EDCI 470 Learning and Teaching in Science

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Learning outcomes for EDCI 470

This course is designed as the second in a sequence for prospective science educators in the undergraduate teacher certification program. It comes in the fall semester of the year-long internship. You will spend time this fall in both middle and high school placement observing and assisting classroom teachers. By the end of the course, you will show:

- basic understanding on science teaching and how it may affect student learning, specifically with respect to conceptual knowledge, reasoning abilities and inquiry, epistemologies, **sustainability** and learning contexts;
- familiarity with instructional strategies of attending, assessing, and responding to student thinking;
- abilities to plan instruction, based on the materials, curriculum, and students in the classes you are teaching or observing;
- abilities to identify, interpret, and design appropriate responses to student thinking as evident in specific case studies of interviews, classroom observations, and first experiences teaching.
- **Familiarity with concepts about sustainability on both a global and local level and the complex interactions between the environment and society.**

General description

The purpose of this course is to help you begin to develop practices of instruction — facilitating discussions, making presentations, providing explanations, assessing students' learning and progress, and preparing lessons. During this course, we will focus attention on student learning and make the transition to think about the relationships and interactions between student learning and instructional strategies.

Activities in the course include:

- reading and discussing research on learning and teaching in science and **sustainability**;
- analyzing student thinking in ways we began in EDCI 411, as it is evident in observations and video of science classes, samples of students' written work, or interviews;
- critically analyzing curriculum;
- observing experienced teachers' practices and analyzing how they address (or may not) aspects of student knowledge and reasoning;
- reviewing and analyzing a range of assessment strategies and practices, from everyday classroom awareness to rubrics and exams;
- planning, implementing, and reflecting on the results of classroom instruction.

The course is designed to build on the foundation established in EDCI 411 of research on learning in science. At the beginning of the course we will review ideas from the previous course, and then continue from there to focus on the craft of teaching: How do teachers understand and address what students need to learn? How do teachers assess and respond to student thinking?

In all, you will be required to

- read minimum of 30-50 pages per week;
- conduct one student interview, with 4-6 pages of written analyses;
- conduct two observations of classroom learning and instruction, with 4-6 pages of written analysis;
- plan, implement, and reflect on two science lessons, with 4-6 pages of analyses;
- read, observe, and comment on other students' work;
- attend and participate in seminar discussions.

Assignments (More detail will follow throughout the semester)

Interviews:

This assignment is a reprise of an assignment from EDCI 411. You will pose a science question (e.g. "Where does all the weight come from, when an acorn grows into a tree?" or "If I leave a wet towel on a rack, and it dries, what happens to the water?") to middle or high school students and interview the students about their thinking. The purposes of the assignment are (1) to develop abilities for eliciting and listening to student reasoning, and (2) to gain insight into that reasoning, into what and how students know and think about natural phenomena.

Analysis of school work:

This assignment is similar to the interviews, but it concerns evidence of students' thinking from classroom observations and samples of written work. This assignment goes beyond the focus on attention to student thinking and shifts the focus to include instruction. Recognizing aspects of student thinking, you are asked to reflect on how these aspects were influenced by the instruction in the class—the teacher's strategies, the curriculum and materials. You will do this in both your middle and high school placement.

Planning and implementing instruction:

This assignment asks you to plan lessons you will teach as part of your fall experience in schools. You will submit, discuss, and revise your plans, and then teach the lessons, finally preparing 4-6 pages of reflection on what took place. This work anticipates the case study assignments you will complete in the third course in the sequence in the spring semester. You will do this in both your middle and high school placement. **For the first lesson, you will plan according to your grade level and discipline considering the standards (1) Nature of Science (Benchmarks for Science Literacy, pp. 3 – 21). Your lesson must cover some aspect of sustainability and must take into consideration students in your class who require modifications.** For the second lesson you will work with your mentor teacher to develop a lesson which aligns with the county standards, taking into consideration any necessary modifications.

Course meetings

Each meeting begins with the discussion of the assigned reading—generally one or two articles, which you are required to read carefully for detailed explication. The other activities during meetings include viewing and discussing video case studies of student thinking from classroom interactions; collaborative groups to present and discuss results from assignments; as well as discussions of topics within science **and how we can combine sustainability and science in the classroom.**

Grading

Grades are determined based on the five written assignments and participation in seminar. The five written assignments are weighed equally, and count for 80% of the grade; seminar participation as well as discussion board participation will count for the remaining 20%.

