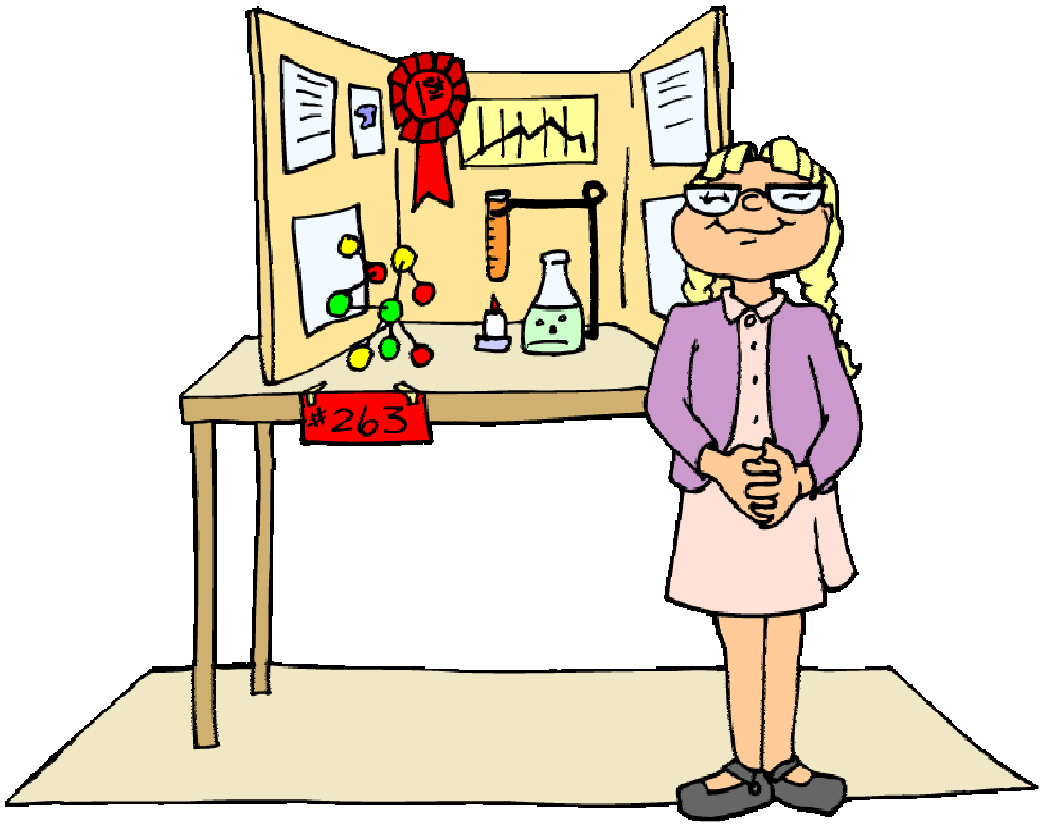
Science Fair
Student Booklet



Science Fair Central

Science Fair Project Application

Name: _____ Date: _____

Teacher's Name: _____ Grade: _____

Project Title: _____

Brief Project Description:

_____

_____

_____

_____

Project Area (circle one):

Biology Chemistry Physics Mathematics Behavioral General Science

Project Type (circle one):

Experiment Research Collection Apparatus Demonstration

Your project should include the following items. Please check the list to confirm you have included each one:

____ **1. Display that can stand by itself**
____ **2. Exhibit and all necessary materials**
____ **3. Abstract (one-page summary) with bibliography**
____ **4. Research paper with bibliography**
____ **5. Oral presentation (3 to 5 minutes)**
____ **6. Logbook of daily work**

Teacher Review (initials): _____

Safety Review: _____

Just a Reminder . . .

