“Education in and about chemistry is critical in addressing challenges such as global climate change, in providing sustainable sources of clean water, food and energy and in maintaining a wholesome environment for the well being of all people…” –UN International Year of Chemistry resolution

Instructor: Dr. Katherine M. Mullaugh  
Office: SSMB 310  Phone: 843-953-6587  Email: mullaughkm@cofc.edu

Class Meeting Time: MWF, 11:00 – 11:50 am  Class Meeting Place: SSMB 327

Pre-requisites: CHEM 220/220L and CHEM 231/231L, or permission of the instructor

Required Materials: Scientific calculator with logarithmic and exponential functions  
Elements of Environmental Chemistry, 2nd edition, by Ronald A. Hites and Jonathan D. Raff

Recommended Materials: A general chemistry textbook for reviewing basic chemical concepts

Course Description:
- This course will be divided into three main units that reflect the most pressing issues in modern environmental chemistry. We will cover:
  - Atmospheric Chemistry and Air Pollution
  - Climate Change and Energy
  - Water Chemistry, Pollution and Treatment
- As a sustainability-related course, students will be required to think broadly about environmental systems to include the social and economic factors of sustainability.

Student Learning Outcomes:
- Students will demonstrate an understanding of the chemical processes that influence the environment (air, water, soil and climate).
- Students will apply fundamental chemical principles (acid-base chemistry, thermodynamics, kinetics, redox reactions and light-matter interactions) to understand the sources, transport, transformation and ultimate fate of various chemical species in the environment.
- Sustainability-related learning outcomes:
  - Students will identify policies and practices that have led to unsustainability. (QEP SLO 3)
  - Students will demonstrate the impact of production/consumption practices on environmental systems. (QEP SLO 5)

Attendance/Participation: I expect you to attend all classes. If you must miss a class due to an illness, school sanctioned event, or off-campus interview, it is your responsibility to inform me and get the material you missed from another student. Regular participation by all students in this class is expected.

Homework: Homework assignments will be in the form of problem sets from the book or instructor-generated problem sets that will be assigned regularly and posted on OAKS. Assignments will not be collected or graded by the instructor, but students are expected to check their own homework using keys posted on OAKS.
Quizzes: Short quizzes will be administered regularly at the start of some class periods (approximately once a week). Quizzes will be used to assess your current understanding of material and ensure you are keeping up with assigned readings. At the end of the semester, the lowest quiz grade will be dropped.

Tests: There will be three in-class tests: 2/7, 3/4 and 4/17. If you know in advance you will miss a test due to a religious observance or school sanctioned event, it is your responsibility to let me know immediately so arrangements can be made. If you miss a test unexpectedly, you must provide documentation in the form of an absence memo if you expect to make it up.

Final Exam: The final exam is cumulative and will cover lecture material from the entire semester. The final exam will be Friday, April 24 4:00 – 7:00 pm.

Sustainability: As a sustainability-related course, students in CHEM 422 will be encouraged to think broadly about environmental issues to encompass economic and social considerations as well. This will occur in our class discussions and in two assignments during the semester:

• Students will be required to attend two sustainability events on campus throughout the semester and write a short (500-word) summary of each. Information about sustainability events will be posted on OAKS and/or announced in class. The official deadline for the summaries is the last day of class (April 22), but students are encouraged to write and submit summaries shortly after attending each event.

• Students will complete a sustainability project related to the QEP theme of food security. Each student will identify one aspect of our agricultural system that is unsustainable and will propose a solution or improvement. Specific details will follow, but important dates are:
  o March 6: Topic due to instructor
  o March 27: Written paper due
  o April 1 – 3: Student presentations

Grading:

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<th>Component</th>
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<td>Three in-class tests</td>
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<tr>
<td>Quizzes</td>
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<td>Sustainability project</td>
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<td>Sustainability event summaries</td>
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<td>Attendance/Participation</td>
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<td>Final Exam</td>
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<td>83.0 – 86.9</td>
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<td>F</td>
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**OAKS:** OAKS will be used for announcements, quizzes, homework assignments, supplementary materials and handouts used in class. You are responsible for printing all necessary materials yourself if you would like a hard copy.

**Office hours:** My regularly scheduled office hours are in the table on the right. If you would like to meet with me and are unavailable at these times, please suggest some different times that work for you and we will be able to schedule a meeting that works for both our schedules.

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<th>Office hours (SSMB 310)</th>
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**Disability Services:** If you are a student with a documented disability who will require accommodations in this course, please provide the proper documentation in the form of a Professor Notification Letter (PNL). Please come to speak with me during office hours about how I may best accommodate you in this course.

**Academic Dishonesty:** Lying, cheating, attempted cheating, and plagiarism are violations of the Honor Code of the College of Charleston (http://studentaffairs.cofc.edu/honor-system/studenthandbook/index.php). As it pertains to this course, examples of academic dishonesty would include copying another student’s work during an exam or collaborating with another student on an individual project. Working together on homework is not considered academic dishonesty in this course, but students should use their best judgment to ensure collaborations are mutual so both/all students benefit from homework as a learning tool.

**Classroom Conduct and Group Work:** We will regularly carry out exercises in small groups or as a class. Please always be respectful of your classmates, listen when others are speaking and refrain from doing anything not related to the class.

**Electronic Device Policy:** Using electronic devices for activities not related to class (e.g., texting) during lecture is rude to me and a distraction to your classmates. If you choose to use a laptop or tablet device during class, you should refrain from any social networking, games, etc. that are distracting to others. If your device becomes a distraction, you may be asked to put it away or move to the back of the classroom.

**Important Dates**

- Wednesday, January 15 – Last day to drop/add
- Monday, January 20 – MLK Day, no class
- Friday, February 7 – Test 1 (Atmospheric Chemistry)
- Wednesday, March 4 – Test 2 (Climate and Energy)
- Friday, March 6 – Sustainability topic due
- Friday, March 13 – Last day to withdraw with a grade of “W”
- Sunday, March 15 – Saturday, March 21 – Spring Break – no class
- Friday, March 27 – Sustainability papers due
- Wednesday and Friday, April 1 and 3 – Student sustainability presentations
- Friday, April 17 – Test 3 (Water)
- Friday, April 24 – Final Exam (4 pm – 7 pm)
Lecture Schedule

Class time will be largely devoted to lectures on new material, discussions on assigned reading from the literature and doing group work. Students are encouraged to ask questions throughout the class period. If significant review of material from general chemistry is needed, students will be encouraged to review this material outside of class.

Lecture Outline

• Chemistry of the Stratosphere
  o Layers of the atmosphere
  o Ozone layer
  o The ozone holes

• Chemistry of the Troposphere
  o Gas concentration units
  o Chemical fate of trace gases
  o Hydroxyl radical reactions
  o Photochemical smog
  o VOC’s, NOx and ground level ozone
  o Aerosols
  o Sulfur dioxide emissions
  o Sources and effects of acid rain

• Chemistry of Climate
  o Mechanism of the greenhouse effect
  o Sources and effects of major greenhouse gases and aerosols

• Energy Use
  o Fossil fuels
  o Biofuels
  o Renewable energy
  o Nuclear energy

• Chemistry of Natural Waters
  o Dissolved oxygen
  o Oxidation of organic material
  o Carbonate System
  o Ocean Acidification

• Pollution and Purification of Water
  o Drinking water purification
  o Waste water treatment
  o Toxic heavy metals
  o Organic pollutants