Marshall Middle School Science Fair Directory

If Found, PLEASE return to Mrs. Irwin in the office

Student's Name: _____

Science Fair Timeline: : 2017-18 Science Fair

Email Questions to Mrs Gillum: mrsg9064@aol.com **Web Page:** http://mrsgillumscience.com
Science Fair Section on Web page: http://mrsgillumscience.com/2012_sf/12SF_index.htm (this is being updated!)
Got Skype? Let me know and we can use it to talk & discuss your questions!

Idea Pages & Interview Dates : Be sure to have your Science Fair Project idea cleared before you leave for the summer!

Research Paper- I will email you the Graphic organizer as a document. Download it and type directly on it.
10 sources suggested which includes: 6 web sites, MINIMUM of 2 books PLUS 1 mentor **Start looking for a mentor NOW! It can be a family friend or someone who wrote one of your researched articles. Your parents CAN be your mentor if this is their area of expertise. Mentors are great to give you guidance through the writing AND experimentation process**.You must find 6 previous experiments that help you understand your project. Only 2 may be previous science fair project experiments. **NO WIKIPEDIA OR "ASK" sites. Be sure to have your parents proof read & Edited!**

Suggested Graphic Organizer Due Dates: All work is to be parent proof-read/edited before sending to me.
May 30th: have your final idea cleared. **June 7**: Have 3 previous experiments **June 14** : have final 3 previous experiments
June 20th: Have your hypothesis/materials/procedures completed for your research paper. **June 25:** Have your core science done
June 30th: complete your bibliography **July 1: email to Mrs Gillum**
If you do this, the toughest part will be finished by the end of June and you'll just have the experiment to do!
Try and complete each deadline, PLUS have your parents proof read & edit before you email to me.

For those of you wanting to start your experiment over the summer, please email me your proposed procedures so I can clear, or make suggestions! It is HIGHLY recommended that you finish your research paper over the summer!

Experiment Process & Notebook

The dates below are SUGGESTED Due dates for these parts. If you follow these due dates, you will not be stressed in Nov.
9/6: Wed: Part 1 Statement of Problem, Purpose, Hypothesis due **by email** (all typed on individual pages)
9/11: Mon: Part 2: Variables & Controls due **by email**
9/15: Fri: Part 2: Materials & Procedures due **by email**
Please: DO NOT START EXPERIMENTATION UNTIL I read or discussed with you, your materials & procedures/hypothesis / variables & controls BY 9/25 All paperwork submitted should be cleared & and experimentation can begin. This is merely a but will help you do a quality project without getting totally stressed out as we get closer to December.

The dates below are SUGGESTED Due dates for these parts.
10/23 Mon**: Pt 1 of Experimentation Results:** Bring in your composition book to show the results from your experiment so far,
11/27: Mon: **FINAL Results** (all 4 parts: observations, data tables, graphs, photos) submitted **by email : DO NOT PRINT**
12/4: Mon: **Final Parts:** Conclusions, Recommendations AND Abstract due **by email: DO NOT PRINT**
12/8 : Friday: Greater San Diego Science Fair Forms: **Proposal Form / Hazard Forms** completed and brought to me signed by you
12/12: Mon: FINAL NOTEBOOK Turned In: THIS INCLUDES: the corrected/edited final research paper/ edited

parts 1-2-3-4, plus Table of Contents, Acknowledgements, Appendix (composition book) **Must have**: messy original data
FINAL DATES: THESE ARE NOT OPTIONAL AND MUST BE MET TO COMPETE:
1/9: Fri: Greater San Diego Science Fair Judging Parts: Power point for screening emailed to me / Final SF Notebook emailed to me
3/5: Tues: BACKBOARD DUE

The Real Deal:

March : San Diego City Science Fair (at Balboa Park) : TBD
April/May California State Science Fair (at USC/LA) : TBD

Science Fair: GETTING THE IDEA

Name (print) _____ your email address: _____ Grade: _____
Parent's email_____ Appointment preference: Before school / Lunch / After school
Do you have Skype? Contact information: _____

PLEASE EMAIL ME TONIGHT IF YOU ARE INTERESTED IN DOING A SF PROJECT! ☺

You may email me this paper too! My email is: mrsg9064@aol.com WebPage: http://mrsgillumscience.com
Check out the web page at: http://www.mrsgillumscience.com/2012_sf/12SF_index.htm

Why do you want to do a science fair project? _____
_____
_____

List 4 things you'll be doing this summer: traveling, (list all the places your are going to) taking classes, camp etc)
1._____ 2._____
3._____ 4._____

Are your parent's scientists? What kind of work they do. Do they have a lab to work in?
_____
_____

Do you have friends or relatives that have a lab or a scientific background that you could work with?
_____
_____

OK, before you start on your questions, **read through this list of DO NOT DO THESE projects below.**

PROJECTS THAT WILL NOT BE ACCEPTED: PLEASE DO NOT ASK TO DO THESE!!

1. **Surveys** that involve opinion sampling, product use, taste testing, etc.
2. Models (volcanoes, solar panels, electric circuits), Collections, Demonstrations: (how a battery works), & Kits
3. Anything in violation of animal or other fair regulations (tobacco, explosives, rocket fuel, etc.)
4. Projects with small sample sizes or ones where it would be impossible to do a lot of tests & trials
5. Illogical or "Who Cares?" tests (effect of Gatorade on plant growth)
6. Projects in which the results are common knowledge
7. Projects which duplicate standard class/text experiments
8. Anything with purely subjective measurements or preferences
9. Product testing (which is best?) that lack science
10. Projects in which the results will take years & years of research (do vaccines cause autism?)
11. Effect of colored light, music, talking on plants
12. Effect of caffeine, smells, music, or anything on test scores or school work
13. Mold or crystal growth
14. Effect of soda, coffee, tea on teeth
15. Effect of running, music, video games, anything, on blood pressure
16. Do we eat balanced diets?
17. Strength/absorbency of paper towels
18. Astrology or ESP
19. Basic maze running (or mouse maze running)
20. Effect of color on anything
21. Optical illusions
22. Reaction times
23. Most male/female comparisons
24. Basic planarian re-growth
25. Laundry detergents on stains
26. Basic flight tests, e.g. planes, rockets
27. Battery life of the plug in & run down type
28. Popcorn volume tests
29. Flower preservation techniques
30. Child-resistant caps tested on kids (arthritics, maybe)
31. Sleep learning
32. Taste or paw-preferences of cats, dogs, etc
33. Ball bounce tests with poor measurement technique
34. Burning plants or leaves

PLEASE RE-READ THE PROJECTS THAT WILL NOT BE ACCEPTED ON THE PREVIOUS PAGE AND THEN COMPLETE THIS SECTION: 1 TOPIC- 3 POSSIBLE PROJECT IDEAS!

Write 3 INTERESTED topics below. For each, develop 3 testable ideas/questions about how this could turn this into a science fair project. Be realistic about the amount of time needed for testing, resources, & HOW you would to test this idea.

Topic #1: _____
Write 3 questions about this topic that could be a SF project are
1. _____
2. _____
3. _____

Topic #2: _____
Write 3 questions about this topic that could be a SF project are
1. _____
2. _____
3. _____

List SOME additional individual project ideas that you may have here:
1. _____
2. _____
3. _____
4. _____
5. _____

Last Step: Circle your favorite questions.
DO NOT simply go to these sites and "borrow" an idea. THAT is totally boring and way overdone. Think of something NEW that you could do with some of these ideas that would make it unique for YOU to test. Remember, the BEST ideas come from something that YOU are really interested in!

Places to look for ideas:
http://www.school.discovery.com/sciencefaircentral
http://www.gsdsef.org
http://www.usc.edu/CSSF/
http://www.gsdsef.org/GeneralInfo/links.shtml
http://www.all-science-fair-projects.com/
http://pbskids.org/dragonflytv/scifair/index.html
http://www.cool-science-projects.com/index.html
http://www.cdli.ca/sciencefairs/intermed.html
http://www.scifair.org/projects/
Science Buddies SF Guide
http://www.sciencebuddies.org/mentoring/project_guide_index.shtml
Lakewood Public Library Guide
http://www.lkwdpl.org/study/sfair/
Another science teacher's take on SF
http://www.ri.net/schools/East_Greenwich/Cole/sciencefair.html

Search Engines for research paper:
http://www.dogpile.com
http://www.yahoo.com
http://www.ajkids.com
http://www.yahooligans.com
http://www.educationworld.com
http://www.infoplease.com
http://www.vlib.org/Science.html
http://www.encarta.msn.com/
http://www.refdesk.com/fastfact.html
http://www.ask.com/index.asp?
http://www.google.com

SF Research Paper Graphic Organizer: <u>WILL BE EMAILED</u>

Research Paper/Graphic Organizer Requirements: MINIMUM: 10 sources:
3 books, 1 mentor and the rest can be from internet sources. NO Wikipedia, Ask or other type of sites like these. Be sure to follow the bibliography format. ALL internet sources are to have a correct IP address. I suggest that you also save these sources as a pdf, so that you can return to the article later, if needed.

THIS IS TO BE TYPED SINGLE SPACED: 12 pt Times New Roman/Arial

Part 1: Introduction ***½ - 1 pg: 3 paragraphs*** **Paragraph 1:** create interest- the "grabber" paragraph **Paragraph 2:** A thorough *description* of the problem being investigated. (Briefly: How you selected this problem; what reading or experience or process led to selection of this problem. and WHY this project is important to you) **Paragraph 3:** Why this is a useful/interesting /important question to investigate? The goal of this section is to arouse the reader's interest. There are to be No: **I, me, we, My, your name, or "you" anywhere in this paper.** There is to be no mention of you except for 1 "experimenter" in which you may use in the hypothesis. **REMEMBER PARAGRAPH STRUCTURES WHICH IS 5-7 SENTENCES PER PARAGRAPH**	

Part 2: **Previous Experiments:** **You want 4-6 previous experiments. This is a very important part of your paper. Each experiment should be 2-3 paragraphs.** **Paragraph 1:** For each past experiment, include a 5-7 sentence summary (of just the experiment) indicating what was done (the problem), what they found out (results & conclusion), & who did it. **Paragraph 2**: After you present the experiment information write 5-7 sentences on how this HELPED YOU understand better what you will be doing, and how this relates to your project. · Be sure to provide reference cite in your footnotes. ·DO NOT list or give numbered steps, but rather a summary. · NO I's Me's You's!!! **A paragraph is 5-7 sentences!** **FOOTNOTES REQUIRED**	
Part 2: continued: **Previous Experiment: #2** **Paragraph 1:** For each past experiment, include a 5-7 sentence summary (of just the experiment) indicating what was done (the problem), what they found out (results & conclusion), & who did it. **Paragraph 2**: After you present the experiment information write 5-7 sentences on how this HELPED YOU understand better what you will be doing, and how this relates to your project. · Be sure to provide reference cite in your footnotes. ·DO NOT list or give numbered steps, but rather a summary. · NO I's Me's You's!!! **A paragraph is 5-7 sentences!** **FOOTNOTES REQUIRED**	

Part 2: **Previous Experiments: 3** **You want 4-6 previous experiments. This is a very important part of your paper. Each experiment should be 2-3 paragraphs.** **Paragraph 1:** For each past experiment, include a 5-7 sentence summary (of just the experiment) indicating what was done (the problem), what they found out (results & conclusion), & who did it. **Paragraph 2**: After you present the experiment information write 5-7 sentences on how this HELPED YOU understand better what you will be doing, and how this relates to your project. · Be sure to provide reference cite in your footnotes. ·DO NOT list or give numbered steps, but rather a summary. · NO I's Me's You's!!! **A paragraph is 5-7 sentences!** **FOOTNOTES REQUIRED**	
Part 2: continued: **Previous Experiment: #4** **Paragraph 1:** For each past experiment, include a 5-7 sentence summary (of just the experiment) indicating what was done (the problem), what they found out (results & conclusion), & who did it. **Paragraph 2**: After you present the experiment information write 5-7 sentences on how this HELPED YOU understand better what you will be doing, and how this relates to your project. · Be sure to provide reference cite in your footnotes. ·DO NOT list or give numbered steps, but rather a summary. · NO I's Me's You's!!! **A paragraph is 5-7 sentences!** **FOOTNOTES REQUIRED**	

Part 2: **Previous Experiments: #5** **You want 4-6 previous experiments. This is a very important part of your paper. Each experiment should be 2-3 paragraphs.** **Paragraph 1:** For each past experiment, include a 5-7 sentence summary (of just the experiment) indicating what was done (the problem), what they found out (results & conclusion), & who did it. **Paragraph 2**: After you present the experiment information write 5-7 sentences on how this HELPED YOU understand better what you will be doing, and how this relates to your project. · Be sure to provide reference cite in your footnotes. ·DO NOT list or give numbered steps, but rather a summary. · NO I's Me's You's!!! **A paragraph is 5-7 sentences!** **FOOTNOTES REQUIRED**	
Part 2: continued: **Previous Experiment: #6** **Paragraph 1:** For each past experiment, include a 5-7 sentence summary (of just the experiment) indicating what was done (the problem), what they found out (results & conclusion), & who did it. **Paragraph 2**: After you present the experiment information write 5-7 sentences on how this HELPED YOU understand better what you will be doing, and how this relates to your project. · Be sure to provide reference cite in your footnotes. ·DO NOT list or give numbered steps, but rather a summary. · NO I's Me's You's!!! **A paragraph is 5-7 sentences!** **FOOTNOTES REQUIRED**	

Part 3: Hypothesis ***½ pg*** **This should be 2-3 paragraphs:** **Please remember that a paragraph is 5-7 sentences.** **Paragraph 1:** a key previous experiment summary, named with the key points summarized **Paragraph 2:** how this relates to your project **Paragraph3:** your hypothesis paragraph **BOLDED** with specifics & numbers An educated guess about the outcome of your experiment. Based upon the PREVIOUS RESEARCH, what results do you expect? It MUST be a **number or percentage**. You must provide SUPPORT for your guess. Use the previous research by telling how it led to or influenced your hypothesis. **BOLD** your hypothesis in some way by using capital letters or a bold font. **No: I, me, we, My, your name, or "you" anywhere in this paper.** **There is to be no mention of you except for 1 approved "experimenter" which you may use in this section.**	

Part 4: Materials & Procedure

(shortened version/summary)

- *½ - ¾ page*

Write a summary **of your experiment in formal language.**

1. **Start with the materials/ equipment** you will need. This is NOT a list, but paragraph.
2. **Describe the techniques that must be mastered** in order for you to conduct this experiment, and a discussion of the resources and assistance that might be required.
3. **Write a summary of how you expect your procedures to go.**

DO NOT write a numbered, step-by-step procedure
WRITE a paragraph .
NO I'S ME'S YOU'S WE'S IN THIS SECTION!!

For your FINAL notebook your will update your procedure with all the changes you had to make. So, please plan to update this section if/when your procedures change. The final notebook will be accurate.
(YOU WON'T change your hypothesis)

Part 2: Core Science Knowledge ***At least 2 pages- SINGLE SPACED typed pages, this section should be 25% of the paper MINIMUM. NO FOOTNOTES.*** ***USE YOUR OWN WORDS!*** ***REMEMBER A PARAGRAPH IS 5-7 SENTENCES*** a. Include core scientific information that helps you understand the science & technical information behind your topic. b. The info should relate directly to your particular research project, not be vaguely in the same area. c. Get this info from science texts, journals, books, newspapers, magazines, websites, scientists and any other references you can find. d. This is NOT filler; only truly necessary & related information should be included. e. You MUST understand what you write & be able to explain it in your own words. f. No copying: IN YOUR OWN WORDS (teachers can always tell the difference!) Look up unfamiliar vocabulary. **This section is especially important & will be used in the conclusion of your SF notebook when you try to explain the results you received. It should also** include the knowledge/advice provided by your mentor. Be sure to include their name, and what their area of expertise is in.	

Part 2: Core Science Knowledge Cont. ***At least 2+ pages, should be 25% of the paper*** **Please type this single spaced.** **You may use art or illustrations to enhance this section, but you MUST have 2+ pages of writing without the pictures.**	

Part 6: **Research Summary:** ***1/2 page*** *3 paragraphs: ½ page* ***REMEMBER A PARAGRAPH IS 5-7 SENTENCES*** **PARAGRAPH 1:** 1. Summary of key points that were made in above sections. 2. Do not use the same words. Instead, reword your thoughts. **PARAGRAPH 2:** 3. Include relevant & key research that led to the hypothesis (one of the three or four described earlier). **4. BOLD your hypothesis** **PARAGRAPH 3:** 5. Finish with a simple ending that's tied into your introduction What is the take home message?	

Research Paper Bibliography- On a separate page:
This is DUE WITH THE GRAPHIC ORGANIZER TURN IN & FINAL RESEARCH PAPER

Bibliography Requirements: 10 sources. 3 of which are books, 1 is a mentor interview.
You may use Internet sources for the remaining 6, however, they must be reputable sources.
NO WIKIPEDIA, ASK or any other like these. Use scientific journals, encyclopedia Britanica, and other good scientific sources. Please use EASYBIB.COM to help format them correctly. The format MUST include: the author's name, if available on the document, the web page source (the whole IP address), and the date you used the source. When you have ALL of your sources be sure to alphabetize them. You do not have to number them

Books

	(last name) (initial)	*(date)*	*(title)*	*(publisher)*	*(city)*
One Author	Bronowski, J.	1973.	The Ascent of Man.	Little & Brown, Inc.,	Boston,
By Editor	Ellis, R. (ed.)	1987.	Sharks.	New York: Wiley,	256 pp.
	(title)			*(date)*	*(source)*
Internet	How to Produce Award-winning Science Projects.	2004.	Nat. Assoc. of Biology Teachers	Bulletin Board,	www.NABT.org *(Internet address)*

Citing "personal communications" with an Expert (or your mentor's bibliography format)
(in person, on the phone, in letters or on the Internet) (full name and title) (date interviewed) (title) (address of work or home) Collins, Dr. Charles 2009. Prof. of Biology, Calif. State Univ., Long Beach, CA.

Footnotes information:
Here is how you do it: After quoting or stating a piece of information in your research paper that came directly from another work (printed on one of your note cards or from your research), you need to CITE the source. After the typing the sentence, do the following: Select Insert (from the toolbar above), Footnote. Make sure Footnote and Auto numbering is selected. After hitting OK – it will place a mini number (starting with one) ***after*** the sentence and a matching one down below (called the footnote). [1] Make sure the footnote is after your punctuation. In the footnote, copy the source's information straight from your MLA Bibliography (copy and paste!).

-
- ***Example***: How do we know that the Milky Way galaxy is 12-14 billion years old? Well "The age was estimated by measuring the amount of beryllium (Be) in distant stars. The amount of beryllium increases as a star gets older."[2] (this footnote is shown at the bottom of the page)

Another quick note:
YOU must have the IP (web) address in the footnote AND the bibliography.
The date the article is written goes BEFORE the IP address, the date you visited the web site goes AFTER the IP address. Please type all footnotes in 10 pt font. You also do NOT need to use n.p.

FOOTNOTE EXAMPLES: PLEASE FOLLOW THIS FORMAT:

They are 10 point, and single spaced.
You have the last name of the writer, then 1st name, The Name of the article, the year the article appeared on the web, the IP web address (in black ink and not underlined), the date you visited this source by: date, month, year. They are shown in 12 point for easier viewing.

[1] Sanders, Sandi. "The Effects of Salinity on Brine Shrimp Growth. " Selah School District, Washington. 1999. Web. <http://www.selah.k12.wa.us/soar/sciproj99/sharisciproj.html> 27 July 2013.

[1] "The Effects of pH and Pollutants on Brine Shrimp." 2004. Web <http://www.odec.ca/projects/2004/john4r0/public_html/applications.html> 27 July 2013.

[1] This is the footnote – copy your MLA Bibliography here – like the example below it is in 10 point and the date you visited the site goes at the very end.
[2] "Galaxies: Milky Way." *Rader's Cosmos4Kids.com - Andrew Radar Studios*. 2006.
<http://www.cosmos4kids.com/files/galaxy_milkyway.html>. 27 Sept. 2007.

