Mountain Shadows

SCIENCE FAIR

Regulations, General Information, and The Scientific Method

Projects due

February 7, 2018

Mountain Shadows Middle School Science Fair

regulations follow those of the

Riverside County Science and Engineering Fair Rules and Regulations

for

2017-2018

Riverside County SEF Display Regulations

Any questions regarding Riverside County SEF Display and Safety regulations to Yami Shimojyo at yshimojyo@rcoe.us

Display and Safety Authority

The Riverside County SEF Display and Safety Committee is the final authority on display and safety issues for projects approved by the SRC to compete in the Riverside County SEF. The Riverside County SEF Display and Safety Committee may require students to make revisions to conform to display and safety regulations.

Students must take full responsibility for the safety of all parts of their exhibits. Please review all display and safety regulations in the following pages. Please note that:

- The purpose of the display is to communicate the experimentation done, but not necessarily to provide a live demonstration of the experimentation. Consider use of photographs and drawings.
- Valuable material and equipment should be simulated or pictured. Items may be brought for demonstration during judging and then removed. No gas or water outlets are provided. Electrical outlets are within six feet if requests on student application.
- No plants, food, chemicals, liquids (including water), hazardous materials or equipment, or unattached items may be on display.
- Containers for high pressure gases must be empty. No open flames are allowed.
- Toxic, hazardous, combustible, or cryogenic materials are prohibited.
- All parts of the exhibit should be securely attached to the display board.

Display Regulations

The following regulations must be adhered to at Riverside County SEF:

Maximum Size of Project:

- Depth (front to back): 2.5 feet or 76 centimeters
- Width (side to side): 4 feet or 122 centimeters
- Height (table): 6.5 feet or 198 centimeters
- Height (floor): 9 feet or 274 centimeters

Please be aware when ordering posters that the mechanism that supports the poster should conform to the maximum size limitations stated above.

1. All project materials and support mechanisms must fit within the project dimensions.

2. Projects displayed on tables are the preferred standard. Projects which require floor access may utilize a table for a portion of their display, but the entire display must still fit within the width and depth limitations specified above. Projects with floor displays may be placed out of numerical sequence and possibly away from other projects in the same subject category.

3. All projects must fit within these prescribed space limitations. This includes elements of the project that may extend or protrude. Displays which are admitted, but are later augmented to exceed the space limitations will be disqualified until brought into conformance. Using the aisle between projects as additional display space, even temporarily during interviews, is cause for disqualification.

Display Content for Regulated Research Institution

1. Regulated Research Institution Projects
   The display must reflect on the work conducted by the student.
   - Minimal reference to mentor's or other researcher's work must only reflect background information or be used to clarify differences between student's and others' work.

Forms Required for All Projects

1. Original of official Abstract and Certification as approved by the Riverside County SEF Scientific Review Committee. *(Submitted with registration forms)*
2. Completed Riverside County SEF Project Set-up Approval Form *(Received on-site at the Fair.)*
3. Project Display Information Form attached to the back of the display board. *(Form available online or available on-site at the Fair.)*

Completed informed consent forms are not allowed to be present at the project display. They are to be submitted with the registration materials.

Audio Visual Presentations/Photographs

Students using audio-visual or multi-media presentations (for example 35mm slides, videotapes, images, graphics, animations, etc., displayed on computer monitors; or other non-print presentation methods) must be prepared to show the entire presentation to the Display and Safety Inspectors before the project is approved.

Any photograph/visual image/chart/table and/or graph is allowed if:

1. It is not deemed offensive or inappropriate *(which includes images/photographs showing invertebrate or vertebrate animals/humans in surgical, necrotizing or dissection situations)* by the Review Committee, the Display and Safety Committee, or Riverside County Office of Education. The decision made by any one of the groups mentioned above is final.

