

Winter 2020 CIV_ENV 495-0-18: Surface Chemistry of Particles in Environmental Systems

MW, 4:00-5:50 pm, Virtual

Instructor

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Office hours:

Thursdays 4 pm-5 pm

<i>Course Grading:</i>	Homework sets (2)	80	(16%)
	Case Study 1	120	(24%)
	Case Study 2	120	(24%)
	Quizzes (4)	140	(28%)
	Participation	<u>40</u>	(8%)
	Total	500	

Course Description and Objectives:

Natural particles such as mineral precipitates, mineral oxides, clay minerals, and organo-mineral composites facilitate the cycling of important elements in the environment, facilitate nutrient availability for agricultural productivity, buffer the adverse effects of climatic conditions in lakes and oceans, and mediate transport and degradation of contaminants in environmental processes. This course covers the surface chemistry of these particles, including fundamental concepts and applications of chemical kinetics, chemical equilibrium, and molecular spectroscopy in particle characterization.

Learning Goals:

- To evaluate the role of particles in environmental processes
- To understand interactions of mineral particles in natural soils and waters
- To learn how to determine chemical kinetics and equilibrium of particles
- To become familiar with key techniques in chemical characterization
- To link particle characteristics to engineered processes

Course Plan:

The course will be divided into the following sections:

Week 1: Background on the Role of Particles in Natural Processes

Case study Example: Response to Climate Change

Week 2: Controlling Mineral Dissolution versus Mineral Formation

Week 3: Surface Chemistry of Particles: Metal/Mineral Oxides, Clay Minerals

Week 4: Surface Chemistry of Particles: Organo-Mineral Complexes

Week 5: *Presentation of Case Study 1*

Week 6: Chemical Equilibrium and Kinetics

Week 7: Linking Particle Chemistry to Engineered Processes

Week 8: Analytical Techniques for Particle Characterization

Week 9: *Presentation of Case Study 2*

Course Materials:

No textbook is required for this course. If needed, supplementary handouts will be posted.

Relevant readings will be taken from the following textbooks:

"Environmental Engineering Science" by William W. Nazaroff and Lisa Alvarez-Cohen;

"The Chemistry of Soils" by Garrison Sposito

"The Surface Chemistry of Natural Particles" by Garrison Sposito

Assignments:

Case Studies, and solution sets will be posted online. There will be three case studies and six quizzes, as indicated on the detailed course outline. Case study assignments will be due online (on Canvas) by the time indicated on the syllabus. You will be given about two weeks to complete each case study. Quizzes count for **35 points each** and case studies count for **120 points each**. *Penalty:* a 10-point penalty for each day a case study is late (A case study turned in at 4:31 pm is considered one-day late).

Please note: Each student in this course is expected to abide by the Northwestern University Code of Academic Integrity

Quiz: Cheating or absence during a quiz will result in an automatic zero for the quiz grade.

Case study: You will be working in pre-arranged groups of 3.

Grade Disputes: If there is a dispute over the grading of a quiz or case study, I reserve the right to re-evaluate the entire work. A written explanation of the dispute will have to be turned in and the appropriate changes will be made and explained to the student. Any grade dispute should be turned in by the next class period after the assignment/exam is returned to you.

Special Needs: Please notify me if you have or develop any documented disabilities or special circumstances that require attention. Appropriate accommodations will be made as soon as possible. Communication is key here. I am only able to help if you communicate to me your special needs.

Emergencies: Documented medical or family emergencies are required to receive extensions on homework assignments. No extensions are given for either professional or athletic trips. For missing case study or quizzes due to emergencies, your grade will be re-calculated to adjust for the missing assignments.

Class Participation:

Class participation is an integral part of the learning process and I encourage you to participate and ask questions. I will frequently elicit answers to questions in class and may randomly select students to answer.

Attendance and class participation will account for **40 points**.