

## 11.0 WRITING THE PAPER

Your report will provide interested readers with a comprehensive look at your topic and research. Your paper should include information collected during the research as well as a complete description of your experiment, data, and conclusion.

There are two types of science research papers, and they may be separate or combined. The first type is a literature review. In the literature review, you compile and summarize large amounts of scientific research done by others that cover the topic chosen for investigation. You do not include your own laboratory investigations in the literature review. The review should be extensive, citing as many sources as you can locate on the topic.

The second type of research paper describes the specific experimental project you have completed. It should contain an abbreviated (abstract) or full literature review as part of the background information as well as your hypothesis, experimental design (methods and materials), experimental results, brief data summary, discussion and analysis of the results, and bibliography.

You can do both types of paper separately, or put them together in one inclusive report. A thorough search of the scientific literature published on the topic covered in the project helps to make you an "expert" in your particular field of study, and prepares you to confidently discuss the area of study with others.

Use scientific terminology in the paper. It will help you to feel more at ease with the topic. Your job is to convey the facts and information you have gleaned in an organized, readable, and concise manner.

**A good research paper** should be written in the past tense and have the following components:

- Title and/or Title Page
- Abstract, Summary Page/Index
- Introduction, including Literature Review
- Hypothesis or Statement of Purpose
- Materials and Experimental Methods
- Data and/or Results
- Discussion and Analysis of Data or Results
- Conclusions
- Acknowledgements
- Bibliography

### Considerations for Engineering or Computer Projects

- Title Page
- Abstract or Summary Page
- Introduction - Background from reading about similar devices or systems, how they work, their history etc.
- Statement of Purpose - What was the device, program or system designed to do?
- Materials and Experimental Methods
  - Describe the structure and parts. How does the device, system or program work?
  - Include a detailed schematic or algorithm.
  - Give measurable characteristics of the device or system (for example: dimensions, weight, power supply, voltage generated, software and hardware requirements).
- Data or Results - How did you prove your device or system works?
- Discussion and analysis

- If the system was tested over a range of conditions, graphs can be used effectively.
- What problems prevent the device or system from being fully successful?
- Give suggested improvements.
- Conclusion – Did the device or system do what it was designed to do?
- Acknowledgements
- Bibliography

**After you have gathered all your information**, you may find the following steps helpful:

1. Produce a report outline that provides a skeletal structure for the entire paper. A good outline will give direction, cohesiveness, and orderliness to the paper, and convey the information in a concise format. Be descriptive but brief. Reduce large quantities of information into brief "bullet statements" for use throughout the paper. Organize them into a step-by-step description to walk the reader through the project in an orderly progression. Use your sources to "work for you" and distill information into a reasonable length. When you write from the outline, each paragraph should have a topic sentence and a concluding sentence to direct the reader.
2. If you use note cards, organize these by sequencing them in a desired order.
3. Write an introductory paragraph that acquaints the reader with the research paper. Give a preview of information that is covered in the paper. Briefly highlight the main points of the paper (50 - 75 words).
4. Take material from the note cards and put it into written text.
5. Footnote or cite sources properly. Cite references directly within the paper with the citation set off by parentheses, and cross-referenced in the Bibliography or List of References. Use citations when you give facts such as numbers, data, and statistics, quote a source directly, cite another researcher's results, or cite information received from another expert in the field.
6. Integrate support material. Be certain that pictures, diagrams, tables, and graph axes are properly labeled and include units of measure.
7. Write a summary paragraph as your conclusion. Make a concluding statement and bring the paper to a close. It should state whether or not the results supported the hypothesis.
8. Be careful to acknowledge all borrowed material whether paraphrased or directly quoted.
9. Be careful to give proper credit. Use quotes and citations where appropriate.
10. Reference sources in the Bibliography, which may also be called the List of References, References Cited, Literature Cited, or Sources Cited.
11. Check spelling, grammar, and punctuation. Do not rely on software alone to do these checks.
12. Read the paper aloud and check for clarity and readability.
13. Have someone else read the paper.
14. Correct errors.
15. Use standard size (8½ x 11) white paper. Use standard margins. Type on one side only.
16. Have your report(s) with you as a part of your display when presenting your project.



## Citing Sources; Avoiding Plagiarism in Scientific Work

When using the work of other scientists you must document their contributions by citing your sources of information. Scientists use the American Psychological Association (A.P.A.) Guidelines, which differ from those used in writing English, or History papers. There are no footnotes at the bottom of the page. The acknowledgement of a direct quotation or your use of some one else's original idea is done within the text of the paper itself. Use citations to cite a fact, quote directly from a source, or to cite information obtained personally from an expert. The citation is set off using a "signal phrase" or with parentheses and is cross-referenced in the Bibliography.

