"Make Life Your Lab"

Canyons School District

Science Fair

Teacher Handbook

Recommendations for School Fairs

1. Start Early. On average, it takes about 6 weeks for students to complete a science fair project. Make sure there is ample time provided.

2. Be explicit in your expectations from students and parents. Ensure that you've let the parents know that the work should only be done by the student.

3. Send home a packet for parents, which should include a letter explaining the process, rubric, timeline, safety guidelines, list of projects to avoid, and abstracts from quality projects.

4. Post a timeline in your classroom, or view the timeline often with the students.

5. Give the students a science fair notebook, or require them to provide one, where they can organize all their work.

6. Have students present their project to the class, and use the provided scoring rubric to give them a grade prior to the fair.

7. Feedback is an important part of the learning process, so give the kids their scoring rubrics back with any positive feedback or improvement feedback.

8. There are many different options for how to arrange your fair. We recommend that it students stand at their boards and present their projects to the judges, as it is good practice for the district and regional science fair. If possible, have 3 to 4 judges score each project.

9. Give visitors at science fair open houses "Stupendous Scientist" cards. When they like a project, they fill out the card and leave it with a project.

10. Check with EBL to determine how many district science fair slots your school will have at the district fair. Choose the projects that were top scorers according to the district approved scoring rubric to participate in the district fair.

Suggested Timeline

September:

- Determine the date(s) and time(s) of your school fair. **Remember that it needs to be completed by the end of the first week in February in order for your students to participate in the district fair.**
- Determine how many students will be participating, and decide where the fair will be held.
  - Work with your custodian if you are having your fair after school hours, if having your fair in a non-classroom setting, and if you need extra tables, or other supplies.
  - Arrange for a location for an awards ceremony to congratulate all students, and to announce those who will advance to the district fair.
- Send home the parent information packet.
- Send a letter to local businesses to gather incentives for students who participate in the fair.
- Order any ribbons/trophies/or certificates that will be needed.
- Parent letter & media release form due

October:

- **Register your school science fair by visiting http://tinyurl.com/csdsciencefairregistration before the last week in October.**
- Project proposal due.
- Research and Bibliography due.

November:

- Hypothesis and Materials due.
- Experimental Design due.

December:

- Student experimentation and data collection begins.
- Send out invitations to the school science fair.

Suggested Timeline Cont.

January:

- Observational data due.
- Graphs/visual form of data due.
- Analysis and Conclusion due.
- Display board due.
- Hold school science fair.

One week before Fair:

- Copy grading rubrics
- Check with custodian on an set-up that needs to happen
- Copy participation certificates for each student
- Ensure that ribbons, trophies, etc. are ready to go.

Day of Fair:

- Set up
- Monitor
- Be sure that all students receive many project visitors.
- Tabulate scores to determine finalists who will advance.
- Hold awards ceremony - give District Fair information and registration packet to those advancing. **Finalists from the school fairs will need to register at least 5 days in advance for the district fair at:** **http://tinyurl.com/CanyonsScienceFairRegistration**
- Clean up.

After the Fair:

- Publicize winners on your school webpage.
- Check in with your finalists to make sure they've registered for the district fair.
- Reflect on changes for next year.
- **Arrange for a volunteer (teacher or parent) to chaperone any of your students who will advance to the regional SLVSEF fair.**

Important Deadlines

- [ ] Register your school science fair by visiting http://tinyurl.com/csdsciencefairregistration **by the last week in October.**

- [ ] You must have your school fair completed **by the first week in February.**

- [ ] Finalists for your school fair **must register for the district fair at least 5 days in advance at** http://tinyurl.com/CanyonsScienceFairRegistration.

Help from SLVSEF

The Salt Lake Valley Science and Engineering Fair offers the following support to science fair participants:

- ☐ Publishes project abstracts from former SLVSEF participants
- ☐ Help finding a lab
- ☐ Help finding a mentor
- ☐ Provides a scientific review committee to pre-approve ISEF paperwork for 9th-12th grade students prior to experimentation. If you have student projects that you feel may qualify to compete in the SLVSEF fair, please make sure that you have them use the scientific review committee that SLVSEF offers.

Please visit www.slvsef.org for information.

Paperwork
9-12th Grade Only

ISEF Forms:

Canyons School District requires that all students grade 9-12 fill out the appropriate ISEF paperwork, before their experimentation begins.   You can find the ISEF paperwork at http://slvsef.org/students

Scientific Review Committee:

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- ✓Compliance with rules and laws governing proper care and housing of animals
- ✓Appropriate use of recombinant DNA, pathogenic organisms, controlled substances, tissues and hazardous substances and devices
- ✓Adequate documentation of the substantial expansion of continuing projects

The SLVSEF members will carefully review all documentation, particularly for research that required prior review and approval. If the project documentation does not attest to this prior review and approval, the project is in violation of the International Rules. Such projects should only be approved if an acceptable written explanation is provided.

