Jensen Beach High School Science Fair Project
Student Guide to
Using the Scientific Method

Introduction

One of the most effective tools you will use in the evaluation of information or events is the scientific method. This is an organized approach to solving a problem. In science, the term "problem" refers to a question for which you want an answer. Use of this method, along with a good science education, enables a student to be a scientifically literate consumer. The singular, most effective, means of learning the scientific method is through the completion of a science project.

The goal of the SCIENCE PROJECT is EDUCATION IN THE USE OF A SOUND PROBLEM SOLVING METHOD. All projects completed according to guidelines given will be entered in the science fair. The goal is not competition but to recognize student achievement in research, experimental design, and presentation of a project. You will gain something by doing a science project. At the very least, you will become better able to use the scientific method and gain confidence in your ability to accept an academic challenge.

This student guide should help you through all steps of your scientific project. Please refer to this guide throughout the time you are working on your project and be sure you are meeting teacher expectations.

Overview of Science Project Steps

1. State a Problem (in the form of a Question)

Probably the biggest mistake students make when they do a science fair project is that they choose something they do not like! Because these projects require a lot of effort, choose something you are interested in. Choose a topic you enjoy. It makes the project much more interesting and fun.

Try using the following format when writing your problem:

- What is the effect of _____(independent variable)_____on____(dependent variable)_____?
  - OR
- How will _____(independent variable)_____affect the _____(dependent variable)_____?
- You can use your problem statement as the title of your project. Choose a title that describes the effect or thing you are investigating. The title should be short and summarize what the investigation will deal with:
  - The Effect of ____(independent variable)____on_____(dependent variable)_____

2. Research with Bibliography

After you have chosen a problem/question, do your research. Find out the science or scientific principles behind your project. This should be an intense search of reference material to obtain as much information as possible concerning your problem. This might involve doing research in the library, interviewing people or using the internet. As you search for information, keep track of where you got your information. You will be required to submit a bibliography of your research. You must site **Five (5)** references as well as www.societyforscience.org as your sixth listing. This is the ISEF website for rules and help. All of sources cannot be from the Internet.

References are written or typed in this form:

Last name of author (or person you talked to), First name. "Title of article or chapter (if any)," Title of reference source (book title, magazine title, or "Conversation). Place where published: then publisher's name, Date, volume: p. #'s used.

The following indicates the type of information required concerning each reference (including actual examples) and the appropriate way to list it in your bibliography:

BOOK BY ONE AUTHOR:

Smith, James. Science Projects. New York: Collier, 1992.

TELEVISION PROGRAM:

"Amei Wallach on Cousteau." The MacNeil/Lehrer News Hour. PBS WNET, New York. March 18, 1992.

MAGAZINE ARTICLE:

Smith, James. "Animal Husbandry." Reptile and Amphibian Magazine. March 1993: pp. 23-35.

NEWSPAPER ARTICLE:
Smith, James. “Nesting Terns.” Northwest Florida Daily News. 7 July 1993. A5
PERSONAL INTERVIEW:
Peterson, Harry. Personal Interview. 24 June 1990.
INTERNET WEBSITE:
International and Science Engineering Fair.2005.Science Service.15 Sept. 2005.<www.sciserv.org/isef/student/rules_regulations.asp>

Also available for help is the website:

http://citationmachine.net/

This is an interactive website in which you select the type of reference used (book, website, etc.) and it will automatically ask for the proper information needed and then format it in the correct order with the correct punctuation.

