Fluid Mechanics Project – Description

For our class project, we are going to have a science and engineering fair on the evening of Friday December 8th. You and a group of your peers (and potentially some local high school students) are going to do a short project related to fluid mechanics. The purpose of this assignment is to:

- Give you freedom to be creative in defining and solving an open-ended problem
- Relate what you are learning in the classroom to the world around you
- Have a hands-on experience with fluid mechanics
- Enhance your teamwork and communication skills
- Give you a mentorship opportunity with younger students
- Have fun!

Your grade on the project will consist of three parts.

1. A proposal (Nov 3)
2. A poster presentation (Dec 8)
3. A peer evaluation form (Dec 11)

You may choose between two types of projects, a science project or an engineering project.

Science Project

A science project answers a question using the scientific method. A project consisting solely of library-style research (i.e. explaining how something works) is not appropriate. You should either measure something (do an experiment), calculate something (using theory/simulation), or both. Of course, library-style research should be used to help you understand the background of your project.

Engineering Project

An engineering project consists of an object or process designed to solve a specific problem. Simply describing an idea is not sufficient; you should have something to show (i.e. a prototype) at the end of your project. Your project should apply your knowledge of fluid mechanics in the design and testing phases.

Project Guidelines

All projects should be safe, specific, related to fluid mechanics, college-level, and approximately the right length. It is easy to pick an ill-defined project that is too long and too complicated.

FAQ

1. How big can my group be? No more than 4 BYU students. You may have 5 students if you also have a high-school student
2. How do I pick a project? Be creative. This is part of your grade. See example ideas below.
3. How long should the project take? Approximately 10 person-hours per group member.
4. Can I make a potato gun? No. This project is not safe enough.

Fluid Dynamics Project – Ideas

This list is here to help you generate ideas, but they are not specific enough to be a proposal. Use them to help you find a specific scientific question you can answer or engineering challenge you can solve with the resources you have available.

1. How do birds fly?
2. Why do birds flock and fish form schools?
3. What makes bees buzz?
4. Why are owl wings quiet?
5. Can a helicopter/bird/airplane fly upside down?
6. What wing design generates optimal lift?
7. Why don't we have flying cars/jetpacks?
8. What is a sonic boom?
9. How do sailboats move into the wind?
10. How is a wake created from a boat?
11. How does a submarine work?
12. Why does my bathtub form a hole in the water when it drains?
13. What is a vortex?
14. Why does adding a polymer to oil in pipelines reduce drag?
15. Why do waves form in lakes and oceans, and why do the break on the shore?
16. Why does a large rock cause water to spurt when thrown into a pool?
17. What causes the trade winds and the jet stream?
18. How long after a lightning strike does a person hear thunder?
19. Is the weight of a truck full of chickens less if the chickens are flying?
20. Why do curve balls curve? How do the seams of a baseball affect a curve-ball? Would higher seams make the ball curve more or less?
21. How does a pipe organ work?
22. How does a boomerang work?
23. How does the shape of a projectile affect its muzzle velocity?
24. At what speeds do feathers and lead balls fall in air?
25. How do bacteria swim?
26. How does a carpet vacuum design affect its ability to pick up dirt?
27. Can air be pumped or sucked faster?
28. What is multi-viscosity oil and how does it work?
29. Do large or small gas jets penetrate further into a flow? Why?
30. How are complex flows predicted?
31. What is the pressure inside a bubble suspended in the air, underwater, and in a water droplet and does this depend on the size of the bubble?
32. Do toilets really swirl in the opposite direction in the southern hemisphere?
33. How does a turbine work?
34. How is it possible to lift a car with such little force using a hydraulic jack?
35. What is cavitation and why are submarine and other ship crews so worried about it in the movies?
36. Why to the pipes in my house clank when the washing machine and faucets turn on and off?
37. Why does Ketchup often not flow out of a bottle and why does it sometimes flow fast after it finally starts?
38. Does peanut butter have a viscosity?
39. How does a tall tree get water to the leaves at the top?
40. Why must drains from sink toilets and other household fluid basins be vented?
41. Which way to windows break (inside or outside of a house) during a tornado, and why?
42. How do ice skates work? Do they work better or worse on cold ice or ice near its melting point?
43. How do different types of windmills work?
44. Do planes feel large changes in drag when they accelerate through the sound barrier?
45. How does a voice box (larynx) work?
46. How do speakers work, and how is Bose able to get so much sound from a small speaker?
47. What makes tornadoes and hurricanes flow in characteristic swirling patterns?

