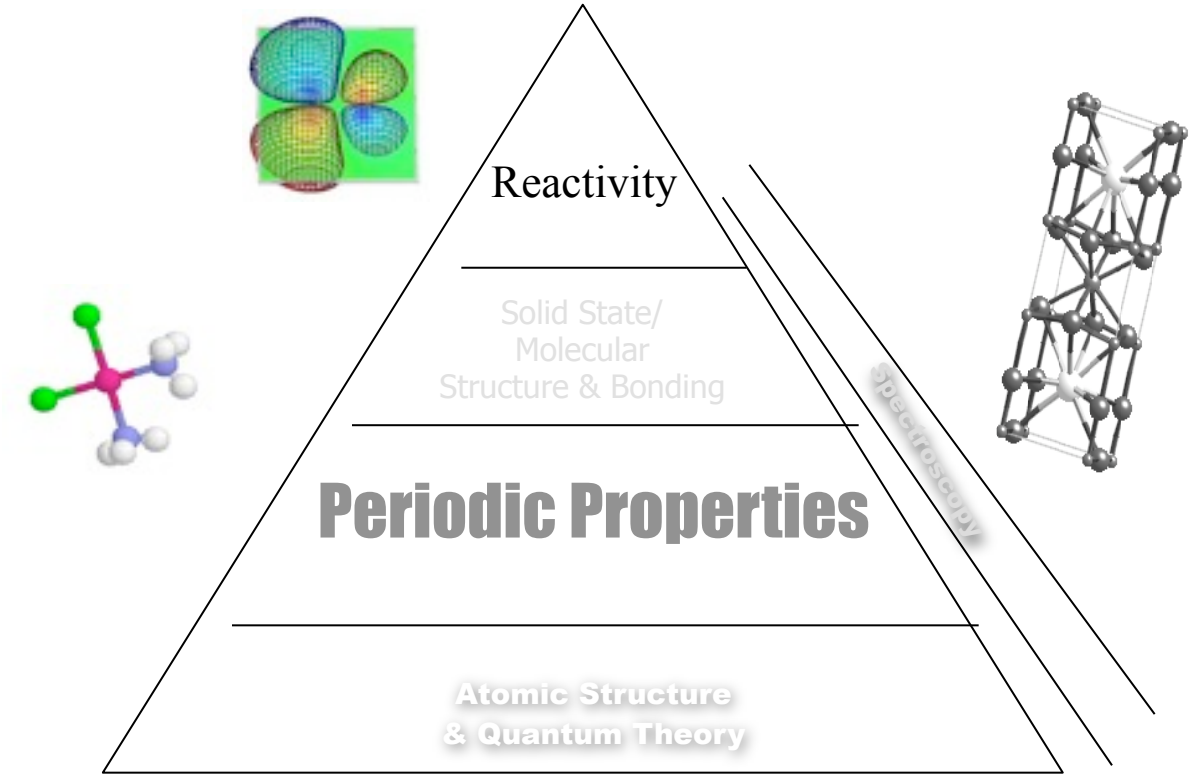
Chemisty 130A
Structure and Properties of Inorganic Compounds

Spring 2010
Prof. Hilary J. Eppley



"Felix qui potuit rerum cognoscere causas" -- Virgil, Georgics: Book 2, Line 490
--Happy is (s)he who is able to know the cause of things

Contact Information

Office: 355 Julian Science and Mathematics Center
Email: heppley@depauw.edu
Campus Phone: 658-4603
Skype name: heppley
AIM: profeppley
Home phone (emergencies only, no later than 10:00 pm): (317) 440-0576

Course Philosophy

The study of inorganic substances is a rich and interesting discipline that is important for understanding of a variety of other sciences and for an appreciation of the chemistry that is everywhere in our everyday lives. The study of inorganic chemistry allows us to understand why how inorganic vanadium compounds can be harnessed to store energy from wind power, why mercury found in Indiana's river fish might be dangerous to humans, how platinum compounds can work as anticancer drugs, how metal-organic frameworks can serve to store H_2 or CO_2, how a catalytic converter makes auto exhaust cleaner, how metals might be isolated from their ores or altered chemically to make the products we use everyday, or

even how chemical issues involved in the nuclear fuel cycle relate to the political issues involved. While the answers to these interesting questions are not accessible to us immediately as we start this course, they are rather something to work toward understanding as we progress through this semester!

