

**Geology 513-001
Hydrogeology
Spring 2025 Syllabus**

Meeting Time and Location

Wednesdays 4:30 – 7:10 pm
Exploratory Hall 1005 (in-person)

Instructor

Dr. Jules Goldspiel
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Office: Exploratory Hall 3414
Office Hours: Mondays 3:00 – 5:00 pm
Other days and times by appointment
e-mail: jgoldspi@gmu.edu (best contact method)

Course Information

3 Credits

Prerequisites: GEOL 101 (Physical Geology) and GEOL 103 (Physical Geology Lab)
or GGS 102 (Physical Geography)
MATH 113 (Analytic Geometry and Calculus I)
CHEM 211 (General Chemistry I)
Or similar lab-science courses in each of Geology, Calculus and Chemistry

This course will focus on the geologic and hydrologic factors that control the occurrence, distribution, movement, quality and development of groundwater. In addition to the general properties that distinguish a groundwater system as an aquifer, this course will cover the physical and chemical properties of groundwater, groundwater interactions with the surface, and how groundwater flow can be calculated and studied analytically, graphically and with computer models. Natural and engineered processes will both be discussed.

The goals of this course are for students to:

- Know the range of physical and chemical properties common in groundwater systems
- Understand how surface conditions affect groundwater systems and vice versa
- Master the principles of groundwater flow, and how flow is characterized and calculated
- Master the principles of groundwater storage, and how storage is characterized
- Understand the practical issues related to aquifer development and depletion
- Understand the processes of aquifer contamination and remediation
- Gain expertise with some of the tools and resources used to monitor, study and understand groundwater systems

Computer modeling will be part of the course. University computers will be available for students to participate in the modeling exercises, but students may also use their own computers. Computers running the Microsoft Windows operating system are best suited for the modeling exercises, but other operating systems may be used also. Students will also find it helpful to have ready access to a scientific calculator, spreadsheet program or other method for calculations. Please talk to instructor if access to any of these tools may be a problem.

Course Textbook and Other References

Primary Lecture Textbook (Recommended)

Applied Hydrogeology, 5th Edition, 2022, C.W. Fetter and D. Kreamer, Waveland Press

Available in print and electronic formats. See GMU Bookstore or publisher (<https://waveland.com>).

Other Useful References

Alley, W. M., et al., 1999, Sustainability of ground-water resources, USGS Circular 1186.

(Available at <https://pubs.usgs.gov/circ/circ1186/pdf/circ1186.pdf>)

Ferris, J. G., et al., 1962, Theory of aquifer tests, USGS Water-Supply Paper 1536-E.

(Available at https://pubs.usgs.gov/wsp/wsp1536-E/pdf/wsp_1536-E.pdf)

Hem, J. D., 1985, Study and interpretation of the chemical characteristics of natural water, 3rd Edition, USGS Water-Supply Paper 2254.

(Available at <https://pubs.usgs.gov/wsp/wsp2254/pdf/wsp2254a.pdf>)

Winter, T.C., et al., 1998, Ground water and surface water: A single resource, USGS Circular 1139.

(Available at <https://pubs.usgs.gov/circ/circ1139/pdf/circ1139.pdf>)

Required Coursework & Grading Weights

Weight	GEOL 513 Coursework
10%	Quizzes (all combined)
10%	Homeworks (all combined)
15%	Semester Exercise and Abstracts
10%	Numerical Model Inputs Summary
15%	Preliminary Exam I
15%	Preliminary Exam II
25%	Final Exam

The graded coursework for this class and the weight of each component is as listed in the table at left.

Quizzes will cover facts and concept details from lectures. They are intended to check your understanding of specific information and concept details discussed since the last quiz. Each quiz will consist of questions in multiple choice and/or short answer format.

Homework assignments will cover quantitative aspects of the course. They will generally involve expert application of calculations, graphing and graph interpretation, basic computer modeling and/or concept questions. Calculators, spreadsheets or other computational programs may be used, but intermediate steps and calculation methods must be shown.

