General Information

Instructor: Dr. Alyssa Vikesland  
Office: Brauer 2008  
Phone: 314-494-7937  
email: avikesland@wustl.edu

Collaborating Instructor: Patricia Widder, M.S. BME  
Office: Brauer 2011  
Phone: 314-935-3560  
email: pwidder@seas.wustl.edu

Lead Teaching Assistant: Rachel Bilski (r.bilski@wustl.edu)

Teaching Assistants: Clark Ingram (clark.ingram@wustl.edu), Caroline Farrington (csfarrington@wustl.edu), and Joseph Dranetz (jmdranetz@wustl.edu)

Lab: Wed 1-4pm, Brauer 2011  
Dr. Vikesland’s office hour: W 12-1pm, and by appointment/email. Please do not hesitate to contact me!

Textbook: “Molecular Driving Forces: Statistical Thermodynamics in Biology, Chemistry, Physics, and Nanoscience,” Second Edition by Dill and Bromberg (the 320B text), as well as materials provided by instructor

Required Materials: Lab notebook and lab safety glasses. Close-fitting clothing covering arms and legs, as well as closed-toe shoes, must be worn in the lab at all times.

Introduction

This course is designed to give you a hands-on opportunity to ask questions, explore ideas, and design and test solutions. In the initial weeks of the course, groups will perform a set of lab exercises, learning about the procedures and materials for each lab. You will spend the later weeks of the course refining your work on just one of those original exercises, by designing and executing further tests on one of the systems. Your chief aim will be to explore—within a supportive and collaborative atmosphere—not to simply follow a set of step-wise instructions.

The lab exercises in this course are based on fundamental principles related to the role of thermodynamics in physical science, specifically biologically relevant engineering. While the experiments may at times seem simple, remember that what seems trivial on the surface seems
more and more complicated as you continue to ask questions and pursue answers. In addition, the experiments are chosen to facilitate you designing and executing your own experiments.

Grading of the course is designed to foster creativity, collaboration, and curiosity. The goal of designing your own experiments is to work as a team to use a creative approach in coming up with ideas, trying out your ideas, and interpreting your results. The emphasis is not simply on getting “right answers,” but on defining the problem/question, designing a solution, testing the solution, and analyzing and presenting the results.

Because this is a fairly new course, you have the opportunity to make a meaningful contribution to future students in this department through your efforts. As in an engineering team or research group, data can and should be shared (with proper citation!), as the class works collaboratively to refine questions, optimize procedures, test ideas, and propose new solutions.

Learning Objectives

- Make observations of physical phenomena related to material covered in 320 B (though concurrent/previous enrollment is not required)
- Read, interpret, and communicate results from published scientific literature
- Optimize procedures to obtain maximally accurate and precise results
- Collaborate with fellow classmates in solving problems in the laboratory
- Gain confidence exploring variables related to experimental questions
- Use experimental results to identify questions for further testing
- Design experiments to address specific questions
- Present a report of experimental findings

Grading

On-time attendance at lab is mandatory. Students are expected to stay through the entire lab period, unless instructor explicitly dismisses class.

Any emergency absences will be handled on a case-by-case basis. Points will be deducted from reports for students arriving late to lab or leaving early.

Specifications will be available in Bb for the assignments.

The first lab report will be turned in twice, allowing you to get extensive feedback before the final submission of the report. The first lab grading rubric will also be available to you. Note the shaded box at the beginning of each section—these questions will apply to all your reports!
You are expected to learn and incorporate excellent lab report writing in the process of writing the first report.

- **5 non-mastery wet labs**, each worth 10% of final grade
  - Before lab: Pre-lab reading assignment and brief in-class quiz at start of lab period (no quiz on first day of lab)
  - During lab: Effort, creativity, precision, teamwork, and problem solving
  - Report (specifications on Bb)

- **1 mastery lab**, worth 50% of final grade
  - Rough draft of proposal and materials list, worth 2% of final grade: done as a group, and turned in by end of mastery lab planning lab period
  - Final draft of proposal, done as a group, worth 3% of final grade
  - Proposal presentation, worth 3% of final grade: done as a group, and presented to class
  - Data summary, worth 5% of final grade: done as a group, must be revised until instructor approves, score will increase with iterations but a penalty per iteration also applies
  - Procedure, worth 5% of final grade: done as a group, must be revised until instructor approves, is written as if for a BME sophomore to follow in the next semester of this course; must be clear, specific, and easy-to-follow; must include any unique instructions for data analysis
  - Participation, worth 2% of final grade: graded by instructors, TAs, and your lab partner(s). Given on basis of effort, creativity, precision, teamwork, and problem solving
  - Report, worth 15% of final grade: done individually, due end of last week of class
  - Presentation, worth 15% of final grade: done as a group, presented to class during Reading Week

Labs will be graded with attention to the details of good scientific writing, per specific guidelines available on Blackboard. Lab reports must be the work of each individual.

