



FER 2023-2024

Project Workbook

Name: _____





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The goal of the year is to complete your Project Map so it can help guide your presentation.

Please be sure to complete each module the week it is assigned so you can make the most of each mentorship session.

Be sure to pick a topic you are curious about and ask your mentors for ideas!!!!

Remember FER projects can only be done by individuals or teams of two.

Email us at mentorship.fer@gmail.com with teacher/grown-up permission if you have any questions.

HAVE FUN BEING AN EMERGING RESEARCHER WITH US!!!



FER 2023-2024 Calendar

Week	Phase	Session	Type	What's Due
1	1	10/30/23 - 11/3/23 Introduction to FER and The Scientific Method	Mentorship Session 1	Nothing!!! Just a curious mind!
2		11/6/23 - 11/10/23 Asking Good Questions	Module 1	Work through module/worksheet
3		11/13/23 - 11/17/23 Developing Research Questions and Finding Supporting Sources	Mentorship Session 2	Please Bring Module 1 Worksheet Completed
x		11/20/23 - 11/24/23 Thanksgiving	None	Break
4	2	11/27/23 - 12/1/23 Crafting Your Hypothesis	Module 2	Work through module/worksheet
5		12/4/23 - 12/8/23 Writing Testable Hypotheses	Mentorship Session 3	Please Bring Module 2 Worksheet Completed
6	3	12/11/23 - 12/15/23 Designing Your Experiment	Module 3	Work through module/worksheet
7		12/18/23 - 12/22/23 Writing Project Proposals	Module 4	Work through module/worksheet and SUBMIT PROPOSAL FOR FEEDBACK
x		12/25/23 - 12/29/23 Winter Break	None	Break
x		1/1/24 - 1/5/24 Winter Break	None	Break
8		1/8/24 - 1/12/24 Understanding Experimental Design	Mentorship Session 4	Please Bring Module 3 and 4 Worksheet Completed
9		1/15/24 - 1/19/24 Conduct Your Experiment	Experiment	Independent
10		1/22/24 - 1/26/24 Conduct Your Experiment	Experiment	Independent
11	4	1/29/24 - 2/2/24 Analyzing Your Data and Results	Module 5	Work through module/worksheet
12		2/5/24 - 2/9/24 How to Analyze Your Data	Mentorship Session 5	Please Bring Module 5 Worksheet Completed
13	5	2/12/24 - 2/16/24 Abstract Writing	Module 6	Work through module/worksheet and SUBMIT ABSTRACT FOR FEEDBACK
14		2/19/24 - 2/23/24 Communicating Your Findings in Presentation	Module 7	Work through module to draft your presentation
15		2/26/24 - 3/1/24 Practice Research Presentations	Mentorship Session 6	Be ready to present your draft presentation to your mentor

Key:	Break	Mentorship Session on WorkAdventure	Online Module	Experiment
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Mentorship Session Dates

*Ask your teacher/grown-up
what team you are on so
you know when to meet us
on WorkAdventure*

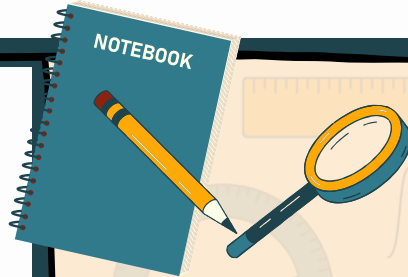
	Chromatic Green Team Mondays	Atomic Orange Team Tuesdays	Volcanic Red Team Wednesdays	Electric Yellow Team Thursdays (Early)	Oceanic Blue Team Thursdays (Late)
Meeting Type	3:00 - 3:45 PM	4:00 - 4:45 PM	3:30 - 4:15 PM	2:45 - 3:30 PM	4:30 - 5:15 PM
Teacher Training	Will be sent a video training as an overview of FER				
Mentorship Session 1	10/30/2023	11/7/2023	11/01/2023	11/02/2023	11/02/2023
Mentorship Session 2	11/13/2023	11/14/2023	11/15/2023	11/16/2023	11/16/2023
Mentorship Session 3	12/04/2023	12/05/2023	12/06/2023	12/07/2023	12/07/2023
Mentorship Session 4	01/08/2024	01/09/2024	01/10/2024	01/11/2024	01/11/2024
Mentorship Session 5	02/05/2024	02/06/2024	02/07/2024	02/08/2024	02/08/2024
Mentorship Session 6	02/26/2024	02/27/2024	02/28/2024	02/29/2024	02/29/2024

What is my question?

(Mentorship Session 2)

What is my research question?

Why is my research question important?



Phase 1

My hypothesis statement is:
(Remember, If/Then format!)



Phase 2

What is my guess?
(Mentorship Session 3)



My FER Project Map

3

I need these materials:



Phase 3

What will I change?