Project Display Checklist

Students should start planning their displays as soon as they begin their projects. Some of the items that should be on display are:

1. **Pictures taken during the experiment**
2. **Data notebook or background research notebook**
3. **Any equipment or material used in the experiment (that is not excluded by rules)**
4. **Abstract**
5. **Title (as a header at the top of the display board)**
6. **Hypothesis**
7. **Procedure**
8. **Results**
9. **Conclusions**
10. **Applications**
11. **Charts, graphs, tables, or other visual aids**
12. **Statistics, where appropriate**

Other Display Tips

- **Arrange your table to fit the space available.**
- **Allow plenty of space between the rows so students, parents, and judges can pass through easily.**
- **Cover your tables with thin vinyl or butcher paper in school colors.**
- **Remind students that they are an important part of their displays, too. They are representing their school to the public and should be dressed appropriately, should not chew gum or listen to music, and should respect other students and judges. Also, be sure they are prepared to describe their projects to a judge in a clear, succinct presentation.**

Student Science Fair Handbook

http://school.discovery.com/sciencefaircentral/scifairstudio/handbook/index.html

http://schools.tdsb.on.ca/valleypark (click on **News**, then **Events**, then **Science Fair**)

So you're going to do a science fair project. Great! Your work could be chosen as an entry in your school fair and even in regional, state, or national competitions. As a participant in any science fair, you'll get to show off your work and possibly receive achievement awards. But most important, you'll also learn a lot about science by observing and sharing with other science fair participants.

A science project is like a mystery in which you are the detective searching for answers. Science projects let you practice and exhibit your detective skills. You not only get to select which mystery to solve, but you can creatively design methods for uncovering clues that will lead to the final revelation of who, what, when, where, how, and why. This book will give you guidance and ideas. It's your job to discover the answers!

This book covers the eight most important points you need to know for science fair success:

1. **Scientific Method**
   Research, Problem, Hypothesis, Experimentation, Conclusion

2. **Topic Research**
   Project Types, Three Steps to a Topic, Research a Topic, Topic Ideas

3. **Project Research**
   Primary Research, Secondary Research

4. **A Sample Project**
   Starting Your Project, Procedures, Results, Explaining Your Results, Hypothesis

5. **Project Report**
   Title Page, Table of Contents, Abstract, Introduction, Experiment and Data, Conclusion, Sources, Acknowledgments

6. **The Display**
   Helpful Hints, Do's and Don'ts, Safety

7. **Presentation and Evaluation**
   Judging Information, Do's and Don'ts at the Fair

From *Janice VanCleave's Guide to the Best Science Fair Projects*,
Janice VanCleave (John Wiley & Sons, Inc., 1997)

Scientific Method

Please refer to your SKILLS HANDBOOK (pg. 9 -18) to learn more about the Scientific Method / Process of Scientific Inquiry.

Research

Do use many references from printed sources—books, journals, magazines, and newspapers—as well as electronic sources—computer software and online services.

Do gather information from professionals—instructors, librarians, and scientists, such as physicians and veterinarians.

Do perform other exploratory experiment related to your topic.

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Problem

Do limit your problem. Note that the previous question is about one life process of molds—reproduction; one type of mold—bread mold; one type of bread—white bread; and one factor that affects its growth—light. To find the answer to a question such as "How does light affect molds?" would require that you test different life processes and an extensive variety of molds.

Do choose a problem that can be solved experimentally. For example, the question "What is a mold?" can be answered by finding the definition of the word *mold* in the dictionary. But, "At room temperature, what is the growth rate of bread mold on white bread?" is a question that can be answered by experimentation.

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Hypothesis

Do state facts from past experiences or observations on which you base your hypothesis.

Do write down your hypothesis before beginning the project experimentation.

Don't change your hypothesis even if experimentation does not support it. If time permits, repeat or redesign the experiment to confirm your results.

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Project Experimentation

The **independent variable** is the variable you purposely manipulate (change). The **dependent variable** is the variable that is being observed, which changes in response to the independent variable. The variables that are not changed are called **controlled variables**.

Do have only one independent variable during an experiment.

Do repeat the experiment more than once to verify your results.

