How to Write a Research Plan

Use this as a template or model as you are writing your research plan. Please make sure you refer to this for each of the 6 sections.

1. **Rationale**
    a. Your rationale should be a several paragraphs, about 2 pages, double spaced and should include background information explaining why your research is important and much include supported and cited information. **IT SHOULD BE WRITTEN IN FUTURE TENSE.**

    Background information should be about your topic, explaining more about your topic to give the reader a sense of understanding. When writing background information, include a funnel from more broad to specifically your project and create a smooth transition from the background information to why the research is important. It should be an explanation for why you're doing this project, explaining why the research is important and why they should care.

2. **Research Question(s), Hypothesis(es), Engineering Goal(s), Expected Outcomes**
    a. **Research Question**
        - First, create a transition from your rationale to your research questions. Your research questions should address any gaps or unasked questions from your rationale. For example, if your topic is environmental research and your background knowledge includes information on an invasive species and why it is bad, use your research questions address what you specifically are looking at. They should be your problem and should address whatever gap in knowledge/literature that exists in the topic.

    b. **Hypothesis(es)**
        - Your hypotheses should be one sentence each and should answer each of your research questions. You should have the same number of hypotheses as research question and each should be specific. For example, if one research question is: "How does the presence of MacroH2A effect the growth of cancer cells", the hypothesis should specifically state what you think the answer to the question will be. Use "If… then…" format.

c. Engineering Goal(s)

- Here, if you are an engineering project, state what you want to achieve. If you want to engineer a way to convert sunlight into energy or create or improve some sort of technology, specifically state what your goals are for creating it. Include if you want to create a machine with a limited amount of resources or that uses a certain amount/type of energy.

d. Expected Outcomes

- Your expected outcomes are almost like your hypothesis, but in paragraph form. You can explain slightly why you expect the outcomes, but make sure your expected outcomes address both your hypotheses and your research questions
- "It is expected that…"

e. Procedure

- Detail the role of the mentor and the role of the student. This section should be titled "Role of Mentor and Role of Student." Include if your mentor provided materials for you (which they most likely did), what guidance they provided with you, and any steps that they did for you in the experiment that you are not allowed to do (ex. If they sacrificed mice in your experiment, if they handled vertebrate mammals in ways that you were not allowed to, etc).
- Write, in detail, all the steps of **YOUR experiment**, do not include the work done by your mentor or others. This includes any designs you make, how you collect your data, how you analyze data. Don't describe work done by others or your mentor, only the work that you do. Be specific: the goal is to describe the experiment in detail as if someone will copy it. You want to format it and be specific enough so someone could redo your experiment and get the same results. Include dosages used, materials used, separate phases of research from other phases of research with italicized titles to differentiate.

****NOTE:** If including the work of the mentor is important to the overall understanding of the experiment then clearly indication "performed by mentor" & "performed by student".

- Do not write this section in paragraph form but rather using bullets, in the order of the steps you will/did take in your experiment.

f. Risk and Safety

- Detail and potential risks. For example, if you handled chemicals, identify the chemicals, why it was necessary for you to use the chemicals and explain safety precautions that you had in place. Make it seem like you planned for everything that could've caused any harm to you.

g. Data Analysis

- Describe how you analyzed your data. This also includes statistics. Again, go into detail so that someone could perfectly replicate your experiment. If someone replicated your experiment perfectly but didn't replicate your data analysis the same way, they could get different results from you. If this includes watching videos, detail how you watched them and what you recorded when watching the videos.

h. Bibliography (Written in APA format)

- List major references from any articles you read. Include articles that helped shape your own project, especially articles with methodology similar to your own or articles that gave you ideas for your project. They should also be articles that provided information for your background.
- If you used vertebrate animals in your project, make sure to include a reference to an animal care guide
- Do NOT use links to cite. Instead, format all citations in APA format. The format should include: Authors (Last name, first initial), date/year of publish, title and source.

3. Human Participants Research (BEHAVIOR PROJECTS ONLY)

a. Participants

- Describe the participants used. Describe age range, gender, race, etc.
- Identify ‘vulnerable’ populations: minors, pregnant women, prisoners, mentally disabled, economically disadvantaged
- Remember: you want someone to be able to read this and be able to replicate your experiments to get your results. If you only used participants aged 13-18, include that so someone wouldn’t replicate the experiment using participants aged 25-30

b. Recruitment

- Include where you found your participants. Did you send out a survey to all high school students? How did you invite them to participate? How did you reach out to them?

