Science Fair Handbook

Wilmette Junior High School

Mr. Ron Sheade, Coordinator

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DUE DATES FOR EXPERIMENT AND BACKROUND RESEARCH PAPER*

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***EXTENTIONS MAY BE GRANTED AFTER A DISCUSSION WITH YOUR SCINCE FAIR COORDINATING TEACHER**

FREQUENTLY ASKED QUESTIONS

How do I get an Idea?

Listen to commericals. They will provide you with countless consumer science projects. Is Tide really the best detergent for your clothes? What's the secret to Secret's drying ability? Why do some people prefer Coke? Can they really tell the difference? Use these commercials for
ideas. For example, does the Energizer bunny really last longer? Design and perform an experiment to answer the question.

Technology is by definition applying science to solve problems in our daily lives. Can you come up with a way to solve a problem you have? Can you provide data to prove that your new method is better than an old established way? Design and perform an experiment to prove it.

Brainstorming is a technique that can generate lots of ideas. Try it with agroup.

What is NOT a science project?

Science projects are NOT science demonstrations. Mixing vinegar and baking soda together to cause a reaction of volcanic proportions is the classic demonstration. No new information is discovered. Other popular science demonstrations include showing how to identify chemicals with a flame test, ow clouds form, how electricity is conducted, etc. IF you can identify a dependent and independent variable to change your demonstration into an experiment, you can collect and display data. THEN you have an experiment. Stay away from the "vocano ideas". It is important for the project to be original and for the experiment to be purposeful .

Students should participate in an experiment where they can make an educated guess ahead of time as to how they think their experiment will turn out. It is okay if they find out later they were hypothesizing incorrectly. If something unexpected occurs during an experiment, the project doesn't need to be dumped; it's all right in an experiment for the hypothesis to be proven invalid. In a demonstration, there are no variables, no data collection, and, therefore NO science project.

What Makes a Good Project?

As kids and parents think about Science Fair projects, they sometimes wonder how to pick a topic - not how to find an idea, but how to decide if the ideais a good one. Here are some thoughts:

1. **You are interested in the topic - it's something you like to think about.**

2. **You can do a test to find an answer to a question.**

A good Science Fair project is an experiment - that means it's a test to find an answer to a question you have. For example, if you are interested in bugs and you saw some ants moving real slowly once on a cold day, you might test to see what effect temperature has on the rate at which bugs move. You'd get some bugs, find a way to make their container a little colder than normal and measure how fast they moved somehow. Then you'd make their container a little warmer than normal and measure what happened then.
Don't do demonstrations or simple reports - those don't use the scientific method. They are just showing what you know about something. For example, a diagram or model of something with no test/experiment.

3. **You can do it with only a little help from parents, teachers and friends.**

The reason to do a project is because it's fun and you will learn something you didn't know before. Having someone else help too much takes away some of your fun and you don't learn as much. Your project doesn't have to be perfect, just neat and following the scientific method. Don't be afraid to ask for help if you really need it.

4. **It doesn't hurt or scare people or animals, including you.**

It's not only a bad idea, it is also against the rules of our science fair and of the regional science fair to hurt or badly scare people or animals as part of an experiment. You also may not use dangerous materials in your project except in very special situations when you get permission from the coordinators. Ask advice about this from your parents and teacher.

5. **It's a project that, even when you are done with it, makes you think of new things you want to know.**

One way to tell if you have a good project is to see if the results make you wonder about other things. Did doing the project, or reading or seeing what happened make you think of other questions you are curious about? That's a great project!

What is the "Purpose of Parents"?

As a parent, you may ask yourself," How can I help my child complete a commendable science project?"

For parents, science projects are often just another intrusion into an already too hectic life. Even the simplest project consumes considerable amounts of precious free time.

Science projects, however, are one of those school assignment where parent assistance is not only allowed, but encouraged (maybe even expected). You feel obligated to help, if only to demonstrate your dedication to your child's education.

And you probably wouldn't mind, if you saw clear-cut objectives. "What, specifically, is my child specifically expected to achieve?" Instead of answering these questions, what scant instructions that are provided are usually murky and difficult to read. The Twin Groves Science Fair website provides detailed answers to your questions. If you can't find the answer
you're looking for, call your child's science teacher directly.

Of course, parent-assisted projects often become parent-dominated projects. It's really annoying to attend the science fair and discover that some of the projects

on display are at times obviously NOT the work of a school-age child. Instead, the fair has become a competition among parents. And, after
all your hard work, you don't win!

Most parents figure out quickly what they need to do to help their child complete a successful project. The project may not rival those achieved by an overabundance of parental assistance, but it will attain its purpose.

PLEASE do help your child, but let him/her do all the work. Many times, as a parent, you will be pleasantly surprised at the quality and quantity of work your child can produce with a lot of encouragement and support from you.

Why do a science project?

Almost daily we hear on the news that a favorite snack is discovered to be "cancer-causing", or a disliked vegetable is found to be "cancer-fighting."

Scientists make these revelations as a result of often lengthy and tedious experimentation. A scientific fact today, becomes a contradiction tomorrow. Scientific research is an ongoing process. Even the simplest experiment can evolve into a complex data collection process, and the experiment's validity and the scientist's integrity are always questioned. As a result, scientific facts are often altered in the light of new evidence and new techniques that can be used to collect and observe data.

Although a student's science project is going to be far simpler than a scientist's, it still follows the same basic process, called the scientific method. This step-by-step procedure consists of:

* Writing a research question
* Researching the topic
* Writing a hypothesis
* Developing an experimental procedure
* Collecting and stating results
* Forming valid conclusions.

Properly done, science projects provide a rare opportunity for students to combine a number of academic skills to produce a quality project. It is a way for students to learn more about a topic of interest and become "experts". In the process, they develop many critical thinking skills and science skills that will cross over and help them in future educational pursuits. It is a way to make learning FUN by pursuing something the students pick!

What is the Experimental Scientific Method?

Not all questions can be dealt with by the experimental scientific method. You must choose a question or problem that can be formulated in terms of hypothesis that can be tested. Tests done to check hypothesis are called experiments. To design a suitable experiment you must make an educated guess about the things that affect the system you want to investigate. These are called variables. This requires thought, information gathering, and a study of the available facts relating to your problem. As you do experiments, you will record data that measures the effect of variables. Using this data you can calculate results. Results are presented in the form of tables or graphs. These results will show you trends related to how the variables affect the system you are working with. Based on these trends, you can draw conclusions about the hypothesis you originally made.

What Is Experimental Science?

Experimental science is actually the search for cause and effect relationships in nature. A hypothesis is your best guess at what this cause and effect relationship is. Your conclusions will allow you to predict the result of future cause and effect relationships. If you can do this, you can harness effects to do things. Technology is the area that applies the findings of the sciences to produce machines, or do things for us.

Can I Trust My Results?

If you did not observe anything different than what happened with your control, the variable you changed may not affect the system you are investigating. If you

did not observe a consistent, reproducible trend in your series of experimental runs there may be experimental errors affecting
your results. The first thing to check is how you are making your measurements. Is the measurement method questionable or unreliable? Maybe you are reading a scale incorrectly, or maybe the measuring instrument isworking erratically.

If you determine that experimental errors are influencing your results, carefully rethink the design of your experiments. Review each step of the procedure to find sources of potential errors. If possible, have a scientist review the procedure with you. Sometimes the designer of an experiment can miss the obvious.

What If My Science Project Doesn't Work?

No matter what happens, you will learn something. Science is not only about getting "the answer." Even if your experiments don't answer your questions, they will provide ideas that can be used to design other experiments. Knowing that something didn't work, is actually knowing quite a lot. Unsuccessful experiments are an important step in finding an answer. Scientists who study extremely complex problems can spend a lifetime and not find "the answer." Even so, their results are valuable. Eventually, someone will use their work to find the answer. Are you that person?

CHOOSING A TOPIC

*** Choose a topic you like and are interested in learning more about.**
*** Choose a topic your parents and teacher will approve.**
*** Narrow down the topic to a single aspect.**
*** Plan your time wisely to allow for completion.**
*** Have teacher approval of entire project BEFORE starting.**
*** Make arrangements with parent and teacher for all needed materials.**

CATEGORIES

Students must design an experiment to investigate a question or problem. A project based solely on library research is not an acceptable project. The following guidelines should give you an indication of what type of experimentation can be done within each category and help to place a given project in the proper category for judging. Note that a model or demonstration is not an acceptable project.

AEROSPACE SCIENCE is the science of the study and investigation of the earth's atmosphere and outer space. In the wide sense, it would include the design, manufacture and operation of aircraft. Some topics that fall within this division are: the operation of rockets, guided missiles, anything related to space travel, operation and/or construction of satellites, observations of air flow patterns within tunnels, and the use of navigational equipment.

ASTRONOMY is the science dealing with all of the celestial bodies in the universe, including the planets and their satellites, comets and meteors, the stars and interstellar matter, the star systems known as galaxies, and clusters of galaxies. Modern astronomy is divided into several branches:, astrometry, the observational study of the position and motions of these bodies; celestial mechanics, the mathematical study of their chemical composition and physical condition from spectrum analysis and the laws of physics; and cosmology, the study of the universe as a whole.

BEHAVIORAL SCIENCE is the science that studies the demeanor or deportment of humans and other animals by means of observable response and the interpretation of the same as offered by the social sciences, sociology, psychology, etc. Some topics that fall within this division are: the effect of stimuli on organisms and their responses, learning, motivation, emotion, perception, thinking,
individuality, personality, and adjustment.

BIOCHEMISTRY is the branch of chemistry relating to the processes and physical properties of living organisms. Topics that fall within the biochemistry division are: the properties and reaction of carbohydrates, lipids, proteins, enzymes, blood, urine, vitamins, hormones, poisons, and drugs. The chemistry of absorption, digestion, metabolism, respiration, and photosynthesis as organic processes also belong in this category.

BOTANY is the division of biology that deals with plant structure, reproduction, physiology, growth, classification, and disease. Some topics included in this category are: specialization in plants, functions of various plant structures, reproduction, and heredity.

CHEMISTRY is the science that deals with the structure, composition and properties of substances and of their transformations. Some topics included in this category are: the composition of various compounds, the formulation of various compounds, the study of gas laws, atomic theory, ionization theory, and the analysis of organic and inorganic products.

COMPUTER SCIENCE includes the study and development of computer hardware, software engineering, Internet networking and communications, graphics (including human interface), simulations/virtual reality or computational science (including data structures, encryption, coding and information theory). Topics in this category may include: writing an original program and comparing it to an existing one, developing a new language and comparing it to an existing one, etc.

CONSUMER SCIENCE is the study of comparisons and evaluations of manufactured or commercial products. Topics included in this category are: taste tests, color preferences, quality control, and product efficiency.

EARTH SCIENCE is the science concerned with the origin, structure, composition and other physical features of the earth. Some topics that fall within this division are: geology (earth composition, rock formation, fossils, minerals, and fossil fuel); geography (land forms, soils, classification of streams, erosion, and sedimentation); oceanography (ocean waves, ocean currents, composition of ocean water and coastal zone management); seismology; geophysics; and meteorology.

ELECTRONICS is the branch of engineering and technology that deals with the manufacture of devices such as radios, television sets and computers that contain electron tubes, transistors, chips, or related components. Topics in this category are: circuits (electrical, electric digital and analog) for communication such as radio, radar, laser, transistor, television and integrated circuits; electricity; electric motors; solar cells and amplifiers.

ENGINEERING is concerned with the practical application of scientific knowledge in the design, construction and operation of roads, bridges, harbors, buildings, machinery, lighting, heating, and communication systems. Some topics in this category are: stress testing of building materials, strength composition of building materials, collection of data from operating systems to compare and contrast their effectiveness.

ENVIRONMENTAL SCIENCE is the study of the protection and care of natural resources. Topics included in this category are: solar energy and its uses, water purification and usage, pollution control, soil chemistry, and insecticides. Within this area is ecology which is the study of ecological systems, and ecological population studies.

HEALTH SCIENCE is that science concerned with the study of the human body and good health practices. Topics to be found under this category are: proper diet, care of the teeth, care of the eyes, and hygiene.

MATERIALS SCIENCE is the study of materials, nonmetallic as well as metallic, and how they can be adapted and fabricated to meet the needs of modern technology. Using the laboratory techniques and research tools of physics, chemistry, and metallurgy, science is finding new ways of using plastics, ceramics, and other nonmetals in applications formerly reserved for metals.

MATHEMATICS is the science dealing with the measurement, properties, and relationships of quantities as expressed in numbers or symbols whether in the abstract or in their practical connections. Some topics included under mathematics are: arithmetic (use of numbers, symbols, and numerical systems); algebra (probability, theory of equations, progressions, permutations and combinations); geometry (topology, study of geometric figures, similar figures, and scale drawings); calculus; trigonometry and graphing.

