Physical Science Honors Research Project Guidelines

The research project is designed to provide a means to authentically assess students' ability to conduct an extensive scientific research project. The research nature of the project involves conducting both a literature search and a laboratory investigation on a chosen topic. Students research a topic in order to acquire sufficient background information, thus allowing for the development of an experimentally testable question. Once a testable question is formulated, the project groups develop a workable experimental procedure to investigate the question and arrive at a reasonable conclusion.

You may work individually or in groups of no more than 4. All work is completed outside of the classroom but documented through google classroom/documents.

Project Overview

Physics and chemistry is an experimental science in which ideas are formulated and tested by experimental investigation in the laboratory. The process begins as the experimenter ponders an interesting (and often relevant) question that can be experimentally answered from data that was collected and analyzed. Such a question is often the result of the experimenter's curiosity. The process continues as the experimenter hypothesizes about the expected answer. The formulation of a hypothesis is often the result of searching a breadth of technical literature on the subject. The experimenter devises an experiment to test the hypothesis. The procedure is drawn up, revised, and refined until the experimenter is certain that the procedure will provide an answer to the question. The procedure is performed, data and observations are collected and organized, experimental findings are carefully analyzed through data tables and graphs, and conclusions are drawn. Finally, the entirety of the process is presented in the form of a report, paper, and a multi-media presentation.

Topics- from the standards that we have covered this semester

<table>
<thead>
<tr>
<th>Chemistry</th>
<th>Physics:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Matter- properties/ phases</td>
<td>• Energy</td>
</tr>
<tr>
<td>• Solutions</td>
<td>o Electricity</td>
</tr>
<tr>
<td>• Acids/bases</td>
<td>o Heat</td>
</tr>
<tr>
<td>• Phase changes</td>
<td>• Waves</td>
</tr>
<tr>
<td>• Gas laws</td>
<td>o Sound</td>
</tr>
<tr>
<td>• Atoms</td>
<td>o Light</td>
</tr>
<tr>
<td>• Periodic table</td>
<td>o Electromagnetic spectrum</td>
</tr>
<tr>
<td>• Elements</td>
<td>• Nuclear chemistry</td>
</tr>
<tr>
<td>• Bonding</td>
<td>o Fission</td>
</tr>
<tr>
<td>• Chemical reactions</td>
<td>o Fusion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TIMELINE</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic selection and approval- identify if working in group or individually – cannot change after this date.</td>
<td>January 12</td>
</tr>
<tr>
<td>Literature Search</td>
<td>February 16</td>
</tr>
<tr>
<td>Materials list and procedures</td>
<td>March 16</td>
</tr>
<tr>
<td>Experimental Investigation/Work – Data table and graphs due</td>
<td>April 20</td>
</tr>
<tr>
<td>Reporting</td>
<td>May 12</td>
</tr>
</tbody>
</table>
Writing a Lab Report - The parts of a lab report

A lab report is like a story about an experiment. The details in the story help others learn from what you did. A good lab report makes it possible for someone else to repeat your experiment. If their results and conclusions are similar to yours, you have support for your ideas. Through this process we come to understand more about how the world works. Your paper will be required to be completed using Google docs and will be shared with the group as well as the teacher. You will all be able to work on the document together in one place. All students are required to contribute equally and this will be checked and verified by the teacher.

Important reminders:

1. Spelling counts
2. Must be 12 pt Times New Roman font
3. Double spaced
4. 1 inch margins
5. Avoid personal pronouns
6. Headings should stand out and each section should be separated by 1 line.
7. Neatness counts
8. Do not copy for verbatim (word for word) from any source. This is plagiarism and will result in a zero.

☐ Title: The title makes it easy for readers to quickly identify the topic of your experiment (independent and dependent variables). Include names of students working in group and class block.

☐ Purpose / Research question: Describe the topic(s) and the objective of your experimental investigation; the purpose should be clearly stated and should clearly identify the manipulated and responding variables. A good guideline is to include the phrase "we will investigate the effect of ____________ (some controllable and modifiable variable) upon the ____________ (a measurable variable)." Procedural steps should not be discussed in the purpose section.

