Fayetteville Christian School

Science and Engineering

Competition Manual

Published in the United States of America in 1998

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Science Fair Introduction

Information and online handouts at http://scienceatfcs.brineyweb.com/science-project

Science Fair Video!

International Science and Engineering Fair

Five levels of Competition: 1) Class, 2) School, 3) Regional, 4) State, 5) International

Awards for Winners

- Cash prizes, certificates, paid trips, mini-microscope trophy, science shirts, ribbons and medals to win ($200 for computers, environment, geo science, biotech, Kodak, engineering, life science, dietetics, and fisheries)
- Specialty awards from special interest groups
- Sigma Kappa certificate for FCS Science club (http://scienceatfcs.wordpress.com/science-club/)

FCS accomplishments

At least one student has represented FCS at the state fair level.
Display boards, winners' photo album, and awards

- 2000 FCS competition Joshua Saldivar won first place, Cherry Evans won second, and Kaleb Kovach was third. At regional, Cherry won first place ($50) and Josh second ($25). Cherry won third place at state and a special award from the Army for outstanding project in Behavioral and Social Science.
- 2001 Regional: seven winners, four first places. Olivia Yates placed first ($50) and went to state.
- 2002 Kaleb Kovach went to state
- 2003 Lisa Briney won second at regional and went to state
- 2004 Terra Summers won third at regional and went to state
- 2005 Heather Ali won second overall at regional fair and competed at the Intel International SEF
- 2006 Heather Ali won first overall at regional fair and competed at the Intel International SEF
- 2007 Heather Ali won second overall at regional fair and competed at the Intel International SEF
- 2008 Greg Jones won overall at FCS.
- These winners have volunteered to help you win too.

For Everyone

- Easy step-by-step procedure written out for you in handout and on the web at http://scienceatfcs.wordpress.com/science-fair-project/.
- Projects are for science lab credit and part of the science experience. It counts as a major part of your grade.

Competitive Goals

- Representation in all fifteen categories.
- Oral competition for NWAJAS
- Science Club: http://scienceatfcs.brineyweb.com/fcs-science-club

How to Win

- Choose a sophisticated subject and title.
- Work in a University lab.
- Extra effort in experimental **repetition** and **statistical analysis** gains more points.
- Use photographs to show work.
- Follow the schedule to reduce stress.
- Be familiar with the judging score card and process.

Project ideas

- Read list of project ideas (http://scienceatfcs.wordpress.com/2013/09/16/science-project-ideas/)
- Read winning titles and abstracts (http://www.scifair.org/)

Do all unto the Lord

- Something to prove: Christians are good at science. Some of the best scientists have been Christians.
- Science sharpens the mind to discern and discover truth.
- The scientific method is used for everything: O -> I -> E
- A test of character and discipline to follow instructions.

Handouts

- Schedule page with web addresses to project ideas.
- Send email request for Science fair ideas and help to your teacher.
- Keep **all** papers in your science project notebook

Information for paperwork

- School name: Fayetteville Christian School
  2006 Mission Blvd, Fayetteville, AR 72703
  479-442-2565
- Teacher/Adult sponsor:
  - Physical Science, Ron Rone
  - Biology, Dr. Patrick Briney
  - Chemistry, Lonnie Deavens
  - Physics, Keith Wiggins
- Your social security number is required in order to collect prize money at regional fair.
- SRC/IRB members
  - Lonnie Deavens, Chemical Engineering
  - Rod Roark, D.D.S., Our local SRC Chairman for FCS
  - Brad Jones, school administrator
  - Wesley Thomas, M.D.

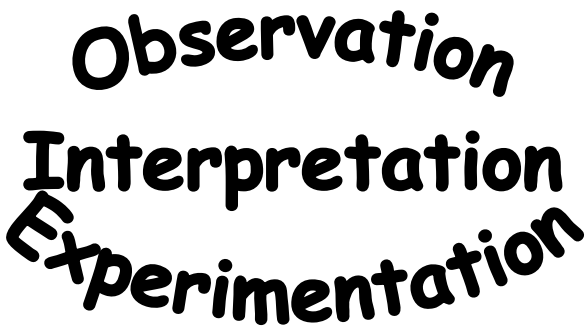
- Check FCS science web site for NWARSEF dates of competition.

