**Introduction to Environmental Chemistry**
**CHEM 2240 (CRN 2115)**
**Spring Quarter, 2023**

**Instructor**: Dr. Debbie Gale Mitchell
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**Contact Info**: Email – debbie.mitchell@du.edu
**Office Hours**: TBA pending class poll

**Class Time**: MWF, 9:00 – 9:50 AM
**Class Location**: ECS 410

**Graduate TA:** Maxwell Freeman
**Office Hours:** Science and Engineering Center (SEC)

**SEC:** Science and Engineering Center in Library
Details: http://portfolio.du.edu/SEC/page/52141

**REQUIRED COURSE ITEMS**

**Calculator**: You will need an inexpensive calculator that has the capability for square roots, logarithms, and exponents. You are responsible for understanding how to perform these operations on your calculator.

**Textbook**: *Environmental Chemistry: A global perspective*, 4th Edition
Van Loon and Duffy, Oxford University Press
E-book ISBN: 9780192522634 ($46.98 for 180 day access)
Print ISBN: 9780198749974

E-book link: https://redshelf.com/book/1062565/environmental-chemistry-1062565-9780192522634-gary-w-vanloon-stephen-j-duffy

Amazon.com: https://www.amazon.com/Environmental-Chemistry-perspective-Gary-vanLoon/dp/019874997X ($65.15 new)

Also available from https://www.bkstr.com/denverstore

**COURSE DESCRIPTION**

Introduction to Environmental Chemistry is designed as the third of three core chemistry requirements for environmental science or ecology majors, although it is expected that a handful of students with other majors and from other disciplines will be enrolled. The course is designed as a "survey" of topics in environmental chemistry; as such, we will not go into extreme detail on any one topic. The aim of the course is to introduce students to environmental chemistry issues and to expose ideas that will provide a basic framework to process complex issues that will face our world today and in coming years.

The course is comprised of both lecture and lab portions. One final grade will be assigned, weighted as a mix of the two portions. As a result, it is not possible to withdraw from lecture or lab independent of the other.

The course is not designed to be an upper division chemistry course; however, Dr. Mitchell will assign assignments and tasks that will often be challenging and that may require significant effort and time. It is expected that during many weeks students should put in ~2-3 hours outside of class per course credit hour, which means ~6-9 hours outside of class per week *on average*. This will not always be the case, and some weeks will require more or less effort. Some topics are often cumulative, so please do not get behind.

**LEARNING OBJECTIVES (approximate)**

- Appreciation for broad, underlying concepts in environmental chemistry
- Invigoration of interest in environmental chemistry, driven partly through curiosity
- Understanding associated with the following topics:
    - Identify major and minor gases in the atmosphere
    - Identify and describe temperature and pressure profiles of troposphere and stratosphere as well as primary physical, chemical, weather characteristics of each zone
    - Calculate the energy associated with electromagnetic radiation given the wavelength of an associated photon
    - Stratospheric ozone chemistry, including major natural sources and sinks, the Chapman mechanism, catalytic cycles of stratospheric ozone destruction, CFCs, PSCs, important international policies, and the difference between issues surrounding the ozone hole and global climate change
    - Calculate absolute concentration of gases from relative concentrations (mixing ratios) and vice versa
    - Sources and effects of acid rain and factors associated with improvements
    - Effect of CO2 on rain and terrestrial waters, including association with the carbonate cycle
    - Sources and basic chemical processes associated with tropospheric ozone and urban smog
    - Sources and properties of particulate matter
    - Chemical reasoning explaining greenhouse gases and effect
    - Basic processes associated with global energy balance, including IPCC summary of Earth radiative balance
    - Basic understanding of redox chemistry as applied to environmental chemistry
    - Basic understanding of complexation in aqueous systems and its application to environmental metals
    - Reasoning behind differences in energy associated with different organic fuel types
    - Basic understanding of nuclear chemistry and applications to both environmentally relevant nuclear decay (i.e. Radon) as well as nuclear energy and weapons
    - Awareness of timely or otherwise key environmental chemistry topics, i.e. including Chernobyl and Fukushima nuclear disasters, nuclear waste at Rocky Flats near Denver, chemical weapons waste at the Rocky Mountain Arsenal facility near Denver, the Bhopal chemical disaster

**LECTURE**

The format of the class meetings will follow traditional lecture format on MWF. I will summarize new material and present illustrations and examples. We will do some group work, but will not have formal groups this quarter.

