

Final Project - Agriscience

First & Last Name: _____ Period/Hour: _____

Overview: you will design an experiment to explore a topic related to agriculture, the environment, or life sciences. Your goal is to create a proposal for a new, valuable, and worthwhile investigation. Approval of your project will depend on its alignment with real-world phenomena, its feasibility, and its potential to produce meaningful data.

Schedule

- Part 1:** Introduction - Preparing Your Proposal
- Part 2:** Proposal Presentation, Feedback, & Revisions
- Part 3:** Data Collection
- Part 4:** Data Analysis
- Part 5:** Presentation Preparation
- Part 6:** Symposium (Present Results & Findings)



[Image source](#)

Part 1: Introduction – Preparing Your Proposal

Overview: Use the questions below as a guide to choosing a study subject for your group.

Research Question - *What are we wondering? What do we want to figure out?*

SEP: Asking questions (for science) and defining problems (for engineering).

1. Brainstorm five questions for your group's research project. Remember, a good question is specific, testable, feasible, original (*i.e.*, the outcome is not known), and scientifically meaningful.

1. _____
2. _____
3. _____
4. _____
5. _____

Hint: you could modify the protocols for investigations such as leaf disk photosynthesis or yeast cellular respiration from previous packets to test how changing one factor (the temperature, pH, salinity, light color, etc.) affects the outcome.

2. As a group, decide which of the following topics you intend to do as a project. Circle it above. Then meet with your instructor to get their initial approval to proceed with this as your topic.

This topic has initial approval _____ (instructor signature)

Hypothesis, Rationale, Variables, etc. - Make a testable prediction based on evidence.

SEP: Planning and carrying out investigations; Developing & using models.

3. Turn your **research question** into a **hypothesis**. A hypothesis is like a guess or a prediction – it is how you would answer your research question based on your existing knowledge. Fill in the blanks below:

We predict that _____

4. Now provide a **rationale** for your hypothesis. A rationale states why you think your hypothesis might be right; it provides some evidence and/or logic that supports the validity of your hypothesis.

We think this because: _____

Note: it's totally ok if your hypothesis ends up being wrong. Either way we'll gain more info. We just need to take a stance for now.

5. Every experiment has two important components: a **dependent variable** & an **independent variable**.

An **independent variable** is the thing you purposely changed to test your hypothesis and answer your research question. Generally speaking, an experiment should only have one independent variable.

What is your independent variable? _____

A **dependent variable** is what you measure to answer your research question and determine if your hypothesis is correct. You can have multiple dependent variables as long as they are relevant.

What is your dependent variable(s)? _____

6. A **control** is a part of your experiment that does not receive any treatment so that we have something to compare to. It enables us to confirm if what we changed had any impact on the outcomes.

In this experiment, what is your control? _____

7. **Sample size** and **trials** affect the validity of your findings. **Sample size** refers to how many points of data will be collected. **Trials** refer to the number of times you will repeat the experiment under the same conditions. The larger the sample size and the more trials you perform, the more reliable and valid your findings tend to be for answering your research question.

What is your sample size (how many points of data are being collected)? _____

How many trials will you have? _____ *How might your sample size and number*

of trials affect the reliability of your findings? _____

8. **Constants** are the conditions that are kept the same between the control & treated groups.

What is being kept constant in this experiment? _____

Methods & Materials - How did you test your hypothesis? SEP: Planning and carrying out investigations.

9. What materials do you need to test your hypothesis? Record these below. Be as specific as you can. Make sure your requests are safe, realistic, and feasible for a classroom setting.

We will need the following: _____

10. Summarize all of the steps needed to complete this experiment. Remember, your methods section should read like a recipe in a cookbook - you should provide clearly & concisely written steps that specifically outline everything that someone would need to do to repeat your experiment.

Part 2: Proposal Presentation, Feedback, & Revisions

Overview: When ready, meet with your instructor. Each group member should contribute to addressing the following questions:

1. What are you proposing for your research? Provide an overview and summary.
2. Summarize your specific research question, hypothesis, and rationale for this work.
3. How are you going to test your hypothesis and what do you need to accomplish this?
4. What do you expect to find and why is this worth doing? Who will benefit from this work?

