

GEO 346C: Introduction to Physical and Chemical Hydrogeology (27560)

Spring 2013

Tuesday and Thursday 11:00am – 12:30pm

Jackson Geosciences Building (JGB) 3.120

GEO 346C (all sections) carries a Quantitative Reasoning Flag

Instructor: Dr. Kevan B. Moffett
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Phone: 512-471-5290
Office Hours: Tuesday & Thursday 3-4pm
Office Location: EPS 2.202

Instructor accessibility:

- Office: It is best if you make an appointment to meet me outside office hours, though if my office door is open you can drop-in and see I have time to talk. If my office door is closed I am unavailable.
- Email: I will typically receive email promptly on weekdays between 9am and 4pm and I will try to address your email that same day. I usually check email at least once during nights/weekends *but you should not count on it* and I may only respond to truly urgent matters at those times. Please be judicious about sending emails. I am happy to receive them, but would prefer to address questions in office hours or quick questions before or after class.
- Phone: I highly recommend sending me an email rather than calling or leaving a voice mail – I'm not always in my office and only infrequently check voice mail.

TAs:	Mr. Allan Jones	Mr. Michael Kanarek
	Email: allan.e.jones@utexas.edu	Email: mkanarek@utexas.edu
	Office Hours: Monday 9-11am	Office Hours: Tuesday 9-11am
	Office Hours Location: TBD	Office Hours Location: TBD

TA accessibility:

- Office: Please respect your TAs' need to spend some time on their own coursework and research. If you wish to meet with them outside office hours, please arrange an appointment ahead of time.
- Email: Please also be judicious about emailing your TAs so their inboxes do not get too clogged.

Course Content

This course applies your foundational knowledge of geology, physics, mathematics, and chemistry to understand and solve quantitative problems regarding hydrogeology. The course is divided into parts:

- I. Overview of hydrology – where water is found and how it works in the Earth System.
- II. Essentials of physical hydrogeology – porous media; the causes of and resistances to groundwater flow; how wells work.
- III. Introduction to chemical hydrogeology –the natural state of groundwater chemistry; some important types of groundwater pollution; how solutes move through and react with the subsurface.
- IV. Special topics – The last two classes are reserved to cover special topics chosen as a class. For example, these could include (some of): water resources, wetlands, ice & snow, aquifer case studies, developing world water use, floods, droughts, climate change, agriculture, water law, hydrogeophysics, etc.

Learning Goals

- 1) Develop the vocabulary to understand and communicate about hydrogeologic science and issues.
- 2) Empower you to make quantitative calculations and estimates regarding water, especially groundwater. For example: how much rain gets into the ground, where that water moves underground and how fast, how much water is available in an aquifer, how difficult it might be to pump water out of an aquifer, and how groundwater chemically interacts with soils and subsurface geology.

Class Format

- Each class session will endeavor to include both a short lecture session and at least one class activity, experiment, discussion, group exercise, or work period.

Expectations

- **Attendance:** 100% on-time class attendance and participation is expected.
- **Questions:** You are strongly encouraged to ask questions and make topical comments.
- **Conduct:** Courteous, kind, and honest conduct is expected at all times toward the instructor, the TA, and your peers.
- **Collaboration:** Homework solutions must be written up and handed in individually unless you are instructed otherwise. Each assignment provides a section at the end in which you will list the resources you used in completing the homework (e.g., text book, class notes, Wikipedia, classmate, etc.). Failing to complete this section will affect your grade but the specific information you provide in this section will not affect your grade (unless you cheated). The purpose of this section is to develop good habits of reporting sources and collaborations, protect you from accusations of copying, and to inform me what resources you are finding most useful.
- **University Honor Code:** All students are expected to abide by the UT Honor Code. The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community. (<http://registrar.utexas.edu/catalogs/gi09-10/ch01/index.html>).
- **Use of Internet-enabled Devices and Cell Phones:** As part of participating in this course on your honor, you are not to use internet-enabled devices or cell phones to seek answers to in-class questions or exercises unless given explicit permission to do so. Use of internet-enabled devices or cell phones during an exam is prohibited and may incur disciplinary action.

