CHEMISTRY 107B
Chemical Structure and Its Importance in the Environment
Syllabus -- Fall 2003

I have a number of general goals and objectives for students in this course.

1. To learn many fundamental concepts of chemistry. Some of these are well established and seem almost beyond refute. Others we will have to accept on faith and a degree of skepticism is worth retaining.

2. To learn that science does not know all the answers. This is especially so in the study of the environment, and many of our current understandings will be revised as further study takes place.

3. To participate in and learn about the process through which scientists undertake investigations and create knowledge.

4. To learn in interaction with, rather than isolation from, other students. Most things in the "real world" are done in interaction with other people, usually as a team effort. To benefit from working with other students, even if you dislike those with whom you are working.

5. To appreciate that science occurs in a social context. To explain a little bit of what I mean with this, think about your response to the following:

Do you trust the scientist who concludes that second-hand smoke is not hazardous to your health when you learn that the person's research was funded by R.J. Reynolds?

Similarly, do you trust the scientist who concludes the opposite when you learn that both of the person's parents were smokers who died of lung cancer at a relatively young age and that the research was funded by the organization "Citizens Against Smoking."

The major emphasis of the classroom portion of Chem 107B will be to develop an understanding of the structure and shape of atoms and molecules, and to appreciate how those aspects of chemistry pertain to the study of the environment. The most intriguing aspect of chemistry is that chemical substances (atoms and molecules) react to produce new substances. If we understand the reasons why some chemicals react with each other, whereas others do not, we can start to predict the possibility of new, unknown reactions. Such predictive ability is valuable for many reasons. As examples, it may enable us to better assess the fate of chemicals in the environment, or the effect of chemicals on living systems. The shape and structure of chemical substances, which does not just include the location of atoms in molecules but also the location of electrons, often determine why reactions occur. An understanding of atomic and molecular structure is therefore fundamental to an understanding of chemistry.

Throughout the course, reading material and problems from *Principles of Chemistry* by Michael Munowitz, W. W. Norton and Company, 2000, will be assigned. This book can be purchased at the bookstore. This is the same book that we used in Chem 107A and B last year, so used copies may be available on campus.

Other reading material that specifically addresses environmental topics such as global warming, photochemical smog, ozone layer depletion, and nuclear chemistry will be assigned throughout the term as well.

The major emphasis of the laboratory portion of Chem 107B will be to conduct a scientific investigation. The question we will examine in lab this year is whether acid rain mobilizes lead from soil so that the lead concentration varies as a function of soil concentration and acidity. We will also develop basic aspects of what is known as stoichiometry to complete the lab experiments.

TOPIC	**READING**
INTRODUCTION	
STRUCTURE OF ATOMS - HISTORICAL DEVELOPMENT	6-11, 103-136
The electron	
Mass-to-charge ratio	
Mass and charge of an electron	
The nuclear atom	
Blackbody radiation	
Global Warming	Handout
Photoelectric effect	
Line spectra of atoms	
Wave-particle duality	
NUCLEAR CHEMISTRY	771-792, Handout
"Women in Radioactivity" in "Women in Chemistry," M. Rayner-Canham, G. Rayner Canham, American Chemical Society, 1998	
STRUCTURE OF ATOMS - CURRENT UNDERSTANDING	
Quantum mechanics and the wave equation	46-54, 136-176
Electronic configurations	177-202
PERIODIC PROPERTIES OF THE ATOMS	
Electronegativity, ionization energies, electron affinity, atomic/ionic radii	202-215, 244-245

STRUCTURE OF MOLECULES

Chemical bonding	217-225
Covalent versus ionic bonds	
Molecular orbital theory - simple diatomics	225-241
Lewis structures	55-56
Resonance	
Shapes of molecules	60-66
Atmospheric chemistry	
Ozone layer depletion	Handout
Acid Rain	
Photochemical Smog	
A BIG PROBLEM	
The shapes of organic molecules are different than the position of the electrons in the component atoms.	
The fictitious solution - Hybrid orbitals	245-258

STATES OF MATTER

Dipole moments and polarity	237-238
Inter- and intramolecular forces	301-311, 393-399
Protein structure	339-344
Nucleic acid structure	
Gases	351-391
Liquids and solutions	
Solubility	
Colligative properties	409-420
Water pollution	Handout
Water quality	
Waste water treatment	
Drinking water treatment	
Phase changes	420-428

CLASS MEETINGS Class will meet from 11:00-11:55 on MWThF unless otherwise announced. Class will be canceled on the following days:

Monday and Tuesday, September 29 and 30
The week of October 20-24
Monday and Tuesday, November 3 and 4

Note: Laboratory sections will meet on these days.

EXAM DATES

October 3
November 14

GRADING

Two hour exams	- 160
Two graded essays	- 30
Lab quiz(zes)	- 40
Final exam	- 100
Lab	- 100
Participation	- 50
Homework	- 50
	530

-Homework credit will be awarded for handing in assignments.

