### EXPLORATION

<table>
<thead>
<tr>
<th>Band</th>
<th>The topic of the investigation is identified and research question is:</th>
<th>Background information provided for the investigation is:</th>
<th>Appropriateness of the methodology of the investigation.</th>
<th>Consideration of factors that may influence the relevance, reliability and sufficiency of collected data.</th>
<th>Evidence of awareness of the significant safety, ethical or environmental issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Relevant and fully focused.</td>
<td>Entirely appropriate and relevant and enhances the understanding of the context of the investigation.</td>
<td>Highly</td>
<td>Nearly all factors considered.</td>
<td>Full - all potential hazards identified and dealt with appropriately</td>
</tr>
<tr>
<td>4</td>
<td>Relevant but not fully focused.</td>
<td>Mainly appropriate and relevant and aids the understanding of the context of the investigation.</td>
<td>Mainly</td>
<td>Some factors considered.</td>
<td>Limited</td>
</tr>
<tr>
<td>2</td>
<td>Some relevance but not focused.</td>
<td>Superficial or of limited relevance and does not aid the understanding of the context of the investigation</td>
<td>Limited</td>
<td>Few factors considered.</td>
<td>Some</td>
</tr>
<tr>
<td>0</td>
<td>Standard not reached</td>
<td>Standard not reached</td>
<td>Standard not reached</td>
<td>Standard not reached</td>
<td>Standard not reached</td>
</tr>
</tbody>
</table>

### 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
  - [ ] It may be in the form of Null and Alternative Hypothesis (if statistical test involved)
  - [ ] Prediction is explained using scientific theory.
  - [ ] Sources are cited appropriately.

**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?
- [ ] Annotated photo of equipment or experimental set-up
- [ ] Method for recording results, including units and uncertainty of tools (± _ )
  
  *Min. 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, 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 stats.
  
  *List all variables to be controlled and present them in a table, for each variable:*
  - [ ] How could it impact the results?
  - [ ] Exactly how will it be controlled? (Value, method for achieving that value)

**Evidence of awareness of the significant safety, ethical or environmental issues**

- [ ] Safety/ ethics/environmental concerns addressed, including animal experimentation policy.
<table>
<thead>
<tr>
<th>Band</th>
<th>Raw data is:</th>
<th>Data processing</th>
<th>Impact of uncertainties</th>
<th>Interpretation of processed data</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Sufficient. Could support a detailed and valid conclusion.</td>
<td>Appropriate and sufficient accuracy enables a conclusion to the RQ to be drawn that is fully consistent with data.</td>
<td>Full and appropriate consideration.</td>
<td>Correct valid and detailed interpretation.</td>
</tr>
<tr>
<td>4</td>
<td>Relevant but incomplete. Could support a simple or partially valid conclusion.</td>
<td>Appropriate and sufficient. Could lead to a broadly valid conclusion but significant inaccuracies and inconsistencies in the processing.</td>
<td>Some consideration.</td>
<td>Broadly valid limited interpretation</td>
</tr>
<tr>
<td>2</td>
<td>Insufficient to support a valid conclusion.</td>
<td>Basic, inaccurate or too insufficient to lead to a valid conclusion.</td>
<td>Little consideration.</td>
<td>Incorrect or insufficient invalid very incomplete</td>
</tr>
</tbody>
</table>

### Student Checklist

#### Recording Raw Data

- [ ] Raw data clearly distinguished from processed data (possibly separate table)
- [ ] Raw data collected is **sufficient** to support a **detailed** and **valid** conclusion.
- [ ] Units of IV and DV present and correct
- [ ] Uncertainties correct ($\pm \_\_\_\_$)
- [ ] 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
- [ ] Calculations or statistical tests appropriate to investigation and address RQ
- [ ] Mathematics correctly applied
- [ ] Worked example calculations given
- [ ] Standard deviations included where appropriate, with appropriate DP.
- [ ] Processed data (and decimal places) consistent with precision of recorded data
- [ ] Graph 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 (e.g. standard deviation) stated and data are correct
- [ ] Line or curve of best fit included and reflect (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.
### Conclusion (data)
- Data related to RQ and hypothesis – to what extent do they agree/disagree?
- Specific numerical reference to data
- Appropriate language used "Supports my hypothesis" (not ‘proves’ or ‘is correct’)
- Associated qualitative data add value to explanations.

### Conclusion (theory) - Comparison to the scientific context
- **Scientific explanation** for results
- Comparison with published data and theoretical texts.
- Sources cited appropriately
- Reference list provided in the appropriate format.

### Discussion of the strengths and weaknesses of the investigation
- Reference to error bars (or STDEV) with regard to variability of results
- **Analysis** of reliability of results:
  - Are data sufficient to address the RQ?
  - Was the range of the IV appropriate?
  - Identify & Explain anomalous data points
  - Refer to quantitative data

  Time management or human error may be mentioned, though these are not scientific errors – they should be eliminated with good practical skills. The focus here should be on the investigation/method.

### Suggestions for the improvement and extension of the investigation
For each weakness or limitation mentioned above, how could improved experimental design **remove** or **reduce** the impact of the error in terms of:
- Techniques used to collect and record data, including precision of equipment
- Design of the investigation, including range of values chosen and repeats of each IV data point
- Realistic, specific (not: “more time” or “more careful work”) and achievable improvements.
- Suggestions for further investigation stated.
### COMMUNICATION

<table>
<thead>
<tr>
<th>Presentation of the investigation</th>
<th>Structure</th>
<th>Relevance</th>
<th>Terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear. Any errors do not hamper understanding of the focus, process and outcomes.</td>
<td>Well-structured and clear: the necessary information on focus, process and outcomes is present and presented in a coherent way.</td>
<td>Relevant and concise thereby facilitating a ready understanding of the focus, process and outcomes of the investigation.</td>
<td>The use of subject specific terminology and conventions is appropriate and correct. Any errors do not hamper understanding.</td>
</tr>
<tr>
<td>Unclear, making it difficult to understand the focus, process and outcomes</td>
<td>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.</td>
<td>The understanding of the focus, process and outcomes of the investigation is obscured by the presence of inappropriate or irrelevant information.</td>
<td>There are many errors in the use of subject specific terminology and conventions*.</td>
</tr>
</tbody>
</table>

Important aspects to take into account:
- Tables & graphs do not break across pages
- Graphs clear, colouring appropriate
- Effective use of space

### PERSONAL ENGAGEMENT

<table>
<thead>
<tr>
<th>Evidence of personal engagement with exploration.</th>
<th>The justification given for choosing the research question and/or the topic under investigation.</th>
<th>Evidence of personal input and initiative in the designing, implementation or presentation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Clear with significant independent thinking, initiative or creativity.</td>
<td>Demonstrates personal significance, interest or curiosity.</td>
<td>A lot</td>
</tr>
<tr>
<td>1 Limited with little independent thinking, initiative or insight.</td>
<td>Does not demonstrate personal significance, interest or curiosity.</td>
<td>Little</td>
</tr>
</tbody>
</table>