Department of Education

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STUDENT HANDBOOK

Grades 4 and 5 Student Guide to Completing a Successful Science Fair Project

Office of School Programs and Partnerships

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Introduction

You are going to do a science fair project. Great! A science fair project gives you hands-on experience and knowledge in your own study involving science. You will learn how to:

- investigate
- conduct interviews
- follow rules and guidelines
- use science tools and equipment
- analyze data
- write a report
- prepare a display
- and speak in public!

A science project studies a scientific problem to be able to answer a proposed question or develop a better technique or final project. The basic procedure involved in a science project is modeled on a process called scientific methodology. **Scientific methodologies** consist of the following elements: problem/purpose, hypothesis, research/procedure, experiment, and analysis of results or conclusion.

With work and dedication on your part, this experience will help you prepare for middle school and beyond. This guide will help you produce a successful science fair project.

The Scientific Methodology

What are scientific methodologies?

Problem/Purpose: The problem or question you are testing or seeking to solve.

Hypothesis: Your educated guess about the solution to the problem and the results you expect to achieve from your experiment.

Research/Procedure: The process by which you gather information. This may include consulting reference materials, the Internet, mentors or professionals in the science field you are studying, or organizations such as museums or zoos that will help you better understand your topic and help you formulate how to test your hypothesis through an experiment.

At this stage students should carefully plan how the experiment will be carried out through project scheduling, variables, and controls, and how the results will be observed and measured.

Experiment: The process by which the procedure is carried out outlined during the research/procedure stage to test the hypothesis.

Analysis and Conclusions: The solution to the proposed question and proof the hypothesis was correct or incorrect.

Steps for Doing a Science Fair Project

What are the steps for doing a science fair project?

Step 1: Get a bound notebook for the notes you will take as you research; number the pages.

Step 2: Select a topic.

Step 3: Narrow the topic to a specific problem. State the topic as a research question with a single variable.

Step 4: Conduct research about the topic and record notes in your notebook.

Step 5: Form a hypothesis or state the purpose of the research.

Step 6: Develop a research plan/experimental design.

Step 7: Apply for approval. Fill out appropriate forms and get signatures of approval.

Step 8: Write the research report.

Step 9: Collect materials and equipment.

Step 10: Conduct the experiment. Record the data.

Step 11: Analyze data.

Step 12: Repeat your experiment, as necessary, to thoroughly explore the problem.

Step 13: Form a conclusion.

Step 14: Create the visual display.

Step 15: Review and polish presentation and display for the science fair.

KEEP A SCIENCE NOTEBOOK

You should start your project by using your science fair notebook to record all of the information about your project. You will use the information in your notebook to put together your project board. Document everything you do including the data you collect and the day-to-day activities and observations of your experiment. You will probably want to have tabs that say: Introduction, Experimental Procedure, Data, Results, Conclusions, Experimental Notes, Research Notes, and References/Acknowledgments.

What should I write in my Notebook?

- Scientific observations
- Thoughts/reflections about observations
- Questions
- Exploration of ideas, questions, and thoughts
- Data collected in experiments
- Connections between observations and science concepts learned
- Notes on experiments
- Labeled graphs, data charts, drawings, images, photographs and/or diagrams with comments
- Sketches on observations from a field trip or lab set up
- Pressed samples or rubbings of a gathered objects
- Reflections and reflections

Accurate notes are very important when you are creating your project. You can use a variety of different sources. Here are some tips that will help you when you are taking notes:

- Never write in complete sentences.
- List information that is important. Remember to look and listen for key words or phrases.
- Write details that support the key ideas or phrases.
- Try to find the main idea of the text that you are reading and then write it in your own words.
- Always write the source, (book, article, website) where you obtained your

information next to the notes that apply to it, so as not to confuse which source applied to which note.

Types of Note-taking

Paraphrase**:** is when you rewrite or rephrase the words of an author.

Summarize**:** is when you use the main idea of one or several authors and write it into your own words.

Quote**:** is when you copy the exact words of an author and indicate that you are doing so by using quotation marks.

