Teaching Science in the Secondary School

EDCI 573

Spring 2004, Mondays 7:20-10:00
A 412 Robinson Hall

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Office Hours
before and after class and by appointment

Course Description

EDCI 573 is the first course in a two-part sequence of science methods courses for preservice and provisionally licensed science teachers. The course is designed to build fundamental knowledge of science teaching and learning including standards-based curriculum design and research-based teaching strategies. The course focuses on developing inquiry-based lessons for students to investigate science and assessing student understanding of science and the nature of science. The teachers will plan lessons for students to learn science, implement lessons in a high school classroom, observe students learning, and evaluate their teaching and student outcomes. Field experience is a required part of this course.

Texts:

At bookstore:

- National Research Council (1996) *National Science Education Standards*, Washington, DC: National Academy Press.
- Cothron, J. H., Giese, R. N., Rezba, R. J. (2000) *Students and Research*. Dubuque, Iowa: Kendall/Hunt.

Online:

- Commonwealth of Virginia (2003) *Standards of Learning for Virginia Public Schools*. Richmond, Virginia: Author. Ask at bookstore or online at http://141.104.22.210/VDOE/Superintendent/Sols/home.shtml. Print out grades 6-Physics.
- *Science Standards of Curriculum Framework Guides*. Online: http://141.104.22.210/VDOE/Instruction/Science/sciCF.html Print out your target grade/subject.
- American Chemical Society (1995). *Safety in Academic Chemistry Laboratories*, 7th edition. Washington, DC: Author. (800 227-5558). Faculty copy. Free single copies. Download free pdf file at http://membership.acs.org/c/ccs/pubs/SACL_faculty.htm
- National Science Teachers' Association. *Science Class* newsletter. Free subscription. http://www.nsta.org/newsletters.

In class:

- *Flinn Chemical & Biological Catalog Reference Manual 2003*

Supplies (These will be used in class activities):

felt pens - multi-colored

transparency pens - 4 colors each, water soluble & permanent
overhead transparency sheets - washable
sticky notes
computer with Internet access

Goals: The preservice and provisionally licensed teacher will:

- Build a repertoire of science teaching and assessment strategies by reading, writing, observing, participating in, and reflecting on the teaching and learning of science;
- Develop strategies to help students become scientifically literate, think critically and creatively, understand the nature of science, and see relationships among science, technology, and society;
- Plan standards-based (local, state, and national) units of science study including daily lesson plans for students that reflect research in effective science teaching and learning;
- Construct science lessons and hands-on experiences that address the needs of a variety of student populations including English language learner, special needs students, and gifted and talented students;
- Learn about science laboratory safety and plan teaching activities that highlight safety;
- Work collaboratively with peers to teach and discuss science and science teaching.

Relationship to Program Goals and Professional Organizations:

EDUC 573 is the first course in a two-course sequence of science methods courses for students seeking a secondary school teaching license in earth science, biology, chemistry, or physics. The course builds on students' knowledge of their subject matter. The course focuses on the teaching of science as called for by the state and national science standards and as outlined by the National Council for Accreditation of Teacher Education (NCATE), the National Science Teachers Association (NSTA), and the Interstate New Teacher Assessment and Support Consortium (INTASC). EDUC 573 builds a repertoire of science teaching and assessment strategies to facilitate student learning.

Nature of Course Delivery:

A variety of teaching strategies will be used to explore the themes of the day. This will include cooperative and collaborative group activities. All students will continuously analyze and evaluate teaching strategies as well as science content and processes. Please dress for hands-on (occasionally messy) problem solving activities that will require mental and physical activity.

General Course Guidelines

Class Schedule and Attendance: Class meets at scheduled times, including special considerations for micro-teaching during the school day. Your participation is critical to your on-going development as a teacher. Treat this class as if it were a part of your job, please be here! Attendance for all classes is a course expectation. Unavoidable circumstances do arise. They

will be handled on a case-by-case basis, which means you talk to the instructor *before*, not after such a circumstance arises (outside of emergency situations, of course). All assignments are due at the beginning of class on the day they are due. Assignments that are late will automatically receive a ten percent grade reduction (one full grade lower).

Grading: Your final grade will be determined from the course activities and projects.

