GEOL 501: Teaching and Learning about the Natural World
A class for future teachers
LO 1227 – Mondays 5:00 pm – 7:45 pm

Instructor Information

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Office Hours
Location: LO 1228
Times: Mondays, 4-5 pm or by appointment.

Special needs

I am committed to accommodating those with special physical or learning needs. Please let me know.

Other Notes

It is the responsibility of each student in this course to know and follow all written guidance given by the instructor in this class.

These policies and schedules are subject to change in the event of extenuating circumstances.

Guiding Questions

When it comes to teaching earth science, which techniques work best, why do they work, and how can we tell that they are working?

- What skills does it take to be good geoscientists? Specifically, what cognitive abilities?
- How do these skills work in the human brain? What does research on cognition say?
- What teaching techniques can we use to improve our students' ability at these tasks? How can we implement these ideas in real classrooms?

With every topic, we strive to see things from three different perspectives:
1) How people learn; 2) Teaching Techniques; 3) Assessment strategies.

Thematic Areas

For each topic within the course, we will always return to three themes:

Approach

My goal is to model best teaching practices. That means that we will explore a range of activities and formats.

Target Audience

Students interested in teaching at any level from K-12 to university. While some discussions will be more appropriate to a specific education level, be sure to say something if you have a question about how an idea could apply to the level you do/will teach.

Team based learning

Research shows that you can learn more from your peers than you can from professors. To facilitate this learning, you will spend a good portion of the class working in teams. You will work with the same team the entire semester, and you will not be able to choose your team. Since having unprepared teammates can impact your experience, there is a procedure for "firing" a student from your team posted on the Moodle website for our class. In past experience, we rarely need to employ this policy. Almost all required teamwork will be in class, so there is no need to worry about coordinating your schedules.

Reading

There is no textbook for this course. Most reading comes from individual articles and book chapters. We'll read about half research studies and half review articles that summarize the most important innovations in education research.

All articles will be available on Moodle. To avoid copyright issues, many of them will only be available to you when you are ON CAMPUS at CSUN. You can download PDF's while you are here and then take them home.

Information on specific activities planned is included in the course schedule

Grades

Like many graduate classes, you will get out of this class what you put in. I have tried to structure the class in such a way that it encourages you to prepare for class, reflect on your learning, and apply your knowledge.

I will calculate your grade using the categories in the table at right. An explanation of each category is on the next page.

No Extra credit. There will be no individual extra credit, though there will be occasional team bonus points awarded for winning competitions, etc.

If You Miss A Class Meeting: Leave Days

Teachers typically get 10-12 days of sick leave that they can miss without penalty. In this class, ***you can miss one day, no questions asked and with no penalty***. To request a leave day, you must ***fill out the form on Moodle*** **either before your absence or within 7 days after**. Using a leave day excuses you from taking the next weekly quiz and submitting the End of Day reflection for the missed class period. You will, however, have to take the previous weekly quiz with no late penalty (on Moodle). After using your leave days, see the policies below for late assignments. I do consider extenuating circumstances.

Late Assignments

Assignments are assigned with specific timing and deadline for an educational reason. There is therefore a significant penalty for missing one of these deadlines. The Leave Day policy should cover many of your needs. But if you miss other material, the following policies apply:

- Weekly "End of Day Reflections" submitted after the due date but before the next class period will receive 50% credit. After that, they will receive no credit.
- Weekly quizzes can be taken *before class* the following week for 50% credit.
- Late mini research projects will receive ZERO credit, so plan accordingly.

Category	**Weight**
Weekly Questions	4%+1%
End of Day Reflections	20%
Weekly Quizzes	25%
Peer assessment	5%
Mini Research Project	25%
Final Exam	20%

In-class learning

My goal is to model best teaching practices. That means that we will explore a range of activities and formats during class time.