Reflective Note-taking*:* If you take notes carefully and react to them with your own thoughts and ideas, you will find that you can make sense of what you are reading. The reactions will prepare you for drawing conclusions and creating your final product without copying someone else's ideas. Use the following tips for reflective note-taking:

NOTES	REACTIONS
Learning logs can be used any time you are responsible for writing down information (from library sources, interviews, lecture notes). Write notes in your own words in the left column and react to those notes in the right column. The purpose of a learning log is to help you learn to interact mentally and emotionally with your notes while taking them. Not only do you learn more while you are taking notes, but you also can identify areas where you need additional information or different perspectives.	Reactions can include: • Personal comments or feelings about the information (*I think companies that dump toxic waste should be heavily fined.*) • Questions (*What are the laws on toxic-waste dumping? What source will give me another perspective on this issue?*) • Notes about organization (*Use this information in my introduction.*) • Connections to previous knowledge (*Toxic-waste dumping is worse than oil spills because it's intentional. I think this information is true because it agrees with 2 other sources.*)

Project-Based Learning: Inspiring Middle School Students to Engage in Deep and Active Learning, p. 39
New York City Department of Education

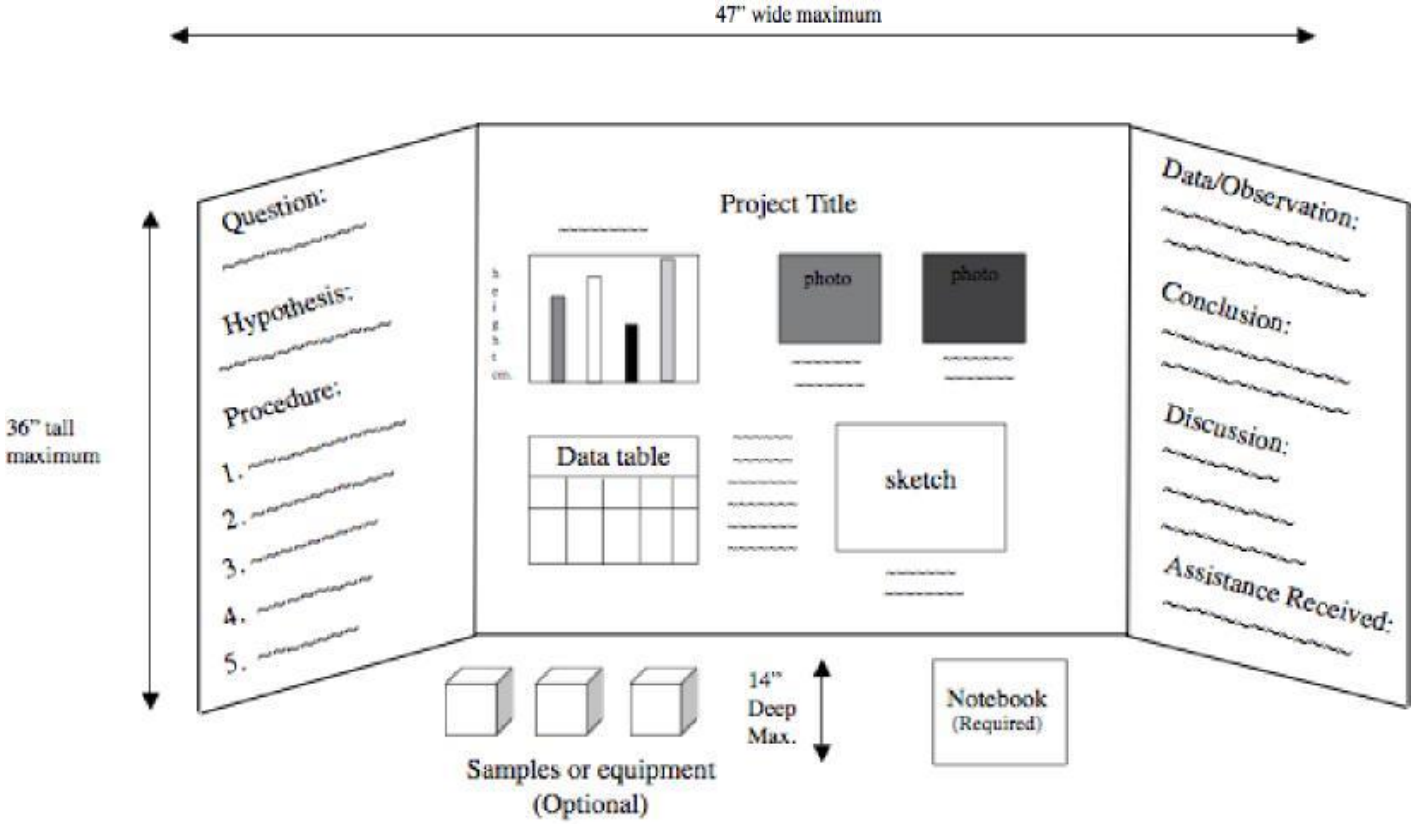
SCHEDULING THE PROJECT

It is important to plan out the amount of time it will take to complete a science fair project. You should plan on finishing your project two weeks before the science fair so that you may practice your presentation several times. Begin by making a list of the things that must be done. Plan the date by which you would like to have each item completed.

