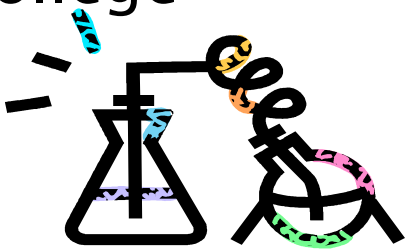
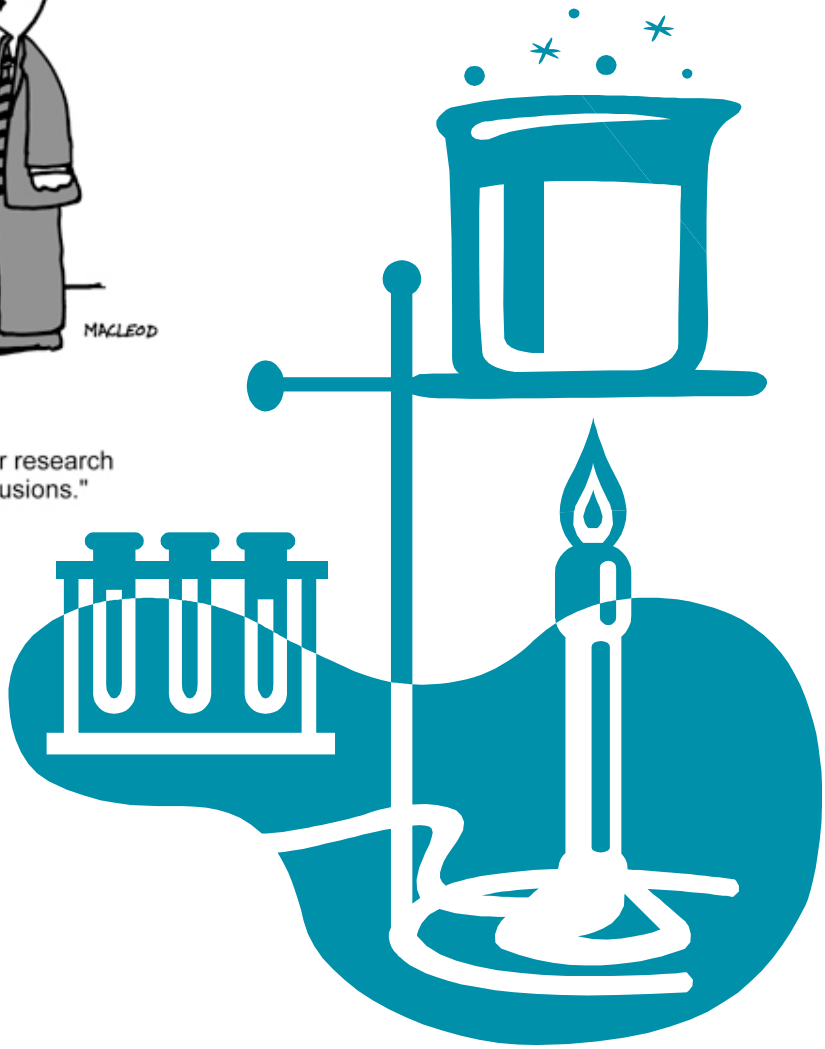
Matthew Flinders Anglican College

Year 12 Biology



Extended Experimental Investigation:

"You are completely free to carry out whatever research you want, so long as you come to these conclusions."



Name _____

YOUR TASK:

Perform an investigation of your own design or develop a familiar experiment to investigate some aspect of biology that interests you.

The investigation will consist of a:

- review of relevant scientific literature
- simple experiment that explores an aspect of biology that you are interested in.
- data collection
- analysis of the data
- conclusion that reflects on your findings and their use in the "real" world

You will need to discuss your proposal with your teacher. A **Proposed Research Plan**, MUST be submitted before commencing work.

