UNIVERSITY OF CALIFORNIA, MERCED
ENVE 184 – Field Methods in Environmental Chemistry (2 units)
Fall 2021
Tuesday 1:30-3:20 pm
ADMIN 355

Instructor: Dr. Marc Beutel; mbeutel@ucmerced.edu
Office Hours: Tuesday 4-5 pm by zoom, or by appointment

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Office Hours: TBD or by appointment

I. Course Description: The course will focus on assessing the environmental chemistry of lakes and wetlands, including pH, dissolved oxygen, redox potenital, nutrients (phosphate, nitrate and ammonia) and metals (iron and manganese). Another focus of the course will be how to develop and test clear experimental hypotheses in the context of chemical cycling in lakes and wetlands. The first part of the course includes lectures related to chemical cycling in aquatic ecosystems. The second part of the course includes lectures and videos related to field monitoring of pH, dissolved oxygen, and redox potenital, and laboratory analysis of nutrients and metals using colorimetric analysis, ion chromatography and inductively coupled plasma. Throughout the lecture phase of the course, students will be randomly called upon to answer daily questions based on each lecture and be assessed on course material via four quizzes. In the last part of the course, students will break into teams to experimentally test a compelling hypothesis focusing on how key environmental variables (time, space, temperature, light and dissolved oxygen) affect chemical cycling in aquatic ecosystems. Hypotheses will be tested in Little Lake, a pond/wetland feature in the center of campus. At the end of the course, student teams will present their experimental study to the class.

II. Course Goals and Outcomes:

a. ***Course Goals:*** The general goals of this course are tied to the Program Learning Outcomes (PLO) for the Civil & Environmental Engineering program including:

PLO 1. Demonstrate a strong disciplinary foundation, engage in interdisciplinary thinking, think critically, problem-solve, monitor and guide their own learning, describe the origins of knowledge, and demonstrate an inquiry-based approach to the world;
PLO 3. Understand and contribute to their local and global communities, possess a sense of place, act ethically, and be responsive to the needs of society; and
PLO 4. Be proficient in collaboration and teamwork, possess strong communication skills, serve as leaders in their professional and civil communities;

The course goals also reflect the national engineering accreditation (ABET) Program Educational Objectives (PEO) for engineering programs including:

PEO 3. An ability to communicate effectively with a range of audiences;
PEO 5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives; and
PEO 6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

b. ***Learning Outcomes:*** Specific learning outcomes are listed below. By the end of this course, students will be able to:

- Describe the water quality implications of key environmental chemicals (pH, dissolved oxygen, redox potenital, nutrients and metals) in aquatic ecosystems.

- Describe spatial and temporal patterns of temperature, dissolved oxygen, pH, nutrients and metals in lakes and wetlands.
- Collect measurements in the field of temperature, dissolved oxygen, pH and redox potenital.
- Collect, preserve and analyze environmental water samples for nutrients and metals.
- Design an experiment with a clear and testable hypothesis related to chemical cycling in lakes and wetlands.
- Analyze and interpret water quality data.
- Develop and apply effective teamwork, written, oral and graphical communication skills.

III. Course Format: The first two-thirds of the course is structured as interactive lectures in which material is presented in real time with students being asked to help explain and interpret the lecture material. Note that videos of the lectures will also be available, and while students are encouraged to watch these lectures, they are also required to attend lectures in person. Lectures will be supplemented with key figures and tables from the text book and educational videos. Students are strongly encouraged to ask questions during lectures and share any insights or appropriate comments they may about the lecture material. Course material will be made available in a timely manner via CatCourses, including a video lecture of the upcoming in class lecture. Students will take four quizzes to assess their mastery of course material. In the last third of the class, student teams will develop and experimentally test a hypothesis related to chemical cycling in aquatic ecosystems.

The course is partly structured around the text book Limnology (Horne and Goldman, 1994); key sections of the text book will be provided. In addition, links to educational videos are provided on the course schedule. It is critical that students do assigned reading and review the videos before lectures. This is needed to prepare for daily questions, a set of questions that students will be randomly asked during lecture.

It is important for students to engage with the course material by taking notes (i.e., copying down what is put on the board and what is said by the professor and students) as the lectures unfold. Finally, work load expectations are around 2 hours per week per course unit outside of class. Thus, you are expected to study at least 4 hours per week outside of class time for this 2-unit course.

IV. Course Requirements:

a. ***Class attendance and participation policy:*** Your active participation during lecture is a critical component of the course and is important to both its success and your ability to learn course material. To optimize your learning effectiveness, it is critical that you take detailed notes during lecture as we develop and discuss course material on the board. Your discussions in class, your response to daily questions, your note taking activities, and your attendance will be recorded. The following rubric will be used to assess your level of participation in the course:
   - Excellent (A): Regularly makes thoughtful and appropriate contributions to discussions that seek to broaden understanding and application of material. Actively taking detailed notes and engaged in lectures. Minimal absences.
   - Good (B): Occasionally makes thoughtful and appropriate contributions to discussions that seek to broaden understanding and application of material. Actively taking detailed notes and engaged in lectures. Occasional absences.
   - Fair (C): Infrequently makes contributions to discussions with only a basic attempt to broaden understanding and application of material. Taking some notes and passive engagement with lectures. Modest number of absences.