- NWAR Junior Academy paperwork due:
- NWARSEF paperwork due:
- NWARSEF SRC meeting:
- NWARSEF:
- ISEF students and teachers:

Science Project Schedule

Example to help you schedule your work.

Aug 16	Science Project Introduction/orientation: Notebook, forms
Week 1	Submit a science project category and topic. Research Forms 1, 1A, 1B
Week 1	Science and the scientific method/ **Quiz**
Week 2	Fair director: Send NWARSEF Affiliation Agreement
Week 2	Narrow topic, search literature, and turn in forms with research plan.
Week 3	Submit quotes and facts from literature reading with references.
Week 4	Submit introduction and bibliography page.
Week 5	Design result table for collecting data: define control and variables
Week 6	Design your experiment: materials and method description in detail
	Pre-SEF Meeting at U of A. 8:3am – 3:00 and register IRB & SRC members
Week 7	Submit edited notebook with edited intro, result table, procedure, & bibliography
Week 8	Submit edited notebook.
Week 10	Submit forms for IRB and SRC approval
	Teachers: Order display boards and awards (1st through 6th place); Fair dates
Nov. 3	Begin experiment: record results, take pictures (*safety and permission).
	Fair director: Submit IRB & SRC members' names to Regional Fair Board
	Fair director: NWARSEF Affiliation Agreement
Jan.	Turn in notebook with experimental data recorded in result tables.
Jan.	Design graphs and charts. Write a result description.
Jan.	Conclusion: Explain why, control, compare with other results, propose next step
	Abstract form: Summary of what you discovered, how you found it, conclusion.
Feb.	Turn in **COPY** of finished **Science Paper**
Feb.	Design display board: Serif v. Sans Serif, color and organization
Feb.	Peer judging
	NWARJAS abstract and paperwork due
	NWARJAS winner notification
Feb.	Edit science paper **and** display
Feb.	FCS **Oral Presentation**s (8 minutes)
Feb.	FCS SCIENCE FAIR & AWARDS
	Compare peer scores with judges' scores
Feb.	Submit NWARSEF Participation Fee Form
	NWARSEF paperwork (1, 1A, 1B, Research plan, etc.): Friday before fair
Feb.	SRC Meeting
Mar	Regional Fair at UA
	Thank you letters to award donors
Apr	State Fair
May	ISEF, National Competition



Observation: information skills

1. Choose topic: read, write, and think about questions to answer.
2. Narrow topic for study and research.
3. Read and take notes about your topic.
4. Ask a question, pose a problem to be solved, or suggest a possible pattern.

Interpretation: reasoning skills

5. Propose an answer to your question, a solution to the problem or a prediction.
6. Design a result table: To focus on the real question being asked and identify observations to be measured.

Experimentation: process skills

7. Design your experiment: materials and method. Repetition and control.
8. Submit Research proposal paperwork
9. Conduct your experiment

Complete the process

10. Record results: observation skills
11. Analyze results: interpretation skills
12. Conclusion and proposal for further experimentation.

Report your research

13. Introduction: State the problem or question and the hypothesis, explain your topic, what others already knew, and why this is important to know.
14. Materials and method: Describe the materials in your experiment and what you did in detail so that someone else can repeat the experiment.
15. Results: Report your results in an easy to understand chart or table. Use descriptive labels on charts and include a written explanation of each chart.
16. Conclusion: Explain why your results lead you to a conclusion and how it compares with other findings and conclusions. Propose further experiment to be done and the significance of your findings.
17. Bibliography: Cite five non-web sources in correct reference format.
18. Abstract: Write a concise, one paragraph explanation of what you discovered and how you discovered it.

Science and Engineering Fair

How points are earned

Creativity (30 points)

1. Project idea: assigned, copied, helped, original
2. Project design: assigned, copied, helped, original
3. Project equipment: assigned, copied, helped, original
4. Project analysis: assigned, copied, helped, original
5. Display design: poor, fair, good

Scientific Thought/Engineering Goals (30 points)

1. Problem defined: none, fair, clear
2. Problem justified: none, unclear, unjustified, justified
3. Predictions made: none, unclear, unjustified, justified
4. Procedure to find solution: none, unclear, inappropriate, appropriate
5. Control and variables: none, unclear, inappropriate, appropriate
6. Application of findings suggested: none, unclear, unjustified, justified

