

CHEM 361 Environmental Chemistry II

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Course description: Chemistry of the environment, including the hydrosphere and geosphere. Principles of physical, inorganic, and organic chemistry are applied to understand the origins of environmental pollutants, their transport, distribution, and decomposition pathways in water and soil environments.

CHEM 361 Prerequisites: CHEM 360 with a grade of C or better.

Required textbook: Environmental Chemistry: A global perspective, Gary W. vanLoon and Stephen J. Duffy, Edition: 3rd (ISBN-13: 978-0199228867) or 2nd (ISBN-10: 0199228868)

Supplementary textbooks (not required): (a) Elements of Environmental Chemistry, Ronald A. Hites, 1st Edition (ISBN-13: 978-0471998150, available electronically via NJIT library website at <http://librarius.njit.edu/vwebv/holdingsInfo?bibId=423296>) ; (b) Principles of Environmental Chemistry, James E. Girard, Edition: 2nd or 3rd edition (ISBN: 9780763759391).

General Chemistry reference materials (not required): (a) ACS General Chemistry Study Guide (<http://chemexams.chem.iastate.edu/students/study-materials>); (b) A good freshman General Chemistry textbook.

Course outline

1. **Introduction:** environment; Earth as a closed system (lithosphere, atmosphere, and hydrosphere); life and ecosystem; global biogeochemical cycles
Reading: vL&D 1
2. **Brief review of fundamental concepts:** concentration units for gas mixtures and aqueous solutions; unit conversions; reaction rates and equilibria; pH of strong and weak acids
Reading: vL&D 2.3, 9.2, 9.3, H 1,2
3. **Hydrosphere:** water cycle; properties of water; distribution of chemical species in aquatic systems
Reading: vL&D 9, 10
4. **Chemicals in water:** gases, organic chemicals, and metals; colloids and surfaces; microbiological processes
Reading: vL&D 11-15

5. **Water pollution and treatment:** definition; water quality; primary, secondary, and tertiary methods; advanced microbiological processes

Reading: vL&D 16

6. **The terrestrial environment:** soil formation and properties

Reading: vL&D 17, 18

7. **Soil contamination:** solid, organic, and mixed urban wastes; synthetic organic chemicals

Reading: vL&D 19, 20

Requirements: bring to every class scientific or engineering calculator; cell phones must be turned off or switched to vibration mode; if you receive an urgent call, step out of the classroom while using the phone (this is a privilege, do not overuse it).

Grading:

Mid-term exam (~9 weeks) ^{1,2}	25%
Final Exam (cumulative) ^{1,2}	30%
Quizzes/Homework ^{1,2,3}	30%
Class project (summary and presentation) ⁴	10%
<u>Attendance</u>	<u>5%</u>
Total: ⁵	100%

¹ Make up exams and quizzes may be arranged only for university-approved excuses.

² Only scientific calculators are allowed during exams and quizzes (e.g., TI-30 or TI-34, but not TI-84 or TI-Nspire)

³ Each 30-min quiz is paired with a homework assignment. The grade for each quiz is counted towards the total quiz grade **only** if the associated homework assignment is turned in on time. The quiz with the lowest grade will not be counted towards total.

⁴ The class project may be based on (a) scientific article from a peer-reviewed journal, (b) your research project (e.g., independent study), or (c) development of a demonstration for CHEM360/361. The article **must cover one of the topics from this course** and **cannot be a magazine article or a review**. Students will work individually and must present the original journal article of their choice, a one-paragraph summary of their research project, or a one-paragraph demonstration proposal (including the source, if available) for approval by the instructor. Presentations (10 min) will be throughout the semester (~1-2 presentations each week). The summary will be due around midterm (1 page, single-spaced, submitted electronically, will be checked for plagiarism using Turnitin).

⁵ Under no circumstances will students be given the opportunity to complete extra-credit assignments to bolster their final grades.

Notes: You are encouraged to discuss with me any difficulties you may encounter during the course. Please do not let the problem linger, contact me as early as possible!

Academic integrity: The consequences of plagiarism or academic misconduct of any kind are severe. The NJIT honor code will be upheld and any violations will be brought to the immediate

attention of the Dean of Students (<http://www.njit.edu/academics/pdf/academic-integrity-code.pdf>)

Course outcomes: by the end of this course, students will be able to

- List major environmental compartments
- Identify factors that control the speciation of chemicals in different environments
- Distinguish cases where pollutant concentrations are controlled by transport or chemical transformations
- Solve problems involving flows, fluxes, and residence times of pollutants
- Present a written summary and an oral overview of an original scientific article
- calculate concentrations and mixing ratios of pollutants using different units
- describe the concepts of global cycles, sources and sinks, and lifetimes of pollutants
- calculate lifetimes and removal rates of pollutants
- identify primary and secondary pollutants
- calculate pH of rainwater under natural and polluted conditions
- describe pollution control methods, regulations, and policies
- assess impacts of air, water, and soil pollution on the environment and human health
- describe the water pollution by heavy toxic metals and their bio-geochemical cycles
- explain the phenomena behind the formation of acid rain
- identify the various types of biological and chemical water pollutants and explain their effects
- describe the water and sewage treatment process and explain the rationale for each step

Disclaimer: the course content can be adjusted by the instructor during the semester as necessary