## Stage 1 Biology: Investigation Folio Task

## Topic 1: Cells and Microorganisms

## Deconstruct and Design Task: Effect of various factors\* on Osmosis in Rhubarb Cells

**Introduction and Purpose of Task:**

Living cells must be able to transport water and other substances in and out of the cell. The vital process for the transport of water in and out of cells is Osmosis. Osmosis occurs across the semi-permeable cell membrane in cells.

Water, like other substances, comes in different concentrations. Pure water is the most concentrated. Once solutes are added to water, the concentration of water in these solutions subsequently decreases. Therefore, like other substances, water is transported due to the concentration gradient. Water will travel from a low solute solution to a high solute solution, as there are more water molecules in a low solute solution than in the high solute solution.

In this task, students will investigate a factor that affects osmosis in rhubarb cells (or other suitable plant cells). They will observe rhubarb cells using a microscope and then design an experiment to determine the effect of a factor on osmosis. The factors that could be considered include SA: Vol, concentration or temperature.

Students will then consider and explore the questions “How do unicellular organisms living in water control the entry/exit of water from their cells? Are they able to live in any environment? How may this be tested?”

**Part A: Observing and Drawing cells**

Materials for the Initial Experiment: Observing osmosis in Rhubarb cells

Rhubarb

Distilled water in a dropping bottle

Salt solution in a dropping bottle

Microscope, slides and coverslips

Forceps and razor blades or scalpel

Paper Towelling

Method:

Rhubarb normally has a very low concentration of salt within its cells.

Rhubarb cells are very distinctive when viewing using a microscope, making them ideal to observe osmosis. The red colour of the rhubarb is a result of red pigment in the cytoplasm of the rhubarb cells, giving their cytoplasm a reddish colour, which enables the cell membrane to be distinguished.

To view rhubarb cells with distilled water and salt solution

1. Clean and dry a slide and coverslip. (They should be clean already!)
2. Obtain a small sample of the red epidermal cells (teacher will demonstrate) from the stalk of the rhubarb by carefully peeling away the layer with forceps.
3. Prepare a wet mount slide of the rhubarb tissue in distilled water only.
4. View your slide under low power on your microscope, and then switch to high power.
5. Draw a diagram of the field of view, and label.
6. Irrigate your slide with the salt solution. Leave for a few minutes.
7. View one of your slides under low power on your microscope, and the switch to high power.
8. Draw a diagram of the field of view, and label.
9. Describe the effect observed on the cells. Consider what has happened to the cells, and explain with reference to the cell membrane, osmosis, direction of water movement and the composition of the internal environment of the cell compared to the composition of the external environment.

**Part B: Design your own experiment**

1. Design your experiment individually to test one factor on osmosis on rhubarb cells (or other suitable source of plant cells). In your design include all details required to undertake a reliable and valid experiment. You must also consider the safety aspects of this experiment.
   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. Results collection and presentation (Include a blank data table to show how you will record the data)
2. In defined groups, students in consultation with the teacher will select one method to perform and to collect data.
3. Individually write a practical report.

**Part C: Deconstruct a question**

Consider the questions, “How do unicellular organisms living in water control the entry/exit of water from their cells? Are they able to live in any environment? How could this be tested?”

Explore the various factors that would be involved in how unicellular organisms control the entry/exit of water, and research if the control of these factors would enable these types of organisms to live in any environment. Make informed decisions about which unicellular organisms might be able to be used to determine experimentally how one factor might affect the ability of this organism to live in a particular environment. Explore the risk factors and ethical considerations of doing an experiment with live organisms. Develop a method to test your factor. This experiment will not be performed.

You may present this portion of the task as a written report or orally with a PowerPoint presentation.

The Investigation Report must include:

* An appropriate introduction – introduces the theory behind the practical, including:
* Aim: what is the purpose of the experiment?
* Hypothesis, Identification of all the variables
* Materials and Method with Safety Audit
* Results Table(s) and Graph(s)
* Discussion- includes analysis of the data and evaluation of the method, and suggests improvements to the method
* Conclusion, with justification
* Deconstruct the question
* Reference List

**Assessment Conditions for this task:**

Class time will be given for students to individually design the investigation question/hypothesis and to deconstruct the question.

A double lesson will be provided for students to undertake the practical in a group.

Each student is to submit a practical report and will individually deconstruct the problem.

Students may submit one draft for feedback, due one week after the experiment is completed. Final copy is due 2 weeks after the experiment is completed.

Word Count: maximum of 1000 words or 6 minutes for an oral presentation for the **introduction, analysis, evaluation and conclusion** sections of the report.

**Assessment Design Criteria**

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

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

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| --- | --- | --- |
| **Section of the Report** | **Requirements/Indicators** | **Performance Standards** |
| **Deconstruction and design** | **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**  **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**  **KA1** |
| **Communication** | **Use of appropriate biological terms and conventions** | **KA4** |
| **Reference List** | **Harvard Referencing Used**  **Sources correctly cited.**  **Bibliography provided** | **KA4** |

Performance Standards for Stage 1 Biology

| - | 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. |