Meeting Times and Place: 10:00 AM to 11:30 AM, TTh, Rudolph Hall 204

Instructor: Jeff Catalano, Rudolph Hall 242, 935-6015, catalano@eps.wustl.edu
Office Hours: M 2:00 to 3:30 PM, W 9:30 to 10:30 AM
Teaching Assistant: Emily Wen, emily.wen@wustl.edu
TA Office Hours: M 3:30 to 4:30, W 2:00 to 3:00 PM, Earth & Planetary Sciences Library

Course Website: http://epsc444.wustl.edu/

Course Goals:
- To comprehend the major chemical components of natural environments
- To learn the fundamental principles of aqueous geochemistry
- To apply these principles to understand how natural processes affect the composition of aquatic environments in terrestrial and planetary settings
- To develop expertise in the use of computer-based geochemical models

Course Description: Introduction to the geochemistry of natural waters and the processes that alter their composition. Key principles of aqueous geochemistry are introduced and then used to describe the main controls on the chemistry of pristine and polluted soil, surface, and ground water environments. Topics covered include mineral solubility, complexation, acids and bases, carbonate chemistry, rock weathering and clay formation, adsorption and ion exchange, redox reactions, microbial energetics and redox zonation, the geochemistry of iron, sulfur, trace elements, and radionuclides, and geochemical kinetics. Geochemical modeling will be introduced.


Other Relevant Texts (* = Helpful for Problem Sets):
* Aqueous Environmental Geochemistry by Langmuir, Prentice Hall, Inc.
* Water Chemistry by Brezonik and Arnold, Oxford University Press
Environmental and Low Temperature Geochemistry by Ryan, Wilek Blackwell
The Geochemistry of Natural Waters by Drever, Prentice Hall, 3rd edition.
Aquatic Chemistry by Stumm and Morgan, Wiley-Interscience.
Soil and Environmental Chemistry by Bleam, Academic Press
Water Chemistry by Benjamin, Waveland Press, Inc.
Principles of Environmental Geochemistry by Eby, Thomson-Brooks/Cole
Geochemistry by White, Wiley-Blackwell
Course Responsibilities: Course grades will be determined based on problems sets, midterm and final exams, and modeling experiments:

**Problem Sets (30%)**: Six problems sets will be assigned during the semester. These are quantitative assignments that address important concepts in the chemical behavior of natural waters.

**Modeling Practicals and Experiments (20%)**: Short assignments to provide both training in geochemical modeling software and a means for students to discover key principles of aqueous geochemistry through experimentation. The modeling experiments will be followed by in class discussion of the results. Assigned every one to two weeks starting in mid-September. These require using the computer lab in Rudolph Hall 308. Modeling assignments will be graded based on completeness and participation in the in-class discussions.

**Exams (50%)**: Two exams will be given. Although focused on the most recent material, students will need to recall information from the entire course to complete the second exam successfully.

**Collaborative Learning**: Students are free to work together on problem sets and other assignments. However, all work turned in must be the original work of the student. You must show your own work for all calculations and answers to questions must be written in your own words. Representing another student’s work as your own is a violation of the university’s academic integrity policies (see below). **No collaborative work is allowed on the take-home final, which must be completed independently without consulting any other person.**

**Grading**: Final grades will be determined by the instructor. However, students are guaranteed the following minimum letter grade:
- A: 90 – 100%
- B: 80 – 90%
- C: 70 – 80%
- D: 60 – 70%
- E: <60%

**Homework Policy**: Late problem sets will be accepted until the graded assignment is returned in class or an answer key is posted (e.g., before an exam). A penalty of -10% per day (including weekends and holidays) will be enforced. Late problem sets must be turned in to the instructor in person unless other arrangements have been made. No assignments will be accepted on weekends and University holidays. Modeling practicals and experiments will not be accepted late without prior consent from the instructor.

**Exam Policy**: If you miss the mid-term exam and provide the instructor with an acceptable written excuse, he may choose to schedule a make-up exam (format to be determined by the instructor) or assign 50% of your grade to the other exam. The final exam is a take-home exam and will not be accepted late.
**Academic Integrity:** All students are expected to adhere to high standards of academic integrity as outlined in our academic integrity policies:

- Undergraduate Students: [http://wustl.edu/policies/undergraduate-academic-integrity.html](http://wustl.edu/policies/undergraduate-academic-integrity.html)
- Graduate Students: [http://graduateschool.wustl.edu/files/graduate/AcademicIntegrity.pdf](http://graduateschool.wustl.edu/files/graduate/AcademicIntegrity.pdf)

If you have any doubts or questions about the policies, please ask the instructor.

**Accommodations Based upon Sexual Assault:** The University is committed to offering reasonable academic accommodations to students who are victims of sexual assault. Students are eligible for accommodation regardless of whether they seek criminal or disciplinary action. Depending on the specific nature of the allegation, such measures may include but are not limited to: implementation of a no-contact order, course/classroom assignment changes, and other academic support services and accommodations. If you need to request such accommodations, please direct your request to Kim Webb (kim_webb@wustl.edu), Director of the Relationship and Sexual Violence Prevention Center. Ms. Webb is a confidential resource; however, requests for accommodations will be shared with the appropriate University administration and faculty. The University will maintain as confidential any accommodations or protective measures provided to an individual student so long as it does not impair the ability to provide such measures.

