Teaching Life Science

Course number: 15:256:553; 11:300:453
Time: Tuesday, 4:50 to 7:30 pm
Location: Waller Hall, Room 209

Professor: Melissa Czerwinski
Email: melissa.czerwinski@rutgers.edu

Course Description

This course explores current trends and research in science education focusing on innovative approaches to science teaching. Course readings will combine studies of student reasoning, studies of science teaching practice, and new paradigms for learning environments in science. The course is organized around a major project: the development of inquiry-based biology units. Students will work in small groups to develop a set of learning goals around a given topic, analyze student conceptions in the domain (through clinical interviews and literature review), and develop a modeling-based inquiry curriculum unit. The goal is to learn how to design inquiry-based science lessons. Four themes are at the core of this course:

- *Scientific practices:* How can we design instruction to foster students' engagement with and understanding of the nature of science and of key scientific practices such as modeling and argumentation?
- *Students' prior conceptions:* Students' existing ideas about scientific content and process influence their understanding of new material. How can we find out about students' prior knowledge, beliefs, and expectations? How can we account for that in our teaching?
- *Assessing students' knowledge:* What are effective ways of assessing students' knowledge and helping students progress in their understanding?
- *The design of learning environments:* How can we design coherent units in biology for high school students? What are some of the design principles that can guide this process?

Course Structure and Assignments

Readings: There will be assigned readings for each class session; you are expected to read them and be prepared to discuss them in class. On occasion an additional reading may be assigned or a new reading may be substituted for an existing one.

Participation: Your participation in class counts towards your grade. It is therefore important that you actively participate in class activities and discussions. Learning is an active process: the more you participate, the more you learn. Interviews are included in your participation grade.

Education journal subscription: Professions have professional associations that, as their name indicates, are associated with them. The teaching profession is no exception. As a science educator you are expected to be an active member of a professional association that is relevant to your work. Towards that end you are asked to subscribe (for the duration of one year) to The Science Teacher (journal of the National Science Teachers Association). You may also subscribe to the American Biology Teacher (the journal of the National Association of Biology Teachers), but you may have to read Science Teacher articles through the library. You will be expected to read and be prepared to discuss articles from your journal.

Teaching experiment: As part of your observations in science classrooms, you will be expected to prepare and teach a lesson within the context of a unit that includes the core scientific practices of modeling and/or argumentation. You will then be expected to write a 3-5 page reflection on the lesson. In your reflection you should begin by briefly describing the lesson plan and your design rationale, then describe what occurred in class (in broad strokes), and finally describe what you learned from the experience and how you would revise the lesson plan. You should audiotape the lesson so that you can better reflect on what occurred and so that you can provide evidence for any claims you make (quotes from students etc). You are expected to do this assignment sometime during the last 2 weeks of April, so be sure to discuss this with your cooperating teacher.

The unit and lesson will be submitted as part of the Teacher Education Portfolio. They are considered the Early Phase unit and lesson plans (2 separate deliverables in the portfolio). Your work will be assessed using a rubric. The highest scores on the rubric describe characteristics of units and lessons written by a professional teacher. The rubrics and templates for the unit and lesson plan can be found on the Sakai Teaching Portfolio site. It is YOUR responsibility to read these fully and to submit the assignments on time. You will be submitting the assignments both to the course Sakai site (under the relevant assignment) and to the Sakai Portfolio site. Make sure you fully submit assignments (they should show up as orange and say "pending").
Students who are NOT in the certification program do not need to submit to the portfolio, but they do need to submit to the course web site on Sakai.

Course project: As noted above, this course is organized around the development of a 2-3 week long inquiry-based biology unit. The design work will be conducted in small groups and will take place both during class and "off-line" between classes. The design will progress in stages and there will be graded and non-graded assignments associated with some of the stages. The following is a brief description of each stage and the relevant assignment:

Defining the learning objectives: Each group will identify a few key learning objectives for their assigned topic and submit a one-page description of the learning objectives, what students should be able to do if they achieved them, what understandings are entailed in such learning, and what the supporting standards are for these objectives.

Defining the project/problem context: Each group will choose a project or problem context and prepare a one-page proposal of the project in which learners will be engaged. The proposal should include a justification of how the chosen context will foster learning of the defined objectives (how it develops a need to know).