2. It has a credit line of origin ("Photograph taken by..." or "Image take from..." or "Graph/Chart/Table taken from..."). *(If all images, etc. being displayed were taken or created by the student or are from the same source, one credit line prominently and vertically displayed on the backboard/poster or tabletop is sufficient.)*

3. It is from the Internet, magazine, newspaper, journal, etc., and a credit line is attached. *(If all photographs, etc. are from the same source, one credit prominently and vertically displayed is sufficient.)*

4. It is a photograph or visual depiction that does not provide any public disclosure or identifying information of human subjects, regardless of the method or modality of that public disclosure *(i.e., pictures, videos, etc.)*. Human participants and the project researcher must have their faces covered.

Items/Materials Not Allowed ON Project DISPLAY

1. Any items that are acknowledgements, self-promotions or external endorsements *(such as naming the research institution, mentor or patent pending statements)* and/or are intended for distribution including:
   a. Any disks, CDs, business cards, printed materials, etc., *(including unofficial abstracts)* designed to be distributed to judges or the public.
   b. Flash drives, brochures, booklets, endorsements, and additional give-away items including, but not limited to, pins, key chains, food, etc.

2. Postal addresses, World Wide Web, email and/or social media addresses, QR codes, telephone and/or fax numbers of a project or student.

3. Awards won in previous competitions.

4. Active Internet or email connections as part of displaying or operating the project at the Riverside County SEF.

5. Prior year's written material or visual depictions on the vertical display board **(Exception: The project title displayed in the student's booth may mention duration of the project).* For example, Year 2 on an Ongoing Study.

*Any attempt to replenish or return removed items from the above list is a violation and will result in items being confiscated by the Display and Safety Committee and may result in the project failing to qualify for competition.

Other Display Regulations

1. No changes, modifications, or additional to projects may be made after approval by the Display and Safety Committee and the Review Committee. Participants who do not adhere to the signed agreement regarding this regulation will fail to qualify for competition.

2. It is highly recommended that your name, school, grade, and district be placed on all notebooks or materials that are left with your project. A project data book and research paper are not required but are highly recommended.

3. Any inadequately insulated apparatus producing extreme temperatures that may cause physical burns is not allowed.

4. Any apparatus with unshielded belts, pulleys, chains, or moving parts with tension or pinch points must be for display only.

5. Project sounds, lights, odors, or any other display items must not be distracting. Exceptions to this rule may be permitted for judging demonstrations. Approval must be given prior to judging.

6. Projects can be continued under the table but it is not be used for storage.

7. Riverside County Office of Education officials, the Review Committee, and/or the Display and Safety Committee reserve the right to remove any project for safety reasons or to protect the integrity of the Riverside County SEF and its rules and regulations.

8. If a project fails to qualify and is not removed by the student, Fair officials will remove the project in the safest manner possible but is not responsible for damage to the project.

Display Items Not Allowed on the Judging Floor

1. Living organisms, including plants.
2. Soil, sand, rock, cement and/or waste samples, even if permanently encased in a slab of acrylic.
3. Taxidermy specimens or parts.
4. Preserved vertebrate or invertebrate animals.
5. Human or animal food as part of the exhibitor demonstration of the project.
6. Human/animal parts or body fluids *(for example, blood, urine).*
7. Plant materials *(living, dead, or preserved)* that are in their raw, unprocessed, or non-manufactured state *(Exception: manufactured construction materials used in building the project or display).*
8. All chemicals including water *(projects may not use water in any form in a demonstration).*
9. All hazardous substances or devices *(including but not limited to poisons, drugs, firearms, weapons, ammunition, reloading devices, and lasers).*
10. Items that may have contained or been in contact with hazardous chemicals *(Exception: item may be permitted if professionally cleaned and documented for such cleaning is available).*
11. 3-D Printers.
12. Dry ice or other sublimating solids.
13. Sharp items *(including but not limited to syringes, needles, pipettes, knives).*
14. Weapons or weapon paraphernalia of any kind.
15. Flames or highly flammable materials *(including magnified light sources).*
    a. A Fresnel lens cannot be used in conjunction with a light source – it becomes an open flame.
16. Batteries with open-top cells or wet cells.