Research Paper/Graphic Organizer Tips

Requirements

Find at least 10 different sources. Of those, *At least 1 source must be a book *1 source must be a personal interview (via email, phone, skype) This is your MENTOR! *The rest may be different websites

Include at least 4-6 previous similar experiments (a MAX of 2 science fair examples, collegiate, or professional) Include all sources in a bibliography.

How do I organize all of this research?

•By taking notes (handwritten or typing them) and then writing the final version into your **graphic organizer**

Organizational Method Example

Keep track of every source & list the bibliography info on a "Reference Sheet". Number these sources 1-10. This way, you don't have to rewrite the website URL on every note that you make on the graphic organizer

I would also suggest that you print your sources and be sure the web page is there. You'll need that for your bib.

Helpful Research Links

Librarians' Internet Index:
http://www.ipl.org/
An index of websites you can trust, maintained by librarians from around the country.

A List of Every Major Science Fair in the Country:
http://physics.usc.edu/ScienceFairs/
Use this site to explore past experiments from other state- & city-wide fairs.

Why is research so important?

* Good experimentation is based on thorough research.
* Real scientists spend years researching before they plan an experiment.
* What if you conduct this absolutely amazing experiment, only to find out that the answer was discovered long ago & is now common knowledge?
* The more you know & the more effort you put into understanding the science behind the topic, the stronger the project will be.
* Also, at the regional & city level, judges may eliminate a project due to "No/limited Background Research".

Note Taking Tips & Tricks

• SUMMARIZE: Only write "notes", not huge paragraphs in itty-bitty writing that you cannot use later.
• REPHRASE: Do not copy anything! Translate the information into your own words. This will save time later anyway.
• BE CHOOSY: DON'T write notes if you do not understand what they mean.
• BE CREATIVE: include definitions, quotes, diagrams, pictures…
• Remember, the goal is to make writing the research paper as easy as possible.

Where do I go to find information?

The Internet will be your main source of information.

BE CAREFUL about the information you find.

Good References	Bad References
Come from a credible source	Come from a source with poor credibility
Not too old	Out of Date
Not biased	Not objective & fair, biased towards one point of view
Free of errors	Prone to errors
Properly cite the original source of all information	Do not cite where the information came from

For each past experiment, list the following: Title of experiment, researcher's name, experiment location, summary of procedures, & explanations of results. Use **footnotes**. **Provide SUPPORT for your hypothesis.** Explain exactly how you came up with it, specially, why you chose the # or % that you did. The previous research should be a big part of your explanation.

Include a # (number) or a % (percent) in the bolded hypothesis

• *Bad*: "This led to the hypothesis that direct sunlight will lead to **more** plant growth than indirect sunlight"
• *Good*: "This led to the hypothesis that direct sunlight will lead to **35% more** plant growth than indirect sunlight"

Keep the person (YOU) out of the paper! Do not use: I, my, our, your, you , we, us…

Affect vs. Effect: Know the difference!

Use "scientific sounding" words & keep the language professional

Instead of:	***Use:***
* stuff, things	* materials, equipment, supplies
* she **did** an experiment about	* an experiment was conducted about
* First, he **got**	* First, the supplies were **obtained**" or "First, the supplies were **received**
* The results **say** that…	* the results **indicate**" or "the results **show**
* This experimenter will use a tool to…"	* A tool will be used to…

SF Research Paper Graphic Organizer:
THIS IS TO BE TYPED SINGLE SPACED: 12 pt Times New Roman

Part 1: Introduction ***½ - 1 page: 3 paragraphs*** **Paragraph 1: create interest- the "grabber" paragraph** **Paragraph 2:** A thorough *description* of the problem being investigated. (Briefly: How you selected this problem; what reading or experience or process led to selection of this problem. and WHY this project is important to you) **Paragraph 3:** Why this is a useful/interesting /important question to investigate? The goal of this section is to arouse the reader's interest. There are to be No: **I, me, we, My, your name, or "you" anywhere in this paper.** **There is to be no mention of you except for 1 "experimenter" in the which you may use in the hypothesis.** **REMEMBER PARAGRAPH STRUCTURES WHICH IS 5-7 SENTENCES PER PARAGRAPH**	Examples: **An Investigation of Marine Plants' Effect on Ocean Acidification** More than 70% of the Planet Earth is comprised of ocean water. The first living organisms originated in the ocean, and the ocean has been a source of transportation as far back as 2500 BC. It also provides human beings with seafood, produces more than 50% of the oxygen in the atmosphere, and generates significant revenue for the tourism industry. Due to the increasing carbon dioxide (CO_2) emissions in the air, the excess CO_2 is being absorbed by the oceans, thereby raising the ocean's acidity level and threatening the marine ecosystem. With an approximate total of 10,000 coral reefs in the ocean, one is being destroyed every other day by ocean acidification. At this rate, coral reefs could become extinct in a matter of seventy years. The destruction of coral reefs could very well lead to mass extinction of the many animals that rely on coral reefs for shelter or food. Ocean acidification is destructive to the core of the ocean ecosystems. If the oceans are further damaged, then humans will become deprived of sea food, and a number of the other benefits the ocean supplies. The experimenter, understanding the significance of this problem, has taken the initiative to conduct an experiment regarding this issue. This project is to test two plants, namely seagrass and sea lettuce that are supposedly believed to reverse ocean acidification. Both these plants are similar in that they both use the process of photosynthesis to create their food, and have similar habitats. The different parameters of pH, salinity, and calcium have been established to be important and will be monitored throughout the investigation. This study will help inform whether marine plants are an alternative solution to the reduction of ocean acidification or that reducing the amount of CO_2 emission, where the problem first emerged, is the only way. **PLEASE REMEMBER you are typing SINGLE SPACED into your graphic organizer. When you submit your final research paper it will be on a clean document with 1 inch borders, 12 point Times New Roman font, spaced 1.5 and will flow as 1 single document.** **You will NOT do page breaks for each of these sections.** **In addition, you will NOT have extra space between paragraphs.**

Example #2: **Introduction**

In a world increasingly dominated and driven by telecommunications, the need to broadcast information of various types, whether sound, images, or data, grows greater. This is exemplified in the increasing popularity of forms of human communications such as face-to-face online video chats and conferences, whereas before, more passive forms of communications such as e-mail and instant messaging services were the norm. Thus, data transmission methods based on fiber optic communication systems are becoming increasingly prevalent. For example, fiber optics has already replaced what was once standard copper wiring in areas such as computer networks and even long-distance telephone lines. Another critical role of fiber optics is in endoscopies, in which optical fibers allow physicians and surgeons to look into a subject's body with only a minor incision. Within a few decades or possibly even years fiber optic transmissions could become the basis of electronic communications, and thus integrate it into the lives of humans even further.

Despite the progress in the development of fiber optic based communication systems, there are many unknowns about what sorts of variables could affect the efficiency, speed, and thus the utility of future high-speed fiber optic communications. Due to the experimenter's curiosity about fiber optics and the communications industry, it was decided to examine the potential effects of an electromagnetic field on the speed and efficiency of a fiber optic transmission system. This experiment will compare the speeds of two standard Wavelength-division multiplexer (WDM), one under the influence of a strong electromagnetic field and the other not. Multiple trials will be conducted under different transmission rates to establish whether or not electromagnetic influence can be an inhibiting, or helpful factor regarding fiber optic transmission speed.

The results of this experiment will help people understand the potential impact of factors like electromagnetism on fiber optic communications, which is quickly becoming one of the most important pillars of telecommunications. In a world that is heading towards a future dominated by information technologies, the knowledge gleaned from this experiment and further experimentation could help in the development of new, improved fiber optic technologies. New fibers resistant to interference could also be critical in extreme long-distance communications and helping devices work at optimum speed. Finally, this experiment will also demonstrate the potential consequences of being unprepared for limiting factors to technologies in nature.

Example 3: **Introduction**

Water – We drink it. We play in it. We eat fish that we catch in it. In San Diego County, most of the "lakes" used for fishing and recreation are actually reservoirs, which store drinking water. Over the past few decades, studies have shown that the United States' waterways are being polluted not only by the usual suspects of industrial waste and sewage, but also by run-off from nearby farmlands and gardens, from areas burned in wildfires and by deposits of air-borne pollution. The resulting high levels of chemicals and heavy metals can be toxic to people. Many of these dangerous pollutants cannot be seen or smelled.

This project will measure the chemical composition of the water in six San Diego County lakes – three in rural areas and three closer to population centers. Specifically, levels of alkalinity, ammonia, carbon dioxide, chloride, chlorine, chromium, copper, cyanide, iron, nitrate, pH, phosphate, and sulfide will be tested in each lake with each lake being tested once a month for four months. This will help determine whether pollution from nearby human activity, particularly air pollution from cars and run-off from landscaping, are causing negative environmental impacts for animals and people. As every aquarium owner knows, small amounts of a toxic chemical can be fatal for fish. By the time the impacts are noticed, it is often too late to prevent more deaths. Given the number of people who fish and enjoy recreational activities in San Diego's lakes and reservoirs, knowledge of the safety of the water and whether it is polluted is critical.

The chemicals we put in the soil and air end up in the water. Recent studies have shown increased levels of mercury in fish and nitrates in drinking water. The sources for this pollution are often not immediately obvious and the pollution itself is not visible. Both mercury in fish and nitrates in water are bad for people, especially children. Without testing, it would be impossible to know that those substances were in the water at all.

Part 2: Previous Experiments: **You want 4-6 previous experiments. This is a very important part of your paper. Each experiment should be 2-3 paragraphs.** **Paragraph 1 &2:** For each past experiment, include a 4-8 sentence summary (of just the experiment) indicating what was done (the problem), what they found out (results & conclusion), & who did it. **Paragraph 3**: After you present the experiment information write 4-5 sentences on how this HELPED YOU understand better what you will be doing, and how this relates to your project. · Be sure to provide reference cite in your footnotes. ·DO NOT list or give numbered steps, but rather a summary. · NO I's Me's You's!!! **A paragraph is 5-7 sentences!** **FOOTNOTES REQUIRED**	Example 1: A final experiment was conducted in the area of Ischia, Italy by a number of scientists. Because 0.5% of the carbon dioxide emissions come from volcanic vents, the chemistry of local oceans is changed. These scientists decided to experiment on how volcanic carbon dioxide vents increase ocean acidity and how it effects the ocean ecosystems. They compared the ecosystems of three locations that had reduced pH levels, anywhere from 0.2-0.4 units, to the ecosystem with a normal pH location. They observed that one of the locations with a pH of 7.8 showed a 30% reduction in the number of plant species when compared to the average ocean. In the location with 7.4 units in pH they noticed that the coral species were not doing as well in terms of calcifying. This led them to conclude that coral reefs may not be able to create their skeletons at all by year 2100 if the increase in ocean acidity continues. When the scientists compared the difference in seagrass growth they noticed that there wasn't a difference in the growth of the individual leaves, but they did observe that seagrass production was highest at a pH of 7.6. They led to the conclusion that plants like seagrass and brown algae do fine at both normal and acidified ocean levels where as corals and other calcifying animals will be unable to survive at an acidified ocean level. Hence, leaving some parts of the ocean ecosystem in danger.[3] The last two experiments were valuable because both gave ideas on how to carry out this experiment. All the experiments used pH to monitor the change that these plants did which also helped to add to the materials and procedures necessary.
Part 2: continued: **Previous Experiment: #2** **Paragraph 1 &2:** For each past experiment, include a 4-8 sentence summary (of just the experiment) indicating what was done (the problem), what they found out (results & conclusion), & who did it. **Paragraph 3**: After you present the experiment information write 4-5 sentences on how this HELPED YOU understand better what you will be doing, and how this relates to your project. · Be sure to provide reference cite in your footnotes. ·DO NOT list or give numbered steps, but rather a summary. · NO I's Me's You's!!! **A paragraph is 5-7 sentences!** **FOOTNOTES REQUIRED**	Example 2: Porins, J., G. Ivanovs, and O. Dzerins conducted and experiment in 2009 to see if electromagnetic interference (EMI) could have a hindering or beneficial effect on fiber-optic communications. It is generally assumed that EMI cannot affect fiber-optics because the mode of transmission is light, instead of electricity, however, several experiments show that electromagnetic interference can indeed have an observable effect on fiber optic transmissions. In a series of experiments to see if electromagnetic disruption could limit the efficiency of standard WDM systems, they tested the WDM systems at several transmission rates, and observed that the plane of polarization and dispersion levels for wavelength division multiplexer systems changed. This influenced the amount of distance needed between different channels to stop a significant loss of efficiency. They concluded that a strong enough external electromagnetic influence could become a problem for certain systems that are sensitive to changes in the plane of polarization. This shows that electromagnetic influence can be a factor regarding the optimal efficiency of fiber-optic based communications. In addition, this experiment illustrates that fiber optic based communications are not necessarily completely immune to EMI. [4]

[3] "Volcanic Carbon Dioxide Vents Show Ecosystem Effects of Ocean Acidification More." *Volcanic Carbon Dioxide Vents Show Ecosystem Effects of Ocean Acidification (Jason Hall-Spencer)*. Macmillan Publishers, 8 June 2008. Web. <http://plymouth.academia.edu/JasonHallSpencer/Papers /151760/Volcanic_carbon_dioxide_vents_show_ecosystem_effects_of_ocean_acidification>. 19 Sept. 2012.

[4] Porins, J., G. Ivanovs, and O. Dzerins. "Influence of External Electromagnetic Disturbance on the Optical Fiber Properties in WDM Systems." *Ee.ktu.lt*. Electronics and Electrical Engineering Journal, 13 Apr. 2009. Web. < http://www.ee.ktu.lt/journal/2009/4/13__ISSN_1392-1215_Influence%20of%20External%20Electromagnetic %20Disturbance%20on%20the%20Optical%20Fiber%20Properties%20in %20WDM%20Systems.pdf > 15 July 2013.

Part 2: continued: **Previous Experiment: #3** **Paragraph 1:** For each past experiment, include a 4-8 sentence summary (of just the experiment) indicating what was done (the problem), what they found out (results & conclusion), & who did it. **Paragraph 2**: After you present the experiment information write 4-5 sentences on how this HELPED YOU understand better what you will be doing, and how this relates to your project. · Be sure to provide reference cite in your footnotes. ·DO NOT list or give numbered steps, but rather a summary. · NO I's Me's You's!!! **A paragraph is 5-7 sentences!** **FOOTNOTES REQUIRED** **Footnote is in 10 pt.**	Example #3: The California State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) commissioned scientists to perform a two year (2007-2008) screening survey of contaminants in sport fish in California lakes and reservoirs. Their teams tested for mercury contamination in various fish species that are known to accumulate high concentrations of contaminants. They are therefore good indicators of contamination problems. They tend to be larger fish, that feed on smaller ones and therefore accumulate mercury in their flesh. The scientists collected 4,905 fish from 272 lakes and reservoirs. They found problems in certain areas of the state, with mercury being of greatest concern. Twenty-one percent of lakes tested had at least one species of fish with mercury levels high enough to pose a threat to human health if eaten, especially by women of childbearing age and young children. Mercury contamination in California is mostly the result of historic mercury and gold mining. However, it can also reach lakes from local and global emissions to the atmosphere. The contamination varied across the state. For example, only 2% of the northern California trout lakes were above an acceptable limit, while, 48% of the lower elevation lakes in northern California and 16% of the lakes in Southern California were above that limit. This study reveals the ongoing problem of contamination in California's lakes and reservoirs. It also shows the ways in which that contamination has the ability to impact human health. Some of this contamination is the result of activity that took place in the past. However, it also results from air pollution. In addition the levels of contamination can vary depending on location. [5]
Part 2: continued: **Previous Experiment: #4**	
Part 2: continued: **Previous Experiment: #5** · NO I's Me's You's!!! **A paragraph is 5-7 sentences!** **FOOTNOTES REQUIRED**	
Part 2: continued: **Previous Experiment: #6** · NO I's Me's You's!!! **A paragraph is 5-7 sentences!** **FOOTNOTES REQUIRED**	

Part 3: Hypothesis

½ pg

This should be 2-3 paragraphs:

Please remember that a paragraph is 5-7 sentences.

Paragraph 1: a key previous experiment summary, named with the key points summarized
Paragraph 2: how this relates to your project
Paragraph3: your hypothesis paragraph **BOLDED** with specifics & numbers
An educated guess about the outcome of your experiment. Based upon the PREVIOUS RESEARCH, what results do you expect? It MUST be a **number or percentage**.
You must provide SUPPORT for your guess. Use the previous research by telling how it led to or influenced your hypothesis.
BOLD your hypothesis in some way by using capital letters or a bold font.
No: I, me, we, My, your name, or "you" anywhere in this paper. There is to be no mention of you except for 1 approved "experimenter" which you may use in this section.

Example 1: Previous experiments on calorimetry have revealed that when a bomb calorimeter is used on a specific food sample, it can bring forth the amount of calories in that food sample. By applying the data gathered from burning the sample in the calorimeter to the formula for Specific Heat, $Q = mc\triangle T$, one can discover the amount of calories in a food item. The resulting number can then be compared to the number of Calories on the food label. In Tyler DeWitt, PhD's experiment, he explains how to find the margin of error between the two numbers. His equation involves taking the value of the sample on the food label and subtracting the measured value, then dividing the difference of the two by the value on the label. After which, the answer is multiplied by 100. The answer will be the percent of error between the label and the measured amount of the calorimeter.

The two equations, for Specific Heat and the formula for the percent of error, are important to this experiment because this project intends to compare the measured amount of calories to the Calories on a food label. The Specific Heat equation will be used to find the measured amount of Calories in a food item, which can then be compared to the food label. The second formula, calculating the percent of error, will prove to be very useful because instead of only giving a rough estimate, a percent of how far off the two numbers are will be used. The second calculation also helped the experimenter in this project formulate a hypothesis, and allowed a comparison of the data in the procedure.

The Food and Drug Administration states on its website that it does not have the resources to check every single food label for accuracy. It simply uses random inspections. It further states in the same article that 5 Calories or less can be considered zero Calories. Food manufacturing companies may be using this "5 Calorie or Less" rule to overestimate or underestimate the food's true Caloric content. **Therefore, based on the previous experiments on calorimetry, it is hypothesized that about 20% out of 100 tested food products will have food labels that do not match the measured amount of Calories. These food items are predicted to have food labels whose Caloric values are 10% higher than that of the measured Calories from the bomb calorimeter.**

Example 2: The results collected will be used to justify whether plants have an effect on ocean acidification. Past experiments have observed that seagrass has a high photosynthesis rate. This plant can reduce the acidity level enough to increase calcification rates and pH levels up to 0.38 units in the general area of the seagrass bed. It was also concluded that seagrass is one of the plants that can survive at a pH of 7.6 just as well, if not even better, that the normal ocean pH level of around 8.1.

Similar to seagrass, sea lettuce has also been sought to reduce acidity levels but at a much lower rate. From the data Osinga collected his outcome was that a sea lettuce bed of 180,000 square kilometers would be able to increase ocean pH 0.1 units. The pH has changed as of now a total of 0.1 units so that amount of increase from sea lettuce would be enough to compensate for ocean acidification. If the oceans continue to acidify at the rate they are going an increase of much more that 0.1 units will be vital for retaining the ocean's natural ecosystem. From this background knowledge, it is thought that seagrass will have a larger effect than sea lettuce because a seagrass bed, normally much smaller than 180,000 square kilometers, was proven multiple times in previous experiments to increase ocean acidity levels more than 0.1 units as a sea lettuce bed of such size would. Since the containers used in these experiments are of much smaller size than the conductions done in the ocean, the pH increase should be greater.

Due to the information collected it is hypothesized that each of tanks will start with an initial pH of 8.0 units. The container with seagrass is predicted to increase the pH 0.25 units by the end of the experiment, resulting in a pH of 8.25. The container with sea lettuce in predicted to increase the water level 0.15 units, ending at 8.15. The last of the containers, containing both seagrass and sea lettuce is thought to have an overall increase of 0.20 units in pH with the outcome of 8.20 pH units.

