Pollution in the Environment
Fall 2012 Syllabus
Instructor: Dr. Vijay M. Vulava

1 Contact Information

Office:	RHSC 336, MF 13:30-16:00 h (or by appoint.)
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Lectures, readings, & links:	"OAKS" on http://my.cofc.edu/

2 Course Goals and Structure

In this course you will obtain theoretical skills required to understand how natural and anthropogenic factors influence pollutant behavior on Earth's near-surface environments. We will primarily focus on fresh water (i.e. streams, lakes, and groundwater) and shallow geological environments.

Since this may be the only environmental chemistry-themed course you may take at the College, it will be a broad survey course and will cover a lot of topics. Paradoxically, you will find that "environmental pollution" is so broad, that we barely touched a fraction of all aspects of this topic in this course. You will, however, have the opportunity to pursue and research topics related to pollution in detail on your own over the course of this class. Some examples of case studies/topics that could be covered are shown in Figure 1. Depending on your interests more cases could be studied.

This course takes a very quantitative approach to understanding environmental pollution issues. Over the course of the semester, you will also be introduced to tools such as (i) PHREEQC, a very powerful hydrogeochemical modeling tool (http://wwwbrr.cr.usgs.gov/projects/GWC_coupled/phreeqc/), (ii) Visual MINTEQ, a visual chemical equilibrium model (http://www2.lwr.kth.se/English/OurSoftware/vminteq/), (iii) Wolfram Alpha, a very powerful visual mathematics programming language (http://www.wolframalpha.com/), and (iv) Excel, to solve and visualize equilibrium chemical problems.

Several of you may be uncomfortable with your arithmetic, geology, and chemistry skills - I assure you that most of you are in the same boat. Just be open to learning lots of new concepts and don't stress out – environmental chemistry and sciences are more fun than you can imagine! I don't expect anyone to fail in this class, but, you need to put in some effort! Class attendance is most important part of this class and you may not do well if you miss classes. *All deadlines will be strictly enforced*, unless you have a very good excuse (death in family, contagious illness, etc., but being stressed out, etc. are not good excuses.)

Unlike the most other science courses you have in Geology, this course is a bit different in two regards:

1. **A case study approach:** The traditional approach of top-down incremental knowledge approach seems too contrived for this kind of a class. Instead, this class takes

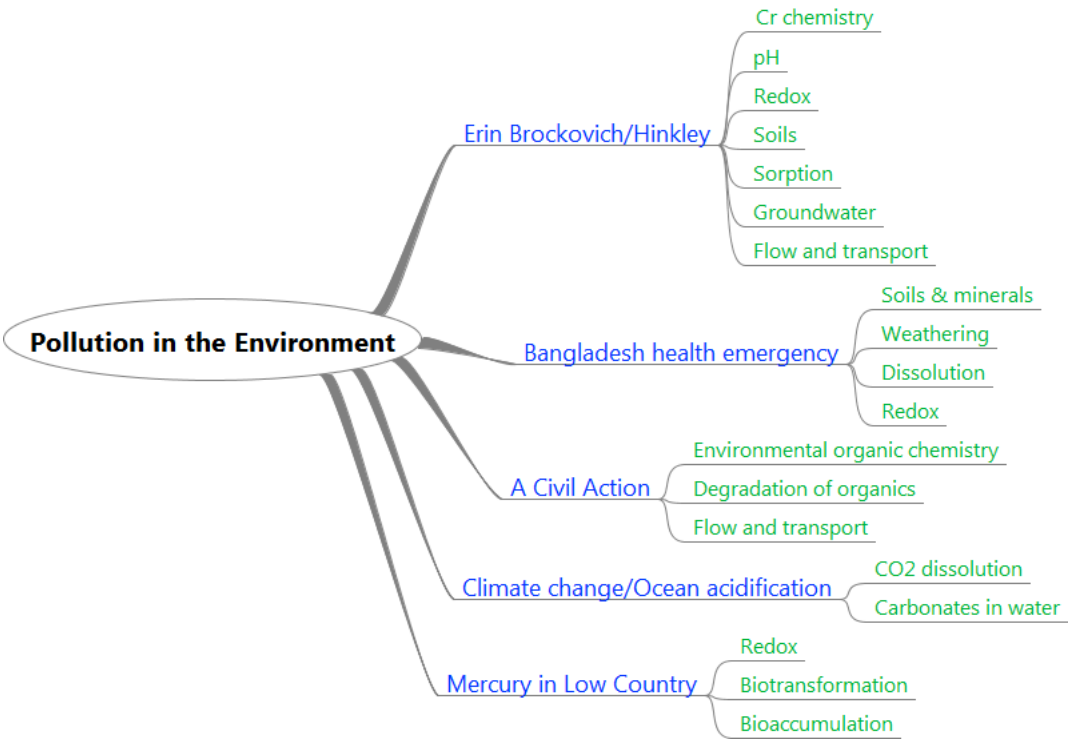

Figure 1: Case studies and themes covered in the course.

an unstructured case study approach to understanding environmental pollution issues. This approach will help you focus on the "big picture" and develop a context for using basic science concepts to understand how environments work. As you try to unravel specific environmental pollution issues, you will learn core science skills necessary to understand and predict outcomes in similar situations. Since this is a significantly different approach than what you probably see in other classes, I expect all of you to fully participate and give me periodic feedback on what is working and what isn't. I will gratefully accept and welcome all comments (positive and negative) and will attempt to incorporate any changes necessary to make your learning experience successful. I expect you to be a full partner in this course.