**OFFICE HOURS**

Office hours will be held in-person

**READING**

Reading sections will periodically be assigned and mentioned in lecture or posted via Canvas. You are encouraged to compete the assigned reading prior to the class lecture and often again after the lecture. In addition, you are also encouraged to attempt the example exercises throughout the text while completing the assigned reading. I recommend that you understand the material and how to solve the sample problems before proceeding to the next section.

**GRADED ASSIGNMENTS**
Weekly assignments will be required to be turned in for a grade. These may be homework assignments of problems taken from a book or may be more conceptual or literature-research driven in nature. Some assignments will be individual efforts and others will require group work. Homework problems will often be more difficult than exam questions in order to make you think.

For all assignments, it is very important that they are: (a) submitted as a single document per assignment in a standard document format, (b) typed or easily readable, (c) oriented in the correct way to be easily read (all pages). Assignments submitted without proper organization or clarity may be returned and may be counted as late and/or receive an additional grade penalty.

**ASSIGNMENT LATE POLICY**
Assignments will generally be due on Saturday at midnight via Canvas. Assignments will be considered on time if submitted before Monday @ 9AM. 10% late penalty if submitted between 9:05 am 10:00 pm on Monday. 25% late penalty if turned in by end of the next class.

**EXAMS**
Three (3) exams will be given during the quarter: two mid-terms and one final exam. The dates of these exams will be given well in advance. **Under NO circumstances may the final be dropped or taken early**.

**GRADES**
Your final grade will be earned according to your performance on a mix of assignments from both the lecture and laboratory portions of the course. The table below lists a tentative estimate of the final break-down that will be used. Any changes will be announced in class. The final letter grade will be assigned based on the table of percentages listed here. I will not grade on a curve, but overall grade averages may be slightly increased if necessary in some cases.

| Component | Points | Percentage |
|---|---|---|
| Assignments | 80 | 20.0% |
| Presentation | 50 | 12.5% |
| Mid-Term #1 | 50 | 12.5% |
| Mid-Term #2 | 50 | 12.5% |
| Final Exam | 70 | 17.5% |
| Labs | 100 | 25.0% |
| | | |
| *Total* | *400* | *100%* |

| Letter Grade | Percentage |
|---|---|
| A | 93.0 - 100 |
| A - | 90.0 - 92.9 |
| B + | 87.0 - 89.9 |
| B | 83.0 - 86.9 |
| B - | 80.0 - 82.9 |
| C + | 75.0 - 79.9 |
| C | 69.0 - 74.9 |
| C - | 65.0 - 68.9 |
| D + | 62.0 - 64.9 |
| D | 58.0 - 61.9 |
| D - | 55.0 - 57.9 |
| F | < 54.9 |

**IMPORTANT DATES**

March 27: Classes begin, Spring Quarter
May 21: Last day to drop (with 'W' grade & approval)
May 29: Memorial Day (No class)
June 3: Last day of classes
**June 07 (Wednesday): Final Exam, 8:00 – 9:50 AM**

