Course Objectives

Description:
This course covers the relationships between food, energy, and water resources, from the perspective of environmental chemical and microbial processes. The crux of this course is the connections between these critical microbial and chemical factors and understanding relevant flows, cycles, balances, and perturbations. The overall structure of this course is somewhat ‘unconventional’ by teaching foundational concepts through immediately and authentically relevant in-depth case studies (rather than tacking on a few examples to first principles derivations). After taking this course you will better understand the foundational concepts related to environmental chemistry and microbiology, how energy flows through ecosystems, the role of biogeochemical cycles, and how these concepts impact water quality and ecosystem / human health and can be employed as management strategies. My goal is to ensure that a few foundational principles are stressed and that you get multiple takes on these. You will not become an in-depth expert in everything per se, but this course will provide an overview and orientation to relevant chemical and microbial processes in the environment and position you to study topics in more depth.

Specific course learning outcomes include:
- Analyze, evaluate, model complex systems
- Design and develop appropriate solutions
- Communicate science in technical formats

Specific technical LEARNING OBJECTIVES include:
- Orientation to foundational and environmentally relevant microbiology and chemical processes
- Understand interconnected microbial and chemical biogeochemical cycles
- Internalize how diverse environmentally relevant redox reactions determines contaminant transformation, fate, toxicity, and energy flow through ecosystems
- Evaluate relevant tools/resources to determine properties of contaminants
- Use these tools and available resources to predict fate of contaminants in novel situations and feasible create design solutions
- Analyze data critically
- Distill scientific literature to create testable hypotheses and design research experiments
- Write in a clear and concise manner for a technical audience

Philosophy:
Solving the problems of tomorrow will require a creative blend of fundamentals with an eye toward application. A thorough understanding of the foundational environmental processes enables people to internalize transferable knowledge and actually become more creative in the process. If one understands how things work, then innovation and new designs are possible. In the world outside the classroom, there are often undefined answers, uncertainty in data, tradeoffs in design, and broader societal impacts. Through this course, we will examine the inherent complexity of real environmental systems while extracting and distilling foundational concepts that are tools for universal problem solving. This course is explicitly designed to be participatory where learning occurs through the strength, diversity, and dynamic vitality of the group. We will learn through multiple modes and through teaching each other. Feedback helps strengthen the critical thinking of all persons involved. Feedback will be given to you from me and peers, and you will provide peers critical and constructive feedback as well. I will also be soliciting feedback during the semester on how this new course is working from your perspective; I value this feedback and try to adjust accordingly.
It is an expectation of this class that everyone who is here wants to be here and will actively participate in the course. This is not a required course for any degree, so everyone here should make efforts to find connections to your own research. This includes making best-effort contributions to HWs, actively participating in problem solving team (PST) discussions and quizzes, and being creative and engaged. This class is not a spectator sport where you will just sit back, take notes, watch me do some spoon-fed examples, and then regurgitate them for a test. People can try to ‘slack’ through assignments and think somehow they have outfoxed the system or something, but the reason these things are there is to help develop you as a researcher. If you think that somehow the topic is a waste of time, then please take a different class. The VAST MAJORITY of students like this class! This is a GRADUATE class. This class is sometimes messy, with nuance, unclear answers, uncertainly, probability density functions and standard deviations rather than cut-and-dry box in the answer questions—in other words, more like “real life.” This is designed to be a first-semester graduate course and launch you on a track for successful research at UIowa.

I fully realize that one of the challenges on this course is that people have many different academic backgrounds—but this can also be a strength as well. My goal is to make it such that everyone gets something out of the course. If you have an extensive background and degree in environmental engineering, you will still learn some new topic areas and also dig in to some neat case studies. If you have little chemistry background, this course will likely be more challenging for you and you will need to work more than others to stay up to speed. If there is something you don’t get right away, that’s fine…it means you’re learning! If you don’t understand after completing a HW, PST discussion, and/or taking a quiz…it means that you need extra help. DO use the reference texts, your peers, come to office hours, etc. If you don’t understand something after I reexplain, that’s my fault…if you never ask, that is your responsibility.

This course is a foundational course and will present concepts that apply throughout environmental systems (redox, equilibrium, kinetics, fate and transformation, energy transfer, etc.), but this class is painted on a Food, Energy, WATER Systems (feWs) canvas, interpreted broadly. Thus, many of our case studies will have examples that relate to these topics, with an emphasis on water. I will try to share my experiences throughout the course, and encourage participants to share their past work and past / current research experiences to create a community. I also want relevant, timely, and authentic examples that people who study both water quality and quantity will care about.

