PERSONAL ENGAGEMENT			
Band	The evidence of personal engagement with the exploration is:	The justification given for choosing the research questions and/or topic under investigation:	There is:
2	Clear with **significant independent thinking**, **initiative** or **creativity**.	Demonstrates **personal significance, interest or curiosity.**	Evidence of **personal input and initiative** in the designing, implementation or presentation of the investigation.
1	**Limited** with little independent thinking, initiative or creativity.	Does **not** demonstrate personal significance, interest or curiosity.	**Little evidence** of personal input and initiative in the designing, implementation or presentation of the investigation.
0	Standard not reached	Standard not reached	Standard not reached

Student Checklist	
☐ Relate research question to personal experience ☐ Statement that indicates independent thought in choice of topic and/or method or inquiry and/or presentation of findings	☐ Topic selected is of suitable complexity (i.e. is not basic that could be done by internet searching) ☐ Relate your idea to published research – does it take it further or approach from a different angle (creativity)Topic selected of

Note: Communication is present in ALL aspects of your write-up. The focus is on the overall presentation of your final report – so all categories should be present in all areas of your write-up.

COMMUNICATION				
Band	Presentation of investigation:	Report structure:	Understanding of report:	Subject-specific terminology:
4	Is **clear**. Any errors do not hamper understanding of the **focus, process and outcomes.**	Well structured and clear: the necessary information on **focus, process and outcomes** is present and presented in a **coherent** way.	Report is **relevant** and **concise** thereby facilitating a ready understanding of the focus, process and outcomes of the investigation.	Use of **terminology and conventions** is appropriate and correct. Any errors do not hamper understanding.
2	Is **unclear**, making it difficult to understand the **focus, process and outcomes.**	Not well structured and is unclear: the necessary information on **focus, process and outcomes** is missing or is presented in an **incoherent** or **disorganized** way.	Understanding of focus, process and outcomes of the investigation is **obscured** by the presence of **inappropriate** or **irrelevant** information.	Many errors in subject-specific terminology and conventions. Example: incorrect/missing labeling of graphs, tables, images; use of units, decimal places.
0	Standard not reached.	Standard not reached.	Standard not reached.	Standard not reached.

EXPLORATION				
Band	The topic of the investigation is identified and the research question is:	Background information provided for the investigation is:	Appropriateness of the methodology of the investigation is:	Evidence of awareness of significant safety, ethical or environmental issues:
6	Relevant and fully focused, and clearly described.	Entirely appropriate and relevant and enhances the understanding of the context of the investigation.	Highly appropriate to address the RQ because it takes into consideration all, or nearly all, of the significant factors that may influence the relevance, reliability and sufficiency of the collected data.	Full – all potential hazards identified and dealt with appropriately.
4	Relevant, but not fully focused is described.	Mainly appropriate and relevant and aids the understanding of the context of the investigation.	Mainly appropriate to address the RQ but has limitations since it takes into consideration only some of the significant factors that may influence the relevance, reliability and sufficiency of the collected data.	Some
2	Some relevance stated, **but not focused**.	**Superficial** or limited relevance and does not aid the understanding of the context of the investigation.	Only appropriate to address the RQ to a very limited extent since it takes into consideration few of the significant factors that may influence the relevance, reliability and sufficiency of the collected data.	Limited
0	Standard not reached	Standard not reached	Standard not reached	Standard not reached

The focus for this portion of your investigation is the overall methodology. You need to take your individual idea and develop that into a workable method. This should include your thinking behind your idea, utilizing what you have learned already. Most importantly, the information you provide **MUST** be targeted towards your research question/aim of the investigation. This should NOT be a summary of a concept (i.e. you are working with plants so provide an overview of photosynthesis – if this is not relevant to your research question/aim, it should NOT be included).

Think about how you will use data to address your research question. Things to consider:

- What kind of data do you need to address the RQ/Aim?
- Can these be measured directly, or do calculations need to be carried out?
- What type of graph would best display the data? Why?
- What statistical test(s) is/are most appropriate? Why?
- What range and increments of the IV will address the RQ/Aim?

- How many repeats do you need to carry out at each point of your IV?
- How are you manipulating the IV and what are its values?
- Exactly how are you recording results, including uncertainties?
- Exactly how are ALL other variables being controlled? State how each might affect the results if NOT controlled and the methods and units for controlling each one.