MICROBIOLOGY is the branch of biology concerned with the study of microorganisms. Topics to be found in this category are: the structure and physiology of bacteria, viruses, yeasts, fungi, and protozoa and studies involving cells or tissues in cultures.

PHYSICS is the science that deals with the laws governing motion, matter and energy under conditions susceptible to precise observation as distinct from chemistry or sciences dealing with living matter. Topics found in the category of physics are: hydrostatic force and pressure, gravity, Newton's Laws, relativity, kinetic theory, motion forces, work, energy, sound, light, and magnetism.

ZOOLOGY is the science that deals with animals with reference to their structure, functions,
development, evolution, and classification. Some topics that fall within this category are: structural and functional studies of vertebrates and invertebrates, physiology, reproduction, heredity, and embryology.

Science Fair Ideas
How to Find a Good Idea

Ways to find a science fair project idea

* Look at lists of science categories and pick one that you are interested in, then narrow that down to a project. (example, say you pick psychology, then narrow it to the differences between boys and girls, then to a topic like "Do boys remember boy-type pictures (footballs) better than girl-type pictures (flowers)?" (Two lists of categories attached)
* Use your experiences Remember a time you noticed something and thought "I wonder how that works?" or "I wonder what would happen if..." then turn that into a project. Check the science section of the school library. Browse and look at book titles, then look inside the ones that look interesting to you. Also thumb through encyclopedias and magazines. Good magazines for ideas are: National Geographic, Discover, Omni, Popular Science, Popular Mechanics, Mother Earth News, High Technology, Prevention, and Garbage. Perhaps go to the downtown Library.
* Think about current events. Look at the newspaper. People are hungry in Africa because of droughts - a project on growing plantswithout much rain, which types grow ok with little water? Or the ozone hole over Antartica - how can we reduce ozone? -a project on nonaerosol ways to spray things. Or oil spills. how can we clean them up? -a project on how to clean oil out of water
* Watch commercials on TV. Test their claims. Does that anti-perspirant really stop wetness better than other ones? What are the real differences between Barbie and imitation Barbie dolls? Can kids tell the difference between coke and pepsi if they don't know which they are drinking?

More Ideas:

Take these ideas and add something of your own, for example, change Are dogs colorblind? to Are cats colorblind? Or look at another of the 5 senses of dogs and test their sense of taste...

* What material is the best insulator
* Are dogs colorblind
* Do soap bubbles last longer on warm or cold days
* Are hot air balloons different from blimps
* What is the best method, other than heat, to melt ice
* What effect does oil have on water plants
* What would happen to the weather if the Earth was a cube
* Do goldfish chemicals they sell you really help the fish adapt to the new aquarium
* How can a tomato plant be grafted to a potato plant How is sound obtained from a compact disk
* How does a nuclear reactor work, how does it look
* How is 2-yr old talk different from ours
* How does burning gasoline make a car move

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2. You can do a test to find an answer to a question.

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NARROW YOUR TOPIC

1. List the relationships that are found within the topic area.

For example, in the area of plants there are relationships between plants and water, plants and sunlight, plants and fertilizer, and plants and temperature. all of these relationships are testable because one affects the other.

2. After you have established a relationship for the topic, ask a question about the relationship. The question should point out a cause and effect which could lead to the purpose of your experiment.

For example, if the relationship between plants and fertilizers is chosen, this question could be asked, "Will fertilizer "x" or "y" cause petunias to grow taller"

3. Your research should include information about: fertilizers ,in general ; fertilizers "x" and "y"; plant growth; and petunia growth.

4. Here is a sample chart of topics, topic relationships, and question:

TOPIC	**TOPIC RELATIONSHIPS**	**QUESTIONS**
Plants	Plants and soil	Will humus, sand or clay cause a tomato plant to grow taller?
Weather	Weather temperature and insulators	Will insulation cause the melting point rate of an ice cube to slow down?
Friction	Friction and rolling	Can surface texture cause a change in my skate board speed?

An Overview of a Research Paper

I. **Pick a topic** (see "CHOOSING A TOPIC")

II. **Research topic**

A. Make a source card for each source used

1. Follow the exact punctuation, indentation, and format shown in "Format for Reference List" in IJAS Handbook
2. Number each source card in upper right hand corner
3. To create the Reference List for your research paper, alphabetize the cards according to the first letter of each entry.

B. Take notes on new note cards

1. Use a different card for each topic
2. Title each card by the idea or topic
3. Use only one topic or idea per card
4. Use same number on note card to match with appropriate source card

C. Do "A" and "B" for all sources

III. **Make an outline**

A. Sort the note cards by idea or topic as noted by the different titles to create individual piles of cards with similar pieces of information

B. Construct a written outline from the piles of notes

V. **Write the paper** (use a word processor and save it on a disk)

A. Rough draft

B. Final copy

STARTING THE BACKGROUND RESEARCH PAPER

This paper is a **Review of the Literature** on your topic. Your experiment will be based on the information you find. The information in this paper should include an explanation of the concepts to be investigated, possibly some history, a discussion if past experiments of others,etc. The information may be paraphrased and/or in direct quotes. A variety of both is best. Remember, all information needs to be cited following the as described in the "**Format for Reference List** " section of this booklet.

You may find your information at your local library, university or research library. While the internet may be a source of information, do not forget to check internet sources such as The guide to *Periodical Literature, Applied Science and Technology Index, and Ask Eric.* Speaking and writing to experts and companies are good ides too.

Record the information on note cards labeled at the top with category information. This will help you organize all your gathered information when you are ready to write your paper. **Be sure to follow every paraphrase or direct quote with the proper citation on every note card.**

HOW TO MAKE SOURCE CARDS

Source Cards are index cards upon which **only the format about the source is written.** You may do this on your computer and staple the information for each source onto a card.

Format for source cards is as follows:

1. You need a source card for every source you use.

2. You need a minimum of 5 sources .

3. Write the information on the source card in the same format as you find it in for tthat source on the "**Format for Reference List**".

4. To create the **Reference List,** use the first word on each source card to alphabetize your list of sources.

5. Only one Encyclopedia may be used as a source.

6. When you are writing your paper and you discover you will not be using a source, discard the source card.

7. Turn the source cards in for evaluation by the deadline.

Examples:

<u>Book</u>

Bernstein,T.M. (1998). <u>The careful botanist.</u> New York: Flower Publishing Co.

Magazine

Gamer,H. (1998,March) What do Babies tell you? Psychology Today. pp.70-78.

Interview

Ledeman, Leon. (1999;Jan.23). Chicago, Illinois. Illinois Institute of Technology

How to Make Notecards

How to make note cards:

Keep these points in mind when taking notes on note cards:

* Use only one idea per card
* Give each card a specific topic heading or title
* All information researched should relate to the topic or idea
* Accuracy is crucial, especially with quotes and statistics
* Place the source # at the top right hand corner, identifying the source's informational card that provides the bibliographic information needed to create the Reference List.
* Identify direct quotes with quotation marks around the phrases or sentences extracted from the source word for word. In the lower right hand corner of the note card, write the page number(s) where the quote was located in the source.

Format for note card:

Source #

Title of Card (specific topic or idea)
Take notes from source here - be sure to identify direct quotes with appropriate quotation marks and page number identified inlower right hand corner of card.

page number(s)

Number of notecards needed :

The number of note cards needed to write a research paper is different for every student. If you cram a lot of information on one card, you will need fewer cards to accomplish the task. The idea is to research all aspects of your topic thoroughly, taking organized notes on note cards. After you have gathered all your information, you will sort your cards by specific titles and arrange them into a logical format. This will become the outline to use in writing the research paper. In past years, students who had between 60 and 100 note cards were able to construct an excellent research paper of 4 to 6 pages in length (typed and double spaced).

How to Take Notes From the Computer

When you are working within a program on the computer such as the internet,or a CD ROM disk, you can easily take notes using the program SimpleText. SimpleText is a simple wordprocessor that is installed on all the computers at WJHS and is accessed through the Apple Menu.

We will use working on the internet as an example of how to use SimpleText to take notes.

1) First open the program you are going to work with, in this case Netscape.

2) Pull down the the Apple Menu and select SimpleText.

3) Drag the lower right corner of the SimpleText screen so that it is shorter and wider than the Netscape screen. This allows you to view sections of both program screens at the same time. You can now easily go between the programs by simply clicking on an exposed section of the program screen you want to be in.

4) While in SimpleText, pull down the File Menu and select Save to save your notes file to your disk. Title the file with the date and subject you are working on.

5) As you are exploring sites on the web and come to a site that you want information from, you can use SimpleText to save important reference information for you "Works Cited" section and notes for your project. First highlight the location bar of Netscape which contains the URL. Copy the URL. Then click on the exposed section of SimpleText. Pull down the Edit Menu and select Paste. Hit the Return key to get the cursor to the next line, ready for the next information you want to include.

6) Click on the exposed section of the Netscape screen to go back to the internet. Highlight and copy the title of the site you are on.

7) Click on the exposed section of SimpleText to go back to your notes and paste the title of the site there. Remember to hit the Return key to get your cursor on the next line. Type the date and hit return. You now have the reference information you will need for your Works Cited section - The URL, the Title of the Site, and the Date you accessed the site. Now would be a good time to save your notes file - you never know when your computer will freeze up!

8) Now click back and forth between your SimpleText notes and Netscape to copy sections, take notes, etc. of the information you need for your project.

9) Then you are ready to continue searching on the net for further information to include in your project and take notes from. When you are finished you have your notes saved to disk and you can print them out.

HOW TO MAKE AN OUTLINE

An outline is a tool to help put your information in an order that will make the ideas flow from one to another. It will help you to write a paper that makes sense of all your information. This outline does not have to be written in a formal manner.

Steps to preparing the outline:

1. Sort your note cards into the catagories noted at the top of the card.
2. Look through the note cards in each catagory and put the information into an order that makes the ideas flow from one card to the next.
3. You should now have several piles of note cards, each in a specific catagory with good information.
-- after sotring the cards in this manner , see if you have enough information in each catagory. If not, do more research in that catagory.
-- If you find the information on a note card is not relavent, throw the note card away.
4. Decide the order that the catagories will follow in your research paper. Put the notcardstogether in that order.
5. Type your outline and turn it in, along with your not cards, by the due date.

Helpful Hints:

1. Title the outline - write the title of your paper at the top of the page
2. Follow the sample outline format below for numbering and letering. Main ideas are the chief points - label them I, II, III, etc. Each main topic must include at least two subtopics.
3. Subtopics for each main topic are labeled A, B, C, etc.
4. Details are labeled 1, 2, 3, etc.
5. Subdetails or examples are labeled a, b, c, etc.
6. Use a period after each division letter or number. Do not place periods after topics or subtopics not stated in the form of a sentence.
7. Begin the main topic, subtopic, and details with capital letters.

8. Maintain a parallel structure throughout the outline; if you start with phrases, do not switch to sentences.

9.Indent as shown in the example below. you should be able to draw a line through all the period safter roman numerals , another through all periods after capital letters,etc.

Example:

I. Introductory Paragraph (Do not Write at this time)

II. Catagories of Information

- A. List 1st catagory
    - 1. main idea of 1st card
    - 2. main idea of 2nd card
    - 3. continue until all cards in this catagory are mentioned
- B. Continue for all catagories until all information is shown

III. Conclusion (Do not write at this time)

WRITING THE BACKGROUND RESEARCH PAPER

(REVIEW OF LITERATURE)

ROUGH DRAFT

Now that all your information is organized in a logical order, you are ready to write your paper. This paper is divided into 3 parts: an introductory paragraph, a body of many paragraphs that discuss your categories, and a concluding paragraph. always remember to write in third person. Your experiment is not discussed in this section.

1. INTRODUCTORY PARAGRAPH

This introduction to your paper should include what the reader will learn about your topic. Be sure to identify all of the categories that will be included. *do not forget to begin with an interesting or catchy sentence* that will get the readers attention.

2. BODY OF PAPER

Begin this part with a paragraph that introduces your first category. Use the information from your note cards in the same order they appear in your outline for that category.Certain categories may need more than one paragraph.

*Always place a citation after a paraphrase or direct quote to indicate where the information was found.*Continue organizing the information from all your categories in the manner described above, until all your categories have been discussed.