It is also an expectation of the course and program that persons eligible to apply to the NSF GRFP will do so. This course will help position yourself to do this, and there are many resources on campus and at IIHR to assist you. The graduate school also has a financial incentive to apply!

Finally, I want to make a few content notes relating the evolving and experimental approach to this course. I am very responsive to course participants—particularly in this class, where I want people to think of themselves as shareholders in the course. As such, based on the systematic involvement from the Ulowa Center for Evaluation as part of the NSF NRT, I have changed some course content. Some specific examples include adding more details on cell metabolism and cutting the toxicology risk section. I'm also adding more examples of 'solutions' rather than so much focus on 'problems.' Students also liked my inclusion of economics (a passion of mine) related to the topics, so I will add more examples peppered throughout. Students also really, REALLY liked the use of case studies and discussion, which I am keeping as a course format. I'm always interested to get your constructive feedback; please keep in mind that the course is evolving, depends heavily on the current year's participants, and should be evaluated in the context of always trying new things (i.e., they won't be perfect, but I will try to make them as valuable as possible to you). Sometimes we will go into a good deal of depth, sometimes aim for breadth, but in all cases I will try to make connections to other things presented and core content. Oftentimes, we will work at the interface between environmental chemistry and microbiology and sometimes be studying these things concurrently.
Course Logistics

Time: 3:30-4:45 Tu, Th
Location: N104 LC

Instructor and Contact: Greg LeFevre
4106 Seamans Center
gregory-lefevre@uiowa.edu
319.335.5655

Office Hours: Wed 3:30-4:45 pm, or by appointment, or drop-in (see below!).

=> To schedule an appointment, please use the UIowa Outlook calendar in the UIowa Office 365 email to find an a not “busy” time
=> I will make an announcement in class or email if there is an extenuating circumstance where I can’t make scheduled office hours.
=> “Open Door Afternoons:” If you have a quick question that has also stumped your peers or can’t make office hours, you can stop by my office in the afternoons (1:00-4:45pm) if my door is open and no one else is there from the class (if the door is not open, I’m either not there or unavailable). If someone else is there from outside the class, please don’t interrupt them; if someone from the class is there please join in and we can all discuss together.

Course Website: ICON hosts the course website. Assignments, announcements, papers, resources, discussions, etc. will be occur through ICON. Some announcements may go to you through your UIowa email, the official means of communication for University correspondence. Students are responsible for materials on ICON and sent via email.

Readings & Resources: Most readings will be literature PDFs of papers. Papers, podcasts, videos, etc. and readings will be provided on ICON. There may be sometimes when you’ll be requested to bring a wifi enabled electronic device (i.e., laptop, tablet, smartphone) to class. Students are expected to read / listen / watch these materials, engage with materials, and come to class ready to discuss and problem solve.

Reference Texts: 1. Lester and Birkett, Microbiology and Chemistry for Environmental Scientists and Engineers, 2nd Ed. E & FN Spon, 1999. (Available as ebook through UIowa Library!).