Uncovering students' existing understandings: For the first project, each group will prepare and conduct clinical interviews with high/middle school students or adults (12 interviewees per group) about the assigned topic focusing on the participants' understandings of concepts related to the learning objectives and the problem context. Interviews should be approximately 20-30 min long and audiotaping is highly recommended. In addition to the interviews, student groups will prepare a similar analysis based on reading existing literature (at least 3 articles) in science education about students' understanding of the topic (use can your subscription for this assignment). Groups will prepare a 5-page summary and analysis of all collected interviews and readings, and the implications for instructional design.

Constructing the project backbone: Each group will figure out the learning progression for their project and outline the main stages of this progression as the project backbone. Groups will prepare a 5-page description of their project to date. This should include the learning objectives and their rationale (and standards), a synopsis of the interview analyses and how they informed the design of the project, the choice of a project context and its rationale, and an outline of the project progression.

Mid point critique: Each group will critique the project backbone of another group using the criteria developed in Biology and Society (criteria may be revised).

Assessment outline: Each group will figure out how to embed assessment in the unit and prepare an assessment map and rubrics.

Lesson design: Groups will design lessons to fill in the project backbone. Each group will prepare one sample lesson for review. These lessons will be reviewed and critiqued by other groups.

Final design: Each group will design all remaining lessons in their project (if need be, additional lessons will be reviewed and critiqued). Groups will prepare their curriculum binder, which should include: motivation and rationale for unit, learning objectives, an overview of the unit, assessment maps and rubrics, and unit lessons (to be submitted as a binder with a corresponding CD). Each group should prepare a 20 min presentation on their curriculum design.

Classroom observations: As part of the course you will spend 30 hours observing a science classroom. Each week there will be an assignment associated with the observations. Occasionally the assignment will involve more than observation of the class (e.g. interviewing students, the teacher, teaching a lesson, analyzing student work). You are expected to prepare a short report on your observations each week (using guiding questions that will be provided).

Individual reflection paper: The last assignment of this course is an individual reflection paper 5 pages long in which you reflect (individually) on what you have learned in this course. This reflection should be based on the contribution of the readings, class activities, and final project to your developing understanding of the design of effective biology instruction.

Grading:

Assignment	Date due	Grade
Participation (individual)	Throughout the course	15%
Teaching experiment (individual)	Week 14	15%
Observations (individual)	Throughout the course	15%
Various benchmarks for projects (group)	Throughout the course	20%
Curriculum presentation (group)	Week 15	5%
Individual reflection paper (individual)	Week 15	20%

Syllabus:
Assignments are due by the end of that week –Friday at 8pm or Saturday at 5pm on Sakai unless otherwise indicated. This syllabus is TENTATIVE, readings and assignments (and due dates) may change according to the progress of the class at the instructor's prerogative.

Week 1 [1-17]-: Introduction

To Do:

1. Become a member of NSTA (National Science Teachers Association) (http://www.nsta.org)

2. *Group contract due Sat (1-21), 8 pm*

3. Learning goals due Sat at 8 pm

Readings for students who have not taken Biology and Society (other assignments will be added as needed):

Donovan, M. J., & Bransford, J. D. (2005). *How Students Learn: Science in the Classroom*. Washington, DC: National Academy Press. Chapter 9 (397-416)

Donovan, M. J., & Bransford, J. D. (2005). *How Students Learn: Science in the Classroom*. Washington, DC: National Academy Press. Chapter 11 (475-515)

Duschl, R. (1990) Restructuring Science Education: The importance of theories and their development. New York: Teachers College Press. Chapter 1 (1-13)

Windschitl, M & Thompson, J. Teaching about science ideas as models. University of Washington (1-11)

Windschitl, Mark. (2008) "What is Inquiry? A Framework for Thinking About Authentic Scientific Practice in the Classroom." In J. Luft, R.L. Bell & J. Gess-Newsome (Eds.) *Science as Inquiry in the Secondary Setting.* (1-20). NSTA Press.

