Mitchell Middle School

Science Project Handbook

Adapted from Grant Park High School

2010-2011

Introduction

Working on a Science Project is an educational experience that should help you "learn how to learn". It is a chance to think critically and to investigate a topic that interests you.

Like most things you do, either in or out of school, the more effort you put into your work, the more benefit you will get from it. When you have put a lot of effort into completing the Science Project, you will have the satisfaction of knowing that you did your best and you will receive a good mark.

Working on a Science project will give you the chance to develop and practice skills that are used throughout your everyday routines, like following directions, meeting deadlines, reading for main ideas, organizing your thoughts, and devising creative solutions to problems. Many of the skills are specific to scientific thought, such as identifying and controlling variables, making observations, measuring, forming hypotheses, drawing conclusions, and manipulating apparatus. All of these skills, whether routine or special, will be used in the development of a good Science Project.

When your project is in the Science Fair, you will be practicing your communication skills. You will have the opportunity to explain your project to other people such as judges and fellow students. The development of a display or exhibit of the project will let you share your work with others. Being able to communicate effectively and in an interesting way is a valuable and rewarding life skill that working on a Science Project will help you develop.

Working on a Science Project should be fun. Therefore, pick a topic that is interesting to you. With the proper guidance from your teacher and parents and with a reasonable amount of personal effort, you should be able to develop a good Science Project. This booklet should help you produce a project of which you can be proud. It will not do the work for you, but it will guide you through the process.

Good Luck!!

WHAT IS A SCIENCE PROJECT?

Simply stated, a Science Project involves trying to solve a problem by using some of the methods of Science such s observation and experimentation.

Like any other assignment that you do in school, your project has to follow the teacher's instructions to do well. In other words, to be successful, your project must fully satisfy the marking scheme.

There are two types of projects: those that are experimental and those that are not. When you examine the marking scheme on the following pages, you will find that experimental projects will tend to do better. They are favored by the marking system. Science is a combination of many parts. Only one part is the body of knowledge we commonly know as "Scientific information". A larger and in some cases more important part of science is the process of reaching a conclusion through hypothesizing, observing, testing and analyzing results. In other words, experimenting. In this competition, projects which focus on experimentation are emphasized and usually result in better marks.

The type of project we encourage students to work on is called the controlled experiment. This is where one tests the effect on one variable on another. Examples of controlled experiments are:

(1) What is the effect of exercise on heart rate?
(2) How does temperature affect the activity of insects?
(3) How does rate affect the rate of swing of a pendulum?

In a controlled experiment, the experimenter changes one variable (called the independent variable) to try to find out what will happen to another variable (called the dependent variable). All other possible variables (called control variables) are held constant so that they do not interfere with the test.

Another type of Science project involves mainly observation and tries to answer questions such as:

(1) What are the eating habits of hummingbirds?
(2) How do the phases of the moon change?
(3) What activities do ants perform?

Some Science projects stress mainly measurement such as those that try to answer these questions:

(1) What is the density of iron?
(2) How much carbon dioxide is in the air?
(3) How much water would fill the Pan Am Swimming Pool?

Other types of projects are perhaps easier to think of but may not be as scientific- things like displays of hobby equipment, models, collections, and historical projects. Simply constructing a model of a volcano is discouraged. Relating the chemical reactions of baking soda and vinegar to the scientific process however, would work.

<u>Choosing a Project</u>

Selecting the topic is probably the hardest part of the science project. Simply put, it is deciding on the problem to try to solve. Once the problem is determined, you will have an objective that you can work towards. In other words, you will have a clear purpose – to try to solve the problem.

You must choose a project that is of interest to you. However, you also have to consider other factors, which will determine the success of the project. Use the points below to decide if your project will have the possibility of being a success.

- Is the subject of the project interesting to me?
- Are the necessary materials and equipment available?
- If some materials must be purchased, can I afford them?
- Has my Science teacher approved the project?
- Have I made a preliminary investigation?
- Do I have the ability to proceed successfully with the project?
- Is the scope of the project narrow enough for me to complete the project on time?
- Are the Science activities in the project safe for both others and me?
- Will I be using the methods of Science to try to solve the problem?
- Does my project fall within the marking scheme and general regulations?