The Semester Exercise will involve collecting, summarizing and understanding groundwater data. The data will be gathered from publicly available U.S. Geological Survey (USGS) websites. GEOL 513 students are further required to formalize the data summaries in the form of short abstracts.

The Numerical Model Inputs Summary assignment will involve collecting and concisely summarizing the geologic and hydrogeologic properties for a specific region of the U.S. so as to permit realistic quantitative modeling of groundwater flow in the region using a professional-level numerical model.

Grade Scale

Grade	A+	A	A-	B+	B	B-	C+	C	C-	D	F
Weighted Score (%)	≥ 99%	92.0 – 98.9%	90.0 – 91.9%	88.0 – 89.9%	82.0 – 87.9%	80.0 – 81.9%	78.0 – 79.9%	70.0 – 77.9%	67.0 – 69.9%	50.0 – 66.9%	< 50%

Course grades will be determined by the weighted percentage of total points possible (see Required Coursework & Grading Weights). The base (i.e., standard) grade scale is as indicated in the table above. The grade scale is subject to change, but if any changes are made, it will be favorable to students (i.e., if the scale is changed, the cutoff for a grade would be at lower percentage not higher).

Tentative Course Schedule

Semester	Week	Date	Topic (and corresponding textbook sections)	Quiz	HW
	1	01/22	Course Information & Hydrogeology Overview (Fetter and Kreamer: Chapters 1, 2.1-2.7)		
	2	01/29	Physical Properties and Physical Environments of Groundwater (Fetter and Kreamer: Chapters 3, 12.1-12.2)	#1	
	3	02/05	Chemical Properties and Chemical Environments of Groundwater (Fetter and Kreamer: Chapter 9)		#1
	4	02/12	Hydrologic Connections Between Groundwater and Surface Water (Fetter and Kreamer: Chapters 2.8-2.14, 6)		#2
	5	02/19	Groundwater Flow and Storage: Controls and Impacts (Fetter and Kreamer: Chapter 8)	#2	
	6	02/26	<i>Preliminary Exam I</i>		
	7	03/05	Groundwater Flow: Governing Equations and Approximations (Fetter and Kreamer: Chapter 4)	#3	
	8	03/12	<i>Spring Break – No Class</i>		
	9	03/19	Groundwater Flow: Wells (Fetter and Kreamer: Chapter 5)		#3
	10	❖ 03/26	Groundwater Flow: Regional Systems (Fetter and Kreamer: Chapter 7)	#4	
	11	04/02	Aquifer Protection, Contamination and Restoration (Fetter and Kreamer: Chapters 10, 11.7-11.8)		#4
	12	■ 04/09	Hydrogeology in Especially Wet, Dry and/or Cold Environments (Fetter and Kreamer: Chapters 7.7, 8.5-8.6)	#5	
	13	04/16	<i>Preliminary Exam II</i>		
	14	04/23	Numerical Modeling: General Principles, Mechanics and Applications (Fetter and Kreamer: Chapter 13)		
	15	04/30	To Be Determined (Possible options: Course Review, Groundwater Rights, Hydrogeology in Planetary Environments, expansion of previous topic and/or topics not previously discussed)		
	16	05/07	<i>Final Exam (4:30-7:15 pm)</i>		

❖ Numerical Model Inputs Summary due

■ Semester Exercise and associated Abstracts due

Quiz and Homework (HW) numbers in the schedule are the weeks these items will be assigned.

Note: Course content and schedule may be modified by the instructor as the semester progresses.

Other Important Dates

Jan 28 Last day to add classes

Feb 04 1st drop deadline (full tuition refund, no record on transcript)

Feb 11 2nd drop deadline (50% tuition refund, no record on transcript)

After the 2nd Drop deadline, Withdrawals for graduate students require academic dean approval.