- Mini-lectures
- Collaborative concept mapping
- Gallery walks
- Team discussions
- Whole-class debates
- Real-time formative assessment (using clickers and web-based systems)
- Micro-research projects in class (where students perform one small component of a research study using video clips of classrooms and/or prepared data).

Out-of-class learning

Most of the at-home assignments are scholarly articles, but there are also video clips, and interactive web tutorials that present the background knowledge. Class time is spent applying course content, so it is essential that you prepare properly by reviewing this material. The weekly quizzes at the beginning of class have relatively high weight to ensure you take this requirement seriously.

Methods of Evaluation

Weekly Questions (4% of course grade)

Each week, you will complete a form with two types of questions:

1. **Weekly Quiz question**. You help build our weekly quizzes! These questions should assess understanding of the content we discussed during the week's class session. Once we discuss Bloom's Taxonomy, you will need to identify the cognitive level of your question. You will receive credit for questions at the two lowest levels of the taxonomy ("remembering" and "understanding"), but don't expect to find them on the quiz!
2. **Question of the Day Question**. One question about pedagogy, education policy, something that happened to you in the classroom that you want advice on, etc. Preferably, the question will not simply be a clarification about a topic in the reading. Instead, it should take us beyond the reading into exciting discussions that get the class moving. We will only answer 1-2 questions per day, selected by the class's votes.

Weekly questions are due by _____ @ ___ pm each week. This is to ensure the material is fresh in your mind.

Question of the Day Voting (1% of course grade)

Voting starts at _____ @ _____ pm (2 minutes after the weekly questions are due).
Voting must be complete by the time class starts on Monday @ 5 pm.

You receive one point for each time you vote and one bonus point for each week your question is chosen as the #1 question.

End of Day Reflection Assignment (20% of course grade)

After each class period, you will submit a summary of what happened in the class. The format and rubric will change each week and will vary based on the content we cover. When discussing concept maps, your summary will be in concept map form. When discussing technology in the classroom, your summary will take the form of a 140 character Twitter post. etc. Look on Moodle for detailed instructions each week.

Reflection Assignments are due by _____ @ ___ pm each week. This is to ensure the material is fresh in your mind.

Weekly Quizzes (25% of course grade)

We will have a quiz each week that covers material from previous class sessions (summative assessment) AND factual questions related to the reading assigned for that day (to ensure adequate preparation for the day's activities). Questions come from your submissions and my own library. Length will vary from quiz to quiz.

Peer Assessment (5% of course grade)

We will work in teams during much of the semester. Your teammates will evaluate your contributions to the team and give you feedback about them.

Mini Research Project (25% of course grade)

During the last third of the course, you will have the opportunity to complete a research project in geoscience education. The project can either be based on observations or a "controlled teaching experiment" if you are currently teaching or have a friend willing to help you.

Final Exam (20% of course grade)

The exam will consist of questions similar to our weekly quizzes along with some culminating questions. It will be cumulative.

Reading & Resource List

(Links to all these items are on Moodle. This list is a formal bibliography for administrative purposes).

Brain Growth, Constructivist Theory of Knowledge, Concept Maps

1) Novak, J.D., Mintzes, J., & Wandersee, J., (2000). Learning, Teaching, and Assessment: A Human Constructivist Perspective, in Assessing Science Understanding: A Human Constructivist View; Novak, J., Mintzes, J., and Wandersee, J., Eds.; Academic Press, California.

2) Novak, J.D. (2002). Key Ideas Underlying Concept Maps And How They Can Be Used - Part 1/2. http://www.youtube.com/watch?v=0ROg4mQkvZo.

Misconceptions

3) Kyle, W. C., Jr., & Shymansky, J. A. (2005). Enhancing Learning Through Conceptual Change Teaching. California Journal of Science Education 5(2), 7-15.

4) Carnine, D. (2002). New Research on the Brain: Implications for Instruction. California Journal of Science Education 2 (2), 55-73.