Completed-by Date	**Task**	**Date Due**
At least 10 weeks before	Choose a topic. Research the topic. State the hypothesis. Plan the Procedure. Gather materials.	
At least 8 weeks before	Begin the first experiment. Complete the first experiment. Repeat the experiment.	
At least 4 weeks before	Begin the written report. Complete the research. Graph the data on a computer or paper.	
At least 3 weeks before	Complete the written report. Complete the notebook or journal Locate a display board. Proofread your work. Begin creating the display. Finish all sections of display board.	
At least 2 weeks before	Select items from experiment to display. Practice presentation in front of a mirror. Practice presentation with parents. Practice presentation with friends.	
During the week it's due	Turn in your project.	
Day of your presentation	Present your project.	

THE DISPLAY BOARD

Note: The diagram below is an example of what a display might look like. The display should include a notebook for grades 3-6.



What are the parts of a science fair project board?

Title

The title should attract attention to your project. It should be thought provoking and creative. Your title must appear on your project board and on the cover of your notebook.

Statement of the Problem (Purpose)

The statement of the problem is a brief description of the problem you are trying to solve or the study you are researching. What question(s) are you trying to answer in this experiment?

Hypothesis

The hypothesis tell your audience what you think will happen. A hypothesis should be in the following form: "If [the independent variable]..., then [the dependent variable].

Materials

In the materials section, be sure to list everything you used in your experiment. Remember to include the amounts (how much) of materials you used. Please use metric units!

Procedure

The procedure will detail step-by-step instructions stating how the project was done. The procedure should be written clearly enough that anyone could repeat it. This component explains how you did the experiment. You must include at least three trials. If you are in grades 3-6, you also need to identify your variables in this section.

<u>Just a reminder:</u>

Independent Variable: the variable that you manipulate or change
Dependent Variable: the variable that changes as a result
Controlled Variable: things that need to be kept constant (cannot change) during the experiment

Data/Results/Observations

What did you find out? When you perform your experiment, record all of your measurements (in metric units) as well as any observations and descriptions. Measurements should be presented in a data table. Whenever possible, construct a graph, chart, or both to make the data easier to understand.

Conclusion

Based on your data, what did you find out? What did the experiment show? Does the data show your hypothesis was correct? Or does the data indicate your hypothesis was wrong? What is the answer to the question/problem?

CREATING A BIBLIOGRAPHY

When doing research and writing a report, it is always necessary to name the source(s) of your information. It is important to note that *Google* is not a source; it is one search engine that can be used to find sources. Sources used in a project should be compiled into a list called a Bibliography. Sources in a bibliography should be listed alphabetically by last name of the author, or if no author, the first word of the citation. (Exclude "a", "an", and "the" when alphabetizing.)

Sample Bibliography Entries

A. FOR A BOOK:
Author's last name, first name. *Title of Book.* Place of publication: Publisher, copyright year.

Example: Fogle, Bruce. *Training Your Dog.* New York: DK Publishing, 2001.

If you only used part of a book:
Fogle, Bruce. *Training Your Dog*. New York: DK Publishing, 2001, pp. 50-55.

B. FOR A MAGAZINE OR NEWSPAPER ARTICLE:
Article author's last name, first name. "Title or Headline of Article." Name of magazine or newspaper. Date of magazine or newspaper, page(s).

Example: McGill, Kristy. "A Baltic Scramble." Faces. May, 2003, p. 27.

C. FOR AN INTERNET ADDRESS:
Author's last name, first name. "Title of item." [Online] Available
http://address/filename, date of document or download.

Example: DiStefano, Vince. "Guidelines for Better Writing." [Online] Available
http://www.usa.net/~vinced/home/better-writing.html, October 5, 2002.