2. **No examinations:** One of the main goals of this course is to enhance your understanding of environmental pollution issues and be able to both qualitatively and quantitatively predict various outcomes. This requires critical thought and practice in both group settings and in individual settings. A traditional way to test your understanding is to have an exam and test your competence, but this is not the best approach for this course. Hence, there will be no exams (or a final exam) in this class, instead, there will be group and solo problem-solving activities and assignments. There will be several collaborative opportunities in this class on research and problem-solving activities.

For those of you that are registered for the laboratory component of this course, atten-

dance is mandatory as these labs are hard to make up if missed (some of these are field trips.) The first half of the semester, you will learn basic environmental analytical techniques and familiarize yourselves with advanced instrumentation. You will hand in brief reports (up to 1500 words including figures and data tables) that contain critical analysis of the experiments conducted. The second half of the semester will focus on your lab-based projects at the end of which you will turn in a 5000-word paper (including references, figures, and tables.)

There will be two to three field trips during the semester that would require more than the allocated class time. Hence, plan on spending 3-4 h during two weekends to attend these field trips. Two of these trips will focus on conducting water quality surveys in Filbin Creek, North Charleston and another to Shem Creek in Mt. Pleasant. If you have other ideas for potential field trips, let me know in advance. On these trips you will have hands-on opportunities to learn about techniques that are used to assess basic environmental parameters in the field.

Since this class is about the environment and ultimately related to sustainable practices, we'll *limit use of paper as much as possible*. Email me all your assignments and project reports in MS Word format (PC format).

3 Learning Outcomes:

On successful completion of this course, you will:

1. develop a solid understanding of environmental processes and pollutant behavior in the environment,
2. develop the requisite skills to apply this knowledge to solve environmental problems, and
3. learn how to make quantitative predictions about outcomes of chemical reactions that occur in context of geological processes.

4 Prerequisites

This course is designed for students that have a two-course sequence of introductory geology (GEOL 101/103 and 105), chemistry (CHEM 111 and 112) and college level introductory math courses, those that are deficient can also do well in this course. Such students may need to spend additional time getting up to speed with the basics. Basic arithmetic is used throughout this class (logarithms, manipulating and solving simultaneous equations, etc.), so if you're out of practice, either look up basic math (Math 101/102) textbooks or come and see me if you need additional help.

5 Textbooks

There is no required textbook for this class. All required readings will come from journal articles, textbook chapters, and other sources. These readings or links to sources will be made available as PDFs on OAKS.

Required Reading for TCE Case Study: J. Harr. 1996. A Civil Action. 502 pp. Random House.

Reference Text: R.A. Hites. 2007. Elements of Environmental Chemistry (Paperback), 224 pp., Wiley. Compact introduction to various concepts in environmental chemistry.

Reference Text: Werner Stumm and J.J. Morgan. 1996. Aquatic Chemistry (Paperback), 3rd Ed., 1040 pp., Wiley. The BIBLE of aqueous chemistry - there is no better reference book than this. Includes several practice and worked problems and also in-depth coverage of several topics.

Reference Text: R. Chang. 2005. Chemistry, 9th Ed. 1152 pp., McGraw-Hill. A good introductory chemistry book used at the College for CHEM 111/112 sequence.

Reference Text: H.F. Hemond and E.J. Fechner-Levy. 2000. Chemical Fate and Transport in the Environment, 2nd Ed., 433 pp., Academic Press Elsevier. Good introduction to pollutant concepts – focus on chapters 1-3.

Reference Text: I.J. Tinsley. 2004. Chemical Concepts of Pollutant Behavior, 2nd Ed., 402 pp., Wiley. Good introduction to pollutant concepts – focus on chapters 2, 3, 5, and 7.

Reference Text: C.R. Fitts. 2002. Groundwater Science, 450 pp., Academic Press Elsevier. Excellent introduction to groundwater and contamination – focus on last two chapters of this book.

