SPRING SEMESTER COURSE ANNOUNCEMENT

GEOCHEMISTRY

CLIMBING THE REDOX TOWER AND OTHER DEADLY ADVENTURES

ΔG

[pH

[x]

d/dt

eH

{X}

Feeling a bit rusty?
Time for a refresher?
Need a spring cleaning?
Here is your chance!

Geological Sciences Bldg. - GEOL 404
9:00 - 10:20 / TR / 3 hour credit
Dr. Ben Brunner GEOL 4316 - CRN 27837
Geochemistry
*Climbing the redox tower and other deadly adventures*

INSTRUCTOR
Dr. Benjamin Brunner
Assistant Professor, Geological Sciences
Office: 404A Geology Building
E-mail: bbrunner@utep.edu

MEETING PATTERN & LOCATION
Tuesday and Thursday 9:00am-10:20am Geology Building 404, 3 credits
BS students (GEOL 4316, CRN 27837)

COURSE DESCRIPTION
Students often find Geochemistry a field that is hard to access. One of the reasons for that challenge is the fact that Geochemistry combines the fields of Geology – bringing in a multitude of minerals with complex chemical compositions – with Chemistry, a topic that some students might feel out of touch with since their first Chemistry studies a few years back. Moreover, Geochemistry is quite often ‘spiced up’ with a hefty dose of Mathematics and Physics. At best, this combination of challenges creates a fairly steep learning curve; at the worst it renders the topic a daunting hurdle.

This class takes a new approach: we will oscillate between geochemical questions that we can understand on a qualitative basis and the review/refreshment of basic tools from Chemistry, Mathematics and Physics that allow for more quantitative approaches. Developing from qualitative to quantitative understanding, we will refresh our skillset in Chemistry, Mathematics and Physics, making our joyful first steps in the exciting field of Geochemistry.

REQUIRED TEXTBOOK
No required textbook. There will be handouts & material posted on Blackboard.

RECOMMENDED READING: All books are available at the office of Dr. Brunner.

COURSE OBJECTIVES
1) Refreshing/Review Mathematical Toolbox:
   a. System analysis: Fluxes and Pools
   b. Algebra
   c. Simple differential equations
   d. First-order kinetics, exponential growth and decay
2) Refreshing/Review Chemical Toolbox:
   a. Chemical equilibrium / disequilibrium
   b. Balancing of chemical equations
   c. Redox reactions
   d. Concentration, partial pressure, activity, fugacity
   e. pH, eH
   f. Thermodynamics
   g. Kinetics
3) Refreshing/Review Physical Toolbox:
   a. Diffusion and Advection
4) Introduction to Geochemistry:
   a. Let’s manage a landfill! => Analyzing Earth Processes from a geochemical perspective

PARTICIPATION IS ESSENTIAL (SEE GRADES)
Please contact Dr. Brunner about any concerns, schedule conflicts, etc. in advance or otherwise as soon as possible! A significant portion of your grade is based on participation, so any missed classes and assignments must have proper documentation or your grade will drop. Valid excuses include illness, absence with the instructor's prior approval, official University business, etc.

Accommodations are possible for active duty military and others, but arrangements must be made in a timely manner. If you are in the military with the potential of being called to military service and/or training during the course of the semester, you are encouraged to contact the instructor as soon as possible.

If you think you may have a disability or if you are experiencing learning difficulties, please contact the Disabled Student Services Office (DSSO) at (915) 747-5148. They are located in Union East room 106 or you can reach them by email at dss@utep.edu. The student is responsible for presenting to the instructor any DSS accommodation letters and instructions.

Important notes:
1) During the classes and as homework assignments, there will be various exercises. In class, students who struggle with the exercises will have the opportunity to work with the instructor in a smaller group to overcome specific hurdles. This is by no means meant to single out students who do not reach the goals of the lecture/exercises – it is an attempt to give everybody a fair chance to immediately address the encountered challenges, and to stay on track with the class. Students who take advantage of this opportunity but still encounter difficulties can schedule additional tutoring with Dr. Brunner.

2) This is a front-loaded class: most reading assignments precede the corresponding class. This will allow us to address the tricky issues of the topic in class. Reading the assignments before the lecture is the absolute key to the success of this form of teaching and learning.

3) Learning in teams is much more effective than learning alone, and is highly encouraged.

4) In the course of this class, Dr. Brunner is going to introduce ‘top-secret’ experiments he is conducting in his laboratory. Interested students can participate in the research projects.

SCHEDULE OF TOPICS – subject to change!

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<tr>
<th>Date:</th>
<th>Topic:</th>
<th>Reading &amp; Assignments</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>• Geochemistry and you? Introduction of participants, discussion of syllabus and course evaluation.</td>
<td>Syllabus</td>
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<td>• You after a field-trip, a bathtub, and system analysis.</td>
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<td>• A self-assessment of our skills in Chemistry, Mathematics, and Physics</td>
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<td>• Spreadsheets, and making plots (Excel® or similar)</td>
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<td>Week 2</td>
<td>• Gallery-walk: We construct a waste dump.</td>
<td>Chemical equilibrium</td>
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<td>• From the bathtub to an exponential curve – how did that happen?</td>
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<td>• Solving a simple differential equation</td>
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| Week 3 | • Discussion of exponential curves: relevance for geochemistry and other processes, lessons learned and refreshed skills  
• Evaluation and discussion of bathtub reports  
• Gallery-walk: We expand our concept of a waste dump. |
| --- | --- |
| Week 4 | • Quiz I: lessons learned from reading “Chemical equilibrium”  
• Discussion of outcome from Quiz I and of reading assignment  
• Solving an equation system – removing the rust from our algebraic skills  
• Solving a quadratic equation |
| Week 5 | • Evaluation and discussion of reports on quadratic equation.  
• Balancing chemical equations  
• Redox reactions – Dr. Brunner’s experiment  
• The carbonic acid system  
• pH – the log scale, and the natural logarithm |
| Week 6 | • Quiz II: lessons learned from reading “Aqueous Solutions”  
• Discussion of outcome from Quiz II and of reading assignment  
• Concentrations, Activities, Ion Strength  
• Partial Pressure, Fugacity  
• Gallery-walk: How does this all fit into our waste dump? |
| Week 7 | • Easing into thermodynamics |
| Week 8 | SPRING BREAK |
| Week 9 | • Entropy, Enthalpy, Free Energy  
• Gallery-walk: Our waste dump turns anoxic |
| Week 10 | • Oxidation Potentials, Redox Potential, Links to Free Energy  
• Consequences for Dr. Brunner’s experiment? |
| Week 11 | • eH-pH diagrams |
| Week 12 | • eH-pH diagrams – the application geochemistry |
| Week 13 | • Gallery-walk: Fluid flow in our waste dump? |
| Week 14 | • Burning topics in geochemistry |
| Week 15 | • Review of Dr. Brunner’s URI experiment |
| Week 16 | Course review |

**Grades:** Quiz & Reports (60%), Participation in discussion (40%)