- Students' performance will be evaluated using letter grades (A - F). A = ≥ 94%; A- = ≥ 90%; B+ = ≥ 87%; B= ≥ 83%; C = ≥ 70%; F ≤ 70%.

Grade Definitions. All students are expected to complete all assignments, attend all classes, and participate fully. This class is all about helping you become a teacher. Consider your priorities.

"A" An "A" indicates that a student is extremely well qualified as evidenced by exceptional performance in all aspects of the class. This student shows excellence and thoroughness in planning, interacting with students, command of subject matter and discusses issues and research in science education. All of these have been well-demonstrated by an active participation in class sessions. This person would never give the impression of being a passive learner "who learns best by just listening." This person uses research findings to support statements and shows a strong commitment to education.

"B" A "B" indicates that this student has done a good job of demonstrating an ability at planning, interacting and dealing with issues in science education. This individual has a good grasp of the subject matter and can implement effective lessons but, curriculum design is more simplistic and written work lacks depth and/or does not consistently use research as evidence. The "B" student shows every sign of being able to become an "A" teacher.

"C" A "C" is earned by a person who has not fully demonstrated competencies deemed necessary for secondary school science teaching. This student may be quite successful in some areas and not so successful in others and most likely will write incomplete lesson plans and lack a solid personal rationale. A "C" student will probably need special attention during student teaching to insure success and certification. (Note: a "C" is not considered a passing grade in graduate school.)

"F" A "F" is earned by a person who has met none of the minimum competencies deemed necessary for middle school science teaching. An "F" student cannot teach and must plan to retake this course, passing with a grade of "C" or better.

Policy on Incompletes: If circumstances warrant, a written request for an incomplete must be provided to the instructor for approval prior to the course final examination date. Requests are accepted at the instructor's discretion, provided your reasons are justified and that a *majo*r percentage of your work has already been completed. Your written request should be regarded as a contract between you and the instructor and must specify the date for completion of work. This date must be at least two weeks prior to the university deadline for changing incompletes to letter grades.

Honor Code: You are expected to be familiar with and abide by the George Mason University honor code.

Due Dates & Grade Percentage Breakdown

Item	Due When?	What's It Worth (pts.)?
Annual Plan	2/9	75
Female/Minority Scientist	2/16	50
Science in the News	2/23	50
Safety Plan	3/1	75
Safety Resource		
Inquiry and Science Teaching	3/22	50
Discovery Lab or Design Brief	3/29	50
Microteaching	variable-no later than 4/19	150
Rationale	4/19	100
Module	4/26	250
Report on Field Experience	variable – no later than 4/26	50
In-class Credit	varies depending on item	50
Final Reflection	5/3	50

Assignments

Science education research shows that frequent assessment of small amounts of material is most effective for learning science. Research suggests that the most effective science teachers assess learning and provide feedback daily. Therefore, in this class formal and informal assessment will be continuously provided on assignments and class activities.

Some assignments ask for two copies to be submitted. One copy will be placed in the class collection for use by future students. If you choose, you may delete or otherwise conceal your name on the second copy of submitted assignments.

On the cover page, include your name, course title, project title, date, and describe the target student population including the grade level, subject, and unit of study. Staple all pages in one assignment together. Make each project something that you will actually use in teaching. All written assignments are to be word-processed.

Participatory (mini) assignments. There are a few assignments done in class and/or at home that are intended for use in the next class session (see * below). Since these assignments are needed for class discussion and reflection, they will not be accepted late. Most of these participatory assignments are one page long and are assessed on whether you have done the assignment or not done the assignment.

*__Safety resources__ ***(independent)*** will be shared with the class. To help prepare for the safety assignment, each person will bring in copies of the best safety resource/activity they can find. Bring enough copies for everyone in the class and the instructor. The safety activities that you receive will be a resource for you in developing your safety plans.

*__Science in the News__ ***(independent)*** is a project that investigates the latest discoveries and findings in science. Newspapers or online news are a source of science current events that are written for the layperson. These articles are of general interest and can be easily read and/or understood by students. For this mini project, you will read one science article published this semester in a newspaper or general online news source. After reading the article, (1) compile a complete citation (author, date, title, source, page numbers), (2) summarize the major issues/findings of the article in 1-3 sentences, (3) write one paragraph about what aspects of the

news item could be used to teach students about the nature of science, (4) write one paragraph about how you would use the article in class, and (5) attach the actual article or a photocopy of the article.

