COURSE SYLLABUS

GEOL 476 & 776 – Groundwater Contamination

(Spring 2011)
Department of Geosciences (http://tornado.sfsu.edu/)
San Francisco State University

**Time and location:**
Tuesday: 11:00 am to 11:50 pm – lecture
Thursday: 11:00 am to 11:50 pm – lecture
Thursday: 2:10 pm to 5:00 pm – lab/seminar

Rooms: Thornton 523 for lecture and Thornton 604 for lab/seminar.

**Professor contact info:**
Jason Gurdak
email: jgurdak@sfsu.edu
office phone: 415-338-6869
fax: 415-338-7705 office: Thornton 537 (outer door from hallway is 538)

**Office hours:**
Tuesday and Thursday: 12:00 to 1:00 pm, and by appointment.

**Course Overview:**
Groundwater Contamination (GEOL 476/776) is an in-depth examination of the physical, chemical, and biological processes affecting the fate and transport of inorganic and organic contaminants in groundwater and pore water in the unsaturated zone. This course is designed to provide students the opportunity to learn, practice, and retain the concepts and tools necessary for practicing hydrogeologists. The course is intended for upper-level majors and graduate students.

**Course web site:**
iLearn (http://ilearn.sfsu.edu).
1. Log into iLearn with your SF State ID and SF State Password.
2. Find and click on the course name (Groundwater Contamination 476).

Note – please read the Technical Requirements page because some internet browsers do NOT work well with iLearn.

Students should become familiar with iLearn and print lecture notes prior to each class. Lecture notes posted on iLearn are not 100% complete and require in-class note taking on the part of the student.
**Required Text:**
1. *Contaminant Hydrogeology* by C.W. Fetter

**Computer Skills:**
You should have access to a PC or Mac running a relatively current version of Windows or Mac equivalent, Microsoft Word, Excel, and an internet browser. Please become familiar with Microsoft Word and Excel. We will use the Mac laptops in TH 604 for computer-based projects using PHREEQC for course labs.

**Course Learning Objectives and Goals**
The overarching goal of the course is to increase your awareness of processes affecting fate and transport of contaminants in groundwater and the unsaturated zone. The specific learning objectives include the following.
1. Review and retain fundamental hydrogeologic principles related to flow of water in aquifers, including Darcy’s Law and hydraulic head.
2. Gain practical field and lab experience in sampling groundwater and measurement of selected aqueous geochemical properties.
3. Gain experience and confidence in performing quantitative analysis: calculations, spreadsheet analyses, and mathematical geochemical models using PHREEQC and spreadsheets.
4. Gain experience and confidence in solving open-ended and/or ill-defined problems and writing a professional report/paper.

By achieving the specific learning objectives, you will improve your critical thinking skills and your ability to make knowledgeable, well thought-out assumptions and decisions that are necessary to solve real-world and research problems in contaminant hydrogeology.

**Class Topics (see Course Calendar):**
1. Administration and introductions
2. Geochemical modeling of groundwater
3. Thermodynamics and Kinetics
4. Groundwater-water quality
5. Inorganic chemicals in groundwater
6. Mass transport in saturated media
7. Transformation, retardation, and attenuation
8. Flow and mass transport in the vadose zone
9. Multiphase-fluid systems (LNAPLS/DNAPLS)
10. Organic contaminants in groundwater
11. Remediation of contaminated groundwater
12. Environmental isotopes
13. Tracing the hydrologic cycle using isotopes
14. Tracing the carbon and nitrogen cycle with isotopes
15. Identifying and dating modern and old groundwater
16. Other groundwater tracers
17. Field methods and lab analyses for groundwater sampling
Course Requirements:
Grades will be based on class participation, leading the discussions of 2 scientific journal articles (only for GEOL 776 students), lab reports, and completion of a final project.

Grading

<table>
<thead>
<tr>
<th>GEOL 476</th>
<th>GEOL 776</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assigned reading and class participation</td>
<td>15% / 5%</td>
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<tr>
<td>Leading discussion of a scientific journal article</td>
<td>0% / 20%</td>
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<tr>
<td>Labs</td>
<td>50% / 50%</td>
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<tr>
<td>Final project</td>
<td>35% / 25%</td>
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</table>

Letter grades will be based on the percentage of possible points earned and are equivalent to the following grade points.