- **Interruptions:** Non-topical interruptions of class (e.g., cell phone calls) are prohibited. Please silence your phone. Please leave the room if you must answer an urgent call.
- **Religious Holy Days:** By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, I will give you an opportunity to complete the missed work within a reasonable time after the absence.
- **Documented Disabilities:** Any student with a documented disability who requires academic accommodations should contact Services for Students with Disabilities (SSD) at (512) 471-6259 (voice) or 1-866-329-3986 (video phone). Faculty are not required to provide accommodations without an official accommodation letter from SSD. Please notify me as quickly as possible if the material being presented in class is not accessible.

Course Readings and Materials

- Recommended course supplies include: writing implement, notebook, scientific calculator, internet access, and access to a computer with MATLAB.
- There is no required textbook. Your notes from class will serve as your primary study material.

You may also choose to look at several highly relevant textbooks:

- *Applied Hydrogeology* by C.W. Fetter (2001)
- *Groundwater* by A. Freeze and J. Cherry (1979)
- *Applied Hydrology* by V.T. Chow, D.R. Maidment and L.W. Mays (1988)
- *Hydrology* by S.L. Dingman (1998).

All of these texts have been placed on 24hr reserve in the Geology Library.

When specific readings are required for homework they will be posted on Blackboard or, for original scientific literature, the citations will be provided so you can practice looking them up online or in the library and obtaining a copy for your reference.

- **Blackboard:** In this class I use *Blackboard*, a Web-based course management system with password-protected access at <http://courses.utexas.edu>, to distribute course materials, to communicate, to post grades, to submit assignments, and to give you online quizzes and surveys. You can find support in using Blackboard at the ITS Help Desk.
- **Use of E-mail for Official Correspondence:** All students should become familiar with the University's official e-mail student notification policy. It is the student's responsibility to keep the University informed as to changes in his or her e-mail address. Students are expected to check e-mail on a frequent and regular basis in order to stay current with University-related communications, recognizing that certain communications may be time-critical. It is recommended that e-mail be checked daily, but at a minimum, twice per week. The complete text of this policy and instructions for updating your e-mail address are available at <http://www.utexas.edu/its/help/utmail/1564>.
- **Emergency Evacuation:** Occupants of buildings on the UT Austin campus are required to evacuate and assemble outside when a fire alarm is activated or an announcement is made. Please be aware of the following policies regarding evacuation:
 - Familiarize yourself with all exit doors of the classroom and the building. Remember that the nearest exit door may not be the one you used when you entered the building.
 - If you require assistance to evacuate, inform me in writing during the first week of class.
 - In the event of an evacuation, follow my instructions or those of other instructors.
 - Do not re-enter a building unless you're given instructions by the Austin Fire Department, the UT Austin Police Department, or the Fire Prevention Services office.

Quantitative Reasoning Flag

This course carries the Quantitative Reasoning flag. Quantitative Reasoning courses are designed to equip you with skills that are necessary for understanding the types of quantitative arguments you will regularly encounter in your adult and professional life. You should therefore expect a substantial portion of your grade to come from your use of quantitative skills to analyze real-world problems.

Grading

In-class activities	20 pts each x 24 classes	= 480 pts	= 24%	(1% each)
Homework	100 pts each x 8 homeworks	= 800 pts	= 40%	(5% each)
Review questions	10 pts each x 3 sessions	= 30 pts	= 1.5%	(0.5% each)
In-class exams	230 pts each x 3 exams	= 690 pts	= 34.5%	(11.5% each)
Total		2000 pts	100%	

Exercise Formats

Four types of exercises will contribute to your final grade:

- **In-class activities:** These activities are intended to be an aid to learning and so will be evaluated primarily in terms of your participation, effort, quantitative reasoning, and thoughtfulness, as reflected in the individual or group reports handed in during class. If you are not in attendance or do not contribute you will get a zero for the day with no make-up available (unless you make prior arrangements with me).
- **Homework:** These exercises are intended as in-depth explorations of course topics. To maximize your chance to learn in your own way and at your own speed, they are large assignments typically spread over two weeks. This format also recognizes your need and ability to manage your time flexibly – **but** it is **strongly** encouraged that you not leave the entire assignment to the last minute. The assignments are long and expected to require distributed thought and effort.
- **Review questions:** You will be asked to submit at least one question that you would like clarified in each before-exam review session. Doing so earns you the points for that session.
- **In-class exams:** The in-class exams are intended to provide periodic focal points for your studies during the semester so you and I can be sure earlier material is well-understood before progressing to later material. Each exam is largely non-cumulative: it will focus on the material from the most recent third of the course, although later material will draw on your understanding of earlier material.

No final: There will be no cumulative final exam during Finals Period. All class exercises are intended primarily to enhance learning (that's what we're here for!) and only secondarily to provide a means of evaluation. In this context, a cumulative final exam serves little purpose to enhance learning once all previous exercises have been completed.

Policies

Late assignments: Homework is due at the beginning of class; homework not received during that class period is considered late. The score will be reduced by 10% per day the assignment is late (including weekends) unless arrangements are made with me at least one weekday before the homework is due.

Make-up exams: If you know you won't be in class on an exam day, let me know as early as possible (at least a week before) so we can schedule a make-up exam.

Tentative Course Schedule

I reserve the right to change the dates or content of this schedule with notification to you as soon as possible.

Class	Wk	Date	Topics	Homework Due
1 Tu	1	Jan-15	Introduction, Global Water	
2 Th		Jan-17	The Hydrologic Cycle	
3 Tu	2	Jan-22	Evaporation, Precipitation	
4 Th		Jan-24	Infiltration, Runoff	HW 1 due
5 Tu	3	Jan-29	Soil Moisture, Transpiration	
6 Th		Jan-31	Watersheds, Water Balance	
7 Tu	4	Feb-5	Hydrology REVIEW	HW 2 due, review questions due
8 Th		Feb-7	Hydrology EXAM	Exam
9 Tu	5	Feb-12	Groundwater, Aquifers	
10 Th		Feb-14	GW-SW Interactions	
11 Tu	6	Feb-19	Groundwater Resources	
12 Th		Feb-21	Porosity, Permeability	HW 3 due
13 Tu	7	Feb-26	Hydraulic Head, Fluid Potential	
14 Th		Feb-28	Conductivity, Darcy's Law	
15 Tu	8	Mar-5	Heterogeneity, Anisotropy	
16 Th		Mar-7	Flow Nets	HW 4 due
			Spring Break (Mar 9-17)	
17 Tu	9	Mar-19	Aquifer Storage, Well Tests	
18 Th		Mar-21	Well Capture, Saltwater Intrusion	
19 Tu	10	Mar-26	Physical Hydrogeology REVIEW	HW 5 due, review questions due
20 Th		Mar-28	Physical Hydrogeology EXAM	Exam
21 Tu	11	Apr-2	Aquatic Chemistry	
22 Th		Apr-4	Fluid-Mineral Interactions	
23 Tu	12	Apr-9	Oxidation-Reduction Chemistry	
24 Th		Apr-11	Groundwater Contamination	HW 6 due
25 Tu	13	Apr-16	Solute Transport	
26 Th		Apr-18	Groundwater Tracers	
27 Tu	14	Apr-23	Chemical Hydrogeology REVIEW	HW 7 due, review questions due
28 Th		Apr-25	Chemical Hydrogeology EXAM	Exam
29 Tu	15	Apr-30	Special Topics*	
30 Th		May-2	Special Topics*	HW 8* due

* Special topics are to be chosen as a class (see Course Content section). The form and content of HW 8 will depend on the topics chosen, e.g., it may be a problem set, modeling exercise, case report, etc.

Notes: