## **Stage 2 Biology – Assessment Type 1: Investigation Folio Task**

## **Topic 4: Evolution**

## **Deconstruct and Design Task: Predator-Prey Relationships and Natural Selection Simulation Investigation.**

**Introduction and Purpose of Task:**

Predators consume other organisms that are considered their prey. These relationships in nature are important. The predator will not survive if it does not have a food source, while the predator helps to control prey numbers so that it too can survive within the ecosystem they share.

Predators and their corresponding prey evolve together, so that they each have specialised adaptations that enable the survival of both species.

Natural Selection enables individuals of a population to survive if they have the characteristics that make them the most suitable to the prevailing environmental conditions. These organisms then are more likely to reproduce and pass on these favourable characteristics to offspring. This alters the gene frequency of characteristics that are favoured.

In this task, students design an experiment to investigate: how a factor that affects the ability of an organism to survive predation may affect a population of prey using an experimental model and evaluate it, observing natural selection in a simulated exercise.

**Part A: Deconstructing the Problem to develop an appropriate method:**

**Preparation of the location and testing**

*Teachers please note*: This practical requires preparation and an appropriate location(s). It is a practical that requires several weeks to undertake. In addition to deconstructing a problem, it is also an opportunity for students to consider the ethical and safety consideration of a practical that uses real organisms in a field setting.

Factors to consider include:

* Collection of data (it is ideal to collect data daily)
* Best time of the year to conduct this experiment, best location, types of birds
* Safety considerations: the use of food dye in foods fed to organisms in the location – use food grade dyes as these are safe for consumption
* Live birds and other animals may be encountered, and certainly their waste will be. Use gloves.
* Working outside, consider sun safety and the environmental conditions.

**Preliminary Investigation**: To determine the best location

1. Look around the school grounds for a location that naturally has birds.
2. Consider the safety of this location.
3. Consider the natural predators or other organisms in the area- will these also be attracted by the food source?
4. If no location is suitable, set up a bird table in an appropriate location.

**Materials and Method:**

Web cam\*

Wild bird food

Spaghetti

Food colouring

1. Acclimatise the local bird population by providing wild bird food in the same area as the experiment to be undertaken.
2. Observe the birds, habits, identify if possible. Use of a web cam if available could assist with this and for data collection later in the experiment.
3. Feed the birds for **at least one week**, to ensure they keep returning.

**Making the Spaghetti Worms** (when ready to start the actual experiment)

1. Cook spaghetti as per instructions
2. Add dye to the cooking water. Food grade dyes are not dangerous to birds.
3. E.g. Green = 15ml of bright green dye, 5 ml of black and 10 ml of red = red/brown etc.
4. They can be kept in the fridge for 3 days or stored in the freezer and thawed before use.

**Method for Investigation (you will need to alter this, based on your independent variable):**

1. Select and mark out the feeding area according to the acclimatisation trials.
2. Present equal numbers of “different” spaghetti worms to the birds.
3. Each day, count the number of worms remaining of each type.
4. Make a new population, the size of the original, but with fresh worms of each type in proportion to the numbers of each type you collected.

**Calculation to determine population after each predation cycle:**

Total number of worms in starting population = N

Number of worms of type A collected = a

Number of worms of type B collected = b [do this for each different type]

Total number of worms collected = (a + b + ….) = n

Number of worms of type A to be put out for next generation = a x N ÷ n [calculate for each type]

**Part B: Design your own experiment**

1. Design your experiment individually to test one factor on the predation of the spaghetti worms. In your design include all details required to undertake a reliable and valid experiment. 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- consider the number of spaghetti worms, the distribution of the worms.
   5. Results collection and presentation (Include a blank data table to show how you will record the data)

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).

1. In defined groups, students in consultation with the teacher will select one method to perform and to collect data.
2. Individually write a practical report.

Factors that could be investigated include: different colour prey, different length or size prey, different areas, different shaped prey.

The Investigation Report must include: (an individual report)

**An appropriate introduction – introduces the theory behind the practical**

**Aim: what is the purpose of the experiment?**

Hypothesis, Identification of all the variables

Materials and Method with Safety and Ethical consideration. This is for the investigation actually undertaken in Step 2 above.

Results Table(s) and Graph(s)

**Discussion**- includes analysis of the data and evaluation of the method used (may not be the one designed by the student).

**Consider the following (not limited to this):** Why use a model? What do the worms represent? How does the use of the model differ from real predator-prey relationships? Sources of Uncertainty? Reliable? Accurate?

**Conclusion-** relates to the data and must be justified. What limitations are associated withthe conclusion?

Reference List (Harvard Referencing System).

Note: The evidence of the deconstruction and design component must be attached to the practical report.

Reflection: How has the model assisted in your understanding of Natural Selection?

**Assessment Conditions for this task:**

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

Several lessons will be provided to set up and undertake the practical in a group. Ongoing- collection of data will be arranged.

Each student submits an individual practical report. Students may submit one draft for feedback, due one week after the collection of the data is completed.

The evidence of deconstruction and design should be attached to the report. This is not included in the word count. Suggested formats for the summary sheet include flow charts, concept maps, tables or notes.

Word Count: maximum of 1500 words or 10 minutes for an oral presentation for the **introduction, analysis, evaluation and conclusion** sections of the report.

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

Refer to your *Guidelines for how to address the Performance Standards a practical report* to help you write your report.

**References:**

“I’m a worm, get me out of here”, Wellcome Trusts, Darwin 2000

A model for Natural Selection- spaghetti worms, Nuffield Foundation.org.

**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. | |