The ultimate goal of this course is to learn about the properties and reactions of inorganic substances well enough to be able to apply them to understand the many fascinating applications of inorganic chemistry both in chemistry and in fields such as geology, medicine, biology, and environmental science. This knowledge will also help you be a better-informed liberally educated citizen. As we gradually learn important core concepts such as atomic structure, spectroscopy, molecular structure and bonding, and reactivity, we will be better able to address these interesting real-world problems. In order to understand the small portion of the complex world of inorganic chemistry that is incorporated into this course, you will need to learn to "think like an inorganic chemist." This will mainly consist of asking (and answering) the kinds of questions that chemists ask about inorganic substances. I will demonstrate and give you ample opportunities to practice this as the semester goes on! While some of you may have learned many of the same concepts in your high school chemistry courses, chances are quite good that you have not learned to think about them in the way that we will in this course. In your high school course you may have focused on learning the facts, definitions, and formulas. In this class you will need to understand the *detailed* "why" behind those facts and definitions and be able to address the "why" on your exams. Learning facts will be important, but it will definitely not be enough to do well in this class. Ultimately you will learn how to apply the concepts to new situations to solve more complex problems!

Goals for the Course

By the end of the course, you should be able to:

- *Recognize and represent inorganic substances using molecular structures, symbols and systematic nomenclature and understand these representations as a chemist would.*
- *Acquire the language and definitions of inorganic chemistry and be able to apply them.*
- *Describe and predict atomic structure and periodic properties of atoms and ion based on the periodic table.*
- *Describe the various models of structure and bonding in covalent, ionic, and metallic substances and use them to predict properties of inorganic compounds and understand how they differ from one another.*
- *Describe, recognize, and predict the products of the major types of inorganic reactions: acid/base, precipitation, redox, and complexation.*
- *Appreciate the role that spectroscopy plays in characterizing inorganic substances*
- *Synthesize information from the above categories to solve more complicated problems*
- *Appreciate the potential of inorganic chemistry for understanding the world around us and see these real-world problems from the perspective of a chemist.*
- *Find relevant chemical information in the library or on the internet.*
- *Develop practical laboratory skills to synthesize and analyze inorganic compounds.*
- *Use a version of the scientific method to design your own chemical experiments to test hypotheses and interpret the data to understand chemical concepts.*
- *Express scientific thoughts clearly in written form: in the lab notebook, lab reports, short writing assignments, and essay questions.*

Class Basics

ClassTimes:

Class	10:30 – 11:30 am MWF	JSC 368
Lab	8:30 am – 11:30 am R	JSC 358

Office hours

I will definitely be in my office each week Monday from 1 pm to 2 pm, Tuesday 12:30 pm – 1:30 pm, and Friday 2 pm – 3 pm. These can be considered "safe" times to drop in to ask me a question. You may also make arrangements to meet me outside of those normal office hours via email. I may also be available during certain evening times on Skype or my AIM account to answer questions you might have via chat or VOIP (this will be arranged on consultation).

Textbooks and Supplies

- ***Chemistry: Structure and Dynamics, 4th Ed.*** *Spencer, Bodner, and Rickard*, Published by Wiley & Sons; New York, 2008.
- Supplemental Modules available online (free)
- Optional Books: these inexpensive books (about $20 each if you buy them used) contain several topics not covered in the textbook and must be ordered on your own. While you can reply on notes from class, these are good resources for students who prefer to be able to read about a topic as well:
    - *Chemical Bonding* (*Oxford Chemistry Primers*, *No. 15)* Mark Winter, 1994. (good for radial probability diagrams, other bonding topics)
    - *d-Block Chemistry* (*Oxford Chemistry Primers, No. 27)* Mark J. Winter, 1995. (good for ligands, HSAB, plus some other types of d-block topics.
    - *Periodicity and the s- and p-block elements*, *Oxford Chemistry Primers*, *No. 51*, N. C. Norman, 1997 (good treatment of periodic property subtleties and Zeff)
- Lab notebook: Lab notebooks with duplicate pages are required.

