TEACHING AND LEARNING PORTFOLIO

by

Sarah Titus

Last Updated: May 2006

This portfolio submitted in partial fulfillment of the requirements for the Delta Certificate in Research, Teaching, and Learning.

Delta Program in Research, Teaching, and Learning
University of Wisconsin-Madison

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2006

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SARAH TITUS
University of Wisconsin - Madison
May 2006

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Introduction

This document represents a snapshot preserving my thoughts, ideas and ruminations about teaching and learning at the end of graduate school before beginning the next phase of my career. It is divided into four main sections starting with a teaching philosophy statement, abbreviated from a version used in job searches, followed by three stand-alone reflections. This is not meant to be an exhaustive portfolio documenting all of my activities in graduate school related to teaching and learning. Instead, I try to highlight some of the most interesting and varied experiences I have had or ones from which I have learned the most about myself as an educator.

The first reflection is about a series of three TA training sessions that I helped run in the Department of Geology and Geophysics at the University of Wisconsin for new TAs. What was most profound for me about leading these workshops was that I probably learned more from the experience than the TAs who I was trying to teach. In order to prepare, I spent a lot of time reading and thinking about assessment techniques, learning styles and intellectual development, and designing group work activities in order to produce condensed kernels of knowledge to share with the TAs. In reality, creating these documents helped distill and organize my knowledge and will be invaluable resources in the future.

The second reflection is about creating a positive classroom environment that is both conducive to learning as well as inclusive for all students. This summarizes some of the best techniques that I know of and have tried (so far) in order to improve my classroom environment, none of which I can take credit for. Instead, the ideas discussed in this reflection are the results of conversations with other geology faculty and graduate students and TAs across the campus, as well as more formal presentations through teaching and learning organizations.

The third reflection details a teaching scholarship project, designed to improve three-dimensional spatial visualization skills in students, that I have helped create and nurture over the past several years. I am probably most intellectually stimulated by the ideas, data, and results discussed in this reflection since it involves applying scientific methods to my own classroom. The materials that I have helped create as part of this project will be incredibly useful once I begin to teach my own courses, and are already being used by other geoscientists.

Teaching Philosophy

My earliest experiences teaching were at summer camps, and while this does not sound particularly glamorous, these formed the foundation for how I teach today. During summers before and between my college years, I taught Norwegian language to students who received high school credit for a simulated immersion experience into the culture of Norway. In my language classes, I created a wide variety of opportunities to promote speaking and thinking in Norwegian including murder mystery role-playing activities, card games and scavenger hunts, and reenactments of Norwegian folk tales like the Three Billy Goats Gruff. Many activities were designed in a broader cultural context, so that we read both classic and modern literature and discussed the current political situation in Norway and in Europe.

At language camp, I received instruction on how to teach before I actually started teaching, which has not been my experience as a graduate student. I think the reason I was able to face my first day as a TA at Wisconsin was because I came with a full battery of creative teaching tactics practiced over five summers and some confidence in my own teaching ability. Because of my later involvement in the Delta Program in Research, Teaching and Learning (an NSF-sponsored initiative for training graduate students how to become better instructors) my teaching skill set has blossomed. Perhaps more importantly, however, is that I have developed a fundamental understanding that good teaching is more than content and more than the tools for content delivery, but also involves thoughtful analysis of what students are learning combined with reflection and reevaluation based on that knowledge in order to improve both my teaching and my students' learning.

The guiding principal for courses that I teach is the idea that (just as at language camp) college students can be *immersed* in the culture of science and in particular of geology. Field trips are one of the best ways to fulfill this goal as students not only see rocks for themselves, but also learn to collect data, read maps, use a compass, and cook and camp in the outdoors. As a current student myself, I know there is no better way to understand real geologic structures than by seeing them in person. In addition to their academic value, field trips represent a way to build a strong learning community, where students and professors get to know each other outside of standard lecture courses.

Since being a scientist includes the ability to effectively use jargon, write in that peculiar detached scientific style, analyze messy data, and solve real-world problems, I try to give students the opportunity to do all these things in my classes. Important benchmark experiences will probably incorporate student presentations, and opportunities for scientific writing with peer review. Both types of activities represent an excellent way that students can teach each other and sounding and thinking like scientists.

For designing everyday classroom activities, I've found through surveys of learning styles that geology students most prefer hands-on learning opportunities. Thus group work and simple experiments are probably more effective than lectures by me. However, I do not wish to cater solely to their preferred learning style since I feel that it is important to exercise all learning-style components (e.g. visual, aural, read/write, kinesthetic). For example, geology is a very visual science and in order to fully understand and appreciate my sub-discipline, structural geology, students must be able to toggle between two-dimensional and three-dimensional information with ease. I have designed numerous exercises to help students develop, practice and improve these three-dimensional visualization skills and plan to continue this teaching scholarship research in the future.

The chance to focus on undergraduate education, in addition to continuing my research, is one of the primary reasons that I am interested in working at a liberal arts institution. I do not expect all students to become geologists after a course with me, but I would be proud to spark an appreciation for geology and promote general scientific literacy and curiosity in my students, no matter what their chosen field of study or where their future career path leads them.

Reflection I: TA training sessions

Although teaching Norwegian language to high school students had prepared me in some ways for teaching in general, I would have appreciated more formal training for teaching science to undergraduates at the University of Wisconsin. New TAs in the geology department have bi-monthly meetings for their first semester at Madison, but meetings tend to focus more on learning where rocks are stored or where to take scantron tests for evaluation rather than on learning how to teach. In an effort to address the lack of training for new TAs, I developed and ran three training sessions about teaching for new TAs in the geology department with fellow graduate student Eric Horsman.

Our TA training sessions were organized around the ideas of (1) assessment *[1]*, (2) learning styles and intellectual development *[2-6]*, and (3) designing and implementing effective group work for students *[7-9]*. For each hour-long session, we tried to demonstrate things that TAs could do in their own classrooms including:

- definition of the learning goals (especially useful to help us frame the topic)
- group work activities during each session (modeling different ways to form groups, different kinds of group work, etc.)
- application and reflection about material presented in the training session (e.g. time for TAs to develop concrete ideas to try a new technique in their classes)
- evaluation of our performance (to demonstrate ways in which TAs might get feedback in their own courses)

Each session had a variety of different activities (some lecture, some brainstorm, some small-group discussion) to show how material content can be covered in a different ways to break-up the hour into manageable chunks for the attention span of those present. We also created several handouts condensing our knowledge about particular topics to serve as a resource for TAs when thinking about ideas such as assessment or online geology tools. An example of the outline that we followed for the first training session is included in Appendix A.