*The **female and minority scientist report** ***(independent)*** is a one-page mini research assignment. Lists of prominent female scientists and minority scientists are provided in the course pack. You will investigate one scientist, either/or female and minority, in encyclopedia type resources or in biographies. For your scientist, create a one-page report that includes a drawing/picture/chart/diagram that shows something significant about the scientist and a short descriptive written summary about the scientist. This information will be shared in class. Also, be prepared to talk with your classmates about your scientists and what their life stories show us about the nature of science.

*Other mini assignments will be generated through in-class work.

The **Annual Planning Project** ***(independent)*** is a two-part project that includes an annual plan and quarterly projects. This project supports the massive planning effort that you have in the beginning years of teaching. For a class you will be teaching, plot on monthly planning schedules/calendars the science units of study including weekly topics. Then develop integrated quarterly projects that your students will do.

The annual plan is an outline of your plans for the year. For each science unit of study, indicate the length of time you predict that each unit will take and break that unit/time span into weekly science topics. For example, a five-week unit on the five senses may have as weekly topics - sight, sound, taste, smell, and touch. The annual plan outlines **what** you will teach not how you will teach. To get started, take monthly planning schedules/calendars and label each month, day, and school holiday. Then, indicate the science units and weekly topics you plan to cover on the monthly schedules. To assist you with this project consult school division, state, and national standards; textbooks; and *Science Standards of Learning Curriculum Frameworks.*

For the four quarterly projects, you will design a student project for each quarter that provides students with a unifying experience for the quarter. The projects should relate to the topics being studied during each quarter and should include a variety of learning strategies such as individual research papers and group presentations. For the projects, consider including science that is relevant to the social studies theme for the year, science that will enhance learning on a field trip, science fair projects, major science events of the year such as an eclipse, and/or research papers. You will receive a grading rubric for this assignment.

The **Inquiry and Science Teaching** ***(independent)*** project involves you in searching out a science lab on the Internet. There are two parts to the assignment, with the second part completed later as a participatory assignment. (1) You will critique the lesson for aspects of inquiry as defined by the Herron Continuum of Scientific Inquiry scale, referencing the level of inquiry found in the laboratory (as written) and also referencing how the laboratory reflects or does not reflect the *National Science Education Standards*, using at least two areas within the NSES content standards and one other area (e.g., assessment). This paper should be about 400-600 words. (2) After class discussion on rubric construction, you will develop a rubric to evaluate student outcomes from the science lab.

Discovery Labs/Design Briefs ***(independent)*** are two kinds of laboratory experiments. You are to design one discovery lab or one design brief. This must be a hands-on problem that secondary

school students could investigate. This lab may be included as part of your module but must also be turned in separately. In class, discovery labs will be contrasted with verification labs and samples of discovery labs and design briefs are in the course pack. The lab you create must follow the format of the examples provided. You are creating laboratory activities for guiding student exploration of science. You will receive examples, as well as a rubric for this assignment.

A **Safety Plan** ***(independent)*** is necessary for the health and safety of your students and yourself, as well as, for legal reasons. You will design a science safety plan which will include a list of safety activities that you will do with your students (one page), a list of safety rules/procedures that ends with a safety contract for the parents and students to sign and date (front and back of one page), one safety quiz over the rules and procedures, and two general safety questions that could be used on science tests sometime during the year. Your plans need to communicate the importance of safety and the on-going emphasis on safety throughout the year. A grading rubric for this project will be given to you.

A **Microteaching** ***(collaborative)*** experience at a nearby secondary school has been arranged—this should not be confused with your field experience (further discussion related to this topic will happen in class.) This will include team teaching a lesson ("event") with some of your class colleagues. You will design and deliver a lesson that will be videotaped. You will have time to review the tape, make adjustments and teach the *same* lesson to another class (i.e., you get a "do-over"). The second lesson will also be videotaped. The class will view team-selected sections of the tapes after each round of microteaching. The teams will lead brief discussions on the teaching and changes evidenced on the tape. Students will use other external analysis tools for self-analysis and team reflection. See the schedule for targeted days for this experience. (Special needs/conflicts will be handled on a case-by-case basis.) You will submit a 300-word reflection and other materials on the microteaching experience on the day your team presents their analysis. A grading rubric for this project will be given to you.