To earn an "A" in the course, you must complete all assignments in a timely fashion, following the guidelines given in class. You must also demonstrate that you can attend to the substance of student thinking in the course assignments. Evidence of attention to student thinking is when you make a claim about student reasoning that is supported by evidence in the data, that is, in a video, transcript, or student written work. It is not sufficient evidence of attention to student thinking for the claim simply to identify whether the student is correct or incorrect; the claim and support must concern the sense of the student's thinking from the student's perspective. We will discuss this at greater length on the first day of class.

Relevant student policies

Religious Observance: The University System of Maryland policy "Assignments and Attendance on Dates of Religious Observance" provides that students *should not be penalized because of observances of their religious beliefs; students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances.*

We are a diverse community and enroll students of many religions; pursuant to policy, we will do what we can when there are students' requests for excused absences and make-up test requests due to reasons of religious observances. *It is the student's responsibility to inform* the instructor of any intended absences for religious observances *in advance. Notice should be provided as soon as possible but no later than the end of the schedule adjustment period.*

Honor Code: The University is one of a small number of universities with a student-administered Code of Academic Integrity and an Honor Pledge. The Code prohibits students from cheating on exams, plagiarizing papers, submitting the same paper for credit in two courses without authorization, buying papers, submitting fraudulent documents, and forging signatures. Students should write the following signed statement on the top of each examination or assignment: *I pledge on my honor that I have not given or received any unauthorized assistance on this examination (or assignment).* Compliance with the code is administered by the Student Honor Council, which strives to promote a "community of trust" on the College Park campus.

Individual Needs Accommodation: The University is legally obligated to provide appropriate accommodations for students with documented disabilities. In order to ascertain what accommodations may need to be provided, students with disabilities should inform the instructors of their needs at the beginning of the semester. The instructor will then consult with Disability Support Services (314-7682). DSS will make arrangements with the student to determine and implement appropriate academic accommodations.

Topics and readings

The semester progresses through **six** general topics of reading. Readings are selected in advance as follows, and then supplemented and adjusted during the course in response to participants' particular interests and ideas. I will e-mail readings to you a week in advance of the date they will be discussed.

Review of models of student learning in science (3 sessions)

Strike, K. A., & Posner, G. J. (1992). A revisionist theory of conceptual change. In R. A. Duschl & R. J. Hamilton (Eds.), *Philosophy of Science, Cognitive Psychology, and Educational Theory and Practice* (pp. 147-176). Albany: State University of New York Press.

Carey, S., & Smith, C. (1993). On understanding the nature of scientific knowledge. *Educational Psychologist, 28*(3), 235-252

Kuhn, D. (1989). Children and adults as intuitive scientists. *Psychological Review*, 96 (4), 674-689.

Leach, J., Millar, R., Ryder, J., & Sere, M. G. (2000). Epistemological understanding in science learning: the consistency of representations across contexts. *Learning and Instruction, 10*(6), 497-527.

Assessment (2 session)

Assessment as inquiry

Coffey, J. E. (2003). Involving students in assessment. In J. M. Atkin & J. E. Coffey (Eds.), *Everyday Assessment in the Science Classroom* (pp. 75-88). Arlington, Va.: NSTA Press.

Black, P. (2003). The importance of everyday assessment. In J. M. Atkin & J. E. Coffey (Eds.), *Everyday Assessment in the Science Classroom* (pp. 1-12). Arlington, Va.: NSTApress.

Issues in assessing student inquiry

Duschl, R.D. & Gitomer, D.H. (1997) Strategies and Challenges to Changing the Focus of Assessment and Instruction in Science Classrooms, *Educational Assessment*, 4 (1), 37-73.

Black, P. & Wiliam, D. (1998). Inside The Black Box. *Phi Delta Kappan, 80* (2), 139-148.

Strategies, curriculum, and materials for teaching science as inquiry (4 sessions)

Conceptualizing inquiry as an objective

Driver, R., Newton, P., & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education, 84*(3), 287-312.

Schwab, J. J. (1964). The Teaching of Science as Enquiry. In *The Teaching of Science* (pp. 3-103). Cambridge, MA: Harvard University Press.

General versus content-specific support

Davis, E. A. (2003). Prompting middle school science students for productive reflection: Generic and directed prompts. *Journal of the Learning Sciences, 12*(1), 91-142.