Throughout your investigation you will be required to keep a **logbook** to record what you are doing. You will use the logbook to record in one place your thoughts and notes about everything from selection of a topic through to completion of your investigation. This would include all observations, measurements, problems, changes in approach and modifications to your initial plans and procedures. It is a no-frills, on-the-spot recording of the essentials of your work. Additionally, it may be used to verify the authenticity of your work. You are also required to include a series of photographs to help illustrate your findings. In a case where there is some doubt about who did a majority of the work in your project you will be require to explain the project and its findings to a panel of Biology teachers who will assess your input into and understanding of the project.

ASSESSMENT AND TIMELINE:

It is important that you follow this timeline. It is intended to allow your teacher to monitor your progress and to prevent you from placing unreasonable expectations on yourself, or on your teacher for assistance. If you fail to reach any of the nominated checkpoints you must immediately renegotiate the timeline. Failure to do so will prevent authentication of your work and will jeopardize your chances of achieving a good result.

Term	Recorded	Section
Term 1 Week 1		Hand out booklet
Week 2	Booklet	Initial Proposal
Week 3	Journal	Initial theory and experimental research start annotated bibliography
Week 3	Journal	Initial Experimental Design
Week 4	Journal	Modifications to Experimental Design and reasoning
Week 6	Journal	Annotated Bibliography Start Experimental work
Holiday	Journal	Experimental work
Term 2 Week 1	Journal	Results
Week 2-3	Journal	Discussion of results
Week 4-5	Journal	Conclusion
Week 6	Draft EEI	Hand in draft
Holiday		
Term 3 Week 3	Completed EEI	Hand in completed EE!

Work in Progress Checklist: A checklist will be used to monitor the management of your task, this will be signed by your teacher at appropriate times. Similarly, you will be offered feedback on your draft report (once only) should you choose to avail yourself of it.

You will need to submit your **logbook**, and your **draft report** along with your **final report**. The logbook, and draft* will not be assessed but are your way of providing evidence that *you engaged in the research process* and that the report is *your own work*.

* In the event that your final report is not submitted on time, your draft report will be assessed.

The secret of a successful project is to select a topic which is interesting and yields interesting results. An infinite number of projects is possible. Most of them are not worth attempting. Be particularly wary of choosing a project which involves too much identification or requires the collection of numerous environmental measurements. Descriptive projects can be valuable if carried out by an enthusiast, but remember that the best way to unravel cause and effect in Biology is to perform experiments.

How to plan and execute your project

(a) Search for a topic which really interests you.

(b) Find a phenomenon, for example, daffodil flowers usually face away from nearby walls.

(c) Think about the phenomenon carefully and write down any explanations of it you can think of. At this stage discussion with friends, teachers or parents may provide ideas which had not previously occurred to you.

(d) Decide on a particular hypothesis to be tested. An hypothesis is a tentative explanation of the phenomenon, which can be tested by experiment or observation, for example, the flower stalks of daffodils are positively phototropic.

(e) Decide what data you need, and how you should obtain it. Do not be too grandiose in your schemes. Beginners greatly overestimate what is possible in the time available. The analysis of the data and the projection of the project report will take at least as long as the practical work.

(f) Consider now how you will present the data in your report. Will negative results be valuable? For example, if the flower stalks of daffodils, in experiments, showed no tendency to grow towards light, could you still write up the project in an interesting manner?

(g) At this stage you should make a list of all the apparatus which you require and check that it is available.

(h) If possible, carry out a pilot experiment or make a trial set of observations. This will tell you if the snags in the experimental technique, suggest extra measurements which might have to be made, and enable you to predict how long the practical work will take. If your methods are unsuitable, a pilot study will expose the problems before you have invested too much time and energy in barking up the wrong tree.

Formatting:

Text: Pitch: 12; line spacing: 1.5 or 2: font: Times New Roman; Margins minimum of 1.5 cm
Tables, figures and diagrams centre on the page with the number, title in bold centred beneath it.

