Research and practice in teaching and learning science
Education 286

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The Research and practice in teaching and learning science course is specifically designed for scientists who want to explore science inquiry teaching and learning. The course will focus on undergraduate and graduate level teaching but is applicable for those teaching high school students as well as in informal learning settings, such as museums. The focus will be on three areas: research on best teaching practice, for example teaching in both small and large groups; learning, what research says about learners; and last, how both of these relate to science inquiry. Each class participant will be expected to design and put into practice several lessons based on these three main areas, science teaching, learning and inquiry.

Logistics
- This is designed as a five-credit course, including both seminar and lab.
- No prior education courses are required.
- The laboratory component will focus on science inquiry; two laboratory sessions will be held at the Exploratorium; these are scheduled for April 7 and 28.
- Regular meetings at UCSC on Mondays and Wednesdays from 1:00 to 2:45 in the CfAO building conference room. May 14 no class.
- We will have video and teleconference links with other CfAO sites and this course coordinates with the Maui graduate professional development inquiry workshop.
- There are two readers; one with core readings; the second contains supplemental readings that can be used for the design project.

DRAFT 1—2.17.03
**Evaluation**

Evaluation will be based on the following

<table>
<thead>
<tr>
<th>Classroom attendance and participation</th>
<th>10 %</th>
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<tbody>
<tr>
<td><strong>Teaching and Assessment Design</strong></td>
<td></td>
</tr>
<tr>
<td>Project Research and Background</td>
<td>20 %</td>
</tr>
<tr>
<td>Assessment plan</td>
<td>20 %</td>
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<tr>
<td>Teaching Event practice</td>
<td>20 %</td>
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<tr>
<td>Final documentation</td>
<td>30 %</td>
</tr>
</tbody>
</table>

**Narrative Evaluation Format**

Overall, this student’s participation and written assignments indicated

- impressive
- well-developed
- a good working
- satisfactory
- uneven
- minimal
- understanding of the ideas in the course.

**Class participation:**

- made strong contributions to class meetings
- was clearly engaged during class meetings
- contributed insightful ideas and supported other students’ learning
- listened actively and contributed to the classroom dynamics
- attended class regularly
- was usually present
- attended irregularly
- was often absent

**Written assignments**

The required Teaching and Assessment Design was:

- extraordinary, with coherent analysis that integrated ideas and evidence in well-developed and eloquent reflections
- very well developed, with clear connections between ideas and evidence to support the arguments
- of good sound quality, reflecting active engagement with the topic, though in places the work would have benefited from being pushed further
- satisfactory though somewhat uneven times sketchy and not sufficiently grounded in the course materials or not addressing the topic fully
- not satisfactory, either showing a lack of adequate engagement with the topic or not turned in at all.
Day 1

Overview of the course
Readings, Scheduling
Design Events, four part design
in teaching and assessment in inquiry science

Part 1 due April 16

Classroom discussion
Discussion on views of Science.

for April 7
Preparation for next week at the Explo
WWW.exploratorium.edu
Visit the Teacher Institute website
http://WWW.exploratorium.edu/ti/
Find one activity that interests you for potential teaching—
Down load and be ready to discuss.
Visit the Institute for Inquiry site and view 3 kinds of hands-on teaching

Week 1

Inquiry and other forms of teaching

Inquiry and other forms of teaching

At the Exploratorium April 7 1-4 PM
(Time before that to observe 10-12)
A laboratory exercise in distinguishing inquiry from other ways of teaching science
With Exploratorium experts
Barry Kluger-Bell and Candice Brown

for April 9
National Academy Press (1999). How people learn. Bridging Research and Practice (if you haven't read this already)


Debrief and discussion of the Explo experience
Reflective video of the experience
Forms of assessment to match this kind of teaching and learning
Some samples

For April 14
Using the resources list at the end of this document, come prepared with information on one of science education researcher in a content area (astronomy, physics, biology, etc) or choose one of your own that explores high school or college students understandings of science.
Have ready a one page synopsis from which to teach others.