The main textbook and the lab notebook are available from the University Bookstore

Laboratory and Class Fees

During your first laboratory of the semester you will need to pick up a pair of safety glasses. You will be billed a nominal fee (about $6) for your safety glasses (cost will go on your bursar's bill). You are also responsible for the cost of glassware broken during lab. You will be billed for any broken glassware at the end of the semester. Students will also pay for copyright permissions for handouts that are copyrighted and for the Xeroxing cost of the laboratory manual.

Important Dates for the Semester

Midterm Grades Due	**Mon, Mar 15**
Withdraw Deadline	**Fri, Mar 19**
Spring Break	**Sat, Mar 22 – Sun Mar 28**
Last Day of Classes	**Thurs, May 14**
Study Days	**Fri, May 15; Sun, May 17**
Final Exam	**Tue, May 18 8:30 am – 11:30 am**

Grading Policies

The grading for the course is broken into the following areas:

In-Class Exams: 36% (12% for each exam)

Cumulative Final exam: 24%

Laboratory: 20%

Various In-Class Assignments, Homework Assignments, Quizzes: 20%

Grading Scale

A	93-100%	C	73-76%
A–	90-92%	C–	70-72%
B+	87-89%	D+	67-69%
B	83-86%	D	63-66%
B–	80-82%	D–	60-62%
C+	77-79%	F	Below 60%

*****YOU MUST PASS BOTH THE IN-CLASS AND THE LABORATORY PARTS OF THE CLASS IN ORDER TO RECEIVE A PASSING GRADE FOR THE COURSE.*****

Exams

EXAM I: Wed, Feb 24 **100 pts**
EXAM II: Wed, Mar 31 **100 pts**
EXAM III: Mon, Apr 28 **100 pts**
Cumulative Final Exam: Tue, May 18 8:30 am – 11:30 am **200 pts, about 35% New, 65% Cumulative**

Make up exams may only be taken by prior arrangement and only for excused absences (significant illness or university-sponsored extracurricular activity). **For conflicts with other classes, sports, or extracurricular activities, make-up exams must be arranged at least *two weeks* in advance.**

If I have not heard from you or someone acting on your behalf 48 h after a missed assignment for any reason to make arrangements for its completion, the assignment will be marked as a zero.

Laboratory

Inorganic chemistry as a science is constantly evolving as new experiments are performed in the laboratory; this is how new knowledge develops. You should treat the laboratory as a place to learn concepts of inorganic chemistry in a different, more hands-on way than you do in the classroom. We will be doing several types of laboratories during the course of the semester. Some of the laboratories will be ones where we learn new techniques and make compounds. Some will be ones where we observe lots of different chemical reactions, and try to come to a conclusion about what those reactions tell us about general trends in chemical reactivity. Some will be labs where you have to design your own experiments, and in some you will use computers to visualize molecules. While these labs will give you many different types of experiences, they are all integral parts of the course. You must complete every laboratory in order to pass the class. You will turn in a lab report of some type for each laboratory that you complete (more information will be given in the laboratory portion of the class).

Class Participation

I expect you to come to class prepared and to arrive on time. I tend to conduct my classes in a very interactive way, and I ask a lot of questions as I go through a class period. If you are not volunteering to answer questions, I will try to coax some answers out of you by calling on you. I am not trying to be "mean" when I do this, I am just trying to make sure that people are following along and are building on the material they have been learning. If you are ever confused in class, please ask a question, even if you don't know exactly what to ask (you can say that too!). Chances are, if you are confused, someone else is as well! Don't be afraid to ask! I want everyone to understand the concepts that I am presenting, and I can't always read your mind to tell if you are confused! If you are shy about doing this out loud, you can drop me an anonymous note at the end of class with your question on it. I will be sure to address it at the beginning of class next time.