Based on your presentation, your instructor will select one of the following options after you finish:

- _____ **Reject** - this proposal will not meet expectations; it is more feasible to start over than to modify it.
- _____ **Accept** - this proposal is completely acceptable as is and does not require any edits or modifications. You can begin your work using your proposed methods once your materials have been acquired.
- _____ **Revise & Resubmit** - this proposal has potential but needs revisions before it can be accepted. These changes should be summarized in the space below. Once the changes have been made, you will need to re-propose your project. If using the same document, indicate changes with a different color of ink.

_____ (instructor signature)

Part 3: Data Collection

Overview: You will carry out your experiment and collect data to answer your research question and address your hypothesis.

Results & Data - *What do our data indicate?*

SEP: Analyzing and interpreting data. Using mathematics and computational thinking.

Directions:

1. Use the space below to determine what data you will collect and how it will be organized (e.g., how will you set up a table to collect and organize your data?).
2. Carry out your experiment as described in your accepted proposal.
3. Record your data below.
4. Create a graph based on your data on the following page and provide a caption.

Results & Data - What do our data indicate?

SEP: Analyzing and interpreting data. Using mathematics and computational thinking.

Create a graph based on your instructor's guidance and the steps below.

1. **First, label each axis. The x-axis is horizontal (*back & forth*); the y-axis is vertical (*up & down*).**
 - a. Usually the independent variable (*what was changed*) is on the horizontal x-axis and the dependent variable (*what was measured*) is on the vertical y-axis.
2. **Next, determine the type of graph you are making.**
 - a. Bar graphs work well for comparing changes in quantities, while line graphs work well for comparing changes over time.
 - b. Each component should be labeled with the type of treatment (e.g., *treated* and *control*).
3. **Third, determine the scale (*range of numbers*) you will use on the y-axis (vertical axis).**
 - a. Determine your highest and lowest values for the data you will be graphing.
 - b. Your scale should be large enough to encompass all of the values of data but should also be small enough to make it easy to compare the differences in data.
 - c. Usually your scale starts at zero (but does not need to).
 - d. Values on the y-axis usually increase by the same amount with each line.
4. **Fourth, create a graph based on the data you collected.**
5. **Finally, create a caption that explains what kinds of trends and patterns are present in this graph. Then explain what these trends indicate for your research question and hypothesis.**
 - a. Often a caption includes phrases like “*This figure shows...*” and “*This suggests that...*”.

