

Ann's Scientific Inquiry Investigation Steps to a Successful STEM Project

Introduction:

This document will step you through the process of a scientific inquiry investigation. It starts with finding a topic and ends with the final steps. Ann also wanted to enter the Science and Engineering Fair of Houston. Follow along with her as she steps through Scientisteer. Ann used the information from the link to help her plan her project.

<https://www.sefhouston.org/sites/sefh/files/docs/2016%20Info%20For%20Students%20Doing%20Projects%20Which%20May%20Be%20Entered%20Into%20SEFH.pdf>

Follow along with her as she steps through Scientisteer.

These are the steps Ann followed in doing her project.

1. Register on Scientisteer.
2. Select a topic and get approval.
3. Set up her logbook.
4. Do research and create bibliography.
5. Compile research question (problem) and hypothesis.
6. Read all the rules related to her topic. Run her project through ISEF's Rules Wizard <https://apps2.societyforscience.org/wizard/index.asp> to confirm paperwork needed.
7. Do her experimental design for the project
8. Do a rough draft of her research plan in a word document to be transferred into Scientisteer when finalized.
9. Complete forms 1A and B in Scientisteer, also any other forms that would need to be completed would be done at this time. Choose a category using the Project Category Definition document to make sure that the research is in the right section..
10. Get approval to move forward with her experiment if SRC is needed.
11. Conduct her experiment
12. Prepare final research paper
13. Prepare and upload abstract to Scientisteer.
14. Once she is certain she has no more changes to her Scientisteer information she will then finalize. If she is not sure she will wait until she is confident that there will be no more changes to her title, category selection or her paperwork.

Finding a Topic:

Ann was tasked with doing an inquiry investigation. One of the hardest parts of doing this was finding a topic. The teacher provided a *Topic Information Sheet* that helped her narrow her interest. Once she decided that she wanted to do something with plants she used *The Four Question Topic Selection Strategy*. to help her narrow it down. She also used the *Introduction, Pointers and Checklist* handout.

Ann's Research:

Ann researched the conditions and time it took for jalapeno peppers to produce from transplants. She learned that they took 60-80 days. She based her decision to end her experiment at 60 days. Soil microbial enhancers were also researched. Ann wanted to make sure that she purchased the type that would increase plant production. Her last line of research involved growing plants in containers. She looked for pointers and things to avoid. Her research leads her to the conclusion that the design of her project would work. Ann used the **Research-the Next Step** guide to help her. She found the following websites that might help her as she did her investigation.

Metric conversion charts:

<http://curezone.com/conversions.asp>

<http://www.fitnessandfreebies.com/conversions.html>

Material and Data Safety information:

www.msdatearch.com

Graphing Tools:

<http://nces.ed.gov/nceskids/createagraph/default.aspx>

MSDS Forms:

<http://www.msdssearch.com/>

<http://www.flinnsci.com>

<http://www.ilpi.com/msds/index.html>

Rationale:

Ann decided that she would use jalapeno pepper plants because they were easy to grow, and her family liked to use them in cooking. She read an article about using soil enhancers to get better production from plants, especially those grown in containers. She wondered about the cost of the enhancers versus the yield from the plant. Her teacher told her to follow the directions for a rationale found on the Houston Science and Engineering Fair website.

RATIONALE: Include a brief synopsis of the background that supports your research problem and explain why this research is important and if applicable, explain any societal impact of your research.

Ann's Research Plan Rationale:

Jalapeno peppers are a favorite for cooks to use everywhere. They are easy to grow from home. Many people that like them do not have yard space but would like to grow them in containers. This can work if the containers have a good quality of soil.

One of the ways to improve soil in containers is to add a microbial soil enhancer. These can be expensive, so do you have to use the recommended amount in the container to get a good harvest of peppers? This experiment will determine if you can use less of a soil enhancer and still get the same results. This could encourage more people to garden in containers.

Summary of Ann's Project: Enhancing Jalapeno Pepper Production

Ann investigated the effect of different concentrations of a soil microbial enhancer on the production of jalapeno pepper plants. Ann hypothesized that if higher concentrations of the soil enhancer were applied, then the plants would produce more peppers.

1. She grew 4 flats of jalapeno pepper plants, 10 plants per flat for 5 days to get them use to their environment.
2. She then applied the soil enhancer as follows:
 - a) Flat 1: 0% Soil Enhancer, the control
 - b) Flat 2: 10% Soil Enhancer
 - c) Flat 3: 20% Soil Enhancer
 - d) Flat 4: 30% Soil Enhancer-the recommended amount.
3. The plants received the same amount of sunlight and water each day. The flats were all the same size.
4. Peppers that ripen and were ready to be picked before the 60 days was up were picked at 10-day intervals.
5. At the end of 60 days Ann recorded the health of the plants (healthy/thriving) the number peppers and the quality of the peppers using a three-point scale. Ratings on the pepper quality scale were defined as follows:

Rating	Description
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Rating of 3	Green color to red color fleshy and firm larger size
Rating of 2:	Green color medium size firm and somewhat fleshy
Rating of 1:	Green color small pepper not fleshy

**Ann's Data
Enhancing Jalapeno Pepper Production**

Number of peppers per plant				Health of Plants				Pepper quality			
Concentration of Soil Enhancer				Concentration of Soil Enhancer				Concentration of Soil Enhancer			
0%	10%	20%	30%	0%	10%	20%	30%	0%	10%	20%	30%
7	10	12	16	H	H	H	T	2	3	4	4
8	9	10	16	H	H	H	T	3	2	3	4
7	12	14	16	H	H	H	T	3	2	3	4
9	8	10	14	H	H	T	H	2	3	4	4
8	6	8	15	H	H	H	T	2	3	4	4
6	6	8	14	H	H	T	T	2	2	2	4
8	9	10	16	H	H	T	H	2	3	4	4
7	8	10	13	H	H	T	T	3	3	4	4
10	10	11	15	H	H	T	T	1	3	4	4
7	11	12	16	H	H	H	T	2	2	3	4

