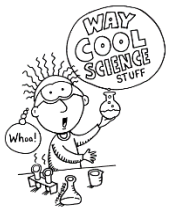


Science Fair – Science 9 - 2023/2024

Science Fair is your opportunity to do an independent project on any topic in science or engineering that you choose. You will carry out an investigation or create an innovation (invention) and then create a report and display to communicate your findings.

Science Fair 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.

In Class Judging – January 31 and Feb 1, 2024

The first round of judging will happen on **Jan 31 and Feb 1**. Judges will be science students in grade 11 and 12, and your teacher. The top projects from each class will be selected for the school finals.

Science Fair Finals – February 22, 2023

If you are invited to the School Science Fair Finals, you will attend the all day judging session in the Gallery. Judges will be science teachers, scientists from the community, and BNS graduates who are currently studying science and/or engineering in University.

Science Fair - Learning Objectives

In addition to learning in-depth about a topic of your choosing, you will also learn and practice a variety of science skills and competencies. Science Fair involves the following skills and processes:

- experimental design and innovation
- measurement
- critical thinking and analysis
- communication (written and verbal)
- scientific literacy (e.g. reading, interpreting, analysis, writing, creating visual representations)

All three "*core competencies*" that are embedded within all school programs are developed and practiced through the Science Fair. The core competencies include:

- *Communication/Literacy (oral, written, visual, digital, and multimedia)*
- *Thinking skills and strategies*
- *Personal and Social Competency*

Choosing a Topic

You can pick any branch of science – for example, you may choose from biology, chemistry, physics, astronomy, engineering, environmental science, geology, ecology, psychology, 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.

Assessment Criteria

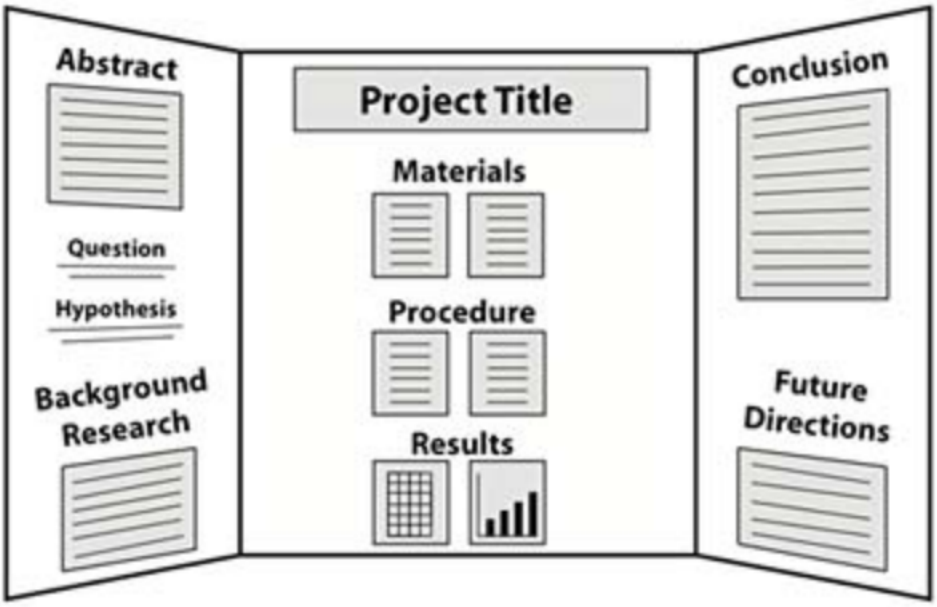
**** REFER TO THE MARKING RUBRIC AS THE MAIN GUIDE TO ASSESSMENT CRITERIA ****
When the Rubric is updated the most recent version will be posted on the website:
https://msbernabei.weebly.com/science-9.html

On presentation day you need a ***physical display***, a ***written report***, and your ***verbal presentation***.

The Physical Display

Your exhibit board should be ***no larger than 152.5 cm tall by 91.5 cm wide***, although it can be smaller. The diagram on the next page shows a typical sample layout for a Science Fair display board. You can be creative and adjust the layout to meet your needs. The display should be attractive and eye-

catching. The written information shown on the display board should summarize the key ideas from your written report, but the display board is not a replacement for a written report – you must submit both. If you wish you may also display objects in front of your board.