Thoroughness (15 points)

1. Problem made relevant to other work: none, inadequate, fair, good
2. References cited: none, inadequate, good
3. Control: none, inappropriate, good
4. Repetition of tests: none, inadequate, good
5. Project notes: none, inadequate, good
6. Time spent on project: none, inadequate, good
7. Result tables: none, inadequate, good

Skill (15 points)

1. Observation and information gathering: simple, challenging, assisted, supervised, individual
2. Assistance required: simple, challenging, assisted, supervised, individual
3. Experimental design: simple, challenging, assisted, supervised, individual
4. Experimental equipment: simple, challenging, assisted, supervised, individual
5. Analysis: simple, challenging, assisted, supervised, individual

Clarity (10 points)

1. Display labels, pictures, and writing: Unclear, readable, easily read
2. Display charts and tables: Unclear, readable, relevant, labeled
3. Display organization and flow:
4. Written science paper organization:
5. Written science paper writing style:
6. Oral presentation and interview:

Project Ideas

1. Most international project winners are originals.
2. Projects must use scientific method, not demonstration.
3. Show innovation and sophistication.

Lots of ideas can be found on the internet. Choose a project worthy of high school competition.

Converting sunlight into electricity
decomposing sawdust
conditions of making coal
formation of evaporite rocks
hydraulic pressure of roots
tensile strength of exoskeletons
conditions which change number of hair bristles on flies
chemo attractants for roaches
surface area efficiency for evaporators on heat pumps
net energy after compressing vaporized alcohol
Mineral content of water after leeching through strata
bacterial static/ antibacterial chemicals in plants
preferred wavelengths of light by insects
hail stone formation
high protein cookies low in fat
conditions for accelerating electrical current
what chemicals dissolve dried paint?
strata formation due to water sorting
Why are some spider webs stronger than others?
conditions for fossilization
what is the role of dust in cloud formation?
does CO2 attract mosquitoes?
does gluten content of wheat affect cookies?
rating soil conditions for conductivity of shock waves released during earthquakes
weed control techniques
sound vibration effect on structural materials
ingredients in shampoos that strengthen hair

Photo conversion to electricity
Decomposition of sawdust
Antimicrobial agents on microbes
Gum chewing and memory/learning
Temperature and pressure relationships
Combustion comparisons
Paint thinner and dissolution of paint
Water sealant and water absorption by wood
Water separation of soil
Comparing tensile strength of spider silk and steel
Uniformity VS catastrophism
Conditions for fossilization of plants
Comparing speed of electricity in different materials
Nutritional needs of molds
Cholesterol free cookies
Plant chemical inhibits growth of bacteria
Rate of leaching (water) through different types of soil
Color preference by insects
Counting hair bristles on insects
Comparing public and private schools
What elements in sand give it color?
Robo roach
Lightening bugs as food for glowing
Presbyopia
Crosswalk safety: bumps, frogs, lights, LEDS
Speed bumps and shocks on cars
Insect repellants

Your Written Science Report

Submit all your work in a <u>paper</u> folder with metal binders.

Your finished notebook will have the following:

<u>ISEF forms</u> (Keep originals and submit duplicates to Regional SRC)

Go to to **<u>TYPE</u>** and **<u>print</u>** your forms.

- Entry form
- Adult Sponsor/Safety Assessment form (1)
- Research Plan (1A)
- One page research plan (1A 9. a-d)
- Abstract (1A 10.)
- Approval form (1B)
- Others if appropriate

