Biology 693P / Chemistry 693P / Geosciences 693P / Physics 693P
Special Topics in Scientific Teaching
Spring 2011

This syllabus and schedule are subject to change. Any changes will be announced in class.

Instructors:

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<thead>
<tr>
<th>Denise Kind</th>
<th>PhD, Biology and Wildlife</th>
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<td>Phone:</td>
<td>474-6298</td>
</tr>
<tr>
<td>Hours:</td>
<td>By appointment</td>
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<tr>
<th>Sarah Fowell</th>
<th>PhD, Geology and Geophysics</th>
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<tr>
<td>Phone:</td>
<td>474-7810</td>
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<tr>
<td>Hours:</td>
<td>By appointment</td>
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Credits: 2
Meeting Time and Location: 308 Bunnell, Monday, 6:00-8:00 pm

Course Materials:
- See the syllabus for additional reading assignments and citations.
- You will be expected to prepare and share materials for courses that you teach, particularly any course that you are currently working with.

Course Description:
This course explores methods for teaching science at the university level. Emphasis is placed on methods of course design, instructional techniques, assessment and course management that have been shown by research to improve student learning. This course is intended for graduate students in the sciences who have an interest in improving their teaching skills. This course will become a component of an instructor training program that is currently under development. The course format will be a mixture of discussions, workshops and seminars. If the course is over-enrolled, priority will be given to teaching assistants who are assigned to teach large, introductory level (100 or 200 level) courses during the semester they are taking this course.

Course Purpose and Objectives:
Our goal is to prepare you to design your own quality undergraduate science courses and strengthen your professional resume. Quality instruction of undergraduate courses is essential to the development of skilled, highly-knowledgeable undergraduates. Good instructional skills, although they take time and effort to acquire, ultimately make an instructor a better and more efficient teacher. This course aims to develop instructional skills of graduate students who are currently teaching undergraduate-level courses and/or labs, and prepare them for careers that may have a strong teaching component to them. This includes not only tenure-track professorial positions, but any positions which require the ability to explain and teach things to others.

By the end of the semester, you will be able to:

1. Design a teachable unit. This is an integrated, 2-3 week block of topics, activities, laboratory exercises and assessments, constructed around clearly stated learning goals (things students should know or be able to do upon completion of the unit). Teachable units are the building blocks of a well-designed undergraduate or graduate science course!

2. Present a 10-minute activity that employs active learning strategies and frame it in the context of your teachable unit.
3. Construct and maintain a learner-centered classroom.

4. Draft a teaching philosophy that reflects understanding of current educational research and how students learn. Such philosophies are a standard part of a college or university faculty application. A philosophy that incorporates active learning strategies, student-centered outcomes and a variety of assessment tools is crucial for positions that involve aspects of teaching and curriculum design.

Course Goals
- to help students and instructors improve their ability to teach both course content and the analytical skills undergraduates need to carry out inquiry-based science
- to familiarize students with the best teaching practices, as established by research
- to provide students with the skills and support to implement active learning in their classrooms
- to provide students with the opportunity to experiment with new instructional and assessment techniques and discuss how well they worked
- to encourage students to reflect on instructional techniques they use and how well suited they are to the students in a particular class
- to familiarize students with resources available to support these goals

Specific Student Learning Outcomes
- apply backwards design to develop a course
- use active and inquiry-based learning in the classroom and the lab
- employ a variety of different teaching techniques to reach a diverse group of students and explain to students why they should take advantage of multiple approaches to learning
- effectively design and use both formative and summative assessments
- integrate a variety of assessment formats into courses
- clearly communicate course and assessment expectations and standards to students
- develop a classroom management strategy to enhance student learning
- use various tools to assess your own efficacy as an instructor and make adjustments

Grading: Teachable units, presentations, participation, reading assessments and teaching philosophies will be graded according to the following scale: 100-90% = A, 89% = A-, 88% = B+, 87-80% = B, 79% = B-, 78% = C+, 77-70% = C, 69% = C-, 68% = D+, 67-60% = D, 59% = D-, <59% = F.