48. Is there a quantitative way to measure the beauty of a singing voice?

49. Are there shock waves in space?

50. Do sound waves, light waves and water waves have common characteristics?

51. How do fish and whales swim?

52. How big are the biggest pumps, valves, turbines, and fans and where are they used?

53. Are there waterfall under the ocean (yes); how big are they and what drives them?

54. How much effect do dimples on golf balls (and roughness on other submerged objects) really have?

Fluid Mechanics Project – Proposal Guidelines

Your proposal is a document that should convince me that your project idea (i) is safe, (ii) is specific, (iii) involves fluid mechanics at a university level, and (iv) is feasible with your given resources. Your tone should reflect the fact that you are addressing an audience who is technically literate, but not intimately aware of the background or details of your project. Your document should be well-formatted, less than 500 words not counting figures or references, and should fit on two pages. Please organize your proposal with the following sections.

Title, Authors and Date

Your title should be descriptive and all group members should be authors.

Introduction

The introduction states your objective and motivates your proposed project. If you are doing a science project, your objective should include a description of the question you are trying to answer. If you are doing an engineering project, your objective should include a description of the problem you are trying to solve, and the device you are designing.

Background

Your background should give a brief summary of what is already known about your science question or engineering goal. This should include a discussion of the relevant fluid dynamics theory that relates to your proposed project. Recall that all projects must show how they relate to fluid dynamics to be approved. Also, remember to properly cite all of your references. (I doesn't matter what format you use as long as you are consistent.)

Project Plan

In this section, you outline the plans for your proposed project. Your plans should include a description of the tasks that need to be accomplished, who is going to do them, what equipment or supplies you will need and what methods you are going to use.

Describe your tasks with specific details. If you are doing a science project, describe the measurements or calculations you are going to make. Discuss the analysis of these measurements or calculations. How will they answer your question? If you are doing an engineering project, describe your device design and testing protocol. How will this solve your stated objective? In both cases, provide a list of all equipment/supplies (including costs) and designs for anything you will be constructing.

Outline specific plans about who will accomplish the tasks. Describe any assigned roles in the group (e.g. group leader). Provide a Gantt chart summarizing the assignments and time-line.

Safety and Feasibility

Conclude with details about safety and feasibility. Discuss any safety risks and how you plan to deal with them. Insufficient discussion of safety protocols will result in a denied proposal.

Comment on the feasibility of finishing on time and on budget. What might go wrong with your plan? What alternatives might you pursue?

Fluid Mechanics Project – Presentation Guidelines

Your poster presentation is the culmination of your fluid mechanics project, and will determine the bulk of your project grade. During the poster session, a grader (Dr. Tree or a TA) will come by for a 5 minute presentation of your poster. One team member should be primarily responsible for presenting the material to the grader. However, all team members should attend the presentation and be available for questions.

Feel free to design your poster in a way that you find aesthetically pleasing, but please generally follow the IMRAD format. For instance, if you are doing a science project, your presentation should include your question, background material, a description of your methods, and your results and conclusions. If you are doing an engineering project, your presentation should include a problem description, background material (including a summary of the relevant theory), details of the design of your device or process, and your results and conclusions. In addition, you are welcome to bring anything you built or a video to share, but I cannot guarantee the availability of a power source or a flat surface.

Presentation Rubric

Project Title:

Team Members:

Category	Score
Design (25 pts) The project is interesting and creative, has an appropriate scope, addresses a specific question or need, and is generally well-conceived. The core of the project is based in fluid mechanics.	
Execution (50 pts) (Sci) The project addresses a scientific question using an experiment or theory. Data was systematically collected and analyzed appropriately. Sufficient data has been collected to support the conclusions. (Eng) A prototype has been built according to an engineering design. The prototype has undergone systematic testing, and the subsequent data has been analyzed appropriately. The project is completed, and the prototype demonstrates engineering skill.	
Presentation (25 pts) The poster is logically organized and aesthetically pleasing, includes background information, methods, results, and references. Group members can clearly and concisely explain the project, understand the relevant fluid mechanics, and can thoughtfully answer questions.	

Fluid Mechanics Project – Peer Evaluation Form

Please evaluate your team members based on their contribution to the group.

5 = This team member made unique and irreplaceable contributions to the group

4 = This team member made important contributions to the group.

3 = This team member made a satisfactory contribution to the group.

2 = This team member made a sub-par contribution to the group

1 = This team member was frequently absent and contributed very little to the group.

0 = This team member was completely absent or disruptive to the group.

Team Member	Ranking