Worksheet 1: Meet Your Mentor(s) & Brainstorm!

Tasks for this week:

- Learn more about your topics!
    - Use science journal articles, books, and internet resources to look for **testable** ideas related to your topics
- Save a full list of sources to refer back to them and use them in your **bibliography**
    - You can print out copies of articles or save them in a folder online
    - Make a list of possible websites, magazines articles (online or in print), and other resources you can use for your research
- **Print these worksheets** out to fill them out! Share a copy with your mentor(s)!

Getting started:

What are 2-3 facts about yourself that you'd like your mentor(s) to know about you? (Examples: your after school activities, hobbies, pets?)

1.

2.

3.

What is your mentor's first name, last name, and email? (If you have 2 mentors, write both)

1.

2.

What are some facts about your mentor(s) that you think are cool?

1.

2.

What are some things you're interested in that you also want to learn more about?

1.

2.

3.

4.

5.

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Worksheet 2: Develop a Rationale & Research Question

Part 1 - PROJECT RATIONALE: Justifying your project (Why did you choose this topic? How will others benefit from your project?)

Tasks for this week:

- Summarize important facts you learned by researching your topic
- Discuss how those facts relate to your project question
- Explain why your project is important or relevant to a group of people
    - and/or explain how your project might impact society as a whole
    - Keep in mind: as long as you present it well & factually, it is a valid justification

Getting started:

Write down any questions you might have based on your research:

1.

2.

3.

Why is your research question important? This can mean a question that is important to you, your community, your school, society as a whole, or it can also be important for people in a specific group, like people who knit, who play football, or who build houses!

1.

2.

3.

4.

5.

Worksheet 2: Develop a Rationale & Research Question

Part 2 - RESEARCH QUESTION / GOAL / HYPOTHESIS (different names for the same thing)

Tasks for this week:

- Narrow your interests down to a single research question (aka hypothesis, aka engineering goal)
- Describe your question or goal
- Explain all expected outcomes to your project
- Tell us how your research question is based on your project justification or "project rationale"

Getting started:

What, exactly, do you want to find out? What is a goal or an expected outcome for your project?

1.

2.

3.

How does your project relate to your project rationale?

1.

2.

3.

If your project results do not support your hypothesis, what information have you gained?

1.

2.

3.

Worksheet 3: Creating Procedures/Methods

What does a procedure consist of?

- Experiment design
- Materials
- Data collection methods

Tasks for this week:

- Come up with a detailed, step-by-step procedure of how you're going to set up your experiment
    - Make sure this procedure is well-written so it can be replicated by someone else
    - **Good hypotheses and methods are those that can be repeated by other scientists!**
- Think about the materials you will be using - are you keeping to a budget?
- Think about which **photos** you'll want to take to show your setup!
- Think about what kind of data you'll need to gather
- When you follow your procedure, write down anything that doesn't go to plan and what you could have done to make it better - this can go in your discussions section

Getting started:

What materials are you using? Include any physical items or computer software. (Bullet points)

-
-
-
-
-
-
-
-
-

What are the steps for setting up your experiment? Include all relevant details: relevant times of day, materials, necessary logical steps, etc.

1.
2.
3.
4.
5.
6.
7.
8.
9.

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Worksheet 3.5: The Many Ways to Gather Data

Think about the type of data you want to collect for your project: observational, experimental, modeling/simulation, and derived/compiled. This data can be either quantitative or qualitative, based on how you design your project.

Glossary

- Qualitative: describes qualities or characteristics through sense, feelings, emotions
    - Example: “On a scale from 1-5, rate how happy you feel right now”
- Quantitative: things that can be compared our counted on numerical scale
    - Example: “This plant grew 4.0 cm in one month”
- Data Point: a single, identifiable value in a dataset
- Statistics: collecting, analyzing, and presenting information about numeric data

Tasks this week: List all the ways you could gather data to help you find an answer to your research question.

- Where will you complete your research (at home, in school, in a research institution)?
- Do you need numeric data (quantitative) or observational data (qualitative)?
- What sort of materials do you need to complete your research?
- What type of data could you collect with a survey? Do you need a survey?
- Can your project be tested by using instruments (i.e., ruler, thermometer, scale)?
- Will making a model (physical or computer-based) help you test your question?
- Is there an existing public database that could be used to test your question?
- Over what time period should you collect data (i.e., minutes, days, weeks)?
- What makes data “robust?” How many data points will you need to collect for a strong study? (i.e., number of measurements, number of days, number of surveys)
- What is a trial? How many trials will you need to run for your data to be significant?
- What does significant data mean?

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Worksheet 4: Risk and Safety Handout

The answers to this handout will be needed for SRC approval, if applicable.

HUMAN SUBJECTS

1. **Participants**: Describe age range, gender, racial/ethnic composition of participants and indicate how participants will be invited to participate. What will participants be asked to do? Will you use any surveys, questionnaires or tests? What is the frequency and length of time involved for each subject?