17. Glass or glass objects unless deemed by the Display and Safety Committee to be an integral and necessary part of the project *(for example, glass that is an integral part of a commercial product such as a computer screen).*

18. Any apparatus deemed unsafe by the Scientific Review Committee, the Display and Safety Committee, or Riverside County Office of Education officials *(examples: large vacuum tubes or dangerous ray-generating devices, empty tanks that previously contained combustible liquids or gases, pressurized tanks, 3D prints, etc.)*

Electrical Regulations

1. Electrical power supplied to the project is 120 volt.

2. Electrical devices must be protectively enclosed. Any enclosure must be non-combustible. All external non-current carrying metal parts must be grounded.

3. Energized wiring, switches, and metal parts must have adequate insulation and over-current safety devices *(such as fuses)* and must be inaccessible to anyone other than the student. Exposed electrical equipment or metal that possibly may be energized must be shielded with a non-conducting material or with a grounded metal box to prevent accidental contact.

4. Decorative lighting or illumination is discouraged. If used, lighting must be as low a voltage as possible and must be LED lighting that does not generate heat. Light bulbs are prohibited. When student is not at the exhibit, all electrical power must be disconnected, or power bars must be switched off *(Exception: during pre-judging audio visual displays may be available).*

5. No exposed live circuits over 36 volts are allowed.

6. There must be an accessible, clearly visible on/off switch or other means of quickly disconnecting from the 120 or 220 volt power source.

Laser Requirements

Any Class 1 or Class 2 lasers, along with only Class 3A or 3R lasers, are allowed to be used provided a student avoids indiscriminate exposure to other students, judges, or visitors *(except if passed through magnifying optics such as microscopes and telephones, in which case they may not be used).* No other lasers may be used or displayed.

1. Displays with lasers should have a warning sign: "LASER RADIATION – DO NOT STARE INTO BEAM."

2. Any laser must be labeled by the manufacturer so that power output can be inspected. Lasers without labels will NOT be "cleared."

3. LED's that consume over 1 watt, unless they are in a commercial light bulk/fixture or otherwise shielded, will not be allowed.

4. Lasers will be confiscated with no warning if not used in a safe manner. Serious offenses may result in failure to qualify.

Tobacco, Alcohol and Controlled Substances
GROUNDS FOR IMMEDIATE DISQUALIFICATION

1. No project may use consumable tobacco, alcohol or illegally obtained narcotics and/or controlled substances. This includes surveys that compare use of the above substances *(e.g., smokers vs. non-smokers).*

2. Controlled substances *(drugs, chemicals, anesthetics, etc., the use of which is regulated by Comprehensive Drug Abuse Prevention and Control Act of 1970)* must conform to existing local, state, and federal laws. Such substances may not be exhibited at the Fair.

Chemicals

1. Projects that use a chemical with a hazard rating of five or with asterisks are not permitted.

2. For help on chemical use, use The Science Safety Handbook for California Public Schools (2014 edition) downloadable at: www.cde.ca.gov/pd/ca/sc/documents/scisafebook2014.pdf.

SAFETY REGULATIONS

The following safety regulations must be adhered to when a student exhibits a project at the Riverside County SEF.

Firearms, Explosives and Projectiles

1. Fire regulations prohibit the use of highly flammable or combustible materials in project displays. Education Code, Section 48915. "Firearm" means any device designed to be used as a weapon from which a projectile is expelled through a barrel by the force of any explosion or other form of combustion. Examples of dangerous objects include but are not limited to: air soft guns, paint ball guns, BB guns, pellet guns, air rifles, brass knuckles, fist packs, nunchaku, sling shots, throwing stars, darts, and any object likely to cause injury to person or property that has no reasonable use at school. Education Code 48900(b).

2. Projects involving the discharge of a single or multiple projectiles by mechanical, chemical or electromagnetic means are not permitted. Examples: archery, tackle, air guns, firearms of any type, etc.

3. Rocket-propelled projectile or similar device with an engine greater than 0.60 inch in diameter.

Biofuels

1. Research regarding biofuel/alcohol production must conform to the U.S. Department of Treasury, Alcohol and Tobacco Trade Bureau regulations.

