SYLLABUS

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Carleton College, Winter 2008
Olin 103, 11:10 AM - 12:20 PM MW
Olin 103, 12:00 PM - 1:00 PM F
Office hours are open, or by appointment.

COURSE MOODLE PAGE:
Will be used! Check it!

PREREQUISITES:
Chemistry 230 or Chemistry 233 or consent of the instructor.
Students are expected to have a working knowledge of general and organic chemistry.
Familiarity with basic chemical instrumentation is helpful.
No prior experience with environmental chemistry is required or assumed.

DETAILED COURSE DESCRIPTION:
Text from the catalog: Humans have had a dramatic impact on the chemistry of the earth's environment. In this course, we will study the chemistry of molecules in the air, water, and soil. Emphasis will be placed on understanding the chemistry in the natural (unpolluted) environment, and the changes which occur due to human activity and pollution. In addition, we will explore the methods which are used to measure pollutants in the environment and their applicability, as well as regulatory issues of relevance to the topics studies.

What will we do? In this course, we will examine in detail some of the issues of current importance in environmental chemistry. Obviously this is a broad field, with a number of issues that researchers, regulators, industry, and policy-enforcers are approaching from a wide variety of angles. We cannot hope to cover the entire topic in one course. A small but representative number of issues will be chosen for detailed discussion in class which are of current environmental importance. Particular emphasis will be placed on understanding the strengths and limitations of the measurement techniques currently employed for measurement of chemicals in the environment, since regulations cannot be more stringent than the state-of-the-art measurement techniques allow (and are sometimes much less stringent). In addition, you'll get your turn to propose a study or a new measurement technique (see below).

How will we do this? This course will be almost entirely discussion-based, and our textbook will be the current literature. First, the class will identify specific papers dealing with chemical measurements of environmental interest in the current literature. We will choose an appropriate number of these for discussion, assuming ~1 paper/week. Each student will be responsible for becoming the local expert about a specific set of issues for our discussions about each paper. The issues that will require expert input include:

- **What is the importance of this paper?**
  - What is the main goal of the authors in performing this research?
  - What do the figures and tables mean, and how do they demonstrate the authors' successes?
  - What are the further questions and/or unresolved issues that are brought up by the paper?
- **What is the basic science underlying this research?**
  - What chemical ideas do we need to understand to know why this issue is of environmental importance?
  - What is the "textbook" chemistry that we need to understand to appreciate this topic?

  - What is the basic environmental chemistry of the system this contaminant occurs in (i.e. air, water, soil)? How prevalent is this species in the environment, and at what concentration levels?

- **What, if any, environmental regulations currently exist to deal with this chemical in the environment?**
  - Is it covered in any major regulations (Clean Air Act, etc.)?
  - Is its release regulated by any organization?
  - What approved methods for measuring this chemical in the environment currently exist, how do they work, and how sensitive are they?
- **What instrumentation/measurement techniques are described in this paper to measure this compound in the environment?**
  - Is this technique standard or new?
  - How does the measurement technique work?
  - How sensitive is the method?
  - How complex/expensive/etc. is the method?

The daily class-periods will be structured around discussion of these issues, with the "experts" on each topic expected to lead the portions of the discussions relevant to their topic. For this approach to be successful, the following things must be done by ***each student*** in preparation for class:

- ***Read each paper carefully***, identifying the portions that you have questions about. If you feel confident that your question falls within one of the expert's areas, make sure to bring that question to class. If you are not confident that the question will be answered this way, try to answer it before class and bring what you learn into the discussion.
- ***Be prepared to teach your classmates***. Think about the most effective way to help your classmates learn the information about which you are the expert. If you are the expert on environmental regulations relating to a particular chemical, for example, prepare appropriate handouts, powerpoints, or other materials to use when discussing this information with your classmates. (Be very sure to reference your materials properly! And remember that wikipedia is not the only source of information!)
- ***Participate in the discussions***. The least interesting way to run this class will have us going around the table, hearing a report from each expert, with no conversation. The most successful way will be if everyone has thought about every issue, has written down their own questions about the topic, and is prepared to pose questions, offer interpretations, and bring their own analysis into the conversation. Our goal is to understand the issues surrounding the paper as well as the details within it. Silence is not an acceptable option in this class.
- ***Specifically address your questions***: For each paper that you are NOT a local expert on, you will be asked to submit a list of 4 – 6 detailed questions at the beginning of the first day of discussion. You will then need to choose one of these questions to answer in a short (1 – 2 page) paper, due the next class period after the discussion of the paper has ended.

What resources are available to us? The library at Carleton contains **journals**, from which we can choose papers and learn about the science involved; **books**, from which we can learn background and technical information; and **government documents**, from which we can get information regarding regulations. We also have a variety of **software products** that provide information about approved methods for measurement of a variety of chemicals in many matrices (air, water, etc.). Finally, there is the **internet**, from which we will also be able to obtain a great deal of information. But be cautious! Not all information is on the internet, and not all information on the internet is complete or correct. Some of the most useful web sites for this course are given below. Please let me know of others that you find useful.

- http://www.epa.gov The starting point for many searches! A useful way in is to click on “browse” from the main page, and choose sub-topics of interest. Also the search is extremely useful if you have specific questions to answer.

- http://www.gpoaccess.gov/cfr/retrieve.html To retrieve specific Codes of Federal Regulations (CFR's), go to the Government Printing Office (GPO) web page. Be prepared with the title, part, and section you want, *eg*. For 40 CFR 261.33, Title = 40, Part = 261, Section = 33. Be prepared to wait. Sometimes crashes when you are asking for .pdf files.
- http://www.epa.gov/air/airtrends/: The most recent available document (2002) discussing trends in air quality, including specific details about the criteria pollutants, monitoring networks, *etc*.
- http://www.epa.gov/OGWDW/methods/methods.html A list of method numbers for evaluating contaminants in drinking water. The details of the method itself are not given here, but the complete text of most of them is available elsewhere.
- http://www.epa.gov/epaoswer/hazwaste/test/main.htm#Chapter On-line test methods for evaluating solid waste (physical/chemical methods). Various chapters contain lists of method numbers and what they are appropriate for. You can then look up the method number (X000 Series), and get step-by-step instructions for the analysis.
- http://pubs.acs.org/ We have access to the full text on-line of the journal *Environmental Science and Technology*, which is the premiere journal for reporting modern advances in Environmental Chemistry, and which also includes a news section. Also the journal *Analytical Chemistry*, for which we also have full-text, will be of interest.
- http://www.sciencedirect.com/science/journal/13522310 We have electronic access to the journal *Atmospheric Environment*, which contains a lot of good information about atmospheric measurements carried out all over the world.

What is meant by "your turn" to propose a study? In addition to classroom discussions, each student will write a grant proposal, in the format required by the EPA. This is a significant undertaking, and will require each of you to identify an area of environmental monitoring that you think needs more research. You will then be asked to submit a proposal to request appropriate funding to carry out your research project. To do this, you will need to provide appropriate background to the problem, discussion of the scope and causes of the problem, current measurement options, and details of your proposed new method. This will be the final paper for the course, and more information will be provided later in the term.

GRADING:
This course will be graded largely based on each student's participation in the daily discussions (50% -- 30% will be from the days when you are presenting, 20% from the days when you are only participating in discussions). There will be a take-home midterm (15%) and the final paper/proposal (35%) as well.

It will not be possible to quantify your grade at any given point throughout the course, given that it is largely based on classroom participation. If at any time you have questions or concerns about your level of participation in the discussions, please let me know. If I have concerns with your level of participation, I will bring them to your attention, as well.