

CI 161  
Methods and Materials for Teaching Secondary Science  
Fall 2011  
Class Room: Sc I Room 324  
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Course Goals:

- Further development of teaching skills through microteaching of science lessons (TPE1B, NCATE 1.1, 1.3)
- Familiarity with major science education reform initiatives and their impact
- Familiarity and development of skills for application of CA Standards for Science
- Familiarity with research on how students learn science
- Effective use of technology in the science classroom
- Teaching all students, all the time including the range of learners in any classroom
- Integration of Environmental Education into the science curriculum
- The multi-cultural classroom and how to effectively teach in diverse settings

Instructional Objectives:

- 1.) Analyze and study the ideas of certain educational theorists who have contributed essential themes, concepts and/or skills related to the teaching of science (CTC Standard 13, TPE 1B).  
Topics  
Effects of Race, Social Class, and Tracking on Students' Opportunities to Learn Science; Directions for Research and Development: Alternative Methods of Assessing Scientific Literacy; Performance Assessment in Science; Teaching Science for Understanding Equitably; The Under-representation of women, minorities, and disabled persons in science. (TPE 2 & 4)
- 2.) Become familiar with the overall secondary science curriculum found in many secondary schools across the nation as well as locally. Included in this objective will be familiarization with the philosophies for the curriculum as it currently is represented as well as the "new" curriculum promoted by the new standards (state and national).
- 3.) Develop effective strategies for using a variety of instructional strategies in teaching science in order to maximize learning of key science concepts. This will be accomplished by having you prepare and deliver more than one science lesson to your peers in this class and also possibly to middle or high school students if you are currently student teaching or interning. These standards-based lessons will be geared to a range of student abilities as reflective of the typical science classroom. The lessons will also incorporate

strategies for linking science topics to technological and societal issues and problems in an effort to make the science topics more relevant to the learner and to motivate students to learn. Access to the Internet and MERLOT (Multi-media Educational Resource for Learning and Online Teaching) to review and secure instructional materials will be an important skill in the process of preparing the lessons. Students will also develop unit plans that include lessons encompassing goals, objectives, strategies, activities, materials and assessment plans congruent with each other and that include essential themes, concepts, and/or skills. Examine, first hand, the many resources and applications associated with current, state of the art teaching technology. (CTC Standard 24/25, TPE 1B, 2, 3, 5, 6C, 9, 10, NCATE 1.1,1.3, 4.1)

Topics:

Providing Comprehensible Input so All Students Have Access to the Whole Curriculum; Select Key Science Concepts from Content Being Taught and the Selections of the Language that Encodes These Science Concepts; Using Technology and Science Instrumentation in a Way That Promotes Success for All Students.

- 4.) Become engaged in role playing and conflict resolution scenarios geared at emphasizing strong student teacher rapport and promoting effective science and science laboratory classroom management skills. This will be primarily accomplished as participants in the micro-teaching experiences. (CTC Standard 22)
- 5.) Students will engage in reading / discussion linked to adaptations of the science curriculum, instructional materials, and technology for teaching science to students whose English is limited. (CTC Standard 12)

Topics:

Using Content Area Materials to Further English Language Development; Allowing Students to Express Meaning in a Variety of Way Using Media and Technology; Using Strategies to Integrate Language and Content Objectives

- 6.) Students will identify and practice strategies for modifying the teaching / learning process in science to meet the needs of linguistically diverse learners (CTC Standard 13, 25, TPE 4,)

Topics:

Grouping Students to Promote Access to Content (i.e. peer tutoring, etc); Grouping Students to Promote Equal Access to Science Content; Grouping Students to Promote Success in Science for All Students.

- 7.) Students will learn strategies and techniques for assessing prior learning and evaluating student achievement following instruction which are most appropriate for teaching science. (CTC 28, TPE 3, NCATE 1.7))

Topics:

Investigate the Many Strategies in Which We Can Install Creative Thinking and Problem-Solving Skills in Science Students Through Such Well Known Projects at "Odyssey" and "STS", "FCEPT", "SMECTEP", "Noyce", and the "PST" program; Methods of Assessment (performance-based, portfolios,

projects, labs, standardized tests, criterion-referenced tests, informal observation, embedded assessment, self-evaluation and self reflection, etc.); Development and Trial Testing of Open-Ended Assessment Items and Become Basically Familiar with Alternative Strategies for Evaluation of Students in the Science Classroom Through Such Means as Use of Portfolios, Journals, Performance-Based Embedded Assessment Techniques, etc.; Ongoing Formative Assessment, State Mandates for Identification, Placement, and Re-Designation/Exit.

- 8.) Students will recognize the importance of using a variety of assessment strategies to allow diverse learners to demonstrate achievement of desired outcomes (CTC Standard 28, TPE 3).

