZQKHaDXCScQFggfMAE&url=http%3A%2F%2Fcsip.cornell.edu%2FCurriculum_Resources%2FCSIP%2FVaccaro%2FSeed_Respiration_Teacher.doc&usg=AFQjCNGctj_9JyjUnSn2oE_gpxYx2hKNUQ>. [Accessed 2 March 2017].