ENVIRONMENTAL CHEMISTRY
CHEM 422-01  Fall 2021

Note: This syllabus is subject to change. Any significant changes will be announced by the instructor and an updated syllabus will be posted on OAKS.

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

Class Meeting Time: TR, 9:25 – 10:40 am  Class Meeting Place: SSMB 145

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, 3rd edition, by Jonathan D. Raff and Ronald A. Hites

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 design a solution to a given sustainability problem. (QEP SLO 6)

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. Recordings or synchronous Zoom streaming will only be available in special circumstances.
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 complete and check their own homework using keys posted on OAKS.

Literature Assignments: Students will be assigned an article from the scientific literature to read for each of the three units covered in this course (Atmospheric Chemistry, Climate Change & Energy, Water). Each article will be accompanied by a short assignment.

Tests: There will be three in-class tests: 9/21, 10/14 and 11/4 (dates subject to change – check OAKS for updates). If you know in advance you will miss a test due to a religious observance, school-sanctioned event or quarantine/isolation protocols, it is your responsibility to let me know as soon as possible so arrangements can be made.

Final Exam: The final exam is cumulative and will cover lecture material from the entire semester. The final exam will be Thursday, December 9, 8:00 – 10:00 am.

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, assignments and a sustainability project briefly described below:

- Students will complete a sustainability project related to a topic of their interest. Each student will identify one environmental problem and will propose a feasible solution that includes social and economic considerations. Specific details will follow, but important dates are:
  - November 4: Topic due to instructor
  - November 18: Paper due to instructor
  - November 30 – December 2: student presentations

Grading:

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<th>Grading Category</th>
<th>Percentage</th>
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<tr>
<td>Three in-class tests</td>
<td>45%</td>
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<tr>
<td>Literature Assignments (3)</td>
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<td>Sustainability project</td>
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<td>Attendance/Participation</td>
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<td>Final Exam</td>
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<td><strong>Total</strong></td>
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<th>Letter Grade</th>
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<td>Failure due to dishonesty</td>
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<td>F</td>
<td>70</td>
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<td>D</td>
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<td>C-</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. We can meet in person (SSMB 310) or via Zoom. If you plan to come to office hours, please email me in advance so I can make sure I am in my office or send you a Zoom link.

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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 Citizenship: We will regularly carry out discussion or exercises in small groups or as a class, sometimes about sensitive topics. Please always be respectful of your classmates, listen when others are speaking and refrain from doing anything not related to the class.

Important Dates

Monday, August 30 – Last day of Drop/Add
*Tuesday, September 20 – Test 1 (Atmospheric Chemistry)
*Thursday, October 14 – Test 2 (Climate and Energy)
Monday – Tuesday, October 18 – 19 – Fall Break (no class)
Wednesday, October 20 – Midterm grades due
Friday, October 29 – Last day to withdraw with a grade of “W”
*Thursday, November 4 – Sustainability project topic due to instructor
*Thursday, November 18 – Sustainability project papers due
*Tuesday, November 23 – Test 3 (Water)
Wednesday – Friday, November 24 – 26 – Thanksgiving Break (no class)
*Tuesday & Thursday, November 30 & December 2 – student presentations
Tuesday, December 7 – Reading Day
*Thursday, December 9 – Final Exam (8 – 10 am)

*Starred dates are specific to this course and subject to change.
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
  - Layers of the atmosphere
  - Ozone layer
  - The ozone holes
- Chemistry of the Troposphere
  - Gas concentration units
  - Chemical fate of trace gases
  - Hydroxyl radical reactions
  - Photochemical smog
  - VOC’s, NOx and ground level ozone
  - Aerosols
  - Sulfur dioxide emissions
  - Sources and effects of acid rain
- Chemistry of Climate
  - Mechanism of the greenhouse effect
  - Sources and effects of major greenhouse gases and aerosols
- Energy Use
  - Fossil fuels
  - Biofuels
  - Renewable energy
  - Nuclear energy
- Chemistry of Natural Waters
  - Dissolved oxygen
  - Oxidation of organic material
  - Carbonate System
  - Ocean Acidification
- Pollution and Purification of Water
  - Drinking water purification
  - Waste water treatment
  - Toxic heavy metals
  - Organic pollutants
**Physical and Mental Health:** If you find yourself experiencing physical health issues, please reach out to Student Health Services (843-953-5520). If you find yourself experiencing mental health challenges (for example, anxiety, depression, stressful life events, sleep deprivation, loneliness / homesickness, etc.) please consider reaching out to either the Counseling Center (professional counselors at [http://counseling.cofc.edu](http://counseling.cofc.edu) or 843-953-5640 3rd floor Robert Scott Small) or Students 4 Support (for certified volunteers text "4support" to 839863, visit [http://counseling.cofc.edu/cct/index.php](http://counseling.cofc.edu/cct/index.php), or meet with them in person 3rd floor Stern Center). These services are there for you to help you cope with difficulties you may be experiencing and to maintain optimal physical and mental health.