- Poor (D/F): Almost never makes contributions to discussions with superficial or off-topic comments that do not broaden understanding and application of material. Taking no notes and not engaging with lectures. Frequent absences.

b. ***Course textbook:*** Limnology 2nd Edition (Horne and Goldman, 1994, McGraw-Hill). I will supply select sections of the text as needed. Perform the assigned reading before lectures and in consultation with the daily questions so that you are prepared to answer the daily questions in class.

c. ***Course assignments and projects:*** Key course assignments include: (i) daily questions, (ii) quizzes, (iii) individual student hypothesis development; and (iv) team experiment and hypothesis presentations. Clear grading rubrics for assignments (iii) and (iv) will be distributed and discussed as part of the assignment.
   - Daily Questions (DQs) related to upcoming lecture topics will be distributed to the class prior to lectures. DQs are meant to help students understand what material in the text to focus on, as well as prepare for lectures and exams. During lecture, random students will be asked to address DQs and the quality of responses will be recorded and applied to your course participation grade.
   - Four quizzes, each covering the previous two lectures, will be given in class to assess student mastery of course material.
   - Students will develop a hypothesis related to how time, space, temperature and/or dissolved oxygen affects chemical cycling in lakes or wetlands and present the hypothesis as a brief PowerPoint presentation to the class.
   - Students will break into five teams (Time, Space, Temperature, Light and Dissolved Oxygen) and present their experimental study to the class as a polished and comprehensive PowerPoint presentation at the end of the course.

V. Grading Procedures: Final grades will be assigned on a standard scale (e.g., 90-92.9 = A-, 93-96.9 = A, 97-100 = A+). I may adjust the scale accordingly at the end of the semester to ensure that an appropriate allocation of grades is obtained. Final grades will be estimated based on the following breakdown:

- Class participation/daily questions: 10%
- Four quizzes: 40% (10% each)
- Individual hypothesis presentation:10%
- Team experiment presentations: 40%

VI. Academic Integrity:

a. Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work.

b. You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an electronic or hard copy. Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.

c. During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

VII. Student Accommodation: University of California, Merced is committed to creating learning environments that are accessible to all. If you anticipate or experience physical or academic barriers based on a disability, please feel welcome to contact Dr. Beutel privately so we can discuss options. In addition, please contact Student Accessibility Services (SAS) at (209) 228-6996 or disabilityservices@ucmerced.edu as soon as possible to explore reasonable accommodations. All accommodations must have prior approval from Student Accessibility Services on the basis of appropriate documentation. If you anticipate or experience barriers due to pregnancy, temporary medical condition, or injury, please feel welcome to contact me so we can discuss options. You are encouraged to contact the Dean of Students for support and resources at (209) 228-3633 or https://studentaffairs.ucmerced.edu/dean-students.

VIII. Tentative Course Schedule: See the following page for a detailed course schedule. The schedule is subject to change.

IX. Commercial Use of Course Materials. All course materials are my intellectual property and are protected by copyright. Selling course material or notes through commercial services, without my written advance permission, may be viewed as copyright infringement and/or an academic integrity violation.

ENVE 184 Fall 2021 - Course Schedule

Week	Lecture Topic	Quizzes	Daily Questions	Reading	Video Lecture	YouTube Links
Introduction to Aquatic Chemistry						
Lect 1 Aug 31	Course Intro; Aquatic ecosystems; Hypotheses		DQ1	Limnology Ch 2; "Writing a Hypothesis"	Lect 1	
Lect 2 Sept 7	Oxygen, carbon dioxide and redox potenital		DQ2	Limnology Ch 7	Lect 2	
Monday Sept 13	Field trip to Merced Wastewater Treatment Plant 9-11 am					
Lect 3 Sept 14	Nitrogen cycling	**Quiz 1 (Lect 1 & 2)**	DQ3	Limnology Ch 8; Beutel 2006	Lect 3	
Lect 4 Sept 21	Phosphorus cycling		DQ4	Limnology Ch 9; Beutel 2006	Lect 4	
Lect 5 Sept 28	Iron and manganese cycling	**Quiz 2 (Lect 3 & 4)**	DQ5	Davison (1993); San Pablo Reservoir Study	Lect 5	
Analytical Methods						
Lect 6 Oct 5	Field sensors: pH, Dissolved oxygen; Redox potenital		DQ6	SM 4500 H+; LDO sensor; Biogeochemistry Redox	Lect 6	https://www.youtube.com/watch?v=PBTn4gTEbkU https://www.youtube.com/watch?v=ElzhhUco414 https://www.youtube.com/watch?v=-BuqEhhDA8U
Lect 7 Oct 12	Lab analyses: Colorimetric; Ion chromatography; Inductively coupled plasma	**Quiz 3 (Lect 5 & 6)**	DQ7	SM 4500 Ammonia (intro A, phenate method F); SM 4110 IC; IC Wiki; SM 3125 ICP; ICP Wiki	Lect 7	https://www.youtube.com/watch?v=noUSORH5JWo https://www.youtube.com/watch?v=p3_WtEYIhTo https://www.spectro.com/icp-oes-principle
Hypothesis Development						
Lect 8 Oct 19	Hypotheses: Time; Space; Temp; Light; Dissolved Oxygen		DQ8	"Writing a Hypothesis"; Beutel 2006; Beutel et al. 2007; Beutel et al. 2009; Beutel and Larson 2015; San Pablo Reservoir Study	Lect 8	
Lect 9 Oct 26	Student hypothesis presentations	**Quiz 4 (Lect 7 & 8)**				
Class Experimental Project						
Lect 10 Nov 2	Implement experiments					
Lect 11 Nov 9	Implement experiments					
Lect 12 Nov 16	Implement experiments					
Thanksgiving Break, Nov 22-26						
Lect 13 Nov 30	Discuss experimental results					
Lect 14 Dec 7	Student team presentations					