Do have a control.

Do have more than one control, with each being identical.

Do organize data. (See A Sample Project for information on organizing data from experiments.)

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Project Conclusion

If your results do not support your hypothesis:

DON'T change your hypothesis.

DON'T leave out experimental results that do not support your hypothesis.

DO give possible reasons for the difference between your hypothesis and the experimental results.

DO give ways that you can experiment further to find a solution.

If your results support your hypothesis:

You might say, for example, "As stated in my hypothesis, I believe that light is not necessary during the germination of bean seeds. My experimentation supports the idea that bean seeds will germinate without light. After seven days, the seeds tested were seen growing in full light and in no light. It is possible that some light reached the 'no light' containers that were placed in a dark closet. If I were to improve on this experiment, I would place the 'no light' containers in a light-proof box and/or wrap them in light-proof material, such as aluminum foil."

Topic Research

Keep a Journal

Purchase a bound notebook to serve as your journal. This notebook should contain topic and project research. It should contain not only your original ideas but also ideas you get from printed sources or from people. It should also include descriptions of your exploratory and project experiments as well as diagrams, graphs, and written observations of all your results.

Every entry should be as neat as possible and dated. A neat, orderly journal provides a complete and accurate record of your project from start to finish, and it can be used to write your project report. It is also proof of the time you spent searching out the answers to the scientific mystery you undertook to solve. You will want to display the journal with your completed project.

Selecting a Topic

Obviously you want to get an A+ on your project, win awards at the science fair, and learn many new things about science. Some or all of these goals are possible, but to reach them you will have to spend a lot of time working on your project, so choose a topic that interests you. It is best to pick a topic and stick with it, but if you find after some work that your topic is not as interesting as you originally thought, stop and select another one. Because it takes time to develop a good project, it is unwise to repeatedly jump from one topic

to another. You may in fact decide to stick with your original idea even if it is not as exciting as you had expected. You might just uncover some very interesting facts that you didn't know.

Remember that the objective of a science project is to learn more about science. Your project doesn't have to be highly complex to be successful. You can develop an excellent project that answers very basic and fundamental questions about an event or situation encountered on a daily basis. There are many easy ways of selecting a topic. The following are just a few of them.

Project Research

After you have completed the topic research and selected a topic, you are ready to begin your project research. This research is generally more thorough than topic research. Project research is the process of collecting information from knowledgeable sources, such as books, magazines, software, librarians, teachers, parents, scientists, or other professionals. It is also data collected from exploratory experimentation. Read widely on the topic you selected so that you understand it and know about the findings of others. Be sure to give credit where credit is due and record all information and data in your journal.

How successful you are with your project will depend largely on how well you understand your topic. The more you read and question people who know something about your topic, the broader your understanding will be. As a result, it will be easier for you to explain your project to other people, especially a science fair judge. There are two basic kinds of research—primary and secondary.

Use Your Research

After you have completed your project research, you are ready to use the information and data collected to express the problem, propose a hypothesis, and design and perform one or more project experiments. The project research will also be useful in writing the project report. The next section, A Sample Project, will guide you step-by-step through a sample project from start to finish.

Primary research is information you collect on your own. This includes information from exploratory experiments you perform, surveys you take, interviews, and responses to your letters.

Secondary research is information and/or data that someone else has collected. You can find this type of information in printed sources (books, magazines, and newspapers) and in electronic sources (CD-ROM encyclopedias, software packages, or online services, such as the Internet). When you use a secondary source, be sure to note, for future reference, where you got the information. If you are required to write a report, you will need the following information for a bibliography or to give credit for any quotes or illustrations you use.

Project Report

http://school.discovery.com/sciencefaircentral/scifairstudio/handbook/projectreport.html

Your report is the written record of your entire project from start to finish. When read by a person unfamiliar with your project, the report should be clear and detailed enough for the reader to know exactly what you did, why you did it, what the results were, whether or not the experimental evidence supported your hypothesis, and where you got your research information. This written document is your spokesperson when you are not present to explain your project, but more than that, it documents all your work.