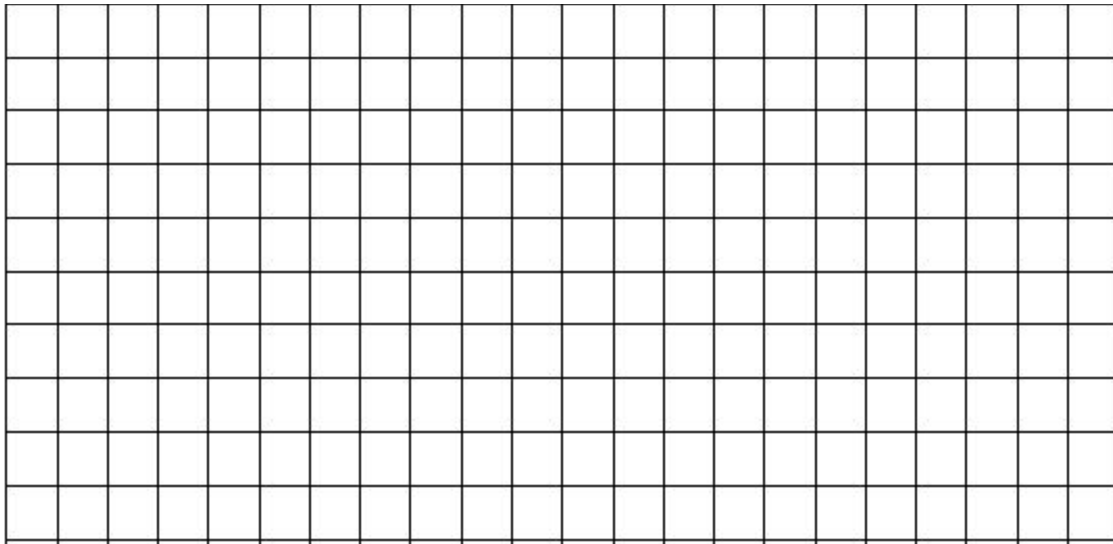


Figure 1: *This figure shows* _____

The key trend in this data is _____

This suggests that _____

Part 4: Data Analysis

Overview: You will determine whether your data support or refute your hypothesis, and develop explanations for how and why your treatment affected animal growth and development.

Discussion & Conclusion - *Is our hypothesis supported by our data? How does this relate to our research question? What conclusions can we reach based on this investigation?*

SEP: Constructing explanations & designing solutions. Making evidence-based arguments. Obtaining, evaluating, & communicating information.

1. Restate your hypothesis - *We predicted:* _____

2. Was your hypothesis supported by your data? Yes / No / Not sure (*circle one*).

3. How did your treated group differ from your control group? What might explain this outcome?

4. Explain your findings by describing what changes occurred at the molecular and/or cellular level.

5. How could you improve this experiment to have more valid and reliable findings in the future?

Part 5: Presentation Preparation

Overview: You will prepare a [presentation](#), [paper](#), or [poster](#) to communicate your findings to a general audience. Use these links to create your own copy. Your work should include all of the following components:

1. **Title** - Includes the subject of the study, the independent and dependent variables, and the outcome. Authors are listed alphabetically by last name below the title; include your school name.
2. **Introduction** - Present the study subject and a clearly testable RQ based on a real-world phenomenon. State your hypothesis and explain how it can be measured with data. Provide a rationale using models, credible evidence, or reasoning to explain the hypothesis. Identify and explain the relationship between the independent (IV) and dependent (DV) variables. Explain how changes to the IV affect outcomes in the system (DV).
3. **Background Information** - Summarize scientific concepts and information needed to understand the RQ and hypothesis. Use only credible and accurate sources, evaluating them for reliability. Properly cite sources in parenthetical format (Author, Year). Include visual aids, such as images or diagrams, to explain how cellular structures or molecular substances affect observed outcomes.
4. **Methods & Materials** - List all materials needed for the investigation. Summarize methods with enough detail for replication. Justify how the methods answer the RQ and test the hypothesis. Critique the limitations of your methods (e.g., sample size, relevance, authenticity). If using a model, simulation, or model organism, explain why it was chosen and how it represents a complex phenomenon.
5. **Results** - Provide all relevant data and observations from the investigation. Use graphs, tables, or charts with clear labels and captions to show trends and patterns. Include ratios, rates, percentages, or other mathematical analyses to interpret the data. Assess the validity and reliability of your data using statistical methods and/or comparisons with credible sources. Acknowledge limitations of the data in addressing the RQ and hypothesis.
6. **Discussion & Conclusion** - Restate your RQ and hypothesis, and explain whether the data support or refute the hypothesis. Use your data and evidence from credible sources to draw conclusions about the phenomenon. Identify cause-and-effect relationships and critique the strength of your evidence and conclusions. Propose a solution to a problem based on the data and evidence. Discuss alternative explanations or solutions.
7. **Reference List** - Provide an alphabetical list of all sources used in APA format (Last Name, First Initial. (Year). Title. Source). Ensure all sources are cited parenthetically (Author, Year) in the text where they are mentioned.

The following rubric will be used to evaluate your final presentation, poster, or paper.