Part 4: Materials & Procedure

(shortened version/summary)

- *½ - ¾ page*

Write a summary **of your experiment in formal language.**

1. **Start with the materials/ equipment** you will need. This is NOT a list, but paragraph.
2. **Describe the techniques that must be mastered** in order for you to conduct this experiment, and a discussion of the resources and assistance that might be required.
3. **Write a summary of how you expect your procedures to go.**

DO NOT write a numbered, step-by-step procedure

WRITE a paragraph .

NO I'S ME'S YOU'S WE'S IN THIS SECTION!!

For your FINAL notebook your will update your procedure with all the changes you had to make. So, please plan to update this section if/when your procedures change. The final notebook will be accurate.

(YOU WON'T change your hypothesis)

Example1: This experiment is about determining whether or not treads are more efficient, when comparing battery usage and speed to reach the determined destination, than wheels. This will help people by allowing them to make rescue robots to be able to be out in the field longer or get to an area faster. The materials needed to test this are, Lego Mindstorms NXT EV3, Lego technic treads, AAA batteries, a computer, Digital multimeter/Volt Ohm ammeter, tape measure, stop watch, paper, and a pencil. An adult may also be needed to help with programming.

The first part of the experiment is building the robots to test. The robot must be able to use both wheels and treads in order for it to work. After the robot is finished it needs to be programmed to move in a straight line for the test. After the programming is finished, the next step will be to test that it works properly. After making sure that it works, the robot is ready to be run through the various terrain tests.

Five terrains are needed to test the robots. Any terrain works as long as all of the terrains are different. To do the testing, first the battery levels must be recorded. Have the robot move three feet on each terrain. Record the battery levels right afterword with the digital multimeter. After testing two robots on all five terrains with treads and wheels, record and analyze the data. Create a conclusion based off of how far it got, whether it made it or not, how much energy it used, and how fast it went.

Example 2: Materials and Procedure with drawings

Photovoltaic devices will be used as the "electric eye" for the sun sensor. The sun sensors that will be used in the experiment generate tiny amounts of electricity or electric signals. These sun sensor signals must be amplified to create enough power to energize the motor that moves the panel. Using Ohm's Law transistors and resistors can be selected to create an amplifier.

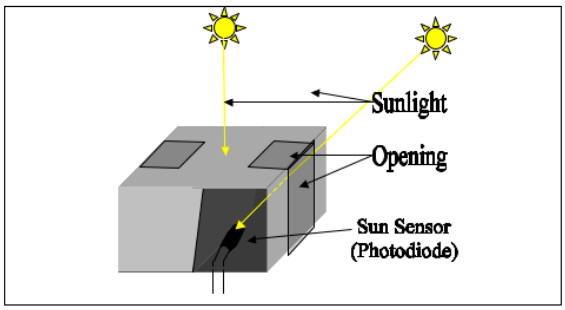


Figure 6: Sun Sensor Shadow Box

An experimental setup will be used to test the sun tracking system performance. The system will be composed of a volt meter, a current meter, a light source, a solar panel, 2 planks of plywood, 2 hinges, 2 sensors, 3 big diodes, 3 to 5 small diodes, 1 actuator, 1/25 of a roll of solder, 2 transistors, and 1 circuit board. The voltage and current during the intervals will be recorded. Data sheets have been obtained for key components: the BPW22A1 (photodiode) and the 2N2222 NPN (transistor).

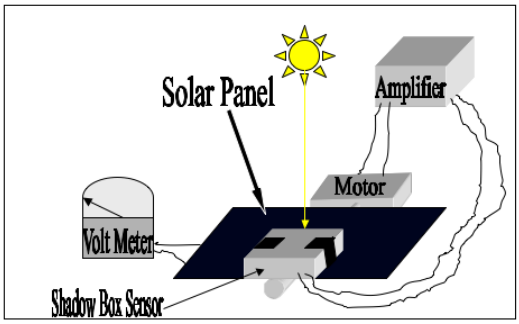


Figure 7: Proposed sun tracking system diagram

It will also be necessary to have the equipment and data sheets for the parts. The photodiode, when it sees light, it lets energy flow easier. It has a plastic cover and costs about 10 cents. The photodiodes will be used as sun sensors. The transistor is an amplifier. It will amplify the current from the photodiode to the motor which will move the panel perpendicular to the sun. It will be an important part of the system because the panel will need to be moved when offline to the sun.

In addition to the required equipment, certain skills and knowledge are needed. It is necessary to know how to make solder joints, have a basic knowledge of electronics, and have a mentor's guidance. Simulations of summer to winter sun angle variations will be tested by changing the angle to the panel. The control for the experiment is a static solar panel. The variable will be a moving solar panel.

A static solar panel and the tracking system will be tested under a moving light source. After the data is collected, the power will be calculated under the various scenarios using both a voltage meter and a current meter. The changes in efficiency will be graphed and will be compared to the hypothesis (the efficiency changes as a factor of the cosine of the difference in the angle of the sun from perpendicular). Finally, the prices of existing solar tracking systems and static solar systems will be compared to the cost of the project's system. If the system can produce more energy at a price lower than or equal to a static system, it will be cost effective. If it is more expensive and is not significantly more efficient, it will not be cost effective. Also, the number of static solar panels that can be replaced with this system and still produce the same amount of energy will be determined.

Example #3 Materials and Procedures

In the experiment a wind tunnel will be built to test different airfoils and gather measurements based on different shapes and angles of the airfoils. Metrics being tested will include lift, drag, and air flow separation. The results are anticipated to change based on different designs of airfoils being placed in the tunnel angle of attack and Reynolds number. Some airfoil shapes that might be tested are wing thickness, wing length, camber, dimples, ruts, outward dimples, and triangles on top of the wing. Using springs, lift and drag will be measuring by calculating the difference in tension of the springs once flow in the tunnel has started.

Velocity will be calculated using a manometer. Air separation will be tested by soaking an airfoil in pigmented motor oil and as the air flows over the airfoil, the oil will collect at the boundary layer separation point demonstrating where the separation occurs. Some skills needed to learn are woodwork to build the tunnel and airfoils, engineering for the measurements and interpretation of the measurements, and aerodynamics to evaluate the airflow and air separation that will occur during the experiment. Mr. Kurtis Long, an aerodynamics expert at NASA has helped to consult on the wind tunnel design, measuring devices and techniques used in testing.

The "Little Smokey" wind tunnel, developed by the NASA Glen Research Center will be used in this experiment. The original design which only allows visual qualitative observations of flow patters will be modified for quantitative measurement to test lift, drag, and air separation. Also, a manifold will be designed to integrate with a variable speed box fan to achieve varying Reynolds Numbers. Plexiglas panels used for observation will also be modified and integrated with spring measurement devices to allow measurement of lift and drag and pigmented motor oil will be applied to the airfoil surfaces to identify the specific point of boundary flow separation on the airfoil surface as a function of angle on attack.

Part 2: Core Science Knowledge

At least 2 pages- SINGLE SPACED typed pages, this section should be 25% of the paper MINIMUM. NO FOOTNOTES. USE YOUR OWN WORDS! REMEMBER A PARAGRAPH IS 5-7 SENTENCES

a. Include core scientific information that helps you understand the science & technical information behind your topic.

b. The info should relate directly to your particular research project, not be vaguely in the same area.

c. Get this info from science texts, journals, books, newspapers, magazines, websites, scientists and any other references you can find.

d. This is NOT filler; only truly necessary & related information should be included.

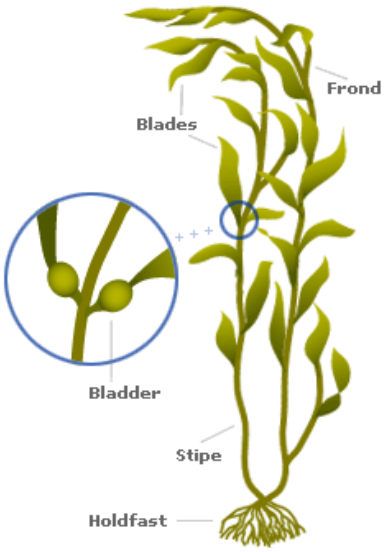
e. You MUST understand what you write & be able to explain it in your own words.

f. No copying: IN YOUR OWN WORDS (teachers can always tell the difference!) Look up unfamiliar vocabulary.

This section is especially important & will be used in the conclusion of your SF notebook when you try to explain the results you received. It should also include the knowledge/advice provided by your mentor. Be sure to include their name, and what their area of expertise is in.

Example: Kelp is the largest marine alga and is part of the group commonly known as seaweed. Large groups form a kelp forest. It thrives off the California coast where nutrient laden water is channeled up from deep canyons that lie just beyond the intertidal zone. It grows in water from ten to one hundred and thirty feet deep. Two common types that grow in California are Giant (Macrocystis pyrifera) and Bull (Nereocystis leutkeana). These underwater forests shelter animals from storms and predators. Many species live on and around it. One example is the sea otter who will wrap itself in it so it does not float away while sleeping. It can grow up to three feet a day in the best conditions. It can also live up to five years. Giant kelp can grow up too three hundred feet.

Kelp is a brown algae and belongs to the Fucaceae family. Though it is not a plant, it still uses photosynthesis. Their main predator is the sea urchin, which eats the anchor stipe and or the blades. Many invertebrates graze on it and the microorganisms that live on it. It prefers water to be less than 68 degrees Fahrenheit. If the water is too warm the blades will start to deteriorate. It gets its natural brown green color from the type one and three chlorophyll. The nutrient levels in water affect it, the more nutrients better. In order to reproduce it releases spores. It can release 600 spores an hour and over a trillion a year. Once at the surface kelp forms a canopy. It is capable of growing a massive forty-five meters a season. It is found along many coastlines from South America to the Polar Region. It is also found all around the world from Tasmania to the Black Sea. There are one hundred and twenty four known species.



Kelp has a structure that looks similar to a leaf on a plant. This structure is called the blade and depending on the species there can be one up to hundreds. These blades absorb nutrients and are where photosynthesis takes place to make energy for it to survive and usually survive for six months. Their length can vary from a quarter inch to a few feet.

The stipe is a structure looks similar to the stem of a plant. It's a very strong vine-like appendage that holds the whole plant together. It can vary from about a quarter of an inch to about three inches in diameter. Attached to the stipe are one or more gas bladders. These assist in keeping it upright and are called pneumatocysts. They are filled with gas and act as a balloon to provide buoyancy. Buoyancy is crucial because it needs as many of the blades in the water column as possible, in order to get the most nutrients.

Kelp does not have roots, however, it does have a structure that looks like roots called the anchor. The anchor's only function is to attach to the bottom of the ocean, which can be hard bottom or have large rocks. The anchor forms a habitat on its own, as star fish, crabs and many other small marine organisms utilize it for shelter and protection. One or more stipe can grow from an anchor, which can survive for several years depending on conditions. When kelp breaks free from the anchor it is called a floater and often washes up on the shore where it dies.

Part 2: Core Science Knowledge Cont.

At least 2+ pages, should be 25% of the paper

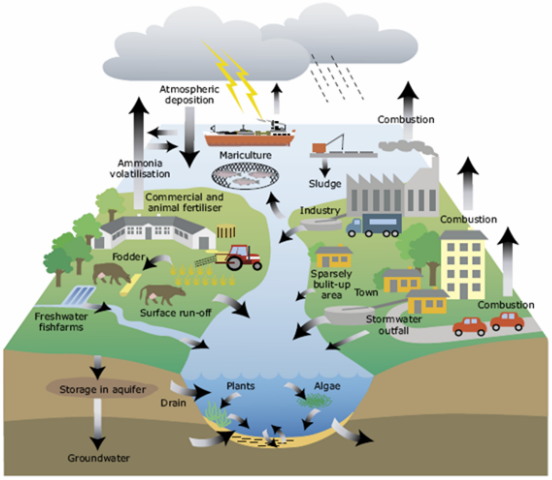
Please type this single spaced.

You may use art or illustrations to enhance this section, but you MUST have 2+ pages of writing without the pictures.

Kelp is edible and very nutritious for human consumption. Giant kelp contains iodine**, calcium, sulfur**, silicon, and **phosphorus, iron, sodium, potassium, magnesium**, chloride, **copper, zinc, manganese**, barium, **boron, chromium**, lithium, nickel, silver, titanium, **vanadium**, aluminum, strontium, bismuth, chlorine, cobalt, gallium, tin, and zirconium. It boosts the immune system, rids the body of toxins, and helps reduce fat absorption. Kelp has high iodine content and reduces cholesterol. Algin is a sticky liquid found in kelp. It is used for various items such as ice cream, toothpaste, milkshakes, and many other man made products. Algin is a thickener, is high in fiber, and can increase the elasticity of skin. It is also a preservative. Out of all the seaweed families kelp is the most harvested and commercially important.

The harvesting of kelp is legal and overseen by the department of Fish and Game. When kelp is harvested about a meter is cut off the top. It can also be burned to produce soda ash. Kelp is a staple food in many Asian cultures and some European as well. The Japanese have used it for over one thousand five hundred years. It is also commonly used as a fertilizer for farming. It is used as dietary supplements, nutritional supplements, a water softener, and a salt substitute.

For decades, there was little concern for what was running into the ocean. Wastewater from sewage plants, industrial wastes from manufacturers, plastics, urban runoff, pesticides and fertilizer from farms, acid rain, and even radiation from nuclear power plants. These pollutants enter the water directly and indirectly. The direct way is runoff, and seepage from boats is shown in the diagram on the right.



One example of indirect pollution is where air is polluted and then falls to the ocean in rain. The diagram shows how all pollution eventually come to the ocean at some point in time and is carried by currents and spread. It is a common misconception that pollutants put in the ocean will just be diluted. Most ocean pollutants, such as plastic don't dilute, which why a floating plastic island exists in the middle of the pacific ocean. Plastic and other human trash also wash onto the shores of remote islands. There are huge algae blooms known as the red tide that occur because of sewage and bacterial buildup. These are very toxic and cause beaches to close because of the danger. It is obvious that decades of pollution have collected in the ocean. Since kelp filters the water to gain nutrients, it is logical for it to absorb the pollution as well.

Part 6: Research Summary: *1/2 page* *3 paragraphs: ½ page* ***REMEMBER A PARAGRAPH IS 5-7 SENTENCES*** **PARAGRAPH 1:** 1. Summary of key points that were made in above sections. 2. Do not use the same words. Instead, reword your thoughts. **PARAGRAPH 2:** 3. Include relevant & key research that led to the hypothesis (one of the three or four described earlier). **4. BOLD your hypothesis** **PARAGRAPH 3:** 5. Finish with a simple ending that's tied into your introduction What is the take home message?	**Example #1:** The research and experimenting is being done to show whether contact lens solutions fulfill their job in sterilizing contact lenses. Contact solutions are comprised of many chemicals that work together to contribute to cleaning lenses. Patients who use contacts believe their cleaning solutions sterilizes their contact lenses, though they aren't aware of how well they work. Contact solutions are thought to clean contact lenses; however through previous research, unsterilized contacts have led to many infections. Infections can easily occur if patients use a contact solutions that does not fully sterilize their contacts. It's essential that the eyes stay healthy when using, these corrective lenses, since the eyes are one of the most important organs in the human body. Based on previous research, some contact solutions may work better than others depending on the type, and some may take longer to eliminate bacteria. In the experiment done by Gilman, she revealed that contact solutions do sterilize contacts and they are much more efficient than homemade solutions. The University of Leicester demonstrated that manufacturers have to work and see if all the ingredients mix well, in order to have the solution to function properly. In the previous research, the solutions they tested eliminated most of the bacteria and worked well. The chemicals and preservatives in these sterilizing solutions work together to kill any microorganisms left on contact lenses. **According to the previous research, the contact solutions used in this experiment will kill most of the bacteria and microorganisms on the lenses. About 95% of the bacteria incubated in this experiment will be killed after about 3 hours.** Cleaning and disinfecting is a major responsibility for a patient using contacts, and without proper hygiene, bacteria can build up on contacts. Proper hygiene and an efficient contact solution is vital in order to keep the eye safe from infections and keeping contacts clean. The results from this experiment will demonstrate how well contact solutions work to eliminate bacteria and keep the eyes healthy. **Example 2:** This research and experimental process aims to determine nutrition label accuracy. One-third of adults and over 20 million children in America are categorized as obese. Research shows that these statistics have increased over time, with heart disease continuing to be the leading cause of death for the past five decades. Obesity and heart disease are directly related. Increased intake of Calories and decreased output of calories, results in weight gain and potential obesity and heart-related illness. The FDA allows manufacturers to round the number of calories down to zero if the food item has 5 or less calories. Additionally, it does not perform routine inspections of food labels. Companies today prefer to use the Atwater system for Caloric calculations. The Atwater system utilizes established values for each macronutrient to determine total Calories and involves results that are rounded up or down to in order to make use of whole numbers. Therefore**, based on the previous experiments on calorimetry, it is hypothesized that about 20% out of 100 tested food products will have food labels that do not match the measured amount of Calories. These food items are predicted to have food labels whose Caloric values are 10% higher than that of the measured Calories from the bomb calorimeter.** This experiment attempts to verify whether food companies are overestimating or underestimating the Calories in their products. It will also compare the difference between the measured and calculated values. This information will be valuable to a vast variety of consumers. Knowledge of Caloric intake will help people become more conscious of what is in the food they are eating and if this will help or hurt their diet goals. This awareness may even lead to a longer, healthier life.

Research Paper Bibliography- On a separate page:
This is DUE WITH THE GRAPHIC ORGANIZER TURN IN & FINAL RESEARCH PAPER

Bibliography Requirements: 10 sources. 3 of which are books, 1 is a mentor interview.

You may use Internet sources for the remaining 6, however, they must be reputable sources.
NO WIKIPEDIA, ASK or any other sources like these. Use scientific journals, encyclopedia Britanica, and other good scientific sources. Please use EASYBIB.COM to help format them correctly. The format MUST include: the author's name, if available on the document, the web page source (the whole IP address), and the date you used the source. When you have ALL of your sources be sure to alphabetize them. You do not have to number them

Books: Devlin, T. PhD. Textbook of Biochemistry With Clinical Correlations 5th Edition. Wiley-Liss., New York. 15pp

Citing "personal communications" with an Expert (or your mentor's bibliography format)
(in person, on the phone, in letters or on the Internet) (full name and title) (date interviewed) (title) (address of work or home)
Collins, Dr. Charles 2009. Prof. of Biology, Calif. State Univ., Long Beach, CA.

Footnotes information:
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1. Students: Your parent IS to proof read, and you ARE to do those corrections BEFORE you send to me.
2. Please do NOT re-label your papers. I label them as a code for me:
   For example: GO1a:
   The number tells me the part that is being worked:1= introduction 2= previous experiments and so on
   The letter tells me how many edits this section has gone through: a=1 edit b=2 edits c=3 edits.
3. This work should be turned in by June 1. It is considered as your writing prompt for Sci Fair admission
4. Remember paragraph structures: which is 5-7 sentences per paragraph
5. Please note: a sentence **should NOT have more** than 20 words, or less than 7.
6. There are to be No: **I, me, we, My, your name, or "you" anywhere in this paper.**
7. Do not start sentences with the words: But, So, Also, And, Well
8. Spell check, spell check, spell check. There should be NO misspelled words in this document.
9. NO parenthesis: ( )
10. NO semi-colons: ;
11. No double spacing between paragraphs.
12. Affect vs effect. Know the difference. Use the words correctly.

Suggested Graphic Organizer Completition Dates: All work is to be parent proof-read before emailing. ☺

I have a number of students that are going to be doing their science fair testing over the summer. It is essential that your research is complete prior to the start of your experimentation. Completing your research paper before the summer will allow you a bunch of time to do your experiment and will make the fall semester MUCH less crazy!

Please be sure to always email me at:
Mrsg9064@aol.com and NOT my school email address. (they sometimes turn it off over the summer!)

Science fair web page (which is currently being updated) :
http://www.mrsgillumscience.com/2012_sf/12SF_index.htm

Bibliography: Format examples:

"Are There Dangers to Microwave Radiation?" Microwave Radiation. 17 Dec. 2011. Web. <http%3A%2F%2Fwww.microwaveradiation.org%2Fare-there-dangers-to-microwave-radiation> 8 June 2014.

