Physics 116 Lab Research or Engineering Design Project

Being able to design, conduct and present a research project are essential skills for scientists and like most skills, being good at them takes practice. For the next four weeks, you will be participating in a real research project or engineering design project of your own design. As a group, you will present the results of your project in an oral presentation and a paper. Because this is new to many of you, we have provided some guidelines for the project and will require you to meet milestones along the way to completing the project.

The engineering design process is a series of steps that engineers follow to come up with a solution to a problem. Many times the solution involves designing a new product or an improved product that meets certain criteria and/or accomplishes a certain task. See http://www.sciencebuddies.org/engineering-design-process/engineering-design-process-steps.shtml#theengineeringdesignprocess for details about the engineering design process.

First, you need to understand what research is and is not.

1. Research is not the demonstration of a principle. For many of the labs we have conducted, we knew in advance what your results should be and were able to check the data you obtained against the expected data. While we make predictions about our results when conducting research, our experiments are designed to test these predictions, not demonstrate or re-prove something we already know.

2. It is not something too vague or too broad. A good research question needs to be specific and measurable. Deciding to build a better mousetrap is great, but you need to decide specifically how your mousetrap will be better (traps more mice at once, traps faster mice, attracts more mice, etc). The same is true when designing an experiment; you need to develop a specific question, decide what you will measure to answer that question and then re-evaluate if your plan will effectively answer the question.

3. Research is about something worth knowing. We can measure a lot of things that we do not know, but many of them are not worth knowing. We could design an experiment to determine how wrapping a car in bubble wrap affects gas mileage or how fast you can run while wearing your left shoe on your right foot and no shoe on your left foot. The experiments might be fun, but the results are not worth knowing. Similarly, an improvement to design must be an improvement worth making.

Because a research project is a big task, we have broken the project down into tasks for each week. You will work during lab time each week and will have brief presentations in Week 11, 12, and 13. A different member of the group must present each week (in a group of 2, one member can present twice). All students are also expected to provide peer critique - feedback - on other groups' presentations: every student must ask at least 2 questions or make 2 useful comments during the three weeks of presentations.

Week 10 (March 30, April 2): Setup

- Form groups of 2-4. As a group, come up with at least two possible topics for your research project. For each topic, you should have a specific research goal and a general description of how you will complete your research project. You must discuss the topics with your
instructor before you leave. Your projects must be physics-related. In addition, your research must manipulate data, either taken or obtained OR if your group is doing an engineering design project, you need to plan to take data about how it functions.

- One member of your group will present a brief proposal at the start of lab next week. You will choose one of your two topic ideas for this proposal and this will be the project your group completes. IF YOU NEED TO PURCHASE MATERIALS, YOU MUST TELL YOUR INSTRUCTOR BY LAB IN WEEK 11.

Week 11: Literature search

- One member of your group will present an overview of your proposed project to the class. All students are expected to provide feedback on others’ projects.
- Prior to or during lab time, find at least five sources relevant to the project. These need to be reputable sources, ideally journal articles, but academic or government websites are also acceptable. Wikipedia is not acceptable. Use the sources to refine your research question. A good research question will build on existing research.
- One member of your group will present the results of your literature search next week.
- Your group also must submit an annotated bibliography with at least 5 sources at the start of class next week. You can find information on annotated bibliographies at https://owl.english.purdue.edu/owl/resource/614/01/.

Week 12: Data collection

- Present the results of the literature search to the class. In addition, you should present your final research question and plan and demonstrate how this relates to the research you found.
- Start data collection. One member of your group will give a progress report on the project at the start of lab next week.

Week 13: Finish data collection and analysis

- Present preliminary data and plans for the day.
- Finish all data collection and begin analysis. If you need help with statistical analysis, this is your chance to talk to your instructor. Statistical analysis is typically required in a research project.

Week 14: Final Presentation, self-evaluation, and paper due

GRADING

15% Presentations in week 11, 12, and 13 (5 points per week, graded as 0, chk-, chk, chk+)
5% Annotated bibliography
15% Final presentation “conference style”
15% Paper
40% Results/quality of research
5% Self-evaluation (independent)
5% Peer-critique (independent)

All work is as a group and grades are to the group as a whole except the self-evaluation and peer critique. Attendance in lab is mandatory as always, absence will impact final grade.