D. FOR AUDIOVISUAL MATERIALS:
Title of material. Type of material. Place of publication: Publisher, copyright date.

Example: Bizet's Dream. Videotape. New York: Sony Wonder, 1998.

E. FOR AN INTERVIEW:
Name of person interviewed (last name first). Kind of interview. Date.

Example:Watson, Cosmo. Personal interview. July 29, 2003.

SAFETY GUIDELINES

Performing science work can be exciting and wonderful work. However, it can also be very dangerous without proper safety precautions. You must remember to follow all safety rules set by your teacher, your school and the New York City Department of Education. Please speak with your teacher if you have any questions or concerns about safety and your science project.

The following items are not permitted:

- No organisms: living, dead or preserved (plants or animals)
- No fungi or bacteria
- No projects which involve the injury or death of vertebrate animals will be accepted
- No fresh or preserved human or vertebrate animal tissue may be displayed

ONLINE RESOURCES

Data & Statistics

Using Data and Statistics
http://www.mathleague.com/help/data/data.htm

Display & Presentation

Discovery Education: Science Fair Central, Science Fair Presentations
http://school.discoveryeducation.com/sciencefaircentral/Science-Fair-Presentations.html
The Science Fair Judging Sheet
http://sciencefairproject.virtualave.net/judging_sheet.htm

Scifair.org: Display Boards
http://scifair.org/tips/how-to-create-a-winning-display.html

Graphs & Charts

Interactive: Pie Chart
http://www.shodor.org/interactivate/activities/PieChart/

Create a Graph
http://nces.ed.gov/nceskids/createagraph/default.aspx

Science Fair Project Ideas

All Science Fair Projects
http://www.all-science-fair-projects.com
Science Fair Idea Exchange
http://scienceclub.org/proj/kidproja.html
Science Fair Project Ideas
http://www.sciencebuddies.org/science-fair-projects/project_ideas.shtml
PBSKIDS.ORG: Dragonfly TV
http://pbskids.org/dragonflytv/scifair/index.html
Pie Network
http://pienetwork.org/
Pie Network: Getting Ideas
http://pienetwork.org/a2z/g/getting_ideas/
Education.com: Science Fair Project Ideas
http://www.education.com/science-fair/help-child-with-science-fair-projects/

Science Fair Helpful Hints and Guides

Discovery: Science Fair Central
http://school.discoveryeducation.com/sciencefaircentral/

7 Steps To A Successful Project -- Science Fair Projects -- Conservation International
http://www.conservation.org/resources/education/science_fair/Pages/projects.aspx

The Ultimate Science Fair Resource
http://www.scifair.org/

Internet Public Library: Science Fair Project Guide
http://www.ipl.org/div/projectguide/

Make It Solar
http://www.makeitsolar.com/science-fair-information/01-the-scientific-method.htm

Science Websites

The Yuckiest Site in the Internet
http://yucky.kids.discovery.com/

Try Science
http://tryscience.com

Search Engines

Google: http://www.google.com

Ask Kids: http://askkids.com

Dogpile: http://www.dogpile.com

KidsClick: http://www.kidsclick.org/

Lycos: http://lycos.com

Metacrawler: http://www.metacrawler.com

Scrub the Web: http://scrubtheweb.com

Yahoo Kids: http://kids.yahoo.com

Before You Start: A Checklist for Student Project Success

Projects offer you the chance to learn on your own and become an expert in a subject that interests you. Projects also require careful organization and steady work in order to complete them successfully, without last-minute scrambling. Consider the tips below to help you stay on track and produce high-quality products, presentations, and performances.

Directions: When you complete one of the tasks listed, place a **check mark** next to it, but only if you feel you've completed that task to the best of your ability.

ORGANIZATION AND STUDY SKILLS

Do you understand the project and what you have to do to be successful?

- Make sure you understand the assignment and all the pieces that are due as a part of the assignment.

Have you completed a long-term plan for completion of all the parts to your assignment?

- If you have a long-term assignment, make a plan for completing each part. Ask your teacher to help you think of all the parts to complete. For example,
  - Complete the research by _____ date.
  - Take notes by _____ date.
  - Write your first draft by _____ date, etc.
  - Keep track of the parts you complete to track your progress. Plan to complete the entire assignment early.

Do you have a clear picture of your due dates?