Homework from the Textbook

Practically every day, I will assign some problems from the text (or some of my own!) so you can hone your problem solving skills. I highly recommend you get together with other members of the class and compare homework answers in small groups. This is a great way to get you talking to one another about problems and to help each other when you run into difficulties. As you will find when you are working in the small groups in class, most people learn better when they have to teach it to someone else. While I will generally not collect these problems, I will put answers to these problems on the

course web site so you can check them, and I'd be happy to go over questions that you have on these problems. Every Friday at the end of the class period there will be a 5-minute quiz that will be directly based on the assigned homework problems from the book (or other very specific things announced previously, such as nomenclature). I will allow you to drop the grades of the two lowest quizzes, but the catch is that if you are late or don't show up for class (including illness or other excused absences) you will have to drop those scores--no excuses! Quizzes will account for about 5% of your grade.

Group Problem Sets

As clear as a concept may seem in lecture or while reading the book, you will not really learn it until you have to apply the concept to a real problem, especially one where you will have to explain your reasoning carefully using correct scientific language. We will practice both of these things frequently in groups in class and outside of class. These assignments are the place where I ask tough questions and let you tackle them in groups. Frequently you will have to write essay answers to the questions so that you learn how to explain science and not just memorize facts! Throughout the semester I will try to give you very thorough feedback on your answers so you can improve for tests as well. I will frequently use group in-class assignments not only to test your grasp of a subject but also your ability to "take it to the next level" so you should expect that these assignments will be significantly more difficult than the problems assigned in the text. You should expect these types of assignments most weeks in class. I will collect one assignment from your group each time but I won't tell you who I am going to pick so it is the group's responsibility that everyone understands their answer and can express it in their own language. Group problems will account for about 10% of your grade.

Chemistry Applications

Two of goals that I have for this class is to get you thinking about the role that inorganic chemistry plays in your life, and to learn to find chemical information that is not written directly in your book and relate it to what you are learning. In these assignments you will get a chance to explore how inorganic chemistry we learn in class is related to real-world applications. These assignments will be a portion of the homework grade for the class (approximately 5% of the overall grade).

Some Tips for Success in this Course

Structure and Properties of Inorganic Compounds is a course designed to provide a foundation in the concepts of inorganic chemistry necessary for study of many scientific fields. Because many students who take this course are first year students, many come into the course with expectations about the amount of work and the level of work required of them that is based on their high school experiences. I have had many students say "but I got an A in high school chemistry" or "we moved more slowly in high school chemistry". Chemistry at the college level is a different beast. We will only take about a week to a week and a half to cover the material in many chapters in the text, and we will cover the material in more significantly more depth than you were expected to in high school. Sometimes you will need to integrate ideas from different parts of the course, learn material that is not in the textbook, or to apply those ideas to a new situation and explain your reasoning. Regardless of your experience level, chemistry is a challenging subject, and will require considerable effort on your part. The class will move at a relatively rapid pace and it is EXTREMELY important to stay caught up in your work. A student from a previous year said on her evaluation of the course "This course taught me much, much more than my AP Chemistry course in high school." Don't be lulled into thinking you know it all from previous courses, but don't be scared either—I'll give you the tools you need to succeed, but you must use them in order to do well!

This course is a partnership between the professor (that's me!) and the student (that's you!). In this partnership, we both have jobs to do:

MY JOB:

- To be excited about the field of inorganic chemistry!
- To willingly answer all questions asked of me **or** provide guidance as to how to go about answering those questions
- To provide guidance on "how to learn chemistry"
- To convey the expectation level for work in the class
- To present material clearly and in a way that makes it easy to take notes
- To return graded work in a timely fashion
- To give fair (fair does not mean "easy") examinations and assignments and provide helpful feedback

YOUR JOB:

- To participate actively in in-class and homework activities
- To challenge me with creative chemical questions (I will try to figure out the answer if I don't know!)
- To come to class and lab on time every day, prepared and ready to engage the course material *actively* (do problems in class, ask and answer questions, etc.)
- To complete homework assignments and lab reports on time
- To ask questions when a particular topic, problem, or classroom policy is unclear
- To be respectful during class while others (including me) are talking

I want you to succeed in this class, regardless of the chemistry background you bring to the class (and your class will likely be as heterogeneous as many I've had before). I will give you many tools to succeed, including extra homework problems, access to old exams, and in-class assignments. I will ask you additional questions to point you in the right direction and provide you with worked answers to problem sets when we have completed them. ***However, YOU are the one who is ultimately responsible for how much effort you put toward your study and understanding of chemistry, how much learn in this course, and the final grade that you receive.***

HOW TO PROSPER IN (AND ENJOY!) CHEM 130

Chem 130 is not an easy course; it will require considerable outside preparation in order to do well in the class. Prepare to spend **at least** two hours outside of class for every class period plus additional time for the laboratory report preparation (some students will require more, some will require less). Therefore, you should spend at least an hour EACH day studying chemistry. This out of class preparation should include reading the chapter before coming to class, re-reading material and doing assigned problem sets and problems in the book as well as using in-class problem sets to guide further studying.