What will I keep constant?

How do I test my guess?

(Mentorship Session 4)

I will be measuring:



What is the best way to present my data?

What did I find?
(Mentorship Session 5)



Are my results meaningful?



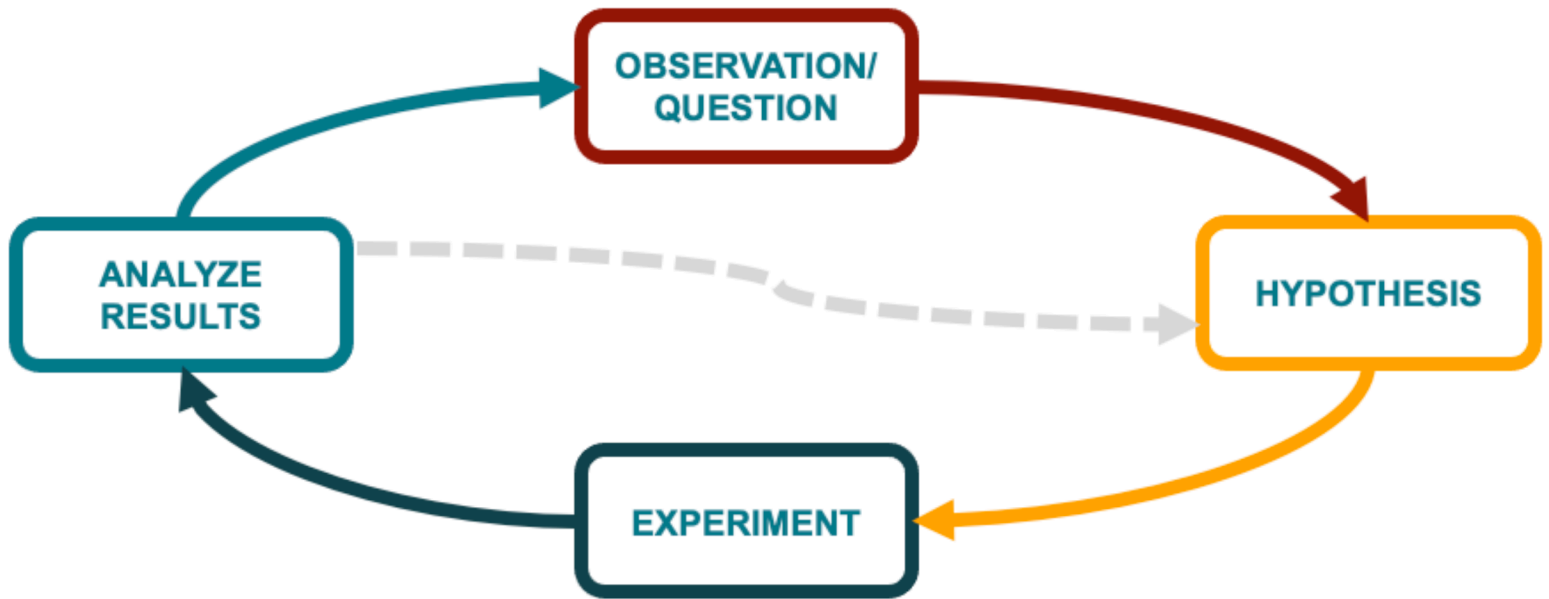
Does my data support or reject my hypothesis?



Mentorship Session 1: Introduction to the Scientific Method

(Week 1- Page 1 of 2)

Part 1: Review the Definitions



Draw arrows to what definition and example matches which scientific method step



Step

OBSERVATION/
QUESTION

HYPOTHESIS

EXPERIMENT

ANALYZE RESULTS

Definition

Figuring out whether your hypothesis is supported or not

A test that will give us data

What you see that will lead to a question

A testable and educated guess

Example

Some volcanos have red lava while some have blue lava

Blue and red lava are the same temperature, so temperature does not determine color

If the lava is at a lower temperature, then it will be the color blue

I will measure the temperature of 3 blue and 3 red lava samples



Mentorship Session 1: Introduction to the Scientific Method

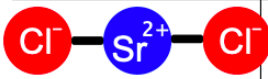
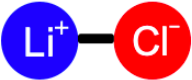



(Week 1- Page 2 of 2)

Part 2: Apply the Definitions

1. What is our hypothesis? (Use an if...then... format)

2. How should we design the experiment? (Hint: LiCl and KCl gave different colors, what is different about them?)

3. What are our results? (Fill in the table as we do the experiment)

Compound	Cation	Anion	Flame Color
None	N/A	N/A	
	Strontium	Chloride	
	Lithium	Chloride	
	Sodium	Chloride	
	Potassium	Chloride	
	Sodium	Nitrate	

4. What is our conclusion? (One sentence, is the anion or cation responsible for color)



Module 1: Developing Research Questions and Finding Supporting Sources

(Week 2: Page 1 of 2, Complete Before Week 3)

Part 1: Review of the Scientific Method

Now that Gemma walked us through her first experiment, let's review how she actually implemented the scientific method. In the table below describe what Gemma actually did as she applied the scientific method to her question.