Abstract

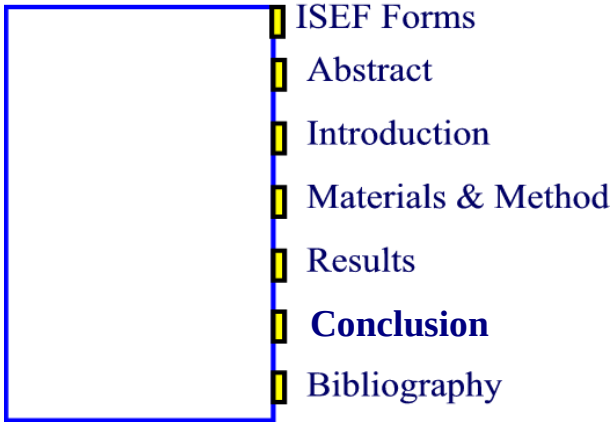
Introduction

Materials and methods

Result tables

Conclusion

Bibliography



The ISEF Competition Forms

International Science and Engineering Forms

1. All forms are available online. If possible, type and print for a professional look.
2. Forms must be filled in completely and correctly to successfully compete.
3. A copy of the forms with the research plan and abstract will be submitted to the Regional SRC for regional competition in this order and stapled.
    a. Entry Form
    b. Abstract
    c. Adult checklist 1
    d. Student checklist 1A
    e. Research Plan (A, B, C, D). Include Risk and safety description in procedure.
    f. Other forms required in # order (2,3,4,5, etc.)
    g. If needed, Continuation Form 7 followed by **previous** 1A, **previous** Research plan, and **previous** abstract Approval form(s)
    h. Form 1B (facing out)

Correct order of dates on forms.

1. Form 1B dates: Student, parent, adult sponsor, and SRC chair approval dates must be signed first and earliest.
2. Form 1A dates for beginning the experiment must be **after** the approval dates.
3. Form 1 date: Adult sponsor signature date must be later than others.
4. Experiment date begins after all other dates.

Forms needed

1. All experiments involving humans in any way must fill out **form 4**.
2. If you are still wondering if you need a form, remember: "When in doubt, fill it out."

Research Plan

(one page in the following format)

Your Name
Title of project

A. Problem/Question

B. Hypothesis/Engineering Goals. (Include the reason you think your hypothesis is correct.)

C. Procedure (materials & method. Include risk and safety description & data analysis if appropriate)

D. Bibliography (5 non-web references in correct form, in correct format)

1.

2.

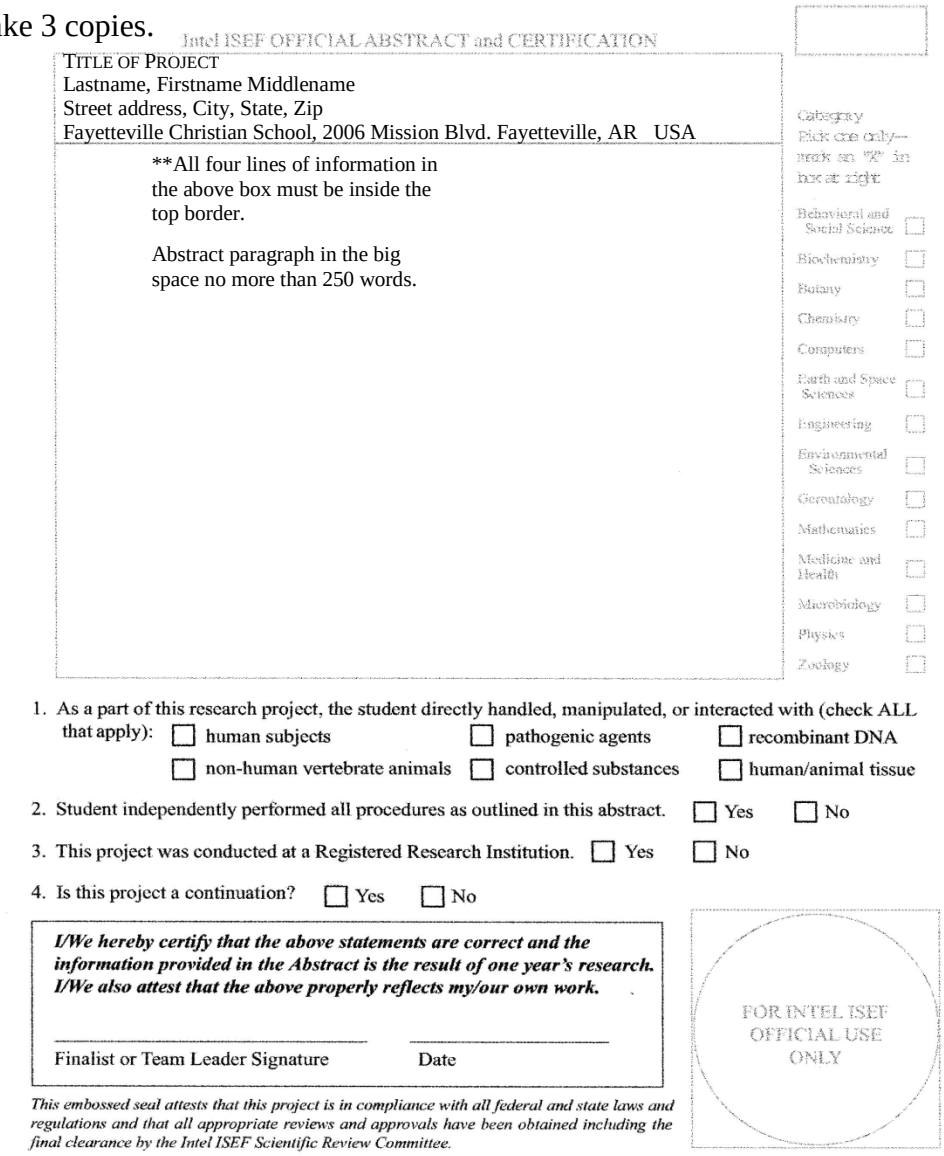
3.