5) National Academies (1997). Misconceptions as Barriers to Understanding Science *in* Science Teaching Reconsidered: A Handbook. Washington DC: National Academies Press, 27-32. http://www.nap.edu/openbook.php?record_id=5287&page=27

Novice/Expert

6) Bransford, J.D., Brown, A. L., & Cocking, R. R., eds. (2000). How Experts Differ from Novices *in* How People Learn: Brain, Mind, Experience, and School: Expanded Edition. Washington DC: National Academies Press, 29-50. http://www.nap.edu/openbook.php?record_id=9853&page=31

7) Petcovic, H.L., and Libarkin, J.C., (2007). Research in Science Education: The Expert-Novice Continuum, Journal of Geoscience Education, 55, 333-339.

8) Lovett, M. C. (2008). Teaching metacognition. Educause Annual meeting. http://hosted4.mediasite.com/Mediasite/Viewer/?peid=bfa453a3-c59b-4178-90af-b389ca9b5853

Attention Span / Alternatives to Lecture

9) Birk, J. P. & Foster, J. (1993) The Importance of Lecture in General Chemistry Course Performance, J. Chem. Educ., 70, 180-182.

10) Carrell, S.E., West, J.E. (2010) Does Professor Quality Matter? Evidence from Random Assignment of Students to Professors, Journal of Political Economy, 118(3), 409-432.

Powerpoint & Clickers

11) Alley, M. (2005). Rethinking the Design of Presentation Slides. U.S. Geological Survey Western Region Colloquium, July 11, 2005. http://media.wr.usgs.gov/colloquium/WRC_11jul05.mp4

12) Carl Wieman Science Education Initiative (2009) An instructor's guide to the effective use of personal response systems ("clickers") in teaching. Vancouver, British Columbia: Carl Wieman Science Education Initiative. Web publication, http://www.cwsei.ubc.ca/resources/SEI_video.html

Field Trips

13) Orion, N., and Hofstein, A., 1994, Factors that influence learning during a scientific field trip in a natural environment: Journal of Research in Science Teaching, v. 31, p. 1097-1119.

14) Hesthammer, J., Fossen, H., Sautter, M., Sæther, B. & Johansen, S.E. 2002: The use of information technology to enhance learning in geological field trips. Journal of Geoscience Education 50, 528-538.

Spatial Thinking

15) Ishikawa, T., Kastens, K. (2005) Why Some Students have Trouble With Maps and Other Spatial Representations, Journal of Geoscience Education, 53 (2), 184-197.

Urban Thinking

16) d'Alessio, M.A. (2012). Schoolyard Geology as a Bridge Between Urban Thinkers and the Natural World, Journal of Geoscience Education, 60 (2), 106-113.

Qualitative v. Quantitative Data

17) Harvard-Smithsonian Center for Astrophysics Science Education Department. (2006) Factors Influencing College Science Success. http://www.ficss.org/. Accessed Nov 1, 2011.

18) Libarkin, J.C., and Kurdziel, J., 2002, Research Methodologies in Science Education: Qualitative Data: Journal of Geoscience Education, v. 50, p. 195-200.

Qualitative Data

19) Libarkin, J.C., Anderson, S. W., Dahl, J.,Beilfuss, M., & Boone, W. (2005) Qualitative Analysis of College Students' Ideas about the Earth: Interviews and Open-Ended Questionnaires v. 53, n. 1, p. 17-26.

20) Libarkin, J.C., and Kurdziel, J., 2002, Research Methodologies in Science Education: The Qualitative/Quantitative Debate: Journal of Geoscience Education, v. 50, p. 78-86.

Assessment items:

21) Cheesman, K.L. (2009). Writing/Using Multiple-Choice Questions to Assess Higher-Order Thinking file *in* Lord. T.R., French, D.P., & Crow, L.W., eds., College Science Teachers Guide to Assessment, Arlington, VA: NSTA Press, 35-41.

