

**Geology 4490-01 - Geochemistry – Spring 2019**  
**Tuesday and Thursdays 9:35-10:50; ESB 1038**

<u>Instructor</u>	<u>Office</u>	<u>e-mail</u>	<u>Office hours</u>
Dr. Kenneth Sims	GEO 314	<a href="mailto:ksims7@uwyo.edu">ksims7@uwyo.edu</a>	<b>In my Office</b> TR 8:30 – 9:00 AM TR 11:00 – 12:00 PM TR 2:45 – 4:00 PM <b>By appointment only</b> M 4:30-5:30PM W 3:00 – 4:00 PM

<u>Teaching Assistant</u>	<u>Office</u>	<u>e-mail</u>	<u>Office hours</u>
Brandi Lawler	GEO 321	<a href="mailto:blawler@uwyo.edu">blawler@uwyo.edu</a>	M 11:45 – 12:45 PM W 1:45 – 2:45 PM

**I. COURSE DESCRIPTION:**

The objective of this course is to develop a quantitative and thorough understanding of the systematics and application of geochemical principles to the study of Earth systems. During this course you will be introduced to the following topics:

Fundamentals

- \* Nuclear Chemistry
- \* Thermodynamics of Geochemical Processes
- \* Kinetics of Geochemical Processes
- \* Acid, Bases and Chemical Weathering

*Essential Tools of Geochemistry and their applications*

- \* Trace Element Behavior
- \* Radiogenic and Stable Isotopes
- \* Phase Equilibria

Geochemical Processes

- \* Nucleosynthesis
- \* Planetary Formation
- \* Earth Differentiation and Structure
- \* Geochemical Cycles on the Earth's Surface

## II. COURSE OUTLINE:

This course is structured into three sections.

**Section 1: Deep Time.** What geochemistry, with a little geophysics, tells us about: the Big Bang; Stellar Nucleosynthesis; Formation of the Solar System; and in particular, the Formation and Differentiation of our Earth.

**Section 2, Theoretical Geochemistry:** The fundamental principles of thermodynamics with a few geological applications, and the study of kinetics and diffusion with a few geological applications.

**Section 3, Here and now:** How geochemistry informs our understanding of geological processes occurring in Earth's history, including: long-term and short-term climate change; chemical and mechanical weathering; water/rock interactions; oxidation and reduction; and even, the genesis and evolution of life on Earth.

**III. LECTURE NOTES:** Many lectures will be given on the whiteboard. When lectures use power point slides, lecture notes can be downloaded on the class Wyocourses site the night before class (midnight latest). No electronic devices in class. Turn phones off.

## IV. COURSE REQUIREMENTS/ASSIGNMENTS:

The homework and tests are comprehensive.

### *i. Grading*

There are 100 points possible in this course. The following is a break down of the grade assessment.

3 Labs (3 @ 15 pts)	45 points
Final Exam:	20 points
Mid Term Exam	15 points
In-Class Quizzes (13 with 5 as throw away scores)	8 points
Home Works (10 @ 1 pt)	10 points
In class participation	2 points
<b>TOTAL POSSIBLE POINTS</b>	<b>100 POINTS</b>

Grading will be on a standard plus/minus scale. Plus/minus grades will be based upon a rounding to the 10ths of a percent place. See below.

The plus/minus grading system would be as follows:

<b>A</b> 92-100 percent	<b>C+</b> 78-79.9 percent	<b>D</b> 60-67.9 percent
<b>A-</b> 90.0-91.9 percent	<b>C</b> 72-77.9 percent	<b>F</b> < 60 percent
<b>B+</b> 88-89.9 percent	<b>C-</b> 70-71.9 percent	
<b>B</b> 82-87.9 percent	<b>D+</b> 68- 69.9 percent	
<b>B-</b> 80-81.9 percent		

**ii. Lab Assignments (45 points):**

There will be three lab problem sets. The labs will be comprehensive.

Lab Assignment Dates February 15, March 15, and April 26 (All due at midnight).

Individuals are required to work on these problem sets entirely on their own. If you have questions see me during office hours.

Late Assignments: Late assignments will be penalized at 5 pts per day. All assignments will be turned in through WyoCourses. Individual assignments will not be curved.

Honor Code: For me to grade this you must sign an honor code at the end of every one of your lab assignments stating: *“that you have neither given nor received help from anyone, either in the class or outside the class. Nor do you know of anyone giving or receiving help”*. You can discuss the concepts of this course with each other, but “walk the line of integrity” and do not work on the homework with others. Come see me for help with these.

**ii. Tests (35 points):**

**Mid-Term Exam (15 points):** Thursday, April 4, 9:35 AM - 10:50 AM

**Final Exam (20 points):** Tuesday, May 9, 10:15 AM to 12:15PM)

***TESTS MUST BE TAKEN ON THE SCHEDULED DATE.*** Make-up exams will be given only to students with an official University excuse, and exams must be made up within one week after returning from an excused absence. Grading will be on a standard scale (90s = A, 80s = B, etc.). Individual exams will not be curved.

