

# Teaching Life Science

Course number: 15:256:553  
Time: 10:55-2:15  
Location: Lipman House; SEBS

Professor: Ravit Golan Duncan  
10 Seminary Place; rm: 222  
Tel: (732) 932 7496 Ext 8355  
Email: ravitduncan@gse.rutgers.edu

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## 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 student 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 participation.

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 either The Science Teacher (journal of the National Science Teachers Association) or American Biology Teacher (the journal of the National Association of Biology Teachers). 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 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 coop teacher.

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 student 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 learners will be engaged with. 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 (3 interviewees per group member) 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 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 project 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. 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:**

<u>Assignment</u>	<u>Date due</u>	<u>Grade</u>
Participation (individual)	Throughout the course	10%
Journal	Throughout the course	15%
Teaching experiment (individual)	Week 13	15%
Technology fair (group)	Week 8	10%
Various benchmarks for projects (group)	Throughout the course	20%
Curriculum presentation (group)	Week 12	10%
Individual reflection paper (individual)	Week 15	20%

### **Syllabus:**

Assignments are due by the end of that week --Saturday at 5pm on Sakai unless indicted otherwise.

#### Week 1 [1-24]-: Introduction

Become a member of NSTA (National Science Teachers Association)

<http://www.nsta.org>

or of NABT National Association of Biology Teachers

<http://www.nabt.org>

#### *Readings for students who have not taken Biology and Society:*

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

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

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

*Group contract due (1-31)*

### Week 2 [1-31]- Design Frameworks and Unit Goals

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 [2-7]- Project Context and Backbone

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 (2-11) Fri at 8pm*

### Week 4 [2-14]- 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 (2-16) Wed at 8pm*

### Week 5 [2-21]- Clinical Interview

Read at least 3 articles about student conceptions regarding your topic  
Conduct interviews

*Individual interview summary due (2-26) Sat 5pm*

Week 6 [2-28]- Project Backbone

Collins, A. (1996). Design issues for learning environments. In S. Vosniadou, E. D. Corte, R. Glaser, & H. Mandl (Eds.), *International perspectives on the design of technology-supported learning environments* (pp. 347-361). Mahwah, NJ: Erlbaum.

*Group clinical interview summary and literature review due (3-5) Sat at 5pm*

Week 7 [3-7]- Project Context and Backbone

*Project backbone draft due (3-10) Thurs at 8pm*

Spring Break [3-14]

No Class

Week 8 [3-21] – Unit Critique

Garrett, T., & Chinn, C. A. (xxxx). Creating well-managed learning environments. Chapter 11

*Revised project backbone due (3-21) bring 2 hard copies to class*

*Unit critique due Sat 5pm (3-26) bring copy to class on Mon 3-28*

Week 9 [3-28]- Assessment

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

Assessment plan (parts 1 and 2 - variables and rubrics) due Thurs 8pm (3-31)

Week 10 [4-4]- Lesson Plans

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

*Draft of inquiry lesson for teaching experiment due online Thurs 8pm (4-7) and in class Mon 4-11 (bring hard copy to class for critique on Mon 4-11)*

*Response to critiques due in class Mon 4-11*

No reading

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

Reading TBD

Critique inquiry lesson for teaching experiment

Revise lesson plan for teaching experiment

*1 unit lesson plan due Sat 5pm (4/16)*

Week 12 [4-18]- Lesson Plans Continued

Reading TBD

Teach revised inquiry lesson this week or next (by 4-30). Audiotape lesson.

2 unit lesson plans due Thurs 8pm (4/21)

Week 13 [4-25]- Lesson plans

No reading

Continue work on unit

1 unit lesson due Thurs 8pm (4-28)

Week 14 [5-2]- Teaching Experiment

*Teaching experiment paper due May 2<sup>nd</sup> by 4pm*

Week 14 [5-9]- Final Unit Presentations (Exam week)

Prepare 20-minute presentation on your unit.

*Final unit (binder and CD) due 5-9 in class*

*Reflection paper due Wed 5-11 by 5pm.*