If a student comes to me to discuss or disclose an instance of sexual assault, sex discrimination, sexual harassment, dating violence, domestic violence or stalking, or if I otherwise observe or become aware of such an allegation, I will keep the information as private as I can, but as a faculty member of Washington University, I am required to immediately report it to my Department Chair or Dean or directly to Ms. Jessica Kennedy, the University’s Title IX Coordinator. If you would like to speak with the Title IX Coordinator directly, Ms. Kennedy can be reached at (314) 935-3118, jwkennedy@wustl.edu, or by visiting her office in the Women’s Building. Additionally, you can report incidents or complaints to Tamara King, Associate Dean for Students and Director of Student Conduct, or by contacting WUPD at (314) 935-5555 or your local law enforcement agency.

You can also speak confidentially and learn more about available resources at the Relationship and Sexual Violence Prevention Center by calling (314) 935-8761 or visiting the 4th floor of Seigle Hall.

**Bias Reporting:** The University has a process through which students, faculty, staff and community members who have experienced or witnessed incidents of bias, prejudice or discrimination against a student can report their experiences to the University’s Bias Report and Support System (BRSS) team at: [https://brss.wustl.edu/](https://brss.wustl.edu/)

**Mental Health:** Mental Health Services’ professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect the academic experience. These include conflicts with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety and depression. More information is available at: [http://shs.wustl.edu/MentalHealth/](http://shs.wustl.edu/MentalHealth/)
Schedule: Listed below is a tentative schedule. All readings are from the textbook except where noted. The relevant textbook chapters are listed in the table below, but the specific sections to read will be announced in class and posted to the course website.

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Topic</th>
<th>Readings</th>
<th>Comments</th>
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<tbody>
<tr>
<td>1</td>
<td>8/30,9/1</td>
<td>Introduction; Overview of Natural Waters; Chemistry Background</td>
<td>Ch. 1, 2, 4</td>
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<tr>
<td>2</td>
<td>9/6,8</td>
<td>Solubility; Real Solutions</td>
<td>Ch. 4</td>
<td></td>
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<tr>
<td>3</td>
<td>9/13,15</td>
<td>Geochemical Modeling</td>
<td>Handout</td>
<td>PS1 Due</td>
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<tr>
<td>4</td>
<td>9/20,22</td>
<td>Complexation; Acids and Bases</td>
<td>Ch. 4</td>
<td></td>
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<tr>
<td>5</td>
<td>9/27,29</td>
<td>Carbonate Chemistry</td>
<td>Handout, Ch. 5</td>
<td>PS2 Due</td>
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<tr>
<td>6</td>
<td>10/4,6</td>
<td>Carbonate Chemistry; Chemical Weathering</td>
<td>Ch. 5, 8</td>
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<tr>
<td>7</td>
<td>10/11,13</td>
<td>Chemical Weathering; Controls on Natural Water Chemistry</td>
<td>Ch. 8, 2</td>
<td>PS3 Due</td>
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<tr>
<td>8</td>
<td>10/18,20</td>
<td>No Class 10/18: Fall Break</td>
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<td>EXAM 1 on 10/20</td>
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<td>9</td>
<td>10/25,27</td>
<td>Clay Minerals</td>
<td>Handout, Ch. 6, 8</td>
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<td>10</td>
<td>11/1,3</td>
<td>Adsorption-Desorption</td>
<td>Ch. 6, 7</td>
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<tr>
<td>11</td>
<td>11/8,10</td>
<td>Natural Organic Matter; Redox Chemistry</td>
<td>Handout, Ch. 7, 9</td>
<td>PS4 Due</td>
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<tr>
<td>12</td>
<td>11/15,17</td>
<td>Redox Diagrams; Redox Zonation</td>
<td>Ch. 9</td>
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<tr>
<td>13</td>
<td>11/22</td>
<td>Kinetics; <strong>No Class 11/24: Thanksgiving Holiday</strong></td>
<td>Ch. 4, 5, 7, 8, Handout</td>
<td>PS 5 Due</td>
</tr>
<tr>
<td>14</td>
<td>11/29,12/1</td>
<td>Kinetics; Iron Geochemistry</td>
<td>Ch. 4, 5, 7, 8, 9, Handout</td>
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<tr>
<td>15</td>
<td>12/6,8</td>
<td>Iron and Sulfur Geochemistry; Heavy Metals; <strong>No Class 12/8</strong></td>
<td>Ch. 9, 7, Handout</td>
<td>PS6 Due</td>
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<tr>
<td></td>
<td>12/20</td>
<td><strong>EXAM 2: Take Home</strong></td>
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<td>Due 6 pm on 12/20</td>
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Note: PS = problem set

The instructor reserves the right to modify this syllabus during the semester. These changes will be announced in class, and it is the students’ responsibility to attend class or make other necessary arrangements to keep abreast of the situation.