

## Chemistry 394-01. Environmental Chemistry

**INSTRUCTOR:** Prof. Keith T. Kuwata, Olin-Rice 318, 696-6768, kuwata@macalester.edu  
Web page: www.macalester.edu/~kuwata (for class handouts and overheads)

**DESCRIPTION:** The chemistry of the environment involves highly complicated processes in the atmosphere, in soil, and in natural waters. To allow for appropriate depth, we will focus the first two-thirds of course on the chemistry of the lower atmosphere. We will use the concepts and techniques of thermodynamics, kinetics, and molecular structure and bonding to explore ozone depletion in the stratosphere and air quality in the troposphere. The final third of the semester will focus on topics that you have chosen and that you will lecture on. Class activities will include critical reading of two environmental chemistry textbooks and articles from the primary literature, lecture and discussion, problem sets, and a final project. Prerequisites: Chemistry 112 or 115 (General Chemistry), and Chemistry 211 (Organic Chemistry I).

**CLASSES:** Tuesdays and Thursdays, 9:40 to 11:10 a.m. in Olin-Rice 301. Attending every class is mandatory, unless you have a valid excuse, such as sickness, bereavement, or sporting event. You must make every effort to inform me beforehand if you will be missing a class.

### TEXTS:

#### Required

- (1) Colin Baird and Michael Cann, *Environmental Chemistry*, 4th Edition, New York: W. H. Freeman, 2008 (purchase at the Lampert Building Bookstore). (Referred to as “BC.”)
- (2) Thomas G. Spiro, Kathleen L. Purvis-Roberts, and William M. Stigliani, *Chemistry of the Environment*, 3rd Edition (Chapters 4 and 5; in review; provided free of charge). (Referred to as “SPS.”)

#### For Reference (on two-hour reserve at the DeWitt Wallace Library)

- (1) Thomas G. Spiro, Kathleen L. Purvis-Roberts, and William M. Stigliani, *Chemistry of the Environment*, 3rd Edition (entire text; in review).
- (2) Martin S. Silberberg, *Chemistry: The Molecular Nature of Matter and Change*, 4th Edition, Boston: McGraw Hill, 2006.
- (3) Robert M. Hanson and Susan M. E. Green, *Introduction to Molecular Thermodynamics*, Northfield, Minnesota: Integrated Graphics, 2006.
- (4) Peter Atkins and Loretta Jones, *Chemical Principles: The Quest for Insight*, 4th Edition, New York: W. H. Freeman, 2008.
- (5) Seyhan Ege, *Organic Chemistry: Structure and Reactivity*, 4th Edition, Boston: Houghton Mifflin, 1999.

Articles: Will be distributed during the semester.

### COURSE WORK COMPONENTS AND GRADING:

- Written Responses (30% of overall grade): You will be reading parallel sections of the two required textbooks, two articles from the primary literature, and attending (at least) one session of the International Roundtable. Brief, but thoughtful, written reactions to what you read and hear will help you process ideas and equip you to contribute to class

discussions. The feedback you provide on the textbooks will also be very help to Professors Spiro, Purvis-Roberts, and Stigliani. These must be turned in on time (unless you have a valid excuse, such as sickness or bereavement), or you will receive no credit. I anticipate grading each response on a 0 to 2 point scale.

- **Problem Sets** (25% of overall grade): Three traditional assignments, consisting of problems from Baird and Cann, and problems of my own devising based on what I cover in lecture. There will be a 20% per day penalty for late homework. As in all Macalester chemistry classes, you are encouraged to work with your classmates on homework. However, you must turn in your own work.
- **Class Participation** (10% of overall grade): You will earn all of the points in this category if you attend every class and occasionally share questions or comments in class.
- **Final Project** (35% of overall grade): You will choose a topic in Baird and Cann that I did not cover in class, assign readings for your classmates and me, prepare and present an hour lecture (not a PowerPoint seminar!) on the topic, and write a five-to-seven page paper summarizing what you have learned. More details to come.

Note that there are no quizzes or tests. Since this is an advanced elective course, I anticipate all final grades will be B+ or higher—but this is not guaranteed!