22) Fuhrman, M. (1996). Developing Good Multiple-Choice Tests and Test Questions." Journal of Geoscience Education, 44, 379-384.

23) Sener, J. (2011). Standardized tests prove I'm better than Michael Jordan. The Washington Post, April 8, 2011. http://www.washingtonpost.com/opinions/standardized-tests-prove-im-better-than-michael-jordan/2011/03/29/AF4sdL4C_story.html

Target Ideas

We follow the course design approach of Goldberg et al (2008)[1] by defining a set of target ideas. These short descriptions of course content are not meant to be assessable objectives. Rather, they are designed to give students a concise description of course content in which they have participated. Typically target ideas would be given to students after they have interacted with the material for the first time.

1) **Peer instruction**. Learning is a social activity, and students learn from discussing ideas with peers.
2) **Metacognition**. Teaching people how they learn can enhance their ability to learn. Self-regulated learning involves an intentional cycle of learning: planning and goal setting, applying strategies for learning, evaluating learning progress, and adapting learning.
3) **Brain growth**. Intelligence is not fixed at birth. As you build new knowledge, your brain actually grows new connections.
4) **Concept maps** are way to visually illustrate how students learn new knowledge by connecting it to the tree of existing knowledge they have.
5) **Prior knowledge**. Learning involves progressively building *prior knowledge* that can be either incorrect or incomplete. Learners see all new information through the lens of their existing knowledge base.
6) **Misconceptions**. Misconceptions are deeply held and must be specifically confronted or they will not be replaced.
7) **Formative Asssessment**. Teachers should probe their students' existing knowledge during instruction. Making both teacher and student explicitly aware of misconceptions can help confront them.
8) **Novices and Experts** think differently. "Experience" can be defined. People with vast experience in a field actually perceive things differently, can quickly raw on a vast background knowledge, know common problem solving strategies, and actively monitor their thinking. All these skills can be developed, but are discipline-specific. Teachers, who are often experts, need to present information in a manner appropriate for novices.
9) **Bloom's Taxonomy**: Cognitive tasks fall into different levels of complexity. Strategies for teaching, learning, and assessing these tasks depend on the level of complexity.
10) **Human attention span is limited**. College-age learners remain focused for 5-15 minutes spans. Student engagement can be monitored and attention can be recaptured by varying activities during instruction.
11) **Alternatives to lecture exist.** Student-centered approaches to introducing classroom content can be more effective than lecture. Many of these methods work because they break the class period into manageable time chunks.
12) **Learning in the field may be unfamiliar to some students**. Students need to be prepared cognitively, psychologically, and geographically before field trips. Preparation reduces this "novelty space," leading to more focused field trips with better learning outcomes.
13) **Spatial skills can be learned.**
14) **Map reading can be taught**. Experts succeed at geologic mapping because they know the range of possible shapes, how to recognize and how to differentiate those shapes. They also read maps more effectively by getting to high ground, orienting their map

[1] Goldberg, F, Kruse, R., Robinson, S., Otero, V., and Thompson, N. (2008). Physical Science & Everyday Thinking. Armonk, NY: It's About Time (Herff Jones).

correctly, and looking for distinct patterns that they can relate between real-life and the map.

15) **Urban thinking**. Urban thinkers have less familiarity with the natural world, so the schemas they have for interpreting the world around them may not be useful for studying geoscience. They may lack interest, be psychologically unprepared for studying the outdoors, or even afraid of it.

16) **Qualitative and quantitative assessment** go hand-in hand. Quantitatively, we measure gain in absolute and relative sense.

17) **Many quantitative data have a qualitative component. The way in which you ask a question may have a large impact on your results.**

18) **Thematic coding allows you to recognize and quantify trends in qualitative data.**

19) **Quantitative assessments of teaching quality require a baseline for comparison. Pre-tests are crucial in measuring learning gains or attitude changes.**

20) **Affective domain**. Values, feelings, motivation, attitudes and stereotypes that may affect one's ability to learn. In many cases, the affective domain is more important than the cognitive domain for controlling student learning.