Peppers Harvested per Flat by Days of Growth

Days Numbers	Flat 1	Flat 2	Flat 3	Flat 4
Days 1-10	0	0	0	0
Days 11-20	0	0	0	0
Days 21-30	0	0	0	0
Days 31-40	0	0	1	3
Days 41-50	5	4	10	13
Days 51-60	72	85	96	135
Total	77	89	107	151

Ann's Research Plan for Scienteer

Ann decided the best way to get her information into Scienteer was to write it out as a word document and then cut and paste it in after it had been reviewed by a parent and teacher. She went to the rules wizard on the Intel Science and Engineering Fair Site to make sure she would have all the correct forms.

<https://apps2.societyforscience.org/wizard/index.asp>

The Research Plan/Project Summary should include the following:

RATIONALE: Include a brief synopsis of the background that supports your research problem and explain why this research is ^{ISEP}important and if applicable, explain any societal impact of your research. ^{ISEP}

Ann's Rationale:

Jalapeno peppers are a favorite for cooks to use everywhere. They are easy to grow

from home. Many people that like them do not have yard space but would like to grow them in containers. This can work if the containers have a good quality of soil. One of the ways to improve soil in containers is to add a microbial soil enhancer. These can be expensive, so do you have to use the recommended amount in the container to get a good harvest of peppers?. This experiment will determine if you can use less of a soil enhancer and still get the same results. This could encourage more people to garden in containers.

RESEARCH QUESTION(S), HYPOTHESIS(ES), ENGINEERING GOAL(S), EXPECTED

OUTCOMES: How is this based on the rationale described above? ^{ISEP}

Research Question: How will adding different concentrations of a soil microbial enhancer affect the production of jalapeno pepper plants?

Hypothesis: If higher concentrations of the soil microbial enhancer are applied, then the plants would produce more peppers.

Describe the following in detail:

Procedures: Detail all procedures and experimental design including methods for data collection. Describe only your project. Do not include work done by mentor or others.

Procedure:

1. Obtain 4 flats of jalapeno pepper plants, 10 plants per flat. All the plants should look similar in health and size. Make sure that each flat will allow for growth and is the same size with the same type of soil.
2. Place the flats in a space where they receive the same amount of sunlight, wind and the same temperature. They will be watered the same amount and on the same day. If one group dries out more then they will be given additional water and it will be recorded.
3. Grow them for 5 days so they can get use to their environment.
4. Mix up the soil enhancer with water as it says on the directions. The following percent's will be used-10%, 20% and 30% (the recommended amount).
5. Apply the soil enhancer as follows: a) Flat 1: 0% Soil Enhancer; b) Flat 2: 10%, c) Flat 3: 20% Soil Enhancer; and d) Flat 4: 30% Soil Enhancer-the recommended amount. The applications will be made as the directions state.
6. Make observations and record data for 60 days. Peppers will be harvested at 10-day intervals if they ripen early.
7. At the end of 60 days record the health of the plants (healthy/thriving), the quality of the peppers using a three-point scale, how many flowers and peppers are present.
8. Garden gloves will be used when handling the jalapeno peppers.

Risk and Safety: Identify any potential risks and safety precautions needed.

Ann's Risk and Safety Evaluation.

Ann reviewed the questions in Scientist about her project. She found that if a project had microbes in it there may be special safety rules and forms that would need to be filled out. She went to the rules and guidelines and found out the type of microbes she was using were exempt from the paperwork. She was not culturing, or growing bacteria and it was what would be found in soil.

The only safety consideration Ann had was dealing with the jalapeño peppers. She added here that she will wear gardening gloves when handling the peppers.

Data Analysis: Describe the procedures you will use to analyze the data/results. [L] [SEP]

Ann's data will be both qualitative and quantitative. She wrote the following for her research plan. **Go to Describing Ann's Data to get details on how she came up with the descriptions below.**

Quantitative data: The number of peppers and when they were picked will tell if the soil enhancer affected pepper production. If the pepper is not intact it will not be counted. The number of peppers per flat in 10-day intervals will be collected along with the number produced by individual plants. This data will show if the soil enhancer increased pepper production. The measures of central tendency used will be the mean, median and mode value of each concentration. These calculations could be significant in the final data analysis. The levels of variation used will be the range and frequency.

Qualitative data: The overall health of the plant will be an indicator if the soil enhancer will work. This will be done by using healthy or thriving. If a plant dies a value of 0 will be given. The quality of the peppers will be measured on a 1-3 scale. The soil enhancer should produce higher quality peppers. The following scale will be used:

Rating	Description
Rating of 3	Green color to red color fleshy and firm larger size
Rating of 2:	Green color medium size firm and somewhat fleshy
Rating of 1:	Green color small pepper not fleshy

Ann will use the same measures of central tendency and variation for this set of data.

BIBLIOGRAPHY: List major references (e.g. science journal articles, books, internet sites) from your literature review. If you plan to [L] [SEP] use vertebrate animals, one of these references must be an animal care reference. [L] [SEP]

Ann will use the format that the teacher requires. She will have 2 plant books and 3 internet sites.

Links that Ann can use to help her site her project.

APA

<https://owl.english.purdue.edu/owl/resource/560/01/>

MLA

<https://owl.english.purdue.edu/owl/resource/747/2/>

After Ann completed her research plan she then went back to Scienteer to put her information in and complete the other forms. She will wait to finalize in Scienteer until the teacher tells her it is time.