Much of the report will be copied from your journal. By recording everything in your journal as the project progresses, all you need to do in preparing the report is to organize and neatly copy the journal's contents.

Neatly and colorfully prepare tables, graphs, and diagrams. If possible, use a computer to prepare some or all of these data displays.

Check with your teacher for the order and content of the report as regulated by the local fair. Generally, a project report should be typewritten, double-spaced, and bound in a folder or notebook. It should contain a title page, a table of contents, an abstract, an introduction, one or more experiments and data, a conclusion, a list of sources, and acknowledgments. The rest of this section describes these parts of a project report and gives examples based on the Sample Project.

Title Page

The content of the title page varies. Some fairs require that only the title of the project be centered on the page. Normally your name would not appear on this page during judging. Your teacher can give you the local fair's rules for this. The title should be attention-getting. It should capture the theme of the project but should not be the same as the problem question.

Table of Contents

The second page of your report is the table of contents. It should contain a list of everything in the report that follows the contents page, as shown in Figure 6.2

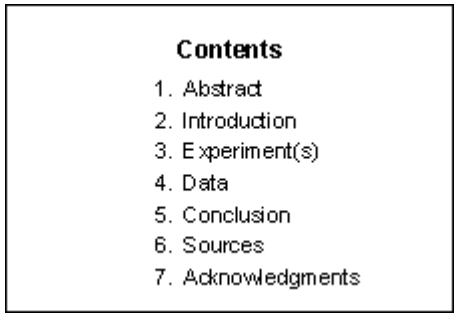
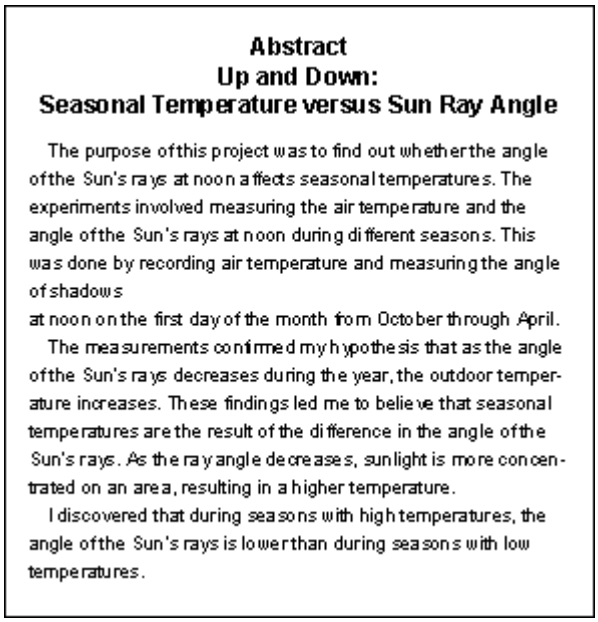


Figure 6.2: A Table of Contents

Abstract

The abstract is a brief overview of the project. It should not be more than one page and should include the project title, a statement of the purpose, a hypothesis, a brief description of the procedure, and the results. There is no one way to write an abstract, but it should be brief, as shown in Figure 6.3. Often, a copy of the abstract must be submitted to the science fair officials on the day of judging, and it is a good idea to have copies available at your display. This gives judges something to refer to when making final decisions. It might also be used to prepare an introduction by a special award sponsor, so do a thorough job on this part of your report.



Abstract
Up and Down:
Seasonal Temperature versus Sun Ray Angle

The purpose of this project was to find out whether the angle of the Sun's rays at noon affects seasonal temperatures. The experiments involved measuring the air temperature and the angle of the Sun's rays at noon during different seasons. This was done by recording air temperature and measuring the angle of shadows
at noon on the first day of the month from October through April.