All ten of these questions must be answered positively before going ahead with a project. If even one questions is answered 'no' then don't proceed with the project. You should look for a project that has ten 'yes' answers.

The best way to choose a project topic is by asking yourself interesting questions. Try to think of things that have puzzled you or things that you have wondered about such as:

- Do shower baths use more water than tub baths?
- Do girls have a faster reaction time than boys?
- Does water sink into all types of soil at the same rate?

These are just a few of the many types of questions that people might 'wonder' about. However, if after really thinking about a project topic, you still can't find one, then go to the library. Browse through card catalogues looking for books dealings with Science, Science activities, and Science projects. If this fails to produce a topic, do not be afraid to approach the librarian or Science teacher for help.

General Regulations

1. All Mitchell Middle School students will develop a Science Project and will participate in the Science Fair.
2. The Mitchell Middle School Science Fair will be held during the morning of **in EARLY APRIL (final date TBA)**.
3. Projects will be set up in the Middle School gym on the previous afternoon.
4. Students will do their project work either individually or in pairs of students from the same class.
5. In the Science Fair, students will compete against students from their own grade. For example, Grade Seven students will compete against Grade Seven students.
6. Student will officially begin their Science Projects in **October , 2010**. The completed project is due on **April , 2011 (final date TBA)**.
7. Your Science teacher will divide up the project into stages. These smaller sections of work will have to be completed according to the time line that your Science teacher has set up.
8. You will receive marks for completing each stage of the project. Refer to the page dealing with 'Time Line and Marking Scheme'.
9. Students are responsible for acquiring all materials for their projects.
10. The competitive nature of the Science Fair is secondary to the educational value of working on a Science project.
11. Students are **not** allowed to perform experiments on vertebrate animals if they will be harmed in any way. Students are **not** permitted to use hazardous chemicals, high voltage electricity, lasers, explosives, fires or harmful bacteria.
12. The School will not be held responsible for any materials or equipment brought to the school by students for the purposes of the Science Project or the Science Fair. Each student has the responsibility to supervise his/her own project materials and equipment to ensure that they are not lost, damaged or stolen.
13. On an evening in **APRIL(final date TBA),** there will be an open house for family and friends to view the projects. At this time there will be an awards ceremony to recognize the top projects in the fair.

Timetable

You will need to budget the time that you spend on the Science Project. The following timetable lays out a plan of action which, if followed closely, will probably result in a good project. However, if you do not devote a certain amount of time and effort each week towards your project, you will find yourself in the very unpleasant situation of having too much to do and not enough time to it in.

<u>October to November</u>

- Start keeping a project notebook.
- Select an interesting topic
- Decide on the problem that you will try to solve. Obtain approval from your teacher.
- Write out the hypothesis that you will test by experiment.
- Put all of the above information in the project notebook.

<u>November to Mid-December</u>

- Write your background report. Visit the library. Obtain reference material on your topic. Take notes based upon your reading. Write the final copy of your report. Your notes, rough draft, and final copy of the report are place in the notebook.
- Write out the plan of the experiment that you will perform to try to solve the problem. Place your plan in the notebook.

<u>January to Mid-February</u>

- Perform the experiment.
- Record the data and results in your project notebook.
- Reach your conclusion based on the data and result, and record it in the project notebook.

<u>Mid- February up to date of Science Fair</u>

- Obtain the board on which you will place the display. Maximum size dimensions are 120cm. From one side to side and 80cm. From front to back. The board should be in three sections and be self-supporting.
- Place the display board on the backboard. The display is a summary of your entire project. It should tell the 'story' of your project. It should have a title to catch the attention and interest of the viewer. The display emphasizes headings such as: **PROBLEM, HYPOTHESIS, PROCEDURE, DATA,** and **CONCLUSION.** The headings must be printed and should be large enough to be clearly seen from a distance of 2 metres. The information under each heading must demonstrate good spelling and grammar.

- The equipment that you used to perform the experiment and the project notebook are important parts of the display. During the Science Fair, the equipment and the notebook are placed on the table immediately in front of the backboard.

