**Individual Project**

**For Biology**

**Research Question:**

Student Name: Max Mustermann

Session number: 1007 - 1234

School Name: Linz International School Auhof (LISA)

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| **Personal****Engagement (2)** | **Exploration****(6)** | **Analysis****(6)** | **Evaluation****(6)** | **Communication****(4)** | **Total****(24)** |
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1. **Exploration**

**Exploration – Topic and Research Question**

* A precise and focused research question
* Dependent and independent variables are identified and measurable

**Exploration – Significance of the Topic**

* Personal significance or at least significance of the research question is explained

**Exploration – Background information**

* The background information must be directly relevant to the research question

**Exploration – Safety and ethical issues**

* Mention safety and ethical issues. Ethical issues can include animal rights, environmental protection issues as well as health issues. Dangerous chemicals involved? Animals harmed? Water contaminated?

**Exploration – Overview method**

* Give an overview method of your experiment. Many students start right away with a detailed method, but this is too difficult to understand.
* Example: “I intend to measure the bacterial density of my dog’s teeth dependent on the amount of toothpaste used.” This is understandable. But if you start right away with “1. Take a dog and put toothpaste on the toothbrush”, then nobody understands what your experiment is going to be about.

**Exploration – Materials used**

* Be specific here and indicate the size of beakers etc.
* What do you need the scissors for? The tape? You have to explain what you need it for!
* Example: “I need the scissors to cut the tape, so that I can fix the dog to the chair while brushing its teeth.”

**Exploration – Control of Controlled variables. You can use regular text, not bullet points.**

* Mention all of the factors that have to be the same.
* How do you keep them the same?

**Exploration – Control of the Independent variable. You can use regular text, not bullet points.**

* This is the one that you change. How do you change it? Range? What determines the range?

**Exploration – Measurement of Dependent Variable. You can use regular text, not bullet points.**

* How do you measure the outcome of the experiement?
* How often do you measure it? Why not more often or less often?

**Exploration – Data Processing. You can use regular text, not bullet points.**

* What calculations are you going to do on the collected data?
1. **Analysis**

**Analysis – Raw data**

* Include the raw data table here
* You can also include the processing here, eg averages, if it makes sense
* Describe the trends of the raw data.
* Indicate measurement uncertainty!

**Analysis – Processing**

* Perform calculations on the raw data.
* Do not forget about standard deviations, averages (if relevant)
* Include % calculations
* Include differences…..

**Analysis – Measurement uncertainty**

* How big is the measurement uncertainty?
* What impact does the measurement uncertainty have on the result?

**Analysis – Graphs**

* Must have lines of best fit, standard deviations etc.
* Processed data must be graphed, not raw data

**Analysis – Qualitative data**

* Mention them and make it clear how this relates to the Research Question.
* Does the qualitative data support in answering the research question?
1. **Evaluation**

**Evaluation of the Data**

* Explain the overall trend
* How good / significant is the collected data?

**Evaluation – Conclusion**

* Detailed conclusion, which makes explicit reference to the data and graphs.
* “Overall the experiment worked out well and supported the hypothesis” is not a conclusion.
* The conclusion must make reference to an accepted scientific context. Is your data in agreement with published science?

**Evaluation – Strengths of the experiment**

* The things that you would keep, when doing the experiment again
* Why was it a strength?

**Evaluation – Weaknesses of the experiment**

* and also the extent of the weakness
* Is the weakness so problematic that it results in bad results?

**Evaluation – Improvements**

* Significant improvements are necessary here. Not just trivial improvements like “I will do more measurements to get better results”. How many more measurements? What’s the point of more measurements, if they are flawed in the first place?
* Discussion of improvements means that you also talk about the degree that they are relevant.
* Improvements should reduce the standard deviation, errors.