Note the dates for exam schedule and final. No electronic devices during the exam.

Tests are comprehensive.

**iii. Homework (10 points).**

*There will be 10 short, easy homework assignments that will make sure you have background information I require in class for lectures. These mini homework are to be done on your own. Homework will be handed out on Thursdays and is due the following Tuesday. No late homework will be graded.*

**In Class Quizzes (8 points)**

*There will be an almost weekly “5- minute quiz” to test you on course material. There are 13 scheduled quizzes, but only 8 of these quizzes will count toward this part of your grade.*

**Class Participation (2 points):**

These two points can make a difference. Please, remember, no question is a dumb question. Do not be shy to ask me to clarify anything.

Three Metrics.

- 1) “In-Class Quizzes”. In class quizzes will be frequent, short and will be graded bimodally (correct or incorrect).
- 2) “Marble Game” Most every lecture someone will be chosen randomly and asked to come to the board to review all previous lectures concepts.
- 3) “Physically and Intellectually Present and Engaged” (i.e. attentiveness, courteous listening to others, no electronic interruptions, no eating, etc).

**CONTACT:**

You always should feel free to contact me (or Brandi) about the material presented. When emailing one of us use a clear distinct subject header and proper salutation, and when emailing Brandi regarding official class business CC me. Do not call us at home or by cell phone.

**CLASS CONDUCT:**

No interrupting. Focus on the person with the floor. No eating in class. No electronic devices (laptops, iPads or cell phones) in class; paper and pencil only.

**TEXT(S) AND READINGS:**

**Geochemistry.** White, W., 2013, Wiley Blackwell

Available at the book store and on line.

<http://www.wiley.com/WileyCDA/WileyTitle/productCd-EHEP002849.html>

**Additional Reading List:**

- 1) Halliday and Lee, GCA 63, 1999; Kleine et al Nature 418, 2002; Qingzhu et al., Nature 418, 2002.
- 2) Molnar and England, Nature 346, 1990
- 3) Rothchild and Mancinelli, Nature 409, 2001.

## IMPORATANT OBLIGATORY MESSAGES:

- 1) **Cheating.** University Regulation 2-114, defines academic dishonesty as “an action attempted or performed that misrepresents one’s involvement in an academic task in any way, or assists another student in misrepresenting his or her involvement in an academic endeavor”. There is a well-defined procedure to judge such cases, and serious penalties may be assessed. In this class, your exams and homework are expected to be your work ONLY.
- 2) **Conduct.** University Regulation 29, change 1, states that the instructor can “establish reasonable standards of conduct for each class which should be made known at the outset.” In this class I expect engagement and participation, including regular attendance, and that we all treat each other with courtesy and respect. This does not mean we have to agree with each other!
- 3) **A&S - Students and Teachers Working Together.**  
A 6-page document is available at:  
  
[http://www.uwyo.edu/as/\\_files/current/students%20and%20teachers%20working%20together.pdf#students%20and%20teachers%20working%20together](http://www.uwyo.edu/as/_files/current/students%20and%20teachers%20working%20together.pdf#students%20and%20teachers%20working%20together)  
  
This document lays out the guidelines for the course syllabus, attendance, classroom deportment (no sleeping or cell phone use!), phone and email protocol, office hours and how to make appointments outside of office hours. Good stuff.
- 4) **Disabilities.** If you have a physical, learning, or psychological disability and require accommodations, please let the instructor know immediately. You will need to register with, and provide documentation of your disability to, University Disability Support Services (UDSS) Room 109 Knight Hall. You may also contact DSS at (307) 766-3073 or [udss@uwyo.edu](mailto:udss@uwyo.edu). It is in the student’s best interest to request accommodations within the first week of classes, understanding that accommodations are not retroactive. Visit the DSS website for more information at: [www.uwyo.edu/udss](http://www.uwyo.edu/udss).
- 5) **Classroom Statement on Diversity:** The University of Wyoming values an educational environment that is diverse, equitable, and inclusive. The diversity that students and faculty bring to class, including age, country of origin, culture, disability, economic class, ethnicity, gender identity, immigration status, linguistic, political affiliation, race, religion, sexual orientation, veteran status, worldview, and other social and cultural diversity is valued, respected, and considered a resource for learning.

- 6) **Duty to Report:** While I want you to feel comfortable coming to me with issues you may be struggling with or concerns you may be having, please be aware that I have some reporting requirements that are part of my job requirements at UW.