- Write down due dates for all short-term or long-term assignments. Review these dates often to make sure you stay on track.

Does your plan include work every night?

- Work a little bit on your project every single night; if you skip a night it will just mean more for next time.

Do you have partners or friends to help you stay on track throughout the project?

- Choose your study buddies and partners for projects carefully – remember the goal is to be responsible for your learning and to succeed.

Have you gathered the supplies that you need?

- Make sure you have the materials you need for any projects that are due (special papers, presentation boards, covers, etc.).

INVESTIGATION SKILLS

Have you found a topic that you really want to learn about?

- Find a topic or research question that interests you. Look for the connections to your own life.

Do you know the steps to follow to investigate your topic?

- Follow a research process and complete each step carefully before moving on to the next step (for example, be sure you have a good topic or research question before you spend a lot of time looking for information).

Do you have an organized way to keep track of your work as you complete each part of the investigation?

- Carefully document your work throughout the process so that you don't waste time trying to find or remember what you already did. For example, write down as you go along:
  - Your topic and questions
  - The key words and search strategy that seem to be the most successful
  - Full bibliographic information on every source you use
  - Notes organized by source or by question/subtopic
  - Outline or graphic organizer of the way you plan to present your information
  - Rough draft
  - Revised final draft.

Do you know what a good final product / presentation / performance looks like? Have you looked at the rubric?

- Take care with the presentation of your final work. Even the best information and thinking are less successful if they are presented in a sloppy or disorganized manner.

Have you given yourself time to practice your final presentation or performance?

- If you are making an oral presentation of your project, practice out loud several times before you have to present. Write reminders of your main points on index cards so that you can easily refer to them during your presentation. Relax – remember, you're the expert on this project.

Preparing To Write Your Science Fair Project: Steps to Follow

Use this worksheet as a guide in writing up your project. Directions and suggestions are given in each section. Fill in the blanks in all the sections.

A. Title – Choose a brief title for your project. Titles are often "catchy", but do not have to be. (You may want to wait until you have completed your experiment before giving it a title.)

The title of my project is _____.

B. Question – What question are you trying to answer by doing your project? A statement and not just a "yes" or a "no" should answer your question. Your question should be fairly specific. A good way to form a question is: "How will changing _____ affect _____?"

Examples:
- How will changing *the color of light plants receive* affect *plant growth*?
- How will changing *the amount of baking soda in cupcakes* affect *cupcake height*?

Remember, you must have at least one variable (something that changes), and a control (something that stays the same).

My Question is_____.

C. Introduction – This section talks about why you chose this experiment, who helped you, and what special research did you do to learn more about this experiment. This section should be 3 or more sentences.

I chose this experiment because_____

I got help from_____

I learned more about_____

D. Hypothesis – This is a guess of **what** you think will happen and **why** it will happen based on your research on your variable. A good way to write a hypothesis is:

"I think that _____ because _____.

Examples:
- I think that *plants that receive white light will grow taller and fuller than plants that just get red or blue light* because *I read that plants need lots of sunlight for growth*.
- I think that *putting more baking soda in cupcakes will make cupcakes taller* because *baking soda produces gas that makes the cupcakes rise*.

My Hypothesis: I think that _____

because_____

_____

E. Materials – List all the materials you will use to perform the experiment. This is similar to the ingredient list of a recipe. More detail is better! Another person should be able to do your experiment based on your list of materials.

These are the items I need to perform my experiment are:

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

F. Procedure – Write a step-by-step guide for doing the experiment. This is similar to the instructions part of a recipe. The more detail the better. Another person should be able to do your experiment based on the instructions in your procedure. You should repeat your experiment 2 or more times to see if you get the same results.

The steps to doing my experiment are:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

Feel free to add more steps if you need to. You may include photographs or drawings of the items in your experiment on your display board.

G. Results – Record the results of your experiment. Make a chart or a graph to make it easier for a person to see what you observed during your experiment. Write a paragraph that talks about the results in your charts and/or graphs. Remember to do your experiment more than once. On your display board, you may include photographs or drawings of the results of your experiment. It may be helpful to show "before" and "after" pictures in some cases.

Chart of Results from Trial 1

Chart of Results from Trial 2

Chart of Results from Trial 3

Feel free to do more trials and chart the results.

Are your results consistent? If yes, what is the trend?