Visit http://slvsef.org/resource-center/scientific-review-committee to submit your paperwork

Evaluation Rubric

Pts.	Evaluation Criteria	Excellent 17-20 points	Good 13-16 points	Fair 9-12 points	Poor 0-8 points
20 score	**Science Project:** • Objectives	-- Clearly stated & well-written -- Appropriate for grade level & original -- Creative approach to problem solving	--Lacking in **1** area: clarity, appropriate level, or creativity	--Lacking in **2** areas: clarity, appropriate level, and/or creativity	--Poorly conceived or lacking in all **3** areas
	• Hypothesis *(question)*	I. Testable, clear, bounded hypothesis	I. Hypothesis present, but not completely testable	I. Hypothesis incomplete or not testable	I. Hypothesis **missing** or poorly defined
	• Use of Resources* ***jr/sr projects only***	– A comprehensive, correctly formatted bibliography was included & footnotes are present in text and display – Student(s) used full resources available (e.g. labs, advisors, experts, scientific periodicals & texts, internet)	– Incomplete citations – Used **most** available resources – **Most** internet resources are scientific & reputable	– **Minimal** effort on citing sources – Used **some** available resources – **Some** internet resources are scientific & reputable	– **No** sources or citations – Project suffered as a result of **not** using available resources – Internet resources are **not** scientific or reputable
	Engineering Project: • Problem Statement *(design criteria)*	A. Clear, original problem statement that meets potential users' needs B. Clearly defined design criteria and goals	A. Statement is **not** original B. Goals/criteria are measurable but **vague**	A. **Incomplete** statement B. Goals/criteria are **poorly defined**/not measurable	A. Statement **missing** or poorly defined B. Goals/criteria **missing**
20 score	**Science Project:** • Design & Procedures *Experimental design & implementation (hypothesis testing)*	I. Exemplary, creative plan to support / refute hypothesis with valid testing II. Sequential experimental procedures are quantitatively and/or qualitatively listed, and connect hypothesis, data & results III. Procedures are logical and repeatable IV. Sample sizes, number of trials are sufficient. Valid control group. V. All other variables are carefully controlled	I. Sufficient plan to support / refute hypothesis with all other criteria met, **or** II. Exemplary plan and **3** of **4** other criteria for excellence met, **or** III. **Some** improvements needed throughout	I. Sufficient plan with **3** of **4** other criteria for excellence met, **or** II. Exemplary plan and **2** of **4** other criteria for excellence met, **or** III. **Major** improvements needed throughout	I. Sufficient plan with **1-2** of **4** other criteria for excellence met, **or** II. Plan information is unclear / missing / insufficient, **or** III. Criteria II-V are **lacking** or grossly defficient
	Engineering Project: • Engineering process *(design & prototype)*	A. Design goals & approach clearly stated & reproducible, alternatives considered B. Design creative, schematics / software provided (as applicable), well labeled C. Assembly details or set-up instructions for device are clearly laid out D. Photos provided or prototype on display E. Materials used in appropriate ways	A. **3-4** of 5 criteria required for excellence are met **or** B. **Some** improvements could be made	A. **1-2** of 5 criteria required for excellence are met **or** B. Existing information is **incomplete**, or needs **major** improvement	A. Description of design & implementation not included or **inadequate** to show how design works and/or if design meets requirements B. No engineering. Project was merely **tinkering.**
20 score	**Science Project:** • Data & Results *(experimentation)*	I. Experiments run are appropriate for hypothesis being tested II. Sufficient data. Repetition of experiments III. Correct & appropriate statistical tests run	I. **2** of the **3** criteria for excellence met II. **Some** improvements could be made	I. **1** of the **3** criteria for excellence met II. **Major** improvements required	I. **Incorrect** experiments and data analysis for hypothesis II. **Insufficient** data
	• Documentation* *(notebook)* ***jr/sr projects only***	– Clearly written, complete and clear – Procedures are easy to follow – Comments, observations included – Records include dates, signatures	– **3** of 4 standards for excellence were met **or** – **Some** improvements could be made	– **2** of 4 standards for excellence were met **or** – **Major** improvements required	– **1** of the standards for excellence were met **or** – No notebook or **missing**
	Engineering Project: • Problem Solution *(testing and redesign)*	A. Measures of performance/improvement have been made (including cost) B. Functionality is fully tested & validated C. Records on testing are included D. Prototype was redesigned or potential design improvements were identified	A. Final design **works** but has not been fully tested B. **No advantage** over original C. **Some** improvements could be made	A. Final design does **not** meet end user's needs B. **No improvement** over original C. **Major** improvements required	A. Little or **no** testing B. **No** records C. **No** redesigns
20 score	**Science Project:** • Discussion & Conclusions	I. Status of the hypothesis is correctly and logically addressed, and stated in an unbiased manner (confirmed / refuted) II. Completeness of work and validity of conclusions are substantiated III. Discussion is insightful, demonstrates clear understanding of research project, broader subject & suggested new work	I. **2** of **3** criteria for excellence met, **or** II. **Some** improvements could be made	I. **1** of **3** criteria for excellence met **or** II. Overall information is **lacking** in quality and perspective	I. **No** discussion / conclusions provided
	Engineering Project: • Evaluation	A. Significance, relevance, applications, utility, cost effectiveness, improvements, benefits and performance addressed	A. **Some** evaluation areas not addressed	A. **Many** evaluation areas not addressed	A. **No** evaluation areas addressed
20 score	**Science+Engineering:** • Interview	Exemplary understanding... – Research findings / design results – Ability to interpret graphs, statistics, etc... – Related background information – Project rational, details & validity	**Good** understanding... – Research findings – Ability to interpret graphs, statistics, etc. – Related background information	**Fair** understanding... – Research findings – Ability to interpret graphs, statistics, etc... – Related background information	**Poor** understanding... – Cannot answer questions adequately and precisely – Does not incorporate display into interview – Unfamiliar with related background information
	• Display	Exemplary display... -- Creativity, clarity, logic, interpretability, construction, writing, graphics, grammar -- All information directly relates to project	**Good** display -- Most information is appropriate, organized and easily accessible.	**Fair** display ... -- Some information is appropriate, organized and easily accessible.	**Poor** display... -- Confusing, unorganized, incorrect or inappropriate information