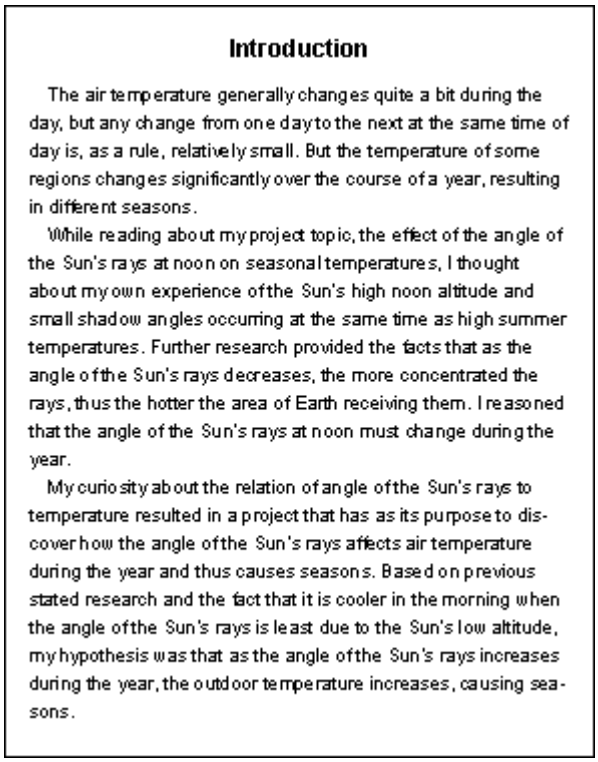
The measurements confirmed my hypothesis that as the angle of the Sun's rays decreases during the year, the outdoor temperature increases. These findings led me to believe that seasonal temperatures are the result of the difference in the angle of the Sun's rays. As the ray angle decreases, sunlight is more concentrated on an area, resulting in a higher temperature.

I discovered that during seasons with high temperatures, the angle of the Sun's rays is lower than during seasons with low temperatures.

Figure 6.3: An Abstract

Introduction

The introduction is a statement of your purpose, along with background information that led you to make this study. It should contain a brief statement of your hypothesis based on your research. In other words, it should state what information or knowledge you had that led you to hypothesize the answer to the project's problem question. Make references to information or experiences that led you to choose the project's purpose. If your teacher requires footnotes, then include one for each information source you have used. The introduction shown in Figure 6.4 does not use footnotes.



Introduction

The air temperature generally changes quite a bit during the day, but any change from one day to the next at the same time of day is, as a rule, relatively small. But the temperature of some regions changes significantly over the course of a year, resulting in different seasons.

While reading about my project topic, the effect of the angle of the Sun's rays at noon on seasonal temperatures, I thought about my own experience of the Sun's high noon altitude and small shadow angles occurring at the same time as high summer temperatures. Further research provided the facts that as the angle of the Sun's rays decreases, the more concentrated the rays, thus the hotter the area of Earth receiving them. I reasoned that the angle of the Sun's rays at noon must change during the year.

My curiosity about the relation of angle of the Sun's rays to temperature resulted in a project that has as its purpose to discover how the angle of the Sun's rays affects air temperature during the year and thus causes seasons. Based on previous stated research and the fact that it is cooler in the morning when the angle of the Sun's rays is least due to the Sun's low altitude, my hypothesis was that as the angle of the Sun's rays increases during the year, the outdoor temperature increases, causing seasons.

Figure 6.4: Introduction

Experiment and Data

List each project experiment in the experiment section of the report. Experiments should include the problem of the experiment, followed first by a list of the materials used and the amount of each, then by the procedural steps in outline or paragraph form, as shown in Figure 6.5. Note that the experiment described in Figure 6.5 determines the average monthly angle of the sun's noon rays during seven consecutive months. A second experiment is needed to measure the average temperature of each month. Write the experiments so that anyone could follow them and expect to get the same results.

