CHEM 282: Environmental Chemistry
Spring 2007

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Course Description:
An introduction to concepts in atmospheric, aquatic and terrestrial chemistry, pollution and energy production and consumption. Regular student involvement and leadership in class discussions of current events related to environmental chemistry will be expected. Laboratory work will include several common sampling techniques, analytical techniques, and methods of statistical analysis involved in determining the level of contaminants in the environment. This course is designated as a community learning course.

Course Objectives:
1. **An introductory liberal arts education in environmental chemistry**: This course will give students a rigorous and yet basic understanding and appreciation of the fundamental principles of the chemistry of natural and polluted waters, the atmosphere, toxins, and energy production. It is understood that in gaining an education at a place like *EMU, an Anabaptist Liberal Arts Institution*, you will be asked to learn things and perform assignments that will not be directly useful in your desired careers so you will be asked to step into the shoes of an environmental *chemist* for one semester.
2. **A pre-graduate school and environmental science professions introduction to the chemistry of the environment**: This course will serve as a foundation for graduate courses, or as pre-professional training in any discipline in the environmental sciences. Understanding the basics principles of environmental chemistry is increasingly critical for success in the following fields: Ecology, Forestry and Natural Resources, Environmental Toxicology, Food Science, Agricultural Engineering and Biotechnology, Astronomy, Geology, Pollution Monitoring and Impact Assessment, etc…
3. **An exploration of environmental topics in analytical chemistry that are relevant to the community**: In this course we will discuss and research current topics related to the environment of Harrisonburg and the Chesapeake-Bay Water shed in order to gain insight into current controversies, to formulate informed opinions, and to ask appropriate questions. In addition, you will gain an understanding of the chemical research process, apply the principles of analytical chemistry to some relevant environmental topics, and learn to access and interpret chemical information regarding the environment; this learning will be shared with the local community by way of our engagement with the local school district. Throughout this process, it is hoped that we will develop an understanding of what it means to be a Christian and a scientist while working for the betterment of the community.

Required Material:
Baird, Colin & Cann, Michael *Environmental Chemistry,* 3rd edition, ISBN: 0716748770
Kebbekus, BB & Mitra, S. *Environmental Chemical Analysis*, ISBN: 075140456
Sewn bound notebook, Scientific calculator, use of excel

Course Requirements
*Attendance Policy***:** Attendance of all classes is *highly* recommended. Attendance or completion of all labs is required to pass the class.

Late assignment policy: Late work will be accepted up until one week after the day it was due. At that point, you will receive a zero.

Field Trip- with the Ecology Class to the Chesapeake Bay (details will follow)

Discussion participation & course engagement is worth 5% of your overall course grade.

Exams- Three exams are scheduled for the semester. At least one of these exams will be open book and take-home and require you to apply skills and knowledge. Each will be equally weighted as 10% of your final grade. The final exam will be cumulative and worth 15% of your final grade. All exams will include questions from the lab texts and materials.

Writing & Activities- worth 20% of your final grade. There should be a papers/ activities due each week throughout the semester (minus weeks where there is an exam). Each will be equally weighted.

Summary of grading:

Participation	5%
Writing/ Activities	20%
Laboratory	30%
Exams (3)	30%
Final Exam	15%

The typical range for grades should be 100-90 = A, 80-89 =B, 70-79 = C, etc. No letter grades are assigned until the end of the semester.

Academic Honesty: Academic dishonesty is defined as: obtaining or providing unauthorized information, assistance or data on examinations, problems or lab reports. This definition includes plagiarism (the intentional use of ideas, words, or data from another source without appropriate credit) and allowing or assisting someone to be dishonest. Confirmed cases of academic dishonesty will result in the loss of credit for the work in question. Repetitive dishonesty will result in a failing grade for this class and referral to the dean. When sharing experimental data, appropriate credit must be given to the source.

Disability statement: If you have received services in the past related to a learning disability or attention deficit disorder and/or feel you may have such a problem in this course, please make an appointment to speak with me during my office hours or with the Coordinator of Student Disability Support Services in the Academic Support Center, Roselawn Ground floor, 432-4233.

Schedule is tentative and will change!