**Tentative Topics Schedule (Subject to adaptation; a schedule is posted to ICON)**

<table>
<thead>
<tr>
<th>Date</th>
<th>TOPIC</th>
<th>Case Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>21-Aug Introduction FEWS Connections Motivation</td>
<td>Other IcT, WoW</td>
</tr>
<tr>
<td>Week 2</td>
<td>28-Aug Cell structure + function</td>
<td>ARGs, pathogen tracking</td>
</tr>
<tr>
<td>Week 3</td>
<td>4-Sep Redox Cycling and Energy transfer</td>
<td>Electron Shuttles</td>
</tr>
<tr>
<td>Week 4</td>
<td>11-Sep Cell metabolism and energetics, biostoich</td>
<td>Naphthalene Mineralization</td>
</tr>
<tr>
<td>Week 5</td>
<td>18-Sep Enzymes and Catabolic Pathways</td>
<td>Fungal Remediation</td>
</tr>
<tr>
<td>Week 6</td>
<td>25-Sep Biogeochemical cycles: Nutrients</td>
<td>Toxic Algal Blooms</td>
</tr>
<tr>
<td>Week 7</td>
<td>2-Oct Biogeochemical cycles: Nutrients</td>
<td>Woodchip Bioreactors, Fixer</td>
</tr>
<tr>
<td>Week 8</td>
<td>9-Oct Biogeochemical cycles: inorganics</td>
<td>Mercury cycling</td>
</tr>
<tr>
<td>Week 9</td>
<td>16-Oct Biotransformation: Pathways and Enzymes</td>
<td>Contaminants in food crops</td>
</tr>
<tr>
<td>Week 10</td>
<td>23-Oct Chem Equilibrium: sorption +bioavailability</td>
<td>Sorption: neonics vs legacy</td>
</tr>
<tr>
<td>Week 11</td>
<td>30-Oct Chem Equilibrium: overview acid/base, solubility</td>
<td>Flint water crisis</td>
</tr>
<tr>
<td>Week 12</td>
<td>6-Nov Abiotic Transformation Processes overview, kinetics</td>
<td>Triclosan to dioxins</td>
</tr>
<tr>
<td>Week 13</td>
<td>13-Nov Chemical Fate: box models</td>
<td>Dicamba: Pigweed Killer</td>
</tr>
<tr>
<td>Week 14</td>
<td>27-Nov Innovative Solutions</td>
<td>PPCP defacto reuse</td>
</tr>
<tr>
<td>Week 15</td>
<td>4-Dec Innovative Solutions</td>
<td>Stormwater CTR</td>
</tr>
</tbody>
</table>
Learning Tools and Assessment

Homework Assignments are typically problems associated with analysis of case studies in the literature and are due as noted on the HW assignment. All HW assignments will be by default worth the same amounts unless specifically communicated at the time of the specific assignment. HW are due one week from the time they are given at the beginning of class, unless stated explicitly otherwise when given. Late, unexcused (see below) assignments penalized by 50% the first day and are not accepted thereafter. HWs will typically be related to the topics and case studies discussed in class. Thus, students will generally be expected to turn in their HW via ICON before going to class, then have opportunities to discuss in small groups and answers will be shared on the board. Students are expected to actively participate in discussions. Any specific expectations for each assignment will be communicated. HWs are considered a place to practice, dive into problems, details, and explore outside data sources. As such, you MIGHT NOT have everything that you need to complete the assignments merely from just lectures. Please use this as an opportunity to “dig in” and investigate, ask questions of others, and use office hours as needed. HW solutions are generally provided and feedback on your HW will be via ICON. You are expected to use answer keys, review assignments, and to ask questions where you don’t understand.

Students (in groups) will lead one discussion section by (1) teaching foundational background on the topic, (2) presenting one additional case study NOT covered in the reading, (3) making connections to the research of both group members, and (4) engaging class members through a topical activity of your choosing. Creativity is good! See the description and rubric for details.

Projects are writing or presentation assignments and will be described in detail, with rubrics and examples. Because writing IS thinking, writing will be an integrating component to the course. The goal of writing in the course will be to experience iterative revision and response, and as such most writing assignments will be short in length, but may go through the peer review process and revision. Because of the increasing premium on EXPERTISE in our global economy, much of the course projects emphasize developing deeper knowledge in a specific area and sharing with others.

Quizzes will be given at various points throughout the semester (4-5 brief quizzes) and emphasize problems and understanding. Quizzes are not scheduled far in advance on the syllabus like tests due to potential changes in timing and adaptive management, but are never ‘pop-quizzes’ (i.e., you will always have notice at least one class period before). Quizzes in my classes are consensus quizzes, whereby the grade is 75% individual effort. The lowest quiz score for the semester is dropped from the final grade for the course.

Midterm is closed book-closed notes. I will provide any equations, conversions, periodic table, and other data need to work the problems. The emphasis is a combination of problem solving and concepts from discussions.

---

The Final Exam will be given during the final exam period scheduled for this class. The final exam will be comprehensive (i.e., cover information from throughout the semester), but the emphasis of the exam will be on demonstrating mastery of concepts covered during the semester.

