Just In Time Teaching In An Introductory Geology Course

Jeanette M. Sablock, Ph.D.

ABSTRACT

The material presented in the poster originates from a course taught in Spring 2007, GLS 170H Honors Physical Geology. Students entering the class with a weak High School science background can find the language and concepts overwhelming, but learning terms alone is not the major goal of any science course, critical thinking and analysis are the more valuable goals. Reaching the higher levels of Bloom's Taxonomy requires both determination and a variety of teaching tools. Two tools to encourage greater preparedness were tried in GLS 170H to prepare students for lecture: Groundwork exercises, based on the methods of Just In Time Teaching, and pre-lectures quizzes.

Just In Time Teaching is a teaching method which encourages active reading of required material before it is covered in class, to enable the class to progress beyond the vocabulary lesson stage into the levels of engaged learning. A typical JiTT assignment consists of three questions, two open-ended and thought provoking, one multiple choice. Students submit their answers electronically, in this case through WebCT, and some of their answers are incorporated into lecture material in some format. The example addressed in the poster concerns the often challenging topic of silicate mineral structure. Student Responses to two questions are separated into exceptional, typical and indifferent, and a student email expressing her frustration is included.

Grades for these exercises are based on effort, 'wrong' answers are expected and often very useful but difficulties arise because students are often resistant to being on their own when learning truly new material, and frustration at not finding the 'right' answer is often the result. Student resistance is the biggest obstacle I've encountered, and a survey of the class asking them to compare Groundwork (the name I've given the JiTT questions) to pre-lecture quizzes showed that 61% of the class preferred the quizzes. 77% of the class agreed that they were better prepared for lecture as a result of doing the groundwork and only one student thought the assignments were a waste of time.

12 Mg Magnesium 24.31

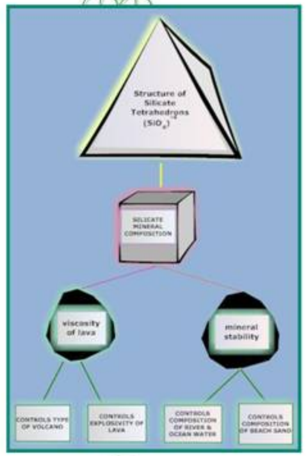
"Now! ... That should clear up a few things around here!"

20 Ca Calcium 40.2

19 K Potassium 39.1

What Many Students Want; What I Want To Avoid

Approximately 95% of the crust consists of rocks composed of silicate minerals. The concept map below illustrates the relations between silicate structure, the characteristics of volcanic activity and volcanoes and the chemical weathering which contributes sediment and ions to rivers and beaches. Understanding some of the basic concepts of silicate structure is essential for reaching higher levels of learning.



The four student responses (misspellings and typos included) reflect the range of work found in this class. Two are exceptional, from students who have both the reading and vocabulary skills enabling them to deal with 'scary' scientific data; two are from less prepared but still willing students who are struggling with this material.

THE GROUNDWORK QUESTION

USE YOUR OWN WORDS!

(a) What is the principle anionic group (complex) in most silicate minerals?

(b) On what basis are silicate minerals further divided into distinct groups?

STRUGGLING—THOUGHT ABOUT IT ...

Student Response 1:

(a)The principle anionic group in most silicate minerals is the oxygen ion. (b) The basis that silicate minerals need to further be divided into distinct groups is bonding. The different bonding between certain ions classifies each silicate mineral into a distinct group. Groups are also defined by the structure of the silicate mineral. Some resemble chains, a tetrahedron, sheets, and frameworks.

TRYING—probably last minute & didn't edit..

(I did not fully understand what these questions were asking, but I am attempting to answer) A: The principle anionic complex in most silicate minerals would be combinations of anion of SiO4 4-. B: Silicate minerals are further divided into distinct groups: Isolated and paired silica tetrahedra Ring silica tethrahedra Single or double chain Sheet silica structure Three demensional structures.