In each session, I learned about how and how not to facilitate these types of workshops and I am very glad that there were three sessions in total, allowing for adjustments and improvements. What follows is a brief synopsis of what was covered in each TA training session, my general reaction after each session, and my personal take-home lesson from each experience.

The first session on assessment was the one that we were probably both most comfortable leading. During the session, we tried to emphasize the importance of assessment (and not just a narrow definition of exams), provide numerous concrete examples of different types of assessments for different purposes in the classroom, and allow TAs to think about a situation in their own course where assessment would be useful. Despite my own comfort with the material, the training session was not good as indicated by my comments following the session:

> *"My general feeling was that this session did not go particularly well. Neither of us had led anything like this before…the first half hour was mainly us talking at the TAs... On the evaluations the TAs turned in for us, we had a 5-point numerical scale rating (1) how much they learned at the session and (2)*

> *the usefulness of the session. We mostly got ratings of 3, which to be honest, hurt my feelings. We got better ratings from the sole experienced TA, who seemed to actually grasp what kinds of resources we were actually providing for her."*

I was quite disappointed by this first session and left feeling discouraged. The experience reminded me that lecturing is not necessarily the best way to convey information. Everyone likes a chance to talk and leading a workshop does not entitle me to talk more than anyone else present.

The second session, about learning styles and intellectual development, was astoundingly better. We all took the VARK learning styles inventory *[10]* and discussed the results. Perhaps most interesting was a whole-group brainstorm about "ways in which your students might be different," designed as a tool to discuss diversity without using the word *diversity*. The group generated a huge list of words, none of which mentioned race, ethnicity, social background, religious background…all the typical buzzwords that I had anticipated. Instead, there were many more suggestions about ways that students might be different which might affect how they learn and how one might approach teaching. This was my reaction following the second TA training session:

> *"This session was way way way better. Our presentation was more streamlined – we used the feedback from the previous session (namely that we talked to much and didn't have them talk as much) to change our format. This time we talked very little…Most of the time was devoted to the TAs talking to each other and brainstorming. There were very lively discussions today. "*

At this session, we ran out of time before the TAs filled out assessments for us and instead, they promised to fill them out and return them later. We only got 3 back (out of 15), an indication to me that I must budget time for evaluation (and assessment in general) if I think that it is important.

The last session focused on the importance of not working alone, both for students in our courses as well as for the TAs who teach them. We discussed how to design effective group work activities both on the short- and long-term scales for a course and showed examples of neat geology exercises that are available from the *Journal of Geoscience Education*. We also discussed available resources for TAs including other TAs for the same course, other graduate students, online resources for geology and teaching, as well as programs across the University that could help them improve their teaching abilities. The feedback we got at the end of this session was pretty positive. On our more open-ended evaluation of the TA training sessions as a whole, we asked TAs what sorts of ideas they might incorporate into their classes in the future. The responses varied but included: anonymous mid-semester teaching evaluations, oral exams for students who don't do well on written exams, group homework problem sets, weekly student feedback, cooperative exams, and revisions of laboratory exercises to reflect higher order thinking skills.

Leading these TA training sessions was an interesting experience for me, in part because they did not run perfectly. Several realizations and experiences stand out most for me during the process of developing and leading the sessions. First, preparing the material for each session stretched my knowledge about topics like intellectual development and group work, and our condensed handouts about assessment, learning styles, and group work will be useful for many years (at least for me). These always got me so excited to present new ideas to help improve teaching and learning, but I realized that I needed to spend more thinking about how to present the material than just developing the content. Second, I was pleased that we were able to adapt our style of leading to one of facilitating productive conversations among all the TAs. Eventually we provided an opportunity for TAs to discuss their experiences, frustrations, and inspirations in the context of a particular topic. Third, I think that it is very important to know your audience. In this case, TAs must *want* to be better teachers in order to gain useful information (and be an actively participating member) in a training session. It is not enough that I tried to condense all my knowledge into distilled handouts to help them avoid making some of the same mistakes that I have made along the way. Instead, I suspect that some of them need to have more experience teaching, and perhaps teaching poorly, to understand the utility of what we were saying.

As an epilogue to this experience, I was pleasantly surprised this spring when a first-year TA showed me short assessment exercises that she had developed independent of the professor she works with to allow her students more practice with the most difficult course concepts. These were similar to exercises that we suggested during the first TA training session about assessment and made me feel that, although the material might not have been immediately useful for the TAs at the time of the training session last fall, perhaps some of the information was retained for when they are ready to become better teachers.

Reflection II: Classroom environment

I am looking forward to making the transition from being a TA, where I only have a limited amount of input about the course material and its presentation, to being a professor, where I have total freedom and flexibility about a particular course. I have to admit that this transition scares me a bit as well, but I view my teaching experiences as a TA at the University of Wisconsin as laying the groundwork for these shifting responsibilities. In particular, as a TA, I have had the opportunity to experiment with different techniques for creating and shaping a classroom environment that is both comfortable for my students as well as conducive to learning. Many great ideas have come from conversations with other TAs both in the geology department and in the broader University community, and several of the best techniques that I have used are described below, as well as areas where I feel that I need improvement.

I use a variety of activities at the start of the semester to gain a better understanding of who my students are. For instance, I try to gauge the students' levels of interest as well as their goals and expectations for a particular course with a short survey. Questions might ask about their prior class experiences, their career goals, and what they do outside of class etc. An example of this survey with why I ask each question is included in Appendix B.

I have also been administering a learning styles inventory (VARK) at the start of the semester *[10]*. Understanding my students' preferred learning styles helps me shape the format of classes and can also be useful for students in their other courses, especially if it helps them realize strategies for improving their learning (available at the survey's websites).

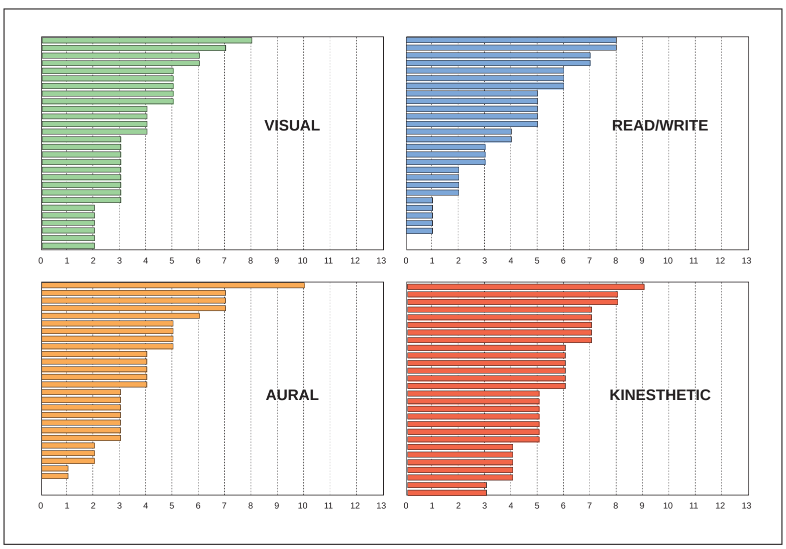


Figure 1. Results of VARK survey for Geology 202 in Fall 2005. The x-axis represents degree to which a particular student prefers a given learning style (13 is the highest possible score). The y-axis shows the number of students (ranked relatively for each style but not correlated through all four charts).