2. Permits must be obtained prior to the production of any alcohol fuel. Application and Regulation information for permits visit: **www.ttb.gov/forms/f511074.pdf**.

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GROUNDS FOR IMMEDIATE DISQUALIFICATION

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2. Controlled substances (drugs, chemicals, anesthetics, etc., the use of which is regulated by Comprehensive Drug Abuse Prevention and Control Act of 1970) must confirm to existing local, state, and federal laws. Such substances may not be exhibited at the Fair.

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www.cde.ca.gov/pd/ca/sc/documents/scisafebook2014.pdf.

Human Subjects and Live Vertebrate Animals

When applicable, the following form(s) must be submitted with your application to the district/affiliate fair coordinator. Personal and school identification, including photograph must be concealed.

- Certification of Humane Treatment of Live Vertebrate Animals Form *(RCSEF Form 4)*
- Certificate of Compliance of Research involving Human Subjects *(RCSEF Form 5)*
- Participant Informed Consent Form *(RCSEF Form 6)*
- Human and Vertebrate Animal Tissue Form *(RCSEF Form 7)*
- *Acceptable substitute forms: ISEF Form 4, 5A, 5B, 6B)*

- The display of bacterial cultures and live or dead vertebrates, invertebrates, plants or microorganisms or their parts, is not permitted (e.g. teeth, hair, fur, feathers). Only illustrations or photographs of microorganisms and animals are permitted.

- Photographs or other visual presentations of surgical techniques, dissections, autopsies, and/or laboratory techniques depicting vertebrate animals in other than normal conditions may not be displayed. Hide a participant's face to protect identity.

- Live vertebrate animals may not be displayed during the fair.

- State of California Education Code 51540: In the public elementary and secondary schools or in public school-sponsored activities and classes held elsewhere than on school premises, live vertebrate animals shall not , as part of a scientific experiment or any purpose whatsoever:
  - Be experimentally medicated or drugged in a manner to cause painful reactions or induce painful or lethal pathological conditions.
  - Be injured through any other treatments, including but not limited to, anesthetization or electric shock.
  - Live animals on the premises of a public elementary or high school shall be housed and cared for in a humane and safe manner.
  - The provisions of this section are not intended to prohibit or constrain vocational instruction in the normal practices of animal husbandry.

Prohibited Research and Disclosure on Human Subjects

1. Student researchers may not publish or display information in a report that identifies the human subject directly or through identifiers linked to the subjects (including photographs) without written consent.
2. Students are prohibited from administering medications and performing medical procedures on human subjects.
3. Students under the age of 21 are prohibited by federal and state law from using controlled substances in their research project. These substances include all forms of alcohol, explosive materials, tobacco, and firearms. *Education Code section 48900 (b)*

Projects That Require Certification of a Biomedical Scientist

When applicable, these items must be submitted with your application to the district/affiliate fair coordinator. Personal and school identification, including photograph must be concealed.

- Certification of Humane Treatment of Live Vertebrate Animals Form *(RCSEF Form 4)*
- Certificate of Compliance of Research involving Human Subjects *(RCSEF Form 5)*
- Participant Informed Consent Form *(RCSEF Form 6)*
- Human and Vertebrate Animal Tissue Form *(RCSEF Form 7)*
- *Acceptable substitute forms: ISEF Form 5A, 5B*

1. All recombinant DNA research must be carried out in accordance with current NIH Guidelines for Research Involving Recombinant DNA Molecules. Only research normally conducted without containment in microbiological laboratories and performed under the supervision of an appropriately qualified scientist will be permitted. The facilities to be used must be described in the research plan. Research requiring containment is prohibited.

2. It is permissible for the student and designated adult supervisor to consult with a biomedical scientist to obtain detailed instructions and guidance in techniques to be used by the student under the direct continuous supervision of a designated adult supervisor (for research not conducted in the biomedical scientist laboratory). In this instance, the designated adult supervisor will be required to certify in writing jointly with the biomedical scientist.

3. Either the biomedical scientist or adult supervisor must provide continuing supervision to assure compliance with the protocol.