2. **Risks**: What are the risks or potential discomforts (physical, psychological, time involved, social, legal, etc.) to participants? How will you minimize risks? How will you protect the privacy of your participants?

3. **Informed Consent Process**: Describe how you will inform participants about the purpose of the study, what they will be asked to do, that their participation is voluntary, and they have the right to stop at any time. Attach a copy of an Informed Consent document to the Research Plan.

VERTEBRATE ANIMAL RESEARCH

1. **Participants**: Detail animal numbers, species, strain, sex, age, source, etc. Describe housing and oversight of daily care.

2. **Risks**: Detail all procedures to be used, including methods used to minimize potential discomfort, distress, pain and injury to the animals and detailed chemical concentrations and drug dosages. Discuss disposition of the animals at the termination of the study.

3. **Alternatives**: Discuss potential alternatives to vertebrate animal use and present justification for use of vertebrates. Explain potential impact or contribution of this research.

HAZARDS: MATERIALS, BIOLOGICAL AGENTS, CHEMICALS, DEVICES, ACTIVITIES

1. **Hazards**: Identify all hazardous materials, biological agents, chemicals, devices, or activities that will be used; identify microorganisms *exempt* from pre-approval.

2. **Risks**: Identify and assess the risks involved with the use of hazardous materials, devices, and/or activities in this project. Identify a supervisor for this project and discuss how this supervision will take place.

3. **Precautions**: Describe the safety precautions and procedures that will be used to reduce the risks. When applicable, describe the disposal procedures that will be used for hazardous materials or biological agents.

Worksheet 4: Risk and Safety

Tasks for this week:

- Write down any risks to you or your participants
- Write down precautions you can take to make your project safer
- If you can't think of any risks, explain why your project does not have safety risks
- **If your project includes human subjects, vertebrate animals or hazardous materials**, your research plan must include answers to the questions in the **Risk and Safety Handout**. This will be similar to your science fair approval paperwork.

Getting started:

What are all the likely risks to you or your participants? Can you foresee any accidents leading to anyone falling, slipping, getting something in their eye, getting injured, etc.? Can you wear something to protect yourself from any of the risks you can think of?

1.
2.
3.
4.
5.

How can you change your methods in order to decrease all possible risks?

1.
2.
3.
4.
5.
6.
7.
8.

Worksheet 4.5: Assembling Your Project Summary

A research plan/project summary includes the following headers:

a) Project Rationale;
b) Research Question (or Hypothesis or Engineering Goal);
c) Procedures;
d) Risk and Safety;
e) Data Analysis;
f) Research Bibliography

By this point, you know what your project rationale, research question, and procedures are.

Tasks for this week:

- Gather all parts of your research plan together and put them in order
- Begin refining everything so you can explain it all to someone who knows nothing about your project

Worksheet 4.5: Research Bibliography

Tasks for this week:

- Make a formal list of all the research you have used
    - (APA format is preferred for scientific papers)
- You may need to add a few new sources to this list after your experiment is done
- **Remember**: if you plan to use **vertebrate** animals
    - One of your references **MUST** be an animal care reference

Worksheet 5: Data Analysis After Experimenting

Tasks for this week:

- Assess your plan to analyze the data and results from your project - does it still work?
    - This might include calculating averages, percentages, yields, or etc.
    - You can compare and contrast data, show frequency of data, and more
- Think how you will best show your data to other people - a bar graph, pie chart, etc.
    - **Note**: data tables are usually kept as unpolished or "raw" data, so we have to make these tables into graphs to show others how your data may show a trend
    - Fun fact: "data" is plural for "datum"

Getting started:

What is a trial? How many trials do you have the time and resources for? Do you need more trials?

What is a dependent variable? What is the dependent variable in your experiment?

What is an independent variable? What are the independent variables in your experiment?

What is a confounding variable? What are the confounding variables in your experiment?

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Oraculi
Rochester, Minnesota

Worksheet 6: Results/Discussion - Putting It Together

Tasks for this week:

- Describe how you plan to analyze the data/results from your project
    - This might be calculating means or percentages
    - Or comparing and contrasting data, showing frequency of data, and more
- Think about how you will show your data to other people - a bar graph, pie chart, etc.

Getting started:

What did I decide to measure? How can I use those measurements as a way to compare my data points? Will I be using the mean, median, or something else?

Will I use a bar graph, scatterplot, pie chart, word cloud, or etc. to show my data?

What photos did I take that illustrate my comparisons best?

What does my data mean for my hypothesis? Is my hypothesis supported or not supported? (Remember, hypotheses cannot be “correct” or “incorrect”)

What would I do to improve my experiment if I were to run it again? Would I use more trials, control for confounding variables, etc.?

