

**Chemistry 08: Chemistry and the Environment**  
**Spring 2010**

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**Course Description:** In this course, fundamental principles of chemistry will be introduced and used to understand the sources, fates, and activities of chemical compounds in natural and polluted environments. Concepts such as the nature of matter and energy, atomic and molecular structure and bonding, chemical change and reaction stoichiometry, the properties and behavior of gases, and the forces driving chemical reactions will be developed. Examples will be drawn from and shed light on environmental issues such as climate change, air quality, stratospheric ozone depletion, acid rain, water pollution and treatment, energy resources, and environmental toxins. In this way, the underlying physical principles will be linked directly to problems of immediate concern in modern society. The course is designed primarily for non-science majors and Environmental Studies majors.

**Prerequisites:** No prior college science or mathematics courses are required.

**Lecture:** Monday, Wednesday, and Friday, 12:00 to 12:50 am, Merrill 401.

**Discussion:** Monday, 2:00 to 3:50 pm, Merrill 314. Most weeks, we will use this timeslot for a 1-hr discussion and problem solving session. Occasionally, we will have a short lab activity or field trip that will occupy the full 2 hours. I will let you know in advance when a longer activity is planned.

**Office Hours:** Tuesday 11:00 – 12:30 and Friday 1:00-2:00, Merrill 517. You may also make an appointment to meet with me outside of the regular office hours.

**Course Materials:** Handouts, assignments, and other materials will be available through the course website. Hard copies of handouts will also be available in the Chemistry Department Office, Merrill 507. The department office is open Monday through Friday from 8:00 A.M. until 4:00 P.M. Mrs. Campbell and Ms. Stillerman will be able to help you find what you need.

**Text:** Thomas R. Gilbert, Rein V. Kirss, Geoffrey Davies, Natalie Foster, *Chemistry: The Science in Context* (Second Edition), W. W. Norton and Co., New York, NY, 2008.

The text will be supplemented by readings from other texts and selected articles from the popular press and scientific literature. We will try to make use of electronic resources when possible. If these are not available, hard copies will be provided. Readings will be listed on the weekly assignment sheet.

**Additional Materials:** A copy of the textbook and the student study guide that accompanies it are on reserve in Keefe Science Library.

**Exams:** There will be one two-hour midterm exam and a scheduled (3-hour) final exam. The midterm exam will be given Wednesday, March 10. The final exam will take place during exam week.

**Weekly Assignments:** Weekly assignments will consist of problems assigned from the textbook and/or brief writing assignments based on the readings. Assignments will be due in class on Mondays. Assignments will be posted on the website one week before the due date and solutions will be posted after the assignments are turned in.

**Final Project:** You will work in groups to research a campus, community-based, or global-scale environmental problem for which you will collect data, develop hypotheses, design experiments, and develop recommendations. Topics will be chosen by students with input from the professor. Some ideas for projects might be to assess the campus greenhouse gas inventory or determine the impact of air pollution generated by commuters to campus. Once a topic is chosen, each group will submit a project plan and meet with me to discuss it. After conducting the research, each group will write a final report and make a short presentation of their findings to the rest of the class.

**Class Participation:** Attendance and participation in class are important components of this course, and will constitute 10% of the final grade.

**Grading:** Your grade in the course will be based on two exams (one mid-term and one final), weekly assignments, the final project, and class participation weighted as follows:

2 Exams (20% each)	40%
Weekly Assignments & Activities	30%
Final Project	25%
Class participation	5%

**Intellectual Responsibility:** Students enrolled in Chemistry 08 are expected to abide by the Amherst College Statement of Intellectual Responsibility (Amherst College Catalog, 2009–10, pp. 61–62). Particular attention should be paid to the statement, "...the College considers it a violation of intellectual responsibility to submit work that is not one's own or otherwise to subvert the conditions under which academic work is performed by oneself or by others." The specific implications of the statement for Chemistry 08 are:

1. **Weekly Assignments:** You are encouraged to discuss the problems and readings with your classmates. However, when your discussions are over, you are expected to be able to work through all problems by yourself. Thus, the solutions that are submitted should represent your mastery of the problems.
2. **Final Project:** The final project will require that you work together in groups. You are expected to discuss your ideas, plans, and results with your classmates, but each student will be responsible for a specific aspect of the final report.
3. **Exams:** Giving or receiving assistance during an exam is dishonest. All work submitted must be your own. This applies to both regularly-scheduled and make-up exams, and to any subsequent discussion concerning the exams.

## Chemistry 08: Chemistry and the Environment

This is an overview of topics to be covered in the course. Please keep in mind that the timing is subject to change.

### Week      Topics Covered

#### **Elements, Compounds, and Cycles**

- 1      Water past, present, and future: The hydrological cycle and the ice core record  
*The scientific method; dealing with data; the properties of matter; Atoms and molecules*
- 2      Fossil fuels, combustion, and the fate of CO<sub>2</sub>  
*Formulas and equations; moles; chemical bookkeeping*
- 3      The sunlight unwinding: photosynthesis and combustion  
*Energy flow in chemical reactions*

#### **Sun and Air**

- 4      Capturing the sun  
*Light and matter; electrons and current; the photon and its energy*
- 5      The air we breathe  
*The gas laws; gas mixtures; a microscopic view of gases*
- 6      Ozone: The Earth's sunscreen  
*Atomic structure and atomic spectra; electron configurations*
- 7      Molecules, free radicals, and the hole in the ozone  
*Models of chemical bonding*
- 8      Chemical reactions and the making of smog  
*Rates and mechanisms of chemical reactions*
- 9      The greenhouse effect  
*Molecular structure, properties, and motions*

#### **Water, Water, Everywhere**

- 10     The hydrosphere revisited  
*Intermolecular forces; phase changes; solubility*
- 11     Polluted waters  
*Solubility; concentration; reactions in solution*
- 12     The big buffer: The ocean and CO<sub>2</sub>  
*Chemical equilibrium; acids and bases*

#### **Technology: The Price of Luxury**

- 13     Synthetic chemicals in our environment  
*The chemistry of poisons and toxins*
- 14     The Age of Plastic  
*The structure and chemistry of polymers*
- 15     Powering the Future  
*Electrochemistry, batteries, and fuel cells*