3. CONCLUDING PARAGRAPH

After all your information is included, write your concluding paragraph. Summarize what was said in the body of your paper, then add some new thoughts of your own. *End this paragraph with a thought provoking last sentence*

NOTES:

* **Use Helvetica or Times font and 12 point**

***Turn the Rough Draft by the due date and include the following:**

1. **Title page (The title should be no more than 25 letters and spaces ; include your name)**

2. **Background research paper**

3. **Alphabetized Reference List**

How to Cite the Literature

DOCUMENTING SOURCES

The **Review of the Literature** is a research paper that reports to the teacher background information and/or work done in the past that pertains to a student's project. The references used to document the research paper must be properly cited within the body of the research paper AND listed correctlyin the section entitled, **"Reference List".** Directions and examples of how to cite electronic resources for your science fair paper are provided in the sections entitled, **"Format for Reference List ".**

Students are expected to document the words and ideas they borrow from other sources using the citation style from the Publication Manual of the American Psychological Association (APA) Fourth Edition. Traditional footnotes are not to be used for citing references.

For example, if a student uses the exact words or a specific piece of information from a book, the student must tell the teacher (or reader of the research paper) where the information is from. This is done through the use of parenthetical ( ) references in the body of the paper. The purpose of aparenthetical expression is to document a source briefly, clearly, and accuratel

1. If a source has an author, cite using the author's last name, the copyright date of the source, and page number(s) in parentheses.

A <u>direct quote</u> in the text should be in the form:

-as Doe (1991) demonstrated..
.-as has been demonstrated (Doe,1991).

Example:

One historian argues that thetelephone (and certainly the advertising that lauded its innovations) created "a new habit of mind - habit of tenseness and alertness, of demanding and expecting immediate results"(Brooks, 1994, p. 118-19).

A paraphrasing of the text should be in the form:

- as Doe (1991) demonstrated...
- as has been demonstrated (Doe,1991).

Page numbers are not necessary when paraphrasing an author's thoughts or ideas.

2. If a source has no author, cite using a shortened version of the title or the entire title (if short) as it is listed in the Reference List. Be sure to underline book titles and put quotes around magazine articles.

Example:

-as has been shown (Plant Growth,1989).

REFERENCE LISTS

The **Reference List** is a list of published articles, books, and other communications actually cited (referred to with a parenthetical expression) in the **Review of Literature** (background research paper). Sources should current (not old). the Reference List section is arranged alphabetically according to the author / editor's last name when it is known, or the first significant word in the title if the author is not known. See format examples in the **"Format for Reference List"** section.

A **Source Card** should be made for each book that is utilized for research notes. It should include a source # in the upper right hand corner of the note card, author/editor when available, publication date, title if book, name of publishing company, city/state of publication, and page number(s) for direct quotes. See format examples for other types of sources. For instance, if the resource is a computer program, the source card should include a source #, author,copyright date,city/state of publication, and publishing company name. Also see the "**How to Make Source Card**" section.

Format for Reference List

The correct style to use for citing references in the ***Reference List*** *section is discussed in detail in the Publication Manual of the American Psychological Association, Fourth Edition or later. The* ***Reference List*** *should be alphabetized according to the first letter of each entry. Be careful to follow the exact punctuation, indentation, and format shown below.* *Although the five-space indent style of citing is the suggested format, the hanging paragraph format is acceptable.*

BOOKS

The author's name is listed first. The author's name is followed by the date of publication, in parentheses, ended with a period. Next include the book title which should be underlined or in italics. Capitalize only the first word of the title (and the first word of the subtitle, if any) and any proper names. Include any additional information necessary for retrieving the book (such as "3rd ed." or "Vol.4") in parentheses, immediately after the title. Close with a final period. End with publication information. Identify the city and, if the city is not well known or could be confused with another city, include the state where the publisher is located. State names should be referred to by two-letter abbreviations in all caps (e.g. IL, VA, MD). Place a colon (:) after the city name. Then identify the name of the publisher, clearly and briefly. Spell out the names of associations and university presses, but omit superfluous terms such as "Publishers," "Co.," or "Inc." If two or more locations are given, give the location listed first or the publisher's home office. Close with a period.

One author:

Arnheim, R. (1971). Art and visual perception. Berkeley, CA: University of California Press.

Multiple authors:

When a work has between two and six authors, cite all authors. When a work has more than six authors cite only the last name of the first author followed by "et al."

Festinger, L., Riecken, H., & Schachter, S. (1985). When prophecy fails. Minneapolis: University of Minnesota Press.

Roeder, K. et al. (1976). Nerve cells and insect behavior. Cambridge, MA: Harvard University Press.

Corporate author:

Institute of Financial Education. (1982). Managing personal funds. Chicago: Midwestern Publishing.

Edited volume:

Maher, B. A. (Ed.). (1972). Progress in experimental personality research. New York: Academic Press.

No author:

Experimental psychology. (1983). New York: Holt.

Work in an anthology:

Rubenstein, J. P. (1967). The effect of television violence on small children. In B.F. Kane (ed.), Television and Juvenile Psychological Development (pp. 112-134). New York: American Psychological Society.

ELECTRONIC SOURCES

World Wide Web, Home page/Secondary page:

Basic form

Author/editor (if known). (Revision or copyright date, if available).Title of page. [Publication medium]. Page publisher. Available: URL(Protocol:Site/Path/File) [Access date].

Examples

Nordstrom personal touch America. [Online]. Nordstrom, Inc. Available: http://www.npta.com/ [1996, Nov. 14].

Goizueta, R. C. (1996, February 26). Annual report to share owners. [Online]. Coca-Cola Company. Available:http://www.cocacola.com/co/chairman.html [1996, Nov. 14].

Encyclopedia article, Online

Basic form

Author/editor (if given). (Date). Title of material accessed. In Source (edition) (if given) [Publication medium]. Producer (optional). Available:URL (Protocol:Site/Path/File) [search term if necessary for retrieval] [Access date].

Example

Stock market crash of 1929. (1995). In Britannica Online [Online]. Encyclopedia Britannica. Available: http://www.eb.com ["stock market"] [1996, June 7].

Encyclopedia article, CD-ROM:

Basic form

Author/editor (if given). (Date). Title of material accessed. In Source(edition, release, or version, if relevant) Available: [Publication medium]. Location: Name of Producer.

Example

Genetic engineering. (1994). In Compton's Interactive Encyclopedia(Version 2.0) Available: [CD-ROM]. Carlsbad, CA: Compton's NewMedia, Inc.

Journal article, Online:

Basic form

Author. (Date). Title. Journal Title [Publication medium], volume (issue)(if given), paging. Available: URL (Protocol:Site/Path/File) [Access date].

Example

Koehn, D. (1995). The ethics of handwriting analysis in pre-employment screening. The Online Journal of Ethics [Online], 1:1, n. pag. Available: http://condor.depaul.edu/ethics/hand.html [1996, June 2].

Magazine article, Online:

Basic form

Author. (Date). Title. Magazine Title [Publication medium], volume (if given), paging. Name of computer service and/or database. Available: URL (Protocol:Site/Path/File) [Access date].

Example

Rosner, H. (1996, March 4). Will e-mail become j-mail? Brandweek [Online], 37, 30. ABI/INFORM. Available: telnet://melvyl.ucop.edu [1996, May 13].

Newspaper article, Online:

Basic form

Author. (Date). Title. Newspaper Title [Publication medium], paging.Available: URL (Protocol:Site/Path/File) [Access date].

Example

Markoff, J. (1996, June 5). Voluntary rules proposed to help insure privacy for Internet users. The New York Times [Online]. Available: http://www.nytimes.com/library/cyber/week/y05dat.html [1996, June 5].

Newsgroup article, Online:

Basic form

Author (if given). (Date). Article title. Newsgroup focus.Available: URL (Protocol:Topic.Subtopic[s]) [Access date].

Example

Japan sends confusing signal of U.S. chip dispute. (1996, June 3). News on world, Asia, and Japan business. Available:news:clari.world.asia.japan.biz [1996, June 5].

Personal electronic communication (E-mail):

Basic form

Sender (Sender's E-mail address). (Date). Subject of Message. E-mail to recipient (Recipient's E-mail address).

Example

Omar, B. W. (bomar@aol.com). (1996, June 5). Excellent Web Sites for Job Seekers.E-mail to M. E. Guffey (meguffey@rain.org).

JOURNALS

Articles in journals with continuous pagination:

Passons, W. (1976). Predictive validities of the ACT, SAT, and high school grades for first semester GPA ad freshman courses. Educational and Psychological Measurement, 27, pp. 1143-1144.

Articles in journals with non-continuous pagination:

Because pagination begins anew with each issue of the journal, it is necessary to include the issue number in parenthesis after the volume number. Note that *there is a comma between the issue number and the page numbers, but no comma between the underlined volume number and the issue number.*

Sawyer, J. (1996). Measurement and prediction, clinical and statistical. Psychological Bulletin, 66 (3), pp. 178-200.

Articles in monthly periodicals:

Chandler-Crisp, S. (1988, May). Aerobic writing: A writing practice model. Writing Lab Newsletter, pp. 9-11.

Articles in weekly periodicals:

Kauffmann, S. (1993, October 18). On films: Class consciousness. The New Republic, p. 30.

Newspaper article:

Monson, M. (1993, September 16). Urbana firm obstacle to office project. The Champaign-Urbana News-Gazette, pp. 1,8.

Newspaper article (no author):

Clinton puts 'human face' on health-care plan. (1993, September 16). TheNew York Times, p. 1.

<u>OTHER SOURCES</u>

Encyclopedias:

Photosynthesis and plants. (1987). Encyclopedia Americana (Volume 22). New York: Americana Corporation.

Films or videotapes:

Weir, P.B. (Producer), & Harrison, B.F. (Director). (1992). Levels of consciousness [Videotape]. Boston, MA: Filmways.

Interviews:

Archer, N. (1993). [Interview with Helen Burns, author of Sense and Perception]. Journal of Sensory Studies, 21, pp. 211-216.

Unpublished interviews do not need a reference page entry because they are what the Publication Manual of the APA calls “personal communications” and so “do not provide recoverable data.”

Archer, N. (1993, October 11). Personal interview.

Recordings:

McFerrin, Bobby (Vocalist). (1990). Medicine music [Cassette Recording]. Hollywood, CA: EMI-USA.

HINTS FOR WRITING A QUALITY RESEARCH PAPER

Desired Qualities of Scientific Writing

The following points should help you to write your paper in an acceptable scientific style:

a. When writing the first draft, do not start until you have clearly thought out our paper; only by chance will clear writing result from muddy thinking. The tone of the paper should be established as one of calmness and objectivity.

b. Learn to use the technical words that save space or that convey meaning better than common words; by all means avoid the use of vague terms. Sentences should also be short and simple. Do not ramble on and on in one sentence. Remember to beconcise.

c. The use of the 1st person "I" or "We" should be avoided where possible. Terms such as "The research experiment" or "The exhibitor" are examples of 3rd person usage. Third person is the preferred method for scientific writing. While scientific writing demands detachment and impartiality, "I", if the clarity and simplicity of the sentence are improved.

d. After you have written your first draft, reread, revise, and rewrite it. Put yourself in someone else's mental shoes and read it slowly and thoughtfully. Have you omitted any steps? Are the steps in the proper order? Do your sentences say what you want them to say? If possible, have someone else read it; if not, put it away for a few days and then reread it yourself. Your paper must be an accurate report of what you have done - check and recheck your calculations, references, spelling, and grammar.

Undesired Qualities of Scientific Writing

Many of the faults in scientific papers can be traced to editing failures - objective reading of the many drafts of your paper will reveal fallacies and other faults that can and should be eliminated from your final draft. Errors to avoid may include:

a. An illogical or unrelated grouping of facts.

b. An unjustified switch in point of view as indicated by a change of subject or voice.

c. The use of obscure and/or doubtful antecedents for pronouns.

d. The omission of vital facts or steps in procedures, interpretations, or conclusions.

e. The needless repetition of facts.

f. The imprecise use of words, the use of words in senses peculiar only to the author or a small group, or the use of words only for the sake of the use of words.

g. The inclusion of inaccurate or improper use of paraphrases or references.

h. The inclusion of only those data that are favorable to a desired conclusion and the exclusion of equally valuable data which are unfavorable to the conclusion.

i. The drawing of conclusions not warranted by the facts and data presented in the paper.

j. Inaccuracy in calculations, spelling, grammar, and quotations.

k. The lack of objectivity.

l. Omitting literature citations in the text of the Review of Literature.

