

INTRODUCTION TO GEOCHEMISTRY

21:460:401 (3 credits)

FALL 2017

MEETING TIMES AND LOCATION

Lecture: Tuesday/Thursday 2:30-3:50 pm

Location: Smith Hall 242

PREREQUISITES Planet Earth or Environmental Geology and General Chemistry

CONTACT INFORMATION

Instructor: Dr. Ashaki A. Rouff;

Office Location: 138B Smith Hall

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Office Hours: After class T/Th 4:00-5:00 pm, or by appointment

COURSE RESOURCES AND MATERIALS

Primary Text: G. Nelson Eby, *Principles of Environmental Geochemistry*

Other resources: Find this course on Blackboard under “My Courses”. Additional handouts and articles will be posted to Blackboard.

COURSE DESCRIPTION

This course will focus on the fundamental principles of geochemistry, the role in natural earth processes, and the application to human-impacted environments. The first half of the course will cover the foundational concepts required to understand basic geochemistry: thermodynamics, kinetics, acids-bases and redox. We will then build on this knowledge, and explore select geochemical processes taking place at the interfaces of water, earth materials and the atmosphere, as they relate to natural and anthropogenic systems. Coursework will include readings from the text, hand calculations, interpretation and application of geochemical data, and a final presentation based on the application of geochemistry in solving environmental problems.

COURSE LEARNING OUTCOMES

To provide students with foundational knowledge in geochemistry with a focus on near-surface earth and environmental systems. During this course students will:

- LO1.** Identify fundamental chemical principles in the context of earth processes;
- LO2.** Express geochemical concepts using both qualitative and quantitative approaches;
- LO3.** Interpret and solve conceptual geochemical problems;
- LO4.** Apply theoretical geochemical concepts to real-world scenarios;
- LO5.** Review and evaluate raw geochemical data;
- LO6.** Assess the role of geochemistry in solving contemporary environmental issues;

LO7. Prepare oral presentations and formulate discussion points based on case studies describing the use of geochemistry in environmental applications.

ASSIGNMENTS AND ASSESSMENT

Quizzes: 6-7 administered randomly throughout the semester. *There will be no make-up quizzes.*

Problem Sets: 5-6 assigned throughout the semester as homework. These will consist of both numerical problems and worded, conceptual questions requiring interpretative and/or numerical responses. Working in groups to discuss and solve these questions is encouraged. All problem sets will be due on the date indicated on the assignment handout. Only in extremely rare circumstances and with appropriate documentation will late work be accepted, and never after the material has been discussed in class. Late assignments, if accepted, will be subject to point deductions of at least 20% for each day past the due date.

***Presentation:** You will be provided with a relevant article/study in the literature on geochemistry research. You will work in groups of 2-3 to prepare an oral presentation of the article, respond to questions and lead a brief discussion to solicit opinions from the class on the environmental, and where relevant social and/or economic implications of the findings. Details on structure and preparation of presentations will be provided during the course. *All group members will receive the same grade for the presentation.*

Exams: There will be two in-semester exams and a final. The exams will be open book, and consist of short answer questions, numerical problems and worded, conceptual questions. *There will be no make-up exams.* If you have a valid emergency that causes you to miss an exam, you need to inform me and provide valid documentation.

Please remember to ask for help and attend office hours if you have difficulty following or understanding material covered in the lectures, readings or problem sets.

