Introduction

As children of God, whether young or old, we experience all of life before the face of God. When we delve into science and explore our Creator's handiwork, we are reminded of whom our Creator is. The creativity, order, and incredible diversity fashioned in creation are a direct revelation of God to His people.

Looking into the world of science demands that we encounter God. "For since the creation of the world God's invisible qualities -- His eternal power and divine nature -- have been clearly seen, being understood from what has been made ..." (Romans 1:20). We see how God intended the world to be: free of sin, and full of order and creative design. At the same time, we are forced to recognize how creation has fallen and our attempts to serve and discover are tainted by sin. We seek our own good and often make choices that use our scientific knowledge for sinful pursuits.

However, God has not given up on His creation -- including His servants within the creation. Just as we become aware of the sin that has infiltrated itself into His world, we see evidence of His grace in the understanding and wisdom He has given us through science. We have been blessed with minds capable of giving us glimpses into how God has arranged each minute detail within His creation. We see His sense of order in the season, the rotation of the planets, the ability of forests to replenish and remain fruitful, and the natural structure within a beehive. We see His creativity in the colours in the rainforest, in the variety of plants and flowers, and in the very unique personalities that He has given to make each of us an original of His.

As such, life flourishes because creation obeys the laws set in place by God. As we investigate more about God's world, we base our understanding on the truth that creation will obey these laws. We also seek to be obedient in our own learning and living within the laws God has set in place for us.

We hope and pray that as our students take the time to prepare their science projects, and reflect on what they are learning, that they will also come to worship, praise and thank God for His grace and provision for their lives.

So, we invite you to come along with us as we study more about the world that our God has created for us to enjoy. We trust that this book will be a useful tool for you in helping your child with his or her science fair project. If you have any further questions or concerns, please contact his or her teacher as soon as possible.

What Is A Science Fair?

A Science Fair is a public exhibition of science projects done by students. The projects are judged for their originality, scientific approach, level of difficulty, and visual presentation. Students also have an interview with the judges.

When students take part in a Science Fair, they are expected to set up their investigation in the same way that a professional scientist would. This means conducting their investigation in an orderly way. It also means making sure that they do a fair test.

Science Fairs assist students in learning valuable job skills such as communication, critical and logical thinking, the ability to evaluate situations, solve problems and make decisions, life-long learning, a positive attitude and self-confidence, a sense of responsibility, the ability to manage time and other resources, appreciation and stewardship of God's creation, and adaptability to changing circumstances and team-work skills.

Students work as scientists, experiencing the excitement, pleasure, frustration and collaboration connected with scientific research. Working on a project develops creativity and enterprise, challenges construction and artistic skills, strengthens communication abilities and provides opportunity for self-expression.

At Science Fairs, students learn from the experience of presenting their work to the judges and general public, from the feedback and suggestions of the judges, from seeing and discussing the work of other entrants and from meeting other students with similar interests. Exhibiting their projects provides students with recognition of their scientific endeavours and encourages young people to take a serious interest in science as a career.

The Science Fair provides students with the chance to study a topic that is of interest to them. It gives students the opportunity to grow in their relationship with Christ as they study His creation and reflect on the greatness of God. It gives students the opportunity to present what they have discovered through scientific inquiry. The fair also presents a wonderful opportunity to promote a variety of learning skills. Writing, reading, logic, communication, mathematics, and critical thinking all play roles in the completion of a project.

Goals

By working on a science project, students learn that science is an active, dynamic field and find that much of the fun is in the doing. The Science Fair project is not about finding answers, but going through the process of asking questions and performing experiments in an attempt to find answers. Making the attempt without answering the questions still satisfies the intent of discovering knowledge and discovering it through doing.

The general goals of the Science Fair are to:

- Enable students to use science and technology to acquire new knowledge and solve problems and to come to a greater appreciation of who God is and what He has created.
- Prepare students to critically address science -- related issues about society, the economy, and the environment and then to reflect on how God would have them live in respect to what they have learned.
- To develop a respect for and an understanding of man's quest for knowledge. To encourage natural curiosity. To provide a basis for creativity.
- To develop in students an understanding of the necessity for organization, planning and experimentation in research. To encourage independent thinking. To develop mechanical skills.
- To expose students to and acquaint them with the use of scientific methods through practical application.
- To provide an opportunity for self-expression. To emphasize the necessity of having and developing the ability to communicate ideas.
- To aid in channeling students into worthwhile science endeavours. To provide stimulation for scientific hobby pursuits. To meet the needs of talented students.
- To offer an opportunity for students to consult and work with specialists in science fields in the community and elsewhere. To provide constructive suggestions for teachers and pupils of science.
- To serve as a showcase for scientific talent. To report to parents and the community about one phase of the academic performance of students and thereby stimulate a greater interest in science by all.
- To encourage teachers of Western Manitoba to view science fairs, projects and displays as an integral part of their science program.