Grading Scheme:

<table>
<thead>
<tr>
<th>Item</th>
<th>Portion of Final Grade</th>
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<tr>
<td>active participation in and preparation for weekly discussions</td>
<td>20%</td>
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<tr>
<td>performance on weekly reading assessments</td>
<td>20%</td>
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<tr>
<td>presentation to group of a learning activity prepared as part of your teachable unit – focused on a particular objective of the unit, approximately 10 minutes in length *</td>
<td>20%</td>
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<tr>
<td>preparation of a teachable unit that includes active learning strategies, lab activities, and both formative and summative assessments with an explanation of how each of these will further the stated goals and objectives*</td>
<td>20%</td>
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<tr>
<td>a written, formal statement of personal teaching philosophy*</td>
<td>20%</td>
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*If this item is of substandard quality, additional revision and resubmission may be required.
### Schedule for Spring 2011, BIOL/CHEM/GEOS/PHYS 693P:
Special Topics in Scientific Teaching (subject to change)

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Due at start of class</th>
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<tbody>
<tr>
<td>Jan. 24</td>
<td>Learning Styles and How People Learn</td>
<td>• Pashler et al. 2009&lt;br&gt;• learning styles assessment</td>
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<td>Jan. 31</td>
<td>Bloom’s Taxonomy – How to help students develop analytical skills and think “like a scientist”; designing formative and summative assessments to develop and evaluate these skills.</td>
<td>• Handelsman et al., Ch. 1&lt;br&gt;• Harris 2002&lt;br&gt;• Kruger and Dunning 1999&lt;br&gt;• Crowe et al. 2008 - skim&lt;br&gt;• bring an exam from an undergraduate course to examine</td>
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<td>Feb. 7</td>
<td>Backward Design – using goals and objectives to drive course design</td>
<td>• Handelsman et al., Ch. 2&lt;br&gt;• Armbruster et al. 2009&lt;br&gt;• Kinchin 2010&lt;br&gt;• Stokes et al. 2007</td>
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<td>Feb. 14</td>
<td>Goals and Objectives – learning how to write useful ones; how to use concept inventories</td>
<td>• D’Avanzo 2008&lt;br&gt;• Handelsman et al., Ch. 3&lt;br&gt;• Libarkin &amp; Anderson 2005&lt;br&gt;• Musante 2009 (only 1 page)&lt;br&gt;• Goals and objectives for a teachable unit</td>
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<td>Feb. 21</td>
<td>Teachable Unit – What is a teachable unit and how can an instructor develop a really good one?</td>
<td>• Ehrlinger et al. 2007&lt;br&gt;• Gautier et al. 2006&lt;br&gt;• Handelsman et al., Ch 5&lt;br&gt;• Outline of a teachable unit</td>
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<td>Feb. 28</td>
<td>Active Learning I – active learning as a formative assessment tool; audience response systems (clickers), case studies, and how to use them</td>
<td>• Grear and Heaney 2004&lt;br&gt;• Roediger and Karpicke 2006.&lt;br&gt;• Rushton 2005&lt;br&gt;• Lesson plan for a teachable unit with revised goals and objectives</td>
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<td>Mar. 7</td>
<td>Active Learning II – other techniques to engage students: minute papers, strip sequences, think-pair-share, concept maps and “illuminated” diagrams</td>
<td>• Knight and Wood 2005&lt;br&gt;• McConnell et al. 2003&lt;br&gt;• Description of an activity for your teachable unit, with goals, objectives, and assessment method</td>
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<td>Mar. 14</td>
<td>Spring Break</td>
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<td>Mar. 21</td>
<td>Active Learning III – engagement continued: kinesthetic activities and modeling processes</td>
<td>• Englebrecht et al. 2005&lt;br&gt;• Hay et al. 2008</td>
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<tr>
<td>Date</td>
<td>Session</td>
<td>Resources</td>
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| Mar. 28  | Writing a Teaching Philosophy – what a teaching philosophy is and how to write a great one | • O’Neal et al. 2007.  
• bring in a sample teaching philosophy statement that you really like (search online or ask people) |
| Apr. 4   | Group Work I – Brainstorming, jigsaw exercises                            | • McConnell et al. 2005  
• Shimazoe and Aldrich 2010  
• draft of teaching philosophy |
| Apr. 11  | Group Work II – Jigsaw wrap-up, peer instruction and collaborative thinking | • Crouch and Mazur 2001  
• Yuretich et al. 2001  
• your piece of the jigsaw |
| Apr. 18  | Inquiry-Based Learning – the difference between investigative labs, guided inquiry and open inquiry learning | • Apedoe et al. 2006  
• Casotti et al. 2008  
• Justice et al. 2007  
• final teaching philosophy  
• bring a lab that you’ve done (not the supplies, but the written exercise) |
| Apr. 25  | Student Presentations of Teachable Unit, Outcomes, and One Complete Activity | • teachable unit presentation |
| May 2    | Student Presentations (continued)                                         | • teachable unit presentation |

**Full citations for articles:**


Additional readings on concept inventories in biology
(not required, strictly for your own interest):