Student Checklist		
Identification of the Topic of Investigation		
☐ Research Question or Aim **clearly stated** ☐ RQ/Aim includes IV and DV (and scientific name of organism if relevant)	*If a hypothesis is required:* ☐ It is quantitative ☐ Is formatted as a **Research Hypothesis** ☐ It may be in the form of Null and Alternative Hypothesis (if statistical test involved)	☐ Predication explained using **scientific theory/principles** ☐ Sources are cited appropriately in text
Background Information		
☐ Background information provided is **relevant** ☐ Background information **explains** the **context** of the investigation clearly.	☐ Sources are cited appropriately (in-text references and reference list provided)	
Appropriateness of the Methodology of the Investigation		
☐ Does plan to collect data **address RQ/Aim?** ☐ Annotated photo of equipment or experimental set-up ☐ Method for recording results, including units and uncertainty of tools (± _)	☐ **Minimum 5 increments** over a suitable range for the IV (unless comparing populations) ☐ Method clearly presented in step-wise format and can be repeated by others ☐ What statistical test(s) will be used? Why?	☐ Results table designed **before investigation is planned**, to guide procedure ☐ Full citation of published protocol, if used
Consideration of Factors that may Influence the Relevance, Reliability and Sufficiency of collected data		
☐ IV correctly identified with **units/range** ☐ Method to manipulate IV, including specific details of **range and increments** ☐ Explain how range of IV was selected	☐ DV correctly identified with **units** and **precision** ☐ Sufficient **repeats** at each increment to ensure **reliability** and allow for statistics	☐ List all variables to be controlled and present them as a table. For each variable: o How could it **impact** the results? o Exactly **how** will it be **controlled**? (Value, with method for achieving that value)
Evidence of Awareness of Significant Safety, Ethical or Environmental Issues		
☐ Safety/ethics/environmental concerns addressed, including **animal experimentation policy**		

ANALYSIS				
Band	Raw data is:	Data processing:	Impact of uncertainties:	Interpretation of processed data:
6	Sufficient relevant quantitative and qualitative. Could support a detailed and valid conclusion to the research question.	Appropriate and sufficient accuracy with **the accuracy** required to enable a conclusion to the RQ to be drawn that is fully **consistent** with data	Full and appropriate consideration	Correct, so that a completely valid and detailed conclusion to the research question can be deduced.
4	Relevant but incomplete quantitative and qualitative. Could support a simple or partially valid conclusion to the research question.	Appropriate and sufficient. Could lead to a broadly valid conclusion, but significant inaccuracies and inconsistencies in the processing.	Some consideration	Broadly valid, but incomplete or limited conclusion to the research question can be deduced.
2	Insufficient to support a valid conclusion to the research question.	**Basic**, but is either too **inaccurate or too insufficient** to lead to a valid conclusion.	Little consideration	Incorrect or insufficient interpretation, so that the conclusion is invalid or very incomplete.
0	Standard not reached	Standard not reached	Standard not reached	Standard not reached

This section is probably the most critical to your report as the processed/manipulated data is what allows you to evaluate your overall investigation and use data to support your response. Keep in mind that variability of data is inevitable – you don't have unlimited time to perfect your procedure and get all the data you might want! So, your conclusion may be tentative – and that is normal. Variability should be demonstrated AND explained and its impact on the conclusion fully acknowledged. In this case, the word "conclusion" refers to deduction based on ***direct interpretation of the data***.

Questions to consider:

- Did you graph your processed (manipulated) data?
- What does the graph show?
- What does the outcome of the statistical test(s) mean? (i.e. interpret your statistics here with meaning! What does standard deviation mean in relation to your investigation?)
- Does the interpretation of your data relate to your research question/aim?
- Are your conclusions based on data collected? Should NOT be based on theory or any expectations you had about the investigation.

Student Checklist	
Recording Raw Data	
☐ Raw data clearly distinguished from processed data (possibly in a separate table) ☐ Table title is **specific** and **clear**, including IV and DV ☐ Raw data collected is **sufficient** to support a **detailed** and **valid** conclusion ☐ Units of IV and DV present and correct	☐ Uncertainties correct (± _) ☐ All data are recorded correctly and honestly ☐ Decimal points consistent throughout ☐ Decimal points consistent with **precision** of the measuring equipment ☐ **Associated qualitative data** (observations) **MUST** be recorded
Processing Raw Data	
☐ Calculations to determine DV carried out, if necessary ☐ Table title is **specific** and **clear**, including IV and DV ☐ Calculations or statistical tests appropriate to investigation to address RQ ☐ Mathematics correctly applied ☐ Worked example calculations given ☐ Standard deviations included where appropriate	☐ Processed data (and decimal places) consistent with precision of recorded data ☐ Titles self-explanatory and complete ☐ Appropriate choice of graph ☐ Axes labeled clearly, including metric/SI units and uncertainties of values ☐ Axes scaled appropriately ☐ Error bars included, unless insignificant ☐ Error bar source (i.e. standard deviation) stated and data are correct ☐ Line or curve of best fit included (if appropriate)
Impact of Uncertainties	
☐ Uncertainties adjusted to reflect any calculations carried out ☐ Uncertainties/errors included in tables and graphs ☐ Uncertainties/errors justified	
Interpretation of Processed Data	
☐ **Patterns and trends** in data stated, with **specific numerical reference** to the graph/tables	☐ Comparisons, if appropriate, are made

