Using the primary literature to engage students in upper-level science courses
Necessary Skills for Scientists

1. Ability to think critically and independently
   - Research projects
   - HW assignments/ In-class activities
   - Lab exercises

2. Ability to understand and communicate science
   - Scientific writing is very difficult to understand
     - Technical and tedious
     - Lots of unfamiliar jargon
     - Dull and uninteresting (to some!)
Teaching Mineralogy, Petrology, and Geochemistry in the 21st Century

- August 7 – 10, 2011
- University of Minnesota
- Attended by 70 Geology faculty from across the country

Format
- Pre-workshop activity review
- Daily group sessions
- Small group break-out sessions
- Share fairs (poster sessions)
Reading the Literature Assignments

• Short, guided readings that emphasize and apply concepts learned during lecture

• Goals
  1. To give students an understanding of how course content is applied in current research
  2. To introduce students to reading the primary literature using (hopefully) interesting and easily readable papers
  3. To improve students’ ability to comprehend scientific papers and to express their understanding in a written and oral format
  4. To incorporate more discussion into a content-heavy lecture course and to encourage students to participate in classroom discussions
Format

- Articles are from the journals Geology or Elements
- Typically 4-6 pages in length
- PDFs of journal articles and questions are posted on Reggienet at least two weeks prior to due date
- Answers to questions are due via Reggienet two hours before class on discussion day
- Responses are used by instructor to guide the discussion, which varies from ~20 minutes to the entire 50 minutes class period
Assessment

50 Pts. **Outstanding performance.** Student demonstrates solid conceptual understanding and insight and is able to make extensions or apply the knowledge to other situations. Assignment demonstrates a deep level of reflection and thought. Material is well written, conveys coherent thoughts, and utilizes proper grammar, correct spelling, and appropriate terminology.

40 Pts. **Good performance.** Student demonstrates good understanding and mastery of content. Assignment is of good quality but not exceptional, demonstrating an acceptable level of reflection and thought. Material is well written, fairly easy to read, and utilizes proper grammar, correct spelling, and appropriate terminology.

30 Pts. **Adequate performance.** Student demonstrates minimally adequate understanding and mastery of content but has difficulty extending or applying knowledge to other situations. Assignment is adequate but shows minimal thought and reflection. Material demonstrates adequate writing skills, but may contain several grammatical, spelling, or terminology errors.

20 Pts **Unacceptable performance.** Student demonstrates poor understanding and mastery of content. Writing indicates little thought and reflection, or is of poor quality, making it difficult to read or understand.

0 Pts Assignment is not turned in.
Example Responses

What is the primary question the authors are trying to address?

50/50 The primary question the authors are trying to address is how MTB's enter new habitats after being absent for long periods of time, and how they interact with that new environment. The control of this experiment was the most recent glaciation in Norway, choosing lakes in a variety of different regions in the country. They would then analyze the varves in lake sediment deposits to find out when the MTBs first arrived after the recent glaciation, and when they were abundant.

40/50 To better understand MTB’s ability to withstand the many changing environments that have taken place over time, this article focuses on MTB’s ability to colonize and recolonize in new and old habitats. So the question would be how did MTBs recolonize the 5 lakes of Scandinavia, with an emphasis on the close time proximity with which they occurred?

30/50 In this paper, the author's are trying to find out how 4 freshwater lakes were colonized at the same time around 10,000 years ago. The lakes aren't very close to each other either.

20/50 How did MTBs colonize and recolonize around the world?
1. What are the basic chemical and structural difference between bone and tooth enamel, and how does the mineral:collagen ratio control the properties of these materials?

2. What kind of role does nucleation play in the mineralization of apatite in bones?

3. How does apatite seem to defy Pauling’s rules, particularly the Principle of Parsimony?

4. Why is it so difficult to synthetic substitutes for bone?

5. Summarize the authors’ argument as to why apatite is the primary mineral used in biomineralization of bones and teeth.

6. What terms did you not understand?

7. What concepts were hard to grasp?
Student Reaction - Year 1

1. Students saw the readings as extra work instead of as an additional learning opportunity
   • They felt that the RTLs took away from time that was better spent lecturing
2. Students were overwhelmed by the frequency of readings
   • Every week (with the exception of test weeks)
   • Lots of effort required - students could not keep up
3. Students felt that the weight of each RTL in their overall grade did not represent the effort required
   • 1% for each RTL, 10% total
   • No motivation or energy to do well
Changes After Year 1

1. Reduced the number of RTLs to six and made each assignment worth 2% of the final grade (12% total)
   • Can allocate more time for each discussion

2. Focused more of my attention on highlighting the connection between the lecture material and the readings
   • Changed the order or readings
   • Discuss why each article is important and how it applies to concepts covered in class
Students Responses to Changes

1. Changes have resulted in a significant improvement in student performance
   • During the 2011-2012 academic year, one-third of the students failed to regularly turn in their assignments
   • Now it is rare for even a single student to miss an assignment

2. Student responses to questions have also improved significantly
   • Students are taking the assignment more seriously

3. Participation in discussions has also improved
   • Room for improvement
Plant-driven fungal weathering: Early stages of mineral alteration at the nanometer scale

Steve Bonneville, Mark M. Smiths, Andrew Brown, John Harrington, Jonathan R. Leake, Rik Brydson, and Liane G. Benning

1. What is the purpose of this study?
2. The authors used several different techniques (e.g. FIB, TEM, STEM-EDS, STXM) to image and analyze the weathered biotite lamellae. Research one of these techniques, and describe how it works and why it is useful in geology.
3. What structural and compositional changes did the authors observe with increasing hypha-lamellae exposure time (from lamellae 1 to lamellae 3)? Be specific.
4. What are the authors’ overall conclusions about plant-driven fungal weathering of rocks?
5. Do you think this type of plant-driven weathering would be prominent in the Bloomington-Normal area? Why or why not?
6. What terms did you not understand?
7. What concepts were hard to grasp?