4. Major deviations from the approved protocol may be implemented only with the written approval of the biomedical scientist, but may never violate the California Education Code.

5. The biomedical scientist or adult supervisor must be in the same locality as the student for the duration of the experimental work except for short trips. This means that a project started in one city may not be continued in another unless an alternate designated adult supervisor, approved by the biomedical scientist prior to the continuation of the experimental work, and agrees to supervise the project.

THE SCIENTIFIC METHOD

STEP 1: Select a Topic Area

The first step in selecting a topic for your science project is to decide on a topic that interests you. The topic is a general area of study (birds, plants, friction). Pick a subject that you already have prior knowledge of and/or find enjoyable. Make sure your topic area is one where:

- you can actually experiment and collect data. Black holes are exciting but you obviously cannot get any data.
- you will have access to all resources and supplies you will need while doing the project.
- you can measure some aspect of the topic. For example, for the topic "Does your mood vary according to the day of the week?", how would you measure mood? In investigation how some factor affects the freezing rate of water, how would you measure freezing time since it is a gradual process?

If you really have no idea where to start, there are many lists that have a lot of good ideas in science books, magazines, newspapers, and computer networks. Don't be shy. Talk to anyone you know who might have an idea.

Is Your Topic Acceptable? Use this checklist to see if a topic is a good one for a science project. If your problem is satisfactory, you will be able to do the following:

You should answer "yes" to all of these.

-Does the topic sound interesting to you?
-Can you get measurements or some kind of number for data?
-Can you measure a change in the variable studied (dependent variable)?
-Can you change the other variable (independent variable)?
-Can you keep other factors from influencing your results?
-Can you find at last 3 sources of written information on the subject?
-Can you collect a lot of data? (20 or more numbers) Do you have all the materials? you need, or will you be able to get all the materials quickly?
-Do you have time to do the experiment twice?
-If the project involves human subjects, are you willing to get permission from every adult and parent permission for every student tested?
-Is the topic interesting enough for you to read about it before you start?

You should answer "no" to all of these.

-Could a younger student do the same project?
-Is it going to cost you more than $10 to do this project?
-Could anyone be even slightly hurt by your project?
-Could any of your data cause any embarrassment to anyone?

STEP 2: Identifying the Problem

After you find the general subject you want to research for your science project, you have to narrow down your topic to a specific question or problem. To do this, it is good to go to the library, or do other research to find a more specific area. For example, if you really found the subject of plants interesting, you would need to go to the library to do research on botany. This would help you narrow down your topic to a smaller area of interest, such as seed germination (sprouting). You next need to find a relationship between this and another variable (e.g. temperature). This then suggests the question that will become your problem: Does temperature affect the rate of seed germination?

Is Your Problem Acceptable?
If your problem is satisfactory, you will be able to do the following:

- Measure a change in the variable studied (seed germination rate).
- Change the other variable (temperature).
- Find background information on the subject.
- Get enough data.
- Be able to get all the materials quickly.
- Have time to do the experiment **twice.**

Examples of Topic Development:

TOPIC	RELATIONSHIP	PROBLEM
BIRDS	Birds and feeder height	Does the height of a bird feeder affect the frequency with which birds will visit it?
BODY TEMPERATURE	Temperature and time of day	Does your body temperature vary with the time of day?
PENDULUMS	Pendulum and its length	Does the length of a pendulum affect its frequency?
EROSION	Erosion and plant cover	How does density of plant cover affect the rate of erosion?

STEP 3: Collect Background Information (Research)

Your **background information** should include the following kinds of information:

- **History** Has any work already been done on your topic, and what was learned?
- **Significance** How is your topic important to us, or how does it make an important contribution to the world around us?
- **Facts** What facts are known about the topic and related terms? Define all terms and concepts included in your project. How are the topics/variables related?
- **Method** What are ways that this topic can be investigated?