Scientific Method Step	What Did Gemma Do?
Observation	
Hypothesis	
Experiment	
Analysis	

Part 2: Observation and Background Research

What is Gemma's Question?

Now that Gemma finished her first experiment, she needs to try again and test a new hypothesis. In order to develop this new we need to do background research. Let's start with a google search and see what we get.

Conduct the google search below



color of sand





Module 1: Developing Research Questions and Finding Supporting Sources

(Week 2: Page 2 of 2, Complete Before Week 3)

From your google search recommend two sources you would have Gemma rely on for each stage of her research. Please list the name of the source (aka website name)

Stage 1 General Learning	Stage 2 Specific Learning
1.	1.
2.	2.

Lets click on this link and read the first paragraph to get another idea of something to test

<http://scienceline.ucsb.edu/getkey>

Why have beach sands different colors? - UCSB Science Line

The color of sand grains comes from the original material that formed the sand. For example, white sand on tropical beaches is pulverized pieces of dead coral.

From this paragraph, why can sand be different colors?

Part 3: What should my topic be?

In order to pick your project we need to identify what interests you have from anywhere in your life and try to match that to an interesting scientific question. Just circle five topics you find exciting and then we will discuss with your mentors about how we can turn those into potential projects:

CIRCLE 5 THINGS YOU ARE INTERESTED IN LEARNING MORE ABOUT!!



Machines/
Robots



Computers



The Brain



Chemical
Reactions



Space



Gardening



Animals



Sports



Health/
Medicine



Cosmetics



People's
Behaviors



Natural
Disasters



Climate
Change



Buildings/
Bridges



Colors

You are now ready for the next mentorship session!!! See you soon!



Module 2: Crafting Your Hypothesis

(Week 4: Page 1 of 1, Complete Before Week 5)

Part 1: Complete with your online module

Write down what are the answers to each question for Gemma's project and yours.

Question	Gemma's Project	Your Project
What are we specifically trying to test?		
What background information helps us guess an answer?		
How can the guess be tested via an experiment?		

Part 2: Complete during your mentorship session

FIRST TRIAL HYPOTHESIS: IF _____,

THEN _____.

SECOND TRIAL HYPOTHESIS: IF _____,

THEN _____.

FINAL HYPOTHESIS: IF _____,

THEN _____.



Module 3: Designing Your Own Experiment

(Week 6: Page 1 of 2, Complete Before Week 7)

Part 1: What is a Model System?

Gemma's question is about dinosaurs, specifically two of her favorite dinosaurs from Jurassic Park. Her hypothesis was:

If the spinosaurus and t-rex lived in the same area, then the spinosaurus lived in the water so the two would not compete.

In order to test this hypothesis she needed to develop a model system.

What is a model system?

Her model system involves studying dinosaur fossil samples and comparing the amounts of heavy oxygen.

Dinosaur	Expected to live...	Relative Amount of Heavy Oxygen (Write Higher or Lower)
T-Rex	On Land	
Spinosaurus	In the Water	

Therefore, Gemma is using quantitative data for her experiment. What are you doing for your experiment?

What type of data are you collecting, qualitative or quantitative?

Why?



Module 3: Designing Your Own Experiment

(Week 6: Page 2 of 2, Complete Before Week 7)

Part 2: What are Experimental Variables?

Gemma now described to us the definition of a variety of variables. Lets review:

Please circle what type of variable each item serves as in Gemma's experiment

Item	Type of Variables		
Amount of Heavy Oxygen	Independent Variable	Dependent Variable	Confounding Variable
Type of Dinosaur	Independent Variable	Dependent Variable	Confounding Variable
Broken Machine	Independent Variable	Dependent Variable	Confounding Variable

What are the variables you have in your experiment?

What are your independent variables?	
What are your dependent variables?	
What are some potential confounding variables you may have?	



Module 4: Writing Project Proposals

(Week 7: Page 1 of 2, Complete Before Week 8)

Part 1: Let's Review Neville's Experimental Design

Gemma's classmate Neville designed his own experiment. Let's review what he did

Please answer each question below about Neville's experiment

Question about experimental design	Description/Answers Related to Neville's Project
What was Neville's Hypothesis?	
What was Neville's Independent Variable?	
What was Neville's Dependent Variable?	
What confounding variable did Neville control for and how?	
Why did Neville want to repeat his experiment?	



