Science Fairs

Expo-Sciences

GENERAL INFORMATION

- **TYPES OF PROJECTS:**

Experiment	Innovation	Study
Undertake an investigation to test a scientific hypothesis by experimental method. At least one independent variable is manipulated; other variables are controlled.	Develop and evaluate new devices, models, theorems, physical theories, techniques, or methods in technology, engineering, computing, natural science, or social science	Analysis of, and possibly collection of, data using accepted methodologies from the natural, social biological, or health sciences. Include studies involving human subjects, biology field studies, data mining, observation and pattern recognition in physical and/or socio-behavioral data.

JUDGING:

1. Students must be present during the judging sessions to explain their project and answer questions from the judges.
2. Participants should be able to present their work to the judges in five minutes or less.
3. Judging is based on the following criteria:

Scientific thought:	25%
Creativity:	20%
Display:	15%
Written Report:	10%
Scientific Concept:	20%
Oral Presentation:	10%
Total:	100%

Note: Judging rubric will be designed to accommodate the three types of projects.

NOTE:

These steps shouldn't be considered as a rigid sequence. They should actually be seen as a "cycle". For example in an *experiment,* it may be necessary to come back to *step 2* and refine the question after having done some research on the topic in *step 3*. A student doing an *innovation* might need to revise the design specifications (step 4) after building the prototype (step 6).

	Experiment	**Innovation**	**Study**
Step 1	Select a Topic	Identify a Design Opportunity	Identify the Area of Study
Step 2	Formulate the Question	Research the Design Opportunity	Do a Literature Review
Step 3	Research the Topic	Brainstorm Possible Solutions	Formulate the Question
Step 4	Formulate the Hypothesis	Draft a Design Brief	Determine how the Study will be Conducted
Step 5	Design the Investigation	Prepare Requirements and Drawings	Gather Relevant Data (or Information)
Step 6	Conduct the Investigation	Build a Solution Prototype	Analyze Data
Step 7	Analyze the Results	Test, Evaluate and Revise	Search for New Understanding Emerging from the Analysis
Step 8	Write the Report	Write the Report	Write the Report
Step 9	Make a Display	Make a Display	Make a Display
Step 10	Prepare a Presentation	Prepare a Presentation	Prepare a Presentation

Science & Technology Fair Projects

TYPES
Experiment

Projects of this type involve an original scientific experiment to test a specific hypothesis in which the student recognizes and controls all significant competing variables and demonstrates excellent collection, analysis, and presentation of data. The experimental design is as important as the actual results from the experiment. The process of designing an investigation should have a cyclical progression and not limited to a sequential or a rigid method.

The Experimental Process

1. Select a Topic.

The first and most important step is to select a topic of interest. Choosing a topic is difficult because the possibilities are endless. The topic you choose should represent something that you are <u>really</u> interested in. It is not enough just to go on the internet and select an experiment that has already been done.

2. Formulate the Question.

After a few days of reflection, you need to formulate an open-ended question that can only be answered by doing an experiment. Good questions are specific. That is, they are testing the relationship between only two variables, not three or four. By keeping the question simple and specific, you are preventing your experiment from taking too long or from being too complicated.

3. Research your Topic.

Once you have identified a question, the next step is to learn as much as possible on the subject. Take some time to do research at the library or on the internet. The object is to be prepared to form an intelligent testable hypothesis.

4. Formulate a Hypothesis.

This step allows you to focus on the details of the investigation. You need to formulate a hypothesis that can be easily verified with an experiment. A hypothesis has the following: i) subject identification, ii) what is being measured, iii) identification of the variables and iv) expected results.