Experimental Design

Next you must consider how many experimental treatments to set up, or how many samples to collect. How should you arrange the collection of data in space and time? Where necessary you must include controls, replication (repeated attempts at the same experimental treatment), randomization and analysis of results by statistical methods.

Possible Topics

Important note

Project work must not be carried out in such a way as to cause any distress to an animal. The animal must not be wounded, poisoned, inflicted with a disease, or starved.

General

- Pollen counts, made by exposing sticky slides to the atmosphere on several successive days, correlated with weather data and hay fever suffering.
- Reproductive behaviour of aquarium fish.
- Analysis of territorial behaviour in birds, e.g. magpies. (Ideal for keen bird-watchers.)
- Analysis of web-building by spiders as an example of innate behaviour.
- Variation in the size of pollen grains in different species of flowering plants.
- The time and location of most active cell division in root tips.
- Thin-layer chromatography of flower pigments in closely-related species.
- Navigation of ants by pheromones (e.g. in trail-following.
- The rate of fall of, and distance traveled by, winged seeds in relation to their structure.
- Direction-finding in pond snails. (In general snails are good animals to work on: they are easy to keep, move slowly and don't answer back!).
- Learning and colour/pattern recognition in relation to feeding behaviour of fishes.
- Effect of light and/or temperature on the behaviour of fish.
- Stalking behaviour in cats. (In general many interesting projects can be carried out on pets but be sure to adopt a rigorous scientific approach.)

Ecological

- Energy budgets of insects of different ages
- Food web for a pond.
- Factors affecting the distribution patterns of different animal species, e.g. planarians, shrimps, barnacles, mussels.
- Testing for salt tolerance or lead tolerance in races of grasses
- Pollination; flower constancy of pollinating insects; pollen identification from insects; flower preferences in relation to tongue length; role of flies in pollen-eating and pollination.
- Mosses and algae on north-south sides of walls or different levels up a salt marsh; distribution pattern in relation to desiccation tolerance.
- Growth of duckweed (*Lemna* species) at different levels of added nitrate and/or phosphate to simulate eutrophication.
- Growth of duckweed (*Lemna* species) at different levels of added detergent to simulate pollution.
- Population dynamics of plants in permanent quadrants; death rates of seedlings and mature plants.
- How does the shell of a snail grow in size and shape as a snail becomes larger?
- Birth and death rates of different leaves on the same plant or leaves on plants from contrasting habitats.
- Mineral nutrient requirements of plants; water and sand cultures.
- Tissue cultures of plants in sterile conditions on agar.

- The effects of different water regimes on plant growth.
- Inter-specific interaction between clover and grass; addition of fertilizer.