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Details for these can be found on the last pages of your GO

Introduction

Obesity is on the rise, and America has been one nation that has been part of that increase. All across the country, people are concerned about what has happened to the citizens of America in the past 30 years, especially the children. Many causes of childhood obesity have been blamed such as overeating, lack of exercise and the influence of a mother's BMI (Body Mass Index). However, could the father's BMI also contribute to a child's obesity and could changing that lead to a dramatic drop in these obesity rates? This project will attempt to test fruit flies to try to answer that question.

Ever since physician David Barker pinpointed parental BMI influence on having an effect on an offspring's BMI, tests have been running on mothers-to-be everywhere. It was believed that mothers would be the only ones with an influence, because they carry the offspring. After his theory was proved many times over, scientists turned to fruit flies to help explain other possible genetically influenced diseases, such as type 2 diabetes. This current science project combines the two, male fruit flies with increased BMI, to make an experiment that has the potential to change the world. This experiment will keep the impregnated mother at normal weight, and BMI while the father is over-fed to see if only the variable of an obese father is enough to affect the offspring.

This problem is majorly linked to the well-known, nationwide obesity epidemic. If a link is shown to a father's obesity, this project could become a one solution to help fight obesity in children. Many people realize that maternal BMI before pregnancy very much affects the BMI of the offspring, but not many studies have tested the impact of paternal BMI! If found to be true, these results may finally present one solution for the ever-rising obesity rates and add a greater foundation on to the theory David Barker created about 20 years ago.

Previous Experiments

The Norwegian Mother and Child Cohort Study by the Norwegian Institute of Public Health studied the role of the intrauterine environment on childhood adiposity, or the state of being overweight, from 2001 until 2008. Comparing the Body Mass Index, or BMI, of fathers and mothers, using the pre-pregnancy BMI, when their children became 3 years old, completed this study. After testing, they found that the maternal and paternal association in the intrauterine environment was almost exactly the same. It was 0.125 per section away from the mean difference of 0.15. This shows that the intrauterine environment doesn't affect the baby's BMI very much.[8]

This study gives an example of how the intrauterine environment doesn't affect the child's BMI as much as other factors like genetics. This gives an idea that the other factors, like genetics and external environment, will have a larger impact on the child when it is 3 years of age. It also shows how both the mother and the father's BMI have almost equal influence on the offspring's BMI. Information like this could be used to help test

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whether or not the father directly influences the child's BMI, without the mother's help. Overall, this study gives a good showing of the influence of genetics on the child by showing that the intrauterine environment barely affects the child.

In a study from 1991 in London, The Institute of Child Health, the goal was to determine if the timing of when parents become overweight, affects the child's BMI. In other words, is the impact on a child greater if their parents became overweight as a child or as an adult? The Institute gathered 16,794 parents, with a variety of BMI's, and their children who were ages 4-18. They found that childhood BMI increased from 0.25-1.10, between both generations, and BMI rose from 10% to 16%. The parent's gain in weight during both childhood and adulthood did influence their children's BMI, but not a big difference was recorded between the two. In conclusion, large gains of BMI during both childhood and adulthood were highly associated with a higher risk of obesity. This shows that lowering this generation's BMI could also lower future generations'.[9]

This experiment is a really good representation of the intergenerational effect of high BMI. In this study, the people are the test subjects; however other types of testers could draw the similar conclusions. Although the conclusion is what is already known about BMI and the intergenerational effect, it shows that it doesn't matter how or when the parents gain the weight, it most likely will affect the child. This experiment doesn't really give a good contrast of the maternal and paternal differences in BMI gain and effect on the child. However, that also can be interpreted as there is not much of a difference, and the fathers can affect the child's BMI as much as the mother can.

St. John's Research Institute scientists attempted to determine to what extent families shared the same diet, weight status and physical activity. This study was completed with families from urban and rural areas of Bangalore, India. To start, 325 children ages 8-21 and their parents, had their dietary, body size, and physical activity data's retrieved. However, only 294 offspring and their parents were used for testing. After measuring all the families BMI's, it was discovered that the offspring's BMI was very similar to their parent's BMI's. Also, the offspring's physical activity level was only correlated with the mother's, and not the fathers. Overall, it was found that the diet, BMI, and physical activity of offspring was highly associated with the parents, and familial issues such as these should be targeted to help reduce obesity.[10]

This experiment is an excellent example of how much the parents impact the offspring's lifestyle. Not only are the BMI's shown to be very similar, but even the level of physical activity of the offspring is similar to that of the mother! This helps show parents that they shape their children's lives every day, and need to be good examples to keep their families healthy. This is also a good example of the intergenerational effect of obesity.

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[9] Li, Leah, Law, Catherine, Lo Conte, Rossella, and Power, Chris. "Intergenerational influences on childhood body mass index: the effect of parental body mass index trajectories." Ajcn.nutrition.org Feb 2009 < http://ajcn.nutrition.org/content/89/2/551.abstract> 15 Jul 2013

[10] Swaminathan, S, Thomas, T, Yusuf, S, Vaz , M. "Clustering of diet, physical activity and overweight in parents and offspring in South India" ncbi.nlm.nih.gov 12 Dec 2012 <http://www.ncbi.nlm.nih.gov/pubmed/23232591>5 Jul 2013

Because the offspring's traits are so similar to their parent's, if they keep those traits, they will pass them down for generations to come, almost ensuring a family of obesity.

Published by the American Academy of Pediatrics, the goal was to find a risk score process for overweight children. This study used infants for a prediction model, and the UK Millennium Cohort Study. A prediction model was made for overweight children at 3 years of age, modeling many different variables. Overall, seven predictors were found to be significantly intertwined with being overweight at 3 years: birth weight, weight gain, paternal BMI, maternal pre pregnancy BMI, gender, breastfeeding status, and smoking in pregnancy. Risk scores went from 0-59, which was the same as the predicted risk going from 4.1% to 73.8%! This experiment showed that using a process to identify problems in infants with obesity can be used to reduce levels of childhood obesity, possibly leading to prevention of that infant.[11]

This experiment shows the biggest predictors for obesity in children that are caused by genetics. One of the causes is paternal BMI influence, which gives a hint that it majorly affects the BMI of the child, is it is in the top seven. Although 3 of the 7 predictors have direct influence with the mother, which says that mothers have a much bigger influence than fathers, it is not known how far the extent of the father is, if the mother is healthy. If, when the mother is healthy, the father is overweight, this study shows there is a chance that that could have a large effect on the child.

The Department of Pediatrics in Kristiansand, Norway, conducted research in 2012 with the goal to determine the associations between maternal BMI, or gestational weight change, which means the weight of the baby at a point in pregnancy, (GWC) and BMI of the child at 3 years of age. The scientists factored many pre-factors and postnatal factors into account when making the hypothesis and doing the experiment. 31,169 women were recruited between 2000 and 2009, with 5,898 fathers included, when the women were at 17-18 weeks of gestation. After tests, both BMI and GWC were shown to be associated with child's BMI at 3 years of age. Pre-pregnancy BMI and GWC interacted, showing another connection with the increase in child BMI with mothers who gained the most weight in pregnancy having the highest pre-pregnancy BMI. In conclusion, this shows that maternal pre-pregnancy BMI and GWC are strongly associated with offspring BMI at age 3, and mothers need to watch not only what they are eating and doing in pregnancy, but before it too.[12]

This study shows an interesting idea of GWC being positively associated with child BMI. This shows new ideas about different parts of pregnancy being associated with child BMI. Although the paternal BMI was mentioned, it was not stated how it affected the child, which may mean it didn't affect it. Although this statement could be true, the researchers brought in the 5,898 fathers, which means they thought that they would

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[11] Weng, Stephen F., et al. "Estimating Overweight Risk in Childhood From Predictors During Infancy"pediatrics.aappublications.org 2013. Web. < http://pediatrics.aappublications.org/content/early /2013/07/10/peds.2012-3858.abstract> 15 Jul 2013

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have effect whether they did or didn't. Overall, this study was another great example of maternal BMI affect, and even added more things for a mother to watch while pregnant.

Hypothesis

Previous research has documented the relationship of the parental genetic influence on childhood obesity. In addition, it has been shown that no matter how and when the parents gain the weight, the child will also be affected. In reviewed experiments, the fathers were, most of the time, supporting information for the main experiment, but never the only ones being analyzed. When the fathers were tested in studies done on mothers, though, they were shown to be influential. In the current experiment, the father will be the one tested, with mothers being of normal weight, a variable that appears to be a new consideration.

Not many published studies on this subject were found in research attempts, so a hypothesis is being based on the few similar studies that contain the father. The previous experiment called "Estimating Overweight Risk in Childhood From Predictors During Infancy", showed the paternal BMI influence as one of the seven biggest predictors for childhood obesity. The study called "Clustering of diet, physical activity and overweight in parents and offspring in South India" found that diet and physical activity habits were associated with both the parents. In almost all the previous experiments, fathers are shown to have some influence on the BMI of the children, which helps create the hypothesis that:

The group of fruit flies with the overweight fathers will be 40% more obese after 10 generations than the control group, with the rates per generation being 5% after the first, 13% after the third, 22% after the fifth, and 34% after the eighth.

Materials and Procedures

For this experiment the materials that are essential include 600 fruit flies. These will also need to be flightless, so that they can be easier for weighing and testing. The three groups being tested will include a control group, with both parents being regularly fed, and two experimental groups. One experimental group will have just the father being overfed, and the other will have both parents being overfed, so that a comparison can be made to determine if the father does have an impact different than just the mother. A good habitat is also essential for the flies to survive, and that habitat must contain some very important items. A plastic vial can be used for the home, yeast and media of water and powdered media for the nutrition, an orange screen which the yeast goes on to attract the attention of the flies, and a foam plug, providing air holes, while still trapping the flies inside. In addition, a milligram scale is needed to measure the fruit fly's weight, due to their microscopic size!

In order for this experiment to be performed right, some techniques are required. Lots of open space is needed, as there will be over 600 fruit flies, in many vials. It is important, though, to give all three groups, the same amount of light and space, so that environment isn't a factor, as genetics is the only thing being tested. Getting the environment set up must also be perfect because any little differences in the flies' habitats will have different effects. This experiment will start with the fruit flies being separated out into groups: the control group

of mothers and fathers, who will all be given the regular amount of food, and the overweight group of mothers and fathers, who will all be overfed. The flies will then mate with their correct partners, weighed afterwards, with their weight being recorded. The flies will be weighed using a sleep aide, which is made up of fumes that put it to sleep without killing it, making it easier to weigh. Then, the egg will hatch, and as soon as the new fly becomes an adult, it will be weighed, and any changes will be recorded. Then, this cycle continues for up to 10 generations, with the new offspring being the new father/mother.

Core Science

In this experiment, there are three main scientific components: the genetic effect from parent to child, the fruit flies as test subjects, and the obesity of both the father and the child.

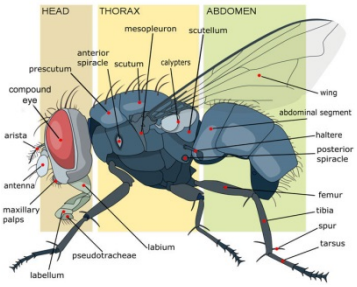
One idea regarding intergenerational effect, comes from Gregor Mendel's Peas. Mendel, also known as the father of genetics, was born in 1822, and used the characteristics of peas to come up with a theory. This theory stated that every trait in the offspring, such as hair color or height, is determined by a single gene, out of the 23 that humans have. Each gene is made up of two alleles, a dominant, and a recessive. He explained in two laws that the transmission of genes from parent to offspring, is segregation and independent assortment. Genes are passed from generation to generation, using probability rules. This theory of inheritance for any organism with a sexual reproduction lifestyle, including fish, flies, and humans. The theory of inheritance can be used to find other diseases such as genetic diseases can be inherited too.

Epigenetics is another theory that is similar to Charles Darwin's theory of evolution but takes it to the cellular level. It is the study of factors that switch part of genomes on and off at strategic times and locations rather than changing the DNA structure itself. Inheritance epigenetics relates to this experiment, as it shows the passing down of genetic information from both the father and the mother through the egg and the sperm, to the offspring. It is possible that environmental effects on the sperm and egg can cause changes in gene expression in the offspring produced by that egg and sperm. Theoretically, the BMI of a parent could cause epigenetic changes in the DNA of the sperm and egg which could influence the offspring's chance of becoming obese.

The fruit fly, or *Drosophila melanogaster*, was made a popular test subject in the early 1910's, and have had about 100,000 articles published on it. It is a good genetic test subject because it has 23 chromosomes, just like humans, and it lives a very short life, which means it is possible for a good intergenerational effect in a short amount of time, being the fastest way to finding genetic changes close to humans without using humans as the test subjects. The fruit fly, like other insects, has a head, abdomen and thorax, six legs, and wings, and has four different stages of life. The life cycle starts when the mother fruit fly finds a moist, sweet environment to lay her eggs in, such as a piece of rotting fruit. Then, after about 30 hours of being laid, the up to 500 eggs hatch as larvae. The larvae then spend 4 days in the fruit they hatched in, eating it for most of the nutrients and materials they need to become pupae.

For pupation to start, larvae find dark, dry places to hide. Then, a pupa case forms around the larvae, and they grow six legs and wings over a four day time span. After pupation, the flies emerge as adults and are ready

to mate in about two days. The mating process is very tedious for the males, as the females are very particular with who they mate with. First, the male approaches the female and makes a sort of tapping noise, which can be compared to humans singing a song. This will either put the female in a romantic state, or not faze her at all. If it doesn't faze her, then the male keeps trying, until the female either gives in, or flies away. After the flies have mated, they leave and the female finds a good place to lay her eggs. This starts the life cycle over.



This picture shows the anatomy of the fruit fly, with its three major sections, the head, the abdomen, and the thorax.

For this experiment to fully serve its purpose, all the facts about the obesity of the father and child fruit fly must be known. A person can be called obese when their Body Mass Index (BMI) is about the 30th percentile. The BMI is calculated using a person's height and weight, compared to other people of their similar body structure/age. Comparing the rates from 1970 to 2007, an almost 20% increase has happened! In America, 14 states have between 30% and 35% of the population obese! Dr. Patricia Cantrell says, "Unless we make some serious changes in how we eat and how we feed our children and activity levels, the problem will continue to grow." It has been estimated that by the year 2020, a whopping 85% of adults will be obese!

Obesity can be developed in two different ways, and can transform a completely healthy adult into a sedentary couch potato. One way to develop obesity is the environment in which a person lives in. Overeating is a huge part of the environmental factor, which means consuming over a person's daily amount of calories. This usually ranges from about 1500-2300 in an adult, and exceeding that each day can build up to a lot of extra weight. A sedentary lifestyle is also a huge cause of obesity, which can be explained as just sitting on the couch all day and watching television and playing video games. Because of all the advanced technology today, it is not needed to get up and do a lot of chores that past generations had to work to do, such as washing machines, cars, and dish washers. Not being able to sleep well has also been shown to cause obesity, because you need food to make up for the energy you didn't get while sleeping, causing an overload on calories.

Genetics are the other factor that can change whether a person is healthy or obese. There is a gene called the "thrifty" gene that takes in the most from the food, so a snack could be taken in like a meal, which can cause obesity, if the person doesn't watch what they eat. This gene, and any other methylated obesity gene, can be passed down from the parents, especially the mother, but the father has a lot more doubt about his influence on the children. This is probably because he is not the one carrying the baby, so he only has his sperm in the baby, which some people don't believe to be enough to influence the baby's BMI. But Dr. Patricia Cantrell thinks differently, "Studies show that when ONE OR MORE of the parents are overweight, the child has a higher risk

of being overweight." However, it is know that a combination of both parents being overweight increases the chance that the child is overweight more than if just one parent is overweight. Throughout many generations, this "thrifty" gene can keep being passed down, causing a lot of obesity in the family, as can the methylated gene. If the people who have this gene don't work hard at staying thin, it is possible that they could be determining their children and grandchildren's weights before they are even born!

Research Summary

This experiment can show one more way that Americans can diminish obesity and stop the ever rising rates. Yearly, the obesity rates are rising, and unless the people of America put a stop to it, soon everyone will be obese! Parental genetics has been known to affect the offspring's BMI, but it has yet to be shown how long a methylated gene can be passed down through generations. This project will test that theory. **It was hypothesized that the obesity rates of the flies would be 40% higher over 10 generations than the starting generation.**

This hypothesis was drawn from previous research showing that obesity can be passed down from the mother and the father to the offspring, and the offspring becoming obese. With an obesity gene being passed down 10 generations, it will be able to be seen whether or not the gene makes the offspring more and more obese over time with only the father passing down the gene. Genetics and environment will have a factor in this experiment, as the food will be controlled to combine the impact of the two obesity factors. The final goal of this project is to see whether or not obesity rates get higher and higher each generation, due to genetics, or if they just stay the same.

This final goal combines the three main factors of this project. The genetics of this goal is to see if the gene that gets methylated in the beginning still gets passed down from generation to generation, and whether or not it affects the flies' BMI. The fruit flies are the test subjects, and will be used as a close comparison with humans because of the 23 chromosomes shared between the two. Finally, the obesity of this goal is the making of the flies obese, by putting the extra food in, and waiting to see how obese they get. Finding this goal out could deter the rapidly rising obesity problem, and can contribute to changing America's path from obese, to healthy.

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SF Notebook Part 1:

Reminder: other than the recommendation section, there are to be NO YOUs/ Mes/ Wes etc written!!
This section includes: Statement of the Problem, Purpose, Hypothesis:

EACH of these are on their own sheet of paper

Statement of the Problem

This is a statement of what problem you hope to solve by what you have learned through your research and from your experiment. It is typically 2-3 paragraphs or 3/4 of a page.

Purpose

This is a statement of why you are doing this experiment. Why is your discovery important? This is usually a 1-3 paragraph section that answers these questions.

Hypothesis

-remember that the hypothesis is always stated in the positive as an "If" and "then" statement
-it is an EDUCATED GUESS about the outcome (results) of your experiment. It is what you think might happen when you do your experimentation. What effects or results do YOU expect, based upon your BACKGROUND RESEARCH?
- The hypothesis usually is in the form of a brief statement. 1-2 paragraphs
- it is NOT as long or as in depth as your research paper's hypothesis,
- Hypothesis is to include a number or percentage. (It is QUANTIATIVE) which is supported by your research.

BOLD the specific numbers of your hypothesis, so it stands out from the rest of your writing.

- NOTE: A hypothesis does NOT have to be RIGHT to earn a top grade. Your goal is to collect experimental evidence to determine if your guess is correct. Report the results honestly!!! Sometimes the greatest knowledge COMES from an "incorrect" hypothesis!

Please note this will NOT be separated as Part 1 in the final Notebook. It is done this way for chunking the work

SF Notebook: Part 1:

Statement of the Problem – Purpose – Hypothesis

What is the Science Fair Notebook?

- It is a collection of ALL work completed for this project.
- The notebook is a 3-ring binder containing all of the edited "parts" typed neatly & orderly.
- I will grade each "part" & return it to you. Then, you carefully edit & update each section. Why? Because the final notebook will eventually be read by judges at the fairs.

Major Rules

- Each "part" goes on a separate page
- Each page should have identical formatting:
  - same simple font (Arial, Times, etc.)
  - 12 point font
  - 1" margins
  - 1.5 spacing
  - Page numbers (you'll do this later…)
- Written in 3rd person: No I's you's me's we's etc
- The title of the section is centered at the top of the page.
- Do NOT write your name on every page
- Email to me as soon as you have them completed

Notebook Parts

Part 1:
- Statement of the Problem
- Hypothesis

Part 2:
- Variables & Controls
- Procedures
- Materials

Final Parts:
- Results
- Conclusion
- Recommendations

Statement of the Problem/Purpose

- Write 3-5 sentences for each of the following:
  1. what you hope to discover
  2. what you have learned through your research (summarized)
  3. what problem you hope to solve

- Each section may be 1 complete paragraph, or merged into 1 large paragraph

Length: 1/2 - 1 page

Example (these were done on the same page, just different sections) :

Statement of the Problem:

Contact lenses are directly inserted into the eye, which means the greatest possible sterility level is necessary for both comfort and health of the eye. Because of this, the solution the lenses are stored in and its effectiveness in discouraging and eradicating bacterial growth is critical to contact lens users' eye health. Many experiments have been done on testing which solution brand performs "better" than the rest, however, there has been no experiment that tested only the trusted and popular brands, the brands that the majority of lens users themselves use. Which of these has the greatest antimicrobial strength? With unsatisfactory bacterial levels in both the eyes and the lenses, infections and diseases such as Conjunctivitis, Keratitis, corneal ulcers and fungal infections can develop. A common bacteria species found naturally in the eye's fauna is the *Staphylococcus Aureus* bacterium, with the potential to cause infection. These infections can be painful, expensive to treat, and may result in loss of vision when severe, so choosing the right lens solution is essential.