3. Develop a Hypothesis that will Identify Variables

Based on your gathered information, make an educated guess about what situations will affect the system you are working with. Identifying variables is necessary before you can make a hypothesis. An independent variable is the variable that is being changed on purpose. It is the one you choose to change to see what happens. The dependent variable is the data you are going to measure to see if the independent variable had any affect. You combine the two variables into an educated guess, your hypothesis. You must write the hypothesis in an “If..., then... statement.” This is easy; think about what comes first in the experiment, and then what you think will happen afterwards. The independent variable is what goes after the IF and the dependent variable goes after the THEN in the hypothesis and ended with the BECAUSE. Any other variables must be identified and stated as being held constant. A constant is anything else that could change the experiment that you didn’t allow to change.
The format should look like:
IF ____(the independent variable)_____ is ___(increased, decreased, changed)____, THEN ____(the dependent variable)_____will ____(increase, decrease, change)____, because _____.

For example:
Independent variable = amount of sunlight
Dependent variable = length of plant growth

HYPOTHESIS—
IF the amount of sunlight is increased, THEN the length of the plant growth will increase BECAUSE light is a requirement for plant growth.

4. Design an Experiment and Complete Paperwork.: The Materials and Procedure

Design an experiment to test the hypothesis. Make a step-by-step list of what you will do to answer each question. This list is called an experimental procedure. For an experiment to give answers you can trust, it must have a “control.” A control is an additional experimental trial or run. It is a separate experiment, done exactly like the others. The only difference is that no experimental variables are changed. A control is a neutral “reference point” for comparison that allows you to see what changing a variable does by comparing it to not changing anything. Dependable controls are sometimes very hard to develop. They can be the hardest part of a project. Without a control you cannot be sure that changing the variable causes your observations. A series of experiments that includes a control is called a “controlled experiment.”
Write a detailed and precise procedure that includes both the correct sequence of steps to be taken and the materials and equipment needed. The procedure should be detailed enough so that another experimenter could duplicate the experiment without having to ask you ANY questions!

MATERIALS
List all the materials you intend to use in your experiment including quantity and dimension. They should be listed in column form and in the order they are used in the experiment. Use the metric system whenever possible.

PROCEDURE

NUMERICALLY list each and every step in the exact order you intend to perform your experiment. Do not format the steps in a paragraph. Explain how you will measure your results and compare them to your hypothesis. Be specific, but try not to make it complicated. Once you decide on your experimental setup, a photo or drawing should be made to add to your log book and to the display board. Throughout your experiment you should take photos of the ongoing process of your experimental procedure. However, no person's face should be included in the photo; including you, the scientist.

GET APPROVAL/COMPLETE FORMS
To find all rules and forms according to ISEF, go to: www.societyforscience.org

All projects require completed forms: (to determine which forms you need you can use the online rules wizard at that site).

Checklist for Adult Sponsor/Safety Assessment Form (1)
Research Plan (1A)
Research Plan Attachment and Approval Form (1B)
**Regulated Research Institutional/Industrial Setting Form (1C), if required
Abstract and Certification

The following areas require review and approval by SRC or IRB **prior to experimentation**:

VERTEBRATE ANIMALS –
Above forms with prior SRC or IACUC approval 5A or 5B **1C, 2, 3, if required
HUMAN SUBJECTS – Above forms with prior IRB approval 4 **1C, 2, 3, if required
PATHOGENIC AGENTS – Above forms with prior SRC approval 2 **1C, 3, if required
CONTROLLED SUBSTANCES – Above forms with prior SRC approval 2 or 3 **1C, 2, 3 as required
RECOMBINANT DNA – Above forms with prior SRC approval **2, 3, 1C as required

The following areas require approval by a Designated Supervisor prior to experimentation:

HUMAN/ANIMAL TISSUE SAMPLES – Above forms with prior Designated Supervisor approval 3, 6 **1C, if required
HAZARDOUS SUBSTANCES OR DEVICES – Above forms with prior Designated Supervisor approval 3 **1C, if required

YOU ARE RESPONSIBLE FOR FOLLOWING
ALL RULES MANDATED BY THE ISEF AS STATED ONLINE AT:
(Please review them carefully)
www.societyforscience.org

5. Test the Experiment (at least 3 times)

The experiment should be repeated at least three times. The more tests are repeated, the more accurate your results will be.