Time Line and Marking Scheme

The project must be done in stages. These stages are shorter assignments of work that must be completed by certain dates. Your teacher will evaluate you work at each stage.

	Place Completed
Stage One (due Nov 15)	
Statement of the problem you will try to solve	____
Statement of the hypothesis to be tested	____
Project notebook (Log section)	____
Stage Two (due Dec 15)	
Background report	____
Plan of the experiment	____
Project notebook	____
Stage Three (due Feb 28)	
Experimental results and conclusion	____
Project notebook (log section)	____
Project notebook (Organization and completeness)	____
Stage Four (due April 4)	
Display/ Exhibit	____

The Project Notebook

When competent scientists plan and perform experiments they keep accurate records in notebooks. They record ideas for experiments, dates and times when experiments are performed, and plans for future experiments. All observations are made and data collected are accurately and honestly recorded.

Scientists often read books and journals. They make notes based upon their reading and then place their notes into notebooks.

Scientists write letters to other scientists requesting or sending information or perhaps asking advice. The results of such correspondence are placed in notebooks.

Why do scientists keep notebooks? They cannot remember everything that they do each day for an entire year. If they did not write things down in notebooks, their work would get very inefficient and unreliable. They would have to be constantly re-doing their work. Who would believe what scientists have to say if they had no information to back up their claims and statements?

For the same reasons as outlined above, students working on Science projects must keep a notebook. The project notebook is organized into two sections.

Section One:

This is the "Log Section" which is similar to a daily journal. Record what you did as well as the dates.

Example:

Sept. 15 - read through the science project booklet
-the teacher explained the project to the class
Sept.18 - visited the library to get ideas for a topic
- browsed through a few books on Science activities
- talked to the librarian about the project
Oct. 8 - visited the Public Library
- found a good book in the growth of plants
Oct. 12 - Hurray! I have a topic: How does magnetism affect the Growth of plants?

Section Two:

This section contains the following:

1. The problem and the hypothesis
2. The background essay
3. The plan of the experiment
4. The data and results
5. The conclusion and the application

The project notebook must contain

1. Title page
2. Table of contents
3. Bibliography

Statement of the Problem

Express the purpose of your investigation in the form of a question or a brief statement. Try to be as specific as possible.

Example: Instead of calling your project "Seed Growth" state exactly what you are investigating about seed growth.

1. How do microwaves affect seed growth?
2. A Study of the Effect of Microwaves on Seed Growth.

Example : Instead of calling your project "Study Habits" state exactly what you are investigating about study habits.

1. How does music affect study habits?
2. A study the Effect of Music on Study Habits.

Example: Instead of calling your project "Chemical Reactions" state exactly what you are investigation about chemical reactions.

1. How does temperature affect the rate of a chemical reaction?
2. A study of the Effect of Temperature on the Rate of a Chemical Reaction.

You should have noticed that there is a pattern or standard form for expressing the statement of the problem.

What is the effect of ___(a)___on ___(b)___?
How does ___(a)___affect___(b)___?
A Study of the Effect of ___(a)___on___(b)___.

The *independent variable* is placed in (a). The independent variable is the variable that the experimenter changes. The *dependent variable* is placed in (b). The dependent variable is the variable that the experimenter measures to find out if or how it changes.

The Hypothesis

The Hypothesis is a statement about the facts that will be investigated. When you hypothesize, you are predicting what you expect to happen during your investigation. The reason fir having the hypothesis is that is gets you started with your experiment. The experiment is designed or planned to 'test' the hypothesis. That is, to determine whether the hypothesis is correct or incorrect. If the results of your experiment support the hypothesis, you can state in your conclusion that the hypothesis is accepted. If the results do not support the hypothesis, you can conclude that the hypothesis is rejected.

Example Problem: How does amount of air affect how a basketball bounces?

The Hypothesis: If air is added to a basketball, it will bounce higher.

The experiment would now be planned. It is easier to design the plan now because the hypothesis clearly sets out the purpose. A basketball will be dropped from the same height many times. More air will be put into the basketball each time it is dropped. The height to which the ball bounces will be measured each time. If the results of the experiment show that the ball does bounce higher whenever more air is in the ball, then the hypothesis will be accepted. It the results indicate that this is not happening, then the hypothesis will be rejected.