Example:

• *When the plants with under the white light grew taller than the plants under the red or blue light*

• *The more baking soda I used, the taller the cupcake.*

If there is no trend, say that your results do not show any trend.

Example:

• *My results were inconclusive because two of the three plants with the white light grew taller than the plants with the red and blue light. But one of the plants with the red light was taller than all the plants with the white light. Also, a couple of the plants with the blue light were taller than the red light plants, but shorter than the white light plants.*

• *The heights of the cupcakes did not vary consistently with the amount of the baking soda used.*

My results show

_____

_____

_____

_____

_____

_____

H. Conclusion – What did you learn from the experiment? Tell whether your results show that your hypothesis was right or wrong. How do your results show that your hypothesis was right or wrong? If your hypothesis was wrong, why do you think you guessed wrong? Did anything go wrong when you did your experiment? What do you think you can change to make the experiment better? Who might benefit from what you have learned in your experiment?

My results show that my hypothesis was

_____

because_____

_____

_____

_____

_____

To make this experiment better, I can

_____

_____

_____

The people who may benefit from what I have learned in this experiment are

_____

because_____

_____

Staying on Track: A Self-Assessment Checklist

Your Name _____ Class_____

Directions: When you complete one of the tasks listed, place a **check mark** next to it, but only if you feel you've completed that task to the best of your ability.

SECTION 1 - Science Understanding

- o I used topics and ideas that we discussed in class or on field trips to come up with a question that I could investigate.
- o I explained my observations and my results by using science concepts, terms and ideas.
- o I used more than one way of explaining my ideas – like words, pictures, diagrams, charts or graphs.
- o I was able to make connections between what I learned from the project and other areas of science.

SECTION 2 - Scientific Process

- o I identified a problem and asked a question that I could investigate. (It was not a "yes or no" question.)
- o I made a hypothesis that I could test. I did not already know for sure what the answer to my hypothesis would be. I also know that my hypothesis does not have to be supported by the data, because in science we can learn both when we get results we expect or when we get results we do not expect.
- o I designed a plan and method to collect data to test my hypothesis.
- o I conducted my research carefully and with scientific accuracy.
- o I collected, recorded and organized data from my work.
- o I made graphs, charts, tables or artwork that represent my data
- o I made a conclusion that says whether my hypothesis was supported or not supported (either one is proper) based upon my data, that explains my observations and why things came out the way they did.

- I explained what I would do differently next time and I discussed any possible sources of error in my project.

- I looked back at my work and explained what I might have changed to make the project even better.

- *"If I were to do the project all over again, here is what I'd do differently this time....."*

SECTION 3 - The Written Report

- I used at least 3 different sources to collect my background research information, which I have written down in my bibliography.

- The report is written in a manner that makes sense. I made sure my report has:
  - an abstract
  - an introduction which includes the purpose and the reason why I chose this topic
  - an hypothesis
  - a materials and methods section
  - my actual data and an analysis/explanation of the data
  - a conclusion that refers back to my hypothesis with a discussion of my results
  - a reflection on the quality of my entire project
  - a glossary of terms
  - a bibliography
  - any attachments (Appendices/Addenda)

- I compared concepts and showed the reader that I understood MORE THAN just what I researched about. I compared it to other things not in my research (...*"**this**" is similar to the idea of* "that").

- I supported my ideas with examples, definitions and references back to other sources of information.

- I gave credit for anything that I did not learn by myself. If I didn't learn it from actually doing this project, then I showed where I got the information.

- I used graphics, charts or artwork to enhance my report.

- I have checked for grammar, spelling, punctuation and sentence structure. I have not included any street talk, slang, or text message abbreviations in my report.

SECTION 4 - The Oral Presentation

- I organized my presentation in a way that people can understand. I know that not everyone listening to the presentation is as much an expert on my topic as I have become.

- I used notes, index cards, or computer slideshows to make sure I followed my presentation in the correct manner and that I am giving accurate data. I did ***NOT*** read directly from my report, and I made eye contact with the audience.

- I gave examples, definitions and direct references and quotes to support my ideas.

- I was able to answer questions about my topic: ***I am the expert!***

- My audience was able to understand my concept.

- I used proper grammar and sentence structure. I did not use any "street talk" or "slang". I spoke slowly, loudly and clearly, so that I could be understood.

- I used some visual display such as: slideshows, tri-fold board, movie or other multimedia to make my presentation more interesting.