| Week # | Meeting # | Lecture # | Exam # | Date | Week-day | Lecture | | Reading Assignment | Homework | | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Available Date | Due Date | Due Date |
| 1 | 1 | 1 | E1.1 | Mar 27 | M | H | Syllabus overview + introduction | | | | |
| | 2 | 2 | E1.2 | Mar 29 | W | H | Atmosphere and photochemistry | Ch. 2.1 - 2.2 | #1 | | |
| | 3 | *L0* | | Mar 30 | Th | | *Lab #1: Statistics* | | | | |
| | 4 | 3 | E1.3 | Mar 31 | F | H | Stratospheric ozone I | Ch. 2.3 (p. 28-37); 9.3 | | | |
| 2 | 5 | 4 | E1.4 | Apr 2 | M | H | Stratospheric ozone II | Ch. 2.3 (p. 38-40); 3.1-3.2 | | | |
| | 6 | 5 | E1.5 | Apr 3 | W | H | Stratospheric ozone III | Ch. 3.3-3.4, 3.7 | #2 | | |
| | 7 | *L1* | | Apr 5 | Th | | *Lab #2: Information Literacy & Line drawings* | | | | |
| | 8 | 6 | E1.6 | Apr 7 | F | H | Acid base equilibria + polyprotic acids | | | | |
| 3 | 9 | 7 | E1.7 | Apr 10 | M | H | Acid rain I | Ch. 5.1-5.2 | | | |
| | 10 | 8 | E1.8 | Apr 12 | W | H | Acid rain II | Ch. 5.6 | #3 | | |
| | 11 | *L2* | | Apr 13 | Th | | *Lab #3: Acid rain & CO2 solubility* | | | | |
| | 12 | 9 | E1.9 | Apr 14 | F | H | Ocean pH + carbonates/CO2 in water | | | | |
| 4 | 13 | 10 | E1.10 | Apr 17 | M | H | Atmospheric oxidation | | | | |
| | 14 | 11 | E1.11 | Apr 19 | W | H | Smog | | | | |
| | 15 | *L3* | | Apr 20 | Th | | *Lab #4: Greenhouse effect* | | | | |
| | 16 | 12 | E2.1 | Apr 21 | F | H + M | Presentation skills + lit searching | | | | |
| 5 | 17 | E | - | Apr 24 | M | - | **Exam #1 (Lectures 1-11)** | | | | |
| | 18 | 13 | E2.2 | Apr 26 | W | H | Particulate matter I | | #4 | | |
| | 19 | *L4* | | Apr 27 | Th | | *Lab #5: Soil Analysis* | | | | |
| | 20 | 14 | E2.3 | Apr 28 | F | H | Particulate matter II | | | | |
| 6 | 21 | 15 | E2.4 | May 1 | M | H | Indoor air quality | | | | |
| | 22 | 16 | E2.5 | May 3 | W | H | Greenhouse I | | #5 | | |
| | 23 | *L5* | | May 4 | Th | | *Lab: Group Presentations* | | | | |
| | 24 | 17 | E2.6 | May 5 | F | H | Greenhouse II | | | | |
| 7 | 25 | 18 | E2.7 | May 8 | M | H | Climate I | | | | |
| | 26 | 19 | E2.8 | May 10 | W | H | Climate II | | #6 | | |
| | 27 | *L6* | | May 11 | Th | | *Lab #6a: Water Quality (Part I)* | | | | |
| | 28 | 20 | E3.1 | May 12 | F | M | Redox chemistry | | | | |
| 8 | 29 | E | - | May 15 | M | - | **Exam #2 (Lectures 12-19)** | | | | |
| | 30 | 21 | E3.2 | May 17 | W | M | Metals in the enviroment | | #7 | | |
| | 31 | *L7* | | May 18 | Th | | *Lab #6b: Water Quality (Part II)* | | | | |
| | 32 | 22 | E3.3 | May 19 | F | M | Aqueous complexation | | | | |
| 9 | 33 | 23 | E3.4 | May 22 | M | H | Fuel energy | | | | |
| | 34 | 24 | E3.5 | May 24 | W | H | Nuclear energy I | | #8 | | |
| | 35 | *L8* | | May 25 | Th | | *Lab #7: EDTA titrations* | | | | |
| | 36 | 25 | E3.6 | May 26 | F | H | Nuclear energy II | | | | |
| 10 | 37 | - | - | May 29 | M | - | ***Memorial Day (No class)*** | | | | |
| | 38 | 26 | E3.7 | May | W | H? M? | Organic pollutants | | | | |
| | 39 | *L9* | | Jun 1 | Th | | *Lab #8: Microplastics* | | | | |
| | 40 | 27 | E3.8 | Jun 2 | F | H | Finish + review | | | | |
| | **41** | - | | **Jun 7** | **Tu** | | **FINAL EXAM, 8:00 - 9:50 AM** | | | | |