Example Problem: A Study of water Conservation in the Home.

The Hypothesis: Shower baths use more water that tub baths.

This example clearly shows the direction that the experiment will take. The experimenter will need to measure the amount of water used during showers and compare this amount to the volume of water used during tub baths. The results of the experiment will determine whether the hypothesis will be accepted or rejected.

The Background Report

The background report deals mainly with a review of the related literature and research on your topic. This is a fancy way of saying: Find out and report on what other people have written or discovered about your topic. The background report could also contain descriptions of subject matter directly related to your topic. Even definitions of important terms could be included here.

Visit school and public libraries. Going to a specialized library such as the science library at a university may produce a bonanza of information.

Obtain information from your Science textbooks, reference books, encyclopedias, magazines, and of course, the Internet. You could write a letter to a company or a government department requesting information. Talking directly to a scientist who has knowledge about your topic may prove helpful. Keep track of all the resources you use by developing a bibliography. The writing of the background report should be neatly done and demonstrate good spelling and grammar.

The length of the report may be as short as two or three pages for some students. It may be as long as six to eight pages for others. Just remember that it should be original work and not a printed document photocopied from a book or downloaded from the Internet.

The Plan of the Experiment

The plan of the experiment is the procedure that you intend to use in trying to prove or disprove your hypothesis. The plan should contain five main parts:

1. Statement of the problem
2. The steps you are going to follow to perform the experiment
3. A list of materials
4. A way of recording observations
5. A time schedule

Refer to the earlier part of this booklet called the 'Statement of the Problem'. After the problem has been identified and clearly stated, important variables must be identified and precisely described. These are the *independent variable,* the *dependent variable,* and the *control variables.*

A well-planned procedure will do the following:

- State the hypothesis to be tested
- Identify the independent variable
- Describe how the independent variable will be changed
- Identify the dependent variable
- Describe the method for measuring any changes in the dependent variable
- Identify other possible independent variables that may affect the dependent variable (these are the control variables)
- Describe the way that the variables in the previous point will be controlled (they are usually held constant or unchanging)

A drawing to show how to build or set up the required equipment may be an important part of your plan.

Make a list or inventory of the equipment that you will require to successfully carry out your plan. If you can't obtain the necessary materials you may have to change your procedure or quite possibly your whole project.

Your plan should also describe the method you will use to record the data that you expect to collect. Sample tables in which data will later be recorded should be part of your plan.

Keep in mind the time schedule in which you are working. Don't put things off or you will run out of time. Plan each step of the experiment for the time required. Keep in mind the due dates and schedule steps counting backwards from these dates. Allow yourself plenty of time for possible setbacks.

Data and Results

After you are satisfied that you have a well-planned procedure, start your experiment. Keep accurate and detailed records of when you try the experiment, what you do and what you observe happening. Make a record of any observations as soon as they occur. This also applies to the collection of data such as measurements. Always record data and observations as soon as they are obtained. Never rely on your memory. Try to repeat your experiment several times so as to improve the accuracy of your results.

An effective way of organizing raw data such as measurements is to place them into tables. Each column of a table should have an appropriate heading and the correct unit of measurement should be stated.

After the raw data have been collected, you might want to summarize them. Graphs, such as line charts and bar charts may reveal patterns and trends in your data. You might want to enter your raw data into a spreadsheet program and have a computer construct the charts for you.

Examine the data carefully. Write statements about what the data are saying. These statements are your results.

Conclusion

The conclusion is the last part of your investigation. Here you want to deal with what you have learned by performing the experiment. Base your conclusion on the data that you have collected.

Look over the data. You may notice patterns or trends. There may be a direct relationship between the independent and dependent variables. For example: *As the number of turns of wires increases, the electromagnet gets stronger.* There may be an inverse relationship between the independent and dependent variables. For example: *As an elastic band gets longer, it's width deceases.* There may be no relationship between the independent and dependent variables. For example: *As the mass of a pendulum increases, its rate of swing remains unchanged.*

You performed the experiment to 'test' the hypothesis. Study and examine the data. Does the data support the hypothesis? If the answer is yes, then state that the hypothesis is 'accepted'. If the answer is no, then state that the hypothesis is 'rejected'.