- A = 95-100% = 4.0
- A- = 90-95% = 3.7
- B+ = 86-89% = 3.3
- B = 83-85% = 3.0
- B- = 80-82% = 2.7
- C+ = 76-79% = 2.3
- C = 73-75% = 2.0
- C- = 70-72% = 1.7
- D+ = 66-69% = 1.3
- D = 63-65% = 1.0
- D- = 60-62% = 0.7
- F = <60% = 0.0

Assigned Reading and Class Participation:
Reading assignments (see course schedule and iLearn) are required to meet the course learning objectives and goals, participate in class discussions (i.e., ask questions and contribute to discussions), and for your overall success in this course. Reading assignments are to be completed before lecture or lab. You will improve your learning and comprehension if you take written notes while reading journal articles, and work through any example problems within each chapter text. A total of 10 journal articles will be assigned for weekly class discussions at the beginning of the lab period (i.e., we will discuss 1 article for each of 10 weeks).

Leading Discussions of a Journal Article (776 Students Only):
GEOL 776 students will lead the class discussion of 2 scientific journal articles during the semester. During the first lab period (Thursday, January 27), 776 students will select papers (see course schedule and iLearn for list) for discussion. Helpful information about leading discussions is posted on iLearn. Grades for leading the discussions will be averaged from professor and anonymous student evaluation forms, which will be made available to each 776 student to use to toward improving the 2nd discussion. The purpose of leading the discussions of a scientific journal article is to:
- Expose students to new topics in the field;
- Encourage students to independently gain an in-depth understanding of a specific topic that is not possible with lectures and labs alone; and
- Opportunity for students to develop and practice professional skills, including critical thinking, critical evaluation of published work, effective presentation, oral communication, and leading group discussions.
Labs:
The labs will be practical exercises related to the fundamentals of aqueous geochemistry and groundwater contamination. The lab report due dates will be announced at the start of each lab period. In general, a concise introduction, methods, results/answers to assigned questions, and discussion section are required for each lab report. You will receive a 0 for a particular lab report if you are not present in the lab, unless you contact me (email or phone) prior to the lab period for documented emergencies in accordance with university policy.

Grading of lab reports is based on using the correct approach, the correct answer, good organization (i.e., work should be easy to follow, the answers should be clearly indicated, etc), and conciseness. Electronic copies of the lab report (please use Microsoft Word) are required unless otherwise specified, and should be emailed to the Professor before the deadline. Please use the following naming convention for Word files: "LastName-Lab-week1.doc". When spreadsheets are used, the Excel file should also be email to the instructor with the following file naming convention “LastName-Lab-week6.xls”.

Lab Topics:
1. Geochemical modeling (weeks 1-4)
2. Arsenic contamination of groundwater in Bangladesh (week 5)
3. Modeling contaminant transport (week 6)
4. The science behind "A Civil Action" groundwater contamination (week 7)
5. Geochemical modeling of tritium in the vadose zone (week 8)
6. Excel modeling of contaminant transport and remediation (week 9)
7. Geochemical modeling of groundwater remediation (week 11)
8. Spreadsheet modeling of isotopes (week 12)
9. Geochemical modeling of carbon and nitrogen cycling (week 13)
10. Spreadsheet modeling of groundwater ages (week 14)
11. Groundwater quality sampling of a well (week 15)
12. Lab analyses of groundwater sample (week 16)

Final Project:
Students will be paired (and depending on student enrollment, divided into a team of 3) will like 476 or 776 students to complete a final groundwater contamination project and written report (using Microsoft Word) to be submitted via email before Tuesday, May 17th before midnight, which is the scheduled final examination day for GEOL 476/776. By week 8, I will distribute actual groundwater quality and contamination data from a well network and site information that you must analyze using the various techniques that we cover throughout the semester. A final written report of approximately 15 to 20 pages including all relevant graphical presentations of the data is required. Additional details, requirements, and questions to address in the written report will be distributed by week 8 with the data.
Late Assignment Policy:  
Late assignments that are NOT excused due to illness or other prior approved circumstances will receive a late penalty, as follows:  
<24 hours late = minus 10 points  
<48 hours late = minus 20 points  
<72 hours late = minus 30 points  
I will NOT accept late assignments after 72 hours.

