Chemical Engineering 374 Project

This project meant to: (1) help you connect the principles dicussed in class and in the textbook with observations and hands on experience; (2) enhance teamwork and communication skills, and (3) be fun.

Students are assigned groups of 4-5.

Each team will conduct an out-of-class fluids project consisting of four parts:

a. Written proposal to me (must be approved before you can start).
b. Experimental work (equipment assembly, data collection, analysis).
c. Oral report given to the class.
d. Leadership feedback

Appropriate Projects:

Possible projects (see attached list for ideas) may include

- Measure a single quantity, such as viscosity, friction factor or shear stress.
- Measure a group of fluid mechanics quantities such as a velocity profile.
- Answer a quantitative question about fluid mechanics.

Appropriatness of projects will be based on whether

- The project is SAFE (see me EARLY if you have questions).
- The project is based on fluid mechanics at a college level.
- The project will lead to definitive results.
- The data can be accurately obtained.
- You can perform the appropriate analysis.

The Proposal

Your proposal (1-2 pages, written as a team) should be written as a Memo to Your "Boss" and should assume that your boss is technically trained, but may not be familiar with your project and may be rusty in his knowledge of fluid mechanics. The proposal should include

1. Objective: What question you intend to answer and why it is important.
2. Methods:
   a. Equipment you will assemble (include a diagram)
   b. Measurements you will make (number of replicates, conditions, etc.)
   c. Information you will gather from the published literature, as appropriate.
   d. SAFETY precautions you will observe. This must be Detailed, not "…we will be safe…"
3. Analysis: How you intend to interpret your data (including pertinent mathematical relationships).
4. Resources: the number of person-hours (including a timeline) and equipment/supplies needed to complete the project.
5. Group team structure/roles: examples include team leader, presentation coordinator, proposal coordinator, materials and experimental specialist. You can rotate the role of the leader.

Oral Report

The oral presentation (~10 minutes). Use the following principles of good oral presentations:

- Powerpoint presentation. Submit all materials in 1 folder titled, e.g., Group_1.
- Slides should not contain long sentences that the audience must read. Use short bulleted phrases.
- Slides should be limited to a few major points and not be too busy.
- The speaker should provide an explanation of all material on each slide (e.g., explain figure axes).

You will grade each others oral reports, and give group members a participation grade.

Leadership Feedback

Consider the following description of leadership and notice how many of the qualities are closely related to teamwork.

Leadership Qualities of a BYU Chemical Engineer

A BYU chemical engineer is a leader in a globalized society because he/she:

- Is reliable and can be counted on to accomplish tasks in a manner that exceeds expectations.
- Takes initiative rather than waits for assignments.
- Develops a vision in his/her scope of responsibility.
- Identifies problems *and* solutions.
- Understands the personality traits of self and others and can work with others in accomplishing tasks.
- Is culturally sensitive and works effectively with people from diverse backgrounds.
- Takes time to evaluate personal performance as a team member and improves when needed.
- Gives honest feedback to others and helps them succeed in their responsibilities.
- Receives criticism and makes changes where appropriate.
- Follows as well as leads.
- Demonstrates a good attitude on life and is pleasant to work with.

In light of this description of a leader, do the following:

Leadership Review:

1. Provide each member of your team with a written statement describing at least two strengths he or she possesses.
2. Provide each member of your team with a written statement describing at least two aspects of *teamwork* or *leadership* where improvements are needed.

Leadership Report:

1. Based on the comments of your group members from the Leadership Review, you will fill out an online form to the instructor that contains the following information:
    a. Name
    b. Outline each strength and weakness provided to you by your teammates.
    c. Select at least one of the weaknesses and develop a goal to improve in that area during the next lab experience. Note that you may be graded at the end of the next lab on your efforts to achieve the goal.
    d. If applicable, describe your efforts to achieve the goal you previously set based upon the feedback from a prior lab.
    e. If you have any serious concerns about one of your teammates that you want to share with the instructor anonymously, please include the comments on the oral report grading form (which will not include your name).

Fluid Mechanics Projects—Questions to Inspire…

1. What is a vortex?
2. How does a boomerang work?
3. Why do waves form in lakes and oceans, and why do they break on the shore?
4. How is a wake created from a boat?
5. How do sailboats move into the wind?
6. Is the weight of a truck full of chickens less if the chickens are flying?
7. Why do curve balls curve?
8. Why does a large rock cause water to spurt when thrown into a pool?
9. How does a pipe organ work?
10. At what speeds do feathers and lead balls fall in air?
11. How does a submarine work?
12. Can a helicopter (bird, airplane, fly) fly upside down?
13. What makes bees buzz?
14. Why are owl wings quiet?
15. How does a carpet vacuum design affect its ability to pick up dirt?
16. How does a potato gun work?
17. How does the shape of a projectile affect its muzzle velocity?
18. Can air be pumped or sucked faster?
19. What is multi-viscosity oil and how does it work?
20. Why does my bathtub form a hole in the water when it drains?
21. Who long after a lightning strike does a person hear the thunder?
22. Do large or small gas jets penetrate farther into a flow and why?
23. How are complex flows predicted?
24. What is a sonic boom?
25. 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?
26. Do toilets really swirl in the opposite direction in the southern hemisphere?
27. How does a turbine work?
28. How do birds fly?
29. What causes the trade winds and the jet stream?
30. How is it possible to lift a car with such little force using a hydraulic jack?
31. What is cavitation and why are submarine (and other ship crews) so worried about it in the movies?
32. Why do the pipes in my house bank when the washing machine or faucets turn on or off?
33. Why does catsup often not flow out of a bottle and why does it sometimes flow fast after it finally starts?
34. How does a tall tree get water to the leaves at the top?
35. Why must drains from sinks, toilets, and other household fluid basins be vented?
36. Which way do windows break (inside or outside the house) on a house during a tornado, and why?
37. How do ice skates work? Do they work better or worse on cold ice compared to ice near its melting point?
38. How do different types of windmills work?
39. Do planes feel large changes in drag when they accelerate through the sound barrier?
40. How does a voice box (larynx) work?
41. How do speakers work and how is Bose able to get so much sound from a small speaker?
42. What makes tornadoes and hurricanes flow in characteristic swirling patters?
43. Is there a quantitative way to measure the beauty of a singing voice?
44. Are there shock waves in space?
45. Do sound waves, light waves, and water waves have common characteristics?
46. How do fish and whales swim?
47. How big are the biggest pumps, valves, turbines, and fans, and where are they used?
48. Are there waterfalls under the ocean (yes); how big are they and what drives them?
49. How much effect do dimples on golf balls (and roughness on other submerged objects) really have?