**Food & Housing Resources:** Many students report experiencing food and housing insecurity. If you are facing challenges in securing food (e.g., not being able to afford groceries or get sufficient food to eat every day) and/or housing (such as lacking a safe and stable place to live), please contact the Dean of Students ([http://studentaffairs.cofc.edu/about/salt.php](http://studentaffairs.cofc.edu/about/salt.php)). Also, you can go to [http://studentaffairs.cofc.edu/student-food-housing-insecurity/index.php](http://studentaffairs.cofc.edu/student-food-housing-insecurity/index.php) to learn about food and housing assistance that is available. In addition, there are several resources on and off campus to help. You can visit the Cougar Pantry in the Stern Center (2nd floor), a student-run food pantry that provides dry-goods and hygiene products at no charge to any student in need. Please also consider reaching out to Professor Mullaugh if you are comfortable in doing so.

**Inclusion:** The College of Charleston offers many resources for LGBTQ+ students, faculty and staff along with their allies.

- Preferred Name and Pronoun Information
- On Campus Gender Inclusive facilities
- Campus Resources
- College of Charleston Reporting Portals
- National Resources for Faculty & Staff
- GSEC Reports
- Documenting LGBTQ Life in the Lowcountry (CofC Addlestone Library Special Collections Project)
- College of Charleston Quality Enhancement Plan (QEP)
- Articles about CofC and LGBTQ+ Issues

**Attendance Verification:** Only students officially registered (graded or auditing) for this course may attend class. During the week following the drop/add deadline, the professor will verify student enrollments in this course. Any student appearing on the class roll but determined not to have attended the class even once will be removed.
**COVID-19 Reminders:**

**Respect for Others**
For the health and safety of yourself and those around you, you are **required to wear a face-covering over both your nose and mouth while inside all campus buildings** (you should do the same inside other public buildings). This mask should fit well; there should not be gaps anywhere between your face and the mask. Also remember that **students, faculty, and staff should not come to campus when they feel unwell.**

**Close Contacts and Infection**
Anyone with known contact with someone who is infected with COVID is required to follow CDC and CofC guidance, which states that unvaccinated people quarantine themselves away from others for 10-14 days after the last known contact and additionally get tested (negative test results do not eliminate the need to quarantine), while vaccinated people monitor themselves for symptoms and, if they become symptomatic, begin quarantine and testing. Additionally, per the CDC, fully vaccinated people should get tested 3-5 days after their exposure, even if they don’t have symptoms, and wear a mask indoors in public for 14 days following exposure or until receiving a negative test result.

Students living in the same household as someone infected with COVID will need to consult Student Health on the length of their quarantine. If a new member of the household becomes sick, they will need to restart their quarantine.

**Anyone who is sick should be tested for COVID and, upon receiving a positive test result, isolate from others for at least 10 days, regardless of vaccination status.** Consult Student Health for whether you can come out of isolation after 10 days.

The CDC’s guidance has changed over the course of the pandemic as new data and new variants have emerged; check the latest info for yourself: [https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/quarantine.html](https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/quarantine.html) and find CofC’s info here: [https://cofc.edu/back-on-the-bricks/](https://cofc.edu/back-on-the-bricks/) The easiest thing to do is to contact Student Health about your particular situation to get their guidance: [https://studenthealth.cofc.edu/](https://studenthealth.cofc.edu/) If you cannot attend class due to a COVID-related situation, contact your instructors for help in making up assignments.

**Online Classes Only**
It is safe for you to attend online classes *from home* during both quarantine and isolation. If you are very ill or hospitalized and cannot attend online classes, notify your instructors for help in making up assignments.

**Resources**
CofC Student Health requests that you inform them of positive COVID testing results and any close contact with someone who is COVID-positive, so they can monitor the campus health situation and give you personalized healthcare. CofC holds regular free testing events on campus for anyone in the campus community to get tested for COVID infection. CofC also holds free vaccination events on campus for all students. Vaccination remains the best way to protect yourself, your family, and those around you.