Science Fair Award

Presented to:

____

For: ______________________________________

Awarded the ______ day of __________ 20___.

____

Signed

Student & Parent Information Packets

Parents should be informed that their students are required to do a science fair project well in advance and have all the information necessary to help their student be successful in completing a project. A parent information packet should include:

- ☐ A letter detailing expectations of parents and students
- ☐ List of projects that students shouldn't do
- ☐ Guidelines and safety rules
- ☐ Project timeline & due dates
- ☐ Abstracts of quality projects
- ☐ Grading rubric
- ☐ Science fair categories
- ☐ How to write a bibliography

A sample information packet follows. The letter should be copied on school letterhead.

Canyons School District

Science Fair

Parent & Student Information Packet

Dear Students and Parents:

It's time to start work on our school's Science Fair! Enclosed is a schedule outlining due dates and important information regarding your student's project. Ample time has been scheduled and work has been spread out, so students can complete the work at a comfortable pace.

This is a **major** project and will represent a **significant portion** of your student's grade for the next grading period(s). The primary objective of this project is to have students approach a problem scientifically. This includes:

1. Asking questions and forming hypotheses
2. Creating experiments to test those hypotheses
3. Organizing data and drawing conclusions
4. Writing about scientific research

The project must be **experimental** in nature as opposed to research oriented. In other words, students must do a test, survey, or experiment to determine the answer to their question instead of just looking it up in a book. We encourage students to pick topics that they are genuinely interested in, since they will be working on these projects for the next several months. Topics must also be "**original**" - something students do not already know.

Project guidelines state that all work must be done by the students; however, assistance may be provided by teachers, parents, etc. It is very difficult to work alone without the exchange of ideas, so we encourage you to brainstorm with your child on different ideas and possible topics your child may want to pursue. Students have been given lists of Science Fair Guidelines, a project timeline, lists of projects often done by students, and abstracts of projects from former regional science fair participants.

Please keep in mind that our school's Science Fair is the first step to participating in the District Science Fair. Students who are finalists in the school Science Fair will be participate in the Canyons School District Science Fair in February.

I am looking forward to working with you to make this a valuable learning experience for your child. I appreciate your support on this important project. As acknowledgement and part of your child's homework, please sign, date, and return the bottom portion of this letter by ______________________.

***Due: _________**

I have reviewed the Science Fair information and timeline with my child, ____________________________, (Printed Name of Student) and we understand the requirements for a successful Science Fair Project.

_________________________________ Parent Signature

_________________________________ Student Signature

In the event that my child is a finalist in our school science fair, I give permission for my my child's name to appear on the school website and in local newspapers.