Course Policies

Electronic Devices: The use of electronic devices (computer, tablet, phone and the like) is permitted during class. While in class, your phone ringer and any other audible alerts on your devices must be off. Be respectful of your peers and instructor and do not use your electronic devices to engage in activities that are unrelated to the class while class is in session. The instructor reserves the right to prohibit the use of electronic devices by any student whose use of a device is unrelated and/or disruptive to the class.

Calculators are the only aid that may be used during exams. If you plan to use a calculator function on a phone, tablet or other electronic device during an exam, you may only use the calculator function. Except for taking online exams themselves in the event the class transitions to online, no other use of electronic devices is allowed during exams, i.e., you may not use electronic devices to access notes or any other information during exams.

All standard university policies apply to the use of university computers and university computer systems for this course. Please see the GMU policies website for a summary of the university computer policies (<https://universitypolicy.gmu.edu/policies/responsible-use-of-computing/>).

Course Materials and Presentations: All course materials and presentations (e.g., lecture outlines, lecture slides, assignments, quizzes, exams, demonstrations) are for course use only. *These materials may not be shared, posted or in any way redistributed outside of the course, either electronically or as hardcopy.* Sharing or redistribution of these materials is a violation of the GMU Academic Standards Code.

Recording of Lectures: Lectures and demonstrations may *not* be electronically recorded in any format without prior permission of the instructor and completion of a recording agreement form. Acceptable agreement forms are the "Recording (Audio/Video) and Copies of Class Presentations Acknowledgement" form from Disability Services, or a similar form provided by the instructor. In all cases, the opinions, questions and comments of other class members may not be shared at any point with anyone else.

Attendance: Students are expected to attend class regularly, but attendance is not strictly required.

Exams: Preliminary Exams will be taken during the class meeting time on the dates listed in the course schedule. The time and date for the Final Exam is as listed on the course schedule. If GMU is closed on the scheduled date of the Final Exam, the make-up date and time for the Final Exam will be announced through the class Blackboard site and GMU e-mail.

All exams will be taken in person unless the class transitions to online, in which case exams will be online.

All exams are closed book and closed notes. Use of these materials, or any other source of information, is prohibited during all exams.

Homeworks and Quizzes: Homework assignments and quizzes will be posted on Blackboard on the dates listed in the course schedule. Except when specifically noted otherwise, quizzes and homework assignments are due by the start of class (4:30 pm) one week after they are issued. Quizzes must be completed within Blackboard. Assignments may be given to instructor directly, e-mailed to the instructor, or submitted through Blackboard if that option is enabled. *Please do not leave assignments in the instructor's office mailbox or in the instructor's office if the instructor is not present at the time.*

Late or Missed Coursework: Reasonable accommodations will be made for late homeworks and quizzes, and for exams missed due to sickness, religious observance and other unavoidable schedule conflicts if the instructor is notified prior to the date the homework or quiz is due or date the exam is given. Without prior notification, late exams and quizzes are subject to a 10% reduction of the possible score (e.g., a 10-point reduction from an exam worth 100 points). Unusual situations that prevent advance notice to the instructor will be handled on a case-by-case basis. In any event, homeworks, quizzes and exams that are not turned in, are not made up, or remain unexcused one week after the scheduled due date or exam date are subject to a grade of zero.

Grade Postings on Blackboard: All course scores will be posted on Blackboard unless otherwise requested.

Collaboration: Students are encouraged to study together and discuss with each other the information and concepts covered in the lectures and course readings. Collaboration on homework assignments, quizzes, the Semester Exercise and the Model Inputs Summary is permitted so long as all students in the collaboration fully participate in the discussion of all questions and do a fair share of the collaborative work. For the Semester Exercise and Model Inputs Summary, collaborating students must also use different data sets and do their own write-ups. Simple division of labor (i.e., dividing questions within the group) is not consistent with this collaboration policy and is not permitted.

Collaboration of any sort is not permitted during exams.