1. Introduction	Criteria	Yes!!!	Kind of	Not Yet
1a	Create a testable research question (RQ) based on an authentic real-world phenomenon.			
1b	Develop a hypothesis based on the RQ that can be directly measured with data.			
1c	Provide a rationale for the hypothesis based on models, data, credible evidence, and/or reasoning.			
1d	Identify the independent variable (IV) & dependent variables (DV); explain the relationships between them.			
	Practices: Asking Questions, Planning & Conducting an Investigation, Crosscutting Concepts: Stability & Change	Total		/16
2. Background	Criteria	Yes!!!	Kind of	Not Yet
2a	Accurately summarize scientific information needed to understand the RQ and hypothesis.			
2b	Evaluate various sources of information and use only credible & accurate sources in project.			
2c	Properly cite all sources used in the project with both parenthetical <i>and</i> APA formats. Parenthetical: (Last Name, Year) APA: Last Name, First Name. (Year). Title. Source.			
2d	Communicate ideas effectively across multiple formats (written, visual, verbal, etc.).			
	Practices: Obtaining, Evaluating, and Communicating Information, Crosscutting Concepts: Structure & Function	Total		/16
3. Methods	Criteria	Yes!!!	Kind of	Not Yet
3a	Provide a detailed materials list summarizing all items needed for this investigation.			
3b	Summarize the methods so others could easily replicate the same experiment.			
3c	Explain how the methods specifically answer the RQ and test the hypothesis.			
3d	Critique the limitations of your methods (e.g., sample size, trials, authenticity, relevance to RQ, etc.).			
3e	If using a model, simulation, or model organism, summarize why it was chosen and how it effectively represents a more complicated phenomenon.			
	Practices: Planning & Conducting an Investigation, Crosscutting Concepts: Models	Total		/20
4. Results	Criteria	Yes!!!	Kind of	Not Yet
4a	Collect and analyze data and explain key trends and patterns across your data.			
4b	Create an effective visualization of your data (graph, chart, etc.) with labeled parts and a detailed caption.			
4c	Use mathematical functions (ratios, rates, percents, etc.) to make accurate conclusions about your data.			
4d	Assess the validity of your data using statistical methods (e.g., standard error) and/or by comparing with other credible sources of info & evidence.			
4e	Acknowledge and explain the limitations of your data and its ability to address your RQ and hypothesis.			
	Practices: Analyzing and Interpreting Data, Mathematics and Computational Thinking, Crosscutting Concepts: Patterns, Scale, Proportion, & Quantity	Total		/20
5. Discussion	Criteria	Yes!!!	Kind of	Not Yet
5a	Restate your RQ & hypothesis, and explain whether your data support or refute your hypothesis.			
5b	Use data and evidence from your investigation and other sources to support your conclusions about the phenomenon you investigated and identify cause-and-effect relationships.			
5c	Critique the strength of your evidence and conclusions and acknowledge their limitations.			
5d	Propose a solution to a problem using your data, evidence, and credible information.			
5e	Consider alternative arguments/explanations/solutions and use evidence to critique their validity.			
	Practices: Constructing Explanations, Evidence-based Arguments, Crosscutting Concepts: Cause & Effect	Total		/20
6. General	Criteria	Yes!!!	Kind of	Not Yet
6a	CS.1&2: Use scientific practices & critical thinking to systematically address a problem in AFNR.			
6b	CS.3: Use technology to find, organize, and create useful information in AFNR contexts.			
6c	CS.4: Use systems-thinking (molecular, cell, organismal, & ecosystem levels) to address AFNR problems.			
6d	Project is free of errors (factual, spelling, grammar, etc.) and reflects the work of adult professionals.			
6e	Students collaborated to evenly divide work, overcome obstacles, and effectively use time & resources.			
	Practices: Constructing Explanations, Evidence-based Arguments, Crosscutting Concepts: Structure & Function, Models, Patterns, Cause & Effect	Total		/20



Peer Review Form

Name: _____ Date: _____ Hour: _____

Directions: Please evaluate your group as well as yourself on the basis of contributions and effort on a scale of 1 to 5. A group member who makes an outstanding contribution and did their best would receive a score of 5. A group member who did the bare minimum would get a 3, and a group member who did nothing or almost nothing would get a 1 or 2. Provide a reason for your score – why did you give that score? (*5's need no reason*)

1. Group Member's Name: _____ Score: 1 2 3 4 5

Reason: _____

2. Group Member's Name: _____ Score: 1 2 3 4 5

Reason: _____

3. Group Member's Name: _____ Score: 1 2 3 4 5

Reason: _____

4. Your Name: _____ Score: 1 2 3 4 5

Reason: _____

Additional comments or concerns: _____

Changes you would recommend for this activity: _____

Rubric (use for copying & pasting)