Grades will be calculated based on the following criteria:

Assessment	%	Learning Outcomes
Quizzes	10	LO1-LO2 remember, understand
Problem Sets	30	LO3-LO5 understand, apply, analyze, evaluate
In-Semester Exams	30	LO2-LO5 understand, apply, analyze, evaluate
Presentation	10	LO5-LO7 analyze, evaluate, create
Final (1)	20	LO3-LO6 understand, apply, analyze, evaluate
Total Points	100	

A	90-100	Outstanding	C+	75-79	Satisfactory	D	60-69	Poor
B+	85-89	Excellent	C	70-74		F	0-59	Failed
B	80-84	Good						

COURSE TOPICS AND SCHEDULE

NB: the schedule is subject to change; updates will be provided as the semester progresses

Date	Topic	Readings/Assignments	Notes
Sep-5	Review	Handouts	What do you already know?
Sep-7, 12	Introduction & Basics	Ch. 1	Electrons, atoms, moles; units of concentration, mass, conversions between moles and masses.
		Problem Set 1	
Sep-14, 19, 21	Thermodynamics	Ch. 2: p. 27-36, 40-42	Every geochemical process has a driving force that allows us to predict which reactions will occur.
		Problem Set 2	
Sep-26, 28 Oct-3	Kinetics	Ch. 2, p. 42-47	Rates of reactions tell us if processes will occur in human or (s/d/yr) or geologic (ka/Ma/ Ga) time.
Oct-5	EXAM 1		
Oct-10, 12, 17	Acids & Bases	Ch. 3	Proton exchange and pH influence processes in water when in contact with minerals, and gases e.g. CO ₂ (g).
		Problem Set 3	
Oct-19, 24, 26	Redox	Ch. 4: p. 94-103, 114-124	O ₂ (g) drives geochemical reactions through electron exchange. This can also occur in the absence of O ₂ (g).
		Problem Set 4	
Oct-31 Nov-2	Environmental Mineralogy	Ch. 7: p. 207-223	Minerals are highly reactive, and exchange/sequester dissolved ions at surfaces and within structures.
Nov-7	EXAM 2		
Nov-9, 14	Geochemistry of Contaminants	Ch. 5: p. 139-159 Ch. 9: p.341-359	Contaminants in water, air and earth materials are controlled by geochemical processes, which can mitigate and/or amplify environmental consequences.
		Problem Set 5	
Nov-16, 21	Weathering	Ch. 9: p. 313-323	Weathering is a natural process that can be understood and predicted using geochemical tools.
Nov-23	THANKSGIVING		
Nov-28, 30	Natural Waters	Ch. 9: p.324-341	The composition of rain, surface and groundwater is controlled by geochemical reactions.
		Problem Set 6	
Dec-5, 7	PRESENTATIONS		
Dec-12	Review		
TBD	FINAL		

FINAL EXAM/PAPER DATE AND TIME

Online Final exam Schedule: <http://finalexams.rutgers.edu/>

ATTENDANCE

Attendance is not mandatory, however multiple absences, consistent tardiness, and leaving class early will put you at a disadvantage for succeeding in this course. If you miss a class, you are responsible for all material presented, and completing all assignments by the given due date.

Note: there will be no make-up Quizzes.

CLASSROOM ETIQUETTE

- Pay attention and be courteous
- Turn off/mute cell phones
- Laptops and other devices should only be used for course materials/activities
- Be prepared for class and participate

UNIVERSITY POLICIES

Students should review the following University Policies:

- **Principles of Academic Integrity:**

<http://academicintegrity.rutgers.edu/academic-integrity-at-rutgers/>

These principles require students to:

- make sure that all work submitted as his/her own is produced without the aid of unsanctioned materials or unsanctioned collaboration;
- neither facilitate academic dishonesty by others nor obstruct their academic progress.

Adherence to these principles is necessary to insure that all student work is fairly evaluated and no student has an inappropriate advantage over others.

- **University Code of Student Conduct:**

<http://studentconduct.rutgers.edu/university-code-of-student-conduct>

When students choose to accept admission to Rutgers University, they accept the rights and responsibilities of membership in the University's academic and social community. As members of the University community, students are expected to uphold our stated values by maintaining a high standard of conduct.

- **Disability Services:**

<http://roberson.rutgers.edu/disability-services/>

Accommodations, auxiliary aids, and services enable qualified students with disabilities to receive the same information and opportunities presented to a student without disabilities. If accommodation is required students are responsible for presenting a Letter of Accommodation promptly and at the start of the semester.