Technical Points of Scientific Writing

In preparing the paper the author should be concerned with the following mechanics:

a. The paper must be typed, doubled spaced, and have at least one-inch margins. Use only one side of the page. The font style and size should be appropriate for a scientific paper. The paper must be neat and legible. There is no limit on the number of pages permitted in the project session portion of the exposition.

b. Type the last name of the author at the top of each page.

c. Tabular information should be kept to a minimum. Each table, chart, or drawing should not be more than one page in length and tabular data should not be duplicated in the text. Headings for tables and columns should be brief. Tables, charts, and drawings should be done on standard 8 1/2 x 11" paper.

d. Graphs should be suitably titled and have both axes correctly labeled. Do not forget to include the correct units of measurement for any numbers.

e. Photographs should be prints of good contrast and should be mounted with captions typed under them.

f. At the State Exposition you are required to have three (3) copies of your complete paper. Keep one copy and the other two copies should be available for collection by Judges or Illinois Junior Academy of Science officials. They may NOT be returned.

SAFETY GUIDELINES FOR EXPERIMENTATION

All project development and experimentation should be conducted only with proper supervision. Because many dangers may not be readily apparent, some guidelines are presented here to aid in making the development of a project more safe.
This is particularly true for chemicals, radiation sources, and biological cultures many of which are governed by many rules and regulations, both State and Federal, that affect both handling and disposal.

You are also required to review in detail the "Rules and Regulations "section of the IJAS Handbook

Biological Cultures

a. This area of science, as many areas of science, may involve many dangers and hazards while
experimenting. It is the sole responsibility of all teacher(s)/sponsor(s) to teach students proper safety
methods and sterile techniques.

b. The Illinois Junior Academy of Science prohibits the use of cultures taken directly or indirectly from humans or other warm blooded animals in any project because of the danger from unknown viruses or other disease causing agents that may be present. Pure cultures of microorganisms known to inhabit warm-blooded animals may be purchased from reputable supply houses and used.

c. Projects involving viruses should be done in a professional research facility under the direct supervision of a professional researcher.

d. Recombinant DNA projects should be done with the help of a research professional trained in
recombinant DNA methodology and should comply with the National Institutes of Health (NIH) Guidelines unless the project is limited to a kit obtained from a legitimate supply house.

e. All cultures should be destroyed by methods such as, autoclaving or with a suitable NaOCl (bleach) solution before disposal.

Chemical

a. Students should always wear eye protection when working with any chemical.

b. The student and the sponsor should seek data from a textbook, Merck Index, or other responsible source regarding the healh hazards, combustibility, and compatibility of the chemical with other chemicals before beginning a project.

c. All chemicals must be disposed of in accordance with State an Federal Environmental Rules and Regulations.

d. If possible, the student should work under the supervision of a responsible chemist.

Electrical and Mechanical

a. All electrical apparatus that operates with 115 volt current should be constructed in accordance with the National Electrical Code (NEC). If in doubt, contact a competent electrician.

b. Many experiments can be done using 6 or 12 volt electrical sources. As these are much safer electrical sources, their use should be considered when doing a project.

Fire and Radiation

a. Students should always wear eye protection when working with any open flame.

b. Students using radiation sources (laser, U-V light, X-ray, microwaves, or high intensity radio waves [RF]) must be adequately shielded from such sources. Many experiments using these sources should not be undertaken unless under the direct supervision of an adult familiar with the equipment and hazards involved.

c. No student may work with any radioactive materials unless the work is conducted in a licensed laboratory under the direct supervision of a licensed individual.

What is the Scientific Method?

There Are Different Forms of the Scientific Method

A confusing aspect of science is that not all fields of science arrive at conclusions in the same way. The physical sciences, like physics and chemistry, use experimental forms of the "scientific method." The physical sciences do experiments to gather numerical data from which relationships are derived, and conclusions are made. The more descriptive sciences, like zoology and anthropology, may use a form of the method that involves gathering of information by visual observation or interviewing. What is common among all sciences, however, is the making of hypothesis to explain observations, the gathering of data, and based on this data, the drawing of conclusions that confirm or deny the original hypothesis. The difference is in what is considered data, and how data is gathered and processed.

Data for a physical scientist is numbers. The numbers are often plotted on graphs. Graphs can be used to derive equations that can be used for making predictions. Data, for an anthropologist, could be a recorded interview. Interviews can be compared to other related information. Hence the distinction between the exact sciences (physical sciences that use numbers to measure and calculate results), and other sciences that use descriptions and inferences to arrive at results. If you are not aware of this difference, you could produce a written report for your science project.

Your project will then only show what you know about something instead of experimentally answering questions you have about observations you have made. The information given below assumes you are doing an experimental science project that uses the experimental method to gather data and test hypothesis.

What is the Experimental Scientific Method?

The steps listed below will help you systematically investigate observations that can be tested with the experimental method. Not all questions can be dealt with by the experimental scientific method. You must choose a question or problem that can be formulated in terms of hypothesis that can be tested. Tests done to check hypothesis are called experiments. To design a suitable experiment you must make an educated guess about the things that affect the system you want to investigate. These are called variables. This requires thought, information gathering, and a study of the available facts relating to your problem. As you do experiments, you will record data that measures the effect of variables. Using this data you can calculate results. Results are presented in the form of tables or graphs. These results will show you trends related to how the variables affect the system you are working with. Based on these trends, you can draw conclusions about the hypothesis you
originally made.

What Makes the Scientific Method Possible?

The existence of "cause and effect relationships" in nature is what makes experimental science possible. Hypothesis can only be verified using the scientific method described here if there is a cause and effect relationship between the variables you have chosen and the system you are studying.

What Is Experimental Science?

Experimental science is actually the search for cause and effect relationships in nature. A hypothesis is your best guess at what this cause and effect relationship is. Your conclusions will allow you to predict the result of future cause and effect relationships. If you can do this, you can harness effects to do things. Technology is the area that applies the findings of the sciences
to produce machines, or do things for us.

NOTE: The information contained on this page was written by David Morano, Assoc. Professor, Mankato State University, Minnesotta and was included with his permission.

Using the Scientific Method

*** Decide exactly what the question or problem is, and state it clearly in words.**

*** Study all the facts to see how they relate to the problem.**

*** Formulate various hypotheses.**

*** Design your experiment. Try to identify possible hazards and then find ways to run your experiment safely, please see the section on experimental safety. If you plan to use vertebrate animals, please see the section concerning the proper use of vertebrates.**

*** Conduct the experiment to gather data and make observations.**

(l) Select ways to measure, observe, and record what happens at each step of th experiment. Use of the metric system is necessary, whenever possible.

(2) Make sure to include a control group or a comparison group in your experiment.

*** Set deadlines for completion of various phases of your project.**

*** Don't abandon negative results: build, capitalize, and benefit by them.**

*** Don't get discouraged - work and repeat until you have reproducible results.**

MATERIALS AND PROCEDURES

Your *Materials* and *Procedure* sections of your report should be a simple chronological account of
how you carried out your experiment. The explanation of what was done should be clear and detailed enough so that the reader can duplicate the work. The apparatus and materials used should be listed. Explain the workings of any apparatus you constructed or used. Drawings, diagrams that are clearly labeled, and photographs are appropriate if they enhance and clarify your explanation . In addition take note of the following:

1. The procedure for your experiment is like a recipe - be precise, number each step and write a each direction on an new line.

2. Ask someone to read your procedure and see if they have any difficulty carrying out your experiment.

3. You should have data from at least 3 trials to average. be sure to measure your data using the metric system.

4. Make a complete list of all of the items you need to conduct the experiment. List the quantity of each item. Listing the brand of certain items might be important.

5. Follow all safety procedures and rules as listed in this handbook and in the IJAS handbook.

Steps to Prepare a Science Fair Experiment

After you have decided on a topic, formed a question to answer, and thoroughly researched your topic, you are ready to construct a hypothesis and develop a controlled experiment to test your hypothesis.

1. State the question or problem to be solved.

2. **Formulate the hypothesis(es)**.

Make a guess about the answer to your problem. This is called the hypothesis. State your hypothesis in the form of an If... then... statement.

Example: **IF** carbon dioxide is kept from a plant, THEN it will die.

3. Develop a controlled experiment.

A controlled experiment is when you regulate all factors that could possibly influence or change the outcome of your experiment, leaving uncontrolled ONLY the thing (variable) to be tested.

Example: If your question is, "What is the effect of a certain fertilizer on a plant's growth?", you need to determine the factors(variables) that can change and affect your plant's ability to grow. Some of the factors are: light, temperature of the air, temperature of the soil, moisture of soil, humidity in air, depth of seed planting type of seed, soil type, and type of fertilizer. You need to **CONTROL** all of the above variables except **ONE**. That becomes your variable.

4. A controlled experiment must be set up once the variable is identified.
The experiment will consist of two identical experiments conducted at the same time, differing only in one variable. The two similar experimental groups are called:

a) the control group - that part of the experiment to be used as a standard of comparison

b) the experimental group - that part of the experiment where the variable is being tested.

Each tested item should almost be identical in size, shape and age, etc.Each group should consist of several items to be tested. For example, you might decide to use 3 Coleus plants, all 21 centimeters tall, planted in the same soil, same amount of soil, same size pot, etc.The variable being tested (type and/or amount of fertilizer) is the only differing factor. Therefore,the results of these two groups can be compared. (Please note that control groups are not necessary in a computer science program or in some mathematics projects .)

5. All materials and equipment must be gathered and all raw materials weighed in metric units.

6. A data collection chart and/or daily log must be created to record observations and numerical data(USING METRICS).

Now that you have the variable isolated, you need to differentiate between the independent variable and the dependent variable. The independent variable is the factor you are changing or varying in the experiment. That would be the type/amount of fertilizer. The dependent variable is what you quantitatively measure to determine the effect of the fertilizer on the plant's growth. That would be best determined by measuring plant growth in centimeters. You need to create a chart that will have a place to record date, which plant, and its length in centimeters.

You must keep accurate records. Measuring a plant's height (or length) in response to a chemical is an okay idea, better still would be to measure additional dimensions - such as width, root mass, number of leaves, stem width, total surface area of leaves, etc. This gives a more complete picture of the effects being studied, thus adding to the VALIDITY of your results. Think about how to measure your results as completely as possible.

7. The validity of your results will be affected if you do not have enough test subjects or do not grow the plants for a sufficient period of time.

Usually you would want to have a minimum of 20 plants (10 in the controlled group and 10 in the experimental group) and record their growth for at least 30 days. Each plant would represent a separate trial.

You need to consult your science teacher for your specific experiment to determine what is sufficient data collection for your particular project. If your results are not what you expected you may want to check out the section on **Experimental Errors.**

8. Now that you have completed the experimental portion of your science fair project, you are ready to complete the write up and create your written project paper (see Writing the BackgroundRresearch Paper).

Experimental Errors

If you did not observe anything different than what happened with your control, the variable you changed may not affect the system you are investigating. If you did not observe a consistent, reproducible trend in your series of experimental runs there may be experimental errors affecting your results. The first thing to check is how you are making your measurements. Is the measurement method questionable or unreliable? Maybe you are reading a scale incorrectly, or maybe the measuring instrument is working erratically.

If you determine that experimental errors are influencing your results, carefully rethink the design of your experiments. Review each step of the procedure to find sources of potential errors. If possible, have a scientist review the procedure with you. Sometimes the designer of an experiment can miss the obvious.

Random Errors

If your measurement method is not the cause, try to determine if the error is systematic or random. Random errors are more obvious. They result in non-reproducible data that doesn't make sense. In this case, runs with the same combination of variables, and even the control itself, cannot be duplicated. Some randomness is always present in nature. No two measurements are exactly the same. You must judge if the differences in your data can be explained by nature operating normally.
A random error may be occurring because you are doing something differently in each run. For example, you are not careful in cleaning your reaction vessels and some of the chemicals are being carried over from the last experiment. Scientists use various statistical tests to determine if the difference between runs is due to randomness in nature, or to the way they are doing the experiments.

Systematic Errors

Systematic errors are harder to find. Your data and results may look consistent and reproducible. Here you may be doing something you are not aware of that is causing all your measurements to be off the same amount. For example, if you were not aware that a piece of your ruler had been cut off and now starts at 2" instead of 1", all your measurements would be one inch too long. This is a systematic error because all your data is affected the same amount, and in the same direction. One way to check for systematic errors is to run experiments of a different design that should give the same answers. Scientists often do different kinds of experiments to cross check their results. Another way to locate errors is to have an independent investigator repeat your experiments. Others should get the same results you did.

Linked Variables

Your results can be invalid if your variables are not independent of one another, and you have not noticed this. Variables are independent if they produce their effects separately from each other. In other words, changing one variable does not affect changes produced by another variable.

NOTE: The information contained on this page was written by David Morano,Assoc. Professor, Mankato State University, Minnesotta and was included with his permission.

RESULTS

The Results section is divided into two parts. The first part is the organization of your data into tables and graphs. Choosing the appropriate graph is important. The second part is a discussion of your evaluation and interpretation of the data you collected.