Promoting inquiry in project-based learning

Polman, J. L. (2004). Dialogic activity structures for project-based learning environments. *Cognition and Instruction, 22*(4), 431-466.

Eliciting productive resources

Ford, M. J. (2005). The game, the pieces, and the players: Generative resources from two instructional portrayals of experimentation. *Journal of the Learning Sciences, 14*(4), 449-487.

Hammer, D., & Elby, A. (2003). Tapping epistemological resources for learning physics. *Journal of the Learning Sciences, 12*(1), 53-91.

Challenges and tensions of attending and responding to student thinking (3 sessions)

Competing conceptualizations of science teaching

Sandoval, W. A., & Daniszewski, K. (2004). Mapping trade-offs in teachers' integration of technology-supported inquiry in high school science classes. *Journal of Science Education and Technology, 13*(2), 161-178.

Coordinating multiple objectives—a view from mathematics

Ball, D. L. (1993). With an eye on the mathematical horizon: dilemmas of teaching elementary school mathematics. *Elementary School Journal, 93*(4), 373-397.

Attending and responding to student thinking — an example in science

Hammer, D. (1997). Discovery learning and discovery teaching. *Cognition and Instruction, 15*(4), 485-529.

Contexts and communities (2 sessions)

Adapting curricula to meet student needs — an example in science

Enyedy, N., & Goldberg, J. (2004). Inquiry in interaction: How local adaptations of curricula shape classroom communities. *Journal of Research in Science Teaching, 41*(9), 905-935.

Tapping cultural funds of knowledge

Seiler, G. (2001). Reversing the "standard" direction: Science emerging from the lives of African American students. *Journal of Research in Science Teaching, 38*(9), 1000-1014.

Sustainability (throughout the semester)

Clark, W. & Dickson, N. (2003). Sustainability science: The emerging research program. Proceedings of the national Academy of Sciences, 100 (14), 8059-8061.

Outwater, Alice. Water-A Natural History. (New York: Basic Books,1996).

Dobson, C., Beck, G. Watersheds- A Practical Handbook for Healthy Water. (Ontario: Firefly Books ltd, 1996).

EDCI 470: Learning and Teaching in Science
Tentative Calendar of Topics and Activities: Fall 2010

Date	What will we do in class?	What should I read?
09/ 01	Cat's Meow Assignments: Interview – Due 09/ 22 **Introduction to sustainability**	Strike and Posner (1992) **Clark and Dickson (2003)** **Outwater (ch.1-2)**
09/ 08	Models of students' conceptual knowledge in science **Concepts science and sustainability**	Carey and Smith (1993) **Clark (2003)** **Outwater (ch.3-4)**
09/ 15	Stream survey- Paint Branch Creek Water Quality and Watershed exploration	Kuhn (1989) Leach, Millar, Ryder & Sere (2000) **Outwater (ch.5)**
09/ 22	Assessment in science classrooms Interview #1 Due.	Coffey (2003) Black (2003) **Outwater (ch.6-7)**
09/ 29	Issues in assessing student inquiry Formative/ summative	Duschl & Gitomer (1997), Black & William (1998) **Outwater (ch.8-9)**
10/ 06	Inquiry as an objective **First lesson plan due for discussion**	Driver, Newton, Osborne (2000) Schwab (1964) **Outwater (ch.10-11)**
10/ 13	General versus content-specific support for inquiry **Lesson plan and reflection assignment due** Last week in first field placement (PBA Due)	Davis (2003)
10/ 20	Promoting inquiry in project-based learning First week in second field placement	Polman (2004)
10/ 27	Eliciting students' productive resources for inquiry First analysis of schoolwork assignment due	Ford (2005) Hammer & Elby (2003)
11/ 03	Competing conceptualizations of science teaching	Sandoval & Daniszewski (2004)
11/ 10	Coordinating multiple objectives	Ball (1993)
11/ 17	Attending and responding to student thinking	Hammer & Elby (2003)
12/ 01	Adapting curricula to meet student needs 2nd lesson planning due for discussion	Enyedy & Goldberg (2004)
12/ 08	Tapping cultural funds of knowledge Lesson Plan #2 & reflection assignment due 2nd analysis of school work due Last week in 2nd field placement (PBA Due)	Seiler (2001)