Sources of background information include:

- books, magazines, and newspapers
- computer searches
- interviews and surveys
- teacher assistance

When doing research, look under topics that are relevant to your topics and related topics and terms. For example, you may find nothing on your topic of "paper airplanes", but you will find information under "flight". Be sure to collect enough information to adequately support your hypothesis and explain your conclusion.

STEP 4: Developing a Hypothesis

Somewhere in your background information you should find some indication of what you expect to find. Write a specific statement or prediction giving the reasons why you expect this. Use "cause and effect" or "if and then" statement.

Examples:

- The seed will germinate faster as the temperature increases because....
- The motor oil will reduce friction the most because....
- If the color of the sugar mixture is red, then the number birds ...

STEP 5: Creating your Experimental Design

This should include:

- An explanation of all project **variables** (you can include these in your journal):
  - **Independent variable:** The one you change
  - **Dependent variable**: The one that you observe or measure (the one supposedly affected by the independent variable)
  - **Constant variables**: The variables that could affect the dependent variable but which you keep constant. A description of all **groups:**
    - **Experimental Group**: The group in which the independent variable is changed.
    - **Control Group**: The group in which the independent variable is not present or is in its normal state. **Note:** You can have more than 1 experimental group. For example in investigating the effect of music on "studying ability", you would have a control group with **no** music, but you might have several experimental groups: classical music, rock music, rap.

- The **size** of the sample groups. A frequent error is sampling too small a group. Can you really reach any significant conclusion on 3 plants? One abnormal plant would totally throw off your results.

- At least one **repetition** of the steps to make sure that your first results are correct.

Example: **Problem** - What is the effect of fertilizer on plant growth?

• **Independent variable**:	amount of fertilizer
• **Dependent variable**:	plant growth measured by the height of the plant
• **Constant variables**:	amount of water, sunlight, soil type, minerals already in the soil, temperature
• **Experimental Group**:	group of plants to received fertilizer
• **Control Group**:	group of plants receiving no fertilizer

- Are you measuring the correct thing? Is plant height really the variable you want to measure? What about plant weight, width, number of leaves, or some combination of these?

STEP 6: Writing a Step-by-step Procedure

Write the procedure as you do the steps of a lab. Be very specific; don't assume that the reader knows how much, how many, or how long. Read your procedure to someone who doesn't know what you are doing. Ask them if they know enough to "do" the experiment. Use their questions to revise your procedure.

Sample Procedure:

1. Clamp light probe in clamp stand.
2. Clamp flashlight in other clamp stand.
3. Put two meter sticks (front-to-back and cm side up) in between the two clamp stands.
4. Set up the light probe program on the TI-83 calculator.
5. Make sure the room is completely dark and no light is shining directly on light probe by getting a zero value with lights off.
6. Put the light end of the flashlight on the end of the meter stick (still in clamp stand over top meter stick.)
7. Make sure that the flashlight is directly shining on the light probe. Adjust to get highest reading for each distance.
8. Get a reading from the CBL at the 200 cm point.
9. Then move the flashlight (still in clamp) to the 190 cm point (make sure the flashlight is still lined up with the light probe).
10. Keep this procedure going for every 10cm and get a reading.
11. Once you have gotten through all the points with the flashlight, repeat the steps 1-11 for the laser in the place of the flashlight.
12. Repeat the experiment with the laser & flashlight **four times** each. (Make sure the light is shinning on the light probe, and that you are recording your data.)
13. Now see if you can find any relationship between the variable.

Sample Procedure:

1. Screw lamps into supports near the project.
2. Open the topsoil and sand bags.
3. Mix both soils in large tote until evenly distributed.
4. Fill all six red and green trays with soil to an inch of the top.
5. Place black tubs under the lights and fill to an inch of the top.
6. Add even amount of aquarium salt to each tank.
7. Set-up power heads and filters.
8. Saturate red and green trays in water.
9. Pour off excess water.
10. With the ruler create the grid below on each tray.
11. Cut the Potamogeton perfoliatus into 72 pieces; each piece is 15 cm.
12. With the pencil make a 5 cm hole where the grid intersects.
13. Place a piece of Potamogeton perfoliatus in each of these holes.
14. Pinch the soil around each stem.
15. Resubmerge trays alternating red and green, place three in each tub.
16. **DO NOT** attempt to re-plant any plants that float up during testing

STEP 7: Developing the Materials List

This should be a complete list of all materials including details and amounts.