☐ Introduction / Literature Search: This paragraph describes what you already know and have researched about the topic, and shows how this information relates to your experiment.
   - Include diagrams, graphs, and other visuals which have been discussed in class or which you found in the book or other literature.
   - Discuss the principles in detail, writing as though your audience was an individual who knows little about your topic.
   - Begin by approaching the topic in rather general terms and then breaking it down into specifics.
   - Define terms, discuss equations and provide sample calculations to illustrate how they can be used and present diagrams and discuss and elaborate upon their meaning.
   - Organize and introduce information which you have gathered from the literature as the result of your literature search; be sure to reference your sources wherever applicable.
   - There is no minimum limit on the number of pages which must be included; and there is certainly not a maximum limit. The actual number of pages will be revealing of your knowledge level; "the more you know, the more you'll write." An average length is 3-4 pages.
   - You must incorporate into and cite information from at least 4 sources: at least 2 electronic ones (Internet sources), at least 1 book, and at least 1 periodical.

☐ Hypothesis: The hypothesis states the prediction you plan to test in your experiment.

☐ Materials: List all the materials you need to do the experiment including size, amounts, brands, types, etc. Be very detailed!!!

☐ Safety: Discuss safety precautions that must be taken during your experiment.

☐ Procedure: Describe the steps involved in your experiment. Make sure that you provide enough detail so readers can repeat what you did. You may want to provide sketches of the lab setup. Be sure to name the experimental variable and tell which variables you controlled.
Data/Observations: This is where you record what happened, using descriptive words (qualitative observations), data tables, and graphs. If necessary, use more than one data table; this is especially important if you conducted several investigations. For example, you modified one variable several times to investigate its effect on a measurable outcome and then repeated several more trials in which you modified a second variable and measured its effect on an outcome. Give each data table a meaningful title (e.g., "Measured Data for Roller Coaster Incline Experiment"). Then include all plots and graphs in this section. The axis of all graphs should be clearly labeled and each graph should be titled so that it clearly indicates exactly what data are being plotted. Finally, include appropriate equations which describe the plotted data.

Analysis: In this section, describe your data and graphs in words. Here’s a good way to start: My data shows that...

Conclusion: This paragraph states whether your hypothesis was correct or incorrect. It may suggest a new research question or a new hypothesis.

- Briefly describe the results of the investigation which you have conducted and discuss the findings; that is, discuss what your data tells you and what conclusions you can make from them.
- Support all conclusions with logic and by reference to the collected data. Make specific reference to the names of the graphs and data tables which you include in the Data section.
- Do not merely restate your data section; rather, make generalizations (e.g., "as the player strikes the ground on a head-first dive, the deceleration is roughly two-times as small as on the feet-first slide") and interpretations of graphs and data (e.g., "the curved line on the velocity-time graph indicates a non-uniform acceleration which is indicative of a changing net force").
- Discuss the principles which would explain the generalizations and conclusions which you made; that is, discuss the theoretical explanations for your results. Use class notes/book/research to explain the science of the experiment.
- Wherever appropriate, discuss any results which surprised you and tell why they surprised you.
- Use a paragraph or two to discuss any errors which might have been associated with your experimentation; that is, discuss the reliability of your results.
- Make some suggestions which would improve the actual experimental procedure. Discuss what changes could be made in your experiment that would make it better.
- Give advice to any experimental groups of the future who might embark on a study of the same topic; that is, discuss suggestions for future students investigating the same topic.
- Finally, discuss what your data and investigation reveals about the physical and chemical world; that is, discuss the implications and meaning of your findings. Make meaning of your study by extending the findings in such a way that you discuss their implications to your topic.

Bibliography: All literature sources (including electronic sources) which you used for the literature search must be listed. Only those sources you used should be listed. Using a source means that information from it can be found in the report and that the information is cited from within the report. Use the standard format learned in English classes for the bibliography.

All members of the group are responsible for these reports (i.e., it must be a team effort). Completion of the report should be a gradual, on-going process. Must be completed in google docs in google classroom!!! All information required must be in write up, presentation is not graded for required information!!!

Your group will present your findings in the form of a 5-8-minute media presentation or demonstration as well as in the written lab report. Hard copies of power points and other presentation material must be provided at time of presentation. Information in presentation is not graded for the report portion - that information must be included in paper to be graded!