PART ONE: ORGANIZING DATA

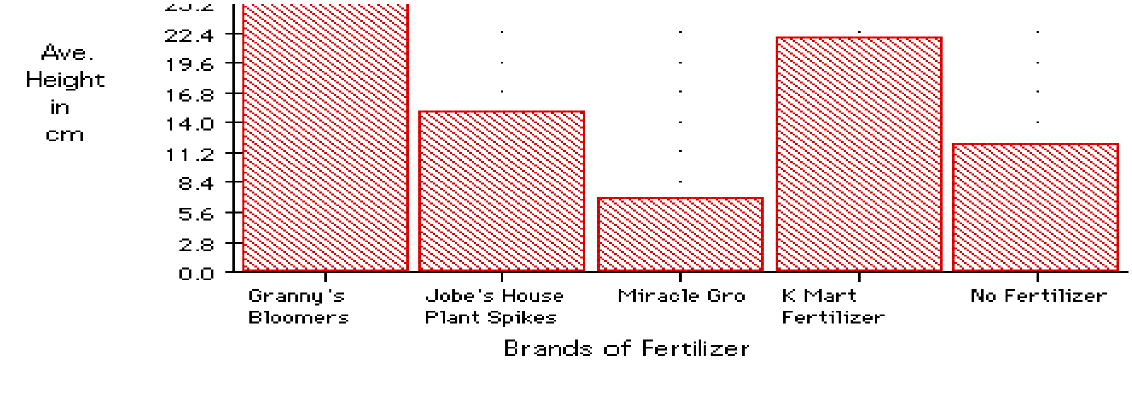
Recording data - when you record your experimental data consider the following:

1. Keep a log (journal) of your observations.
2. Data should be measured in metric units.
3. It is better to have too much data than not enough.
4. Keep track of the materials used and their quantities.
5. Take photographs as your investigation progresses (Chemical, glassware and large bulky equipment cannot be displayed so pictures are a good idea).

Displaying data -

Tables, charts and graphs are convenient ways to clearly show your data. Be sure to consider how to best show your results with appropriate graph forms. You might want to consult with your teacher. Be sure to give your charts and graphs an appropriate title that explains what the data measures. On line and bar graphs, the x and y axes must be appropriately labeled with correct unit of measure (in metrics where applicable).

The easiest way to create a graph is to enter your data into a spreadsheet program (Microsoft Works, ClarisWorks, Excel, etc.). These programs will generate graphs from the data you enter. The examples of graphs included below were done in Microsoft Works but could easily be replicated in any spreadsheet program.



There are three basic graph forms. The bar graph, the line graph, and the circle (or pie) graph. Notice how each of the following examples are used to illustrate different kinds of data. Choose the best graph form to express your results. Check out the **Reminders** before leaving.

Data Table:

A data table shows the collected measurements in an organized way. A typical data table might look like this:

Plant growth (in cm)

Fertilizer	week#!	week#2	week#3	week#4	Total	Average
“x“	3cm	6cm	10cm	13cm	32cm	8cm
“y”	2cm	5cm	9cm	12cm	28cm	7cm
no fertilizer	2cm	5cm	7cm	10cm	24cm	6cm

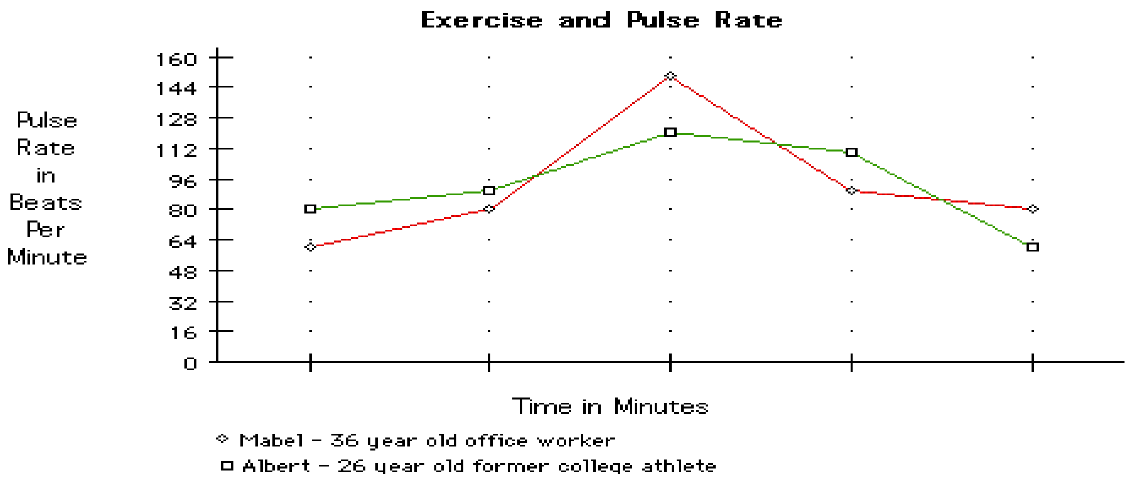
A bar graph:

A bar graph is used to show relationships between groups. The two items being compared do not need to affect each other. It's a fast way to show big differences. Notice how easy it is to see what was done in the experiment below with bean plant growth and different brands of fertilizer.

A typical chart or table for this graph might look like this:

A line graph:

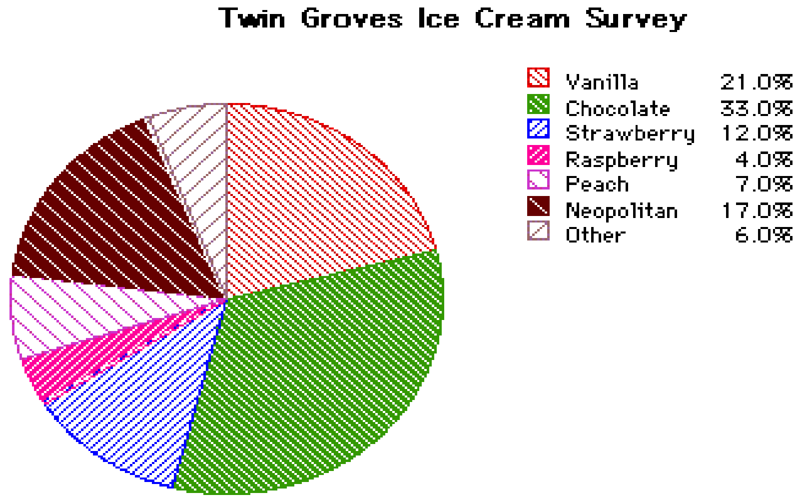
A line graph is used to show continuing data; how one thing is affected by another. It's clear to see how things are going by the rises and falls a line graph shows. This kind of graph is needed to show the effect of an independent variable on a dependent variable. In the sample below, the pulse rate of a person is shown to change over time. As time continues, the pulse rate changes. A typical chart or table or this graph might look like this:



*

A circle (pie) graph:

A circle graph is used to show how a part of something relates to the whole. This kind of graph is needed to show percentages effectively. A typical chart or table for this graph might look like this:



PART TWO: EVALUATING AND INTERPRETING DATA

Study your data carefully and then:

1. Describe in detail what happened during the experiment. It should state what happened on the average to the dependent variable,each time you manipulated the independent variable.

2. Study the graph(s) and/or table(s) in FULL. Decide what can be determined from the graphs, by evaluating relationships between variables by looking for trends, patterns, extrapolations, etc.

3. Some experiments may lend themselves to a discussion of not only the mean (averages), but also median and/or mode.

CONCLUSION

Conclusions are the ending to your story. Without conclusions your experiment is incomplete. In paragraph form state ,in a concise and logical order, the conclusions you can draw from the experimentation you have done and the data and/or observations obtained. Be sure to include the points in the order listed below.

1. Restate your purpose in the past tense. Example : This experiment determined.

2. State whether or not your results supported your hypothesis. Provide evidence that supports your conclusion.

3. Answer all questions that were generated by the experiment.

4. State any other information that was discovered in the process of the experiment or points of interest.

5. Describe how this experiment could be extended.

PUTTING IT ALL TOGETHER

The physical arrangement of the written report:

Once all sections of your report have been completed, it must be put together in a logical order. The appropriate order for your final project report is as follows:

1. **Abstract ***
2. **Safety sheet ***
3. **Endorsement sheet ***
4. **Titile Page**
5. **Table of contents (include page numbers)**
6. **Acknowledgements (thank those who helped you)**
7. **Purpose and Hypothesis**
8. **Review of Literature (background research paper)**
9. **Materials and Methods of Procedure**
10. **Results (parts 1 and 2)**
11. **Conclusion**
12. **Reference List**

*** Copies of these sheets are in this handbook or available from the science fair coordinator**

Note the following when preparing your report:

1.Your final report must be word processed with your last name on every page.

2. Each page must be numbered.

3. Your entire report from #1 to #12 should be no less than 15 pages and no more than 30 pages

4. Enclose your report in a clear report cover.

Backboard Display

Exhibiting Your Project

The next step is to plan an exhibit that will tell the whole story of your project. The display must be self standing and fit on a card table provided by you. Height should be no taller than 122 cm (4 ft), and the width should fit on a standard card table (within 76 X 122 cm limitations). No equipment
or parts of the display can hang over the table nor can there be any equipment on the floor. Most science fairs do not allow table coverings. Your title should be short, to the point and appropriate to the nature of your experiment. Do not letter with markers directly on the board. Your final display board should be neat and double checked for spelling errors.

By looking at your display board, an observer should be able to clearly see:

1. Title
2. Your purpose
3. Hypothesis
4. Procedure
5. Experimental data in the form of charts and/or graphs
6. A shortened version of the conclusion in your project paper.

Arrange your graphs, charts, tables, photographs and/or diagrams neatly across your display board. Remember to take time to use stencils or carefully made letters for all printed titles. You want to give your board a "professional" or "polished" appearance. Hand written words can give a messy look to your hard work.

Note: Nothing is to be stored under the table.

It is also required that you review in detail the "Safety Rules for Display" and the "State Student Project and Safety Checklist" in the IJAS handbook .

Exhibiting an Animal Research Project

Presentation of research data can be done very well without the actual physical presence of caged animals. By use of pictures, slides, or videotape, research results can be effectively presented with maximum impact. In many cases, judges prefer this extra effort on the part of the student researcher and consider the presence of the animals as "proving nothing". Live vertebrate animals are not allowed at the WJHS, regional and state science fairs.

Oral Presentation

You must consider your presentation as an important part of your project. Use an outline or note cards to aid in your presentation. It is your project. Have conficence in your work and in yourself. Don't memorize your presentation! Practice explaining your project. Limit your presentation to
10 minutes.

In presenting to the judges, the following approach is suggested:

Introduction: Give title, your name(s), grade, school and science teacher. State how you got interested in this project and your reason for choosing it. Give some background explanation for your project (to familiarize the judges), scope of your study, etc.

Purpose: State exactly what the investigation is attempting to discover.

Acknowledgements: Give credit to those whom you have ontacted and to those who have helped you. Also indicate any work done in the past pertaining to your project.

Procedure: Be complete and do not leave out necessary details. Proceed in a very logical manner, telling what you did step-by-step, beginning at the very beginning. Use visual aids: Charts, pictures, graphs and diagrams. Point to your display, but stand aside when you do this. Use a pointer for
pointing if you wish. Explain how your apparatus was used. If you constructed it yourself, tell the judges. If not, give credit to those who did. Note that judges are more interested in your experiments, results and conclusions than in your apparatus.

Results: Explain both your controls and variables. Remember to use proper metric units with your data. Point to charts, graphs, etc. on the display.

Discussion or Conclusion: State in a concise and logical order the conclusions you can validly draw from the experimentaion you have done and the data and observations obtained. Admit any deficiencies or limitations in this regard. Judges will respect this.

Future Plans: Be sure to tell how you plan to carry on your project. You will probably find that this will be a test of your interest.

Questions: When you are finished, ask the judges if there are any questions they would like to ask. When they question you, think and answer slowly. If you don't know the answer, admit that you don't and indicate that you will check into the matter. If the question they ask doesn't appear to be related to your work, clarify exactly what the judges are asking. If you are still convinced that the question is unrelated, politely redirect the conversation back to your project. Thank them for any suggestions they may have for improving your project.

Helpful Hints: It is best not to skip any of the above sections. Speak slowly. Be forward but polite, dynamic, and above all enthusiastic about whay you are presenting.

Practice your presentaion. You might stand in front of a mirror to practice eye contact and gestures. Practice in front of parents, friends and other willing victims. You may consider tape recording your presentation so you can hear how you sound to others.