_________________________________ Parent Signature

_________________________________ Date

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	• Use of Resources* ***jr/sr projects only***	– A comprehensive, correctly formatted bibliography was included & footnotes are present in text and display – Student(s) used full resources available (e.g. labs, advisors, experts, scientific periodicals & texts, internet)	– Incomplete citations – Used **most** available resources – **Most** internet resources are scientific & reputable	– **Minimal** effort on citing sources – Used **some** available resources – **Some** internet resources are scientific & reputable	– **No** sources or citations – Project suffered as a result of **not** using available resources – Internet resources are **not** scientific or reputable
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Projects often done by students

Projects should be experiments, NOT demonstrations and should reflect the student's own work and ideas. As an experiment the project is a collection and analysis of data. The following list outlines topics that are commonly seen at science fairs and ARE NOT necessarily unique ideas or projects. If your student does a similar project, make sure it is well thought out with a lot of data and multiple trials and has a creative twist.

1. Effect of music/talking on plants
2. Effect of light/dark/colored lights on plants
3. Effects of different liquids on plants
4. Effect of soda/coffee/etc. on teeth
5. Effect of running/jumping/music/video games on blood pressure, etc.
6. Strength/absorbency of paper towels
7. Which is better? Brand wars (popcorn, soaps, fertilizers, batters, etc.)
8. Basic maze running
9. Effect of color on memory/emotion/mood/etc.
10. Effect of color on food taste
11. Optical illusions
12. How music effects learning
13. Color choices of gold fish
14. Fingerprints and Heredity
15. Hovercraft design
16. Colonizing bacteria from doorknobs, hands, places around school
17. Mentos and Coke

Guidelines and Safety

***Failure to abide by the guidelines will result in disqualification.**

1. Individual projects must be the work of a single student.

2. Team projects must consist of no more than 3 participants.

3. All work presented must be the student's work.

4. Parents can be guides. Adults can supervise the investigation, but not take part expect in cases of safety.

5. Parents should not participate in the preparation of the presentation, except to help collect materials and act as an audience for practice.

6. Students must cite research, using the rules that the teacher provides.

7. Students must keep dated, step-by-step log book recordings of the project including all references, procedures, dates, and other relevant materials.

8. Students may have procedures performed by a scientist or other person(s) that he/she did not perform. Credit must be given to the scientist or any other person performing any part of the student's research, collection of data, experimentation, analysis of data, etc.

9. Students should not work with hazardous, controlled, or regulated substances.

10. Students should not experiment on vertebrates (animals with backbones).

11. Students should never grow bacteria at home. All bacteria should be contained in a laboratory, where colonies can be properly disposed of.

12. Students should not employ any procedures that would place them in danger.

Timeline

Due Dates:

___________	Purchase a science fair log book
___________	Select a topic and an experimental question
___________	Complete your research report
___________	Write a bibliography
___________	Form a hypothesis
___________	Determine independent/dependent/and constant variables.
___________	Design your experiment
___________	Observe and collect data
___________	Make a visual representation (graph) of your data
___________	Review and analyze data to determine a conclusion
___________	Preparing project display board
___________	Present your findings to your classmates/teacher
___________	Compete in the school science fair.

Science Fair Categories

1 Animal Science (AS)

2 Behavioral & Social Sciences (BSS)

3 Biochemistry (BC)

4 Cellular & Molecular Biology (CMB)

5 Chemistry (C)

6 Computer Science (CS)

7 Earth & Planetary Science (EPS)

8 Energy & Transportation (ET)

9 Engineering: Electrical & Mechanical (EEM)

10 Engineering: Materials & Bioengineering (EMB)

11 Environmental Management (EM)

12 Environmental Sciences (ES)

13 Mathematical Sciences (MS)

14 Medicine & Health Sciences (MHS)

15 Microbiology (MB)

16 Physics & Astronomy (PA)

17 Plant Sciences (PS)

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Quality Project Abstracts

[Biochemistry] How Factors Influence The Effectiveness Of The Lactase Enzyme

The purpose of this experiment was to determine the efficiency of the lactase enzyme, with varying concentrations and temperatures of lactose. In depth the purpose was to see if the performance of the lactase enzyme would change if the temperature was changed or if there were less or more concentrations of the lactase enzyme used. To determine if the performance would change, glucose test strips were used to determine the concentration of glucose in the milk. Lactase enzymes break down milk sugar (lactose) into glucose, making it digestible for people with lactose intolerance. To do this experiment glucose test strips were used to determine the level of glucose for lactose-free soymilk, 1% milk, 2% milk, and whole milk (4% milk), before and after putting in lactase enzyme tablets. The main purpose of this project was the exploration of an enzyme function. Testing the effect of concentration of lactase enzyme and effect of temperature can show the characteristics of an enzyme. But, the big picture of this project was linked to lactose intolerance. What can possibly be done to help all the people around the world that have lactose intolerance? What can make lactase enzyme be more effective? People who have trouble digesting food containing dairy products can take a lactase enzyme tablet or drop to help increase their tolerance of lactose based food. This experiment shows that taking a certain amount of a lactase enzyme or taking a lactase caplet at a specific temperature can help the effectiveness of it.

[Cellular & Molecular Biology] The Effects Of Suforaphane On Dna Damage In Zebrafish

Ultraviolet radiation (UVR) is the leading environmental cause of skin cancer, the most common cancer in the world. One of the ways that UVR leads to skin cancer is by causing oxidative stress that results in mutations in DNA. It is currently unknown whether sulforaphane, an antioxidant derived from broccoli sprouts, can reduce DNA damage from UVR. The hypothesis underlying this project is that if zebrafish embryos are pre-treated with sulforaphane before they are exposed to UVR, then they will be protected against the UV damage as measured by cell death and DNA damage. Cell death was measured by acridine orange staining of whole embryos followed by fluorescence microscopy. DNA damage was determined by Southwestern blot analysis utilizing an antibody directed against DNA cyclobutane pyrimidine dimers (CPDs). A zebrafish UVR assay was developed by evaluating multiple UVR doses and time courses of treatment. Once optimized, a sulforaphane dose-response treatment course revealed that embryos pretreated with 10-60 micromolar sulforaphane (prior to 30 minutes of UV exposure after 4 hours) had less cell death than non-treated controls. The DNA damage assay did not work well on the zebrafish DNA and possible reasons for this failure are explored.

[Computer Science] Improving Genetic Algorithms

The project examines the application of biology to genetic algorithms, especially the importance of mutation scaling in a genetic algorithm. Genetic algorithms are computer simulations of a population which migrate towards a general solution. The idea comes from the Darwinian theory of evolution in which a population evolves so that each individual has a better chance of surviving in the environment. Genetic algorithms are usually applied to problems which have complex solutions, or a ridiculously large search space. I wrote an algorithm that tested the effects of mutation scaling, and tested it against an algorithm that did not utilize mutation scaling, making changes for optimization. I found that mutation scaling is a promising way of drastically increasing the efficiency of a genetic algorithm, made more efficient by changing other variables in the algorithm as well. The theory of mutation scaling worked well in many diverse population spaces, suggesting that continued research into this area is promising.

[Environmental Sciences] The Albedo Of Ice And Soot

My project, "The Albedo of Ice and Soot" determines whether various concentrations of ash and coal dust coating the surface of ice causes that ice to melt more quickly in the presence of sunlight. I did this experiment to investigate if the deposition of air pollution can increase the loss of ice and snow pack.

[Medicine & Health Sciences] Dance Vs. Soccer: Comparison Of Hamstring To Quadricep Strength Ratios In Young Female Dancers And Soccer Players Using Surface Electromyography

Non-contact anterior cruciate ligament injuries occur at a 2-8 times higher rate in female athletes vs. male athletes. Female characteristics that are thought to contribute to this are: 1. greater Q- angle from pelvis to knee, 2. narrower femoral codylar notch, and 3. lower hamstring to quadricep strength ratio resulting in quadricep muscle dominence and decreased dynamic stability at the knee. In our experiment, we wanted to compare the HS/Quad strength ratio between female dancers (who have a low incidence of ACL injuries) and female soccer players (who have a much higher incidence of ACL injuries), hypothesizing that the dancers would demonstrate a stronger HS/Quad strength ratio than the soccer players. Our test subjects consisted of 11 female soccer players from Park City Soccer Club and 14 dancers from Park City Dance Academy, all between ages of 11-15 yrs. Using 2 leads from our surface electromyography equipment, we simultaneously tested muscle activity of both the hamstrings and quadriceps muscle groups during 3 consecutive repetitions of a single leg squat. Then, using the averages recorded by our sEMG program of the strength generated by these muscle groups (measured in microvolts), we calculated the HS/Quad strength ratios of each participant.

Canyons School District Science Fair

Guidelines for Log Book, Experimental Report, and Display Board

Science Fair Log Book

A science log book is a hand-written/typed, start to finish, dated record of all the work done on your project, and is the most valuable part of your science fair project. It will need to be neat and easy to read, as you'll need all the information to synthesize a conclusion, and it will also be displayed at the science fair with your display board.

Things that should be included:

✓Brainstorm lists of potential topics, ideas, areas of interest, etc.
✓The topic you chose and why
✓Project title and problem statement
✓Research notes from literature pertaining to the project, including references and citation
✓Questions you have as you're researching
✓Identification of variables
✓hypothesis, materials list, procedure
✓Data tables and data summary
✓Pictures that were taken, or drawings that you did
✓Graphs
✓Observations (similar to a diary)
✓Thoughts and reflections

Notebook Tips:

✓Don't remove any pages. Simply put a line through errors
✓All pages should be numbered before any data is entered
✓All entries should be dated
✓Each new entry should begin on a separate page
✓Use more than one notebook if necessary
✓Don't put rough drafts of the research paper in the notebook

Selecting a Topic:

One of the most difficult parts of a science project is to select a topic of interest, and a question to research. Begin by writing a list of things you're interested in, and then think of possible questions for those topics that might make for interesting projects. When determining your topic and question, please consider the guidelines and safety requirements:

✓ Individual projects must be the work of a single student.

✓ Team projects must consist of no more than 3 participants.

✓ All work presented must be the student's work.

✓ Parents can be guides. Adults can supervise the investigation, but not take part expect in cases of safety.

✓ Parents should not participate in the preparation of the presentation, except to help with materials and act as an audience for practice.

✓ Students must cite research, using the rules that the teacher provides.

✓ Students must keep dated, step-by-step notebook recordings of the project including all references, procedures, dates, and other relevant materials.

✓ Students may have procedures performed by a scientist or other person(s) that he/she did not perform. Credit must be given to the scientist or any other person performing any part of the student's research, collection of data, experimentation, analysis of data, etc.

✓ Students should not work with hazardous, controlled, or regulated substances.

✓ Students should not experiment on vertebrates (animals with backbones).

✓ Students should never grow bacteria at home. All bacteria should be contained in a laboratory, where colonies can be properly disposed of.

✓ Students should not employ any procedures that would place them in danger.

*If you need to conduct your experiment in a laboratory, or need a mentor to help you complete your experiment, visit www.slvsef.org.

Research

Once you have decided what topic you'd like to research, you can begin to do research on your topic. Find out everything you possibly can on the topic, and as you're researching, write down any ideas you might have for what specific question you'd like to do your experiment on.

You are expected to find information from at least 5 sources. Make sure to gather all information that will be required to create a bibliography as you are researching.

Seek out advice from professionals, go to the library, read books, find magazine articles, look through published studies, etc. Pioneer library, which can be accessed through uen.org is a great place to find published literature on many topics.

☐ Write a background summary in your log book which includes:

- ✓ historical background - important people and their findings
- ✓ factual summary - major terms and definitions, and an explanation of any science concepts needed to understand your experiment
- ✓ summary of importance - what is important or significant to mankind about this topic? Why is this experiment worth doing?

☐ Record information for each source that you will need when writing a bibliography.

Writing a Bibliography

☐ Write a bibliography for all the sources you used in your research

A bibliography is a list of all the sources you looked at when writing your report. Sources are listed in alphabetical order by the author's last name or by the title, if no author is given. It is to be double-spaced and the second line of each listing should be indented one-half inch. The bibliography is the last page of your written report. Below are examples showing how to write a citation for several different types of sources.

Magazine: Author's last name, first name. "Article Title." Magazine Title. Date: Page numbers.

Newspaper: Author's last name, First name. "Article Title." Newspaper name. Date: Page.

Interview: Interviewee's last name, First name. Personal Interview. Data.

Book: Author's last name, First name. Title. Place of publication: Publisher, Copyright date.

Internet: Author's last name, First name. "Document Title." Title of Site. Date of Document. Address. Date of access.

Problem Statement & Variables

☐Identify your variables:

✓In your experiment you will be altering one variable. Lets say you are interested in skateboards, and want to know if altering the shape of your skateboard will help with performance of some tricks. The shape of your skateboard is what you will alter. At the same time, you must keep other variables constant, like the number of wheels on the skateboard, the type of trick you'll be doing, the rider of the skateboard, etc. When you think you know what variables may be involved, think about ways to change one at a time. This will help you determine your problem statement.

✓The one condition that you choose to manipulate or alter in your experiment is called the **independent variable** (shape of the skateboard). What you will observe and measure in your experiment is you **dependent variable** (trick performance). Conditions that you will keep the same throughout your experiment are called **constants(**type of trick, rider of the skateboard, etc). Choose your variables carefully.

☐write your problem statement in the form of a question:

✓"What is the effect of (the independent variable) on the (dependent variable) of/in (your object or system you are studying)?

Procedure & Materials

A procedure is a step-by-step list of what you are going to do in your experiment. It must be so specific that someone else could repeat your experiment in exactly the same way you did.

❏ Write your procedure.

- ✓ Number each step and give very specific instructions
- ✓ All methods need to be explained in detail (like how to use a certain piece of machinery, etc.)
- ✓ Begin each sentence with a verb (fold, aim, collect, conduct)
- ✓ Write in the third person, do not use I, me, we, etc.
- ✓ All measurements should be in the metric system
- ✓ Repeat your experiment at least 3 times to ensure accuracy and obtain average results
- ✓ Be sure you have a control

❏ Write a list of all the materials you will need in order to perform your experiment.

- ✓ Have your parents sign your list of materials in your log book to acknowledge they approve of the equipment you will be using.
- ✓ Check with your science teacher if you need any special equipment of supplies.

Data Collection & Experimentation

Before beginning the actual experiment, you will need to design a data table for recoding your observations, measurements, etc.

☐Create your data. Make sure it includes:

- ✓Have a title describing the data that will be collected
- ✓Each change of the independent variable should be a column heading, and each row is a trial or sample
- ✓Make sure you include metric units

☐Collect your data! Don't take any shortcuts that might produce errors in your data. Repeat your experiment and run enough trials until you are sure you have enough data to allow you to form a reliable conclusion. Tips:

- ✓Take photographs of your materials, and of anything else you might think be important to help determine the results of your experiment.
- ✓Record all measurement on your data table in your log book.
- ✓Calculate the average result for all your trails.
- ✓Your data should also include written observations of what you noticed during the experiment:
  - ✓What did you see happening?
  - ✓What was unexpected?
  - ✓What problems did you encounter?
- ✓Keep careful notes of everything you do, and of everything that happens, as they will be helpful when determining your conclusion.

Graph & Data Summary

A graph is a visual display of your averaged data.

- [ ] Determine which type of graph you will use to appropriately display your data.

    ✓Line Graph: Use when tracking changes over short or long periods of time

    ✓Pie Chart: Use when comparing parts of a whole

    ✓Bar Graph: Use when comparing things between different groups

    ✓Scatter Plot: Use when determining relationships between two different things.

- [ ] Appropriately label your graph:

    ✓Title your graph

    ✓Label the independent variable on the x-axis (horizontal axis) with its unit of measurement.

    ✓Label the dependent variable on the y-axis (vertical axis) with its unit of measurement

    ✓Use an appropriate number scale by determining what the smallest and largest data points are

- [ ] Plot your data

- [ ] Write a statement describing any trends you see in your graph

Conclusion

A conclusion is a reaction to the hypothesis and a connection between the results of the study and the background information that was gathered. It also discusses why the results of the study are significant or important.

☐Write your conclusion, which should include:

- ✓Restating your hypothesis, and whether it was or was not supported
- ✓Explain how your results support or do not support your hypothesis
- ✓If your hypothesis was not supported, explain why you think this may have happened
- ✓tell how your results and your conclusion relate to facts in your background information
- ✓Describe how your findings are significant or important
- ✓Describe what you might do differently next time
- ✓Discuss any difficulties or problems you had during the experiment
- ✓What sources of error could have affected your results
- ✓What new questions occurred to you while doing the experiment

Components of Experimental Report

Your formal report should present in detail your purpose, the process, and any findings from your experiment. This is required for all secondary projects. Your report should include:

- ☐ Title Page
- ☐ Table of Contents
- ☐ Acknowledgements (if needed)
- ☐ Background information
- ☐ Method of Investigation
  - ☐ Problem statement
  - ☐ Variables
  - ☐ Materials
  - ☐ Procedure
- ☐ Results
  - ☐ Data tables
  - ☐ Observations
  - ☐ Graphs
  - ☐ Summary of results
- ☐ Conclusion and Scientific worth
- ☐ Bibliography
- ☐ Appendices (if needed)

Format of Experimental Report

- [ ] Neatly typed on 8.5” by 11” white, unlined paper
- [ ] 1” margins except for a 1.5” left margin
- [ ] Numbered pages
- [ ] Section titled underlined or in bold
- [ ] Double space between sections
- [ ] Writing style is clear, concise, and objective
- [ ] Proper sentence and paragraph structures
- [ ] Correct grammar and spelling
- [ ] All writing is in the third person
- [ ] Underline or italicize scientific names
- [ ] Correct bibliography form
- [ ] Finished report in folder or report cover

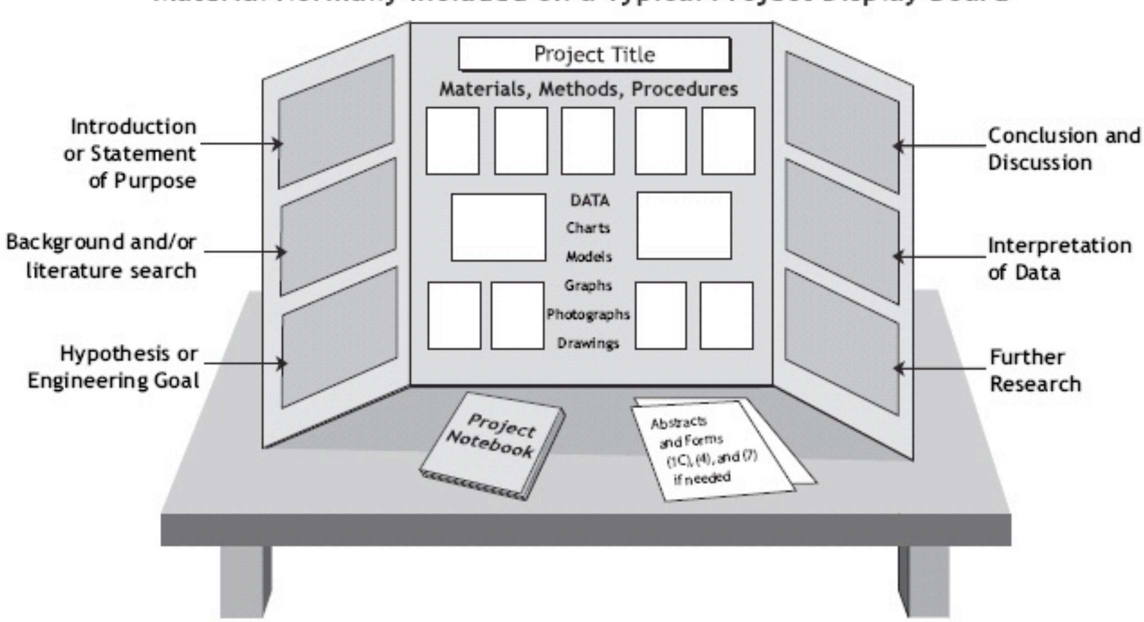
Display Board Tips

Your display board is important. It's not nearly as important as your judging interviews and the content on the board, but it's important. First impressions matter, and the first impression judges get about your project is what they see on your display board, read in your abstract, and find in your lab notebook.

What should my display board say?
Your display board should do two things: First, it should tell a story about what you did, why you did it, how you did it, and why people should care. Second, your board should highlight the end result of your project: your conclusion and its importance, the useful tool you engineered, or the exciting proof that you solved.

How can I make my board look good?
1. Make your text readable. Font sizes larger than 100 for your title, 32-48 for headers, 16-18 for body text, and 12-14 for captions. Larger font sizes limit the amount of text on your board. Putting too much information on the display board is a common mistake.
2. Figures are great. Use graphs, flow charts, diagrams, and pictures whenever possible. Make sure they are large enough to be read from a distance, and be sure that your figures have captions.
3. Use a paper cutter for nice, straight edges.
4. Use matte photo for your photos, as it makes them easier to view.
5. Bacteria, plants, or anything else living or dead may not be displayed with your project. Please use photos if you'd like to include them somehow in your display.

Material Normally Included on a Typical Project Display Board



Display Board Tips Continued

Projects having displays that include any of the following items will be disqualified:

- ✓ Living organisms, including plants
- ✓ Soil, sand, rock, and or waste samples even if permanently encased in plastic
- ✓ Taxidermy specimens or parts
- ✓ Preserved vertebrate or invertebrate animals
- ✓ Human or animal food
- ✓ Human/animal part or body fluids (e.g. blood, urine, etc.)
- ✓ Plant materials (living, dead, or preserved).
- ✓ All chemicals including water
- ✓ All hazardous substances or devices (e.g. firearms, weapons, ammunitions, lasers, etc.)
- ✓ Dry ice or other sublimating solids
- ✓ Sharp items (e.g. syringes, needles, pipettes, knives)
- ✓ Flames or highly flammable materials
- ✓ Batteries with open-top cells
- ✓ Photographs or other visual presentations depicting vertebrate animals in surgical techniques, dissections, necropsies, or other lab procedures
- ✓ Glass or glass objects
- ✓ Any apparatus with unshielded belts, pulleys, chains, or moving parts