Physiological

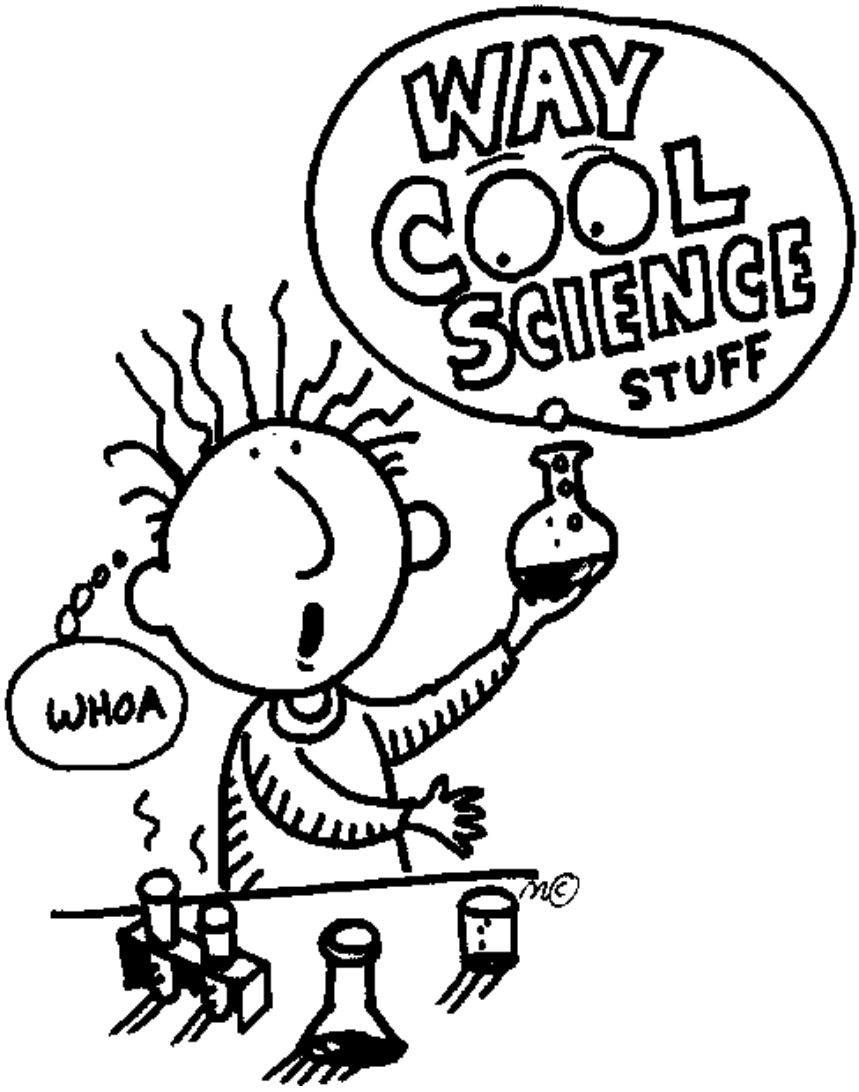
- Effects of various wavelengths of light, particularly red: far-red ratio, on seed germination, the tropic response of plants.
- Factors affecting aerial (adventitious) root growth in ivy.
- Light compensation points of sun and shade plants.
- Influence of different wavelengths of light on the phototropic response of plants.

Applied

- Effectiveness of antiseptics and/or disinfectants in destroying bacteria.
- Factors, internal and external, affective the rate of which bread goes mouldy.
- Effectiveness of biological washing powders in removing protein stains.
- Damaging effects of fizzy drinks on human teeth.
- Factors affecting the fermentation activity of yeast.
- Different types of food-processing in relation to shelf-life

Helpful Pages for Extended Experimental Investigations (Year 11 Work book)

Designing a Field Study	p 335
Sampling Populations	p 333/345
Population Growth Curves	p327-329
Forming a Hypothesis	p 19
Planning an Investigation	p 21
Experimental Method	p 23
Recording Results	p 25
Variables and Data	p 26
Transforming Raw Data	p 27
Terms and Notation	p 18
Data Presentation	p 25-27
Drawing graphs	p 28-34
Interpreting graphs	p 37
Biological drawings	p 39
Data Analysis	p 41-51
Structure of a report	p 52
Writing the Methods Section	p 53
Writing your Results	p 54
Writing your discussion	p 55



Student Designed Experiment

What is your area of Interest?

_____

_____

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_____

What available resources are there?

_____

_____

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_____

Hypothesis or Prediction

From the information you have about this topic, develop a hypothesis that could be tested in a controlled experiment that will gather quantitative data.

Answer the following questions to develop your hypothesis:

1/ What is the question you are investigating?

_____

_____

_____

_____

2/ What variables are you testing?

_____

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_____

3/ What are the controls for the experiment?

_____

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_____

4/ What is your hypothesis for this experiment?

_____

_____

_____

Plan of investigation

Design a controlled experiment based on your hypothesis. Make a numbered list of steps, similar to a recipe, that anyone could follow. Design a table that will be convenient for recording your data.

1/ What will you measure?