Figure 1 shows the results from Geology 202, an introductory structural geology course where we used the 13-question VARK learning styles inventory. It is clear that our students as an aggregate most prefer kinesthetic learning and least prefer visual learning. This was startling, and a little bit scary frankly, since geology is an extremely visual discipline and lectures are primarily visual/aural experiences. With this new knowledge, I have begun to integrate more hands-on activities for students during lecture instead of showing photos and delivering straight lectures. Also, I now to try to cover some of the really key ideas in lecture and lab with multiple different types of activities, to ensure that students receive the information in at least one of their preferred learning styles.

After finding out more about who my students are, I try to create a classroom where students feel free to ask questions and discuss scientific problems with me and with their peers. To accomplish this, at the start of each lab, I often pose a quick thought-experiment, taking the lecture material and pushing it a bit further so students must practice using what they have learned in order to answer a particular question or problem. The correct answer wins a prize (nothing valuable or fancy – more like post-it pads or dinosaur figurines) from my mystery prize bag.

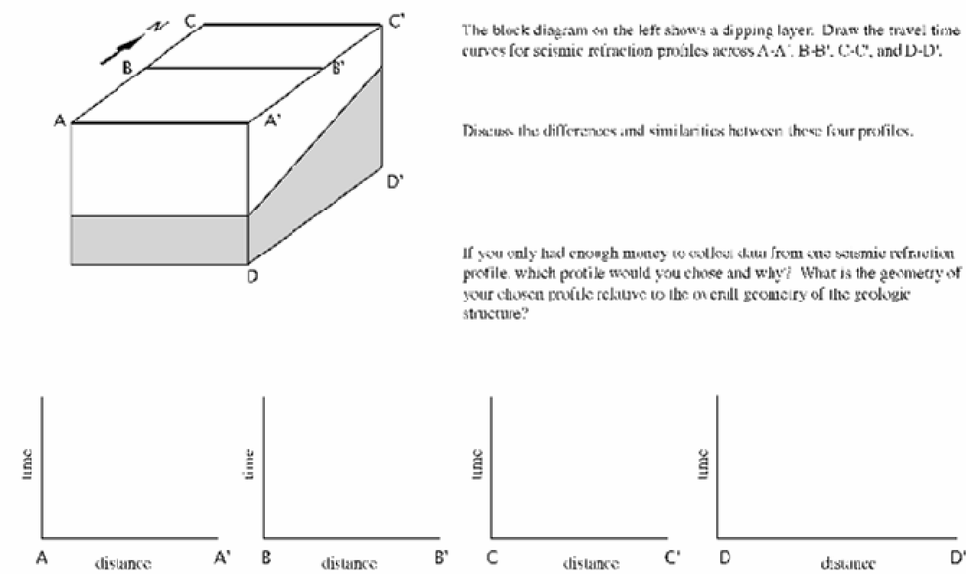


Figure 2. Example of a simple conceptual exercise about seismic refraction developed for students in Geology 594 during Fall 2005. Unlike homeworks about seismic refraction, no mathematics is required to solve this problem but one must understand the basics about refraction.

As another example, if I know that a particular concept may be difficult for students, I often develop simple conceptual exercises that separate the actual idea from the numbers and equations used to solve similar problem on homework or laboratory exercises. This ensures that students have practice thinking about the concepts behind the mathematics of each particular idea. An example of one of these exercises is shown in Figure 2; exercises are typically ungraded and we discuss the answers as a class. Since I have taken the time to draft these exercises (often with keys on hidden layers in the Illustrator files), I will have a set of exercises to use in the future and I have already started sharing them with some of my colleagues at other institutions.

Ideally, I try to foster a classroom environment where everyone is included. I have had mixed success with this in graduate school. In two separate courses, I have had non-native-English-speaking graduate students in classes with American undergraduates mainly from Wisconsin. Often the graduate students are snubbed when students are allowed to choose their lab partners, which is a shame for two reasons. First, having lived in a foreign country before, I know how difficult it can be to be included in the culture of the host country. Second, the graduate students almost always turn in higher quality labs and homework and the undergraduates could benefit from a partnership with them. If this is a problem in the future, I plan to assign lab partners on a rotating basis to make sure that people work together and no one is excluded.

I try to assure my students that I am available outside of class if they have questions. I answer questions pretty quickly over email and get to class early and leave slowly to answer as many questions as possible. However, one practice that has changed throughout graduate school is my attitude towards office hours. I used to have an open-door policy allowing students to stop by and ask questions at any time. I found, however, that my students would come an hour before homework was due and further, that my own work was often disrupted by many small intrusions instead of one consistent hour of student questions. In recognition of this, I now set my office hours after the first course meeting, deciding which times allow the majority of students to attend at least one office hour and I plan to continue this practice in the future.

On the whole, I feel like I have made a good start towards learning how to develop a positive classroom environment. Student feedback from evaluations suggests that they also appreciate my efforts to date, as indicated by these selected comments:

> "*There are usually several ways used to describe different concepts. Very available after class.*" – Spring 2004

> *"Sarah is a nice person, provides a friendly environment conducive to learning and tries to make students think."* – Spring 2004

> *"Sarah is a rock star at TAing. I would have like office hours that were on the days off the class, but other than that she was great at everything. I really liked the worksheets she made since they really seemed to solidify concepts for me."* – Fall 2005