***Example**: Bean plants grown under a green light 24hrs a day, for a period of 2 weeks, will grow taller than bean plants grown under a natural light over the same period of time.*

i) Subject: Bean plant
ii)) Measurement: Height of the bean plant
iii) Independent variable: Color of the light
Dependent variable: Height of the plant
iv) Result expected: Green light is better than natural light

5. Design the Investigation. (Experimental Design)

The plan needs to include the following:

I. Materials needed
II. Variables involved
III. Detailed procedure
IV. Data collection plan

Before you begin your experimental design, you need to identify the variables and controls. There are three things to identify:

a) ***Independent Variable:*** This is the variable that is manipulated. This is what you purposefully change in the experiment.

b) ***Dependent Variable:*** The purpose of the experiment is to see if this variable will be affected by the changes you make. The dependent variable is what is being measured in the experiment.

c) ***Controlled Variable:*** These are the variables that need to be constant throughout the experiment.

6. Conduct the Investigation.

This is when you actually do the experiment (this can happen at home). During the experiment, you may take pictures, record data and keep detailed notes of observations.

7. Analyze the Results.

When the experiment is over, you need to compare the results with your hypothesis and form a conclusion. You need to establish if your hypothesis was confirmed or not. At this point, you may have found new questions to be answered and suggest new variables, different materials or a procedure for another investigation.

Results:

The results that are collected can occur in two forms:

- If the results can be physically measured, counted and/or if it can be timed… the results are presented in tables and/or graphs.
- If the results are visuals, illustrations, photographs or a video recording maybe more appropriate.

Conclusion:

- Discuss or mention every table, graph, illustration etc...
- Make reference to the hypothesis.
- Indicate whether or not the results support your hypothesis.
- Review the variables.
- Indicate what could be done differently next time to avoid the same mistakes.
- Highlight some practical applications where this knowledge maybe useful.
- Include ideas for future study.

8. Write the Report.

Writing a report about all that was done, how it was done, and what was discovered is an important aspect of a Science Fair Project. Scientists need to communicate their investigation clearly to allow others to conduct the same investigation and arrive at the same conclusions. The written report is a summary of everything you did to investigate your question or problem. It provides information about the extent of the project as well as what you learned through it. The maximum number of pages is 5 plus the bibliography. The contents of the report should include:

Title page: Include first and last name, date, division, category and registration number.

Purpose (Introduction): This should state the objective in only a few lines (less than 8). It is also worth mentioning the main details of the work accomplished.

Question: What do I want to find out? What do I want to understand?

Hypothesis: An educated guess that answers the problem. It is based on what the student already knows and on the research they have done on the topic. What is a possible and measurable explanation to the question?

Materials: Anything used in the project (equipment).

Experimental procedure: Steps taken from beginning to end.

Observation and results: This is the body of the report. Ensure time is taken to explain the results, details and information regarding research.

Conclusion (Discussion): Summarize details of the project and conditions in which the work was done. This is also a good place to write about possible future endeavours for the topic/ project.

Bibliography: Any science fair project should have had some type of resources consulted; everyone **must** cite all sources used for the project.

Acknowledgments: This is where students acknowledge those persons who assisted them in research etc. Remember the importance of not plagiarizing someone else's work.

9. Make a Display.

The display is an important part of attracting people to the student's project. The display must reflect the topic accurately. During public viewings students are encouraged to use demonstrations and hands on materials like models and videos etc. This will aid in attracting people, as well generate interest and questions. However, these demonstrations cannot be used during judging.

The display needs to be neat and organized onto a self-standing background that can be put on a table (see the guide rules and security). It should be self-explanatory and take no more than 5 minutes for an audience to understand from beginning to end.

c) Tips for an effective display that will attract people:

- Have a title that grabs people's attention, use imagination!
- Make things flow from left to right.
- Using bright colors makes the project stand out from others.
- Use a large font, bold writing and limit text.
- Using more pictures, graphs, and diagrams makes the project more interesting and easier to understand. These also can help guide the presentation and emphasize important results and conclusions.