2/ How will you show your results in graphs?

Materials needed:

Procedures:

Data Analyses and Interpretation:

Design charts and tables for your data.

Answer the following questions as part of your write up.

1/ How do your data relate to your hypothesis?

_____

_____

_____

_____

2/ What caused errors in your experiment?

_____

_____

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_____

3/ What other questions came from your results?

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4 To what other biology topics is this lab related?

_____

_____

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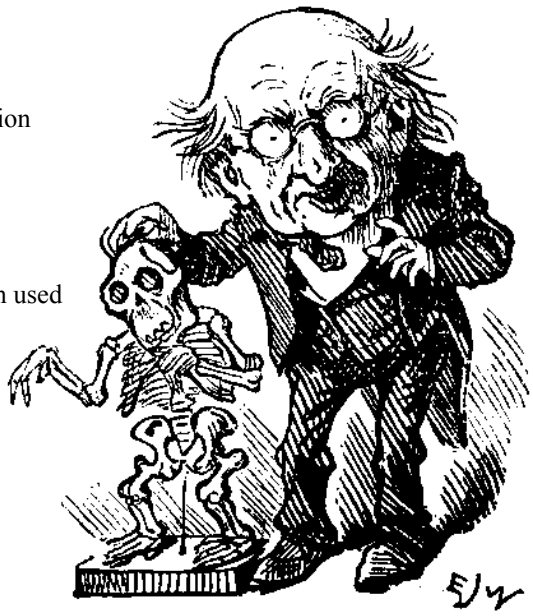
_____

Formal write-up check list



Abstract **Possible word length: 200 words**

- ☐ Back ground to study, Summary of results; Summary of Conclusion

Title

- ☐ Gives a clear indication of what the study is about
- ☐ Includes the species name and the common name of the organism used

Introduction **Possible word length: 300 - 400 words**

- ☐ Includes a clear aim
- ☐ Includes a well written hypothesis
- ☐ Includes a general overview of the topic

Materials and Methods **Possible word length: 300 – 500 words**

- ☐ Describes the final methods that were used, written clearly, (maybe in point form where appropriate).
- ☐ Includes details of how the data was collected and variables controlled.
- ☐ Includes explanatory diagrams of how equipment was set up
- ☐ Written in past tense and in active voice

Results **This is up to you how you present the data, it is difficult to place a recommended word length**

- ☐ Includes raw data
- ☐ Where necessary, raw data has been averaged or transformed
- ☐ Includes graphs where appropriate
- ☐ Each figure (table, graph, drawing or photo) has a title and number eg Fig. 1, and referred to in the text

Discussion **Possible word length: 500 words**

- ☐ Includes an analysis of the data in which the findings, including trends and patterns, are discussed in relationship to the biological concepts involved.
- ☐ Includes an evaluation of sources of error, assumptions, and possible improvement to design

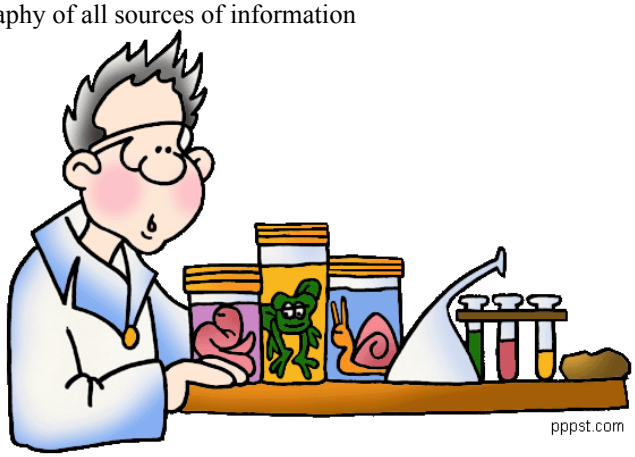
Conclusion **Possible word length: 500 – 750 words**

- ☐ Written as a clear statement, which relates directly to the hypothesis

Bibliography

- ☐ Annotated bibliography of all sources of information

Appendices



MATTHEW FLINDERS ANGLICAN COLLEGE
Assignment Declaration

DECLARATION: I _____ declare that:

- I have read the Matthew Finders Anglican College Senior Assignment Policy on "My Flinders" agree to its terms
- No part of this assignment has been copied from any other person's work except where due acknowledgement is made in the text, and
- No part of this assignment has been written by any other person except where such collaboration has been authorised by my teacher

Signature …….Date…….