1. **Book or Article:** Author(s) last name(s), year of publication  
"Many more worms were found in the dark compost than the light compost" (Martin and Stephen, 2000).  
**OR**  
Martin and Stephen (2000) found that worms prefer dark colored compost.  
**OR**  
Worms prefer dark colored compost (Martin and Stephen, 2000).
2. **Encyclopedia or CD-ROM:** Author or if no author is listed article title, year, encyclopedia or CD-ROM  
(Worms, 2000, Encyclopedia Britannica)
3. **Letter or Conversation with an Expert:** Name of expert, state "personal comm." (for personal communication), date of the communication  
Martin (pers. comm., September 13, 1952) said that worms prefer dark colored compost.  
**OR**  
Over 50% more worms were found in the dark compost than the light compost (Stephen, pers. comm., September 13, 1952)
4. **Internet source:** Author, date, and state "Internet"  
(Martin and Stephen, 2000, Internet) **OR** (Compost and Worms, 1952, Internet)

For more details you may want to consult A Writer's Reference by Diana Hacker or Purdue University's APA Style Guide (<http://owl.english.purdue.edu/>).

## Bibliography or References

Most scientists use the American Psychological Association (APA) system for citation and references; guidelines are as follows:

1. Give the last name of the author followed by initials. Include all of the authors' names in full (not et al as is found when citing in text).
2. Alphabetize your entries by last name of author or editor. If there is neither, use the first important word in the title.
3. With two or more works by the same author, use the author's name for all entries and arrange the entries by date, the earliest first.
4. Indent the second and additional lines of each entry five spaces.
5. Place the date of publication in parenthesis immediately after the last author's name.
6. Underline or italicize the titles and subtitles of books; capitalize only the first word of the title and subtitle (as well as all proper nouns).

7. Before page numbers of newspaper articles and works in anthologies use “p.” or the plural ‘pp.’ before the page numbers. Do not use these before page numbers of articles appearing in magazines and scholarly journals.
8. The publisher’s name may be given in short form as long as it is easily identifiable.

Note the punctuation in the samples below. Each item is separated by a period “. ” A comma “,” precedes the pages. A colon “:” separates city of publication and publisher.

## **BOOKS**

Author’s last name, Initials. (Year of Publication). Title of Book. City of Publication:  
Publisher

Emery, K.O. (1997). A Coastal Pond Studied by Oceanographic Methods. Woods Hole, MA: Oyster Pond Environmental Trust Inc.

## **JOURNALS, SERIALS OR MAGAZINE ARTICLES**

If Author is Named:

Author’s last name, Initials. (Year of Publication). Title of article. *Journal name (or abbreviation)*. *Volume (number)*, page numbers.

Weiss, P. (May 13, 200). Gravity gets measured to a greater certainty. *Science News*, *Volume 157, No. 20*, 311-312

If No Author is Named:

Title of Article. (Year of Publication). Journal Name. Volume (number), page numbers.

Gravity gets measured to a greater certainty. (May 13, 2000). *Science News*, Volume 15, No. 20, 311-312

## **NEWSPAPER**

Author’s last name, Initials. (Year of Publication, month, day). Title of article. *Name of Newspaper*, Page number(s)

Zuckoff, M. (2000, 10, 31). What’s killing the coral reefs? *The Boston Globe*, F1-F2

## **PERSONAL INTERVIEW, LETTER OR TELEPHONE CONVERSATION**

Name. Title or position, Institution, Location. Type of communication, date(s) of interview(s)

Shore, S. Senior Scientist. Woods Hole Oceanographic Institution, Woods Hle, MA. Pers. Comm., June 14, 1984.

## ELECTRONIC INFORMATION

Give the same publishing information that you would give for any material and in addition give the pertinent information about the electronic source (address). For material retrieved from an online source, also provide the date that you accessed information.

### CD-ROM

Author, A. (Date). Title of article. In Title of the database (Type of medium). Available: Supplier/Database Identifier or Number (Version).

Lawrence, J. C. (1996). Algae. In The 1996 Grolier Multimedia Encyclopedia. (CD-ROM). Available: Mindscape, Inc. (Version 8.0.3)

### INTERNET SOURCES

#### If Author is Named:

Author, A. (Date). Title. <address>

Smith, M. (Dec. 25, 2000). How to Do Your Science Project. <<http://www.scifair.com/>>

#### If No Author is Named:

Title. (Date). <Address>

How to Do Your Science Fair Project. (Dec.25, 2000). <<http://www.scifair.com/>>