Purpose:

The purpose of this experiment is to see if there are any significant differences in the performances of varying lens care solutions. Out of the widely available one-step solutions, which is the best performing? Which contact lens solution is truly more superior than others in prohibiting bacterial growth? If the results showed large differences in eliminating bacteria, the results derived from such an experiment could be used to benefit the health of contact lens users' eyes and receive efficient cleaning and disinfection for the cost of the solution. Learning what could be better for the eyes is a significant step towards maintaining clear, healthy and potentially prolonged vision.

Hypothesis

Part 1: State the Hypothesis

- A hypothesis is an educated guess or prediction about the experiment's outcome.
- What effects or results do you expect, based upon you're the background research?
- *A good hypothesis is quantitative & includes a number or percentage.*
- Why? So once you've obtained results, you can accurately state whether you hypothesized correctly or incorrectly.
- ***Hypothesis Examples:***
  - Bubbles made with Factor X will have an average diameter 5 cm greater than bubbles made with Factor Y.
  - Plants grown in green light will be 15% taller than plants grown in other colors.

Important Point
A hypothesis does not have to be right or wrong. Your grade does not depend on how well you guess. Just collect experimental evidence to determine if your hypothesis is correct and report the results honestly!!! Sometimes the greatest knowledge comes from a "wrong" hypothesis!

Part 2: Support the Hypothesis

- You must provide support for the hypothesis.
- In other words, explain how & why you came up with this particular hypothesis.
- Use the research & past experiments
- Include the following:
  - What led you to develop this hypothesis?
  - What did you learn in your research paper?
  - Explain how you selected the particular numbers/percents.
- Overall Length: 1/2 page

Examples: Hypothesis

The taller and heavier a skater, the harder it is for a skater to generate speed to enter a spin. Prior research has indicated that an object farther away from their axis of rotation rotates slower than when it is closer to their axis of rotation. Since the axis of rotation in a person is found across the torso and a center line from the middle of the head to her feet, a taller or heavier person will have an increased axis of rotation. Therefore, they will likely have a slower spin than someone who is shorter or is lighter. Weight has a bigger effect on an object traveling in a circular motion than radius length or height. However, there are many factors that are extremely difficult to control, such as the friction of the ice, the type of blade the ice skater uses, etc. In addition, there may be ice skaters that are over 45 kilograms, but the majority of the weight is muscle, which weighs more than fat.

These particular ice skaters could use their muscles to restrict the inward pulling found spinning in a circular motion, which may help them spin faster. As the majority of ice skaters are women, they usually have weaker muscles then men, due to their build. The taller and heavier people should have an average speed that is slower than people who are smaller and thinner. As mentioned earlier, since weight usually has a bigger effect of an object traveling in a circular motion than distance, the percentages of the hypothesis were adjusted accordingly. People with extra body fat are limited to the duration and the intensity of an activity. Therefore, their speed on the ice should be slower, and the overall speed of their spin should be slower.

Due to the information collected, it is hypothesized that

1. 70% of ice skaters taller than 1.5 m will have slower spins than skaters shorter than 1.5 m

2. 85% of ice skaters weighing more than 45 kg will have slower spins as compared to those skaters weight less than 45 kg. In addition, any ice skater who has extra body fat, as compared to the body mass index found in the healthy weight range, will have slower spins than those skaters with a body mass index in the healthy weight range, despite their height measurements or their weight amount.

Notebook Part 1 examples

Please note, YOUR final copy will be 1.5 spaced with 1 inch margins AND on their own separate pages.
This is single spaced only for examples

Statement of the Problem

Example 1: For years, people have been taking photos of important events in their life. These photos were taken to preserve the moment in time, and act as a reminder of the event. But how could a photo preserve the moment if the photo itself wasn't preserved? Researchers and librarians have conducted many experiments and have come up with numerous conclusions about the best way to preserve black –and-white, and color photographs. Recently, due the lower cost and ease of home use of home printmaking, the classic photograph has been replaced by the homemade inkjet color print. This change has become so definite that one of America's biggest companies, Kodak, has declared bankruptcy. So as people now save their treasures on inkjet prints, new science is needed to find out the best way to preserve these images forever.

It is known that humidity, temperature, and exposure to bright lights can cause damage to photos and to inkjet prints. However, the question still remains whether different types of environmental gases affect the preservation of inkjet prints. If normal environmental gases can cause an inkjet print to fade in color or lose resolution then people must be made aware of this possible threat. People, librarians, and historians can warned of this possible damage and take steps to protect their images.

Example 2: The world is headed into one of the most challenging times we have faced in producing enough food to feed all people. Food production is becoming more difficult due to less fertile land from erosion, increased population, and poor farming practices. Farming on each acre is increasing, but the over-use of pesticides and fertilizer is environmentally harmful. There is an increasing demand for high-quality, fresh vegetables, free of pesticides that are locally grown. In places all over the world, the climate makes it impossible to meet year round needs for local produce. Long distance transport significantly affects quality of the food. It is also very expensive.

The world population is increasing 1.6 percent every year and the amount of space available to grow food down sizing. According to Ecology Action, over the last 40 years, 30% of the world's farmable land has been abandoned due to erosion. For each pound of food that is eaten in the United States, about 6 pounds of fertile soil are lost due to farming practices. In developing countries 12 pounds of fertile soil are lost, and 18 pounds of fertile soil are lost in China due to farming.

About 213,000 people are born every day, requiring 34,000 additional acres to feed the newly born humans. A study by the Food and Agriculture Organization of the U.N. reported that there are over 1 billion people out of our total population of 7 billion, that do not get enough food to eat for a nutritional diet. There is less farmland because of demands by mining, solar and wind generation, and expanding cities are prioritized above farming. There is also a diversion of food to support biofuel, such as ethanol additives made from corn for gas. The "Green" revolution in farming has been a huge increase in food production but relies heavily on water, fuel and fertilizer. In order to meet the needs of the people, it is important to increase economic and environmental efficiency of farms.

People are also seeing a decline in many species of fish in the oceans due to pollution and over fishing. The "Blue" revolution in fish production now allows almost 50% of seafood to be farm raised. While this helps production, there are however, many problems from algae blooms, cage conflicts in the ocean and fish waste.

PURPOSE (done separately)

Example 1: The purpose of this experiment is to investigate which is the best environmental gas to preserve inkjet prints in and determine which gases can cause the most damage. The gases that will be tested are carbon dioxide, oxygen, nitrogen, and room air because these are the most common environmental gases. Most traditional photographs are kept in room air, and most photographs have a history of eventually fading. It has also been shown that if photographs are laminated, or sealed in some sort of a vacuum, they won't fade as quickly as photos exposed to room air. This information has been useful to many common people and historians who have photographs that they hope to be able to keep for generations.

Research shows that different ink and paper combinations can affect how long the newer inkjet and laser prints will last. However, most people prefer inkjet printers, dye-based inks, and plain or medium quality paper because of its low price. These lower cost and lower quality products do not have the ability to withstand environmental attack as well as the high quality laser or pigmented prints. Since the most common type of print used is the inkjet print, the fading expectancy should be studied under different conditions. To protect these prints, research has shown that prints should be stored in low humidity areas with a minimal amount of exposure to bright light and/or sunlight.

It has been shown that oxidation can ruin a photograph because oxygen may cause the different photographic colors to fade. This effect of oxygen and other environmental gases has not been studied using inkjet prints. The following experiments will help to solve one of the issues of how to keep prints vibrant and looking as though they had just been printed. This research will hopefully show how to keep them in an ideal condition for many years to come.

Example 2: Scientists are strategizing and analyzing ways to change the way humans create food forever. Controlled Environment Agriculture is growing food in a set environment for the best results. Controlled environment agriculture combines horticultural and engineering techniques for the best crop quality, production and efficiency. One emerging approach that is looking at growing both plants and fish in a small space with fewer resources is called aquaponics.

The use of aquaponics provides a more efficient use of natural resources. It is interesting because it is a self-contained ecosystem that is reliable, a great alternative to traditional farming, and it can be setup and used anywhere. The importance of this experiment is that it has a potential impact towards fixing world hunger, minimizes pollution, and is a lower cost towards feeding people. Economic research shows that hydroponics can grow a head of lettuce for 5 cents. Aquaponics can grow a head of lettuce in 12 cents, plus you get fish.

The following experiment will examine if using aquaponics, hydroponics, PH controlled aquaponics, or growing in soil is the most efficient way to grow nutritious and healthy plants in a short amount of time. This problem was selected after researching global issues online and world hunger was found as a major and growing problem. Research on aquaponics was found throughout the searching of this topic and seemed like a very important science that could be proved and expanded on in a science fair project.

(combination): Statement of the Problem and Purpose

Example1: The primary goal of this project is to discover the importance of the Wide Area Augmentation System (WAAS) during the solar maximum. This project will also determine how strongly GPS receivers are impacted by solar flares and other types of solar activity. Space weather could greatly affect GPS receivers and other forms of communication on Earth. Therefore, it is important to understand the effects these space events could have on life on Earth.

Solar flares, coronal mass ejections, solar wind, and other forms of solar activity could cause storms in the Earth's ionosphere, an area in the upper atmosphere. Signals from GPS satellites slow as they travel through the ionosphere, and are affected by any storms. Because the travel times of the signals are affected by storms, this may cause the GPS receiver's calculations to be in error. However, many receivers have WAAS, which is a second set of signals that may help correct for these errors.

Through this project, it is hoped that the impact of solar activity on GPS receivers will be more fully understood, and therefore result in less errors in receivers' calculations. It is hoped that this project will help improve the ease of using GPS during the solar maximum. This project may also aid in understanding the relationship between solar activity and communications devices on Earth.

Solving this problem could bring scientists one step closer to putting an end to catastrophic events caused by solar storms, such as the March 13, 1989 electrical power blackout in Quebec. These storms can cost up to 26 billion dollars per day and can affect millions of people. In addition, modern society greatly relies on satellite technology, which is vulnerable to the effects of solar activity. Satellite technology is also very costly to replace. Understanding the effects of solar activity on GPS devices could, in the future, assist scientists in avoiding severe power blackouts and satellite failures.

Example 2: Statement of problem and purpose

Today, existing solar trackers are very expensive and very complex. The high cost for tracking systems forces people to buy more static solar panels rather than using the more efficient sun trackers. The project's goal is to analyze efficiency of a tracking system and create a sun tracking system that is cost efficient and produces more energy than a static solar panel. The project will analyze the amount of energy being generated from a static solar panel and a solar tracking panel made for this experiment. If price could be reduced, more people would switch to solar energy. Such change can only benefit earth's environment by reducing the reliance on hydrocarbon fuels.

The experiment's purpose is to evaluate the effect of sun angle on the energy generated by a solar panel. If a tracking system does not need to track north to south, the complexity of the tracker can be reduced making it less expensive. In this experiment, solar panel efficiency will be evaluated and a solar tracker will be built using a simple shadow box sun sensor. The experiment will determine whether the loss in efficiency by not tracking north to south is inconsequential. The cost of installation and supplies for each panel will be more than a static system, but fewer panels should be needed to produce the same power. The cost savings from the enhanced efficiency of the system will be evaluated and compared to the excess cost of installation and supplies for the tracking system.

After interviewing representatives of solar installation companies, the gathered information was evaluated to see if there was any pattern. It was discovered that the most popular solar panel is Sunpower because it is the most efficient solar panel on the market. One can conclude from this trend that there is a market for more efficient solar systems. The average number of panels for a 6000 watt system varies from 15 to 25. The average cost for a 6000 watt system is approximately $30,000 to $35,000 before rebates.

Both the Omni-directional differential sun sensor experiment and the Naval Research Laboratory (NRL) spin replenishment and spin axis altitude control system experiment contributed to the project. The Omni-directional differential sun sensor experiment used the cosine in their experiment to estimate solar azimuth and elevation: north to south movement and east to west movement. The Naval Research Laboratory (NRL) spin replenishment and spin axis altitude control system experiment used an inexpensive sun tracker to determine where the sun was. Most solar installation companies do not sell solar tracking systems because the systems are too expensive.

If a tracking system was 39% more efficient as was estimated using the formula that will be tested in this experiment an existing static array of 20 panels costing $30,000 could be reduced to a tracking system with 12 panels. Assuming each panel costs approximately $1,500 installed ($30,000/20 panels), the cost of a tracking system of 12 panels (before additional installation cost and the cost of the tracking system) would be $18,000. If a tracking system could be installed for $12,000 or less, the system would be cost effective. Based on preliminary research, it appears possible to make more solar energy by maintaining the solar panel's perpendicular angle to the sun. The solar tracker will save energy and money by only tracking east to west. It also is believed that this can be accomplished in inexpensively.

Hypothesis : Spacing IS 1.5. This is single spaced for examples only.
You want to place a little previous information and BOLD the specific quantitative numbers

Example 1

Kirill Slobodyanyuk, completed an experiment which showed that geomagnetic storms affected GPS precision, and that 24 feet (about 7 meters) was the average amount of error. However, an error of 7 meters would probably have little effect, and is unlikely to cause a person to lose their way. Therefore, it was concluded that a stronger storm would be needed to cause a greater error of about 20 meters, enough to cause confusion for the user of the GPS receiver.

Another previous experiment, carried out by Dr. Keith Groves, revealed that a Kp-index of 8 could affect WAAS, the second set of signals used to correct for errors caused by the ionosphere. Therefore, a storm with a lower Kp-index may not affect WAAS, but could certainly affect a receiver without WAAS. A Kp-index of 6 is a reasonable estimate for the strength of a storm that could cause significant error in a GPS receiver's calculations.

The hypothesis for this project is that a Kp-index of 6 or more, resulting in an error of at least 20 meters, could cause the user of a GPS receiver without WAAS to get lost. This hypothesis was formed using a combination of background research and previous experiments. A Kp-index is a number from zero to nine that describes variation in the geomagnetic field for each three-hour interval. A Kp-index greater than 4 indicates that a geomagnetic storm has occurred. A Kp-index of 6, therefore, would indicate a moderate storm. Anything greater would be a more severe storm. Previous research indicates that there would need to be a moderate to strong storm to have any impact on a GPS receiver.

Hypothesis: Example 2

The hypothesis for this experiment was decided by many different facts and core science. The same force that was identified to cause a concussion will be delivered to the helmet to see if the helmet can disperse the impact and prevent injury. The blunt impact will be 90 and 100 g's. This is the range within which most concussions occur. When a 90 to 100 g hit occurs, it is similar to a player getting hit at twenty miles per hour. A 90 to 100 g hit will not always cause a concussion. There are many factors to take in to consideration when determining if the impact will cause a concussion.

In this experiment the helmets should be able to prevent most of the paintballs from popping at 90 to 100 G's. The expense of the helmets will also come into play during the experiment because the more expensive helmet or the higher quality helmet will be expected to perform better than the less expensive helmet or the lower quality/beginner helmet. This means that the Pro7 and the undetermined helmet are expected to surpass the clh2 in safety and quality. The age of the design of the helmets also helps predict the overall outcome of the experiment.

The hypothesis for this experiment is that the Pro7 will be able to withstand 10 g's more impact than the average of g's necessary for a concussion and the clh2 will be able to withstand 5 g's more than the average range of g's that cause a concussion. This was decided by evaluating the helmets designs, analyzing protective abilities of helmets, and facts from core science.

SF Notebook Part 2:

Variables & Controls / Materials /Procedures

Reminder: other than the recommendation section, there are to be NO YOUs/ Mes/ we etc written!!

Type in outline form, not sentence form :
I) VARIABLE TO BE CHANGED:
II) VARIABLE TO BE MEASURED:
III) CONTROLS:

-A VARIABLE is either one factor YOU CHANGE in an experiment or is one factor you are trying TO MEASURE in an experiment which results from that change.
-**A CONTROL GROUP** is a separate experimental group which is in a "normal" condition in which you do NOT apply the

VARIABLE YOU ARE CHANGING IN THE OTHER EXPERIMENTAL GROUPS.
(be as specific as possible-- list everything you will change including amounts, intervals, conditions,-- everything!)
-**the VARIABLE** you are studying and the one item you are **CHANGING** in your experimental to find it's effect on your subjects.

-Write down the **VARIABLE** you are **MEASURING,** the specific effect you are trying to determine as a result of changing the VARIABLE . The MEASURED VARIABLE would be the growth rate of the plants.

-Write down **HOW you will establish a CONTROL GROUP...** a group of subjects under "normal" conditions. The CONTROL group is used for a standard, for comparison with the experimental subjects.

-Write down a list of all those factors which must NOT BE ALLOWED TO CHANGE... factors which must remain the same in ALL GROUPS during the experiment... these factors are known as VARIABLES TO BE CONTROLLED, or simply, "CONTROLS"

-Don't get "CONTROLS" mixed up with the term "CONTROL GROUP". .

Materials

In a numbered list, describe every item you will need to run this experiment.
Include quantities, sizes, brands, colors, shapes, tools, volumes. Use metrics when possible.
Use diagrams or sketches if needed.

Procedures & Design

Procedures are the **step by step** recipe of how you will perform you experiment!
Be very complete. Could someone in another state perform you lab EXACTLY as you did?
Your procedure is one of the most important parts of your project! The way you plan and design your experiment will make or break your project. Judges look closely at procedures to see if EXPERIMENTAL DESIGN really answered the QUESTION that was set out to be solved.

In complete sentences, written in past tense, write a minimum of a 15 step procedure.

Be specific. Use diagrams, sketches, or photos if necessary. Do not include steps involving library research, obtaining materials, writing reports, etc. Start with the experiment itself. Tell how often and what you will be measuring. BE DETAILED!! The procedures are so detailed that anyone reading them could perform your experiments EXACTLY as you did it EXACTLY the same size, quantity, brands of equipment, subjects, etc. Make sure you use a LARGE number of subjects/test runs in your experimentation or the results will not be believable leaving the experiment useless.

Please note this will NOT be separated as Part 2 in the final Notebook.
It is done this way for chunking the work into smaller "bites"

Variables & Controls: Procedures – Materials:

- In this section, you are going to start planning your experiment.
- You should already have an idea of how you are going to test your idea, but now is the time to truly plan it out.
- The **Variables & Controls** is an outline defining what you are changing in the experiment, what you are measuring, and what remains the same.
- The **Procedures** is a numbered list of every single step in the experiment.
- The **Materials** is a list of every item you need to run the experiment.

Variables & Controls

What is a variable? A factor that is being changed

- **Independent Variable**: a factor that is being changed but not influenced or affected by others in the experiment, such as:
  - *amount of sunlight a plant receives*
  - *the fingers that are being fingerprinted*
  - *the location of the water samples*
- **Dependent Variable**: a factor that relies on another and is being measured in the experiment, such as:
  - *The height or growth of the plant*
  - *the number of whorls in the fingerprints*
  - *the pH of the water*

Manipulated: the variable that you purposely manipulate (change)

Dependent: the variable that is being observed which changes in response to the manipulated (independent) variable.

Responding: a factor that acts or behaves in reaction to something

What is a Control? These are factors WHICH ARE NOT CHANGED

- **Control Group**: a separate experimental group in which you do NOT apply the experimental variable. In other words, the group that does NOT change, such as:
  - *the plant that is not moved from the sun*
  - *No control group for fingerprints*
  - *Using distilled water instead of tap water*
- **Controls**: everything that remains the same during the experiment
  - *same amount of water, same amount of light, same type of plant, same fertilizer…*

Independent Variable (Manipulated) CAUSE	Dependent Variable (Responding) EFFECT	Control (constant)
The 1 thing you are testing Can only 1 Exp.:Type of fertilizer used	The results of your experiment Can be 1 or more Exp.: Plant growth Number of leaves Amount of fruit on plant	Everything that you kept the same Exp. Amount and type of soil, Water, Sunshine

Examples: Variables and Controls

I. **Independent Variable:**

Radiation that the Mealworms Receive

This variable will be changed by the ultraviolet radiation that the mealworms are irradiated with.