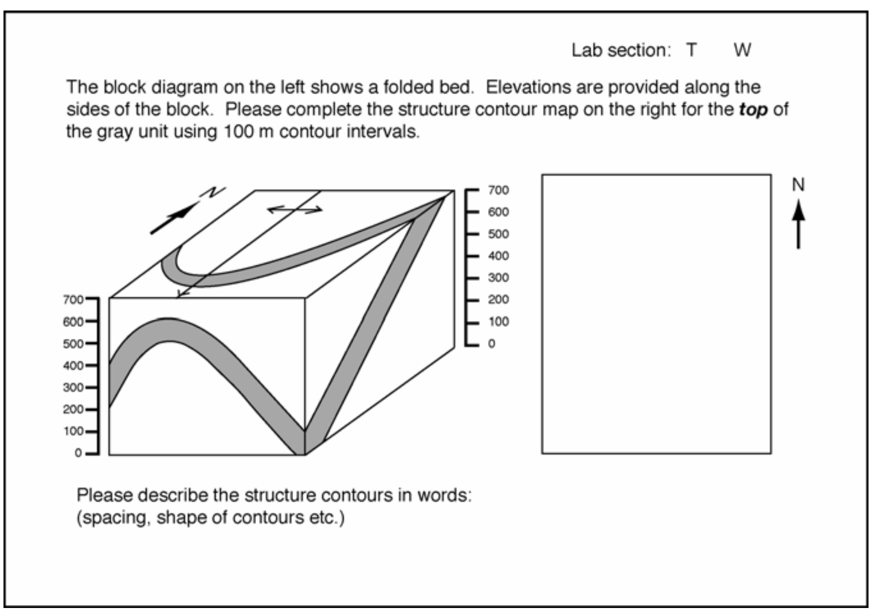
In the future, I plan to experiment more with assigned lab groups and developing material that is sufficiently difficult so that collaboration will be imperative in order to solve problems. I believe it is an important life-skill for students to learn how to work together, even with people that they do not necessarily like. I hope to include more serious group projects in courses that I teach, using the composition of groups to combine students with different learning styles and educational backgrounds. This creates chances for students to teach one another based on their own specialties and diverse backgrounds. I will also continue to experiment with different forms of assessment to continually gauge students' learning as well as their comfort in the classroom.

Reflection III: Teaching scholarship

Although many geology students seem to prefer more kinesthetic forms of learning (VARK results in previous section), it is also important to give them practice with their less preferred learning styles. In particular, I am interested in improving their visual skills. Understanding geologic structures would be very difficult without basic three-dimensional spatial visualization skills *[11-13]* but these types of skills are rarely formally taught in college courses *[14]*. Geologic structures, such as faults and folds, are inherently three-dimensional and it is important for students to be able to visualize, for example, how these structures interact with the landscape or would be represented on a geologic map *[15-17]*. Furthermore, it is important for students to be able to toggle between three-dimensional data (e.g. measurements taken in the field) and two-dimensional data (representation of field data in the form of maps, cross-sections, etc.).

Over the past several years, I have been developing instructional materials to help students in both lower- and upper-division structural geology courses at the University of Wisconsin become better at visualizing three-dimensional geologic structures. This project has been an evolving, collaborative effort over the past three years between two professors and several graduate students in the geology department, especially fellow graduate student Eric Horsman. Delving into the primary literature revealed that (1) visualization can be broken into several component skills *[18-21]* and (2) although students may initially have different levels of visualization ability *[22-26]*, practice tends to improve everyone's skills *[27-30]*.

Figure 3. Example of a skill puzzle for Geology 455.



These two findings provide the foundation for our instructional materials, called skill puzzles, which are short (5-10 minute) exercises designed to isolate a single component of visualization in a geologically realistic problem and are used in both lecture and lab (Fig. 3). The answers are reviewed immediately following the exercise, and students are encouraged to ask questions. Throughout the semester, the skill puzzles address three-dimensional problems of increasing complexity and similar problems are given on exams as a way to assess student learning.

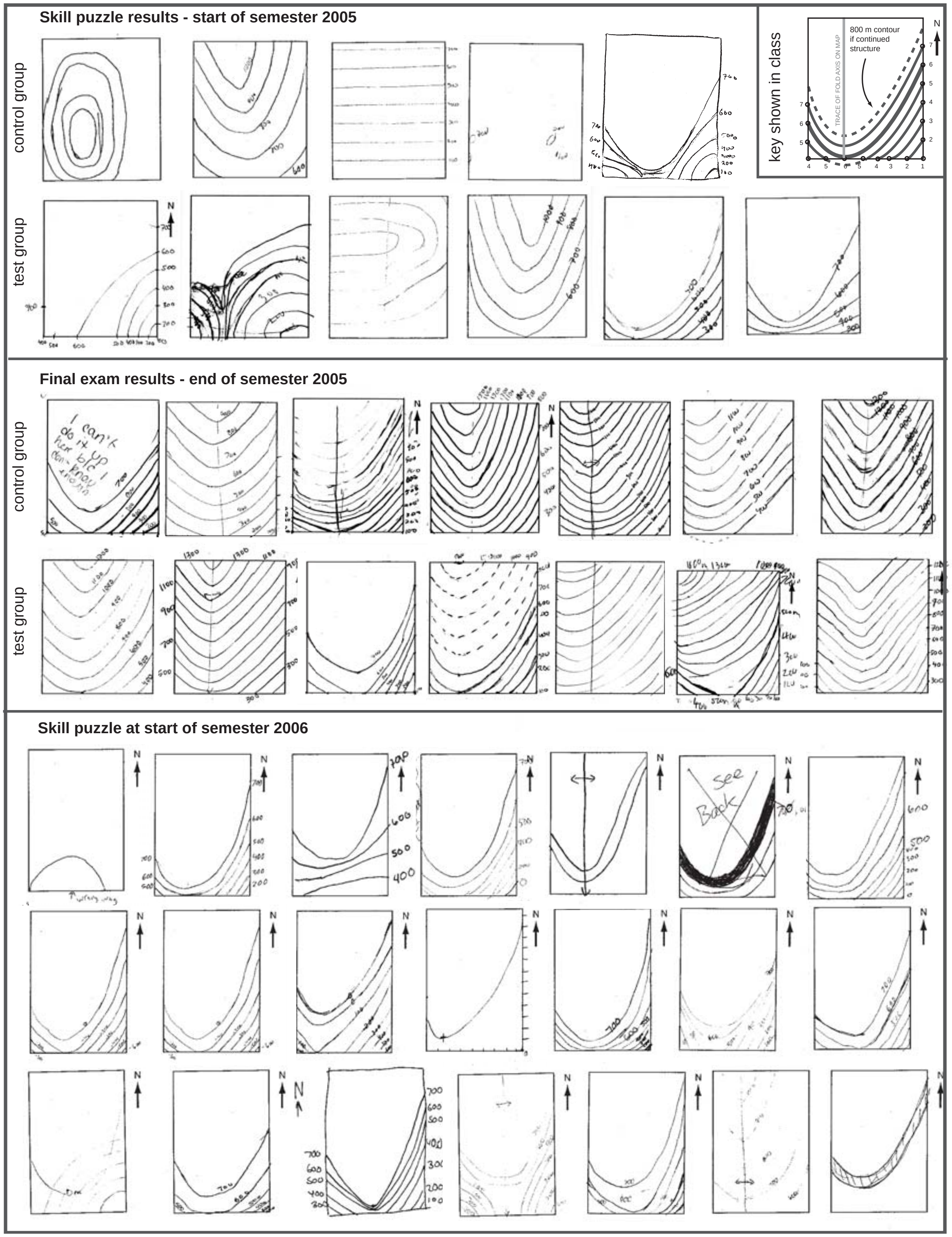


Figure 4. Example student answers for the skill puzzle shown in Figure 3. The top set of answers is from the start of the semester in 2005. The second set comes from the same students end of the semester in 2005. The third set is from students in the same course at the start of the semester in 2006.