Some other tips that will make you presentation more professional include:

* Dress neatly and stand up straight.
* Don't chew gum or candy.
* Stand to the side of your display.
* Speak loudly enough to be heard by both judges.
* Involve the judges in your work by giving your research paper to them at the beginning of your presentation.
* Make eye contact with both judges.
* If you have a partner, be sure you share equally in the presentation.

Relax and enjoy presenting your research. The judges want you to do a good job and have a rewarding experience.

Criteria for Outstanding Project in a Category

I. Physical Arrangement: Paper

1. Paper is organized according to IJAS Handbook (see State Student Project and Safety Checklist)
2. Good grammar and spelling are evident (paper has been proofread by your teacher)
3. Paper is typed and saved on a disk
4. Margins according to IJAS Handbook(see Writing Scientific Research Paper for Science Project) 5. Type is double spaced
6. Distinctly legible and neat
7. Abstract, Safety Sheet and Title Page are in correct order and completed properly
8. Human or Nonhuman Vertebrate Endorsement Forms present if applicable

II. Literature Cited and Reference List

1. Reference List is in the correct alphabetical format (APA style)
2. 10 or more references highly recommended (excluding encyclopedias)
3. Most sources are more recent than 1990
4. Citations correctly formatted with parenthetical expressions within the Review of the Literature
5. References come from a variety of sources

III. Graphs - Charts - Drawings - Photographs

1. Pertinent graphs, charts, or photos are clear and legible
2. Graphs are titled and labeled using metric units
3. All graphs show correct units

IV. Experimental Results Explanined in a Conclusion

1. Are the materials listed?
2. Was a hypothesis or prediction is given ?

3. Is evaluation and interpretation of data present?
4. Do the results show up in three forms: written, tables or charts, and graphs?
5. Does the conclusion refer back to the hypothesis or prediction?
6. Does the conclusion seem based on represented data?

V. Physical Arrangement: Display Board

1. The backboard is well organized and neatly arranged
2. Good grammar and spelling are evident using stencils or computer generated type
3. Backboard shows creativity and originality
4. Pertinent graphs, charts or photos are attractively displayed
5. All graphs are titled and labeled with correct metric units

SCIENCE PROJECT GUIDE
(TIPS FROM JUDGES)

For the past several years the scientists on the Life Sciences Support Contract here at the Kennedy Space Center have participated in judging local school science fairs. Although we are always amazed by the effort and enthusiasm that the students show in working through their projects, we consistently see some problems with how they go about their investigations. Some of the inconsistencies we routinely see in their procedures are unfortunately some of the fundamentals to good scientific research procedures. The lack of these fundamentals then prevents their projects from getting the recognition they deserve. With this in mind, we have written the following guidelines for students and teachers to review before the projects are underway. These are basic steps that should be followed when working through an experiment. Students are encouraged to refer back to these guidelines while they are running their experiments to understand how to deal with any difficulties they might encounter and how to interpret their results. We have also included some hints on how to present these results in a competition once the projects are complete. We hope that by giving students and teachers a chance to review these fundamentals, they can avoid many of the pitfalls we have consistently seen.

Defining a problem

You’ll want to pick a subject for your science project that you like and that you want to spend some time looking into. Right at the beginning, do some background research to familiarize yourself with the subject. You’ll also want to understand any terms associated with your subject that you’re unfamiliar with. If you're not sure what you would like to do, consult with local professionals in the subject area you would like to investigate. Many people would be glad to help, they just need to be asked. Also, continue to keep in touch with these people, as they could give you advice and direction throughout your project. Perhaps you could even review your final project with them and go over how you would like to present your project. They might be able to spot areas you need to improve on and point out the strong points that would be worth emphasizing.

Formulating a hypothesis

Come up with an idea about something you want to test. A hypothesis is just an idea of what you think might happen given the understanding you've gained on the subject while doing your background research. You will learn much more about your project as you work through it and your hypothesis can change accordingly. The main purpose of setting a hypothesis at the beginning is to keep you focused on answering a specific question and to keep your experiment on track . It is not intended to lock you into one idea that can't be changed later on when you find that it was incorrect. An example of a hypothesis would be: Does frost have a damaging effect on tropical plant growth?

Designing your experiment

*** Simplicity**

Keep things as simple as possible. Many students think that they never to have many variables in an experiment to make the experiment valid. This is not the case. It's much better to test only one variable thoroughly than to test many at once. For example, if you're investigating the effects of freezing temperatures on tropical plant , don't add different lighting sources and nutrients as well. Only look at the effect of freezing temperatures.

*** Controls**

All experiments need to have an appropriate control. You need to have a standard to test your experimental results against. For example, if you're studying the effect of freezing temperatures on tropical plant growth, you will probably put some of your plants outside for a few cold nights. When you take them back in your house to see how the cold affected their growth, you'll need to have some plants that were not exposed to those cold temperatures to compare them to. The plants that did not see the colder temperatures are called a "control". All experiments must have controls and it's worth taking time to figure out what a good control would be for your experiment.

*** Sample Size**

You will need to have several "subjects" in your experiment. For example, back to the effects of freezing temperatures on tropicals, you'll need to set several plants out in those temperatures, not just one.

*** Time**

Allow enough time for the experiment to be repeated. Also, allow enough time for complications- things don't always (if ever) go right the first time and you might need to start your experiment over again. Begin early! Understand the project before you begin, and allow 6-8 weeks to complete the experiment.

*** Keep a detailed notebook**

* Don't cross anything out, you might need to refer back to it later.

* Entries should be dated with the date and the number of days into the experiment.

* Include all observations, don't assume you'll remember points and particulars. What might not seem important at the time might be an important result later and might actually support your conclusion, so you'll want an accurate record of it.

<u>Collecting data</u>

Quantify your results by reporting things in numbers, not just observations. For example, say that your plants grew 1 centimeter. Don't say that the plants "look bigger today than they did yesterday". Words like "bigger" mean different things to different people, so reporting your results using words can lead to confusion. You want to tell people exactly how much yourplants grew.

<u>Formulating a conclusion</u>

Did your data support your hypothesis? If not, that's a result too. It doesn't mean that the experiment didn't work. Also, consider other possible explanations for your results. Did your treatment kill your plants or was it that you left them outside and some insects ate some of the leaves? You're not out to "prove" your hypothesis. Think more along the lines of "here's what I thought was going to happen and here's what actually happened" and then go on to explain why you think it happened the way it did.

The Final Presentation: Tips For the Science Fair

There are several essential elements to a good presentation:

* Present your data using averages, not individual measurements. Also, don't present the data more than once. Don't make a line graph and pie chart of the same data. Finally, don't include more than one variable on a graph or it gets confusing.

* Report sample size (n=?). Older students should give some statistical analysis of their data, such as standard deviationt.

* Have print large enough to read from a distance.

* Be sure that you understand all the terms and acronyms you present.

* Think about future experiments and how you could expand on a project. Many students do science fair projects in consecutive years. You should think about expanding and significantly changing your project, not just repeating the same project.

JUDGING CRITERIA FOR THE PROJECT AND PAPER SESSIONS

The following are guidelines for the Illinois Junior Academy of Science judging procedure. Judges who are not agents of the Illinois Junior Academy of Science may use other criteria for selection of their special awards. The decision of thejudges is final.

SCIENTIFIC METHOD

Knowledge Gained-The student exhibits a thorough understanding of the topic as demonstrated through presentation and/or correct responses to questions. The student has acquired scientific skills.

Scientific Approach-The experimenter has defined the problem and uses a logical, orderly method for solving the problem. The problem was solved using scientific principles.

Experimental Approach

Variables - A single variable was tested for each experimental group; all other variables were controlled or accounted for.

***Control* -** The method is appropriate and effective. A control or comparison group was in evidence.

***Data*-**The data collected is numerical and metric, if applicable. Repeated trials provide for adequate data. The data is reliable.

***Conclusion*--**The conclusion is consistent with the data and/or observations. The conclusion is based on the data collected.

***Originality*--**The project demonstrates a novel approach and/or idea. It is highly creative.

WRITTEN REPORT

Abstract-The abstract contains a concise summary of the purpose, procedure, and conclusion in 200 words or less.

Safety Sheet-The safety sheet identifies all of the major safety hazards.

Title Page and Table of Contents-The title page is clear and concise. The table of contents is complete and ncludes pagination.

Purpose and Hypothesis-The problem has been defined and a prediction has been made.

Review of Literature-The Review of Literature is thorough and adequately cited. The research is pertinent to the topic being investigated.

Materials-All materials are listed and measurements are in metric, if applicable.

Procedure-The procedure is complete and easy to follow; all steps have been included. Measurements are in metric, if applicable.

Results-The results are organized in tables or graphs and can be easily read by someone not familiar with the work. Data is quantitative and explanations are given when needed.

Conclusion-The conclusion reflects a concise evaluation and interpretation of the data and/or results. The conclusion referred to the purpose and hypothesis.

Reference List-The quality and quantity of sources is adequate for the topic. The sources listed are cited within the Review of Literature using APA format, Fourth Edition or
ater. Both the hanging paragraph and 5-space indent style of citing are acceptable.

ORAL PRESENTATION

Presentation Quality-The presentation is clear and concisely summarizes the project. The information presented is relevant and pertinent.

Dynamics-The presenter speaks fluently with good eye contact; is polite, dynamic, and interested in their project.

DISPLAY

Information-The backboard gives a complete explanation of the project. It includes graphics,
charts, and/or pictures.

Artistic Qualities-The backboard is neat, organized, and appealing.

RATING CRITERIA-When rating the project and paper, consider the following:

Outstanding - The following criteria may identify an outstanding project:

a. ***Scientific approach to a specific problem with relevant experimentation.***

(1) Approach indicates creativity.
(2) Conclusions logically deduced from experimental data.
(3) Clear concise research paper containing abstract in required form, safety sheet, and vertebrate endorsement where appropriate.

b. ***Students can speak knowledgeably on contents of paper and area of investigation.***

c. ***Good quality and quantity of background information in Reference List.***

First and Second - A lesser degree of the above, e.g., insufficient Reference List, lack of thoroughness in experimental technique or observation, or lack of knowledge of subject area.

Third - A serious omission or mistake is present - e.g., no proof of experimentation or no scientific approach is evident. Any model or demonstration should be rated a third. The judging chair will supply specific tips and pointers for a given category.

Awards

This year seventh and eighth graders will be offered the opportunity to complete a science fair experiment or write a scientific essay and to enter in the local WJHS Junior High Science Fair. You will also have your project exhibited in the school science fair and you might earn a ribbon or medal.

If you qualify for Regional Science Fair, you will also enjoy the following:

* Get your name in the newspaper
* Go on a field trip during the school year
* Be mentioned in an article in the school newspaper
* Help us win a school trophy or plaque

If your experiment qualifies for the State Science Fair you will enjoy the following:

- Go to U of I in Champaign over a Friday, Saturday and Sunday
- Stay overnight in motel [with indoor pool when possible]
- Certificate of accomplishment
- Chance at both regional and state to win cash, calculators, bonds, and other special awards

WJHS SCIENCE FAIR ENTRY FORM

(PLEASE PRINT CLEARLY!)

PROJECT NUMBER: ___________________________

(TEACHER WILL FILL IN)

CATEGORY: (CIRCLE ONE-IT SHOULD MATCH ABSTRACT)

Aerospace,
Behavioral Science
Botonay
Biochemistry
Chemistry
Computers
Conservation
Consumer Science
Earth Science
Electronics
Engineering
Health Science
Mathematics
Microbiology
Physics
Zoology

PROJECT TITLE:____

(make your title is short enough to take up no more than 25 spaces)

STUDENT NAME (S): ____________________________ Gr 7 or 8 (circle one)

____________________________ Gr 7 or 8 (circle one)

ELECTRICITY:

_____I Need electricity and will bring a 6 to 25 foot extension cord.

_____I do Not need electricity.

SPONSOR (enter the name of your science teacher sponsor):

____

THINGS TO REMEMBER FOR THE REGIONAL SCIENCE FAIR

Date:

Place:

1. I must bring a STANDARD (36" X 36") card table with rubber bottoms to protect the floor for my project. (Anyone not bringing their own card table will have to set up their display on the floor).

2. I KNOW my project number (see attached).

3. I will bring a book or something quiet to do while I am waiting to be judged.

4. If I need electricity, I have already told my teacher and will bring a short, three-pronged extension cord in case I need it.

5. I have my booklet to take to the fair, and I HAVE GIVEN MY SCIENCE TEACHER AN EXTRA COPY just in case something happens to mine before I get judged.

6. I know my talk very well (memorized if possible) and have gone over judge's suggestions from our Science Fair.

7. I typed my name and home address on the back of the abstract.

8. My abstract is the first page of my booklet and the safety sheet is second. MY science teacher has signed my safety sheet.