Week 2 [1-24]- Design Frameworks and Project Context

Edelson, D. C. (2001). Learning-for-Use: A Framework for the Design of Technology-Supported Inquiry Activities. *Journal of Research in Science Teaching*, 38 (3), p355-85

Wiggins, G. & McTighe, J. (1998). Understanding by design. Association for Supervision and Curriculum Development: Alexandria, Virginia.

Week 3 [1-31]- Project Context and Backbone Continued

Kanter, D. E., Schwille, K., MacKenzie, S., & Reiser, B. J. (2003). Curriculum design strategies support content learning in task-structured science curricula. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching. Philadelphia, PA.

Project goals and problem context due (2-3) Fri at 8pm

Week 4 [2-7]- Clinical Interviews

Driver, R., Squires, A., Rushworth, P. and Wood-Robinson, V. (1994). Chapters: Introduction, 1& 21. In *Making sense of secondary science: Research into children's ideas*. London: Routledge.

Hammer, D. (1996). Misconceptions or P-Prims: How may Alternative perspectives of cognitive Structure Influence Instructional Perceptions and Intentions? *The Journal of the Learning Sciences*, 5 (2), pp. 97-127.

Clinical interview protocol due (2-8) Wednesday at 8pm

Week 5 [2-14]- Assessment

Wilson, M., & Sloane, K. (2000). From Principles to Practice: An Embedded Assessment System*. Applied Measurement in Education,* 13 (2), p181-208.

Read at least 3 articles about student conceptions regarding your topic

Conduct interviews

Individual interview summary due (2-21) Tues, by the beginning of class

Week 6 [2-21] - Clinical Interview Summary and Project Backbone Revised

Edelson, D. C., Tarnoff, A., Schwille, K., Bruozas, M., & Switzer, A. (2006). Learning to make systematic decisions. The Science Teacher, 73(4), 40-45.

Revise backbone

Group clinical interview summary and literature review due (2-25) Sat at 5pm

Week 7 [2-28]- Project Context and Backbone

Handbook of the LS Chapter 20: Making Authentic Practices Accessible to Learners

Project backbone draft due (3-2) Fri at 8pm

Week 8 [3-6] – Unit Critique

No Readings

Revised project backbone due (3-6) bring 2 hard copies to class

Unit critique due Sat 5pm (3-10) bring copy to class on Tues 3-20

Spring Break [3-13] - No Class

Week 9 [3-20]- Assessment Plan and Lesson Plans

Reading – Chapter 7- Inquiry-based science instruction for students with disabilities. Kathy Trundle.

Develop assessment plan

Develop unit lessons

Assessment plan (parts 1 and 2 - variables and rubrics) due Fri 8pm (3-23)

Week 10 [3-27]- Lesson Plans

No class- groups meet to develop lesson plans and respond to critique

Draft of inquiry lesson for teaching experiment due online Fri 8pm (3-30) and in class Tues (4-3) (bring hard copy to class for critique on Tues, 4/3

Response to critiques due in class Tues 4-3

No reading

Week 11 [4-3]- Interlude- Teaching experiment preparation

Ladson-Billings, G. (1995a). But that's just good teaching! The case for culturally relevant pedagogy. *Theory Into Practice*, 34(3), 159-165.

Revise lesson plan for teaching experiment

1 unit lesson plan due Fri 8pm (4/6)

Week 12 [4-10]- Lesson Plans Continued

No Reading

Teach revised inquiry lesson this week or next (by 4-20). Audiotape lesson.

1 unit lesson plans due Fri 8pm (4/13)

Week 13 [4-17]- Lesson plans

Geier, R., Blumenfeld, P.C., Marx, R.W., Krajcik, J.S., Fishman, B., Soloway, E., & Clay-Chambers, J. (2008). Standardized test outcomes for students engaged in inquiry-based science curricula in the context of urban reform. *Journal of Research in Science Teaching*, 45(8), 922-939.

Continue work on unit

1 unit lesson due Fri 8pm (4-20)

Week 14 [4-24]- Teaching Experiment

No Reading

Teaching experiment paper due April 24th by 4pm

Week 15 [5-1]- Final Unit Presentations (Exam week)

No Reading

Prepare 20-minute presentation on your unit.

Final unit (binder and CD) due 5-1 in class

Reflection paper due Wed 5-2 by 8 pm.