The Rationale. Your **rationale** is a personal statement of who you are/will be as a teacher, using the information you have gained in this class and other education classes to support your philosophies. Your discussion should be rich in examples from the literature and from your own experience that demonstrate you have solid reasons, both practical and theoretical, for teaching as you do. The picture must include you and your students. What will you be doing in and outside of your classroom as a teacher? If I visit you in three years in your classroom, what will I see your students doing, hear them saying, etc.? What will you be doing, saying, etc.? By expressing your personal synthesis of the ideas from this class and other classes, you strengthen your foundation as a teacher of science. Turn in two copies of your rationale – one for grading and a second for the class rationale collection. Detailed guidelines and a rubric for grading the rationale will be given to you.

The Module ***(independent***): Your curriculum (module) will reflect your ability to incorporate practical and theoretical aspects of teaching ranging from methods to technology, inquiry, safety, continuity, and assessment. The assignment will also assist you in considering the various logistical and management problems that must be overcome in order for the greatest amount of learning to take place in finite amounts of time. We will use the learning cycle and the module format described in the module guidelines. This should be a product that you will teach someday

(perhaps during student teaching or even during microteaching)!
These learning events must be connected and integrated, connecting each lesson to the next, and connecting more than one area of science at the grade level of your choice. Aim for at least 4 weeks (~10 lessons w/ block scheduling). *You may share ideas, materials, and resources with your classmates, but you must write your own lessons for your module.* Safety considerations, learning cycle approach, nature of science, inquiry-based activities, inclusion of technology(ies) and "connectivity" are a must. Your module should be developed in sufficient detail (including student and teacher support materials) that you or a substitute teacher could use it to teach from.
The Secondary Education Program faculty have developed unit guidelines for students in their first methods courses here at George Mason University. The guidelines are based upon the requirements of INTASC, NCATE, and the NSTA (for acronym reference, see p. 2). We will be using these guidelines. The grading rubric used in this class incorporates the guidelines.
Include a completed self-assessment with your completed module. Please turn in two copies of your module – one for grading and a second for the class module collection.

Field Experience – Observing other teachers *(independent).* You are required to do 15 hours of field observation, analysis, and possibly team or independent teaching under the supervision of a practicing teacher. You should be attuned to the concepts and content being addressed, teaching (e.g., questioning habits, activity-based, etc) and assessment (e.g., traditional and alternative) strategies, and students' reactions to instruction. *Within a day of each of your observations you should write a 2-4-sentence summary noting your most significant observations in a log.* Your signed observation form and a short reflection on the experiences will be completed. We have a partnership with Edison and Chantilly High Schools. The science department chairs welcome GMU students to observe the science classes there. Please contact leslie.pierce@fcps.edu (Edison) and andrea.cobb@fcps.edu (Chantilly) ahead of time to let them know you're coming. You may observe in other schools. Strive for a range of student populations (high/low income, ESOL, special needs) observed over the semester.

In-class Credit *(collaborative or independent).* We constantly will be engaged in class activities and a variety of events. Some will include a product, "creation," or written reflection. These events will occasionally be included as graded items. These may be unannounced, usually are non-threatening, and since these various activities will require participation through your presence in class, make-ups will not be allowed. However, if you are going to miss that particular class (conflict with job, etc.) or were ill **and** in either instance notified the instructor **before** you missed class, then some type of substitute product can be submitted for credit (i.e., points); otherwise substitute products will not be an option.

Final Reflection *(independent).* At the end of the semester, you will write an approximately 800-word analysis assessing your development as a teacher throughout this course (what worked, what didn't, and how to improve). In particular, discuss where you started in teaching, where you are now, and where you hope to go. Areas addressed in the paper might include your general goals for your students, questioning, learning cycle, wait time I and II, delivery strategies (e.g., cooperative learning, lectures, & didactic teaching) assessment, role of nature of science in your instruction, gender, and culturally sensitive teaching.