We have seen definite improvement throughout the course of the semester as illustrated by the sample answers shown on the previous page. Figure 4 shows student answers from a skill puzzle given during the first week of the upper-division Geology 455 in Spring 2005. The correct answer is shown in the upper right corner. Few student answers are correct, although students had been exposed to this type of problem in the introductory course Geology 202. These results were startling for all of the instructors involved in the course – we had no idea that students had not mastered these concepts. Figure 4 also shows answers from the same students on their final exam in 2005. The improvement is striking – everyone has the right answer and many answers are technically more correct than the sample answer that we showed at the start of the semester (there should be parallel curved lines filling out the entire rectangle).

Perhaps even more encouraging than this remarkable improvement during the course of a single semester is the improvement observed over several years as students progress from the introductory course to the upper-division course. Giving the same exercise in 2006 to a new crop of Geology 455 students demonstrated they had much greater mastery of the ideas than students from 2005 (see last panel in Fig. 4). This appears to be due to more frequent practice at the introductory level (also through many skill puzzle type exercises) aiding long-term retention of the material, especially remarkable since many students wait two semesters before taking the upper-division course.

In addition to the skill puzzles given to all students in the lecture section of a course, we have also used skill puzzles in a controlled teaching experiment during Spring 2005, using two laboratory sections of Geology 455 as test and control groups. One lab section received weekly exercises involving stereonets, which are two-dimensional ways to represent three-dimensional data commonly used in Structural Geology. The second lab group did not receive these exercises and all students were given new types of problems involving stereonets on each of the three exams.

TABLE 1: Comparison of exam scores between the test and control group

n=7	**EXAM 1**			**EXAM 2**			**EXAM 3**		
for each group	total score	visual questions	other questions	total score	visual questions	other questions	total score	visual questions	other questions
t-statistic	-1.12	-2.05	-0.55	-1.82	-2.48	-1.19	-1.17	-0.90	-0.87
p-value	0.29	**0.05**	0.60	0.11	**0.03**	0.28	0.26	**0.38**	0.41

Table 1 summarizes the differences between these groups on each exam. The most exciting result of this project was that on exams 1 and 2, the test group outperformed the control group at a statistically significant level on questions involving stereonets and three-dimensional visualization. There is no difference between groups on the non-visualization questions (labeled “other questions” in Table 1) suggesting that our targeted methods had their intended effect. On exam 3, the final exam, we did not see this pattern replicated, perhaps due to testing anxiety and grading policies. In the future, we plan to assess the efficacy of these controlled experiments by using assessments other than exams.

The student reaction to this project has been quite positive. The increased number of activities in Geology 455 that focus on visualization has had the unintended effect that students now preceive visualization as an important skill. Further, students seem genuinely interested to be part of a research project. They ask questions about the results and are curious if they are making improving throughout the semester.

Eric and I have compiled all of our skill puzzles and preliminary findings in a report and eventually plan to publish these results in the *Journal of Geoscience Education*. We have also presented at several local meetings in Madison as well as at the national Geological Society of America meeting, where several geologists expressed interest in using our activities. Our skill puzzles, with answer keys and grading rubrics, are now available online.

On a larger scale than that of this particular project, the idea of turning my skills as a research scientist onto my own class has had a profound affect on the way that I approach teaching. Instead of worrying solely about content, I now stop to think about how I will present information, how I will assess whether students are understanding the information (see Appendix A), as well as trying to design ways for students to really think about geologic problems in three-dimensions. I believe that my experiences have channeled my scientific curiosity, general reserved for my own research projects, back into my classroom and has made teaching a much more exciting experience for me, and hopefully for my students as well.

I am already brimming with ideas for new projects centered on my teaching that I would like to design and implement in the future. For example, Eric and I are planning to study the efficacy of geology field trips for improving not only student learning of content but also in improving the overall learning environment. Generally, most geologists feel that field trips improve learning (see my teaching philosophy statement, for example), but there is little quantitative evidence that this is the case *[31-33]*. I hope to continue studying and critically evaluating my own teaching in the future in order to refine, improve and enrich my teaching and my students' learning.

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Appendix A: TA TRAINING SESSION 1 PLAN includes

- A1: outline of the session
- A2: handout about assessment with many examples
- A3: evaluation form for the session

A1. OUTLINE

0. Learning goals for this session: (1) Recognize that traditional methods of assessment may not be testing what you want/think. (2) Recognize that directed testing of specific knowledge/skills can be much more effective than traditional assessment. (3) Be able to think specifically about how assessment techniques can be applied to the class you are teaching (even internet classes).

1. Introduction

a. who we are, why we like teaching – if you improve your teaching, it makes teaching both more fun and more satisfying. We're in the Delta program, an on-campus coalition designed to improve the teaching of STEM fields. Some of what we are presenting has come from our experience in this program; other parts come from our teaching experience; other parts come from discussions with other teachers and TAs. We're not going to describe a way to approach teaching from what is traditionally practiced. We are not going to provide you with a thorough justification for how and why this may be a better way to teach. But we'd gladly discuss that sort of stuff with you later. Ask us questions at any point.

b. Ask TAs to introduce themselves to us (since we're old and asocial and probably don't know them). Suggest they share their name, class TAing, specialty, most memorable/effective learning experience.

2. Starting activity [sarah]

a. brainstorm answers for the following question: *As a student (say in your intro Geology course), how did your professors determine what you learned?*

Expect: exams, quizzes, homework, papers, evaluations? (not student feedback)

b. Present some Concept Puzzles results to demonstrate that students may not be learning what you think? Maybe Trina's residence time story is better. But it's already mentioned in the assessment tools summary.