4.

5.

Preparing Your Abstract

1. This is the <u>last</u> page you write.
2. Write a summary paragraph describing what you discovered and how you discovered it. You should have a minimum of …
    a. At least one sentence summarizing your introduction.
    b. At least one sentence summarizing your method.
    c. At least one sentence summarizing your results.
    d. At least one sentence summarizing your conclusion.
3. 250 words or less, single spaced, 12 point type, in a space of 5.5" x 6", **on official form (**See also page 11, or go to http://www.societyforscience.org/isef/document/abstrct.pdf).
4. Make 3 copies.



Intel ISEF OFFICIAL ABSTRACT and CERTIFICATION

TITLE OF PROJECT
Lastname, Firstname Middlename
Street address, City, State, Zip
Fayetteville Christian School, 2006 Mission Blvd. Fayetteville, AR USA

**All four lines of information in the above box must be inside the top border.

Abstract paragraph in the big space no more than 250 words.

Category
Pick one only—mark an "X" in box at right

- Behavioral and Social Science ☐
- Biochemistry ☐
- Botany ☐
- Chemistry ☐
- Computers ☐
- Earth and Space Sciences ☐
- Engineering ☐
- Environmental Sciences ☐
- Gerontology ☐
- Mathematics ☐
- Medicine and Health ☐
- Microbiology ☐
- Physics ☐
- Zoology ☐

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check ALL that apply): ☐ human subjects ☐ pathogenic agents ☐ recombinant DNA ☐ non-human vertebrate animals ☐ controlled substances ☐ human/animal tissue
2. Student independently performed all procedures as outlined in this abstract. ☐ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☐ No

I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I/We also attest that the above properly reflects my/our own work.

_____ _____
Finalist or Team Leader Signature Date

FOR INTEL ISEF OFFICIAL USE ONLY

This embossed seal attests that this project is in compliance with all federal and state laws and regulations and that all appropriate reviews and approvals have been obtained including the final clearance by the Intel ISEF Scientific Review Committee.

Introduction

1. First paragraph introduces your topic of interest and its interest to science. Begin with the question to answer or the problem to solve. Explain (1) why you chose this topic, and (2) emphasize the uniqueness, novelty, and innovation of the idea.

2. Second paragraph states your hypothesis and the reason why you think your experiment will support your hypothesis.

3. Third paragraph describes what is already known about the topic. Cite quotes and claims by other researchers.

4. Cite at least five references at the end of your paper. (See bibliography instruction on correct reference format)

Materials and Method

1. List and describe the materials used in your experiment. (Include brand names, quantities, model names of equipment, etc.)
2. Describe how to do the experiment as you would a cooking recipe.
3. Describe risk and safety assessment.
4. Include a drawing or picture of your experiment if appropriate.
5. If appropriate, emphasize creativity, your own design, self-construction, a new approach, innovation.
6. Identify the control and variables in the experiment.
7. Point out the repetition.
8. Describe statistical analysis method is appropriate.
9. Write in objective, third person present tense style.

Results

There are four parts to your result section: 1) Result description, 2) result tables, 3) result graphs and charts, and 4) result pictures.