c. Methods

- Describe what your participants will be asked to do. Did they take a survey, questionnaire or test? If they used a survey/questionnaire/test, did you make it? And if you did not, describe where and how you obtained it. Make sure you write that you required permission to use said survey/questionnaire/test.
- Explain the frequency and length of time involved for each participant.
    1. For example, if you used human participants in memory testing, explain what you had them do in order to test your memory. If you created your own test, write that. If you used a previously created one, explain that and that you got it from a professor or scientist that created it and explain that you required permission. Explain the length of the test: if it took the participant a half-hour or a half hour. Explain how often participants took a test; if you tested the effect of drinking coffee on memory, or something in which a stimulus would be introduced several times and required several tests, describe the frequency and if the length of each test changed or remained the same.

d. Risk Assessments

- Describe and risks exposed to participants. If you had participants do rigorous exercise before a test, describe this. Emphasize how you minimized risks: make it seem like you planned for everything and made your experiment as safe and comfortable as possible.

e. Protection of Privacy

- Describe how you kept everything anonymous. If you collected information such as names, telephone numbers, birthdays or contact information, describe how that would be kept private. Anonymity and confidentiality in these projects is very important, so make sure they know that everything was proper and anonymous OR safely confidential.
- If anonymous, describe how data was collected whilst still staying anonymous. Describe whatever way you used to differentiate data, if you did, while still keeping everything anonymous.
- Describe where data would be stored and who would have access to the data, as well as what you would do with data once the experiment was over.

f. Informed Consent Process

- Describe how you informed participants of your purpose, what they would be asked to do and that their participation was voluntary AND could be stopped at any time.
- If you used a signed form or any form, make sure you clarify that participants were notified of the above. If you used a survey, make sure that there were questions or information on the survey that clarified this and describe this.

4. Vertebrate Animal Research—For each section, include what you did and what your mentor did

a. Discuss potential alternatives to vertebrate animal use and present justification for use of vertebrates

- Describe other ways you could have done this research without the use of vertebrate animals. Could you have tested on non-vertebrates? Could you have used cell cultures instead of physically testing on the animals?

- Justify why you had to use vertebrates. Make it seem like it was crucial and was the only way to collect data well. The reader should agree that using vertebrate animals was the best way to conduct this research and that your justification was enough.

b. Explain potential impact or contribution of this research
    - Describe why this research is important to make the reader understand that, even though it was justified, using vertebrate animals was useful for you and helped your research, which impacted your field, or the world, in whatever way it did.

c. 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.
    - Describe what you did to the vertebrates. If you took blood samples, describe how you took the blood samples (from where, how much blood) and emphasize how and what you did to minimize discomfort, distress, pain or injury.
    - If you used drugs or chemicals with your research, include concentrations and dosages. Again, you want someone to be able to read this and replicate your experiment and get the same results.
    - If you're worried that something is too vague, add another sentence or bullet to clear it up or make it more specific. It's better to be a bit too specific than to be too vague.

d. Detail animal numbers, species, strain, sex, age, source, etc., include justification of the numbers planned
    - Include all the details about your vertebrate animals. If you used mice, thoroughly explain the species, the population, the sex and age of the mice and include where you or your mentor got the mice.
    - Justify your populations: if you used one hundred mice in your experiment, explain why you used a hundred instead of fifty or two hundred

e. Describe housing and oversight of daily care

- Describe how your mice were kept. Were males and females kept separate? Were they separated by age?
- Describe how they were cared for. How did you make sure the mice were in good shape and were properly cared for?

f. Discuss disposition of the animals at the termination of the study

- What happened to the mice once the study was done? If they were killed, explain how your MENTOR did this.

5. **Potentially Hazardous Biological Agents Research**—**For each section, include what you did and what your mentor did**

a. Give source of the organisms and describe BSL assessment process and BSL determination

- Describe where you got the potentially hazardous agent. If they were collected from tissue, describe how this step was completed.
- Describe how the BSL level was assessed and what was determined. Include the level and if the BSL level was higher than a student is allowed to conduct research with, make sure you state what level you completed research at

b. Detail safety precautions and discuss methods of safety

- Detail what precautions you took to make sure everyone was safe. If lab members wore protective clothing, make sure to detail what they wore (ex. close toed shoes, special gloves, lab coats, safety goggles).
- Describe how the agent was disposed of and make sure that this was in a safe way that limited exposure and danger.

6. **Hazardous Chemicals, Activities and Devices**—**For each section, include what you did and what your mentor did**

    a. Describe Risk Assessment process, supervision, safety precautions and methods of disposal

        - Describe how you analyzed the risk and how the laboratory would undergo Risk Assessment. Make sure you include if your laboratory or storage containers would meet a fire code or safety code
        - Describe any supervision you were under. Make sure to include that your mentor would supervise you at all times you were working with (even potentially) dangerous chemicals.
        - Describe safety procedures. This includes what you wore to limit exposure to the hazardous chemical/activity/device. You want to communicate that you were safe when working with this.
        - Describe the methods of disposal. How did you dispose of the chemical in a SAFE and proper manner? You once again want to communicate that you were safe and that you handled disposal in a mature and professional manner.