Attendance Policy:  
Attendance is crucial for this course. If you miss a class, you will miss the learning opportunity, lecture notes, handouts, announcements, assignments, and discussion. Lecture notes posted on iLearn are not 100% complete and require in-class note taking on the part of the student. Poor attendance typically results indirectly in a poor grade. Please be on time to class. The beginning of class is reserved for important announcements. Being late for class is a disruption for classroom activities. **Students who miss any classes during the first two weeks of the semester will be administratively withdrawn from the course without prior notification of the instructor for documented emergencies in accordance with university policy.**

Academic Dishonesty:  
All forms of academic dishonesty, including but not limited to cheating and plagiarism will NOT be tolerated and will be subject to University academic policy. SFSU defines plagiarism as “a form of cheating or fraud; it occurs when a student misrepresents the work of another as his or her own. Plagiarism may consist of using the ideas, sentences, paragraphs, or the whole text of another without appropriate acknowledgment, but it also includes employing or allowing another person to write or substantially alter work that a student then submits as his or her own.”

Important Dates (fixed):  
1. Drop deadline (see **University Administration** below): February 4  
2. Final report due: Tuesday, May 17 by 11:59 pm (before midnight)  
3. University-wide Holiday dates relevant to GEOL 476/777:  
   - Tuesday March 29 (Spring Recess)  
   - Thursday March 31 (Spring Recess)

SFSU Disability Policy:  
Students with disabilities who need reasonable accommodations are encouraged to contact the instructor. The Disability Programs and Resource Center (DPRC) is available to facilitate the reasonable accommodations process. The DPRC is located in the Student Service Building and can be reached by telephone (voice/TTY 415-338-2472) or by email (dprc@sfsu.edu) (http://www.sfsu.edu/~dprc/).
University Administration:

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SAN FRANCISCO STATE UNIVERSITY

College of Science & Engineering

Spring 2011

Dropping, Withdrawing & Grading Option Procedures

**DROPPING DURING THE FIRST TWO WEEKS**

During the first two weeks of instruction, dropping a course(s) is permitted without academic penalty. No symbol is recorded on the student's permanent record. Students are responsible for making changes to their official academic schedule. If you decide not to attend a class you enrolled in, you must drop that class through GATOR REG during access hours. If you have added a class during the first two weeks and then decide to drop, you must drop through the GATOR REG system during access hours. As a courtesy, you are expected to notify the instructor of your intent to drop the class.

Jan 24 – Feb 4:  Dropping class(es) using GATOR REG
8 am to Midnight Sunday through Friday

**WITHDRAWING AFTER THE FIRST TWO WEEKS**

After the first two weeks of instruction, withdrawal from a course is not permitted except for serious and compelling reasons. The "W" grade carries no commutation of quality of student performance and is not used as units attempted in calculating grade point average or progress points. The expectation of being dropped for nonattendance is not a sufficient reason for withdrawal.

Feb 5 – Apr 22:  Withdrawal from a course(s) is permissible only for serious and compelling reasons. If the withdrawal is approved, the student will receive a "W" grade.

PROCEDURE:  Requests for withdrawal are to be reviewed by the Instructor and Department Chair. Students must submit their unofficial transcripts along with their petitions.

April 23 – May 13:  Withdrawals are normally not permitted during this period except in cases of verified accident or serious illness where the cause of withdrawal is due to circumstances clearly beyond the student's control and where the assignment of an incomplete is not practical. Ordinarily, withdrawals in this category involves a total withdrawal from the University.

PROCEDURE:  All requests during this period must be reviewed by the Instructor, Department Chair, and Associate Dean. Students must submit their unofficial transcripts and appropriate documentation along with their petitions.

**CREDITING CREDIT OPTION**

In a course where CR/NC grading is permitted, the student must notify the instructor and request it through GATOR REG on or before March 18. Requests for changes in grading option after the deadline are made on the Petition for Waiver of College Regulations form and must be accompanied by an ADD form. The CR/NC grading symbols carry no grade point credit. The CR grading symbol used in an undergraduate level course is equivalent to grades A through C- or in a graduate level course is equivalent to grades A through B-. Students should be aware that other institutions often interpret CR as a C grade and NC as an F grade in evaluating transcripts. Grading option change after the deadline is seldom granted.

