Course Description: This course focuses on the chemistry of the natural world and the chemical evolution of the Earth over geological time. We will discuss practical and theoretical geochemistry, with an emphasis on how chemical principles are used to study Earth Sciences. The course is composed of a three modules: (a) geochemical fundamentals; (b) natural and anthropogenically perturbed aspects of the Earth's hydrosphere and its interaction with surficial rocks, sediments, soils, the biosphere and the atmosphere and (c) the origin and evolution of Earth (crust-mantle-core) and the solar system through nuclear and high temperature chemical processes.

Geochemical Fundamentals
- The Elements; basic principles of inorganic chemistry, periodic properties
- Thermodynamics and chemical reactions, solubility
- Aquatic Chemistry, pH-pE, Biology and redox
- Organic Chemistry

Low temperature geochemistry
- Chemical Processes, Photosynthesis/respiration, Aquatic Microbial Biochemistry in rain, rivers, lakes, estuaries
- Chemical weathering, soil formation, geochemistry of clays.
- The oceans, marine chemistry, primary productivity, Gaia, Marine Sediments: a record of environmental global history, light isotope geochemistry.
- Global Climate: Present and Future, atmospheric CO2

High temperature geochemistry
- Age and Origin of the Solar System.
- Planet formation, differentiation of the Earth.
- Igneous processes
- Radiogenic isotope geology/Geochronology

GG Learning Objectives:
GG department has defined 5 learning objectives for the undergraduate degree program related to Relevance of Geology and Geophysics, Technical knowledge, Scientific method, Oral and written skills, and Evaluating Phenomena. This course directly incorporates content relevant to 4 of those:
- SLO1 - throughout the course you will learn about the relevance of geochemistry to understanding and providing for human needs, and to impacts on society and planet Earth.
- SLO2 - you will solve problems using real world data sets
- SLO4 - you will reconstruct knowledge in a written report (final project).
SLO5 - in all assignments you will evaluate, interpret, and summarize basic principles to explain complex phenomena at the interfaces of chemistry, geology, biology, hydrology, soil science, geography and human industry.

Course Goals:
This class is about using chemical information and chemical reasoning to better understand geological, hydrological and biological process and their interplays on Earth. We will use quantitative and qualitative approaches to learn how the compositions of Earth materials constrain active processes and Earth history.

Textbook:
We will use the book by William White on Geochemistry. Although you are welcome to purchase your own copy, pdf chapters of a pre-publication version will be made available through the website. Other background reading may also be provided as needed through the semester.

Laboratory: There is no separate lab component for this class; however, there will be exercises and/or problems that you will need to turn in for a grade.

Attendance: Not all the material discussed in class will be in the book, so it is important to make it to class. To encourage attendance, there will be a “Question of the day”.

Grading Policy

Grading (see below for more information on grading policy, etc):

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work handed in</td>
<td>20%</td>
</tr>
<tr>
<td>Question of the Day</td>
<td>10%</td>
</tr>
<tr>
<td>Mid-Term Exam</td>
<td>35%</td>
</tr>
<tr>
<td>Final Project</td>
<td>35%</td>
</tr>
</tbody>
</table>

Letter Grade Breakdown: A = 90%+; B = 80 – 89%; C = 70 – 79%; D = 60 – 69% ; F = < 60%

Homework
There will be occasional work to be handed in, and not all of it will be finished during class time. In addition, you will need to work on your final report outside of lecture times. All work handed in should be readable, (consider typing), and correct grammar and spelling will be appreciated. Deductions will be made for ambiguous or incomprehensible text.

Working Together on Homework: Studies have shown that students learn best when they work together. I encourage you to work with each other on assigned problems. However, each student must turn in his or her own assignment, written using his or her own words. In case of identical answers between different students, neither student will receive any credit for that particular question – see academic honesty below.

Academic integrity
University guidelines for acceptable student conduct are very specific and will be strictly followed. Please read the guidelines (http://www.catalog.hawaii.edu/about-uh/campus-policies1.htm) and contact your instructors if you have any concerns. Academic dishonesty will be reported, and any exams or assignments affected by dishonesty will receive “0” credit and cannot not be retaken.

Question of the day
We will set up a schedule, where one-by-one each student will have to come up with a review question covering the material of the previous lecture. The rest of the class will have to answer the question and turn
in their answer. After that we will discuss the question and the student that designed the question will explain the answer. The question will be posed during the lecture (likely the beginning of the lecture) and everyone will have a few minutes to write down the answer, after which they will all be collected.

**Midterm**
There will be one midterm exam, which will be in essay format, unless the class size does not allow that.

**Final project**
We will have a final project in lieu of a standard final exam. A written report will have to be handed in for this component.

**Make-Up Exams/Early Exams**
Make-up exams will not be given except when a student misses the exam for a legitimate reason such as illness or family emergency (a doctor's note is required in the case of illness). Please contact me as soon as possible if such a situation arises. Anyone with official UH-sponsored event conflicts (e.g. UH sports teams) must provide at least 2 weeks notice with appropriate signed paperwork.

Note that make-up and/or early exams will be essay format and may be substantially more difficult.

**Dropping this class – deadline reminders**
Last day to drop without a “W”: August, 31st
Last day to withdraw with a “W”: October 23rd
You will need to drop the class by filing appropriate paperwork: non-attendance will not result in being dropped, but you will get zeros for the remaining work and consequently fail the class.

**Students with Disabilities:**
The Geology and Geophysics Department will make every effort to assist those with disability and related access needs. For confidential services, please contact the Office for Students with Disabilities (known as “Kokua”) located in the Queen Lili'uoakalani Center for Student Services (Room 013):
KOKUA Program; 2600 Campus Road; Honolulu, Hawaii 96822_
Voice: 956-7511; Email: kokua@hawaii.edu; URL: www.hawaii.edu/kokua