If you find that you are struggling in Chem 130 (i.e. cannot do the in-class assignments or assigned problems, or do poorly on the first exam), you should:

- Participate in a study group with other members of the class
- Make an appointment to see me to discuss your study strategies
- Come to my office with questions about the material (there are no stupid questons!)
- Do extra problems like the ones you are having difficulty with (I usually assign less than half of the problems in the book--try another problem similar to the one you are having trouble with)
- Make sure you are attending class regularly
- Take good notes in class (I will help suggest note-taking strategies if you are unsure about your note-taking skills)
- Seek help from the Q Center (part of the Academic Resource Center) The Q-center is located in Room 115, Asbury Hall and has a satellite location in room 50 of the Prevo Science Library. The website is http://www.depauw.edu/admin/arc/qcenter.asp. Students can link to the tutoring schedule

from this site and schedule appointments at x4039. I will provide information about Q-center tutoring hours as they become available.

I have seen students improve to *A* work after a less than stellar first exam with a concerted effort, but I have seen many other students refuse to get the help they need until it is too late. If you have a weak chemistry background AND are unwilling to put in 2 hours of preparation for every class period, you are setting yourself up to struggle in this class. If you work hard, you can succeed in spite of a weak background! If you've read the syllabus this closely, you obviously want to do well in the course, so email me within 24 hours of receiving this syllabus to set up an appointment to see me in person, and I'll give you 2 extra points toward your homework grade.

Academic Honesty and Late Policy for Labs and Homework

Academic dishonesty of any form will not be tolerated in this class. Please refer to the University's Academic Integrity policy in DePauw's Student Handbook. If you are unclear about what constitutes academic dishonesty in this class, ask. There are many times when I will encourage collaboration between students to facilitate learning, while there are other times when I will clearly indicate that students are required to work alone. However, at no time should you be copying someone else's assignment, lab notebook, etc word for word, even if you are working as part of a group in class or lab. If you are ever unclear about how an assignment is to be completed, get me to clarify it. The penalty for academic dishonesty is always worse than failing or not completing the assignment.

I understand that students frequently have multiple assignments due at the same time in different classes. To accommodate these circumstances, I will give each person a total of 2 "late days" for the semester. That means you can turn in one assignment or lab 2 days late or 2 assignments each 1 day late (weekend days count toward this total). After your 2 days is up, any late assignment loses 40% of its points. **You do need to tell me the day an assignment is due when you are planning to turn an assignment in late.**

Course Outline and Web Site

The course outline, with appropriate homework and lab assignments will be posted on the course Moodle site (http://moodle.depauw.edu). I will keep you informed about where we are and what is due in class. Copies of all handouts will be posted to the web site, so if you miss a day of class, consult the website to download what you've missed!

Other Chemistry Courses

Those students considering majoring in Chemistry or Biochemistry or who are interested in taking additional chemistry courses in the future should consider registering this semester for Chemistry 170, Stoichiometric Calculations if they haven't done so already. This is a self-paced, 0.25 credit course covering basic chemical calculations such as mole conversions, yields, solutions and gas laws. Chemistry 170 is a pre-requisite for Chemistry 260, Thermodynamics, Equilibrium and Kinetics. After you complete Chemistry 130, the courses you can take are Chemistry 120 (Structure and Properties of Organic Compounds), and Chemistry 260 (Thermodynamics, Equilibrium and Kinetics). You and your advisor (or any member of the Chemistry Department) can discuss which course(s) are most appropriate for your major and career objectives. You can visit the Chemistry Department web site (http://www.depauw.edu/acad/Chemistry/) for additional information on the chemistry curriculum.