1. Record your quantified observations in tables.
2. Organize and present the result information in graphs and charts to clearly show patterns. [Tables, graphs, and charts should be clearly understood on their own.]
3. Include pictures if appropriate of results and compare with controls. You must give credit to the photographer and anyone other than you must sign a consent-to-use form.
4. Write a description of your results as portrayed in your tables and graphs.
    - Be sure to label all tables, graphs, charts, and pictures with titles; legends, and axes descriptions.
    - Be sure to indicate which results are experimental and control.

Examples of a result table. Notice the title and labels.

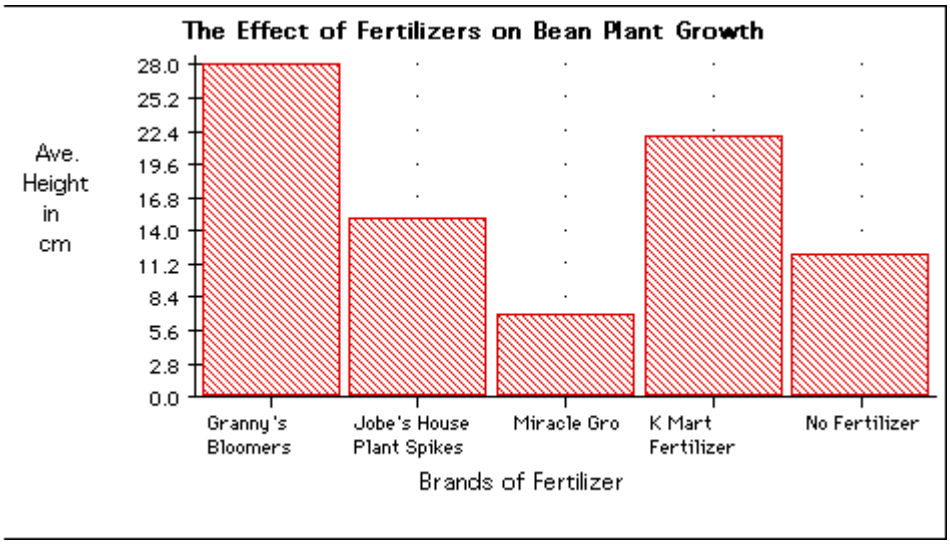
Table 1. Tensile strength (Newtons) of three different spider webs.

Spider species	**Force (N) to stretch**	**Force (N) to break**	**Length (mm) of stretch**	**Force of elasticity**
Genus species 1				
1				
2				
3				
Genus species 2				
1				
2				
3				
Genus species 3				
1				
2				
3				

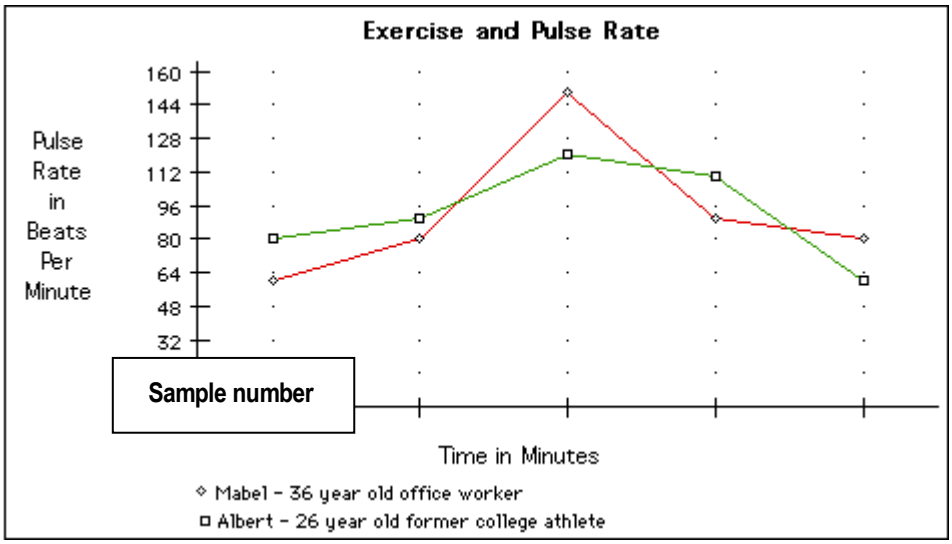
Table 2. The effect of temperature change on carbon dioxide concentration in air.