9. Remember, any little thing NOT fixed will result in points taken off. At the regional, ONE point can make the difference in getting to go to the State Science Fair.

10. I have told my parents that I must arrive between 7:30 A.M. and 8:30 A.M. to be safety judged that morning. They know that they must leave after they help me set-up unless one or both are judges that morning. They may return at noon to view the projects.

11. I must be sure to give my parents any packing materials before they leave, because the only thing I can store under my card table is my coat.

12. Any student with a conflict who needs to be judged early or late must accept the responsibility of informing the judges. The judges will make contact with students prior to judging. Students with a conflict should ask the judges to judge them at the best time possible.

13. Students not present to meet with the judges should leave a note on their board letting them know when they will return.

14. If I become ill and can't attend the regional fair, I will call Mr. Sheade or my Sponsor Teacher right away and let them know. Don't be a NO SHOW! Let one of us know if an emergency arises.

15. Because special judges do their judging between 9:00 and 11:30 A.M. I will stay by my project the whole time, even if I have already been judged by the regular judges earlier in the morning.

16. I WILL DRESS UP!

NOTES: After you have been judged, **you must leave your project in place until 2:30 P.M**. You are welcome to leave the area after you have been judged and after noon, but you must make arrangements to have your project picked up after 2:30 P.M. **During the day, there will be lunch available for purchase.** The science projects are open to the public for viewing between 12:30 and 2:30. **The Awards Ceremony begins at 1:00 P.M. and you will be able to leave by 3:30 p.m.**

Teacher________________________ Student:__________________________

Design an Experiment

1. Identify the independent (manipulated) variable.

____

2. Identify the dependent (responding) variable.

____

3. Come up with a research question.

____

____

4. State you hypothesis.

____

____

5. Describe the materials you will need to do the experiment.

____

____

6. On the back of this form, or a separate sheet of paper, write a procedure to test your hypothesis. Remember to include safety considerations and a detailed set-up.

7. Identify your control..

____

8. Describe the variables that you will hold constant.

---

9. On a separate sheet of paper, design a data table to collect and display your results.

10. What kind of graph or chart would you use to present your data?

line/bar/circle

11. Be ready to graph your data on graph paper. Include a title, labels, and units for the vertical and horizontal axis.

SAFETY SHEET

The Illinois Junior Academy of Science

Directions: After carefully reading the first part, the student is asked to read this introduction carefully, fill out the bottom of this sheet, and sign it. The science teacher and/or advisor must sign in the indicated space.

This sheet should then be placed in the student's research paper, immediately following the abstract.

SAFETY AND THE STUDENT: Experimentation or research may involve an element of risk or injury to the student and to others. Recognition of such hazards and provision for adequate control measures are joint responsibilities of the student and the sponsor. Some of the more common risks encountered in research are those of electrical shock; infection from pathogenic organisms; uncontrolled reactions of incompatible chemicals; eye injury from materials or procedures; and fire in apparatus or work area. Countering these hazards and others with suitable controls is an integral part of good scientific research.

On the following lines, list the principal hazards associated with your project, if any, and what specific measures you have used as safeguards. Be sure to read the entire section in the Guidebook of the Illinois Junior Academy of Science entitled "SAFETY GUIDELINES FOR EXPERIMENTATION" before completing this form.

SIGNED____

Student Exhibitor(s)

SIGNED____

Sponsor

This Sheet Must Be Typed

HUMANS AS TEST SUBJECTS ENDORSEMENT

The Illinois Junior Academy of Science

THESE RULES WILL BE STRICTLY ENFORCED FOR THE STATE SCIENCE EXPOSITION. NO REGION SHOULD SEND A PROJECT TO THE STATE EXPOSITION THAT DOES NOT MEETTHESE REGULATIONS.

This form must be completed by students and sponsors doing a human vertebrate project. The signature of the student or students and the sponsor indicates that the project was done within these rules and regulations. Failure to comply with these rules will mean the disqualification of the project at the state level. This form must follow the safety sheet.

(1) No cultures involving humans (mouth, throat, skin, or otherwise) will be allowed. However, tissue cultures purchased from reputable biological supply houses or research facilities are suitable for student use.

(2) Quantities of normal food and non-alcoholic beverages are limited to normal serving amounts or less. "Normal" must be substantiated with reliable documentation. This documentation must be attached to this form. No project may use over-the-counter or prescription drugs or any other chemical agents in order to measure their effect on a person.

(3) The only human blood that may be used is that which is either purchased or obtained from a blood bank, hospital, or laboratory. No blood may be drawn by any person or from any person specifically for a science project. This rule does not preclude a student making use of data collected from blood tests not made exclusively for a science project.

(4) Projects that involve exercise and its effect on pulse, respiration rate, blood pressure, and so on are allowed provided the exercise is not carried to the extreme. A valid, normal physical examination must be on file for each test subject. Documentation of same must be attached to this form.

(5) Projects that involve learning, ESP, motivation, hearing, vision, and surveys present no problem.

(6) No project will be allowed that is in violation of any of these rules. No person may perform any experiment for the student that violates any of these rules.

(7) No person may give permission for a project that is in violation of these rules except in special cases as described in the guidebook under the section entitled "Exceptions to Humans as Test Subjects and Non- Human Vertebrate Rules".

In this space, briefly describe the use of humans in your project. Use the back page if necessary.

The signatures of the student or students and sponsor below indicate that the project conforms to the above rules of the Illinois Junior Academy of Science.

____

(Sponsor)

____

(Student)

____

(Student

____

(Date)

This Sheet Must Be Typed. It is recommended that a copy of this form be displayed on the exhibitor’s backboard

NON-HUMAN VERTEBRATE ENDORSEMENT
The Illinois Junior Academy of Science

THESE RULES WILL BE STRICTLY ENFORCED FOR THE STATE SCIENCE EXPOSITION. NO REGION SHOULD SEND A PROJECT TO THE STATE EXPOSITION THAT DOES NOT MEET THESE REGULATIONS.

This form must be completed by students and sponsors doing a non-human vertebrate project. The signature of the student or students and the sponsor indicates that the project was done within these rules and regulations. Failure to comply with these rules will mean the disqualification of the project at the state level. This form must follow the safety sheet.

(1) No cultures involving warm blooded animals (mouth, throat, skin, or otherwise) will be allowed. However, tissue cultures purchased from reputable biological supply houses or research facilities are suitable for student use.

(2) No intrusive techniques may be used. Included in intrusive techniques would be things such as surgery, injections, taking of blood, burning, or giving of drugs and other chemical agents to measure their effect.

(3) No changes may be made in an organism's normal environment. "Normal" must be substantiated with reliable documentation. This documentation must be attached to this form

(4) For maze running and other learning or conditioning activities, food or water cannot be used or withheld for more than 24 hours.

(5) The student and the sponsor have the responsibility to see that all animals are properly cared for in well-ventilated, lighted, and warm locations with adequate food, water, and sanitary conditions. Care must be taken to see that the organisms are properly cared for during weekends and vacation periods.

(6) Chicken or other bird embryo projects must be terminated at or before ninety-six hours.

(7) Projects that involve behavioral studies of newly-hatched chickens or other birds will be allowed if no change has been made in the normal incubation and hatching of the organism and all vertebrate rules are followed.

(8) No non-human vertebrate project will be allowed that is in violation of any of these rules. No person may perform any experiment for the students that violates any of these rules.

(9) No person may give permission for a project that is in violation of these rules except in special cases as described in the guidebook under the section entitled "Exceptions to Humans as Test Subjects and Non- Human Vertebrate Rules".

In this space, briefly describe the use of non-human vertebrates in your project. Use the back page if necessary.

The signatures of the student or students and sponsor below indicate that the project conforms to the above rules of the Illinois Junior Academy of Science.

____

(Sponsor)

____

(Student)

____

(Student)

____

(Date)

This Sheet Must Be Typed. It is recommended that a copy of this form be displayed on the exhibitor’s backboard

ABSTRACT

The Illinois Junior Academy of Science

STATE

CATEGORY ______________________

REGION # ______________________

NAME ______________________

ADDRESS ______________________

CITY/ZIP ______________________

PHONE ______________________

GRADE ______________________

NAME ______________________

ADDRESS ______________________

CITY/ZIP ______________________

PHONE ______________________

GRADE ______________________

SCHOOL ______________________

JAS SCHOOL# ______________________

CITY/ZIP ______________________

PHONE ______________________

SPONSOR ______________________

PROJECT TITLE

____

1. Limit Abstract to 3 paragraphs (about 200 words or less). a) Purpose - what you set out to investigate; b) Procedure - how you did it; c) Conclusion - based on your results.
2. Must be typed, single spaced on the front of this form. DO NOT write on the back side of this form.
3.THREE (3) copies of your COMPLETE paper are required at the State Science Project Exposition

FOUR (4) copies of your COMPLETE paper are required for the State Paper Session Competition

The above form must be duplicated exactly. (Student generated forms must use the same format)

It is recommended that a copy of this form be displayed on the exhibitor's backboard

WJHS STUDENT PROJECT AND SAFETY CHECKLIST
The Illinois Junior Academy of Science

Project Checklist

Abstract:
_______ First page of paper.
_______ 3 paragraphs with proper headings: Purpose, Procedure and Conclusion.
_______ Typed single-spaced.
_______ 200 words or less.

Safety:
_______ Second page of paper.
_______ Hazards listed, precautions described.
_______ Signed by sponsor.

Humans as Test Subject or Non-Human Vertebrate Endorsement, if applicable:
_______ Third page of paper.
_______ Signed by student and sponsor; proper documentation is attached, if necessary.

Title Page:
_______ Clear and concise.

Table of Contents:
_______ Pagination is accurate.

Acknowledgments:
_______ Credit is given to those who have helped.

Purpose and Hypothesis:
_______ States precisely what the investigation was attempting to discover.
_______ States a definite question or problem.

________ Hypothesis is present.

Review of the Literature:

________ Use of 3rd person is evident.
________ Logical and/or related grouping of information.
________ Accuracy in calculations, spelling, grammar, and quotations.
________ Typed double-spaced, one inch margins, single-sided.
________ Sources in the **Reference List** are parenthetically cited in the **Review of Literature.**
________ Quality and quantity of sources cited are adequate for topic(10 or more current references recommended)

Materials and Methods of Procedure:

________ Apparatus and materials are listed.
________ Drawings and photographs are present if they enhance and clarify the apparatus.
________ Step-by-step, chronological procedures are present.
________ Number of test groups is adequate and the number of trials within each test group is adequate (consult your teacher **before** starting your experiment).
________ The control of variables is evident.

Results:

________ Data is organized into tables or charts with accompanying graphs, if appropriate.
________ Data is quantitative and correct units of measurement (metric) are used.
________ Data is clear and accurate.

Conclusions:

________ Evaluation and interpretation of data is present.
________ Refers back to purpose and hypothesis; answers the original question.
________ Is **valid** and limited to the results of the experiment.
________Information gathered in **Review of Literature** is referenced when applicable.

Reference List:

________ References come from a variety of sources.
________ References are current.
________ Reference list is alphabetical.
________ Proper format is used for all references.
________ All sources cited in the **Review of Literature** are listed in the **Reference List**

Experiment Safety (All experimental designs must be reviewed and accepted by your science teacher before you begin your experiment - use the "Design an Experiment" form):

If experimenting with humans the following procedures were followed:

________ No cultures were obtained from humans.
________ Quantities of food and non-alcoholic beverages were limited to normal serving sizes.
________ Blood was not drawn exclusively for the science project.
________ Projects involving exercise have a valid normal physical examination on file and exercise was not carried to the extreme.

If experimenting with a non-human vertebrate the following procedures were followed:

________ No cultures were obtained from warm-blooded animals.
________ No intrusive techniques were used.
________ No changes were made in the organism's normal environment.
________ Food or water was not withheld for more than 24 hours.
________ Animals were properly cared for with adequate ventilation, food, and water.
________ Chicken or other bird embryo projects were terminated at or before 96 hours.
________ Projects involving the use of recombinant DNA received approval prior to December 1.

Exhibition Safety

________ Project fits on table top within 76 X 122 cm limitations allowed; is no taller than 122 cm (4 ft).

_______ Glassware, if displayed, is stable and pushed far back from the front edge of the table.

_______ Chemicals that present any hazard at all are not displayed; colored water or photographs have been substituted.

_______ Crystals other than sucrose (sugar) and sodium chloride (salt) are **not** displayed. Projects involving crystals have been represented by pictures or other three-dimensional models.

_______ Hazardous materials: explosive, flammable, corrosive or poisonous materials, rockets, compressed or aerosol cans are not displayed.

_______ Fire hazards: **no** open flames, torches, or burners are displayed; electric hot plates are on non-combustible bases.