- KEEP A LOG BOOK OF ALL THE INFORMATION YOU HAVE GATHERED IN YOUR EXPERIMENT!
- Your log book should be a BOUND NOTEBOOK. Which means one where you cannot tear out the pages.
- All entries should be made in INK!

6. Record Observations and Data with Log Book

Every science fair project is required to have a project notebook. You should begin your log book Day 1 of your project. The project notebook or log book should contain any and all information about your project that is not listed on your display board, including any raw data you acquired and your actual data log/chart. Any previous experiments or research you have conducted on your problem should also be included in the project notebook. You should write down what happened during your experiment.

There are two different types of observations—qualitative and quantitative. Qualitative observations are word and descriptive writings. These are any changes you see, hear, smell, or feel! Quantitative observations are your number recordings. Quantitative observations are usually measurements. All measurements are recorded with units. Measurements are taken and recorded correctly in a table that is labeled correctly. Do not try to explain your results at this point, just record them in the form of a data table. BOTH need to be made, and both are important. Both observations should be recorded in your log book.

Quantitative data are kept in charts or tables. Each data table is labeled correctly with titles given for each variable.

Data Table Title			
Independent Variable (Cause)	Dependent Variable Name (Effect)		Average
	Trial #		
	1	2	3

7. Summarize and Analyze Results with Graphs

Present the data recorded in your chart/table in a visual graph. When using a graph, you can see trends that will tell you how different variables cause our observations. Based on these trends, you can draw conclusions about the testing experiment. These results can help you confirm or deny your original hypothesis.
The written results paragraph will summarize the data and your analysis of how it relates to the questions you're hoping to answer through your experiment. It should state what actually happened in the experiment, even if it is not what was expected in your hypothesis. An example results paragraph would include a topic sentence stating the independent and dependent variables and a reference to the table and graph, sentences comparing the measures of the average testing samples (including statistical numbers), and finally sentences stating support (or non-support) of the hypothesis by the data including a restatement of the hypothesis.

8. Draw Conclusions

A conclusion paragraph usually contains a description of the purpose of the experiment, a discussion of your major findings, an explanation of your findings, and recommendations for further study. Usually the following questions are presented in paragraph form:
What was the purpose of the experiment?
What were the major findings from your results?
Was the hypothesis supported by the data? Why or why not?
How did your findings compare with those of other researchers?
What happened that you did not expect? How can you explain this?
What recommendations do you have for improving this experiment?
What recommendations do you have for further study?

Evaluate and Apply to the World

The evaluation paragraph takes a look at the overall experiment. It should find two or more things that limit the results. This would include things that kept your experiment under control or that kept the experiment from working in a better way. The paragraph should explain how the experiment could be done in a better way. The evaluation paragraph should make suggestions on how your experiment could contribute to real life situations; this is known as application. You could list some questions or problems that your results could form to extend knowledge. For example; once you learn something it makes you think of more questions. What else could you investigate about this problem? Also, how would you be able to use the information found from your experiment? Could the information you used be put to use by an industry? How could this information affect normal everyday life?

9. Science Project Paper

After you have completed all the components to your project, the parts will be placed on your project backboard and typed up for your project paper. Both the backboard and project paper include the same material EXCEPT your backboard will not have an "introduction" which includes your research, your project paper will. Once you have typed up your project paper print two copies of each part—one for the board and one for the project paper. The project paper should adhere to the following guidelines:

TITLE PAGE
Project Title, Student Name, Teacher name & Period, School
TABLE OF CONTENTS
A listing of each section and its page number
INTRODUCTION
Explain the background research information about the problem and the reason behind the choice of study, its purpose, and then state the problem. Establish a strong reason for the usefulness of the study of your project. Conclude by stating your hypothesis.
MATERIALS & PROCEDURES
List all materials needed to complete the experiment. State the steps of the procedure to conduct the experiment.
RESULTS
Present the data and graphs made from the experiment. Include your results paragraph.
CONCLUSION
Include your conclusion paragraph.
EVALUATION & APPLICATION
Include your evaluation and application paragraph.
ACKNOWLEDGEMENTS & CREDITS
Credit anyone who assisted you in completing the project. This could include mentors, parents, teachers, those who contributed materials to help you conduct the experiment, and those who allowed you the use of their facility.
BIBLIOGRAPHY
List should include any material from outside sources (books, websites, papers, journal articles, and any communications cited in your research paper). You must cite a minimum of five references as well as the www.sciserv.org website.
COPY OF YOUR ABSTRACT

10. Abstract

Below is the format for a typed abstract. You will need to use the ISEF form found on their website. IT CANNOT BE SAVED. Be sure to print several copies. If possible, copy and paste onto your hard drive or a disk for safe keeping:

www.societyforscience.org

TITLE OF PROJECT (IN ALL CAPS)
(Do not include name until after judging)
School Name, City and State
The abstract must include a maximum of 250 words, and the print font should be Times New Roman and size can be no smaller than 10-pt. type. The paper size should be 8½ x 11 inches. The abstract is a summary of your project that should include:
Paragraph 1 –

1. The purpose of the research (why you did your project)
2. A statement of the hypothesis

Paragraph 2 –

3. The procedures of your experiment

Paragraph 3 –

4. Observations, results, and conclusions

Print four copies – one for display board, one for research paper, extra for ISEF (if needed), one for yourself.

11. Display Board

Your display should be designed so that judges and spectators can easily follow your experiment and the results you have obtained. All graphs, charts, and photographs that you use should be clearly labeled and your headings visible. The display must be freestanding.
Size limitations are: 30” deep x 48” wide x 108” high
Suggested materials are: stiff cardboard, hardboard, plyboard, corkboard, and paneling
On the very back (not side flaps) should be: Student name (first & last)
Teacher’s last name
Period

TOPIC CATEGORIES

Behavioral and Social Sciences
How people or animals react to different circumstances

Biochemistry
Studies done with chemicals associated with living things

Botany
Studies conducted on plants

Chemistry
Study of nature and the composition of matter and laws governing it

Computers
Programs and studies associated with computers

Earth and Space Science
Studies related to the earth and space

Engineering
Technology: application of scientific principles to manufacturing and practical uses

Environmental Science
Studies concerned with the environment

Mathematics
Probability studies/fractals or related topics

Medicine and Health
Study of diseases and health of humans and animals

Microbiology
Studies related to microscopic organisms

Physics
Theories, principles and laws governing energy and the effect of energy on matter

Zoology
Studies dealing with animals; either vertebrates or invertebrates

Team
Any project performed by more than one person

Science Fair Project Judging and Grading

Name (Member #1) _____
Name (Member #2) _____
Project Title: _____

	Possible Points	
	Individual Projects	Team Projects
Creative Ability There was an unknown question asked Within the student's ability The scientific method was used	_____/30	_____/25
Scientific Thought Well thought out Goals were well defined Logical hypothesis Data related to hypothesis	_____*/30*	_____*/25*
Thoroughness Data was complete Controls were identified Sample size and populations were appropriate Variable was clearly defined Replications and duplications were utilized Data collected in quantitative units Several trials were done Study was complete Data thoroughly analyzed	_____/15	_____/12
Skill Protocols were handled with skill Experiment designed with care Measurements done precisely, using metrics Detailed notebook or log was kept Student's work, no excessive help	_____/15	_____/12
Clarity Student can explain what was done Student understands research Student understands meaning of results Student understands future implications Student is clear hypothesis was either supported or unsupported	_____/10	_____/10
Teamwork	_____/0	____/16
TOTAL POINTS	_____*/100*	_____*/100*

This report and presentation will weighted as a double TEST grade.