

Aquatic Chemistry
CHEM 3411
Spring Quarter, 2011

Instructor Dr. Keith Miller
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Class Time: TR 12:00 – 1:50PM
Class Location: Olin 103
Office Hours: By arrangement

REQUIRE COURSE ITEMS

Textbook: *The Geochemistry of Natural Waters*, 3rd ed., James I. Drever (1997) Prentice-Hall, Upper Saddle River, NJ (A reprint at reduced price is available at the DU Bookstore; please do not buy an expensive, second-hand copy!)

Calculator: An inexpensive calculator is required. It should have the capabilities for square roots, logarithms, and exponential (scientific) notation operations. The calculator will be used for problem sets, quizzes, and exams. You are responsible for understanding how to perform each of the operations on your calculator. **Remember to bring your calculator (or laptop) with you to every class.**

SUPPLEMENTAL COURSE ITEMS

Study and interpretation of the chemical characteristics of natural water, 3rd ed., J.D. Hem (1985) U.S. Geological Survey Water-Supply Paper 2254 (28 MB pdf file available).

Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters, 3rd ed., W. Stumm, J.J. Morgan (1996) John Wiley & Sons, New York, NY.

Principles of Environmental Geochemistry, G. Nelson Eby (2004) Brooks/Cole

National Recommended Water Quality Criteria, US Environmental Protection Agency (2004) (pdf on class website)

Other EPA and Colorado State weblinks will be available on the class website.

COURSE DESCRIPTION

This course will cover advanced topics in aquatic chemistry, specifically as they apply to natural waters. The material will be off of concepts in Analysis of Equilibrium Systems (CHEM 2011), and will include topics in chemical equilibrium, solubility, dissolution, weathering processes and redox equilibria. Included in the course will be significant coverage of water quality of surface and ground waters including a course-long project that focuses on the treatment of an impaired drinking water source.

TOPICS

- Introduction; hydrologic cycle, water quality
- Equilibrium review, activities, species Distribution, pH-C diagrams
- Carbonate system, buffering
- Clay minerals, adsorption processes, organic compounds
- Redox equilibria, solubility, kinetics, weathering
- Special topics – water treatment, acid mine drainage, isotopes

READINGS/CLASS PARTICIPATION

You are expected to complete the assigned reading prior to the class lecture. I recommend that you understand the material and how to solve the sample problems before proceeding to the next section. I will assign readings (and suggested problems) on a weekly basis. Additional readings from secondary sources will also be suggested. It is often very helpful to read similar material from different texts. In addition, I expect everyone to fully participate in class discussions and on the class water treatment project.

PROBLEM SETS

Problem solving is an important component of all chemistry and most science courses. I will post suggested problem sets throughout the course. These problem sets **WILL NOT** be graded. You are encouraged to work together to complete the problem set. These problems are typical of those you might encounter on the exam.

EXAMS

Two (2) exams will be given during the quarter. They will occur during weeks 4 and 8. The exact dates and format for the exams will be provided the second week of the course. **NO MAKE-UP EXAMS WILL BE GIVEN.** If you will be out of town for a University sanctioned function (e.g., athletic team or music group), you are responsible for making arrangements with Dr. Miller at least one week in advance to complete the exam ahead of the due date.

WATER TREATMENT PROJECT (GROUP PROJECT)

A significant portion of the course will be devoted to investigating a water quality crisis from a developing country. Specifically, the class will study drinking water sources that have elevated levels of fluoride from natural sources. Depending on class size, water supplies from two different regions may be study. As part of the project, the class will evaluate different methods to reduce the levels of fluoride in the water source. The project will culminate with the class demonstrating the effectiveness of the water treatment process with a small, pilot-scale treatment system that could be used in developing countries. Details of the class project will be finalized during the first week of class. Significant time outside of class will be required to complete this project successfully. This is not an analytical chemistry course, so I will not be expected to be experts in all aspects of instrumentation. I will provide support here as needed. I will, however, expect you to understand the principles behind all analyses.

INDIVIDUAL PROJECT

There are many topics related to aquatic chemistry that we will not have a chance to cover during this course. Thus, each student will be asked to research and study a topic that we

will not cover in-depth in class. I will develop a “short list” of potential topics during the first week for review. Topics that focus on fluoride and bottled water WILL NOT be allowed. During the last week of class, students will give a short presentation on their selected topics. Specific guidelines for the project will be provided early in the course.

GRADES

At the end of the quarter, you will be graded according to your performance on the paper/presentation, exams, class participation, and the water treatment project. Cooperative learning is encouraged. As such, I will not grade on a curve. Your final grade will be determined by the point totals with the following components:

| <u>Component</u> | <u>Points</u> |
|---|----------------------|
| Paper/Presentation/Project (Individual) | 200 |
| Exams | 400 |
| Water Treatment Project (Group) | 400 |
| Total Points | 1000 |

CELLULAR PHONE, PAGER AND LAPTOP POLICY. I respect the need for each individual to stay in contact with family and friends. The use of cellular phones and pagers, however, is disrupting to the learning environment. Thus, I request that the ringers of all cellular phones and pagers be muted during class. If an emergency arises, and you need to make a call on your phone, I request that you quietly leave the room and conduct your conversation out in the hallway. Laptops can be quite disrupting in class; therefore, ONLY laptops used for taking notes will be allowed. If you use your laptop, I might request that a copy of your notes be emailed to me at the end of class.

LECTURE AND TESTING ACCOMODATIONS. I will make every effort to accommodate students diagnosed with a learning disability. I will do this in complete confidence. I do, however, request that any student requiring these accommodations inform me the first week of class. For further information, please see the University Disability Services' website at <http://www.du.edu/disability/dsp/index.html>.

ACADEMIC DISHONESTY. While I advocate collaborative learning and teamwork, I also firmly believe that each individual should maintain the highest ethical standards in all of life's endeavors. As such, I support and will strictly enforce the Honor Code of the University of Denver. For your reference, I have included the link to the Honor Code Statement at <http://www.du.edu/ccs/honorcode.html>.