T° (C)	**CO_2 (g/m^3)**
20	10
15	15
8	20
0	30

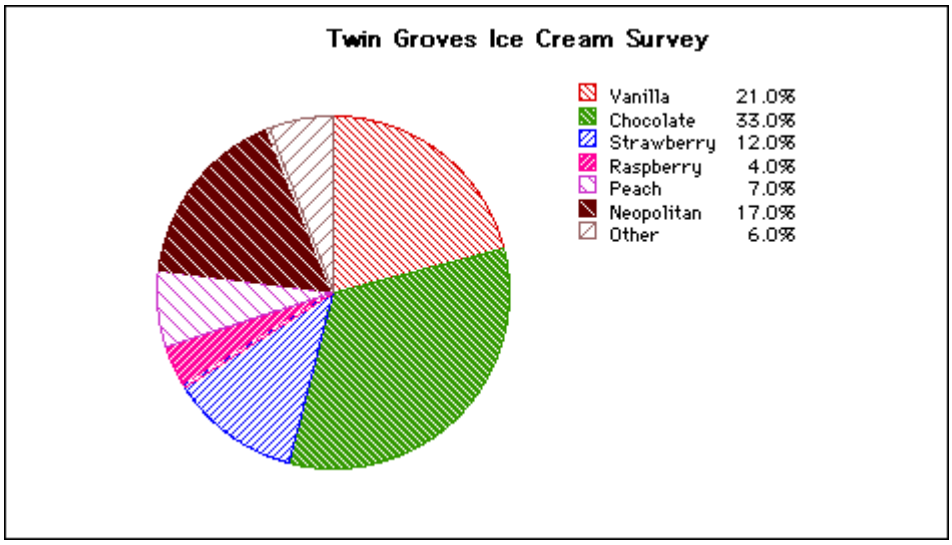
A bar graph example: A bar graph is used to compare results from different groups. Notice how easy it is to see what was done in the experiment below with bean plant growth and different brands of fertilizer. (adapted from http://www.twingroves.district96.k12.il.us/ScienceInternet/ChartsGraphs.html)



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. (adapted from http://www.twingroves.district96.k12.il.us/ScienceInternet/ChartsGraphs.html)



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. (adapted from http://www.twingroves.district96.k12.il.us/ScienceInternet/ChartsGraphs.html)



Photographs are useful to show the judges visual scales of colors and shades, lab technique, results, devices used in the experiment, and/or lab environment. People in a picture need to sign a release form approving use of the picture in your results. Make sure that pictures are appropriate and do not show violation of safety procedures. Also, every photo must indicate credit to the photographer.

Result description. The result description is a written description explaining your observations. Refer to your table, graphs, charts, and photos (cite the ID number of the table, chart, etc.) as you explain what happened during your experiment. You do not draw conclusions from the results in this section. You just describe the facts and point out things the reader should notice, such as trends, changes, similarities and differences.

Conclusion

1. State your conclusion in your first sentence.
2. Explain how and why the results support your conclusion in light of your control and repetition.
3. Explain how variables contributed to the results and the possible involvement of uncontrolled variables.
4. Explain difficulties to avoid next time.
5. Compare your findings with the findings of others.
6. Discuss what else could be done or other questions to be answered.
7. Propose future experiments to continue this project.

Bibliography

Cite a minimum of five non-web references*

How to reference in your paper:

1. After referring to an author's work, enclose in parenthesis the author's name and date of publication. Example: Cell wall toxicity causes headaches **(Alrich, et. al., 1982).**
2. List your references in the bibliography in alphabetical order so that readers can easily find the reference.
3. Must have at least five literature references not from the web.
4. If vertebrates are used, you must include an additional literature reference for animal care. You can go to http://dels.nas.edu/ilar/careanduse.asp to order a free book on animal care.

- **Reference format example for periodicals**

  Alrich, J., F.M. Bush, and R. Fult. 1982. The comparative studies of pathogenic mechanisms. Journal of Medicine **23**:43-56.

- **Reference format example for books**

  Gehron, Paul. Studies of Disease, edited by Prather B. Guillen, published by Kirken Brothers & Comp., Chicago, IL. Copyright 1985. Page 14.

- **Reference format example for encyclopedias**

  The World Book Encyclopedia, 1983 ed. S.v. "Nuclear Energy," by Alvin M. Weinberg.