Non-mastery lab grade makeup (of a possible 100 pts) generally is as follows:

- Up to 5 pts for lab quiz
- Up to 90 pts for lab report
- 0-10 pts for “Effort, creativity, precision, teamwork, and problem solving.” To obtain potential overall full credit (100 pts) for the lab, a student must obtain 5 of the 10 pts. This will documented in a section of the lab report following the Abstract, called
Experimental Contributions. In it, you will give a **brief summary** of your contributions regarding any distinctive effort, creativity, or innovation in problem solving, experimental design or engineering, or data analysis. Make sure your contributions are also fully described in the appropriate section. Excellence will merit scores in the 5-10 pts range.

Grading for the mastery lab will be based on logic and creativity of the experimental design, thoroughness of background research, collaborative approach, and precision and clarity in written report and oral presentation.

Lab report submission and grading will be through Blackboard. To ensure fair, unbiased grading by TAs, all reports must be submitted in accordance with the following guidelines:

- In PDF format
- All report text in 12 pt, Times New Roman. Use 1.5 spacing within paragraphs, and a full space between paragraphs. Sections should be set apart with appropriate but not overly unique style headings.
- Inclusion of a cover page that contains ONLY title of the lab, date, and **student ID number**. No fancy/unique designs.
- Report MUST NOT include student’s name and/or any identifying/unique items.
- In the submission space on Bb for every lab, type your **student ID number**.

The instructor will download the reports, then the TAs will grade reports according to the instructor’s guidelines and rubric. The TAs will not be aware whose work they are grading.

There are no exams in this course.

**Grading Scale**

The following overall final scores (given as percentages) are the minimum required to obtain each grade. The scores to receive the grade may be lowered from here, at the instructor’s discretion, depending on class performance.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>94</td>
</tr>
<tr>
<td>A-</td>
<td>90</td>
</tr>
<tr>
<td>B+</td>
<td>86</td>
</tr>
<tr>
<td>B</td>
<td>82</td>
</tr>
<tr>
<td>B-</td>
<td>78</td>
</tr>
<tr>
<td>C+</td>
<td>74</td>
</tr>
<tr>
<td>C</td>
<td>70</td>
</tr>
<tr>
<td>C-</td>
<td>66</td>
</tr>
</tbody>
</table>
Anything below a 54% will be considered an F.

**Late Policy**

The penalty for a late lab report will be 1/24 of the student’s grade for each of the first three hours late. For reports later than 3 hours, the penalty is 1/8 of the student’s grade, per day. (Note: this is the same policy as in Quantitative Physiology Lab).

Showing up late to lab or leaving early (without instructor permission/dismissal) will result in a penalty on the lab report grade, and reduced/no time to take the pre-lab quiz.

**Lab Exercises**

1. **Equation of State for Air**

Use pressure and temperature sensors to observe the relationships between temperature, volume, pressure, and moles of gas.

2. **Phase Transitions in Polymers (two weeks)**

Observe the cloud point transition in solutions of PEG/water/salt.

The second week, students have an option to do UV-vis analysis of the PEG solutions, or to use the solution calorimetry instruments to do an experiment. There is one report for both weeks of Lab 2.

3. **Thermodynamics of Rubber Bands and Muscles (two weeks)**

Observe the balance between enthalpic and entropic forces on a rubber band during Week 1. During the second week, the experiments will be repeated on a frog gastrocnemius.
4. Compression of Biphasic Materials

Observe the effect of compression on a biphasic material.

5. Osmosis and Dialysis

Observe the effects of gradients across a dialysis membrane in glucose solutions, quantifying the temperature-dependence of the effects.

**Academic Integrity**

Students are encouraged to work together to share ideas, design experiments, and troubleshoot problems. Engineering research and work often requires people to work closely together, and so this experience is seen as a valuable part of the course. However, written lab reports for the first five wet lab exercises and the final mastery lab report must be your individual work, and the final mastery lab presentation must be the work of only the lab group.