Week 2

Design principles for science teaching and assessment  April 14

Backwards design
Match activity to purpose
Deliberate sequencing

April 16
1. Wiggins and McTighe, Designing for science, Chapter
2. California State Science content standards 9-12  scan

The Design Project part 1 April 16

Designing for Inquiry

Part 1 is due—Discussion

For April 21 --Jigsaw
Each person will read one of these
3. The Astronomy test/the physics diagnostic tests

Week 3 April 21

Assessment continued

Jigsaw of reading

For April 30
Content readings in the sciences
Choose one of the following


April 23

Jigsaw on content
Role of teaching structures, matching activity to purpose
For April 28  
TBA

Week 4  
Explanatorium inquiry experience 9-4  April 28

At the Exploratorium 9-4  
A day-long inquiry experience with Exploratorium experts  
Barry Kluger-Bell and Candice Brown

For April 30  
Read Brown et al, 1993, Distributed Expertise or  
How People Learn chapter on Classroom Design  
Or Wiggins & McTighe chapter on Designing for Assessment

Matching assessment to design  April 30  
Part 2 of design due  
The assessment piece

For May 5  
Trends in Undergraduate Education, Science 293 (5535) p. 1607-1626  

Week 5-6 May 5
Teaching  
Large group and small  
Participation structures

For May 7  
TBA

Matching teaching to assessment  May 7  
Large format lecture

For May 12  
Read one of the following

May 12  
Discussion on talking science  
Different viewing of making sense of sense dialogically
No class May 14

Week 7-8  

Equity and Science Teaching and Learning

An overview of equity issues

For May 26

Read


May 19

May 21

Design project part 3 is due

May 26

Reading

As above

May 28

Reading

TBA

Week 9

Putting it all together

Final project due

June 2

June 4

Last class
Resources

Physics
Physics education research group
Univ of Washington
http://www.phys.washington.edu/groups/peg/
Physics by Inquiry
http://www.phys.washington.edu/groups/peg/pbi.html
Physics demos
http://www.physics.ncsu.edu/pira/demosite.html
Univ of Maryland Physics lecture/demo facility
http://www.physics.umd.edu/deptinfo/facilities/lecdem/

Biology
Biology undergraduate education
http://www.hhmi.org/BeyondBio101/

Astronomy
Undergraduate Research Educational Initiative
At Haystack

Improving the Quality of Undergraduate Astronomy Courses
A Selected List of Web Sites for Instructors of Introductory Astronomy Courses
http://www.physics.ncsu.edu/pira/demosite.html

Astronomy diagnostic test
http://solar.physics.montana.edu/aae/adt/
http://www.physics.umd.edu/deptinfo/facilities/lecdem/services/demos/subtopicse.htm

University of Maryland Demos
E1. GRAVITATION AND ORBITS
E2-24: UMBRA AND PENUMBRA - COLOR FILTERS

Other
Collaborative Learning
NISE
National Institute of Science Education
http://www.wcer.wisc.edu/nise/cl1/
http://www.wcer.wisc.edu/nise/cl1/CL/doingcl/DCL1.asp
http://www.wcer.wisc.edu/nise/cl1/CL/resource/R1.asp
Role-Playing and Problem-Based Exercises for Teaching Undergraduate Astronomy
http://msowww.anu.edu.au/%7Epfrancis/roleplay.html

**Other Online resources**
Center for Science, Mathematics, and Engineering Education (more titles from CSMEE)
http://books.nap.edu/books/0309053269/html

http://www.nap.edu/catalog/9596.html

Inquiry: Thoughts, Views, and Strategies for the K-5 Classroom: A monograph for professionals in science, mathematics, and technology education
Written by Institute for Inquiry Staff and Colleagues for the FOUNDATIONS series, published by the National Science Foundation.
http://www.exploratorium.com/IFI/resources/ifibook.html

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**Core Reader**


2. California State Science Framework and Content Standards, K-12


Supplemental


Roth, K. Talking to Understand Science, Unpublished paper
Van Zee, et al. Student and Teacher Questioning during Conversations about Science.  

Warren, et al. Rethinking Diversity in Learning Science: The Logic of Everyday  