GEOL 501 Introduction to Teaching and Learning in the Sciences

Spring 2013 Course Schedule v. 1 — Professor Matthew d'Alessio

There is a quiz at the beginning of class EVERY class period (except the final project presentation day)
Each day, students are responsible for completing
1) an End of Day Reflection
2) Writing a question to be included in our weekly quiz;
3) Bringing to class an open-ended question to share during the "Question of the Day" period.

Section	Week	Day	Date	Topic	Classroom Activities	Readings Due Today*	Target ideas*
How People Learn	1	Mon	28-Jan	**Intro / Brain Growth / Concept Maps**	Human Likert Scale; Draw-a-science-teacher; Word Association Fun; What makes a good science class gallery walk; Concept Map about Shoes		1,2,3,4
	2	Mon	4-Feb	**Misconceptions**	Private Universe Video; Concept maps & Misconceptions about sight; Formative assessment probes	1, 2	4,5,6,7
	3	Mon	11-Feb	**Novice v. Expert Thinking**	Misconception strategies; Misconceptions gallery walk; Blink audio book; Poor-man's eye-tracking	3, 4, 5	6,7,8
	4	Mon	18-Feb	**Metacognition**	Bloom's Taxonomy sorting activity; Think-aloud problem solving: Identifying a fault;	6, 7, 8	8,9
Teaching Techniques	5	Mon	25-Feb	**Lectures / Attention Span**	Lectures work v. Don't work debate; Attention span monitoring protocol example; Pros & Cons of Presentation Software	Last names A J: 9; K-Z: 10	10, 11
	6	Mon	4-Mar	**Alternatives to Lectures**	Clickers in action demo; Interactive Teaching Methods jigsaw; Powerpoint slide critique; Clickers in the K-12 classroom discussion; Field trip experience virtual gallery walk; Field trip vignette reading	11, 12	11
	7	Mon	11-Mar	**Field Trips**	Attitudes towards field trips survey; 3 Dimensions of Novelty Intro; Video analysis of field trip; 3 Dimensions of Novelty Gallery Walk; Piaget's Water Level tests; Mental Rotation test	13, 14	12, 13
	8	Mon	18-Mar	**Urban Thinking**	Schoolyard geology outdoor quest; Urban thinking overview	16	15
Assessment & Research Methodologies	9	Mon	25-Mar	**Qualitative v. Quantitative Research Methods**	Qualitative v. Quantitative Debate; FICSS Study deconstruction; Research Questions Gallery Walk; Can you identify good teachers from quantitatively assessing their students' knowledge? Debate; Gain calculation worksheets. Final project discussion	17, 18	16, 17, 19
	11	Mon	1-Apr	**Cesar Chavez Day**	NO CLASS		
	11	Mon	8-Apr	**SPRING RECESS**	NO CLASS		
	12	Mon	15-Apr	**Qualitative Data**	Team concept map of qualitative research methods; Open coding example; Thematic coding example;	19, 20	16, 17, 18
	13	Mon	22-Apr	**Quantitative Assessment and Multiple Choice**	Critique our Quiz; Common pitfalls of multiple choice test question writing; Item analysis introduction & worksheet; Research projects methods pair-share discussion	21, 22, 23	19
	14	Mon	29-Apr	**Affective Domain & Science Phobia / REVIEW**	Non-cognitive barriers to learning; Intro to affective domain; Attitudes towards science Intro; Affective domain role playing; A reflection on the course structure, content, and what we learned.	none	20
	15	Mon	6-May	**Final Projects**	Final project presentations.	none	1-20

Final Exam Mon., May 13, 5:30-7:30 pm — Live Oak 1227*

(Per University policy, no individual may take the final exam before the scheduled time block) (our regular classroom)