On your lab reports, you are free to use the resources available to you through the library, internet, or your peers, so long as you clearly cite all references/sources consulted. We live in the age of information, and I expect you to utilize and synthesize the information available to you. **Please remember not all information is good information!** I expect you to rely on trustworthy resources.

It is acceptable to include/reference data from other students in your lab report so long as there is a clear citation to the student(s) who collected that data. **You must make your data figures/tables and write any computer code individually.** You are encouraged to share ideas as you plan mastery labs in the later weeks of the course, but again, please reference by name anyone who contributed to your data/results.

Violations of academic integrity by any student will be handled according to the guidelines laid out for all Washington University students: http://www.wustl.edu/policies/undergraduate-academic-integrity.html

Exceptions to any of the policies outlined in this syllabus for an individual student (e.g., due dates and times) will be handled on a case-by-case basis.
Course Schedule (subject to change at instructor discretion; students will be notified of any changes)

<table>
<thead>
<tr>
<th>Day &amp; Date</th>
<th>Number</th>
<th>Lab Period</th>
<th>Assignment Due (assume Thurs midnight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday 01/14/15</td>
<td>Lab 1</td>
<td>Equation of State for Air</td>
<td></td>
</tr>
<tr>
<td>Wednesday 01/21/15</td>
<td>Lab 2, part 1</td>
<td>Phase Transitions in Polymers I</td>
<td>Reports for Lab 1</td>
</tr>
<tr>
<td>Wednesday 01/28/15</td>
<td>Lab 2, part 2</td>
<td>Phase Transitions in Polymers II</td>
<td></td>
</tr>
<tr>
<td>Wednesday 02/04/15</td>
<td>Lab 3, part 1</td>
<td>Thermodynamics of Rubber Bands and Muscles I</td>
<td>Resubmit reports for Lab 1</td>
</tr>
<tr>
<td>Wednesday 02/11/15</td>
<td>Lab 3, part 2</td>
<td>Thermodynamics of Rubber Bands and Muscles II</td>
<td>Reports for Lab 2</td>
</tr>
<tr>
<td>Wednesday 02/18/15</td>
<td>Lab 4</td>
<td>Compression of Biphasic Materials</td>
<td>Reports for Lab 3</td>
</tr>
<tr>
<td>Wednesday 02/25/15</td>
<td>Lab 5</td>
<td>Osmosis/Dialysis</td>
<td>Reports for Lab 4</td>
</tr>
<tr>
<td>Wednesday 03/04/15</td>
<td>Planning for mastery lab project</td>
<td>Plan mastery lab; write first draft of mastery lab proposal</td>
<td>First draft of mastery lab proposal (with materials list!) due end of class</td>
</tr>
<tr>
<td>Wednesday 03/11/15</td>
<td>NO CLASS</td>
<td>Spring break</td>
<td></td>
</tr>
<tr>
<td>Wednesday 03/18/15</td>
<td>Mastery lab work</td>
<td>Work on mastery lab</td>
<td>Final draft of mastery proposal</td>
</tr>
<tr>
<td>Wednesday 03/25/15</td>
<td>Mastery lab work</td>
<td>Work on mastery lab</td>
<td></td>
</tr>
<tr>
<td>Wednesday</td>
<td>Mastery lab</td>
<td>Work on mastery lab</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Activity</td>
<td>Event Description</td>
<td>Notes</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------</td>
<td>------------------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>04/01/15</td>
<td>work</td>
<td>Work on mastery lab</td>
<td>Mastery lab data summary</td>
</tr>
<tr>
<td>Wednesday</td>
<td>Mastery lab work</td>
<td>Work on mastery lab</td>
<td>Mastery lab procedure</td>
</tr>
<tr>
<td>04/08/15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wednesday</td>
<td>Mastery lab work</td>
<td>Work on mastery lab</td>
<td>Mastery lab report</td>
</tr>
<tr>
<td>04/15/15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wednesday</td>
<td>Mastery lab completion</td>
<td>Lab groups meet with Dr. Vikesland</td>
<td></td>
</tr>
<tr>
<td>04/22/15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuesday</td>
<td>Final presentation</td>
<td>Mastery Lab Presentations</td>
<td>Submit presentation file</td>
</tr>
<tr>
<td>04/28/15</td>
<td>(Reading Week)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>