NB

- A teacher has, and may exercise the right not to mark the assignment if the above declaration has not been signed
- If the above declaration is found to be false, no marks will be awarded for the assignment

Draft Report – Feedback Checklist

Aspect	Areas that might need improvement (marked by a ✔)		Date
Task	Awareness of the purpose of task.		
Subject Matter	You need to provide more detail in the following sections:		
	Abstract		
	Method		
	Results		
	Analysis of Results		
	Discussion: critical analysis of investigation needs improvement including interpretations/ synthesis and evaluation and beyond merely restating the findings.		
	Discussion: include sources of error and account for how they would have influenced your final results and conclusions		
	Conclusion		
	Provide follow-on investigations that could be undertaken (with reasons)		
	Bibliography – is not included.		
	– insufficient number of sources		
	– referencing style not consistent or contains errors		
	Only include the most important and relevant information from your library research.		
	You will need to include illustrations/tables.		
	You need to provide evidence or a reference for your comment or claims.		
Structure and cohesion	Generic structure needs improvement. Check the report format guidelines.		
	The arrangement of material could be difficult for your audience to follow		
	Introduction needs improvement to include topic using general themes or ideas which focus on the purpose of the investigation.		
	Introduction needs improvement to grab reader's attention		
	Body needs clearly defined paragraphs based on topics studied, and each clearly introduced to show an understanding of them		
Language	Vocabulary needs improvement a greater level of sophistication		
	The words highlighted need to be replaced with more precise or scientific terms.		
Sentences	Break up some of the longer sentences.		
	Sentences how a lack of variety in form and length.		
	Be consistent using active/passive voice and tense.		
	Some sentences should be separated; use a full stop or semicolon, not always a comma.		
Grammar	Apostrophes, capitals, commas, grammar.		
Paragraphs	Do not consistently contain a topic sentence (usually at beginning).		
	Do not consistently contain a concluding sentence.		
	Improvement required in linking ideas and paragraphs.		
Spelling	Spelling errors need correction – a few are circled.		
Length	Too long/too short		
Presentation	Choose formatting that makes your report easy to follow		
	Layout and neatness need improvement		