II. **Dependent Variable: The Percentage of Mutated Beetles**

This variable will be measured by recording mutations in the exterior anatomy of the beetles such as deformed wings, legs, antennas, eyes, or wings.

III. **Control Group**

The control group in this experiment is a batch of mealworms that will not be irradiated with ultraviolet radiation. This batch will be tested under the same parameters as the test group. Mutations in the control group will be recorded as will be in the test group. This group will test to see the difference in percentage of mutated beetles in irradiated and non-irradiated mealworms.

IV. **Controls**

Same supplier of worms
All containers containing worms will be cleansed
Type of storage container that will be used
Location that the groups of mealworms will be stored
Temperature that mealworms will be stored at
Humidity that they will be exposed to
Natural sunlight that they will receive
Same diet that the mealworms will receive
Same feeding time

Variables and Controls

I. **Independent Variable**:

This variable will be changed by modifying the time of day (morning and afternoon) that the math test will be administered to each student

II. Dependent Variable:

This variable will be measured by comparing each subject's score on the test in the morning versus the afternoon

III. Control Group:

At least one class of students will be tested in the reverse order (e.g. in the afternoon for the first test; in the morning for the second test) than the other classes to control for improvement on the test by being re-exposed to the same questions a second time

IV. Controls:

* Same math multiplication problems in a different order on all tests
* Same amount of time allotted for each test-taking period (four minutes)
* Morning is the same timeframe every day (7:30 A.M. - 8:30 A.M.)
* Afternoon is the same timeframe every day (1 P.M. – 2 P.M.)
* Same students are assessed in the A.M. and P.M
* Same amount of problems on every test (40 problems)

VARIABLES AND CONTROLS (This is another format to set up your Variables & Controls)

I. Experimental Variables:

- The first experimental variable is the type of water in which the plastic samples will be tested.
  - This experiment uses fresh water from Miramar Lake in San Diego, California and salt water taken from the pier at the Scripps Institute of Oceanography.
- The second experimental variable is the type of plastic.
  - This experiment tests four types of plastic: high density polyethylene (HDPE), HDPE with an additive that speeds degradation, corn-based BioBag™, and wood cellulose-based NatureFlex™ cellophane.

II. Measured Variables:

- The variables that will be measured are the change in mass and appearance of the samples.
- Changes in mass will be measured by weighing each of the plastic samples weekly for the first five weeks of the experiment and then samples will be weighed on an alternating bi-weekly basis.
- Changes in appearance will be measured by observing color, stiffness, level of transparency, and dimensions.

III. Control Group:

- The control group consists of 10 samples of each type of plastic that are stored in file folders and not exposed to the water or elements.

IV. Controls:

- Test samples are all placed in fish tanks with water circulated by air stones to simulate the currents in the water.
- All fish tanks are exposed to the same conditions (weather and UV radiation).
- The same procedure is used for drying and weighing plastic samples.
- The specific gravity of the water in the salt water tanks is monitored and adjusted as needed on a weekly basis to maintain a constant level of salinity.

Procedures

- The procedures are one of the most important parts of the project.
- The way you plan & design your experiment will make or break your project.
- Judges look closely at procedures to see if experimental design really answered the question that you first wanted to solve.
- If you change steps during the actual experiment, you are expected to rewrite the procedures to include these changes.

Good Experimental Procedures…

- Use as much detail as possible. Include sketches, diagrams, amounts, brands, sizes, everything!
- Are a step-by-step list of everything you must do to perform your experiment.
- Tell how you will change the one & only experimental variable & how you will measure that change.
- Explain how you will measure the measured variable.
- Explain how the controlled variables will be maintained at a constant value.
- Specify how many times you intend to repeat the experiment, so that you can verify that your results are reproducible.
- Enables someone else to duplicate your experiment exactly!

Procedure Rules

Number each step (> 15 steps) Complete sentences, include periods Written in 3rd person: no Is or Yous
Single space within a step, double space between steps
Do not include steps involving library research, obtaining materials, or typing up the results.

Materials

- In a **numbered** list, describe every item you will need to run this experiment.
- Include quantities, sizes, brands, colors, shapes, tools, volumes.
- Use metrics when possible.
- Use diagrams or sketches if needed
- Add to this list as new items arise. **Attach any forms, tests, surveys**

These would be on separate pieces of paper,

1.5 spacing between materials, Single space within a specific procedure, 1.5 space BETWEEN procedure steps

Materials

Radiation

1. Verilux Clean Wave UV-C Sanitizing Wand

Storage

1. Two Sterilite brand 3 drawer white storage containers (36.2cm x 28.3cm x 26.4cm)
2. Cardboard box (6cm x 21 cm)
3. Large Clear Storage Container

Test Subject and Staples

1. One thousand Jumbo mealworms
2. Slices of apple
3. Bran
4. Rolled Oats
5. Slices of Potatoes
6. Cup measurement

Both Materials and Procedures are on separate pages.

PLEASE NOTE FORMAT:

Materials:

Numbered list of materials.

Spacing is 1.5 between materials

Procedures

Procedure steps are numbered

It is single spaced within a step.

And 1.5 spacing between steps

If you are building something THAT needs to be drawn/photos taken, and procedures for that building are needed.

Procedures:

Observations: 1. Magnified glass

Part I: Quarantining the Mealworms

1. Clean a large storage container by wiping it down with a wet paper towel.
2. Place a layer of five parts bran one part rolled oats staple food at the bottom of the storage container.
3. Place one thousand mealworms into the cleaned storage container.
4. Place multiple slices of apple throughout the container.

Part II: Transferring Mealworms into Testing Drawers

1. Wipe down each of the test drawers with a wet paper towel.
2. Measure and mark 2 centimeters from the bottom of each drawer.
3. Select 100 healthy mealworms for each of the 3 test groups.
4. Select 100 healthy mealworms for each of the 3 control groups.
5. In each testing drawer, pour a mixture of five parts bran one part rolled oats, enough to cover two centimeters of the bottom of the drawer.
6. In each test drawer, place 10 slices of thinly sliced apple evenly spaced throughout the area of the drawer.
7. Place the selected worms into the drawers.

Part III: Maintaining the Mealworms: Every Day for Every Drawer:

1. Remove any perished worms and record.
2. Replace the 10 thin slices of apple with new ones.

Every Week for Every Drawer:

3. Refill the mixture of food to the two centimeter mark on the drawers

Part IV: Irradiating the Test Group with UV-C Radiation:Daily for each of the 3 Test Groups:

1. Add a thin layer of bran, enough to cover the bottom of the cardboard box.
2. Transfer the mealworms from the test drawer to the cardboard box.
3. Place the Verilux UV-C Cleansing Wand over the cardboard box.
4. Irradiate the worms for one minute. (time subject to change)
5. Remove Cleansing Wand from the box.
6. Transfer the worms back into their original drawer and be sure to avoid moving any extra bran into the drawer as it could affect the results.

Part V: Terminating the Radiation

1. Each day, observe carefully for pupations in the worms.
2. Once a pupa is spotted, terminate radiation for ALL test groups, ensuring that all the mealworms were irradiated to the same amount of radiation.
3. Continue daily and weekly routines of replacing apple slices and food.

Part VI: Terminating the Food Supply

1. Observe each drawer everyday until all the mealworms have pupated.
2. Once all of the mealworms have pupated, terminate the daily and weekly food supply of bran, rolled oats, and apple slices.

Part VII: Cleaning out the Drawers after all the Mealworms have Pupated

1. Once all the mealworms in a drawer have pupated, remove the pupa from drawer and place them in the cardboard box temporarily.
2. Remove all the leftover food in the drawers and discard.
3. Wipe down the drawer with a damp paper towel and allow for time to air dry, preventing and mold from growing.
4. Measure and mark a one centimeter line from the bottom of the drawer.
5. Fill the drawer to the one centimeter line with the mixture of food. (bran and rolled oats)
6. Carefully transfer the pupa back into the storage container. Be careful not to damage any of the pupa as that could affect the results of this experiment.
7. Repeat steps 1-6 for every drawer once all the worms have pupated.

Variables and Controls **Please note this would be 1.5 spaced! It is single spaced just to show content**

I. **Independent Variable: WAAS on/off**
   - This variable will be changed by turning the Wide Area Augmentation System (WAAS) off on one receiver using the SiRFDemo.exe program.
   - The other receiver will still have WAAS enabled.
   - The receiver with WAAS disabled may have error created by the ionosphere. The receiver with WAAS enabled will, however, automatically correct for this error.

II. **Dependent Variable: Altitude Measurements**
   - This variable will be measured by the GPS receivers according to the data they collect from the satellites.
   - The altitude measurements from the receiver with WAAS and the receiver without WAAS will be compared by computing the altitude difference for each second.

III. **Control Group: Measurements from days without geomagnetic activity**
   - The control group will be made up of altitude measurements from days or intervals of time with low geomagnetic activity, and therefore, less chance of error in the GPS receivers' calculations.
   - These measurements will show how much solar activity impacts the precision of GPS receivers by providing data for days without much solar activity.
   - These days will have a low Kp-index of either zero or one.

IV. **Controls:**
   - Same GPS receivers, in the same location and altitude, for each trial
   - The location of the satellites should be nearly the same when the measurements are taken at the same period of time each day, within a week of each other.
     1. Alternatively, averaging three hours or more should cancel out the errors caused by differing satellite geometry.
   - Same weather (cloudy, sunny, raining, etc.)
   - Measurements from WAAS and no WAAS receivers are taken at the same time.

Variables and Controls **(another format available to use)**

I. Experimental Variable: Type of Solar Panel System
- This variable will be changed by using two different types of solar panels.
- The first type will be a static solar panel.
- The second type will be a solar tracking mechanism made for this experiment using a simple shadow box sun sensor.

II. Measured Variables: The Energy Output From the Solar Panel
- This variable will be measured using a volt meter attached to each panel.
- The sun will be simulated using a flashlight or shop light.
- The sun angles will be calculated in 10° increments.

III. Control Group
- A tracking solar panel will be the control group
- The tracking solar panel will not change its angle to the sun

IV. Controls
- The interval time (5 minutes)
- The light source
- The light location
- The solar panel
- The test location

Procedures: a step by step NUMBERED procedure/single spacing within the step/1.5 spacing between steps

Part I: Placing Light Traps

1. Find areas with available beehives.
2. Bring all traps, tools, and storage containers to the testing location in the cardboard box or container to keep supplies.
3. Locate hive and observe its surroundings.
4. Take the traps and put them on the ground at least 15ft. away from the hive.
5. Make sure the hives cannot be seen directly from the entrance of the hive.

Part II: Setting and Activating Light Traps

1. Secure the lights on the traps.
2. Make sure they are pointed to the bottom of the funnel part of the trap.
3. Also make sure the light can be seen clearly from the distance of the hive.
4. Turn on lights each night when it becomes dark outside.

Part III: Collecting Findings

1. Go out to the traps the morning after the night they were activated.
2. Remove duct tape and funnel.
3. Use the tweezers to pick bees out of the trap, hold them by the wing.
4. Poke air holes in containers with the thumbtack or needle.
5. Put each bee in a separate storage container.
6. Label each container with the location and date collected.
7. Organize containers by location and date.
8. Create a table to record findings.
9. Fill table accordingly with what was collected.

Part IV: Observing Findings

1. Keep containers with bees at room temperature for 5-13 days.
2. Each day write observations of every collected bee.
3. After the 13^{th} day, if phorid larvae do not emerge, discard the bee.
4. Keep a record of the number of infected, and uninfected bees.
5. Use these results to create a conclusion based on the hypothesis.

Procedures (example showing drawings) Remember: this is a step by step NUMBERED procedure

Part 1: Setup

1. Locate an accessible area with an unobstructed view of the sky, without any objects that may interfere with satellite signal reception.

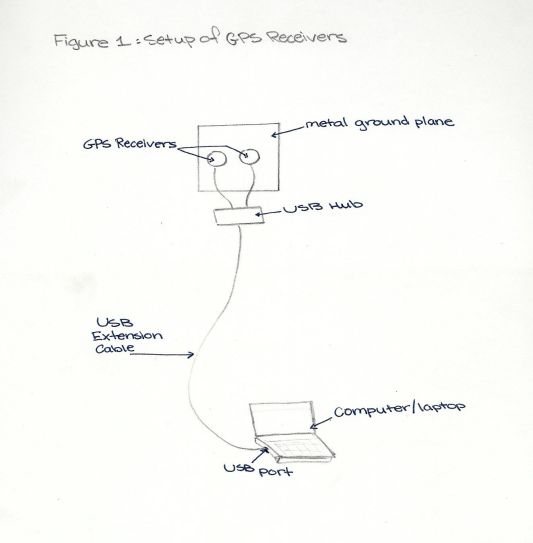
2. Take the two GlobalSat BU-353 WAAS GPS receivers and the square piece of metal to this location, using a ladder if needed.

3. Attach the magnetic part of the GPS receivers to the metal.

4. Place the metal, along with the GPS receivers, in the chosen location so that the metal plate is parallel to the ground and the GPS receivers point upward.

5. Attach the multi-port USB hub to the receivers and the extension cable.

6. Insert the opposite end of the extension cable into the USB port on the computer or laptop.



7. Sign up for solar storm alerts in the 3D Sun Application.

Materials (note: this should be a NUMBERED list)

Light Trap

1. Flower pot or bucket
2. Light source (preferably cordless/battery operated)
3. Tape (preferably duct tape)
4. Funnel to match diameter of pot or bucket
5. Stick or wire (rulers work well)
6. Batteries (if needed for light source)

Collection

1. Ziploc Tupperware containers
2. Label maker or labels
3. Pen or marker (if using regular labels)
4. Tweezers
5. Thumbtack or needle
6. Cardboard box

Observation

1. Room kept at normal room temperature
2. Paper or notebook
3. Pencil or writing utensil

SF Notebook Part 3:

The experimental notebook / composition book

Observations/Results: Data & Graphs/ Conclusions/ Recommendations

Reminder: other than the recommendation section, there are to be NO YOUs/ Mes/ we etc written!!

Please note this will NOT be separated as Part 3 in the final Notebook. It is done this way for chunking the work

Experimental Log The Composition Book

KEEP A SCIENTIFIC LOG OF EVERYTHING THAT HAPPENS WITH YOUR EXPERIMENT!!

This will be a composition book that will be placed in the back pocket of your science notebook.

First, get a composition book (I will give you one!)
o Before you begin, you need to get a journal or notebook to record everything.
o This will be your log or diary
o Include the date in the top corner, and record everything you did that day, as it relates to your SF experiment.
o This may be retroactive, meaning, what things you have already done (ie, purchased equipment….)
o Example: 10/30 Today I received permission from my teacher to survey every student in her class.
This includes 75 boy and 80 girls, which should provide me with roughly 155 students.

Second, make a to-do list
o Make yourself a check off list of everything you need to do BEFORE starting the experiment
o Maybe you need permission from an adult/coach/teacher
o This includes obtaining all of your supplies and materials!

Third, Collect Materials This could be tricky!
o Obtain ALL of your materials
o Make sure you have EVERYTHING you need before starting the experiment.
o Perhaps you need a video camera, ball machine, digital camera, etc.
o For each day in your "diary", be clear about what materials you got.
o Example: 9 / 4 Today I borrowed 100 50ml beakers from school. I will use these for my samples, but I still need to get 50 more.

Fourth, prepare to collect data
There are two types of data to record:
o Quantitative Data - using numbers! this is data you can count and measure. example: the growth of the plant in cm
o Qualitative Data - using adjectives! this is description of your observations such as the color and shape of things, what they look like, what changes you saw. example: the color of the flower petal

Part a: **Quantitative: Create Data Tables**
o Based on your variables, prepare charts and/or data tables to use during the experiment.
o Create one for each variable you are changing, paired with the variable you are measuring.
o This will help you stay organized during the experiment, when things may get hectic and you don't have time to make a cool little chart.

Part b: Qualitative: Take Pictures
o Use a camera and take pictures of everything
o Paste copies into your composition book
o Make extra copies to use in your results section and to put onto your backboard
o Also, describe EVERYTHING that occurs during your experiment - conditions, observations,
problems, solutions, back up plans, etc.

Fifth, obtain permission: This is VERY important
o If you are doing an experiment involving people (surveys or testing) YOU MUST have signed permission slips
o Create a permission slip form where you get their name, age, signature, and parent signatures to participate in your experiment
o Keep these - you will need them in your SF notebook appendix
o If you are doing an experiment involving bacteria/ hazardous materials/chemicals, animals, etc, there are special forms you must complete and have signed BEFORE you being! Ask Mrs Gillum for these forms.

Ok, are you finally ready?
o You have all of your materials
o You've received permission from all necessary participants/adults
o Your procedures have been approved
o You made data tables and put them in your notebook…
o Sounds good to me! **Begin the experiment!**

Some additional tips to consider!!

1. Make sure to record the conditions of your experiment and changes that you are making(so you can update your procedures) Did you skip a step? Add a step? What is the weather like? Does this matter or could it affect your results?
2. You need to record EVERYTHING! Be honest, you can explain mistakes or negative results later.
3. Tip: It is always better to write as much as you possibly can, than to be "short" of info later.
4. All of this info will end up in your final notebook under the "observations" and "results" sections… make it neat and professional.
5. In the results sections, you will include all of your observations, data, tables, charts, pictures, diagrams, sketches, statistical analysis, and general descriptions.
6. This part will be at least 2 pages long, without even adding your pics and diagrams.

Results - Conclusion - Recommendations

Results:

Here, you will show & write what happened during he experiment. Tables, graphs, charts, sketches, photographs, statistical analyses, & general descriptions of observations are included. Do not include the actual math. Do that in the composition book.

The goal of the results section is to…

- Explain everything in the written discussion & show it through graphs, data tables, & photographs.
- Save any conclusions for later.
- This section consists of 5 parts:

Part A: Results*: An initial summary of what was tested & how.*

A few paragraphs introducing the experimentation

Part B: Data Table

- You already created & saved a digital data table. Now, copy the info from the comp. book.
- Include all variables, trials & controls.
- Don't forget to include units!
- Round every number to the same decimal spot. In other words, everything should be rounded to the tenth or hundredth place.
- Calculate & include: averages, percentages, & percent change.
- LABEL EVERYTHING!!! Titles, tables, columns, rows!

Part C: Graphs

- Typically, you will be graphing measured variable vs. changed variable.
- Use Excel to produce your graphs - no "hand drawn graph paper" graphs will be accepted.
- Choose the right intervals for the graph. If you're measuring to the nearest hundredth, don't make a graph with intervals of 50.
- **LABEL EVERYTHING!!!** Titles, tables, columns, rows, axis's, everything!
- Using the appropriate graph (line vs. bar vs. pie) for your data is very important. If the graph doesn't show any trends, change the graph type or what's on each axis.

Part D: Photographs

- Assign a number to each one - figure 1, figure 2.
- Include a brief caption or title for each one
- These may also be placed within the written discussion.
- Sketches or diagrams can be included, but must be professional looking.

Part E: Discussion

- Write a detailed summary of the experiment, which is a MINIMUM of 1 page 1.5 spaced.
  - Describe the entire experiment in detail!
  - What happened when you tested each variable?

Which variable had positive results & which did not

  - Describe each trial. How were they the same? How were they different?
  - What problems (if any) did you encounter?
  - Did any unplanned variables affect the results?
  - What changes (if any) did you make to the procedures?
  - Refer to your hypothesis & describe how the ending results differed from the hypothesis.
  - DO NOT form any conclusions. That's later!