**GETTING HELP:** I will be available in my office Monday noon – 1:00 p.m., Tuesday 1:30-2:30 p.m., Wednesday noon – 1:00 p.m., and Friday 1:30-2:30 p.m. If you can't make one of these office hours, please make an appointment with me, or just come by—I'll usually be somewhere in Olin-Rice during business hours.

**ACADEMIC INTEGRITY:** Copying another student's written responses or problem sets, or plagiarizing materials for either your lecture or final paper all constitute cheating and are expressly forbidden. Following college policy, I will report any clear violation of academic integrity standards to Ann Minnick, the Director of Academic Programs.

### **COURSE SCHEDULE (timing of lecture topics may vary)**

<b>Sept 10</b>	In Class:	Introduction, Lecture on natural stratospheric chemistry (BC Chap 1)
	Work Due:	None
<b>Sept 15</b>	In Class:	Discuss BC Chap 1 and SPS; Lecture on natural stratospheric chemistry
	Work Due:	Written Response 1
<b>Sept 17</b>	In Class:	Lecture on natural stratospheric chemistry
	Work Due:	None
<b>Sept 22</b>	In Class:	Lecture on natural stratospheric chemistry
	Work Due:	None
<b>Sept 24</b>	In Class:	Lecture on perturbed stratospheric chemistry (BC Chap 2)
	Work Due:	Problem Set 1 (have until Friday, Sept 25 to turn in)
<b>Sept 29</b>	In Class:	Discuss BC Chap 2 and SPS; Lecture on perturbed stratospheric chemistry

	Work Due:	Written Response 2
<b>Oct 1</b>	In Class:	Lecture on perturbed stratospheric chemistry
	Work Due:	None
<b>Oct 6</b>	In Class	Discuss Rowland and Molina, <i>Nature</i> <b>1974</b> , 249, 810-812
	Work Due	Written Response 3
<b>Oct 8</b>	<b>Class Canceled; Attend at least one International Roundtable session</b>	
<b>Oct 13</b>	In Class	Discuss International Roundtable
	Work Due	Written Response 4
<b>Oct 15</b>	In Class	Lecture on systematics of tropospheric chemistry (BC Chap 5)
	Work Due	Problem Set 2
<b>Oct 20</b>	In Class	Discuss BC Chap 5 and SPS; Lecture on systematics of tropospheric chem
	Work Due	Written Response 5
<b>Oct 22</b>	In Class	Lecture on systematics of tropospheric chemistry
	Work Due	None
<b>Oct 27</b>	In Class	Lecture on systematics of tropospheric chemistry
	Work Due	Final Project Proposal
<b>Oct 29</b>	<b>Fall Break: No Class</b>	
<b>Nov 3</b>	In Class	Lecture on systematics of tropospheric chemistry
	Work Due	None
<b>Nov 5</b>	In Class	Discuss and lecture on tropospheric chemistry article (to be announced)
	Work Due	Written Response 6
<b>Nov 10</b>	In Class	Lecture on tropospheric chemistry article
	Work Due	Problem Set 3
<b>Nov 12</b>	In Class	Lecture on tropospheric chemistry article
	Work Due	None
<b>Nov 17</b>	In Class	Student Lecture 1 + Discussion
	Work Due	Written Response 7
<b>Nov 19</b>	In Class	Student Lecture 2 + Discussion
	Work Due	Written Response 8
<b>Nov 24</b>	In Class	Student Lecture 3 + Discussion
	Work Due	Written Response 9
<b>Nov 26</b>	<b>Thanksgiving: No Class</b>	

<b>Dec 1</b>	In Class	Student Lecture 4 + Discussion
	Work Due	Written Response 10
<b>Dec 3</b>	In Class	Student Lecture 5 + Discussion
	Work Due	Written Response 11
<b>Dec 8</b>	In Class	Student Lecture 6 + Discussion
	Work Due	Written Response 12
<b>Dec 10</b>	In Class	Student Lecture 7 + Discussion
	Work Due	Written Response 13
<b>Dec 15</b>	In Class	Final Comments + Student Evaluations
	Work Due	None
<b>Dec 21</b>	<b>Final Paper Due</b>	