Physics 11H Project/Science Fair - 2023/2024

The Physics Project is your opportunity to carry out an investigation or create an innovation (invention) that involves any branch(es) of physics that interest you, and then create a report and display to communicate your findings.

Projects may be done individually or in pairs. In accordance with rule for the Regional and National Science Fair, groups of more than 2 are not permitted. Your mark for this project will be included within the "*Major Assessments*" section of your overall mark.

If you think you may want to submit your project to the Science Fair, you should conform to the rules and guidelines of the "Greater Vancouver Regional Science Fair" organization. If you don't want to participate in Science Fair, your presentation format and style doesn't have to perfectly match the GVRSF guidelines. But, the overall organizational structure is useful, and is similar to the way that professional scientists and engineers work.

Refer to the following websites for Science Fair info:

- https://gvrsf.ca/
- https://gvrsf.ca/students/handbook/

Choosing a Topic

Your project should include physics, and may also include other branches of science (e.g. biophysics, geophysics, medical physics, etc). Choose something that interests you, and that you are curious about.

If you choose to do a **controlled experiment** you need to decide upon a research question. The question must be testable through experimentation i.e. something for which it is possible to collect evidence and compare variables – if the question is too broad, or too vague, you will have difficulty testing it and gathering evidence.

If you choose to create an **innovation/invention** (e.g. an engineering project) you should build and test it. The testing process is similar to a controlled experiment, but with a focus on testing the function of the innovation to determine whether or not it does the job it was intended to do.

Throughout the process of experimentation or innovation you will record your process and progress in a research journal/logbook/notebook. You will then write a formal report and make a display to communicate your findings with others.

Project Type and Quality - Expectations

High school Science Fair projects must involve an ***original experimental investigation*** or ***innovation/invention***.

If you choose to carry out an **experiment**, it should explore a question through the use of a controlled experiment that tests at least one or two variable factors. A more sophisticated project could include an experiment, or series of linked experiments, in which all possible variables are investigated, and results cannot be attributed to sources of experimental error or variance. This type of research typically leads to more questions and further research possibilities. A well designed experiment:

- tests the question being asked, and **only** the question being asked
- has clearly defined independent and dependent variables
- has controls
- has clear results that can be measured
- has been done more than once to check the results (multiple trials)
- can be easily replicated (e.g. if another researcher wanted to confirm your results, they could do so by repeating the experiment as you have described it)

If you choose to create an **innovation/invention** it can either be an original invention or an adaptation to a pre-existing device. The innovation should have a clearly stated purpose (to do a particular job) and its function should be tested.

The Written Report

Your written report should be typed, and double-spaced. The report should be written in ***past tense***, since people will read it after the research has been completed. Diagrams, graphs, and charts can be added to illustrate your results.

Sections to include in the report

Abstract: An *abstract* is a brief summary of the most important points in a scientific paper. Although this section is placed at the beginning of your report (like an introduction), it is actually the last thing that you will write. After all your research and analysis are complete, summarize the key ideas in an abstract.

Question/Topic: State your research question(s): What are you investigating? Which variables are investigated?

Hypothesis/Rationale: In this section explain the reasoning behind your research design and describe what you hope and expect to determine through your research. A hypothesis is a supposition or proposed explanation made on the basis of limited evidence. It is a starting point for further investigation (it is not a conclusion). *Note: Your research design and hypothesis should be informed by your background research – it is not just guesswork.*

Background Research: Before fully developing your research plan and experimental design, you need to find out what is already known about the topic. You should use resources from the library, internet searches using high quality sources, and you should reach out to experts for advice and insight. In this section of the report you should describe the history of topic, describe previous research, and highlight key questions or problems that still are not well understood. In other words: What is already known about your topic? What gaps in understanding do you hope to fill through your research, or what problem are you trying to solve with your invention/innovation?

*Note: It is very important that you create a **"Works Cited"** section to reference all the sources you used for information, including verbal discussions with experts*.

Materials: Provide a list of all equipment and materials that you used. This section may include diagrams in addition to words.

Procedures/Method: Describe your experimental method in past tense, and in sentence/paragraph form. Describe what you did to carry out the research (do ***not*** write this section as a list of instructions for someone else to follow – rather, it is a description of what you already did). Use descriptive language and include diagrams to help the reader better understand the experimental set-up. This section should be written clearly enough so that if someone else wanted to replicate your experiment, they would be able do so.

Data and Observations: This section is where you will show your quantitative (measured) and qualitative (descriptive, but not measured) observations. Typically, quantitative data is shown in the form of charts and graphs. Qualitative data may be shown in charts, in descriptive sentences and paragraphs, and/or with visuals such as diagrams and photographs.

Findings (results) and Data Analysis: In this section you should state the key findings (results) and explain the meaning of those findings. When you review your data and observations you may notice trends and patterns. "*Analysis*" refers to the process of searching for patterns and trying to understand and explain why those patterns exist. This section should be written in descriptive sentences and paragraphs, with tables and diagrams where relevant.

Conclusion(s): In a few concise sentences, state your findings. What did you prove, verify, or disprove? When you write the conclusion, you should refer back to the wording you used for your research question(s) and hypothesis. Make sure that your conclusion addresses the research question(s) and is supported with evidence (conclusions must be consistent with your data).

Discussion: The *discussion* section of the research report is essentially a conversation with other scientists and innovators. Here, you consider the relevance of your study, and potential future research that could develop from it. In this section you can be creative and thoughtful. Focus on 3 key topics:

- The ***scientific meaning and relevance*** of your research findings (relevance to society, the environment, etc). How do your findings contribute to scientific understanding? Could your findings potentially lead to practical applications?

- Questions and suggestions for ***furthering and deepening the field of research***: Typically, with each scientific discovery many new questions arise, and ideas for further research emerge. Did this research generate new questions and ideas in your mind? If you had more time, would you extend the research? Explain your ideas for future developments and research.
- ***Sources of error and suggestions for improvement*** to the experimental design (e.g. if you were to repeat the same kind of experiment again, what would you do differently? Were there pitfalls or challenges with your experimental design?)

Works Cited: List of resources you used for background research. Instructions on how to create Works Cited lists are available in the school library.

DUE DATES and DEADLINES

Required Tasks	Due Dates
Library periods – *choose a topic and work on your research plan*	*Oct 11/13*
Submit: Topic idea with preliminary research plan *(refer to handout)*	*Oct 30, 2023*
Submit: Detailed Research Plan *(refer to handout)*	*Before the end of Nov, 2023*
Discussion with the teacher	*Nov/Dec, 2023*
Draft: Share/discuss with classmates: Rough draft of written report for *peer editing and supportive feedback*	*Jan 30, 2024*
Final report due – presentation day (in class sharing)	***Feb 13, 2024***

Optional: ***School Science Fair***	*Thursday Feb 22, 2024*
School Finalists: Greater Vancouver Regional Science Fair	*April ???, 2024 at UBC*