- **Usenet posting**

  Stoddard M. Re: How do you cite URL's in a bibliography? (not in FAQ). comp.infosystems.www.users [Usenet newsgroup] 16 March 1995. No archive known. [Accessed 17 March 1995].

- **Web page**

  Stoddard M. AHSL Educational Services. Feb 1995; http://amber.medlib.arizona.edu/homepage.html. [Accessed 16 Mar 1995].

  Berners-Lee, T. Uniform Resource Locators (URL). 1994 Dec; <URL: ftp://ds.internic.net/rfc/rfc1738.txt>. [Accessed 16 Mar 1995].

*After the five literature citations, you can cite as many others as you want.

Grading of Final Written Science Report

	Points
Notebook turned in on time	40
Notebook folder	10
Order	10
Forms	20
Entry	
Forms 1, 1A, 1B, research plan, abstract	
Others	
Introduction	20
Method and Materials	10
Results (written description, tables/charts, labels)	30
Conclusion	20
Bibliography (five correctly formatted)	20
Total	**180**

Points are given for keeping up with assignments leading up to the final product.

Your Science Project Display

Information to include…

- Summary: State problem or question, hypothesis, and abstract information. "Abstract" label cannot be used on display board.
- A brief introduction.
- A brief description of your procedure. Materials may not be necessary.
- Present your results in tables and/or graphs fully labeled.
- A brief statement of your conclusion.
- All pictures of people must have consent forms and photographer credited.

Design of Display

- Use the standard science fair project display board. Write name, school, and phone number on back. (30" deep, 48" width, 108" height: floor to top. Table is 36" high & standard board 62" high)
- Title and headings should be 36 point or larger sans serif font.
- Text should be minimally 18 point serif font type.
- Information should be organized so that viewers read the summary first (make sure problem and hypothesis are stated first and identified), then the introduction, then the method, then the results, then conclusion.
- Use an artistic and creative design to make the board attractive and interesting. Photographs, charts, and graphs say a lot and enhance appearance.
- The goal is to communicate simply, quickly, and clearly.

Grading of Display Board

Points		
1.	Turned in on time	40
2.	Display labels -(title, introduction, procedure, results, conclusion)	25
	• Font size and clarity of labels	25
	• Fail to use "summary" instead of "abstract"	-15
1.	Flow and organization	20
2.	Text font clarity and size	15
3.	Charts, tables, Pictures	15
4.	No consent form for pictures with other people in it	-15
5.	Visual presentation and clarity	20
6.	Creativity	20
	Total	**180**

Oral Competition

Prepare visual aids of:

1. Title page
2. Problem or Question
3. Hypothesis
4. Bullet list of why this project is significant
5. Bullet list of what is known about this project
6. State how you propose to answer your question
7. Bullet list of your procedure
8. Result charts and graphs (one graph per slide)
9. Conclusion and proposal for future application and research on this topic
10. Use 18 point font or larger
11. Color makes it nicer
12. Keep it simple. One thought per slide.

Points for Oral Presentation

1. ***Presented on time (2 or 8 minutes)***	20
2. ***Length (8 minutes)***	10
3. ***Flow of thought***	10
4. ***Clarity of thought:***	20
5. ***Visual Aids:*** clear and appropriate	20
6. ***Presentation style:*** Eye contact, gestures, poise, appearance, voice	20
Total	***100***

Preparing for the Interview

1. Look the judges in the eye and answer questions with confidence.
2. State your purpose and problem.
3. Explain your project design and conclusions.
4. Where and how did you get the idea?
5. Why did you choose this project?
6. What was your control? How much repetition?
7. Explain how the equipment works.
8. Explain the implications of your conclusion.
9. Were other methods considered?
10. Emphasize and state plainly originality and innovation in your project.
11. Propose future direction, application, and plans for the project.
12. Prepare a single sided fact sheet with talking points.

Appendix and Notes

1. Easy bibliography maker, http://www.easybib.com
2. FCS Science Fair resources and information, http://scienceatfcs.brineyweb.com/science-project
3. ISEF forms online, https://student.societyforscience.org/international-rules-pre-college-science-research?pid=312
4. Regional fair info at Center for Mathematics and Science Education
5. State Fair preparation, Search internet for cmase NWASEF at the U of A