Point: These traditional assessment tools aren't necessarily bad but they may not provide a good measure of what students have learned. Traditional assessment tends to be infrequent and can easily leave students harboring misconceptions until exam time.

c. Expand this repertoire with practical tips for assessment in your classroom

Why? Can assess student learning, your teaching style, make classroom more interesting

Today's main points: (1) why assessment is important; (2) some assessment tools you can use in your classroom (3) mid-semester evaluation

3. Why care about assessment? [sarah]

a. if thinking about assessment before writing an exam at end of semester, helps you define the learning goals for each class (this list above was an example of the learning goals for this session)

b. training thoughtful citizens – facts aren't really what is important; critical thinking, problem solving, group work, data analysis are life skills
c. can also test for misconceptions – cognitive dissonance
d. short attention span – break things up like Sesame Street

4. Other types of assessments [eric]
a. brainstorm was one example; useful to get some active participation in class
b. concept puzzles – show example from structure with different student answers – these are nice ways to give students more benchmarks to try problems (other than on tests)
c. concept maps – show Robyn's example; we don't exactly know how to use this but these are nice to show students how much they have learned
d. muddiest point – these are useful to gauge your own teaching style

5. Assessment design activity [eric]
Given what we just talked about, think about a problem/question that you want students to learn, then think about a way to test that. (5 minutes) Pick appropriate type of test. Work alone initially, then share with others the idea you came up with. (5 minutes)

6. Evaluations
a. not just for end of semester - muddiest point is one way to get student feedback
b. Students assess your performance and/or the course as a whole. Like gauging student understanding, collecting students' opinions about how the class is going can be a useful way to modify how or what you're teaching while the course is still on-going.
c. examples of mid-semester evals

7. Evaluation design activity
Given this brief discussion of evaluations, begin to design a mid-semester evaluation. Think about two or three (or more) questions that you want to ask. How and when do you want to give mid-semester evaluation? Share some thoughts with the group?

8. Random thoughts
a. review sessions
b. office hours – online?
c. late assignments – coupon system
d. student survey at start of class
e. students responsible for own learning

9. If time – idea of TAR –
a. if you start to approach your teaching from more scientific point of view, can become a better teacher and also tend to find it a more rewarding experience
b. photocopy students answers

10. Short evaluation at end of session.

A2. ASSESSMENT TOOLS

There is a growing recognition in pedagogy that useful assessments are not just exams or term papers. Instead, more frequent forms of assessment (often smaller) can help you define (1) what you want students to be learning, and (2) whether students are learning what you want them to learn. This may seem like an elementary idea but many of us have sat through lectures where (1) was not clear and (2) certainly did not match (1). As an instructor, thinking about how to assess your teaching can often lead to defining your learning objectives more clearly. More frequent assessment means that you can adjust your teaching accordingly as you determine what students do and do not understand. (You may also be able to spread out your grading into smaller, less painful bundles.)

The assessment tools described below represent techniques that you can use in your laboratory or lecture classes for a variety of purposes including:

- testing and reinforcing new material
- problem-solving practice
- improvement of your own teaching style
- feedback about course material and topics
- development of an active classroom environment

For each tool, we have tried to give examples that could be used in an introductory course as well as an upper level course (in this case, structural geology). This is by no means an exhaustive list of tools – if you are really interested, you can check out an enormous book full of assessment ideas called: Classroom Assessment Techniques: A Handbook for College Teachers by Angelo and Cross.

When well designed, assessment tools can provide a means to challenge students' misconceptions. Confronting students' misconceptions is an important step in the learning process. Only by the active process of realizing that there are discrepancies between their previous beliefs and new information presented can students really progress with their learning. This process of reconciliation between former and new ideas is known as *cognitive dissonance*. An example of a common misconception in the geosciences (held even by some high school earth science teachers) is that the Earth's mantle is in a liquid form. This misconception may stem from the analogy of boiling water often used to describe convection cells with the mantle.

Many of the assessment tools described below can be used to diagnose and combat misconceptions. However, care must be used with some of the techniques, especially those that rely on peer-to-peer learning that misconceptions do not spread. This can be forestalled by ensuring that, when students are discussing material with one another, their conclusions are monitored in some way. For example, you as the instructor can walk between groups and make sure that no one is being led astray. Alternatively, you can solicit responses to questions from students. If a misconception turns up in this way you can challenge this incorrect idea (note that this is very different from challenging the student – the incorrect idea is the problem, not the student) in front of the class and deal with the issue.

Concept tests

Concept tests are a broad type of tool, and as such, can be used to challenge student misconceptions, test new material, and give students practice solving problems. Concept tests can be used at any point during class, can be graded or ungraded, and can be anonymous if desired. However, we strongly recommend that the answer is discussed immediately following the test. For some people, a concept test might be a well-worded multiple-choice question, designed to demonstrate previous misconceptions. For example:

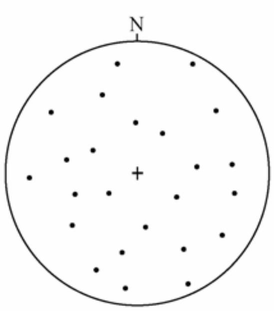
Which layer(s) of the Earth are liquid?
(a) crust
(b) mantle
(c) inner core
(d) outer core

Please note that it is actually quite time-consuming to design well-worded multiple-choice questions. Multiple-choice questions are often used in classes that use clicker technology. See websites such as:
http://mazur-www.harvard.edu/research/detailspage.php?ed=1&rowid=52
http://www.news.wisc.edu/11142.html

Concept puzzles

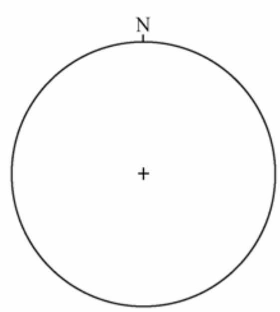
This is a kind of problem that we like to use a lot in teaching. Concept puzzles (we just named them that) provide students the opportunity to apply their understanding of course material to questions. Examples include:

- *textbook figures* with pertinent features whited out (students fill in the new terms)
- *quick computational problems* – e.g. if the scale on a map is 1:24,000 what distance does a centimeter on the map represent?
- *specialty problems* – example below from Structural Geology



The lines plotted on this stereonet represent the long axes of clasts in a conglomerate. Based on the clast orientations, do you think the rock has experienced much deformation?

Please describe in words the fabric of this rock.



Now imagine that the conglomerate described above experienced a flattening deformation with S_3 oriented vertically. Please plot on this stereonet the orientations of the long axes of at least 10 clasts.

Please describe in words the fabric of this rock.