Water Chemistry			
Jan. 8	**LABORATORY**	Jan. 10	Jan. 12- Chapter 9
Jan. 15	Read: ECA Ch 1 & 2	Jan. 17 Chapter 10	Jan. 19 *Documentary film: Thirst* ***Lab notebook due***
Jan. 22	Read: ECA Ch 3, 4, & 8	Jan. 24 Chapter 11	Jan. 26 ***Lab notebook due***
Jan. 29	Read: ECA Ch 6	Jan 31	Feb.2 ***Exam 1***

Atmospheric Chemistry- Stratosphere and ozone			
Feb. 5 *Documentary film: Buffalo Creek*	ECA Ch 7	Feb. 7 Chapter 1	Feb. 9 ***Lab notebook due***
Feb. 12 Chapter 2		Feb. 14	Feb. 16 ***Lab notebook due***
Feb. 19 Chapter 3	ECA Ch 10	Feb. 21	Feb. 23 *Nova: What's up with the weather?* Feb 23-24 Happy Feet (PG)
Atmospheric Chemistry- Green House gases			
Feb. 26 Chapter 4		Feb 28 *Film: An inconvenient truth*	March 2 ***Lab notebook due***
SPRING BREAK			
Join the SASS book study on The Omnivore's Dilemma: A Natural History of Four Meals by Michael Pollan. Thursdays, noon, SC 16, March 15 to April 5.			
Mar. 12 Chapter 5	ECA CH 9	Mar. 14	Mar. 16 ***Lab notebook due***
Mar. 19		Mar. 21	Mar. 23 ***Exam 2 (EC Ch 1-5)***
Toxic Organics			
Mar. 26 Intro to Orgo: Functional groups & Intermolecular Forces	ECA Ch 5	Mar. 28 Chapter 7	Mar 30 ***Lab notebook due***
Field trip with the Ecology Class to the Chesapeake Bay			
April 2		Apr.4 Chapter 8	Apr. 6 ***Easter Break no class***
Food and Farming Week			
Apr. 9		Apr. 11 ***Exam 3 (EC 5-8)***	Apr. 13 Chapter 13 ***Required Suter Science Seminar Supporting Resource Management Worldwide with Geospatial Technologies, Dr. Heatwole, 4 pm, SC 104***
Apr. 16 ***Poster draft due***	CLEAN-UP & CHECK OUT OF LAB	Apr. 18 ***Poster revisions in class***	Apr. 20
Blacks Run Clean-Up Day, April 21 (perhaps the 14th) Final Exam, Friday, April 27th, 8 am			

LABORATORY

Course objectives:

- Learn appropriate sampling techniques for environmental chemical analysis.
- Perform rigorous environmental studies with statistical analysis of the relevancy of the data.
- Work in and with the local community on projects that are important to our community

Community Learning (CL) designated courses require students to be involved in the community in a setting which relates to the subject matter of the course. Academic credit is given for the learning that occurs in the community setting. Students are expected to engage in critical

analysis of community issues and synthesize classroom based knowledge and personal experience. Community Learning designate courses require a minimum of 15 hours in the community, often more.

Laboratory Requirements:

*Attendance Policy***:** Attendance or completion of all labs is required to pass the class. This typically requires at least 60 hours of in-lab time per semester.

Late assignment policy: Late work will be accepted up until one week after the day it was due. You will lose 5% of the grade per day that it is late. At that point, you will receive a zero.

Grade:
Your grade for the laboratory will come from:

10 % Participation on THMS trips* and writing assignments
30% Notebook & Reporting
30% Journal Article
30% Poster

*Failure to complete the CL part of this class will result in failure of the entire class.

You should be a good lab citizen: To exemplify a professional attitude towards your work, you should demonstrate habits such as neatness, organization, punctuality, and efficiency with a general good demeanor. These habits are closely tied to working safely and with respect for the properties of chemicals. Many potential dangers can be minimized by awareness, prevention and the proper attitude.

Lab reports-
***** All writing in this course is held to the standards in the EMU Writing Grid. You are encouraged to use Longman Handbook for grammar guidelines.

Journal Article- Trial one, due Feb 23; final version: due Friday, March 2. This report should be written in the fashion of a Journal of Analytical Chemistry (examples available in the lab).

- Title
- Abstract (purpose + summary of your results)- this is single spaced!
- Introduction (including any relevant predictions about your work, key information regarding the techniques chosen, any relevant background information)
- Experimental section, also called methods (past passive voice for your procedure, include: information regarding your samples, the name of the instrument (if used), reference to technique or procedure followed)
- Results-Discussion (data- raw (table format) and analyzed): The discussion should address any relevant questions brought to mind by your analysis and include suggestions for improvement or extension of the experiment. DO NOT REPEAT THE PROCEDURE; it is a waste of paper! You should also address the certainty with which you report your numbers. I may ask you to include a propagation of experimental error. This value should be compared to the statistical analysis of data: i.e. standard deviation. Data that you do not include in your final analysis should be removed on the basis of a Q-test. You should compare your analysis of environmental samples to expected or recommended values: some are available on-line or in your book. You must include a reference for this.
- References should be included as endnotes (your text, lab partners, handouts, etc.)
- *Please double space and use 12-font on your lab reports.*