What were some unexpected outcomes, if any? How do I suspect these arose? If I did this experiment again, would I want to change my experimental conditions to account for these?

When did I stop the experiment? Was there a predetermined point in time? Did I run out of materials and then decide to stop?

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Worksheet 7: How to Give Good Feedback

What makes feedback "good" and why is good feedback important?

- Good feedback is constructive and is delivered in a way that doesn't make us feel bad
    - Ex: "The sentences in your introduction would make more sense in a different order - let me show you what I mean."
    - NOT: "You're not good at writing introductions."
- Good feedback is **specific**
    - Ex: "I like your use of bullet points because it makes your project easy to read."
    - Ex: "I think a pie chart would work better here because you are trying to show percentages as part of a whole."
    - NOT: "I don't like your project."
- Good feedback is **positive** and focuses on what can be changed and why
- We can learn from good feedback and use it to improve our projects
- We can also learn how others may interpret our projects differently, so we can clarify our presentation beforehand

What are some tips to help us give good feedback?

- Ask your peer(s) if there is anything in specific they want feedback on
    - Feedback is a two-way street; you're not just giving feedback, they are also receiving it
    - We can learn from the feedback we give others as well
- We can use the "I like, I wish, I wonder" approach
    - Mention something about the project that you like, something you wish were different, and anything it makes you wonder about
    - Ex: "**I like** how you did a project on daphnia (water fleas) and their heartbeats because of how transparent their bodies are. **I wish** you had measured their heartbeats for 60 seconds instead of measuring for 10 seconds and multiplying it by 6 to see if that affects accuracy. **I wonder** what other animals are totally transparent.
- Be empathetic - we're still learning at every stage of our lives
    - Something totally obvious to you may not be totally obvious to someone else
    - Something that's easy for someone else may have been something you've been really struggling with
- Follow up on the feedback you've given and the changes your peer(s) made
    - Reinforce what they have done well and ask about any further changes they are hoping to make

Tasks for this week:

- Practice presenting
- Practice giving your peers good feedback on their projects!

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Worksheet 8: Writing an Abstract

What is an abstract?

- A short summary of what your project is about - it includes:
    - The problem or the key issue
    - Key parts of your research methodology
    - Your most important findings
    - Your conclusion from your findings
    - Keywords to your method and content
- Usually has a word limit of 150-250 words, but check with STEM Fair guidelines

Tasks for this week:

- Write one or two sentences of necessary background information about the key issue
- Write one or two sentences including key parts of your research methodology
- Write one or two sentences mentioning what your most important results are
- Write one or two sentences describing the importance of your results for other scientists in your field or for people this project could impact
- Put all the sentences together and edit what you wrote! Congrats, you have an abstract!

Getting started:

Background info explaining why your project problem exists/why it is a problem:

Key parts of your research methodology:

Your results:

The importance of your results:

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Worksheet 9: Presentation Tips!

Tasks for this week:

- Practice your presentation!

When writing your presentation (papers and powerpoints)

- **Takeaway**: Imagine you're presenting in a classroom; you want the person in the last row to be able to clearly read your slides and hear your voice
- **Word choice**: use “etc.” instead of “and things/stuff”
- **References**: for any format you ever use, fill in all the information you have and leave blank any information you don't have (use citationmachine.net while you still can!)
- **When writing**, please tell us about what you did! 1st person, active voice
    - Ex: "I conducted research," "I collected data," "I overcooked the sausages"
    - This conveys that the scientist takes responsibility for their actions
    - In the past: 3rd person passive voice was used, but this has changed
        - Ex: “research was conducted, data were collected, the sausages were overcooked”

When putting your presentation together (powerpoint slides)

- **Use bullet points!**
    - This makes everything much easier to read (for you and the audience)
    - Use words on the slides to concisely state & emphasize your points; less is more
        - It takes practice to learn what to write down and what to leave out!
- **No paragraphs or long sentences**
    - Break your paragraphs into bullet points
    - Delete walls of text in your presentation that you can use notecards for
        - Notecards can contain more details on what to say or how you want to say something, these can be used as an aid when practicing
        - BUT try not to use notecards as a crutch! We want you to become comfortable with presenting
    - Use photos or diagrams rather than words when possible
- The background behind your text should be only one or two colors throughout
- The text should contrast with the background, so you can see the text clearly
    - Ex: a white background and black text or a dark blue background and yellow text
- **Number the slides** so your audience can ask questions and tell you which slide it was on

Worksheet 9: Presentation Tips!

When speaking and presenting your research (poster presentation)

- **When speaking**, please tell us about what you did! 1st person, active voice
    - ("I conducted research," "I collected data," "I overcooked the sausages")
- **Project confidence!** Life is too short for too many "maybes"
    - You know your project better than anyone - you know why you made your choices, and if a question comes up that is unexpected, do your best to answer with confidence