Comments

Matthew Flinders Anglican College: Biology: TASK 7: (Year 12 EEI) Criteria sheet

Name_____

	General Objective	Sections	A	B	C	D	E
UB	*1. Apply ideas, concepts and theories relevant to the context of the task.*	All of task	Linked the theoretical principles to the experimental situation by discussing relevant ideas.	Explained the theoretical principles of the experimental situation.	Described the theoretical principles of the experimental situation.	Has correctly stated some principles.	Has used terminology appropriate to the experimental situation.
	2. Use ideas, concepts and theories to make links between complex aspects of the task.	Discussion	Accurately interpreted results and linked them to theoretical principles.	Interpreted results and linked them to theoretical principles.	Discussed results.	Used data to answer questions with errors.	Answered questions.
IB	*1. Identify and formulate questions/hypotheses for investigation and research.*	Proposal / Introduction	A valid researchable question has been identified based on the student's own research. A reasonable hypothesis is proposed and justified.	A researchable question has been identified from a range of possibilities. A reasonable hypothesis has been proposed.	A question to research has been selected from a list of possibilities. A simple hypothesis has been proposed.	A researchable question was supplied. A hypothesis has been presented.	A question and hypothesis were supplied.
	2. Designs and manages the investigation	Proposal / Materials and Method	The student has designed, assessed and modified (if necessary) and carried out their own experimental design with attention to accuracy and precision.	The student has selected, modified and carried out an experiment with attention to accuracy.	The student has selected and carried out an experiment.	The student has carried out an experiment provided for them.	A set of instructions were followed.
	2. Carries out the investigation	Method	Determine type of data to be collected and identify procedures for validating the authenticity and reliability of the data.	Determine the type of data to be collected and suggests reasons for the usefulness of the data	Determine the type of data to be collected.	Identifies that data is to be collected.	Accepts suggestions as to the type of data to be collected.
	3. Collect, organise, interpret, model and present primary data	Method and Results	Used valid data collection methods and effectively employed appropriate technologies.	Used valid data collection methods and effectively employed technology.	Used data collection methods and technology to gather results.	Followed given procedures for data collection.	Followed directions to collect data.
		Results and Discussion	Assess the accuracy and relevance of any measurements and calculations and identify trends and anomalies.	Assess the accuracy of measurements and calculations and identified trends and anomalies.	Accepted the accuracy of measurements and calculations and identified patterns.	Accepted the accuracy of measurements and calculations.	Accepted measurements.
		Results and Discussion	Present information using formats that demonstrate results, relationships and sources clearly, accurately and succinctly.	Present information using formats that demonstrate results, relationships and sources clearly and accurately.	Present information using formats that clearly demonstrate results, relationships and sources.	Present information using formats that demonstrate results and sources clearly.	Present information using defined formats.
	4. Analyse data gathered from an investigation	Discussion/ conclusions	Identify trends, patterns, relationships as well as anomalies to justify inferences and conclusions.	Identify trends, patterns relationships and anomalies to formulates conclusions	Uses trends and patterns to make a conclusion.	Recognises trends and patterns.	Accepted trends or patterns.
	5. Make judgments and draw conclusions	Discussion/ conclusions	Predictions of likely results were compared to actual results to generate a plausible explanation.	Predictions of results were used to explain the actual results and compare them to the hypothesis.	Results of the investigation are used to make a statement regarding the hypothesis.	A statement regarding the hypothesis is made.	A statement regarding the hypothesis is made.
	3. Evaluate and assess the reliability/ authenticity/ relevance/ accuracy and bias of sources and methods of collection	Discussion	Critically evaluates the reliability, relevance and authenticity of data considering the sources and relationship to the investigation.	Evaluate the reliability, relevance and authenticity of data with respect to the investigation.	Discusses the reliability of data with respect to the investigation recognising some limitations.	Recognises the relevance of data with respect to the investigation without recognising limitations.	Accepted the reliability and relevance of all data regardless of the limitations of the source.
	4. Justify decisions and develop future research ideas	Discussion	Arrived at a justified decision acknowledging the validity of the contributing/detracting factors. A plausible link is explained to generate a new research question.	Arrived at a justified decision acknowledging the contributing/ detracting factors. A link is identified to generate a new research question.	Arrived at a decision acknowledging the contributing factors. A related research question is proposed.	Made a decision based on contributing factors. A new experiment is suggested.	Made a decision.
EBI	1. Gathering, critically analysing and evaluating information from a variety of valid and reliable resources	Conclusion	Gathers, critically analysing and evaluating information and data	Draws inferences from the results	Draws inferences from the results	Makes conclusion however not related to results	Conclusion not clear
	2. integrating the information and data to make justified and responsible decissions	Conclusion	Makes suitable supported conclusions using at more than 3 different references for support.	makes suitable supported conclusions using between 3-1 different references for support.	makes suitable conclusions		
	3consider alternatives and predictions relevant in past, present and future biological contexts	Conclusion	Relates conclusion to "real world situations" using appropriate examples	Relates conclusion to "real world situations"			

UB ☐ **IB** ☐ **EBI** ☐