1. Introduction	Criteria	Yes!!!	Kind of	Not Yet
1a	Create a testable research question (RQ) based on an authentic real-world phenomenon.			
1b	Develop a hypothesis based on the RQ that can be directly measured with data.			
1c	Provide a rationale for the hypothesis based on models, data, credible evidence, and/or reasoning.			
1d	Identify the independent variable (IV) & dependent variables (DV); explain the relationships between them.			
	<i>Practices: Asking Questions. Planning & Conducting an Investigation. Crosscutting Concepts: Stability & Change</i>	Total	/16	
2. Background	Criteria	Yes!!!	Kind of	Not Yet
2a	Accurately summarize scientific information needed to understand the RQ and hypothesis.			
2b	Evaluate various sources of information and use only credible & accurate sources in project.			
2c	Properly cite all sources used in the project with both parenthetical <i>and</i> APA formats. <u>Parenthetical</u> : (Last Name, Year) <u>APA</u> : Last Name, First Name. (Year). Title. Source.			
2d	Communicate ideas effectively across multiple formats (written, visual, verbal, etc.).			
	<i>Practices: Obtaining, Evaluating, and Communicating Information. Crosscutting Concepts: Structure & Function</i>	Total	/16	
3. Methods	Criteria	Yes!!!	Kind of	Not Yet
3a	Provide a detailed materials list summarizing all items needed for this investigation.			
3b	Summarize the methods so others could easily replicate the same experiment.			
3c	Explain how the methods specifically answer the RQ and test the hypothesis.			
3d	Critique the limitations of your methods (e.g., sample size, trials, authenticity, relevance to RQ, etc.).			
3e	If using a model, simulation, or model organism, summarize why it was chosen and how it effectively represents a more complicated phenomenon.			
	<i>Practices: Planning & Conducting an Investigation. Crosscutting Concepts: Models</i>	Total	/20	
4. Results	Criteria	Yes!!!	Kind of	Not Yet
4a	Collect and analyze data and explain key trends and patterns across your data.			
4b	Create an effective visualization of your data (graph, chart, etc.) with labeled parts and a detailed caption.			
4c	Use mathematical functions (ratios, rates, percents, etc.) to make accurate conclusions about your data.			

4d	Assess the validity of your data using statistical methods (e.g., standard error) and/or by comparing with other credible sources of info & evidence.			
4e	Acknowledge and explain the limitations of your data and its ability to address your RQ and hypothesis.			
	<i>Practices: Analyzing and Interpreting Data, Mathematics and Computational Thinking. Crosscutting Concepts: Patterns; Scale, Proportion, & Quantity</i>	Total	/20	
5. Discussion	Criteria	Yes!!!	Kind of	Not Yet
5a	Restate your RQ & hypothesis, and explain whether your data support or refute your hypothesis.			
5b	Use data and evidence from your investigation and other sources to support your conclusions about the phenomenon you investigated and identify cause-and-effect relationships.			
5c	Critique the strength of your evidence and conclusions and acknowledge their limitations.			
5d	Propose a solution to a problem using your data, evidence, and credible information.			
5e	Consider alternative arguments/explanations/solutions and use evidence to critique their validity.			
	<i>Practices: Constructing Explanations, Evidence-based Arguments. Crosscutting Concepts: Cause & Effect</i>	Total	/20	
6. General	Criteria	Yes!!!	Kind of	Not Yet
6a	CS.1&2: Use scientific practices & critical thinking to systematically address a problem in AFNR.			
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6d	Project is free of errors (factual, spelling, grammar, etc.) and reflects the work of adult professionals.			
6e	Students collaborated to evenly divide work, overcome obstacles, and effectively use time & resources.			
	<i>Practices: Constructing Explanations, Evidence-based Arguments. Crosscutting Concepts: Structure & Function, Models, Patterns, Cause & Effect</i>	Total	/20	
Comments:		Final Score:		
			Max: 112	