It is very important to understand that rejecting the hypothesis does not mean that the experiment is a failure. On the contrary, you have made a worthwhile discovery. However, now you might want to state a different hypothesis and then perform another experiment.

In conclusion, you want to make a decision. Did I accomplish what I set out to do? Remember you carried out the project to try to find a solution to a problem. Base your solution on the data you collected and perhaps also on what you found out in your background report.

Applications

After you have described the results of the experiment and the conclusion that follows from these results, you should now consider some practical ways to apply this knowledge.

Suppose that you discovered that water sinks through clay soil more slowly that through sandy soil. This information, when put into practice, would be helpful in the construction of outdoor skating rinks. A clay soil would prevent water that is flooded onto the rink from seeping into the ground. A rink constructed on sandy soil would require much more water to develop a good ice surface.

However, someone landscaping the yard around a newly-built house would apply the same knowledge in a different way. If good drainage into the ground is desirable, the landscaper would not put clay soil directly under the grass sod.

Tips on Presenting Your Project

1. The Title
   a) Relate the title to a **SPECIFIC** question investigated.
   Example: Instead of the general topic 'Molds' relate to the specific question investigated: ie.
      What causes Mold to grow on bread?
      OR
      Where can we find Molds?
   b) The same title you choose for your project report may be an acceptable exhibit title. (see # 1 above)
   c) Remember, regardless of your choice, your title should be **brief** and as non-technical as possible. A sub-title may explain or simplify the main title.
2. Reasons For Title Selection
   a) The people viewing your project generally know less about it than you. Technical titles scare viewers away.
   b) The use of a very general heading such as 'Molds' places pressure directly on the presenter to guide both judges and observers to the actual question about molds being investigated.
   c) By selecting a specific title, the presenter directs the judge or observer to the problem being investigated and sets the stage for discussion on areas which were investigated and information has been collected.
   d) A specific title helps avoid stress on the presenter and possible low evaluation by judges because it avoids areas which have not bee studied.
3. How much Should You Write (see presenting page)
   a) Keep written material to a minimum.
   b) Viewers come to **see** an exhibit, not read it.
   c) A good illustration, or graphic representation can save many words.
   d) Where text is needed, letter it clearly or large enough for easy reading.

   e) Avoid unnecessary large or garish lettering – titles should only explain, not dominate your exhibit.

4. White Space (see Presenting Your Project)
   a) Rule of thumb, approximately 40% of your available display space should be occupied by absolutely nothing.
   b) Crowded, busy panels defeat their purpose, for viewers usually take one hurried glance, decide that understanding so cluttered an exhibit would be a chore and move on to simpler displays.

5. Apparatus (see figure 1)
   a) Do not get carried away with enthusiasm.
   b) Large arrays of mechanical apparatus are unnecessary and confusing.
   c) Often best to display the unique piece of equipment alongside a drawing of photo of the complete assembly.

6. Photos (see figure 2)
   a) Photos should be large enough to view details without stopping and squinting.
   b) One large color photo adds interest to a group of black and white photos.

7. Graphs and Charts (see figure 3)
   a) Keep them simple.
   b) Use simple bar, circular, line or picture graphs.
   c) Caption and explain graphs and charts adequately.
   d) Avoid line graphs which recross many times, logarithmic charts, scattergrams- these are too confusing for the average viewer.
   e) Use of colors will make the various factors more discernible.

8. Color
   a) In the small space provided fir your display use one or two basic colors plus black and white.
   b) Use color in a few large blocks, not in many small patches.
   c) Different basic colors can be used to define:
      -different main areas of emphasis
      -different shades of the basic colors can be used to define sub-areas
   d) Colors should attract and enhance, not shock or confuse.
   e) Visibility and impact of illustrations and specimens can be increased by mounting them against contrasting backgrounds.
   f) Life Sciences – use more intense colors.