Think-pair-share

Think-pair-share is a tool than can get students thinking and talking in class, and is especially helpful in large lecture courses where it is impossible to hear from each student. A question is posed, students think about the answer for themselves, then share their answer with surrounding students. Sharing the answer with peers is sometimes less intimidating than sharing with the entire class – after discussing, the instructor may chose to ask several groups to share their ideas. For example:

1. Does the fossil record support the theory of evolution?
2. What sort of volcanism would you predict occurs in Hawaii?
3. Given a vertical strike-slip fault, where would you look to observe sense of shear indicators and what might you expect to observe in a brittle regime? A ductile regime?

The first question is clearly provocative and contentious, but illustrates how to limit the focus of a discussion onto topics that have been discussed in the course. The second question might be posed after students have learned the basics of plate tectonics, and would be asked to apply their knowledge to intraplate volcanism. The third is admittedly a nerdy structural geology question, but was actually very useful.

Muddiest point

The muddiest point is a way to quickly get feedback from students about your lectures and can be used at the start of lecture (asking about a previous lectures material) or at the end of lecture. Although the name implies that you are trying to find out what students did not understand in a lecture, you could ask a number of different questions:

What do you still have questions about after today's lecture?
What were three main points of today's lecture?
What was least clear about today's lecture?

This assessment technique is particularly well-suited to not only address lecture content, but also address your style of lecturing, depending on what sorts of questions you pose. An effective way to use the muddiest point is to have students fill out their answers on a 3x5 notecard. You may chose to have anonymous notecards, or you might chose to require their names as a way of unofficially taking attendance (particularly useful in large lecture settings). If you have students ask questions, its important to have a way to address their questions – either on a website, via email, or at the start of the next class (depending on how many different types of questions there were).

One-minute papers

A short, ungraded, in-class exercise can be a great way of gauging the depth of students' understanding of a particular topic without students worrying about grades. A professor in the engineering department here at UW gauges everyone's understanding of residence time by asking each student to calculate the residence time of a six pack of beer in his or her refrigerator on a weekend. The correct answer is something like this: residence time = six beers divided by three beers per hour = 2 hours. (As a brief aside, the first time this professor gave this one-minute quiz, the class failed miserably. Having just spent a week discussing the concept of residence time, the professor realized that her teaching had been ineffective and decided to try again. It's much better to find these things out while you're still teaching rather than when you're grading a final exam.) Here are some other examples:

1. Please describe the three kinds of unconformities. Feel free to use words or sketches or both.
2. Imagine you were given two white rocks: one igneous and the other sedimentary. Please list three characteristics you could use to distinguish between these rocks.
3. Please list three way-up indicators you might find in sedimentary rocks.
4. Please list the chemical formulas for these three minerals: magnetite, fayalite, and dolomite.

Brainstorm

Having students think to themselves for a short time about a topic pertinent to course material is a good way to break up the monotony of lecturing without losing much time. It works something like this. Ask the class to think about a topic. Then, after thirty seconds or a minute, ask them to start yelling out answers. Don't be afraid if students don't immediately answer – you can wait them out and eventually someone will get the brainstorm rolling. For example, you could ask:

What geological factors or processes influence climate.
What sorts of topographic features suggest that glaciers might have been active in a region?
What sort of structural features might you find near the San Andreas fault?

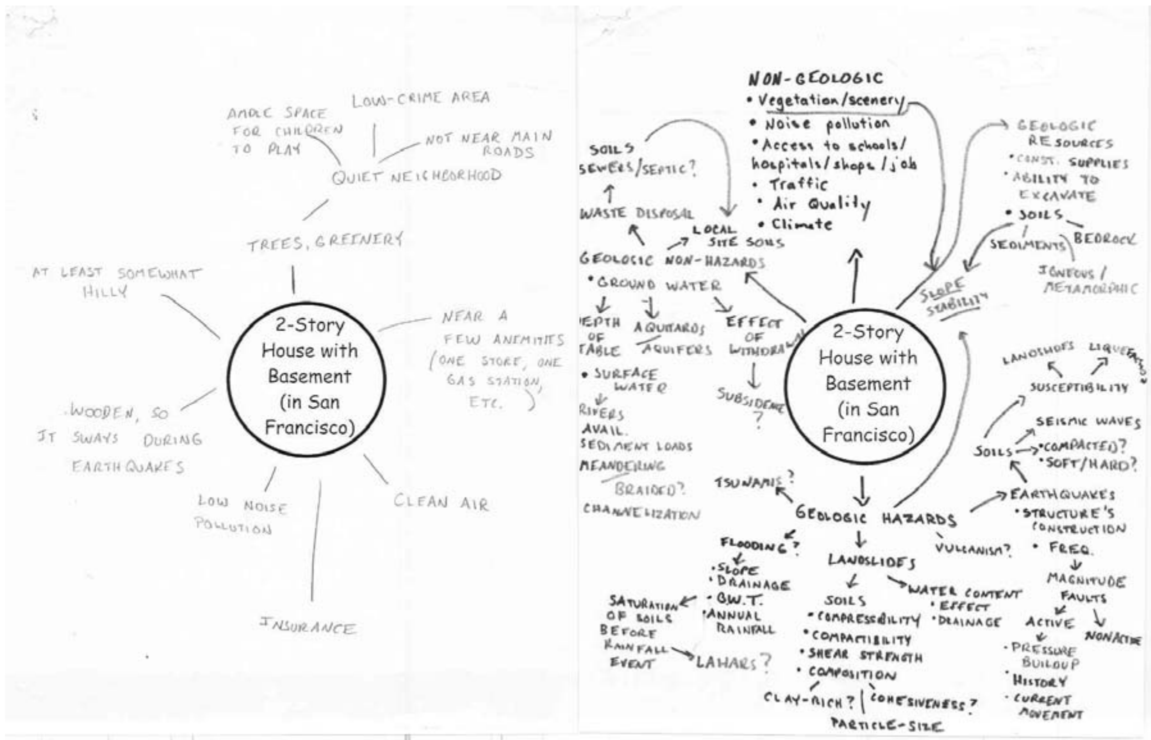
When appropriate, use the students' answers as jumping off points for topics you'd like to discuss in more depth. Brainstorming is also a good way for you to look for misconceptions.

Concept maps

Concept maps are graphical ways to illustrate how different factors might relate to a particular question or problem. These are often extremely useful and informative for you as an instructor to gauge students' prior knowledge. If used at the start of the semester and the end of the semester (or particular unit), concept maps can demonstrate to students how much they have learned throughout the course (which can often surprise them).