Conclusion :

- Draw conclusions based upon the data you reported in the Results section. Use the graphs!
- Start with a powerful opener & continue it with topic sentences until the end. Make sure each paragraph focuses on one topic.
- Use scientific writing. No I's and you's
- Length: *at least* 1 1/2 pages 1.5 spacing
- Please include the following, preferably in order:
  1. Discuss the DATA & results! Look at any possible patterns, explanations of data, or your own theories as to why it turned out the way it did.
  2. Restate the original hypothesis & discuss how accurate or inaccurate your prediction was. Provide a possible explanation for any discrepancies or accuracies.
  3. Here comes the science… How can you explain your results, using science? This should be the bulk of the paper & is the most important part. You may need to do some research to find answers. You must be able to explain WHY you obtained these results.
  4. Refer back to the purpose & statement of the problem. Did you answer the big question?
  5. Finally, end with the big picture. Why does this experiment matter to you or the world?

Recommendations:

- This section analyzes the strengths & weaknesses of the project.
- Look at what went wrong & explain why.
- Make suggestions or explanations for inaccurate or unexpected results.
- Suggest future improvement on the design of your experiment, what should you have done, or how you can make this experiment better.
- If someone were interested in this topic, what would you recommend they tested?
- Worth 20 points, credit/no credit
- Length: ½ - 1 page 1.5 spacing

Observations (below are some GREAT examples!) This would normally be 1.5 spacing)

This experiment was conducted to see if seagrass and sea lettuce, two different oceanic plants could reduce ocean acidity. For this experiment, it took a total of four containers to carry out one trial. The first aquarium didn't have any plants inside for it served as the control. The second aquarium had seagrass while the third had sea lettuce. In the final container, both seagrass and sea lettuce were combined. The tests were run for two weeks to see if over this period of time the plants had an effect on the water's pH, the primary variable. Salinity, specific gravity, calcium and temperature were also recorded, as sanity variables, to make sure the oceanic conditions are within the coral reef environmental range. Eight containers were used in order to have two trials run in parallel. This was done in order to collect more data.

pH was recorded by using a pH monitor. When measuring the pH throughout the experiment, it was noted that the pH was normally around the 8.5 mark. This was surprising in the beginning of testing when it was thought that the pH would be closer to 8.2, the general oceanic pH. The control's pH seemed to bounce around follow no particular pattern. Some days the pH was relatively high and other times it would drop as much as 0.4 units. On the other hand, the containers with plants seemed to be increasing at a slow rate. Trials A and B have more active trend lines, where as Trial C and D are more subtle.

Salinity and specific gravity were recorded using the same device, an ocean hydrometer. The natural salinity level is suppose to be 35ppt. The salinity trend levels ranged between 32ppt and 39ppt. In every trial a similar factor occurred in which salt particles formed on the lids and even on the tables. This was an interesting observation also because the sea lettuce containers seemed to accumulate the most salt. Since salinity and specific gravity are water conditions that should stay relatively the same, they are being recorded as sanity variables to make sure the ocean water does not reach extremes. The overall salinity levels were in a close enough range to represent a coral reef environment. The specific gravity, a comparison of the density to regular water stayed quite consistent throughout, ranging from 1.024-1.029. This also stayed in regular oceanic water conditions.

Temperature was measured using a basic thermometer. The water temperatures reached as low as 19 degrees Celsius on one day, and as high as 28 degrees Celsius on another, however the majority of the time, the water temperature was in-between 23-25 degrees Celsius. The average water temperature for coral reefs is between 23.3-28.9 degrees Celsius. Therefore the temperature was in the correct range as well.

The final parameter measured was calcium. The natural calcium level is 420ppm, however research has stated that staying between the range of 380ppm-450ppm are suitable as well. The interesting factor about calcium levels are that lower calcium levels will negatively impact the marine environment; however calcium levels higher than 450 do not impact the plants the plants anyway. There are some breaks in the calcium trend lines because this data couldn't be recorded on a few days, due to a lack of calcium test solution. The range of calcium levels in this experiment were from 400-490. Even though this might seem like a big range, the calcium level did not drop below 380 which is the true issue.

It was observed that seagrass plants did not do nearly as well as sea lettuce plants. After around nine to ten days in the aquariums, the seagrass plants began to turn brown and look more wilted. Therefore at the half point of testing, when Trials A and B finished and Trials C and D began, the seagrass plants had to be replaced with healthier ones. This same observation also occurred with Trial C and D. On the other hand, the sea lettuce plants seemed to prosper throughout all the trials. The plants never showed distress unlike the seagrass plants.

The hypothesis for this experiment was that each of tanks will start with an initial pH of 8.0 units. The container with seagrass is predicted to increase the pH 0.25 units by the end of the experiment, resulting in a pH of 8.25. The container with sea lettuce in predicted to increase the water level 0.15 units, ending at 8.15. The last of the containers, containing both seagrass and sea lettuce is thought to have an overall increase of 0.20 units in pH with the outcome of 8.20 pH units. This hypothesis was entirely wrong from the beginning to the end of testing. The data collected in this experiment showed that the control fluctuated where as when plants are added to an aquarium (or in the ocean) an increasing pH rate is established.

Data Tables

EXAMPLE: How to Read Data Tables Correctly

The first number refers to the amount of days the plants have been in the aquariums. In the brackets, the number refers to the first half of testing (when Trials A and B were running) or the second half of testing (when Trials C and D were running).

This example:

The plants have been in this container for 7 days. This is also the second half of testing, when trials C and D were running.

This refers to the date the data was collected on.

This example:

This data was collected on November 24, 2012 (11-24-12).

This refers to the time-frame it took to collect the data.

This example:

It took from 5:02 pm to 5:28 pm to collect the data.

Test #: 7 (2)	Date: 11-24-12			Time: 5:02 pm - 5:28 pm	
Container Name	pH (units)	salinity (ppt)	gravity (unit)	temp. (Celsius)	calcium (ppm)
C-1	8.66	38	1.029	24	460
C-2	8.6	37	1.028	23	460
C-3	8.69	37	1.028	23.5	460
C-4	8.69	38	1.029	23.5	460
D-1	8.7	38	1.029	23.5	460
D-2	8.67	38	1.029	23	460
D-3	8.65	38	1.029	24.5	460
D-4	8.63	38	1.029	24.5	460

These labels are the aquarium names. The letter refers to the Trial (Trial A, B, C, or D). The number refers to the plant inside.

1= control

2=seagrass

3= sea lettuce

4= both (seagrass and sea lettuce)

This example:

This container is part of Trial D. This is the container with seagrass.

This column is where the pH values are recorded.

This example:

The pH for container D-2 is 8.67

This column is where the salinity values are recorded (in ppt-parts per thousand)

This example:

The salinity level for container D-2 is 38 ppt.

This column is where the gravity values are recorded.

This example:

The gravity of D-2 is 1.029 units.

This column is where the temperature values are recorded (in Celsius).

This example:

The temperature in D-2 is 23 degrees Celsius.

This column is where the calcium levels are recorded (in ppm-parts per million).

This example:

The calcium level for D-2 is 460 ppm.

Test #: 1 (1)	Date: 11-1-12			Time: 3:21 pm - 4:40 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.47	35.5	1.027	n/a	400
A-2	8.31	32	1.024	n/a	460
A-3	8.45	35	1.026	n/a	480
A-4	8.43	37	1.028	n/a	500
B-1	8.45	36.5	1.027	n/a	450
B-2	8.36	37	1.028	n/a	450
B-3	8.45	36.5	1.0275	n/a	480
B-4	8.45	36.5	1.0275	n/a	460

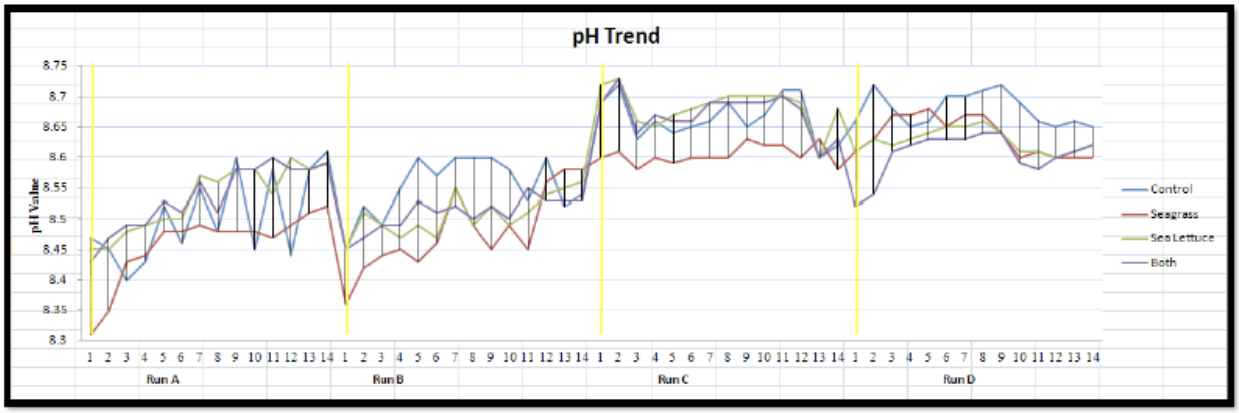
Test #: 2 (1)	Date: 11-2-12			Time: 3:07 pm - 3:55 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.45	34	1.025	23	420
A-2	8.35	36	1.027	22.5	460
A-3	8.45	36	1.027	23	460
A-4	8.47	37	1.0285	22.5	440
B-1	8.52	39	1.029	22	440
B-2	8.42	37	1.0285	22	440
B-3	8.51	36	1.027	22	470
B-4	8.47	37	1.0285	22.5	440

Test #: 3 (1)	Date: 11-3-12			Time: 12:00 pm - 12:45 pm	
Container Name	pH (units)	Salinity (ppt)	Gravity (unit)	Temp. (celcius)	Calcium (ppm)
A-1	8.4	37	1.028	21	450
A-2	8.43	34	1.026	20	460
A-3	8.48	36	1.027	22	480
A-4	8.49	36	1.027	20	460
B-1	8.49	36	1.027	21	470
B-2	8.44	37	1.0285	20	460
B-3	8.49	37	1.0285	21	440
B-4	8.49	36.5	1.0275	21	460

This student actually had 8 pages of data tables. Only a portion of her work is shown here.

This student also had 4 pages of graphs, and only 1 page is shown here

Data Graphs



This chart displays the pH changes with the different ocean plants. The four different runs are all shown, one after another, for convenience to compare trend lines. The yellow line marks the beginning of the next trial, and well as the run through name is marked on the x-axis.

The Conclusion and Recommendation on the next page were actually 1.5 spaced, 12 point Times New Roman font, with 1 inch margins, and were on separate pages. They have been reduced and changed to save space.

Example: **Conclusion** (this would normally be 1.5 spacing)

The oceans are an essential part of human life. More than 70% of the Planet Earth is comprised of ocean water. The oceans serve as a source of transportation, provide food, and produce more than 50% of the oxygen in the atmosphere. However, the much resourceful oceans are being destroyed by the process of ocean acidification. When the excess CO2 in the atmosphere is absorbed into the oceans, the water becomes more acidic and this is known as ocean acidification. The acidic ocean water does not allow for calcification to occur, which means coral reef formation and shelled animal growth are endangered. As the process of ocean acidification progresses, the entire ocean ecosystem is at risk of becoming unstable and potentially extinct over time.

In this experiment, seagrass and sea lettuce were tested in tanks filled with ocean water to determine if these plants can reduce the acidity or reverse the effects of acidification. It was hypothesized that each of the different tanks will start with a pH of 8.0 units. The container with seagrass is predicted to increase the pH 0.25 units by the end of the experiment, resulting in a pH of 8.25. The container with sea lettuce in predicted to increase the water level 0.15 units, ending at 8.15. The last of the containers, containing both seagrass and sea lettuce is thought to have an overall increase of 0.20 units in pH with the outcome of 8.20 pH units. This hypothesis was incorrect because the containers started off with a pH significantly above 8.0 units.

The control tank's pH did not show any consistency or pattern throughout the trials conducted. The pH of just plain ocean water would increase and drop significantly, as much as 0.3 unit fluctuation. However, the containers with plants showed an increasing trend in the pH values throughout the trials conducted. The pH of tanks with plants would sometimes read lower than the control but was much more predictable as it followed a gradual inclining pattern.

The other variables measured were sanity variables. These variables were measured to make sure this water matched the natural environment of a coral reef, where ocean acidification is having most effect. All of the sanity variables: salinity, specific gravity, calcium level, and temperature stayed in the natural levels for the most part. Salinity varied from 32-39ppt and averaged 37ppt from all the data. This is just slightly over the natural salinity level of 35ppt. The temperature of a coral reef is normally warm water, between 23.3-28.8 degrees Celsius. The temperature readings in this experiment were within this range. The average calcium level from all the tests is 452ppm. This is also slightly above the natural level of 420ppm, but as researched, higher calcium level provides no harm where as lower calcium level can be fatal to an ocean ecosystem. Because all of the sanity variables stayed within the range required, the data and conclusions is representative of a coral reef environment.

Since seagrass and sea lettuce both reduce acidity (increase pH), these plants could be used to buffer the effects of ocean acidification on coral reefs. The coral reefs are getting hit the hardest right now and if decreasing the carbon dioxide emissions in the atmosphere is not convenient enough, growing seagrass and sea lettuce is the other best alternative. If seagrass beds and sea lettuce fields were to be propagated near/in coral reefs by marine biologists, this would slow down and perhaps even stop ocean acidification from destroying yet another reef.

Example: **Recommendations** (this would normally be on its own page and 1.5 spacing)

This experiment had its strengths and some challenges. Throughout testing, five different variables were measured: pH, salinity, specific gravity, temperature, and calcium level. These variables were sufficient for the purpose of this experiment but if more variables were measured the data would be even more accurate. If one was to measure alkalinity, magnesium, phosphate, and ammonia in addition to the variables measured in this experiment, this would allow even more accuracy. The main variable in this experiment was measuring the pH. Therefore it would be more beneficial to use a pH monitor that detected up to the thousandths place. This would provide more accuracy, and even the slightest changes in pH would be recorded.

In this experiment, the light on the aquariums was turned on in the morning time and turned off in the night, however no specific time. It is recommended that one would say turn the aquarium light on at 7:00 am and turn it off at 5:00 pm. This would prevent the plants from getting more light on some days than others, and would be more consistent.

For this experiment, the data was recorded at various times in the day. If the data was to be recorded at the same time every day, it would be more consistent, and the graph would be able to represent the data spaced by twenty-four hours. It would also avoid from creating confusion in the temperature variable because it was observed that when the data was recorded earlier in the day, the temperature was slightly lower. This is because the light bulb had been on for less time, but when the graphs are generated, the time of day the data was recorded is not indicated. Therefore, it looks like a drop in temperature all of a sudden. Recording the data at a consistent hour would avoid these misinterpretations.

Another aspect of this project that could be done differently is the time span of a trial. The trials in this experiment ran for fourteen day, or two weeks but perhaps someone else could increase the time span of a trial to a month. This would be able to illustrate the pH increase after the two week mark of whether it continues increasing at this rate or stabilizes.

A final revision of this experiment would be to use bigger testing containers. This experiment was preceded in one gallon containers. It would be interesting to see if the pH increase rate is the same for a two gallon or even five gallon container with the same concentration of plants. Even though there are places this experiment can be revised, it is evident that this experiment was conducted well enough to form a solid conclusion.

(additional examples! remember 1.5 spacing is always used, these examples are for writing)

Conclusions

The oceans are an essential part of human life. More than 70% of the Planet Earth is comprised of ocean water. The oceans serve as a source of transportation, provide food, and produce more than 50% of the oxygen in the atmosphere. However, the much resourceful oceans are being destroyed by the process of ocean acidification. When the excess CO_2 in the atmosphere is absorbed into the oceans, the water becomes more acidic and this is known as ocean acidification. The acidic ocean water does not allow for calcification to occur, which means coral reef formation and shelled animal growth are endangered. As the process of ocean acidification progresses, the entire ocean ecosystem is at risk of becoming unstable and potentially extinct over time.

In this experiment, seagrass and sea lettuce were tested in tanks filled with ocean water to determine if these plants can reduce the acidity or reverse the effects of acidification**. It was hypothesized that each of the different tanks will start with a pH of 8.0 units. The container with seagrass is predicted to increase the pH 0.25 units by the end of the experiment, resulting in a pH of 8.25. The container with sea lettuce in predicted to increase the water level 0.15 units, ending at 8.15. The last of the containers, containing both seagrass and sea lettuce is thought to have an overall increase of 0.20 units in pH with the outcome of 8.20 pH units.** This hypothesis was incorrect because the containers started off with a pH significantly above 8.0 units.

The control tank's pH did not show any consistency or pattern throughout the trials conducted. The pH of just plain ocean water would increase and drop significantly, as much as 0.3 unit fluctuation. However, the containers with plants showed an increasing trend in the pH values throughout the trials conducted. The pH of tanks with plants would sometimes read lower than the control but was much more predictable as it followed a gradual inclining pattern.

The other variables measured were sanity variables. These variables were measured to make sure this water matched the natural environment of a coral reef, where ocean acidification is having most effect. All of the sanity variables: salinity, specific gravity, calcium level, and temperature stayed in the natural levels for the most part. Salinity varied from 32-39ppt and averaged 37ppt from all the data. This is just slightly over the natural salinity level of 35ppt. The temperature of a coral reef is normally warm water, between 23.3-28.8 degrees Celsius. The temperature readings in this experiment were within this range. The average calcium level from all the tests is 452ppm. This is also slightly above the natural level of 420ppm, but as researched, higher calcium level provides no harm where as lower calcium level can be fatal to an ocean ecosystem. Because all of the sanity variables stayed within the range required, the data and conclusions is representative of a coral reef environment.

Since seagrass and sea lettuce both reduce acidity (increase pH), these plants could be used to buffer the effects of ocean acidification on coral reefs. The coral reefs are getting hit the hardest right now and if decreasing the carbon dioxide emissions in the atmosphere is not convenient enough, growing seagrass and sea lettuce is the other best alternative. If seagrass beds and sea lettuce fields were to be propagated near/in coral reefs by marine biologists, this would slow down and perhaps even stop ocean acidification from destroying yet another reef.

Recommendations

This experiment had its strengths and areas that could be modified if done again in the future. Throughout testing, five different variables were measured: pH, salinity, specific gravity, temperature, and calcium level. These variables were sufficient for the purpose of this experiment but if more variables were measured the data would be even more accurate. If one was to measure alkalinity, magnesium, phosphate, and ammonia in addition to the variables measured in this experiment, this would allow even more accuracy.

The main variable in this experiment was measuring the pH. Therefore it would be more beneficial to use a pH monitor that detected up to the thousandths place. This would provide more accuracy, and even the slightest changes in pH would be recorded.

In this experiment, the light on the aquariums was turned on in the morning time and turned off in the night, however no specific time. It is recommended that one would say turn the aquarium light on at 7:00 am and turn it off at 5:00 pm. This would prevent the plants from getting more light on some days than others, and would be more consistent.

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A final revision of this experiment would be to use bigger testing containers. This experiment was preceded in one gallon containers. It would be interesting to see if the pH increase rate is the same for a two gallon or even five gallon container with the same concentration of plants. Even though there are places this experiment can be revised, it is evident that this experiment was conducted well enough to form a solid conclusion.

Additional Parts to Complete

These are completed after the project has been completed.

1. Abstract (goes after the title page in your notebook)

2. Acknowledgements: A short "Thank You" to the people that helped you

3. Forms: There are 2 or 3 "official" forms you'll need to complete for submitting your project to the fair. I'll provide them closer to the final deadline in January.

4. Powerpoint PDF. This is for the pre-judging prior to the actual city fair. This is required the first of January and is a summary of your project . There are only 13 slides, so be SURE to follow what is specifically on the pages.

5. Your backboard. This is SOOOOO Important. I will provide lots of examples, PLUS there are photos of boards on line. Be SURE to check them out before you start building your board. It will need to be completed by Mar 1

Greater San Diego Science and Engineering Fair (abstract format!)
2018 PROJECT SUMMARY

Name:

Grade: 8 **School: Marshall Middle School** **Advisor: Mrs. Gillum**

Project Title:

Abstract

Objectives/Goals

Hypothesis

Methods/Materials

Results

Conclusions/Discussion

Summary Statement

Help Received

Writing Your Abstract

Objective or Goal:
State the objective, goal, or hypothesis upon which the project is based. Example: My objective was to learn if the feeding habits of hummingbirds are affected by color.