For example, if you inform me of an issue of sexual harassment, sexual assault, or discrimination I will keep the information as private as I can, but I am required to bring it to the attention of the institution's Title IX Coordinator. If you would like to talk to those offices directly, you can contact Equal Opportunity Report and Response (Bureau of Mines Room 319, 766-5200, [report-it@uwyo.edu](mailto:report-it@uwyo.edu), [www.uwyo.edu/reportit](http://www.uwyo.edu/reportit)). Additionally, you can also report incidents or complaints to the UW Police Department. You can also get support at the STOP Violence program ([stopviolence@uwyo.edu](mailto:stopviolence@uwyo.edu), [www.uwyo.edu/stop](http://www.uwyo.edu/stop), 766-3296) (or SAFE Project ([www.safeproject.org](http://www.safeproject.org), [campus@safeproject.org](mailto:campus@safeproject.org), 766-3434, 24-Hour hotline: 745-3556).

Another common example is if you are struggling with an issue that may be traumatic or unusual stress. I will likely inform the Dean of Students Office or Counseling Center. If you would like to reach out directly to them for assistance, you can contact them using the info below or going to [www.uwyo.edu/dos/uwyocares](http://www.uwyo.edu/dos/uwyocares).

Finally, know that if, for some reason, our interaction involves a disruptive behavior or potential violation of policy, I inform the Dean of Students, even when you and I may have reached an informal resolution to the incident. The purpose of this is to keep the Dean apprised of any behaviors and what was done to resolve them.

- 7) **Final Disclaimer:** As the instructor I reserve the option to make changes to the schedule (particularly the suggested readings) throughout the course. Changes will be announced in class or via e-mail.

## ***COURSE SYLLABUS***

<b>Week</b>	<b>Dates</b>	<b>Topic</b>	<b>Homework</b>
1	Jan 29 & 31	Periodic table; electronic structure of atoms; chemical bonds; ionic radii, and crystal chemistry	Quiz 1 HW 1 Handed Out
2	Feb 5 & 7	Movie- Energy and thermodynamics Isotope principles: fusion, fission and radioactive decay (note this will include a differential calculus review of 1st order differential equations.)	HW 1 Due Quiz 2 HW 2 Handed Out
3	Feb 12 & 14	Stellar Nucleosynthesis  Age of the Elements	HW 2 Due  Quiz 3  HW 3 Handed Out  <b>Lab 1 due</b> Friday Feb 15 (Midnight)
4	Feb 19 & 21	Deep Time and Deep Earth  Accretion and Differentiation of the Solar System and Earth  Earth Structure and Differentiation Core Formation Hf-W	HW 3 Due  Quiz 4  HW 4 Handed Out  <b>Lab 1 returned</b> Thurs. Feb 21
5	Feb 26 & 28	Mantle Structure, Geotherm,  Magma Genesis and Magma Differentiation	HW 4 Due  Quiz 5  HW 5 Handed Out
6	March 5 & 7	Differential Calculus Review II (PDEs)  Thermodynamics Basics	HW 5 Due  Quiz 6  HW 6 Handed Out

<b>Week</b>	<b>Dates</b>	<b>Topic</b>	<b>Homework</b>
7	Mar.12 & 14	Thermodynamics Basics  Thermodynamics Basics	HW 6 Due  Quiz 7  <b>Lab 2 Due</b> Fri., March 15 (Midnight)
8	Mar. 18-22	<i>no classes- spring break</i>	<i>Spring Break</i>
9	Mar 26 & 28	A Thermodynamic perspective of the Earth	Quiz 8  <b>Lab 2 returned</b> Tue. March 26
9	April 2 & 4	Review Session  <b>Mid Term Thursday (April 4) Comprehensive</b>	
10	April 9 & 11	Kinetics and Diffusion (Rates of Reaction)	Quiz 9  HW 7 Handed Out
11	Apr 16 & 18	Eh – pH Acid -Base Redox Reactions  No Class on Thursday	HW 7 Due  Quiz 10  HW 8 Handed Out
12	Apr 23 & 25	Formation of the Earth's Atmosphere and Oceans.  Stable Isotopes  Climate and Climate Change	HW 8 Due  Quiz 11  HW 9 Handed Out  <b>Lab 3 due</b> Fri., April 26 (Midnight)

<b>Week</b>	<b>Dates</b>	<b>Topic</b>	<b>Homework</b>
13	Apr 30 & May 2	Geochemical cycles recorded in ocean waters and sedimentary rocks  Geochemical processes in hydrothermal systems and life in extreme environments	HW 9 Due  Quiz 12  HW 10 Handed Out  <b>Lab 3 returned</b> Thurs. May 2
14	May 7 & 9	Finals Review Week	HW 10 Due  Quiz 13
<b>Final</b>	<b>May 14</b> <b>Tuesday</b>	<b>Final (Comprehensive)</b> <b>10:15AM – 12:15PM</b>	