Poster- Draft one due April 16; final draft is due April 20.
One of this most common ways of reporting scientific research is the presentation of a poster. Your second project will culminate in the production of a poster(s) that summarize the background, method, results and importance of the data obtained. You can make your poster using either powerpoint or publisher- both programs are available in the computer labs. Here are a few sites about producing a poster of your work:
From the ACS: Handbook for Speakers
(http://www.chemistry.org/portal/a/c/s/1/acsdisplay.html?DOC=meetings%5Chandbook.html)

Lab Notebooks
You are required to record all of your experimental work, data, observations, results, spectra, and analysis of your results in a sewn bound notebook. The goal is for your lab notebook to contain a usable record of your work. Anyone with the same level of chemistry experience which you currently have should be able to reproduce your results from your notebook alone.

General Lab notebook rules:

- Pages must be numbered.
- All pages should be dated
- Ink must be used, as well as legible handwriting.
- Pages must not be torn out of the notebook.
- A line through the mistake with your initials is appropriate.
- Each project should be signed when the analysis is complete.
- Table of contents should be kept up to date.
- All data and observations must be copied directly into the lab notebook in pen! All data should be summarized in table format, including relevant information from spectroscopic analysis (UV-Vis, IR, HPLC, GC, etc.) Excel® or other graphing/ calculating programs can and should be used for most data evaluation. These reports should be treated as observations and stapled into your lab notebook immediately.
- **This is very important for all analytical tests: For all reagents: note the manufacturer, the purity, and the lot number.**
- For all calculations and numbers:
  - Include one representative calculation & the formula used
  - Include significant figures, uncertainty in measurements, and the standard deviation when applicable
  - Remember to include units

SAFETY NOTES: All of your prepared chemicals should be stored in clean, dry labeled containers. Labels should include: Your initials, name & structure of chemical (exact molarity, if solution). You should look at the MSDS (material safety data sheets) for each chemical that you use in lab. They are available on-line and mention relevant hazards. *For starters try one of these sites: http://msds.ehs.cornell.edu/msdssrch.asp or http://hazard.com/msds/index.php*

Lab projects will revolve mostly around on-going water monitoring of the Blacks Run River: This project will involve using new handheld instruments, a dissolved oxygen meter and a colorimeter (cheap version of a UV-Vis spectrophotometer) to monitor the health of the Blacks Run River. This project will require appropriate collection of samples from the Blacks Run River to obtain and analysis pertinent data concerning the health of this waterway. Quality control, reproducibility and appropriate dissemination of the results will be emphasized. To that end, most of the tests will be first run in a laboratory setting using standard Waste Water or EPA methods.

This project will involve working with the Friends of the Blacks Run Greenway (http://www.blacksrungreenway.org/index.html) and the Harrisonburg City public school system. Part of this project will entail helping a group of middle school students perform and understand this analysis. We will also participate in the local Blacks Run Clean-Up Day Scheduled for April (usually the Saturday before finals week).

Tests of interest: dO (titration & meter), BOD (titration & meter), temperature, pH (colorimeter & meter), total alkalinity (buffering capacity) (titration), hardness (titration & colorimeter), nutrients (nitrate, nitrite, ammonium, phosphates) (colorimeter), turbidity (colorimeter), extractable hydrocarbons (distillation), presence of antibiotics (tetracycline, bacitracin, & virginiamycin) by fluorimetry & HPLC, and Coliscan ecoli tests.

Possible activities for the middle school trips:

- Oxygen demand (in the classroom): Measure dO in tap water, then setup a series of 'experiments' in fishbowls- One empty fishbowl, one fishbowl with a fish, one fishbowl with a plant, one fishbowl with fish & plant, one with plant & nutrients (say miracle grow?), we could also check dO in a tank that has a bubbler to mimic faster stream flow. We have the students make predictions and re-measure dO 2 weeks later.
- Use well-plates to do mini-titrations to determine hardness of the water (a classroom thing)
- E Coli tests (a classroom activity): We bring plates for the students to read & maps to consider what the source of pollution are; we set-up tests that are read a week later.
- Build little conductivity meters from equipment from Radioshack
- Water walk: use LaMotte Kits to test for nutrients, pH, etc.
- Macro invertebrate study for our last trip as part of the water walk