Materials and Methods:
Indicate the materials, methods, and experimental design used in your project. Briefly describe your experiment or engineering methods.

Results:
Summarize the results of your experiment and indicate how they pertain to your objective.

Conclusion/Discussion:
Indicate if your results supported your hypothesis or enabled you to attain your objective. Discuss briefly how information from this project expands our knowledge about the category subject.

Example

The Frequency of Antibiotic Resistant *E. coli* in Alimentary Tracts
Objective: The objective is to determine if the average American has ampicillin- and tetracycline-resistant strains of *E. coli* in their alimentary tract.

Materials and Methods: Informed consent was obtained from 100 randomly selected people, 50 men and 50 women ranging in age from 10 to 92 years. An isolate of *E. coli* was obtained from the stool of each subject and grown in the presence of tetracycline and ampicillin. The area of inhibition was measured and compared to that of a non-resistant strain of *E. coli*. The percentage of sensitive and resistant organisms was determined by age and sex.

Results: Thirty percent of the men and 24% of the women were found to have ampicillin-resistant *E. coli*. The majority of the sample population was found to be under the age of 50. Slightly more people age 50 and over were found to be resistant than those under 50. Only 12% of both men and women were found to have tetracycline-resistant *E. coli*, with the older population again having a somewhat higher incidence of resistance.

Discussion: Penicillin and its derivatives such as ampicillin, were the first commercially available antibiotics. Tetracycline was introduced later. The length of exposure to the antibiotics is reflected in the greater percentage of subjects with ampicillin-resistant *E. coli* (24% to 30%), compared to those with tetracycline-resistant organisms (12%). In addition, subjects age 50 and over who would have a longer life-time exposure to both antibiotics were more likely to harbor antibiotic resistant *E. coli*. These data suggest that antibiotics should be carefully dispensed and monitored by health care professionals.

For examples of good abstracts, go here: http://www.usc.edu/CSSF/Current/Awards/

SF Backboards: Displaying your hard work!

Backboard: Summary
This comes directly from the San Diego Science Fair Website: "The display is essentially a compromise of content versus time. Ideally, it should stand on its own, describing the major elements of the project and should be easily read from 3 feet away. If logically and neatly organized, it should require no more than sixty seconds reading time. While appropriate graphs, photographs, illustrations and equipment displays are encouraged, gimmicks (e.g., flashing lights) are not. If, after reviewing the display, you feel confused rather than hungry for more, it has not served its primary purpose -- but keep in mind that it is only a small part of the overall project."

The Basics
Each student will construct a display.
This display will be set up at the fair along with the Science Fair Notebook and any equipment the student may wish to display.
The backboard briefly summarizes the problem, hypothesis, procedures, results, and conclusions.

The Board
The board itself is preferably made out of cardboard or foam-board.The display is 3-sectioned and self-standing.
You can buy these at Art & Office stores (Michaels, Staples) for around $6.On the board, you may ONLY attach paper, poster paper, cardboard or fabric --> so no electronics or samples of your materials.
Board Size:

Maximum width	4 feet (122 cm)
Maximum depth	2.5 feet (76 cm)
Maximum height	6.5 feet (198 cm) (table) 9 feet (274 cm) (floor)

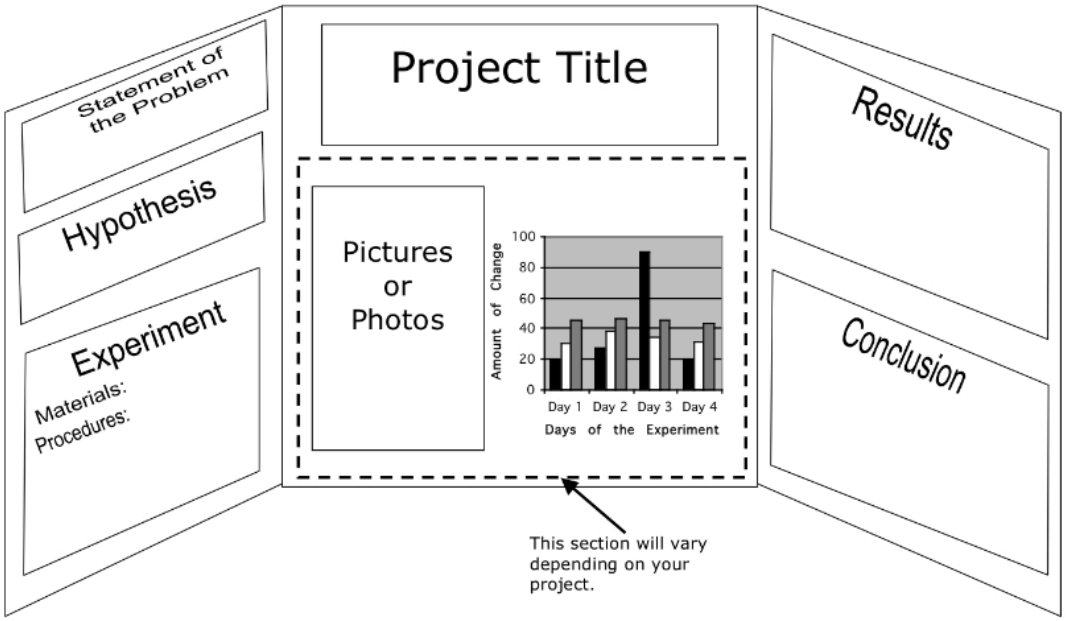
Attachments
The final Science Project Notebook is attached by at least 2 feet of thin rope to the lower left portion of the MIDDLE DISPLAY section.
I will provide this at the school SF open house.
The name of the student, school, and science teacher's name should be clearly written on a 3x5 card and adhered to BACK of Right top CORNER

What do I include on my backboard?
First, you need a title. Come up with a catchy question or title that will grab everyone's attention and say "That board sounds cool, lets go check it out!"
Then, attach summaries of the following: Statement of the Problem/Purpose, Hypothesis, Materials/Procedures, Variables & Controls Results: photographs/art, graphs, and data tables, results/discussion, Conclusions.
All written work, graphs, and tables must be computerized and professional looking, with perfect spelling.
Do NOT put your name anywhere on the board.
Do NOT put any direct face photos on the board.

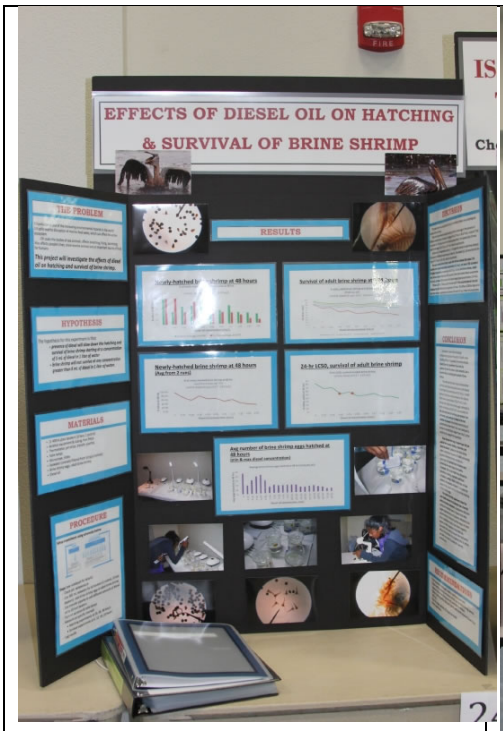
Tips & Tricks
The parts are only summaries; the judges can refer to your notebook for the specific details.
Thoroughly edit and spell-check each of these "parts"
When checked, print out the documents using a relatively large font, about 16-22 size. The boards should be easy to read, from about 3 feet away.
Cut everything with a paper cutter.
Place each part on a colorful piece of paper, making a "frame". Colorful cardstock (available at Michaels) is great
Should you have extra pieces, you can stack them behind each other and lift up to read more.
When you have all of your parts ready to go, arrange your parts on the board.
Test out a few different layouts.
Don't glue the parts down until they are all perfect and you have a clean-looking layout that looks nice.
Feel free to include relevant, professional-looking graphics and/or stickers to spice it up.
Use a gluestick to paste the work on your board – white glue makes it look clumpy and double sided tape doesn't usually last very long.

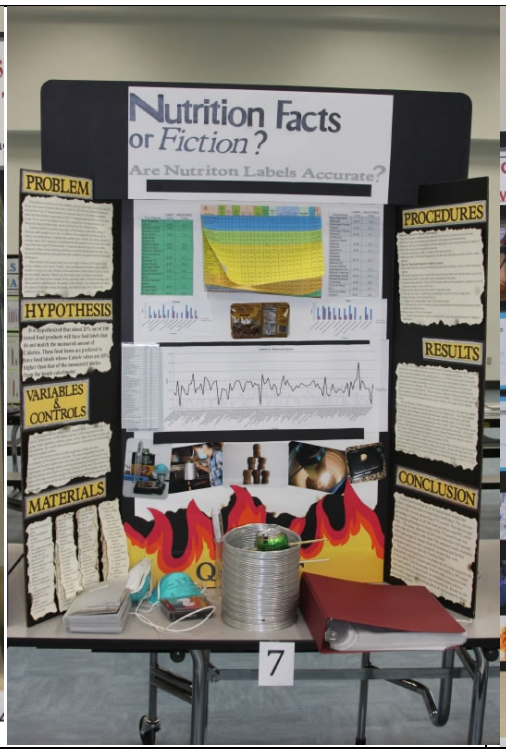
Selling yourself!
The goal of the backboard is to grab the judges' attention. Think of it as an advertisement, briefly showing off your hard work. Ideally, the judges should look at it, understand the main concepts and results of your experiment, but want to learn more! Then, they'll go for your notebook where the real goods are!

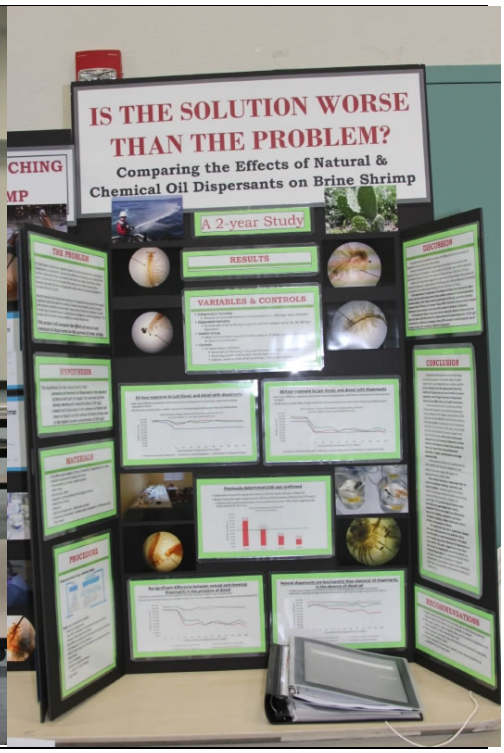
Sample Science Fair Display Board



Be sure to include Variables & controls in the experiment section







How to Survive Science Fair Without Losing Your Mind! A Parent's Guide

Parents: please email me tonight, so that I can create the "parent" email address book. My email is: mrsg9064@aol.com DO NOT USE THE SCHOOL EMAIL ! Thanks!!

Deadlines: **Research paper** DUE June 1: By email and by hard copy**. Graphic Organizer** DUE by email only June1
This is the only deadline that we are covering tonight. All other deadlines are on the "Time-line" page in the notebook.
DO NOT SAVE WORK AS A PDF. I can't type corrections on to pdfs.

What PARENTS have to do to help :

Proof read ALL of your student's writing. THIS IS CRITICAL. There are more than 55 science fair students. What will be sent to me are their final papers. Writing that has misspellings, directions not followed, ANY you's /me's, poor sentence and paragraph structure ect. will result in them not passing this writing assessment, and being dropped from the advanced science fair program. **Key things to watch for and correct:**

1. Be sure the paragraphs are only 5-7 sentences NOT 9+ sentences or even longer
2. NO YOU'S, mes, wes, etc. They are NOT to use 3rd person either. They get 1 "experimenter" used in the hypothesis.
3. A sentence **should NOT have more** than 20 words, or less than 7.
4. Do not start sentences with the words: But, So, Also, And, Well
5. Spell check, spell check, spell check. There should be NO misspelled words in this document.
5. NO parenthesis: ( ) NO semi-colons: ; No double spacing between paragraphs.
7. ALL typing is 12pt, Times New Roman. Footnotes are 10 pt font. Everything on the graphic organizer is single spaced, everything on the final paper is 1.5 spacing- EXCEPT the footnotes that are 10 pt font and single spaced.
8. Footnotes should total no more than 7. They are specifically to be used for the previous experiments. All other work is simply listed in the bibliography (in addition to the footnotes also being in the bibliography). PLEASE follow footnote and bibliography formatting as shown on the graphic organizer.

Graphic Organizer:
Your student has received a notebook that has examples of each of the sections. Be sure to review it so you know what I am expecting, and the type of writing for each of the sections. If I say 3 paragraphs, I mean 3 paragraphs not 2. I tried to be as specific as possible, so the students have a very clear understanding of what I want, and how I want it.

Parents, the research paper is where you are allowed to help, but PLEASE DO NOT rewrite. The students need to master this upper level of writing if they are to complete this project successfully. They have never been taught this type of writing, at this level, so they are going to struggle. I can guarantee that by the end of the project, their writing ability will be at high school level, but this first document is going to be tough. Encouragement to them, will be greatly needed, and appreciated!

POWERPOINT PRESENTATION FOR CITY JUDGING

You are allowed 12 full page cards with specific information on them. PLEASE follow this guideline example.

Card 1:
Title of Project
Picture pertaining to Project

Your Name/ Grade
Marshall Middle School /Mrs. Gillum

Introduction / Statement of the Problem/Purpose

- Utilize your introduction from your research paper for paragraph 1: The Introduction
- Edit your statement of the problem to fit as paragraph 2: Statement of the Problem
- State your Purpose in paragraph 3.
- Put ALL 3 of these items on this page using 12pt times new roman type, that is also single spaced.
- Remember your 5 sentence paragraph structure!

Pg3

Research Paper: Previous experiments

- Utilize 3-4 of your previous experiments, presenting the information, and then how this experiment helps you with your current project (just exactly as you have already written)
- You're simply going to put 3 of the 6 on this page. 12pt, single spaced. You are going to have a numbered bibliography as the last page. Place the source number instead of a footnote after the previous experiment and before your analysis.
- You only get this card, so make your choices count.

Pg4

Core Science

- You get this 1 page to put the most important core science on this page. 12 pt, single spaced.

Pg5

Hypothesis

- You get this 1/2 page to put your hypothesis on. 12 pt, single spaced.
- My suggestion would be to use your hypothesis from your research paper with your validation. Be sure to **BOLD** your actual hypothesis with the numbers.
- **Materials:**
  You get this 1/2 page to put your material list on. Use 2 columns 12 pt, single spaced.

Pg6

Procedures

- 12 pt, single spaced bullet points.
  NO SPACING between steps.
  You only have this page, so make your procedures fit. Use drawings/small photos if you can get them to fit in this space

Pg7

Observations & Results

- Here is where your put your written observations/ and results. Single space, remember paragraph structure, 12 pt font.
- You only get this 1 slide for discussion.
  Make sure you use it well.

Pg8

Data Tables / Graphs Summary

- This is going to be a tough section to condense to just 3 cards.
  I think you can get 2 data tables and 2 graphs if you divide the page into ¼'s.
- Use 10pt type for the data tables, and use summary graphs .
- You want to do your best at showing your results so the reviewers can see what you discovered.

Pg9

Data Tables / Graphs Summary

Pg10

Data Tables / Graphs Summary

Pg11

Conclusions / Recommendations

- ¾ of this space is for your conclusions.
- 12 pt, single space.
- Include your analysis and what you learned.

- ¼ of this space is for recommendations.
- Simply summarize in 5 sentences what you would suggest for further studies, and how you might improve your project.

Pg12

Bibliography

- NUMBER your alphabetized list.
- Take your perfect research paper bib, and number it (so that your can refer to those sources you used in your previous experiments). and simply paste it to this card. You may use 1-2 more cards if you have to. Be sure the font size is 12 pt. Single space within the source, 1.5 spacing between.

JUDGING DAY

To Bring to the city science fair: Your ID Lanyard, Your ORIGINAL data that is in your composition book. Leave only a Xerox at the setup. A Chair, (ladies- don't bring a low beach chair- they are too difficult to get up out of in a skirt/dress Bottle of water, Lunch- with your name on the bag A book
PHONES must be in your purse or back pocket, taken out ONLY for emergencies! NO texting, no games, no calls.
Ladies: you will wear a dress or skirt- NO scoop neck blouses, NO short skirts, NO heals
Gentlemen: you will wear long pants (NO JEANS) a shirt and a tie (bow ties are acceptable)

7:15 a.m. Meet at the Balboa Park Activity Center White Tent. **Note: NO food/drink OR OPEN CELL PHONES allowed in the exhibit area.** Be sure your sack lunch has your name/school written on the bag.
8:00 a.m. Orientation in White Tent
8:20 a.m. Students enter the hall. Set up chairs. Stand by your project. Be sure to smile! ☺ You may use the bathrooms in the front of the building, but be sure to hurry. You don't want to miss a judge's visit.
11:15 a.m. Students leave the hall and have lunch until around noon. They then return for afternoon professional judging AND SWEEPSTAKES JUDGING.

ELEMENTS OF A SCIENCE FAIR PROJECT

NOTEBOOK : Every project should have a notebook, a detailed written record of the scientific study. The contents should be specific and concise and should display the student's use of the scientific method. Among its contents should be an Abstract, Hypothesis (or, in the case of engineering and computer projects, Statement of Goals), Procedures (showing sufficient repetition of tests/experiments), Results, Conclusions, Recommendations, Bibliography and Appendix (tables, figures, raw data). Additional sections may include an Introduction, Background Information, Nomenclature, Statement of Theory, Statistical Analysis and other topics specific to the individual project. Although you will not be able to thoroughly examine every notebook, you will find it helpful to check the contents at least briefly.
DISPLAY/BACKBOARD: The display is essentially a compromise of content versus time. Ideally, it should stand on its own, describing the major elements of the project and should be easily read from 3 feet away. If logically and neatly organized, it should require no more than sixty seconds reading time. While appropriate graphs, photographs, illustrations and equipment displays are encouraged, gimmicks (e.g., flashing lights) are not. If, after reviewing the display, you feel confused rather than hungry for more, it has not served its primary purpose – but keep in mind that it is only a small part of the overall project.
INTERVIEW WITH THE EXHIBITOR: A genuine interest in the student's work, coupled with the determination to make judging a positive learning experience, is a good formula to use here. The interview a) allows students to present their work in their own way, b) permits the judges to, by asking specific questions, review the work done and determine the student's understanding of the field and c) encourages verbal communication between exhibitors and judges.
Ideally, exhibitors will be well organized, familiar with their field of study, relatively composed, courteous and eager to learn. Please remember, however, that for many young exhibitors this is their first experience in a pressure situation. The importance of a positive approach cannot be over-emphasized. Your own maturity will prove a valuable tool in drawing out theirs.

Questions you WILL BE ASKED during the Interview

1. How did you get this idea? Where was your project done?
2. What was the most interesting background reading you did? How does your project differ from others you researched?
3. Which are your control factors? Your variables? What is/are the difference(s) between your control & experimental groups(s)?
4. Where did you get you animals (bacteria, plants, etc.)?
5. What skills did you acquire to do this project?
6. What help did you receive from others (students, adults, teachers, family, etc.)?
7. How many times did you repeat this experiments and what changes, if any, did you make?
8. Why did you choose the statistical test used and what do your results mean?
9. Explain this graph to me.
10. What is the most important thing you found out in doing this experiment? What changes would you make if you continued this project
11. What application does this project have to your/my life?
14. How does this experiment conform to the scientific method?
15. What experimental errors are in your project and how did you correct for them?
16. How did you determine the sample size to be used?
17. Explain your procedure to me.