Grading Weights for final semester grade:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>HW + Discussions</td>
<td>15%</td>
</tr>
<tr>
<td>Projects (total)</td>
<td>20%</td>
</tr>
<tr>
<td>Quizzes (total, drop lowest)</td>
<td>20%</td>
</tr>
<tr>
<td>Midterm</td>
<td>20%</td>
</tr>
<tr>
<td>Final</td>
<td>25%</td>
</tr>
</tbody>
</table>

Letter grades for the semester are converted from the weighted numerical scores above using the “standard” scale:

- ≥100%  A+
- 93-99.99%  A
- 90-92.99%  A-
- 87-89.99%  B+
- 83-86.99%  B
- 80-82.99%  B-
- 77-79.99%  C+
- 73-76.99%  C
- 70-72.99%  C-
- 67-69.99%  D+
- 63-66.99  D
- 60-62.99  D-
- <60%  F

If there is a problem with anyone in the problem-solving teams, then please see me to discuss.

If you need to miss class (e.g., for a conference) or cannot turn in an assignment on time for whatever reason, it is easiest and best to talk to me ahead of time for prior approval. If there is a situation where you unexpectedly miss class or a HW due date, please notify me via email as soon as possible. If an absence is an emergency that requires a ‘major accommodation’ (e.g., missing a test, turning in HW past the late deadline), you may need to work with the Associate Dean for Academic Programs for accommodations. For example, if you have a family emergency or illness, that’s not my business to judge and the aforementioned dean will simply communicate than an accommodation is needed (avoiding potentially awkward explanations to the instructor).

**Other Information [aka required stuff]**

**Possible Changes**
Changes may be made to the syllabus during the semester and will be announced and posted to ICON.

**Administrative Home**
Class policies on matters such as requirements, grading, and sanctions for academic dishonesty are governed by the College of Engineering. Students wishing to add or drop this course after the official deadline must receive the approval of the Associate Dean for Academic and Student Affairs in the College of Engineering.
Electronic Communication
University policy specifies that students are responsible for all official correspondences sent to their standard University of Iowa e-mail accounts. Students should check this account frequently.

Special Accommodations
I want to hear from anyone who has a disability that may require some modification of seating or other class requirements. Please contact me during my office hours, by e-mail or after class. Special academic arrangements for students with disabilities are handled in cooperation with Student Disability Services (www.uiowa.edu/~sds). Students who feel they need special accommodations for any aspect of the course are encouraged to contact SDS and to speak with the instructor early in the semester, so that accommodation can be made as soon as possible.

Understanding Sexual Harassment
Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community have a responsibility to uphold this mission and to contribute to a safe environment that enhances learning. Incidents of sexual harassment should be reported immediately. See the UI Comprehensive Guide on Sexual Harassment for assistance, definitions, and the full University policy.

Reacting Safely to Severe Weather
In severe weather, class members should seek appropriate shelter immediately, leaving the classroom if necessary. The class will continue, if possible, when the event is over. For more information on Hawk Alert and the siren warning system, visit http://hawkalert.uiowa.edu or http://police.uiowa.edu.

Concerns about the Instructor
Students with a complaint or problem in the course should first visit with me and then, should the issue remain unresolved, with, Dr. Andrew Beckett, Assistant Dean of University College. Complaints must be made within six months of the incident.

Instructor Absence for Travel
There may be some instances in which the instructor may be unable to be present due to professional conference travel as part of his/her active research mission and s/he may have a guest lecturer present in class or can attempt to schedule and evening exam to make up for the missed class periods. Great efforts will be made to minimize missed class time, but some make be required.

Academic Misconduct
Academic Misconduct relative to this class includes but is not limited to the following:
- copying from someone else’s exam or homework assignment
- allowing someone to copy or submit one’s work as his/her own;
- using notes or other materials during a test or exam without authorization.

Using an example test/exam from a prior year to study or providing such a test to another student

Policy on Homework Collaboration and Academic Misconduct: It generally benefits students to work together outside class. Discussion of homework and use of study groups is encouraged; however, homework submissions must represent a student's independent effort. Put another way, students may collaborate by discussing homework problems and working out solutions together; however, when preparing the document that will be submitted for a grade, each student must work independently. Collaborating on homework document preparation, copying someone's homework, sharing copies of figures or tables or spreadsheets with others, and giving (or receiving) a copy of someone's homework (a paper or electronic version), using past year exams or providing exams to students in future years, are all examples of cheating. On exams and quizzes, copying from others or working together is cheating. Plagiarism is the use of others' work represented as your own and is considered cheating. Students who cheat will be disciplined according to the College of Engineering’s regulations on Academic Misconduct:
http://www.engineering.uiowa.edu/ess/current-students/academic-policies-standards/academic-misconduct