Academic Integrity

One of the most important traditions in the scientific community is the tradition of academic integrity. Scientists build on others' achievements and they must be able to trust the integrity of the published literature they build on. Students want to work in communities where competition is fair, integrity is respected and cheating is not tolerated. At all science fairs, including the Western Manitoba Science Fair, students are required to present work that is the result of their own efforts. All assistance received from others must be acknowledged, and all written material that draws on the work of others must be accompanied by appropriate references.
Specific examples of violations include:

- Plagiarism – presenting the work of others as your own without acknowledging the source. This includes work done by a family member or a mentor.
- Fabricating or falsifying data
- Forging signatures
- Fabricating or falsifying registration information
- Entering a project that is either derived from a previous project or is a continuation or revision of a previous project by the student (or by another) without documentation of the previous work.

Parental Support & Involvement

Christian Heritage School recommends that parents/guardians play a supportive and encouraging role regarding their child(ren)'s participation in the Science Fair. Science fair projects from time to time will be mentored, or receive outside assistance. Mentors may be scientists, teachers, parents or, sometimes, other students. It is important to understand that mentorship is not at all discouraged; it can be a useful way for students to conduct research and gain knowledge pertaining to their project. Mentorship will not be considered an 'unfair advantage' as long as the following guidelines are strictly followed:

- Always keep in mind that the project is the student's and not the mentor's. It is the student's role, and not the mentor's, to conceive the project's specific topic.
- All data taking and analysis of the data must be the student's own, unless the student does not present it as his or her own and credits the actual data taker properly. When mentors take over these responsibilities, they deprive students of valuable learning experiences.
- If a project has been mentored, it should be declared in the references and or bibliography in the accompanying project report/abstract
- The student must be knowledgeable in the subject/project, and can answer all questions about information they've presented in the project.

- Encourage the development of a 6-week time plan.
- Help access resources and materials from public libraries, the Internet, retail stores, etc.
- Guide through difficult areas.
- Participate in brainstorming for ideas.
- Encourage neatness & creativity.
- Assist with transporting the project.
- Perform a task, which is potentially dangerous.
- The entry should reflect your child(ren)'s efforts.
- All writing, typing, painting, labeling, & displaying must be done by the entrant(s).

General Guidelines

1.) A student may enter a project on an individual basis or with a partner. A group project entry will be classified under the grade level of the highest grade student in the partnership.

2.) Students are responsible for bringing and setting up their projects in the morning on the day of the fair.

3.) Projects will not be allowed on the school buses due to space and safety reasons.

4.) Project entries are subject to reclassification by the Science Fair Committee and / or judges, if the need arises.

5.) Each Science Fair entrant will receive recognition for his/her participation.

6.) Students are encouraged to use school resources. Teachers are prepared to provide support and general guidance to their students.

7.) Maximum dimensions for projects, including backboards, are 0.8 metres from front to back, 1.2 metres from side to side, 2.0 metres high. No part of the exhibit rests on the floor. It must be confined to the table space designated for the exhibit.

8.) Exhibits should be durable, with moving parts securely fastened and safe. Self-supporting backboards and extension cords are to be furnished by the exhibitors.

Paper on back- boards should be securely applied so there are minimal air pockets behind the paper. Overlapping or loose sheets of paper should be stored in a data book.

9.) Local fire regulations must be followed. No flammable liquids, compressed gas cylinders or open flames may be used.

10.) Dangerous chemicals may not be exhibited. Simulations may be used for display purposes.

11.) All extension cords and 110 volt alternating current apparatus must be CSA – approved. Chords must have a 3-wire grounded connection and they may not be more than 7m in length. No exposed live parts over 36 volts are allowed. Current (amperage) must be low so as not to cause any discomfort or danger if touched. Wet cells are not allowed because of the hazardous chemicals involved.

12.) No firearms or ammunition are allowed at the fair. Experiments using firearms must be carried out in accordance with federal and provincial legislation.

13.) Lasers, radioisotopes and x-ray or radiation producing apparatus may not be displayed. High voltage apparatus capable of generating in excess of 10kV is considered an x-ray hazard.