10. Prepare a Presentation.

Prepare a 5 minute oral presentation describing the project. The purpose of the presentation is to share the information and findings with the judges as well as the general audience. Be sure to use language which can be understood by all on- lookers. Ensure that students understand all information being presented, as a question may be asked relating to any aspect of the project. The main goal is to present all information in a clear and understandable way. DO NOT memorize a script. Instead of notes, consider using the display as a guide for the presentation. If notes must be used, use point form notes for important points to discuss. Relax and have fun!

Innovation

Projects of this type involve the creation and development of new devices, models or technologies. Usually, an original device is constructed or designed that has commercial applications or is beneficial to humans. The design process is as important as the actual end product.

The Design Process

*(*Adapted from: *Design and Discovery Curriculum, Intel, 2004)*

The design process is a systematic problem-solving strategy used to develop many possible solutions to solve a problem or satisfy human needs and wants and narrow down the possible solutions to one final choice. It is a recognized set of generally defined steps

designers and engineers use based on a problem solving strategy that leads to product development.

1- Identify a Design Opportunity.

The design process begins with identifying a need. Notice that opportunities to design a new product or redesign an existing one are everywhere. They often come from a problem that has been experienced personally. The goal is to identify many design opportunities and narrow them down later.

2- Research the Design Opportunity.

Gather a lot of information about the nature of the problem in order to narrow down your choice. Find out if other people experience the same problem and research any existing products or solutions that may currently be used to solve the problem. Choose a design opportunity to address the problem. Write a problem statement.

3- Brainstorm Possible Solutions to the Problem.

Try to come up with as many ideas as you can for solving the problem or addressing the design opportunity. Brainstorming may involve the use of techniques such as *SCAMPER*. Then, narrow down your solutions and choose one to three to pursue further.

4- Draft a Design Brief.

Write a design brief to outline the problem. A design brief includes a problem statement, a description of the user needs, a proposed solution, and often a sketch of the idea or solution. This is a working document that can be changed.

5- Prepare Design Requirements and Conceptual Drawings.

Define the criteria the solution must meet (design requirements) and sketch conceptual drawings.

6- Build a Solution Prototype.

Develop detailed project specifications, consider material properties required, choose materials, and create a working prototype.

7- Test, Evaluate and Revise your Solution.

Evaluate the prototype for function, feasibility, safety, aesthetics and other criteria. Consider how it could be improved. Modify your prototype or create another and test it.

8. Write the Report.

Writing a report about all that was done, how it was done, and what was discovered is an important aspect of a Science Fair Project. Scientists need to communicate their investigation clearly to allow others to conduct the same investigation and arrive at the same conclusions. The written report is a summary of everything you did to investigate your question or problem. It provides information about the extent of the project as well as what you learned through it. The maximum number of pages is 5 plus the bibliography. The contents of the report should include:

Title page: Include first and last name, date, division, category and registration number.

Introduction: This should state the design opportunity and the problem or the need that you want to address. Is the project suggesting improvements to an existing product or creating a new product from a new design?

Research on the Design Opportunity: This section should include what you have learned from your research about what already exists concerning your proposed design opportunity.

Design Brief: Include all design specifications and drawings.

Materials: Anything used in the project (equipment).

Procedure: Steps taken from the first to the final versions of the prototype.

Observation and results: This is the body of the report. Explain whether or not the final prototype meets the design specifications.

Conclusion (Discussion): Summarize details of the project and conditions in which the work was done. This is also a good place to write about possible future endeavours for the topic/ project.

Bibliography: Any science fair project should have had some type of resources consulted; everyone **must** cite all sources used for the project.

Acknowledgments: This is where students acknowledge those persons who assisted them in research etc. Remember the importance of not plagiarizing someone else's work.

9. Make a Display.

The display is an important part of attracting people to the student's project. The display must reflect the topic accurately. For an innovation, you are encouraged to demonstrate how your prototype actually works. This will aid in attracting people, as well generate interest and questions.