Examples of types of questions:
1. What factors should you consider when building a two-story house in San Francisco?
2. What characteristics could you use to identify different types of rocks?
3. You get dropped off in an unknown area and you are given three days to complete a geologic map. You have a topographic map, compass, hand lens, and plenty of food and water. What will you do?

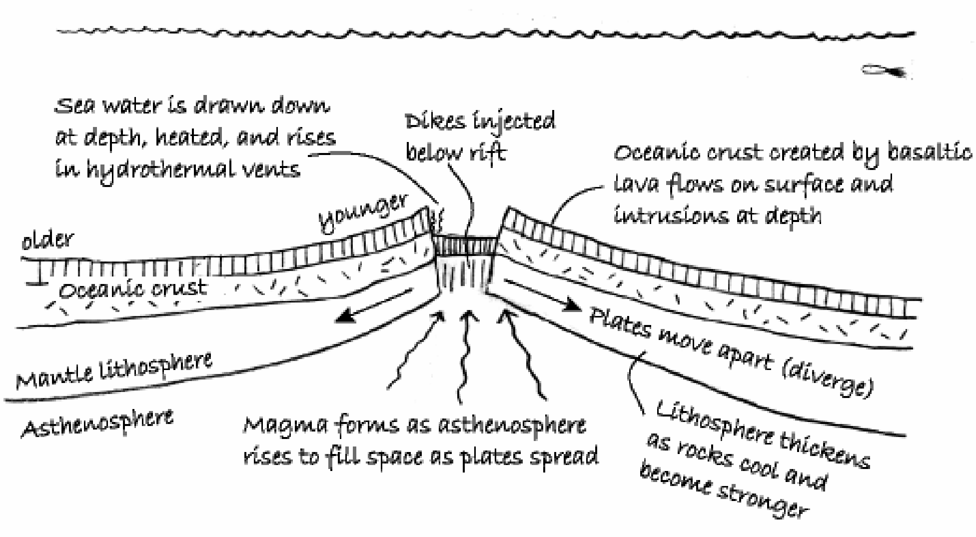
Example: from Robyn Wright-Dunbar (who notes that these aren't well-constructed concept maps but are useful for as a pre- and post-assesment tool).



Concept sketch

A concept sketch can be thought of as a very well labeled sketch. They are similar to concept maps, but the emphasis is on processes and not on how different concepts tie together. They are very useful for geoscience education because of the fact that much of what we study deals with interrelated physical processes.

Draw a cross-section through the crust in California. What types of rocks do you expect to see? What are the approximate temperatures? What types of structures do you expect to see?



This example of a concept sketch is taken from the following paper:
Johnson J.K. & Reynolds S.J. (2005). Concept sketches – Using student- and instructor-generated, annotated sketches for learning, teaching, and assessment in geology courses. J. Geoscience Education, v51 n1 pp

Small competitions

Competition is a surprisingly great way to get students involved in class. It's often useful to assign small groups (maybe three or four students, pre-selected by you) and to have these groups compete against one another for some small prize, like candy. Competitions are also a great way to review course material before tests.

This is Sarah's strategy: I divide the class into groups – maybe groups of 4-5 or perhaps just divide the class in half. I have a series of questions of increasing difficulty. I read the question, the groups discuss the answer, and one student from each group goes to the board to complete the answer. Once completed, the student puts down the chalk. The first group to put down the chalk and get the right answer receives a point. (Here you can get other groups to determine whether the answer was correct.) I try to create a slightly competitive atmosphere so that students hurry, but also have an absurd point tallying system to ensure that it doesn't become too serious. Each student in the group must go to the board at least once before there can be repeat students. In the end, I always give the reward to the entire class since winning is totally arbitrary.

How to run a review session

There are several ways to approach helping students review from tests. It's important to keep in mind that your job as a TA is to answer students' questions, not to re-present all of the material that could theoretically be on the test. One approach to reviewing is for you to select some topics you think are important and to focus on those topics somehow. Some people create Jeopardy-style contests – these are a lot of work to create before the review session. Another, less preparation-intensive, approach is to force students to take responsibility of the situation and explain in advance how the review session will work. For example, you might insist that students come to the review session ready to ask you questions. When their questions run out, the session is over.

A3. EVALUATION FORM:

What do you think was the most useful discussion in this session?

What is something that you still don't quite understand?

Please rate the following:

How much you learned at this session (1=nothing; 5=a lot)	1	2	3	4	5	NA
How useful was this session (1=not useful; 5=extremely useful)	1	2	3	4	5	NA

Please give us suggestions for how this TA training session could be improved. Feel free to continue writing on the back of this page.

What do you think is the most useful discussion in this session?

What is something that you still don't quite understand?

Please rate the following:

How much you learned at this session (1=nothing; 5=a lot)	1	2	3	4	5	NA
How useful was this session (1=not useful; 5=extremely useful)	1	2	3	4	5	NA

Please give us suggestions for how this TA training session could be improved. Feel free to continue writing on the back of this page.

Appendix B: Sample questionnaire
This is a sample of what Sarah asks her students at the start of the semester, formally written down as part of the TA training sessions. Questions are in BOLD. (I usually ask them to take out a piece of paper and answer the questions on their own paper, but this is generally because I haven't been quite organized to make up a sheet beforehand.)

NAME

YEAR IN SCHOOL

HOMETOWN (useful if you want to use local examples for problems)

EMAIL (useful if need to send individual emails and not use the doit lists)

MAJOR (in case a non-majors course)

WHAT OTHER GEOLOGY COURSES HAVE YOU TAKEN? (to see how much it is reasonable to expect that they would know)

WHAT OTHER COURSES ARE YOU CURRENTLY TAKING? (to know how busy your students might be)

WHY ARE YOU TAKING THIS COURSE? (to help understand student expectations)

IS THERE ANYTHING ELSE ABOUT YOU THAT I SHOULD KNOW (if students need to disclose learning disabilities, need for extra time on tests, etc. this is a pretty noninvasive way to allow them to tell you this information)

A FUN QUESTION like: WHAT IS YOUR FAVORITE KIND OF FOOD-TREAT? (useful if you want to bring treats to class)

I also set my office hours so that the majority of students can attend at least one office hour. I also set them for times after class (so they cannot ask questions about homework on the day that it is due). I used to allow drop-in visits but found that no one used my office hours and just stopped by when it was convenient for them (which was inconvenient for me). My strategy for setting office hours is as follows:

Write a list of numbers 1-6 on your paper. Draw an X by the office hours that you can attend. You do not need to recopy the times.

1. M 9-10
2. M 10-11
3. T 11-12
4. T 12-1
5. W 9-10
6. W 10-11