**AUDITING A CLASS**

To register in a class as an Auditor, the student must obtain instructor approval to audit by having the instructor sign an ADD form with the "Audit" bubble marked. Auditors may not change to credit status and vice versa after the February 4 deadline.

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Syllabus and Course Calendar are Subject to Change:
This syllabus and associated course schedule are subject to change in the event of extenuating circumstances. All major changes will be announced at class and via email.
<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic may change. Watch for updates.</th>
<th>Fetter Chpts:</th>
<th>Lab Topic</th>
<th>Discussion Paper Topics</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan 25 T</td>
<td>Administrative overview; Fundamentals GW contamination Standards; Units of Measurement</td>
<td>1.1-1.7</td>
<td>Modeling (overview)</td>
<td>No paper</td>
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<td></td>
<td>Jan 27 Th</td>
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<td>Modeling</td>
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<td>2</td>
<td>Feb 1 T</td>
<td>Intro to geochemical modeling</td>
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<td>Modeling (prep./construction)</td>
<td>No paper</td>
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<td>Feb 3 Th</td>
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<td>3</td>
<td>Feb 8 T</td>
<td>Thermodynamics</td>
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<td>Geochem. modeling</td>
<td>Redox</td>
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<td>4</td>
<td>Feb 15 T</td>
<td>Thermodynamics</td>
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<td>Geochem. modeling</td>
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<td>5</td>
<td>Feb 22 T</td>
<td>Groundwater Quality</td>
<td>6</td>
<td>As in Bangladesh</td>
<td>Arsenic</td>
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<td>6</td>
<td>March 1 T</td>
<td>Mass Transport in Saturated Media</td>
<td>2</td>
<td>Contam. Transport</td>
<td>No paper</td>
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<td>March 3 Th</td>
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<td>7</td>
<td>March 8 T</td>
<td>Transformation, Retardation, &amp; Attenuation</td>
<td>3</td>
<td>A Civil Action</td>
<td>A Civil Action</td>
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<td>March 10 Th</td>
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<td>8</td>
<td>March 15 T</td>
<td>Flow/Mass Transport: Vadose Zone</td>
<td>4</td>
<td>Geochem. modeling (tritium)</td>
<td>Recharge</td>
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<td>March 17 Th</td>
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<tr>
<td>9</td>
<td>March 22 T</td>
<td>Multiphase fluid systems</td>
<td>5.1-5.9</td>
<td>Contam. Transport &amp; Remediation</td>
<td>Emerging Contaminants</td>
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<td>March 24 Th</td>
<td>Organic contaminants</td>
<td>7.1-7.5</td>
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<td>10</td>
<td>March 29 T</td>
<td>No Class: Spring Recess</td>
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<td>March 31 Th</td>
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<td>11</td>
<td>April 5 T</td>
<td>Remediation: removal options</td>
<td>9</td>
<td>Modeling (remediation)</td>
<td>Remediatio</td>
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<td>April 7 Th</td>
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<tr>
<td>12</td>
<td>April 12 T</td>
<td>Environ. isotopes: overview</td>
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<td>Modeling (isotopes)</td>
<td>Tracing Hydro-cycle</td>
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<td>April 14 Th</td>
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<td>13</td>
<td>April 19 T</td>
<td>Tracing the Carbon cycle</td>
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<td>Geochem. modeling (nitrate)</td>
<td>Nitrate</td>
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<td>April 21 Th</td>
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<tr>
<td>14</td>
<td>April 26 T</td>
<td>Identifying/ dating modern GW</td>
<td></td>
<td>Spreadsheet modeling (GW age)</td>
<td>GW age</td>
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<td>April 28 Th</td>
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<tr>
<td>15</td>
<td>May 3 T</td>
<td>Overview of GW tracers</td>
<td>8</td>
<td>Well sampling</td>
<td>No paper</td>
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<td>May 5 Th</td>
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<td>16</td>
<td>May 10 T</td>
<td>Sample local well</td>
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<td>Lab analyses of GW sample</td>
<td>No paper</td>
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<td>May 12 Th</td>
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<td>17</td>
<td>May 17 T</td>
<td>No class: Finals Week</td>
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<td></td>
<td>May 19 Th</td>
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