Unscheduled University Closure: In the event of an unscheduled university closure or access limitation due to weather or other reasons, check Blackboard and your GMU e-mail for any class announcements. If class cannot meet because of a closure or access limitations, supplementary activities may be assigned.

Extended Emergency Adaptation: All classes are scheduled to be conducted in person. If an extended emergency situation prevents in-person classes, classes may be shifted to a synchronous online mode (i.e., live online) and conducted through Blackboard. You will be told if classes are being shifted to online mode and given instructions on how to access the online system.

University Policies

The University Catalog is the central resource for GMU policies affecting student, faculty and staff conduct in university academic affairs. Please see the catalog (<https://catalog.gmu.edu>) or the University Policy web site (<https://universitypolicy.gmu.edu>) for information on academic and non-academic policies not explicitly specified in the syllabus.

Common policies that affect all courses at GMU are listed below. These common policies regard Academic Standards, Accommodations for Students with Disabilities, FERPA and Use of GMU E-mail Addresses for Course Communication, and Title IX Resources and Required Reporting. These policies are also posted at <https://sternscenter.gmu.edu/home/gmu-common-course-policies/>.

Academic Standards: Academic Standards exist to promote authentic scholarship, support the institution's goal of maintaining high standards of academic excellence, and encourage continued ethical behavior of faculty and students to cultivate an educational community which values integrity and produces graduates who carry this commitment forward into professional practice.

As members of the George Mason University community, we are committed to fostering an environment of trust, respect, and scholarly excellence. Our academic standards are the foundation of this commitment, guiding our behavior and interactions within this academic community. The practices for implementing these standards adapt to modern practices, disciplinary contexts, and technological advancements. Our standards are embodied in our courses, policies, and scholarship, and are upheld in the following principles:

- **Honesty**: Providing accurate information in all academic endeavors, including communications, assignments, and examinations.
- **Acknowledgement**: Giving proper credit for all contributions to one's work. This involves the use of accurate citations and references for any ideas, words, or materials created by others in the style appropriate to the discipline. It also includes acknowledging shared authorship in group projects, co-authored pieces, and project reports.
- **Uniqueness of Work**: Ensuring that all submitted work is the result of one's own effort and is original, including free from self-plagiarism. This principle extends to written assignments, code, presentations, exams, and all other forms of academic work.

Violations of these standards — including but not limited to plagiarism, fabrication, and cheating — are taken seriously and will be addressed in accordance with university policies. The process for reporting, investigating, and adjudicating violations is outlined in the university's procedures (see <https://academicstandards.gmu.edu/>). Consequences of violations may include academic sanctions, disciplinary actions, and other measures necessary to uphold the integrity of our academic community.

The principles outlined in these academic standards reflect our collective commitment to upholding the highest standards of honesty, acknowledgement, and uniqueness of work. By adhering to these principles, we ensure the continued excellence and integrity of George Mason University's academic community.

Student responsibility: Students are responsible for understanding how these general expectations regarding academic standards apply to each course, assignment, or exam they participate in; students should ask their instructor for clarification on any aspect that is not clear to them.

Accommodations for Students with Disabilities: Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at GMU. If you are seeking accommodations, please visit <https://ds.gmu.edu/> for detailed information about the Disability Services registration process. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email: ods@gmu.edu. Phone: (703) 993-2474.

Student responsibility: Students are responsible for registering with Disability Services and communicating about their approved accommodations with their instructor *in advance* of any relevant class meeting, assignment, or exam.

FERPA and Use of GMU Email Addresses for Course Communication: The Family Educational Rights and Privacy Act (FERPA) governs the disclosure of education records for eligible students and is an essential aspect of any course (see <https://studentprivacy.ed.gov/ferpa> and <https://registrar.gmu.edu/ferpa/>). Students must use their GMU email account to receive important University information, including communications related to this class. Instructors will not respond to messages sent from or send messages regarding course content to a non-GMU email address.