13 Al Aluminum 27.0

14 Si Silicon 28.1

Student Responses: 2 students who read & understood

a) (SiO4)^4- b) Silicate minerals are further divided into seven groups, of which the text chooses to divulge only five. The basis for this division is the way in which the silicate molecules, (SiO4)^4-, "link together" (123), by which I assume they mean bond covalently (or perhaps they mean Van Der Waals' forces -- "link together" is somewhat vague). Because you didn't ask for a list of the groups and their characteristics, I won't provide it. I will, however, rant that it's irritating (to me) that the silicate minerals, which evidently make up 95% of the earth's continental crust, should be anions that require interspersed cations to balance the charges and create a stable mineral. I would have thought that the silicon and oxygen would have been able to compromise and agree on SiO2 although I know it's far more complicated than that, and that Silicon "wants" four molecules. Still. It's dissatisfying that something so common should be so unstable and needy. On second thought, perhaps I shouldn't be surprised.

(a) The principle anionic group is composed of silicon and oxygen, and the major building block in most silicate minerals is the silicon-oxyen tetrahedron. This means that there is one small silicon atom surrounded by four larger oxygen atoms. The bonds between these atoms form a shape with three oxygen atoms at the base, one at the top, and the silicon atom in the center. (b) The way in which the silicon-oxygen tetrahedron is arranged within a silicate mineral is what creates distinct groups. There are indepdent tetrahedra, single chains, double chains, sheet silicates, and framework silicates. The independent tetrahedra from the most basic structure, as none of the oxygen atoms are shared or linked together. Down the list respectivley, the arrangement gets more complex as more oxygen atoms are shared.

A QUESTION OF PERCEPTION

The email below is from a student who in fact got from the exercise exactly what she needed to, but didn't realize it. Because of her efforts to understand the text she was better prepared to learn from the lecture—what I call plowing the field. She received full credit for her effort and I got some valuable information about what I needed to work on in class, but she is obviously having a hard time coping with the process of trying to learn new information. In spite of repeated reassurance that groundwork exercises are graded on effort (& a rubric showing this approach) the student expresses concerns about her grade. How do we teach students that persistence in the face of frustration is the key to learning & that getting the right answer is not always the point.

8 O Oxygen 16.0

"Hello,
I started the groundwork and then I just ended up being entirely confused by it and closing it and giving up. I don't like to read the e-book because it hurts my eyes, it is kind of dense, and the information that is in it really confuses me.
I got through the first question ok, and then I was confused by the second and third ones. I don't entirely understand the concept of a silicate and I couldn't find anything abut what anions are in silicates. Those words mean nothing to me. .... Once again, the book is not helping at all and I can't even begin to read it. But I'm sure that I'm going to understand all of this when you explain it in class. And since the groundwork goes towards our grade I have to try to answer something that I am just going to get wrong because I feel like all of these concepts are completely over my head. I just think that I benefit more from coming to class than I do trying to learn things on my own and answering

SURVEY SAYS ....

		Agree	Disagree	N/A
1.	I understood the lecture material more because of GW	9	2	2
2.	I think GWs were a waste of time	1	10	2
3.	I would have read & understood the text before lecture on my own so I didn't need the GW assignments	8	3	2
4.	I only read the text before an exam.	8	4	1
5.	Seeing other students' work made me realize I should work harder on my own.	2	10	1
6.	I preferred the quizzes to the GW.	9	2	2
7.	I learned more from preparing for quizzes than from GW.	8	3	2
8	I enjoyed using WebCT to do my course work.	8	2	3
9.	I prefer on-line assignments & projects to paper ones.	7	3	3
10	I prefer a paper textbook to an e-book.	11	2	

Table 1. This survey was handed out on the last day of class. Because the sampling size was small (13 respondents) the results are given in raw form rather than as percentages. Overall the students preferred the quizzes to the groundworks, but I am not convinced that they learned more from preparing for quizzes.