_______ Radiation: **no** laser, UV-light, X-rays, or other radioactive materials are displayed.

_______ Packing materials are **not** on or under the table.

_______ **No** table drapes or other coverings are present.

_______ **No** living vertebrates are displayed.

_______ **No** hypodermic needles or syringes are displayed.

_______ **No** cultures of any kind are displayed.

_______ Electrical and/or mechanical equipment is(are) shielded, durable, enclosed, insulated, and quiet.

Miscellaneous (for students who attend the WJHS fair):

______Bring two copies of the complete project paper

_______Bring display board **and** card table - Remember, no table covers allowed

_______If you designated your project for an electric outlet, bring a UL approved extension cord

Miscellaneous (for students who attend the Regional Science Fair):

_____Bring three copies of the completed project paper

______Bring display board and card table- Remember, no table covers allowed

______If you designated your project for an electric outlet, bring a UL approved extension cord.

______Obtain directions and project number from your science teacher.

Miscellaneous (for students who qualify for state):

________ Three copies of the complete research paper for Project Session participants.

________ Display board - Reminder: no chairs or table covers are allowed.

________ Entry Tag Ribbon

________ A copy of the abstract, safety sheet, and endorsements (if applicable) are attached to the display board.

________ Electrical extension cord, if needed for your project and the project has already beendesignated as needing electricity.

________ Friday night banquet tickets - see sponsor for information.

PROJECT # ____________

WJHS JUNIOR HIGH SCHOOL
COMMENT SHEET FOR STUDENT(S)

PROJECT: ____

EXHIBITOR(S):

____ GRADE 7 OR 8

____ GRADE 7 OR 8

****

STRENGTHS OF PROJECT:

SCIENTIFIC METHOD ____________________________________

PAPER ____

ORAL ____

BACKBOARD & APPARATUS ______________________________

****

SUGGESTIONS FOR IMPROVEMENT

SCIENTIFIC METHOD _____________________________________

PAPER ____

ORAL ____

BACKBOARD & APPARATUS ___________________________

To Parents: Introducing Our Science Fair

Dear Parents:

Your child has been invited to take part in an exciting school event-a science fair.

Science fairs can be one of the most exciting parts of the entire school year. They provide children with an opportunity to explore the mysteries and marvels of the world in which we live and to develop an appreciation for the work of scientists.

Yet for many families the announcement of an upcoming science fair can be an upsetting experience. Parents and children ask: How do we get started? Where do we get information? What should the final project look like? How much time do we need?

The science fair coordinators will provide your child with a thorough, systematic approach to developing a successful science fair project. Students should meet once a week with a coordinator and will be guided step-by-step-from choosing a topic to the final project. This will include:

* How to plan and develop a project
* Sources of information and guidance
* Success factors that contribute to a display
* A host of potential ideas and projects
* How to assemble a project and write a report
* Standards used by science fair judges to evaluate projects
* A plan of action to ensure that the project will not have to be completed the night before the fair!

The intent of a fair is to help your child enjoy the process of science discovery. Success is defined by how well your child uses creative and investigative thinking skills to discover more about his or her world. What better opportunity for your child to develop such skills than to participate in a science fair. The thinking skills a child develops while doing a science fair project are the same basic skills he or she will use daily throughout his or her life-to sense and clarify problems that exist, and to find creative solutions to those problems.

We encourage you to support your child's efforts at every step-guiding and encouraging whenever necessary. Parents sometime want to build an entire project, to make it "perfect". It is more important that your child wrestle with problems and try to solve them, because learning is in doing. Guide your child whenever and wherever you can, but let the final project reflect your child's individual effort and design.

I have attached a booklet prepared by Patrick McGinn that contains many frequently asked questions. If you have any additional questions please call me at 256-7280.

Sincerely.

Ron Sheade
Science Fair Coordinator

Science Projects

By Patrick McGinn

Purpose of this booklet

Help yourself and help your children complete a commendable science project.

For parents, science projects are often just another intrusion into an already too hectic life. Even the simplest project consumes considerable amounts of precious free time.

Science projects, however, are one of those school assignment where parent assistance is not only allowed, but encouraged (maybe even expected). You feel obligated to help, if only to demonstrate your dedication to your child's education.

And you probably wouldn't mind, if you saw clear-cut objectives. "What, specifically, is my child specifically expected to achieve?" Instead of answering these questions, what scant instructions that are provided are usually murky and difficult to read.

Of course, parent-assisted projects often become parent-dominated projects. It's really annoying to attend the science fair and discover that the projects on display are often obviously NOT the work of a school-age child. Instead, the fair has become a competition among parents. And, after all your hard work, you don't win!

This booklet is intended to help parents get quickly to what they need to do to help their child complete a successful project. The project may not rival those achieved by an overabundance of parental assistance, but it wil attain its purpose.

Why do science projects?

Almost daily (or so it seems) some favored snack is identified as "cancer-causing", or some detested vegetable is labeled "cancer-fighting."

Scientists make these determinations by experimentation. Scientific research is often cited in newspapers and then contradicted. Why? Because even the simplest experiment can become complex and the experiment's validity shadowed by doubt. This explains much of the controversy surrounding "scientific facts," and an important lesson to learn from our own experiments.

Although a student's science project is going to be far simpler than a scientist's, its still follows the same basic procedure, called the Scientific Process. This five-step process consists of:

1. Writing a research question
2. Writing a hypothesis
3. Developing a procedure
4. Stating results
5. Stating conclusions.

These five steps will be dealt with in greater detail later in this booklet. Finally, properly done, science projects provides a rare opportunity for students to combine a number of academic skills to produce an end product.

What science projects are Not

Too often, science projects are equated with science demonstrations. It's cute to see that vinegar and baking soda together cause a reaction, and if the reaction occurs in a mock-up of a volcano, it's a rather distinctive demonstration. But that's all it is. A demonstration. No new information was discovered. (Note: science demonstrations may be acceptable at some science fairs, but it really isn't a science experiment. If demonstrations aren't acceptable, and that's what your child turns in, it could harm your child's grade.) Some popular science demonstrations include showing how clouds form, how electricity is conducted, how caterpillars become butterflies, etc.

These science fair projects should be shelved. Besides, they require far too much effort.

What science projects are

Science projects should involve students in an experiment where the result can be guessed at by isn't known for sure. This is actually an advantage over the demonstration projects: if something unexpected occurs with an experiment, the projects doesn't need to be trashed; it's all right in an experiment for the conclusion to contract the hypothesis. The demonstration project should only have one result; if that goes wrong, you and your child blew it.

Keep It Simple

Science Projects do become complex, so keep the experiment simple. This is actually very important to the scientific process: the simpler the experiment, the less likely than some unknown variable caused the result. Besides, it's like starting a homeowners project: replace the drapes and the carpet suddenly looks awful; replace the carpet and the tiling looks out of place; replace the tiling . . . you know. So if you start simple, hopefully the experiment will stay manageable.

What is simple? With the battery example, choose just two types of batteries -- not every battery on the market. For detergent, the same thing applies. If the experiment involves plants, choose two types of plants. Which lasts longer, Duracell or Eveready? Which cleans better, Tide or Bold? What grows better in damp soil, marigolds or periwinkles?

Experiment Ideas

Commericals are a gold mine for ideas for simple experiments. Does Joy lastlonger than the leading bargain brand? Does Tide really clean better than its competitors? You can use these commercials for inspiration. For example, does the battery that propels silly bunnies across endless commercials really last longer? If you're a cynic, you say no. If you're taken in by the ads, you say yes. If you're a budding scientist, you say, "let's experiment."

Experiment ideas are all over, and the near at hand are the best. After all, science is expected to improve our daily lives. By applying science to problems in our lives, it can do just that.

Again, commercials provide a lot of ideas. And they provide a lot of humor too, which can help when presentation time comes round.

Other ideas

Have a spot in the garden where nothing grows? Try a couple of different plants.

Do you think you may be overwatering the lawn? Take a patch of out-of-the-way grass. Water if carefully with different amounts of water. What are the results?

Which type of house plant will do better under a skylight? In a kitchen window? In a dark corner?

Does an aluminum bat hit a ball farther than a wood bat?

Does saccharine attract ants like sugar does?

Which diaper is really more absorbent?

Before you get decide on a science experiment, brainstorm a long list. Get silly about it. Write them down. Let your child think about them for a while. Then decide.

The five steps in the Scientific Method

To conduct a proper experiment, you must follow the scientific method. The scientific method requires:

* a research question or problem
* a hypothesis.
* the procedure
* the results
* conclusions

The research question

The research question is, very simply, what is the scientific experiment about. For example, with the battery-operated bunny, the question is: Which battery lasts longer, Everlasting or Unstoppable? If you chose diapers for the experiment, the question is, which diaper lasts longer, Unquenchables or Drinklots?

The hypothesis

The hypothesis, simply put, is the expected outcome of your experiment. You've always liked Unquenchables, you've told everyone you know about Unquenchables and now youÕre going to prove to any doubters out there that Unquenchables are, indeed, better than Drinklots. Your hypothesis is, "Unquenchables absorb more liquid than Drinklots."

Note: It's important to word your hypothesis correctly. For example, don't say that Unquenchables are better than Drinklots, because better is very subjective. Better in what way? Drinklots may have really cute bunnies and rabbits while Unquenchables come in plain white. To many, Drinklots is better because it's cuter.

The procedure

When young experimenters work on the procedure to conduct their experiment, the simple becomes complex.

That's because procedure has to focus on one variable. If there's more than one variable, the experiment becomes flawed. For example, Battery Unstoppable was tested in a small toy and Battery Everlasting in a larger one. Battery Unstoppable

lasted longer. However, Battery Unstoppable may not be the longer-lasting battery because there were two variables: 1) the battery and 2) the toys. Quite likely, the larger toy required more energy, thus draining the battery faster. This is an obvious example, but subtle variables in other experiments have invalidated those experiments.Therefore, a successful procedure will eliminate all but the one variable that is being
tested.

The procedure itself may cause complexity. For example, if testing how plants grow under different conditions, how long will it take to complete the experiment. Weeks? Months? If soil conditions call for moist and dry, what steps will the student take to ensure that that moisture stays moist (or dry, if its during the rainy season).

Once a procedure has been decided upon, it should be written down carefully. For example:

1. Purchase two Everlasting D batteries and two Unstoppable D batteries.
2. Purchase two identical bunny toys
3. Install the batteries and turn both toys on.
4. Keep a log of what the bunny toys are doing during the experiment
5. Note which toy fails first

The simple experiment also becomes complex when research is considered. Why would one battery last longer than another? More importantly, why do batteries work at all? The experimenter has to answer these questions. For the batteries, and for many other commercial products, great research is only 32 cents away. Have your child write a letter to the producer of the product.

Other sources of information:

* The encyclopedia
* The school library
* The public library

* Through the computer, if you or your school is hooked into one of the on-line services, such as America On Line or Compuserve.

Results and Conclusions

The final two items gives students considerable difficulties because, to them, they are the same thing. They're not. The confusions comes from the fact that conclusions directly follow results.

Results are the specific results of the experiment. If Unstoppable batteries lasted longer than the Everlasting batteries, the results of the experiment would be:

"The Unstoppable D batteries continued to power the toy 22 minute longer than the Everlasting D batteries."

The conclusion would be:

"From my experiment, I determined that my hypothesis was correct (or incorrect). Unstoppable batteries last longer than Everlasting batteries."

Summary

The summary (it sometimes goes by the title of Abstract) is the final bit of exhausting work, and yet it is among the most important tasks your child undertakes. It's also difficult. The reason: he or she has to write in about a page the most important information accumulated during the entire science project. It's important, because, despite all your hard work (and your child's) on the notebook, most attendees (and even judges) won't get much beyond the the summary.

Make sure the summary includes:

* The research question
* The hypothesis
* Why your child chose this experiment
* The results

* What your child learned

Notebook

Different schools will have different requirements about the notebook. It should certainly include a Title Page, the problem, the hypothesis, the procedure, results and conclusions. It should also contain a research report and a bibliography (style shown below.). The most important page should be acknowledgements -- the people who helped your child. Don't let your child pretend he or she didn't have help. It should help with the judges that he or she acknowleges the help and clearly states how much help he or she receives.

The Display

Display boards are often available in office products stores and in educational supply stores. They cost about $6. They are another expense, but they do make it easier to complete the board. Board can also be constructed of pegboard and joined by hinges. Displays should clearly state the title of the project plus, of course, the problem, the hypothesis, the procedure, results and conclusions. Thus they have to be brief. In addition, acknowledgements should, in my opinion, be included. Additional written work (summary and notebook) should be separate. Displays (toy bunnies) are helpful but not essential.