-Participation credit is for attending class on a regular basis and participating in group-learning activities. Students will undertake a peer-evaluation process, the results of which will be factored into the participation grade.

LABORATORY

All students must complete the laboratory portion of the course to pass Chem 107B. The format and procedures for the lab will be discussed in your individual sections during the first week of lab. The first lab meetings are on Sept. 4 (Thur), 8 (Mon), and 9 (Tue). You may only attend the lab section for which you are registered to complete your experiments. Prior to your first lab meeting, it is essential that you buy the following items.

Lab notebook (any bound notebook will do)
Goggles (glasses are not sufficient)

These items can be purchased at the bookstore.

INSTRUCTOR

Tom Wenzel - 322 Dana - 786-6296 - twenzel@bates.edu

Office Hours: When I am not teaching class or involved in a committee meeting, I am generally in my office or lab. I encourage you to seek out my help when you need it. Feel free to drop in unannounced, or better yet to call or email me for an appointment.

COOPERATIVE LEARNING

"The challenge in college teaching is not covering the material, but *uncovering* it."[1]

It is important to keep in mind that the goal of any course is learning. As described at the beginning of this syllabus, there are a variety of different learning goals for this course. As a teacher, it seems to me that my fundamental task is to create an environment that facilitates your learning. In doing so, I must recognize that you have other demands on your time so my expectations, while they might be high, are not unreasonable. As a student, it seems that your fundamental task is to participate in the varied activities that will occur in this course, keep up with the work, and make a good faith effort to learn and facilitate learning.

In a learning environment it is not important who teaches you. I may be the primary source of information in this course. However, I am in no way the only source of information in this course.

-A classmate who understands a concept can explain it to you. You will benefit from their explanation. They will benefit by providing it as it will serve to deepen their own understanding of the concept.

-You may verbalize what you do not understand about a topic in a way that captures the difficulty others were having but could not verbalize.

-You may solve a problem in a way that makes sense to a classmate, thereby enabling that person to understand how to do the problem.

Since the goal is learning, we will be better off if we can use all teaching resources at our disposal.

For several years now I have employed cooperative learning in my upper level chemistry courses. I have become convinced that cooperative learning is a more effective instructional strategy than conventional methods in which science instructors usually lecture to the class. Last year I used cooperative learning for portions of Chem 107B. There are certain logistical constraints caused by having 60 students in the class compared to enrollments of about 15 in my upper-level courses. But the method seems to offer so many advantages that I am convinced it is worth us using.

I wish to emphasize the phrase, "worth **us** using", because the method can only be successful if students operate as full participants in the process. How is cooperative learning structured? What I will do, based on information I gather on the first day of class, is to divide the class into groups with four or five students in each. Then, rather than always lecturing on material, on some days I will provide you with in-class questions or problems that you are to discuss or solve within your group. My role is that of a facilitator. I will circulate among the groups. When I hear things that are important, I will tell you so. When groups are stumped, I will try to provide leading questions. One virtue in cooperative-learning is that all of you must assume the role of teacher as well as student. If you appreciate a concept or understand how a particular problem might be answered while someone else in your group does not, it becomes

your responsibility to explain it to that person. That way, we will all have more people to look toward for help than the instructor. With only one of me and as many as 60 of you, it is impossible for me to be able to provide each of you with the level of help you might need in the course. Having others to talk with on a regular basis is of considerable value.

If groups only met in class, however, the value of group learning is diminished considerably. What I will also provide on a regular basis are out-of-class assignments that you are required to complete. Groups **must** meet prior to submission of the out-of-class assignments to discuss the problems. (The first thing you will do when your group meets in class for the first time is to exchange names, phone numbers, and email addresses). There are different formats your group may choose for performing out-of-class problems. One is that you would all try them individually and then compare answers. Another is that you meet and work as a group on each problem. Even though each of you is required to submit your own set of answers, the answers of all members of a group ought to be identical, thereby reflecting the consensus of the group as to the correct answer to the problem. I also will schedule evening help sessions, usually the night before an out-of-class assignment is due. Individuals, portions of groups, or entire groups are encouraged to attend these sessions. We will divide into whatever arrangements seem best, and work on solving the questions in the assignment.

Reiterating a point I have already made, cooperative learning can be a better way for students to learn science, but it can only be successful if the students involved in the process participate with an open mind and willingness to work with others and share their insights and knowledge. The key to success is cooperation, not competition, among the members of the class. It is important to know that I have no set expectation on how many A's, B's, etc. I will give in a particular course. If everyone in the class does A work, I will give all A's. If everyone does failing work, I will give all F's. Therefore, it is best if we work together, trying to help each other learn the concepts presented in the course.

1) Cooperative Learning, D. W. Johnson, R.T. Johnson, and K. A. Smith, ASHE-ERIC Higher Education Report, 1991, p. 81.