14.) Biological hazards, including live cultured bacteria, cells and tissues, or any material which may decompose are suitable for research under controlled laboratory conditions, but may not be displayed at the fair. Simulations (must be labeled ‘simulated’) or pictures may be displayed. Live plants can not be brought to the fair. Example: Displaying pictures of plant growth cycle is proper; bringing the actual plants is not allowed.

15.) Living vertebrate animals are not to be used in experiments with the following exceptions: observations of normal living patterns of wild animals in the free living state or in zoological parks, gardens or aquaria, and observation of pets, fish or domestic animals. No live animals, mounted specimens or animal parts may be displayed at the fair.

Categories of Projects

Students may enter a project in ONE of the three categories:

1. Experiment

Undertake an investigation to test a scientific hypothesis by the experimental method. At least one independent variable is manipulated; other variables are controlled.

2. Innovation

Develop and evaluate new devices, models, theorems, physical theories, techniques, or methods in technology, engineering, computing, natural science, or social science.

3. Study

Analysis of, and possibly collections of, data using accepted methodologies from the natural, social, biological, or heath sciences. Includes studies involving human subjects, biology field studies, data mining, observation and pattern recognition in physical and/or socio-behavioural data.

Giving ©redit Where ©redit Is Due!

BIBLIOGRAPHY BASICS

#1 - Write "Works Cited" at the top of the page & centre it.

#2 - Alphabetize all citations by the first word in each citation. Usually this will be the author's last name, but when there is no cited author, it might be the first word of another piece of information.

#3 - Double-space the entire page, but do not leave additional spaces between citations.

#4 - Start each citation against the left margin.

The second and subsequent lines of each citation should be indented.

CITING A PRINT SOURCE (BOOK OR MAGAZINE)

#5 - Write the author's last name & then put a comma.

Write the author's first name, middle initial, & then put a period.

#6 - Write the title of the article (if applicable) in quotation marks, with a period at the end.

#7 - Write the name of the book or magazine in italics, followed by a period.

#8 - Write the place of publication & then put a colon.

#9 - Write the publishing company's name & then put a comma, the date of publication & a period.

CITING AN ONLINE SOURCE

#10 - Write the name of the author or editor (if you can find it on the website) & then put a period.

#11 - Write the name of the article & put it in quotation marks. Then put a period.

#12 - Write the name of the overall website in italics & then put a period.

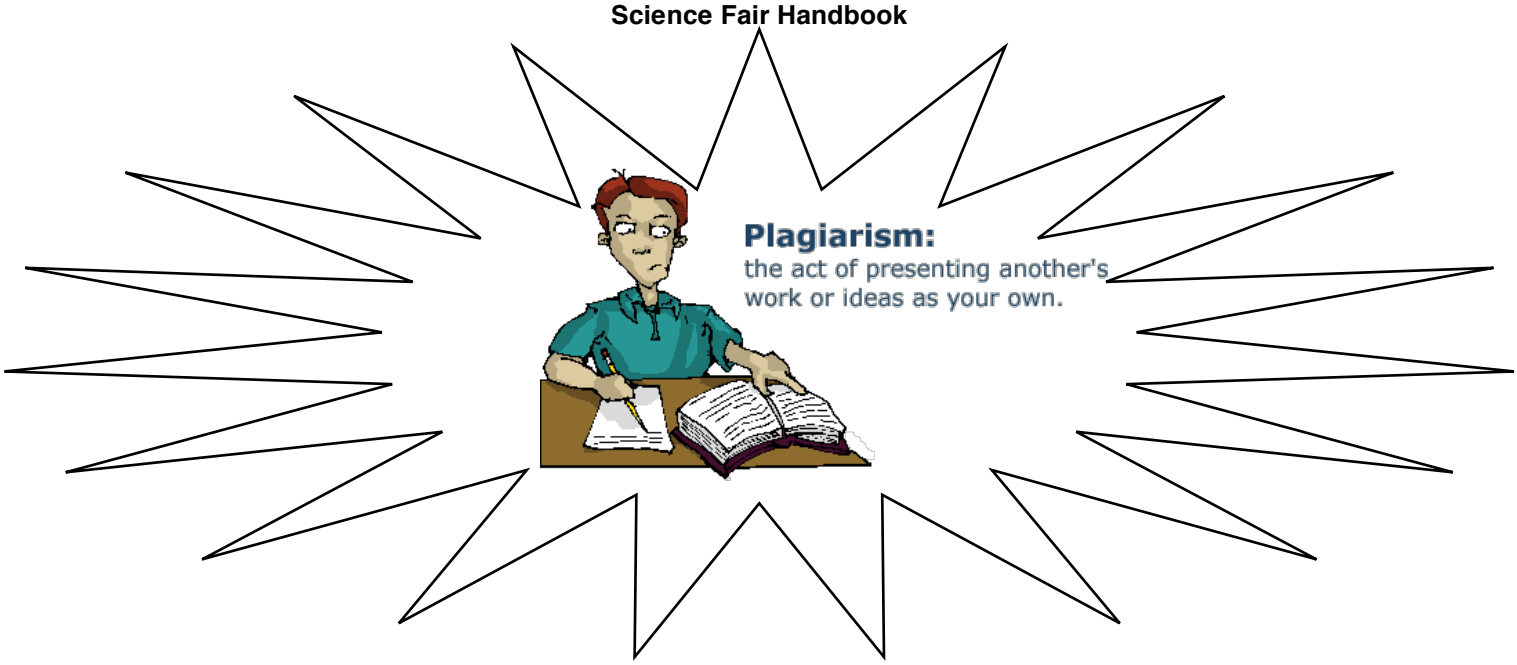
#13 - Write the name of the publisher, if available.

If this information is not available, write "n.p" (no publisher).

Then write the date of publication, if available. If this information is not available, write "n.d." (no date).

#14 - Write the word "Web" to show that you got the information from the Internet & then put a period.

#15 - Write the date that you accessed the website, in the form: [day] [month] [year]. Then put a period.



When you work hard to write something, you don't want your friends to loaf and just copy it. Every author feels the same way.

Plagiarism is when someone copies the words, pictures, diagrams, or ideas of someone else and presents them as his or her own. When you find information in a book, on the Internet, or from some other source, you MUST give the author of that information credit in a citation. If you copy a sentence or paragraph exactly, you should also use quotation marks around the text.

The surprising thing to many students is how easy it is for parents, teachers, and science fair judges to detect and prove plagiarism. So, don't go there, and don't make us try to hunt you down!

The Scientific Method is used in developing a science fair project. The careful use of this method to obtain reliable experimental results has been the foundation of scientific progress.

Abstract: An abstract is written once your research and experimentation are complete. It should include the project name, name(s) of students, a statement of the problem/purpose of the experiment, a brief summary of observations and/or data, and a summation or generalization of the conclusions drawn as a result of the investigation. Abstracts are distributed to the judges before coming to the project to familiarize them with the project. The abstract is evaluated as part of the project.

Data Book: A project data book should contain accurate and detailed notes to demonstrate consistency and thoroughness to the judges.

- **Title Page**: a clear statement of exactly what the focus of your project is. Centre the project title and put your name, address, school and grade at the bottom right.
- **Table of Contents**: Include a page number for the beginning of each section.
- **Introduction**: define your purpose — what you are trying to find out by doing your project. Include your hypothesis, an explanation of what prompted your research and what you hoped to achieve. Your hypothesis is an educated guess of what you expect to find out by doing your project.
- **Background Information / Research**: what you learned about your project subject from sources of reference.
- **The Experiment**: Describe in detail the methodology used to collect your data or make your observations. Include enough information for someone to repeat the experiment. Include your materials, procedure, and applicable photographs or drawings.
- **Discussion**: Thoroughly discuss exactly what you did in your project. Your results should be compared with theoretical values, published data, commonly held beliefs and/or expected results. A discussion of possible errors should be included as well as how the data varied between repeated observations, how your results were affected by uncontrolled events, what you would do differently if you repeated the project and what other experiments should be conducted.
- **Conclusion**: a statement of what you learned from doing your project. It should match your purpose and your results.
- **Acknowledgements/References**: Credit individuals, businesses and educational or research institutions that assisted you. Identify financial support or in-kind donations. List any documentation that is not your own (ie: books, journal articles)
- **Applications**: how the findings of your project could be applied in everyday situations.

Christian Heritage School
Science Fair Handbook

Data Booklet

(Each project must have a complete data booklet)

INTRODUCTION

Include your purpose or initial question, your hypothesis, an explanation of what prompted your research (inspiration) and how you hope this project will help our community.

The hypothesis is one of the most important parts of your project. It is your proposed explanation for a scientific question based on facts that you have gathered from literature. Your hypothesis will set the "theme" of your project. How you design your experiment and collect data, are all related to how you form your hypothesis.