Bad Materials List	Good Materials List
water	500 ml of distilled water
watch	stopwatch with .01 sec accuracy
people	40 subjects 10 males, age 10 - 14 10 females, age 10 - 14 10 males, age 15 - 19 10 females, age 15 - 19

STEP 8: Collecting Preliminary Data

To see if your procedure works and if you will get the kind of data you need, do a short run of your experiment. Show the data to the teacher, and make any revisions in your procedure required. For example:

- If it takes too long to get data, shorten your procedure.
- If something is too awkward to measure, alter slightly what you are doing.

STEP 9: Collecting your Data

This is the heart and real fun of your project: doing what you've been planning for so long. There is a tendency to hurry or to forget to record everything that happens, even data from tests that seem to not work. So many projects are ruined because data is lost or good records are not kept. To judges, your records and data are the most impressive part of your project.

Note: Make sure that all measurements are in Metric units: centimeters, grams, milliliters, etc. Not only is this how scientific data is recorded, but you will not have to use fractions (just decimals).

STEP 10: Making a Data Table

The key to starting to interpret or analyze your data is a good Data Table. A good table should have the following parts:

Title
Column (Variable) Titles
Units listed for each variable

Note: Use a computer spreadsheet to make a table. It is already arranged in columns and rows. You can then graph from the spreadsheet, and you can cut and paste the table into a word processing document.

SAMPLE TABLE

Effect of Temperature on Plant Growth

TEMPERATURE (C°)	PLANT GROWTH (cm)
10	14.2
15	15.7
20	17.1
25	18.9

STEP 11: Analyzing your Data

When organizing data into tables and graphs, always be sure to label columns/axes correctly and include units of measurement.

- Organize data into a table.
- Find appropriate measure of central tendency: mean, median, mode.
- Select correct graph(s) to display what you want to show:
  - **-Bar graph** for comparing 2 - 4 independent groups.
  - **-Line graph** if the independent variable is numerical, and a trend (upward or downward or change over time) is indicated.
  - **-Circle Graph** (pie chart) if graphing parts of a whole (percentages).
  - **-Scatter plot** (x-y graph) when you are trying to show a possible relationship between 2 variables.
  - **-Box and whisker plot** to show distribution of data within each group.

STEP 12: Writing the Conclusion

In this section you will discuss what your project is proving. If your data does not show a pattern or if the difference between groups is small, you should say that there was no relationship or difference. This does not mean your project is a failure. Finding that there is **no** relationship is just as important to science as finding that there is. Also include:

- Acceptance or rejection of your hypothesis.
- Summary of what the project shows us, relating background reading and data.
- Explanation of whether you think your results are significant or possible affected by error or caused by coincidence.
- Significance or possible application of your findings.
- Recommendation for further investigation of the topic.

STEP 13: Writing an Abstract

The abstract is the summary of your entire project. In its basic form, it should do 3 things:

1. Summarize what your project was about, why you chose it, and what you were attempting to learn.
2. Explain how you did it - describe briefly your procedure, groups, and variables.
3. What did you learn? - List data highlights, summarize what the data shows, and extend your project by indicating how you would do it again or apply the results to other situations.

Sample Abstract:

The Effect of Surface Finish on Rocket Drag
Grades 6-12

Objectives/Goals: *My project was to determine if surface finish has an effect on the drag on a model rocket. I believe that a model with a smooth surface will have lower drag and will reach higher altitudes.*

Methods and Materials: *Five model rockets with identical size and shape, but different surface preparations, were conducted. One rocket was left with an unfinished surface, three had surfaces finished to various degrees of smoothness, and the fifth rocket had its surface sealed, primed, sanded to 600 grit, painted, and covered with clear gloss. The rockets were ballasted to weigh the same and flown 10 times each with B5-4 motors*