3. The Backboard
   d) The Canada wide Science Fair maximum size restrictions:
      1.2 metres wide
      0.8 metres deep
      3.5 metres high from the floor

e) Staples or the Carillon have pre-made backboards at a reasonable price.

Judges' Score Sheet

Student's Name ____________________________

Category (CE, SS, I) ________________________

Title of Project ____

1. **Knowledge Gained** **1 2 3 4 5 6 7 8 9 10**
   (Has student acquired knowledge by doing this project?)
2. **Information** **1 2 3 4 5 6 7 8 9 10**
   (Information collected through research valid and appropriate to grade level?)
3. **Scientific Approach – Mark each type of project separately.**
   a. *Controlled Experiment* **1 2 3 4 5 6 7 8 9 10**
   (Was scientific process and control variable used in experiment?)
   b. *Scientific Study* **1 2 3 4 5**
   (Was the research and data collection thorough and exhaustive?)
4. **Collection of Data** **1 2 3 4 5 6 7 8 9 10**
   (Were measurements accurate, sources of info varied, and the data organized and logically presented?)
5. **Conclusions** **1 2 3 4 5 6 7 8 9 10**
   (Were stated and conclusion logical and valid?)
6. **Written Work** **1 2 3 4 5 6 7 8 9 10**
   (Logbook present and was organized/complete?)
7. **Oral Presentation** **1 2 3 4 5 6 7 8 9 10**
   (Was it well planned and interesting?)
8. **Exhibit** **1 2 3 4 5 6 7 8 9 10**
   (Visually appealing, neat, and attractive?)
9. **Effort** **1 2 3 4 5 6 7 8 9 10**
   (Degree of individual effort demonstrated?)
10. **Creativity and Originality** **1 2 3 4 5 6 7 8 9 10**
    (Does project show creative approach or thought in design or presentation?)

Comments: ____

____

Category Awards

Gold	90-100
Blue	80-89
Yellow	65-79
White	1-65

Total Score _______

Average/Final Score Calculation

Judges Signature ___________________

Name: ____________________
Project Title: ____________________

Judge's Sheet

Part A: Scientific Thought (40 marks, mark only 1 section)

Controlled Experiment

Problem/hypothesis – clear vs. unclear	0 1 2 3 4 5 6 7 8 9 10
Method/procedure – simple vs. extensive	0 1 2 3 4 5 6 7 8 9 10
Observations, results, presenting results	0 1 2 3 4 5 6 7 8 9 10
Interpreting data, conclusion, application	0 1 2 3 4 5 6 7 8 9 10

Scientific Study

Personal observations (interviewing/testing)	0 1 2 3 4 5 6 7 8 9 10
Analysis – simple vs. extensive	0 1 2 3 4 5 6 7 8 9 10
Use of existing information (application)	0 1 2 3 4 5 6 7 8 9 10
Student's grasp of topic	0 1 2 3 4 5 6 7 8 9 10

Innovation

Models existing technology	0 1 2 3 4 5 6 7 8 9 10
Extends existing technology	0 1 2 3 4 5 6 7 8 9 10
Economic or human justification	0 1 2 3 4 5 6 7 8 9 10
Grasp of specified technology	0 1 2 3 4 5 6 7 8 9 10

Part B: Originality, Skill and Creativity (25 marks)

Originality of topic	0 1 2 3 4 5
Originality of approach	0 1 2 3 4 5
Use of equipment and media services	0 1 2 3 4 5
Interpretation of information or data	0 1 2 3 4 5
Applies scientific skills to get results	0 1 2 3 4 5

Part C: Project Appearance (15 marks)

Layout is logical and self-explanatory	0 1 2 3 4 5
Exhibit attractive and well constructed	0 1 2 3 4 5
Multi-sensory display	0 1 2 3 4 5

Part D: Presentation (15 marks)

Oral presentation clear and enthusiastic	0 1 2 3 4 5
Uses and understands scientific terms	0 1 2 3 4 5
Pleasant, respectful, and friendly	0 1 2 3 4 5

Part E: Notebook (5 marks)

Completeness of information	0 1 2 3
Information clear, accurate and orderly	0 1 2

Total: _____