Example: Dishcloth vs. Sponge. Is it better to use a dishcloth or a sponge to do the dishes?

Hypothesis A: My hypothesis is that it is better to use a dishcloth to do the dishes.
Hypothesis B: Since bacteria tends to multiply in moist and protected places and sponges have many holes to protect the bacteria from being washed away, my hypothesis is that it is better to use a dishcloth than a sponge to do the dishes.

In this example, Hypothesis B is better than Hypothesis A even though they predicted the same thing. On top of the prediction, Hypothesis B stated the variable, bacteria, that will be tested to determine what "better" means.

THE EXPERIMENT

Describe in detail the methodology (procedure) used to collect your data or make your observations. Include a list of supplies, equipment, and enough information for someone to repeat the experiment/research. Clearly state your manipulated variables and controlled variable. This is something that many students overlook in their projects. The variable is one element or detail that you are manipulating and changing to test for your hypothesis.

For example, in the Dishcloth vs. Sponge project, the variable is the materials used to wash dishes: sponge and dishcloth.

The manipulated variable is NOT the amount of bacteria because you are not manipulating this element of your study; you are merely observing how this element is affected. The purpose of a controlled variable is to make sure that the observations you make from your experiments are the result of changing your variable, and ONLY that variable.

Using the same example, if we just compare the amount of bacteria in a dishcloth and sponge, we will not get a valid result because a dishcloth has a larger surface area than a sponge and a sponge is thicker than a dishcloth, which can greatly impact your results. Keeping in mind that you are testing for a difference between the materials only, a control that you can do would be cutting the sponge so that it is the same thickness and area of a dishcloth, and then compare the amount of bacteria in those two materials. You can also cut the two materials so that they are the same weight, and then compare their bacterial content.

Include detailed photographs or drawings or the equipment, tools or apparatus.

RESULTS

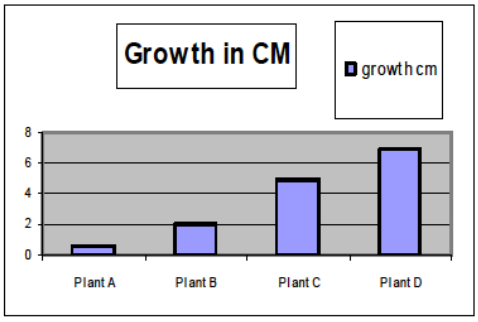
Include a written record of your observations (unaltered qualitative or quantitative) as well as analyzed data. **A table or chart may be helpful to organize your data**. In your data analysis, it is crucial to include statistics. Without statistics, you cannot say for sure whether the differences you observed were significant differences or were simply out of luck. You can also include photos or videos of your results.

For example, my raw data would include the size and thickness of each piece of dishcloth and sponge, the temperature of the room when I conducted my experiment, how long I soaked my materials in dirty water, and how much bacteria was found in each piece of material. For my data analysis, I can average out the amount of bacteria in all of my cloth samples and compare that to the average from sponge samples. If, say, the amount of bacteria in sponges was higher than in cloths, I can use standard deviation to determine whether the difference is significant or not.

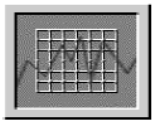
Use the right graph(s) for your experiment:

- **Pie graphs** are good to use if you are showing percentages of groups. Remember that you can't have more than 100% and all the pieces need to add up to 100%. This type of graph is great if you are doing surveys

- **Bar graphs** are good to use if you are comparing amounts of things because the bars show those amounts in an easy to read way. This way the judges will be able to tell your results at a glance. Usually the bars go up and down. The x axis (or horizontal axis) is where you label what is being measured, (like plant A, B, C and D) and the y axis (or vertical axis) is labeled to show the unit being measured (in this case it would be centimeters that the plant grew)



- **Line graphs** are good to use if you are showing how changes occurred in your experiments over time. In this particular case you would be using the x axis to show the time increments (minutes, hours, days, weeks, months) and then you would use the Y axis to show what you were measuring at that point in time.



DISCUSSION

Thoroughly discuss exactly what you did in your project (especially if it was different from your original procedure). Your results should be compared with theoretical values, published data, commonly held beliefs and/or expected results. Did you results support or disprove your hypothesis? (Don't forget to use the online resources through "Destiny" and also cite your sources!) A discussion of possible errors should be included as well as how the data varied between repeated observations, how your results were affected by uncontrolled events, what you would do differently if you repeated the project and what other experiments should be conducted. Also include how your project can help the community and what modifications can be done so that it will further a positive impact.