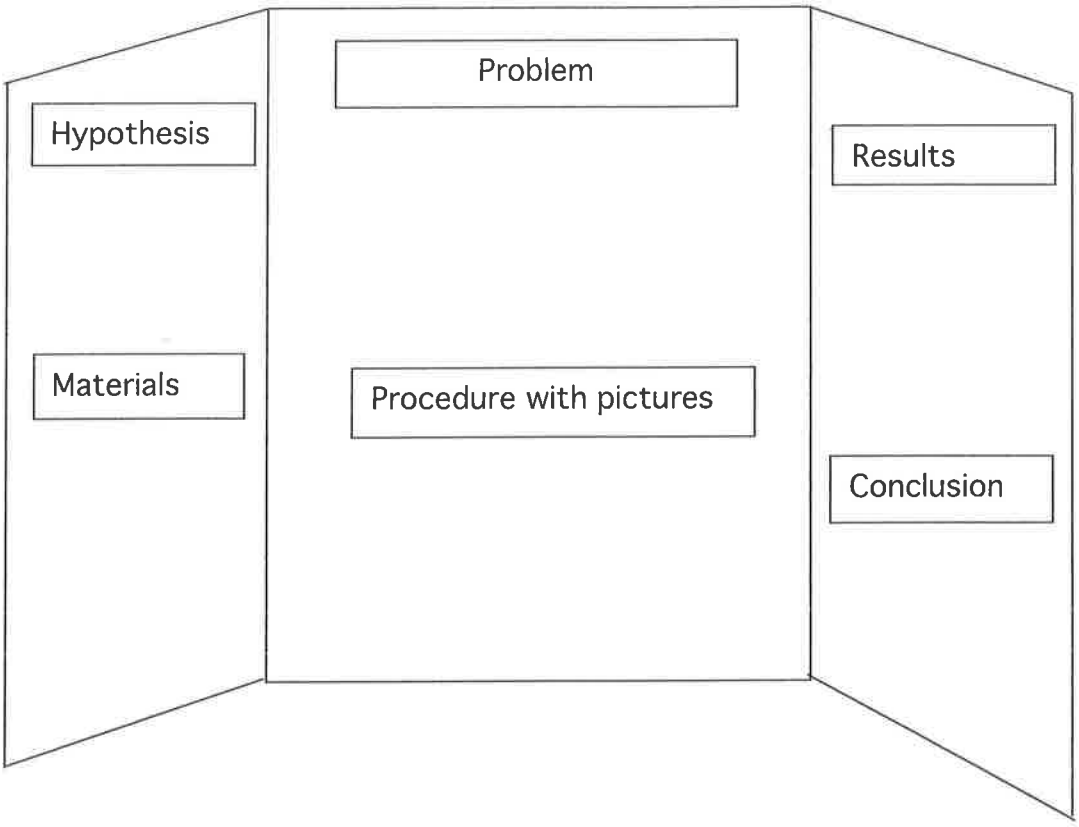
Results: *The rocket with the clear gloss finish consistently reached the highest altitudes of all 5 rockets, while the unfinished rocket consistently reached the lowest altitude.*

Conclusions: *My conclusion is that surface finish has an important role in model rocket drag and rockets by allowing the air to move easier over the surface.*

STEP 14: Creating your Display

- You don't have to use a fancy display board, but REMEMBER your project must invite a person to want to learn more.
- You want a nice looking display, but remember this is only a very small portion of your score. How much you learned, your experimental design, and your data are what are most important.
- Put only your data summary and a key graph or two on the display. Too much detracts from what you want to show.
- Photographs and diagrams help show what you are doing.

SCIENCE PROJECT BOARD
(Sample Layout)



REQUIRED

Notebook

All projects must have a notebook.

Dividers needed:

- Abstract
- Introduction
- Problem
- Research
- Hypothesis
- Materials
- Procedure
- Experiment
- Results
- Conclusion
- Bibliography
- Acknowledgements

Journal

All projects will have a journal.

The journal is a record of procedures and the results of the experiment.

Entries are to be in diary format.