Student responsibility: Students are responsible for checking their GMU email regularly for course-related information, and/or ensuring that GMU email messages are forwarded to an account they do check.

Title IX Resources and Required Reporting: As a part of George Mason University's commitment to providing a safe and non-discriminatory learning, living, and working environment for all members of the University community, the University does not discriminate on the basis of sex or gender in any of its education or employment programs and activities. Accordingly, all non-confidential employees, including your faculty member, have a legal requirement to report to the Title IX Coordinator, all relevant details obtained directly or indirectly about any incident of Prohibited Conduct (such as sexual harassment, sexual assault, gender-based stalking, dating/domestic violence). Upon notifying the Title IX Coordinator of possible Prohibited Conduct, the Title IX Coordinator will assess the report and determine if outreach is required. If outreach is required, the individual the report is about (the "Complainant") will receive a communication, likely in the form of an email, offering that person the option to meet with a representative of the Title IX office.

For more information about non-confidential employees, resources, and Prohibited Conduct, please see University Policy 1202: Sexual and Gender-Based Misconduct and Other Forms of Interpersonal Violence (<https://universitypolicy.gmu.edu/policies/sexual-harassment-policy/>). Questions regarding Title IX can

be directed to the Title IX Coordinator via email to TitleIX@gmu.edu, by phone at 703-993-8730, or in person on the Fairfax campus in Aquia 373.

Student opportunity: If you prefer to speak to someone *confidentially*, please contact one of Mason's confidential employees in Student Support and Advocacy (SSAC), Counseling and Psychological Services (CAPS), Student Health Services (SHS), and/or the Office of the University Ombudsperson.

Diversity and Inclusion: Through its curriculum, programs, policies, procedures, services and resources, GMU strives to maintain a quality environment for work, study and personal growth. An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals.

Diversity is broadly defined to include such characteristics as, but not limited to, race, color, ethnicity, national origin, religion, age, disability, gender identity and expression, pregnancy status, sex and sexual orientation. Diversity also entails different viewpoints, philosophies and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds and practices have the opportunity to be voiced, heard and respected.

Students, instructors and staff are all expected to uphold GMU's commitment to equitable access and meaningful inclusiveness for all within the GMU community.

Title IX

Title IX is a federal civil rights law that prohibits discrimination on the basis of sex under any education program or activity receiving federal funding. GMU receives federal funds in many forms and so is required to comply with Title IX.

Sexual assault and sexual harassment are forms of sex discrimination covered by Title IX. Other issues that are investigated under Title IX include stalking, intimate partner violence, gender-based harassment, sexual exploitation, complicity in the commission of any act prohibited by this policy, and retaliation for good faith reporting of any of these forms of conduct or participation in any investigation or proceeding.

More information is at: <https://diversity.gmu.edu/title-ix/what-title-ix/university-title-ix-statement> and <https://www.ed.gov/laws-and-policy/civil-rights-laws/sex-discrimination/Title-IX-and-Sex-Discrimination>

Student Support Resources

GMU has several support resources available to all students. Potentially useful starting points include:

- Mason email: <https://mail.gmu.edu>
- Learning Services: <https://learningservices.gmu.edu>
- Student Health Services: <https://shs.gmu.edu>
- Counseling and Psychological Services: <https://caps.gmu.edu>
- Student Support and Advocacy Center: <https://ssac.gmu.edu>
- University Career Services: <https://careers.gmu.edu>
- Office of the University Ombudsperson: <https://ombuds.gmu.edu>
- Diversity, Equity and Inclusion: <https://diversity.gmu.edu>
- Sexual Misconduct, Harassment and Discrimination resources:
<https://diversity.gmu.edu/equity-access-services/title-ix>
- Title IX Contacts at Mason:
<https://diversity.gmu.edu/equity-access-services/title-ix/who-can-i-speak>

Many other resources are listed under Student Life: <https://www.gmu.edu/student-life>