Module 4: Writing Project Proposals

(Week 7: Page 2 of 2, Complete Before Week 8)

Part 2: Your Project Proposal

Over the last 7 weeks you all have worked extremely hard to learn about experimental design. We are almost ready to begin doing your experiment. Lets review everything about your experiment so you can get feedback from your mentors. Answer the questions below in full sentences:

(After drafting your sentences on this worksheet submit a typed version on our website for feedback!)

Question about your experiment	Your full sentence answer about your FER Project
What is your question?	
Why is answering your question important to others?	
How will you conduct your experiment? (can be 2-3 sentences)	
What do you think the results of your experiment will be?	
What are the limitations to your experiment?	



Module 5: Analyzing Your Data and Results

(Week 11: Page 1 of 2, Complete Before Week 12)

Part 1: Analyzing Your Data

Let's review the major concepts related to analyzing your data

Question	What do we learn about our data by answering this question?
Question 1: Is the data reliable?	
Question 2: What conditions do the results apply to?	
Question 3: Are the results meaningful?	

Let's now consider what are the answers to these questions for your experiment

Your hypothesis: _____

Question	Answer about your experimental results
Question 4: Is your data reliable? (Is it consistent and reproducible?)	
Question 5: What conditions do the results apply to? (Do you have any limitations?)	
Question 6: Are the results meaningful? (Is there enough similarity or difference to help support your hypothesis?)	



Module 5: Analyzing Your Data and Results

(Week 11: Page 2 of 2, Complete Before Week 12)

Part 2: Visualizing Your Data

Matching: What does each type of visual or graph tell you about the data it represents?
Match the visual to the correct description

Graph Type

Data Table

Pie Chart

Line Graph

Bar Graph

Purpose or Use

A graph that uses bars to represent a particular value or category of data in a set, with two axes and a legend.

A table used to organize and label data clearly, as well as display calculated values like totals and averages. Used with both qualitative and quantitative data.

A graph that shows proportions of a whole to which a value belongs.

A graph that usually shows change over time, with two axes and points scattered throughout to represent the data, connected by a line.

Now that you are familiar with a few different ways to visualize data, pick the best visual for your project. Watch the video tutorial for how to make a graph using google sheets, and then try it with your own data. You can follow along with the video tutorial, or watch first and then try on your own.

We recommend that you make a data table first to organize your results, and then make either a line graph, a bar graph, or a pie chart. If you want to make a different graph you can! Whatever you make, bring it with you to the next session! Try to keep it on google slides so you can share it with your mentor.

**Once you have a data visual, answer this question:
Is your hypothesis supported? Explain why or why not.**



Module 6: Writing Your Abstract

(Week 13: Page 1 of 2, Submit Abstract Online this week)

Part 1: How to Organize an Abstract

Use your noggin! What order do you think these parts of an abstract should be in? Here's a hint - it's similar to the scientific method and the way we've learned about it this year!

Order in Abstract

First

Second

Third

Fourth

Fifth

Sixth

Part of Abstract

The observation you made that led to your research question

A summary of your results

Introduce the background and significance of the topic of your experiment

A short explanation of your experimental design and how you collected data

A single sentence stating your conclusion based on your evidence

What your hypothesis is (in the standard If/Then format)

Answer the following question below:
Why do we use abstracts to explain our experiments?



Module 6: Writing Your Abstract

(Week 13: Page 1 of 2, Submit Abstract Online this week)

Part 2: Let's Write Your Abstract

While watching the last video fill out the table below. You can use Gemma's abstract for inspiration. When you are happy with your full sentences you can submit your answers for comments from our mentors using the link in the module.

Part of Abstract	Gemma's Abstract Sentence(s)	Your Abstract Sentence(s)
Introduce the background and significance of the topic of your experiment	"As pollution production has increased in recent years, acid rain has become a more prominent problem causing damage to our natural ecosystem, damaging plant and animal health."	1
The observation you made that led to your research question	"While I was looking at areas with lots of acid rain, I noticed that the rocks looked more broken, so I questioned if an increase in acid rain would weaken rocks, which may then damage natural or man-made rock structures."	2
Your hypothesis statement (in if/then format)	"I hypothesize that if rocks are kept in an acidic environment, then the rock will weaken tremendously."	3
A short explanation of your experimental design and how you collected data	"I collected rocks from a beach near me that were equal in size, shape, and color. Rocks were left in either lemon juice or water overnight and then I tested their strength using the Moh's hardness test."	4
A summary of your results and findings	"I found that the rock soaked in lemon juice was scratched easier than the one left in water."	5
A single sentence stating your conclusion based on your evidence	"Based on my experiment, I can conclude that more acidic solutions cause rocks to weaken in strength."	6