6 Tentative Class Schedule

Wk	Dates	Lecture Topics	Event and Deadlines
1	8/22-8/24	Introduction	
2	8/27-8/31	Cr contamination	
3	9/3-9/7	Chemical concepts	
4	9/10-9/14		**9/14, Outline and abstract for paper due**
5	9/17-9/21		
6	9/24-9/28	Soils/ groundwater	
7	10/1-10/5		
8	10/8-10/12	As contamination	
9	10/15-10/19		10/15 - Fall Break
10	10/22-10/26	A Civil Action/ TCE contamination	**10/26, First draft of paper due**
11	10/29-11/2		
12	11/5-11/9		
13	11/12-11/16	Climate change/Ocean acidification	
14	11/19-11/23		11/21-25 - Thanksgiving
15	11/26-11/30	Research presentations	
16	12/3		**Last Day of class, Final paper due**

7 Student Expectations

I expect you to have a working background in basic sciences (biology or physics and chemistry) and basic math, including algebra – all of these are geology major requirements. If it has been a while, you will take the opportunity to brush up basic skills. You may not have had much experience with research projects as well as scientific writing and presentations, all of which as essential components of this class. While the learning curve may be steep, I expect you to make an honest effort to master these aspects of this course. You are also expected to participate or lead a group projects or be able to work independently as required as per my instructions.

8 Assessment

You performance in this course will be assessed based on your understanding of basic environmental pollution concepts and the demonstration of your ability to apply this knowledge. This will involve a combination of (i) group problem-solving exercises – you will work in groups or by yourself, (ii) solo problem-solving exercises, (iii) paper and presentation associated with your research projects and case studies, and (iv) class participation.

1. Group problem-solving exercises will include solving problems and synthesis and interpretation of published data - there will be approximately 10 of these – 20% of total grade. Notes: All students in the group get identical grade and hence it is important to work well together. It is not necessary to work in a group, but, it is strongly encouraged. In some cases, I'll pre-assign groups and all students within the group will have to work together. I'll clearly specify if the exercise can be worked as a group assignment.
2. Solo problem-solving exercises include similar problems as above - there will be about 5-6 exercises total – 30% of total grade.
3. Brief, but in-depth, pollution case studies in areas *not* covered by me. This will be a small group (3-4 students) exercise. Each self-selected group identifies appropriate research papers ahead of time and shares these papers with entire class and then leads a discussion group of 15-min each. One or two of these exercises over the semester – 10% of total grade (entire group gets same grade.)
4. A 5000-word lab-based research paper that is comprehensive and original in scope and takes a good look at specific aspect of a pollution related topic. Come and see me before you create an outline to discuss your topic. Use the journal "Environmental Pollution" as a model for your paper (see http://bit.ly/qyZNhg for instructions on preparing the project report in a manuscript form) – 30% of total grade. Notes: Grade includes grades for all aspects of the paper, including the outline, the draft, and the final paper. Check course schedule for deadlines.
5. A 15 minute presentation of your project to the class during last week of class – 10% of total grade.
6. Laboratory grade is separate from the lecture grade and will be based on lab reports (70%), lab journals (15%), and the quality of lab work (15%). Weekly projects are collaborative efforts, but each of you will synthesize and submit your own reports.

The grade you earn by the end of the semester will be based on this scale:

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

9 Course Product (or What you will get from this course)

On successful completion of this course, you will be able to

- Critically understand processes related to environmental contamination
- Interpret the behavior of naturally complex environmental systems
- Critically analyze environmental data and explain your findings and conclusions to your peers
- Integrate various basic sciences (chemistry, biology, geology, etc.) and mathematical skills to solve multidisciplinary problems
- Collaboratively develop research projects
- Develop other ancillary skills:
  - Become familiar with journals and technical sources in subject area
  - Become proficient in conducting literature reviews
  - Improve your presentation and science writing skills
  - Learn how to use generic software (Excel, etc.) to analyze and visualize chemical/physical data

10 CofC's Honor Code and Academic Integrity

Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified, are investigated. Each incident will be examined to determine the degree of deception involved.

Incidents where the instructor determines the student's actions are clearly related more to a misunderstanding will handled by the instructor. A written intervention designed to help prevent the student from repeating the error will be given to the student. The intervention, submitted by form and signed by both the instructor and the student will be forwarded to the Dean of Students and placed in the student's file.

Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Dean of Students. A student found responsible by the Honor Board for academic dishonesty will receive a XF in the course, indicating failure of the course due to academic dishonesty. This grade will appear on the student's transcript for two years after which the student may petition for the X to be expunged. The student may also be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from the College by the Honor Board.

Students should be aware that unauthorized collaboration–working together without permission–is a form of cheating. Unless the instructor specifies that students can work together on an assignment and/or test, no collaboration is permitted. Other forms of cheating include possessing or using an unauthorized study aid (such as an iPhone or other smartphones), copying from others' exams, fabricating data, and giving unauthorized assistance.

Research conducted and/or papers written for other classes cannot be used in whole or in part for any assignment in this class without obtaining prior permission from the instructor.

Find the complete Honor Code and all related documents at http://bit.ly/beXIuo.