EVALUATION				
Band	A detailed conclusion is:	A conclusion is:	Strengths and weaknesses of the investigations, such as limitations of data and sources of error, are:	The student has:
6	**Described and justified**, which is entirely relevant to the research question and fully supported by the data presented.	Correctly **described** and **justified** through relevant comparison to the accepted **scientific context**.	**Discussed** and provide evidence of a **clear understanding** of the **methodological issues** involved in establishing the conclusion.	**Discussed** realistic and relevant suggestions for improvement and extension of the investigation.
4	Is **described** which is relevant to the research question and supported by data presented.	Described, which makes some relevant comparison to accepted scientific context.	**Described** and provide evidence of **some awareness of methodological issues** involved in establishing the conclusion.	**Described** some realistic and relevant suggestions for the improvement and extension of the investigation.
2	**Outlined** (not detailed) and is not relevant to the question or it is not supported by the data presented.	A superficial comparison to the accepted scientific context.	**Outlined**, but are restricted to an **account of the practical or procedural issues** faced.	**Outlined** very few realistic and relevant suggestions for improvement and extension of the investigation.
0	Standard not reached.	Standard not reached.	Standard not reached.	Standard not reached.

In this section, you are expected to ***put the conclusion into the context of the original aim of the investigation***. This is NOT a repeat of your analysis. This is the point where you decide if your conclusions do/do not support your original aim/research question. If not, you should discuss limitations of the method and suggest how the method could be changed to enable collection of data that could help draw a stronger conclusion.

Example: In the analysis section, you may have stated (and explained!) that there was a positive correlation between *x* and *y*. In the evaluation section, you should now be able to explain HOW that correlation relates to your original aim/research question and hypothesis/prediction. If you included a Null and Alternative Hypothesis, this is also where you would relate that interpretation to your original aim/research question.

Questions to consider:

- Have you related the interpreted results back to your RQ/aim?
- Have you used supporting scientific theory/concepts – BEYOND your textbook – to support your findings? Citations!
- Evaluate your results – this is the power of using statistics. Were the data collected sufficient and appropriate to address the RQ effectively? If not, how could this be improved?
- Have you included a table to address: limitations/sources of error (measurements/instruments, systemic/procedural, or random biological variation)? Effect this had on the results? Specific method to address each issue?
- Have you thought of a way this investigation could be extended?

<table>
<tr><th colspan="2">Student Checklist</th></tr>
<tr><th colspan="2">Conclusion</th></tr>
<tr><td>☐ Patterns and trends in data are stated, with reference to graphs/tables
☐ Comparisons made within the dataset, where appropriate
☐ Comparison with published data and theoretical texts, if possible
☐ Scientific explanation for results, with justification
☐ Associated qualitative data add value to explanations</td><td>☐ Data related to hypothesis or research question – to what extent do they agree/disagree?
☐ Appropriate language used “Supports my hypothesis…” (not “proves” or “is correct”)
☐ Suggestions for further investigations stated
☐ Sources cited appropriately</td></tr>
<tr><th colspan="2">Evaluating Procedures</th></tr>
<tr><td>☐ Reference to error bars (or standard deviation) with regard to variability or results and validity of conclusion
☐ Analysis of sufficiency of data to address the aim/RQ
☐ Analysis of appropriateness of the range of IV values with regard to aim/RQ
☐ Anomalous points (outliers) identified and explained, where appropriate
☐ Associated qualitative data referred to where appropriate</td><td>Any of the following could be addressed in a table format – this is the evaluation of possible effect on data and magnitude of error.
☐ Random biological variation
☐ Measurement/instrumentation errors
☐ Systemic errors (problems with methodology)
☐ All other limitations relevant to the investigation</td></tr>
<tr><th colspan="2">Improving the Investigation</th></tr>
<tr><td>Improvements for the limitations/sources of error:
☐ Are realistic and achievable
☐ Address the Research Question or Aim quantitatively (improving control of IV, DV and CV)</td><td>☐ Are specific and clearly explained
☐ Are cited where improvement relate to published protocols or techniques</td></tr>
</table>

Terminology Used in Rubric:

Outline	Give a brief account or summary
Describe	Give a detailed account
State	Give a specific name, value or other brief answer without explanation or calculation
Compare	Give an account of the similarities between two (or more) items or situations, referring to both (all) of them throughout.
Discuss	Offer a considered and balanced review that includes a range of arguments, factors or hypotheses. Opinions or conclusions should be presented clearly and supported by appropriate evidence.
Explain / Justify	Give a detailed account including reasons or causes.
Calculate	Obtain a numerical answer showing the relevant stages in the working (unless instructed not to do so).