The Written Report

Your written report should be at least 500 words, typed, and double-spaced (*note: 500 words is a minimum length, but your report may be longer*). The report should be written in ***past tense***, since people will read it after the research has been completed. 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: State your research question(s): What are you investigating? Which variables are investigated?

Hypothesis: 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 (e.g. if you are interested in developing an experiment to determine the factors relevant to baking better cookies, talk to a professional baker about how and why different ingredients and techniques are used). 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?

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: 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.

Journal/Logbook/Notebook

Every science fair project must include a research journal/logbook/notebook. This is a record of your research and development process. It is like a daily diary for scientists and innovators. It shows what you did and thought at every step along the way.

Guidelines:

- Write your logbook in a bound notebook
- Write the date for each entry - Make an entry every time you work on your project
- Write your notes in point form (the logbook is an informal, but complete, record)
- Don't worry about neatness; do not re-copy your logbook to make it look "tidy"
- Organize your logbook into sections such as: *schedule, daily notes and ideas, background research, contacts and references, experimental procedure/method, data collection, observations/results, conclusions, thoughts/ideas for the discussion section*
- Write everything down, even if it seems insignificant; the information may later turn out to be useful
- Describe your ideas and processes in enough detail that anyone else reading your logbook would be able to understand and repeat the experiment.
- *You must keep your logbook up to date throughout all stages of your research*: It is unacceptable to write your logbook from memory after you have finished your project. Professional scientists maintain a habit of keeping their logbooks up to date. The logbook helps them remember what they've done, and, there have been legal cases when the scientists' daily logbook was the key piece of evidence proving that a discovery was theirs, and not the work of someone else (i.e. it ensured that they got credit for their work, rather than someone else taking credit).

Scientific Method - Summary

Summary of the Scientific Method process:

1. **Choose a question** that you are curious about. It must be the kind of question that can be answered by doing a scientific experiment that has measurable results.
2. Make a list of all the **variables** that might have an impact on your results.
3. Decide **which variables need to be controlled** (kept constant). What will you keep constant for all trials, and what will you change?
4. Is there a standard value (a control) that your results should be compared against?
5. Decide what **measurements** you will need to take and record. Set up a system for organizing your data (e.g. data tables, charts, lists, diagrams)
6. Decide on your **experimental steps** and write them down in fine detail, in an organized way. Using diagrams as well as words helps make the steps clear. ** Note: When you write your report, write in past tense, describing what you did.*
7. **Practice/Test run(s)**. Try out your experimental method at least once before the "real" experiment, paying close attention to any difficulties you face performing the experiment, taking measurements, or interpreting results. If necessary, make adjustments and improvements to your method (write your observations and ideas for changes in your journal).
8. When you carry out the actual experiment, complete multiple trials. For most experiments, there should be at least **three trials** (perform the experiment three times, to check for consistency of results). Your final results will be the average of the trials.
9. **Lab Journal/logbook:** Throughout your experiment process, from "idea" stage to final analysis and conclusions, you must keep records in a lab notebook/logbook. Record all your data, quantitative observations (measurements), qualitative observations, diagrams of the equipment and how it is set up, and any other things that you noticed.

DUE DATES and DEADLINES

Required Tasks	**Due Dates (to be determined)**
Library periods – *choose a topic and work on your research plan*	*Oct 11/13 (Block 1 and 4)* *Oct 10/12 (Block 7)*
Submit: Topic idea with preliminary research plan *(refer to handout)*	*O*ct 18/19*, 2023*
Submit: Detailed Research Plan *(refer to handout)*	*Oct 30/31, 2023*
Discussion with the teacher	*Oct/Nov, 2023*
Submit: Journal in progress	*Dec 4/5, 2023*
Submit: Rough draft of written report *(peer editing of reports)*	*Jan 15/16, 2024*
Be ready: In class *practice* presentations (with a partner group)	*Jan 29/30, 2024*
Final report due – presentation day (in class judging)	***Jan 31/Feb 1, 2024***

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