Remember, if your hypothesis is disproved, it's not the end of the world! Many exciting discoveries are based on disproved hypotheses.

For example: Which would make ice cubes faster? Hot water, or cold water? Instinctively, your hypothesis would be that cold water freezes faster than hot water, that is, if you haven't heard of the Mpemba effect. This phenomenon is the observation that hot water freezes faster than cold water. It was not discovered by a famous physicist or chemist. The phenomenon was discovered by a Tanzanian high school student named Erasto B. Mpemba. Mpemba was making ice cream in cooking class but fell behind on schedule. So instead of freezing his ice cream after it's been chilled, he froze it while it's still hot and it froze before everyone else's!

CONCLUSION

The conclusion is not just a summary of your results; it is the answer to your question. It is what you have shed sweat and tears, and possibly blood, for over the past few months. Write it wisely and to-the-point! You don't want to hide your genius discoveries behind run-on sentences and poetic verses. You want to very simply tell your audience: "This is what I found and it tells me that my hypothesis is true/false. From this I learned that …" In your conclusion, also mention whether your data was reliable. If you did the same experiment again, would you come up with the same results?

ACKNOWLEDGEMENTS/REFERENCES

Credit individuals, businesses and educational or research institutions which assisted you (don't forget your parents!). Identify financial support or donations.
List any documentation that is not your own (i.e., books, journal articles, websites). You can have two sections for references: Sources Cited for those that are directly referenced to in your poster and report, and Sources Consulted for other references. Sources that are directly referenced in your text should have the name of the author and date immediately after the text as well as an entry in the Sources Cited section.

HOW TO DO WELL IN A SCIENCE FAIR

1. Find something that you wonder about. It must be something you don't yet know but that you find fascinating. If you are not learning anything new, you are doing the research for the wrong reason.

2. Once you have an idea for a research topic, look at the judging form. Start with Part A. The whole page looks complicated, but it is not really. Grades 1 to 6 students must decide whether their project is science or technology. Ask a teacher for help with the definitions. Grades 7 to 12 students must decide whether they are going to do an experiment, an innovation or a study. Keep the definition in mind throughout your project. The Levels below your choice give an excellent idea of what the judges will be looking for.

3. Start a journal. Each time you do some work, write down the date and a brief description of what you did and what happened. Start a new entry every time you work on your project. Record the failures as well as the successes. It is often wise to take pictures of your progress. Projects involving plants, for example, look much different by the time the Western Manitoba Fair comes along than they did for the school fair. For the Western Manitoba Fair pictures are much better than the actual plants.

4. Once your project is well underway, refer to the rest of the judging form often to keep yourself on track. Part B has to do with original creativity. Good scientists take a creative approach to problems to find new solutions. Try to work toward a higher rank because the marks are higher.

5. As the fair approaches, decide what type of display you are going to need. Be sure that it meets the size limits. Remember that the display is only 20% of the total mark.

6. Prepare for your interview with the judges. They will want to know whether you understand your project. The judging form gives some good guidelines.

7. All grade 7 to 12 projects must submit a one page abstract with their entry form. The judges get this before fair day. It is worth 10% of your final mark. Entries without a summary are at a real disadvantage. A good summary sets out the purpose of the project, a summary of what happened and a brief conclusion. Be sure you enjoy the experience.

Helpful Hints for the Display Board

- Your title should be simple and represent your research accurately.
- If elements of your project cannot be safely exhibited at the Fair, incorporate photographs of important phases of your experiment to use in your display.
- Photographs of people require their consent.
- Your display should be presented logically and be easy to read. When you arrange your display, imagine you are seeing it for the first time. Conventionally, the audience will read your poster from left to right, thus this is the most logical way to present your poster.
- Make your display stand out. Use neat, colourful headings, charts and graphs. Homemade equipment, construction paper and coloured markers are excellent for project displays. Pay special attention to the labelling of graphs, charts, diagrams and tables.
- Be sure to adhere to the size limitations and safety rules when displaying your project.
- Make sure your display is sturdy.

Checklist:

- Abstract
- Data Booklet
  - Title Page
  - Table of Contents
  - Introduction/Purpose
  - Hypothesis
  - Data
  - Results
  - Possible Errors
  - Conclusion
  - Acknowledgements/References
  - Application
- Logbook (evidence of planning)
- Backboard