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Study

Studies are probably the least common type of project. They involve the collection or use of data for personal analysis, in order to reveal patterns, relationships or discoveries. The information (data) may be collected by the student themselves or from outside sources, other than the students. The analysis of the data should lead students to make claims that are supported by the data.

Research Process

1-Identify an Area of Study.

The first and most important step is to select a topic of interest. Choosing a topic is difficult because the possibilities are endless. The topic you choose should represent something *related to science* that you are <u>really</u> interested in. Typically, it could be a subject that affects/concerns you, your family or your community.

2- Literature Review.

An in-depth research in the library or on the internet should provide you with the background information you need to formulate a research question.

3- Research Question.

After reflecting on your new background information, you need to formulate an open-ended question that will be answered at the end of your study. Good questions are specific and simple. By keeping it that way, you are preventing your study from taking too long or from being too complicated.

4- Determine how the Study will be conducted.

What kind of data (information) are you looking for? *Primary data* is information you collect yourself. Methods for collecting primary include: questionnaires, surveys, interviews and observation. *Secondary data* is information that someone else has collected. Sources for collecting secondary data may include: books, magazines, journals,

newspapers, internet, etc… You need to decide which way is the best to collect the data to answer your question and make a plan of action

5- Gather Relevant Data.

Having now determined the type of data you need (primary or secondary) and the plan for collecting it, you need to implement your plan to collect all your data.

6- Data Analysis.

At this stage, you have gathered a lot of information and need to simplify it into general categories. Initially, you may have 10-20 different categories. Keep in mind that you are trying to answer your initial question. Look at all the data several times and try to see if there are any relationships between the categories. Eventually, you may end up with 5-6 distinct categories of information.

7- Search for New Understanding.

After spending a lot of time looking at the data and the different categories, you will be able to detect some patterns, relationships and discoveries. You need to write down what you see. These are the claims you are making as a result of your study.

8- Write the Report.

Writing a report about all that was done, how it was done, and what was discovered is an important aspect of a Science Fair Project. You need to communicate clearly about everything you did to investigate your question or problem. It provides a summary about the extent of the project as well as what you learned through it. The maximum number of pages is 5 plus the bibliography. The contents of the report should include:

Title page: Include first and last name, date, division, category and registration number.

Introduction: This should state your topic of interest, the reason why you selected it and the question you want to answer.

Review of the literature: This section should include what you have learned from your preliminary research about what already exists concerning your topic.

Research Method: You need to explain the kind of data you collected and how you collected it.

Data Analysis and Results: Elaborate on how you analyzed your data and what results you found. What claims can be made from the analysis?

Conclusion (Discussion): Summarize the findings of your study. Are you able to answer your initial question? This is also a good place to write about possible implications from those findings.

Reference: Include all the sources where you took your data. You should follow this format:

Hodson, D. (2006). Why we should prioritize learning about science. *Canadian Journal of Science, Mathematics & Technology Education*, 6:3 July, 2006, 293-311.

Acknowledgments: This is where students acknowledge those persons who assisted them in research etc. Remember the importance of not plagiarizing someone else's work.

9. Make a Display.

The display is an important part of attracting people to the student's project. The display must reflect the topic accurately. For your study, you are encouraged to show (graphs, tables…) any evidence supporting your claims. This will aid in attracting people, as well generate interest and questions.

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Regional Science Fair Project Evaluation Rubric

Project Type:

EXPERIMENT	INNOVATION	STUDY

Project Number:

Project Title:_____

Student(s):_____

Group: _____ **Biology** _____ **Physical Science**

Category: ____ **Junior** ____ **Senior**

Performance Criteria	Low	Fair	Good	Excellent
Scientific Thought (25%)	**EXPERIMENT** ● Duplication of a known experiment to confirm a hypothesis; totally predictable. **INNOVATION** ● Build a model or device to duplicates existing technology. **STUDY** ● Existing published material is presented, without analysis.	**EXPERIMENT** ● Modification of the question hypothesis, variables, and procedures of a known experiment. **INNOVATION** ● Improve or demonstrate new applications for existing technologies, and justify them. **STUDY** ● Existing published material is presented with modest analysis and/or ● A simple study giving limited data with no meaningful results	**EXPERIMENT** ● Elaboration of an original experiment with own question and hypothesis. ● Some variables are identified and controlled. ● Data presented in simple graph. **INNOVATION** ● Design and build innovative technology. Benefits to humans should be evident. **STUDY** ● Study based on systematic observation and a literature review. ● Detailed description of the methodology to collect and analyze the data.	**EXPERIMENT** ● Elaboration of an original experiment with own question and hypothesis. ● Most variables are identified and controlled. ● Data well presented and analyzed. **INNOVATION** ● Integrate several technologies or inventions or design and construct an innovative application with human and/or commercial benefit. **STUDY** ● Study correlates information from a variety of peer-reviewed publications and reveals significant new information or solution to a problem ● Detailed description of the methodology to collect and analyze the data.
Mark Range	**1 to 6**	**7 to 12**	**13 to 19**	**20 to 25**
Project Creativity (20%)	● Little imagination. ● Simple project design: ● Partial plan to validate hypothesis. ● Minimal student input. ● A textbook type project.	● Some creativity. ● Fair to good design: ● Sufficient plan to validate hypothesis. ● Standard use of common resources. ● Common topic.	● Imaginative project. ● Good design: ● Above ordinary approach. ● Good use of resources. ● Creativity in design and topic.	● Highly original project. ● Exemplary design: ● Original approach. ● Very creative use of equipment and/or construction.
Mark Range	**1 to 5**	**6 to 10**	**11 to 15**	**16 to 20**

Display (15%)	● Needs to be held upright. ● Hard to read and understand. ● Shows little effort.	● Stays upright but flimsy. ● Understood if explained. ● Readable. ● Shows some effort.	● Self-standing; proper dimensions. ● Easy to read and understand. ● Well done. ● Shows a lot of effort.	● Self-standing and attractive; proper dimensions. ● Self explanatory. ● Flows logically. ● Very well done. ● Shows a great deal of effort.
Mark Range	**1 to 4**	**5 to 8**	**9 to 12**	**13 to 15**
Written Report (10%)	● No title page. ● Format incomplete. ● Weak presentation. ● Many spelling and/or grammar mistakes.	● Adequate title page. ● Missing format elements. ● Adequate presentation. ● Some spelling and/or grammar mistakes.	● Very good title page. ● Content complete. ● Very good presentation. ● Some spelling and or grammar mistakes.	● Excellent title page. ● All elements are neat. ● Well presented. ● Accurate spelling and grammar.
Mark Range	**1 to 3**	**4 to 5**	**6 to 8**	**9 to 10**
Scientific Concepts (20%)	● No scientific concepts are explained or have been learned.	● Some brief explanation revealing that something scientific was learned.	● Good explanation about the science that was learned. ● Concepts are related to the experiment.	● Excellent explanation about what was discovered, which may be used to pursue new questions for a possible experiment.
Mark Range	**1 to 5**	**6 to 10**	**11 to 15**	**16 to 20**
Oral Presentation (10%)	● Poor presentation. ● Lack of knowledge.	● Fair presentation. ● Little knowledge communicated.	● Very good presentation. ● Adequate knowledge communicated.	● Excellent presentation. ● Confident about knowledge communicated. ● Convincing and enthusiastic.
Mark Range	**1 to 3**	**4 to 5**	**6 to 8**	**9 to 10**

Total Marks

Scientific Thought:	**_____/25**	**Written Report:**	**_____/10**		
Project Creativity:	**_____/20**	**Scientific Concept:**	**_____/20**	**TOTAL:**	**_____/100**
Display:	**_____/15**	**Oral Presentation:**	**_____/10**		

Judge's Comments:

_____

_____

_____

Signed:_____ **Date:**_____