Following each experiment, include all the measurements you took and all the observations you made during each experiment. Graphs, tables, and charts created from your data should be labeled and, if possible, colorful. Figure 6.6 shows a table and Figure 6.7 a bar graph for the experiment shown in Figure 6.5. If there is a large amount of data, you may choose to put most of it in an appendix, which can be placed in a separate binder or notebook. If you do separate the material, place a summary of the data in the data section of the report.

Experiment

Purpose

To determine the angle of the Sun's rays at noon (standard time) during different seasons.

Materials

yardstick (meterstick)

cup with pencil and string prepared in the Sample Experiment

protractor

Procedure

1. At around 11:45 A.M., set the measuring stick on a flat surface in a sunny area outdoors with its pointer end facing the horizon directly below the Sun.
2. Set the cup in the middle of the stick. Move the pointer end of the stick so that the shadow cast by the pencil falls on the stick.
3. At 12:00 P.M. (noon), move the cup back and forth along the stick until the end of the shadow touches the measuring line. *NOTE: If the shadow is longer than the measuring stick, place two measuring sticks end to end.*
4. Hold the cup in place and extend the string from the top of the pencil to the measuring line. Ask a helper to use the protractor to measure the angle between the pencil and string.
5. Repeat steps 1 through 3 one or more times each week during 6 or more consecutive months.
6. Average the angles measured for each month.

Figure 6.5: An Experiment

SUN RAY ANGLES AT NOON

Month	Average Monthly Angle (degrees, □)
October	40
November	31
December	24
January	31
February	40
March	48
April	56

Figure 6.6: A Table

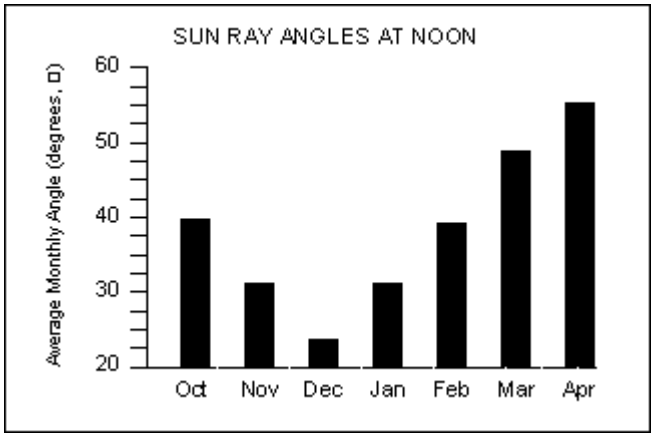
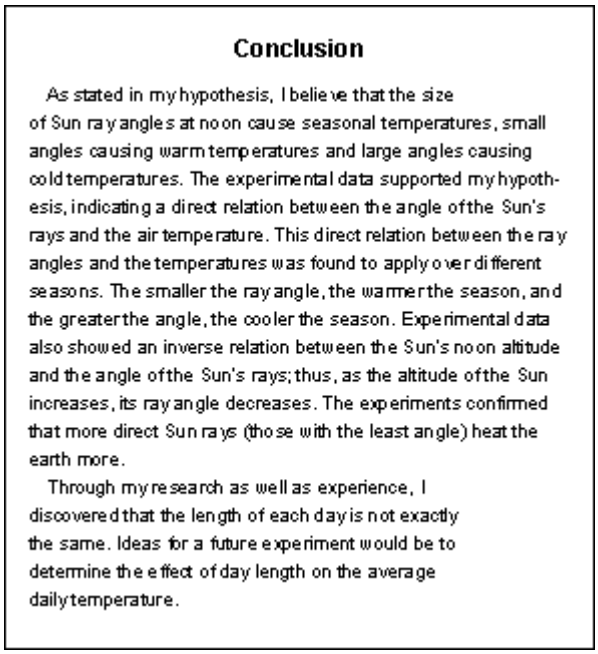


Figure 6.7: Example of a Bar Graph

Conclusion

The conclusion summarizes, in about one page or less, what you discovered based on your experimental results, as shown in Figure 6.8. The conclusion states the hypothesis and indicates whether the data supports it. The conclusion can also include a brief description of plans for exploring ideas for future experiments.



Conclusion

As stated in my hypothesis, I believe that the size of Sun ray angles at noon cause seasonal temperatures, small angles causing warm temperatures and large angles causing cold temperatures. The experimental data supported my hypothesis, indicating a direct relation between the angle of the Sun's rays and the air temperature. This direct relation between the ray angles and the temperatures was found to apply over different seasons. The smaller the ray angle, the warmer the season, and the greater the angle, the cooler the season. Experimental data also showed an inverse relation between the Sun's noon altitude and the angle of the Sun's rays; thus, as the altitude of the Sun increases, its ray angle decreases. The experiments confirmed that more direct Sun rays (those with the least angle) heat the earth more.

Through my research as well as experience, I discovered that the length of each day is not exactly the same. Ideas for a future experiment would be to determine the effect of day length on the average daily temperature.

Figure 6.8: A Project Conclusion

Sources

Sources are the places where you obtained information, including all of the written materials as well as the people you have interviewed.

For the written materials, write a bibliography. List people that you interviewed, separately, in alphabetical order by last name. Provide their titles and with permission give their business addresses and telephone numbers, as shown in Figure 6.9. Do not list home addresses or home telephone numbers.

Source Interviewed

Lynn, Jennifer
Astronomer
100 Rainy Drive
San Francisco, California 00001
(001) 222-0000

Figure 6.9: An Interview Source

Bibliography

Here are some examples:

A book with a single author:
Lobdell, Jared. *England and Always: Tolkien's World of the Rings.* Grand Rapids: Eerdmans, 1981.

A book with two authors:
Welsch, Roger L., and Linda K. Welsch. *Cather's Kitchens: Foodways in Literature and Life.* Lincoln: U of Nebraska P, 1987.

A signed article in an encyclopedia:
Chiappini, Luciano. "Este, House of." *Encyclopedia Britannica: Macropaedia.* 1974 ed.

An unsigned article in an encyclopedia:
"Melodeon." Encyclopedia Americana. 1985 ed.

An article in a journal:
Booth, Wayne C. "Kenneth Burke's Way of Knowing." Critical Inquiry 1 (1974): 1-22. Winks, Robin W. "The Sinister Oriental Thriller: Fiction and the Asian Scene." Journal of Popular Culture 19.2 (1985): 49-61.

An article in a weekly magazine:
Wheeler, David L. "Artificial-Intelligence Researchers Develop Electronic 'Tutors' to Aid Learning Process." *Chronicle of Higher Education* 20 May 1987: 6-8.

An article in a daily newspaper:
Greely, Andrew. "Today Morality Play: The Sitcom." *New York Times* 17 May 1987, late ed., sec. 2: 1+.

WORLD WIDE WEB
Structure:
Author or originator. Title of item. [Online] Date of document or download (day, month, year). URL <http://address/filename>.

Example:
U.S. Census Bureau. "American FactFinder: Facts About My Community." [Online] 17 August 2001. <http://factfinder.census.gov/servlet/BasicFactsServlet>.

Acknowledgments

Even though technically your project is to be your work alone, it is permissible to have some help. The acknowledgments is not a list of names, but a short paragraph stating the names of people who helped you and how, as shown in Figure 6.10.

Note that when listing family members or relatives, it is generally not necessary to include their names.

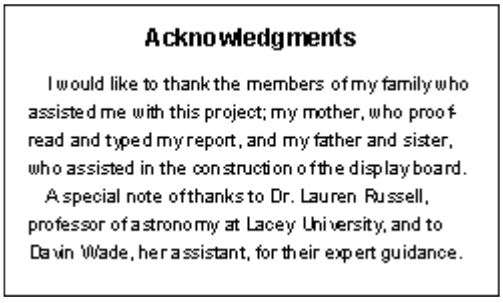


Figure 6.10: Acknowledgments