Topics:

Multiple Intelligence; Multiple Modalities; Choices for Demonstrating Understanding

- 9.) Identify and describe effective strategies for meeting the needs of a wide range of learners whether we are dealing with ethnically, cognitively, culturally, or linguistically diverse learners. Hands-on science can be effective for enhancing the success of all learners (building self esteem) in your classroom. Creation and/or selection of hands-on, inquiry-based science lessons appropriate for all learners will enhance this teaching skill. (CTC Standard 31, TPE 4, 8).
- 10.) Examine the many opportunities in the science education classroom to afford students an opportunity to improve and expand their written expression through use of journals, portfolios, and laboratory record notebooks, etc. Development of and familiarization with classroom management strategies which are especially appropriate for teaching science and promoting student interest and participation in science (CTC Standard 25/26, TPE 9).

Topics:

Conflict Resolution in Science Laboratories; Classroom Management in Multi-Cultural Science Classrooms; Journals and Portfolios as a Means of Understanding Your Students; Examine and Discuss Effective Strategies for Classroom Management; Using Classroom Organization That Promotes Interaction Among Students and Between Teacher and Student.

- 11.) Students will explore ways to relating content to students who have diverse interests and backgrounds and conceptions about science concepts (CTC Standard 24, TPE 4)

Topics:

Incorporating multi-cultural emphasis into curriculum/materials selection; Promote diversity as a valuable resource; and Present Content from a Multi-Cultural Perspective

- 12.) Students will develop lessons and activities which emphasize the use of higher order thinking skills in science (CTC Standard 29, TPE 9))

Topics:

Effective student grouping to promote academic achievement and development of higher order thinking and problem solving

- 13.) Students will identify multi-cultural curriculum materials designed to promote and enhance cross-cultural understanding and will investigate other ways that they can make their curriculum more multi-cultural in content and perspective (CTC Standard 25,31, TPE 4,5)

Topics:

Identification of curriculum materials that enhance cultural understandings; Cultural resources from the community; The importance of valuing diversity in the classroom and in the community; and presenting content from a multi-cultural perspective

- 14.) Students will discuss strategies appropriate for managing students' safety in a science lab setting (CTC Standard 26)

Topics: Fostering positive relationships among students in inquiry science investigations

- 15.) Students will develop and practice teaching techniques and activities which are likely to actively engage diverse learners and to promote equal access to the science curriculum. Students will also conduct regular self-analysis as part of the micro-teaching experience. Reflection on the delivery of the lesson will be a key component of these experiences. (CTC Standard 12/14/25, TPE 13)

Topics:

Using a variety of interactive teaching strategies and styles such as student-student interaction and teacher-student interaction; Using media and technology effectively, Organizing/ displaying information in a variety of ways.

- 16.) Many lessons in the class, whether delivered by students or instructor, will be geared to the so-called constructivistic model whereby students are encouraged through intrinsic motivational strategies to become positive and confident about learning and to become independent thinkers (CTC Standard 29).

Topics:

Learning science by doing science; The learner's conception about the nature of science.

- 17.) Discuss and share unit plans that are being used in student teaching in which students are currently engage ( CTC Standard 4)

### **TPE IB (Teacher Performance Expectation IB) Teaching Science in a Single Subject Assignment**

This course will emphasize elements from the Teacher Performance Expectation IB in all of the microteaching and unit development activities as described below:

Candidates for a Single Subject Teaching Credential in Science demonstrate the ability to teach the state-adopted academic content standards for students in science (Grades 7-12). They balance the focus of instruction between science information, concepts, and principles. Their explanations, demonstrations, and class activities serve to illustrate science concepts, and principles, scientific investigation, and experimentation. Candidates emphasize the importance of accuracy, precision, and estimation. Candidates encourage students to pursue science interests, especially students from groups underrepresented in science careers. When live animals are present in the classroom, candidates teach students to provide ethical care. They demonstrate sensitivity to students' cultural and ethnic backgrounds in designing science instruction.

Additionally, Single Subject Candidates guide, monitor and encourage students during investigations and experiments. They demonstrate and encourage use of multiple ways to measure and record scientific data, including the use of mathematical symbols. Single Subject Candidates structure and sequence science instruction to enhance students' academic knowledge to meet or exceed the state-adopted academic content standards for students. They establish and monitor procedures for the care, safe use, and storage of equipment and materials, and for the disposal of potentially hazardous materials.

#### Teaching Strategies:

- Experience planning yearly, unit, and daily lesson planning (some of these, not all)
- Learning to teach science process lessons and thinking skills
- Using student-centered lessons such as lab activities, cooperative learning groups, science through inquiry, etc
- Use teacher-centered lessons including leading effective discussions and using effective questioning techniques; using technology effectively
- Understanding and using the special curricular concerns such as: science safety, planning field trips, multi-cultural grouping, heterogeneous grouping; and remedial and extracurricular activities.

Much of this will be included in discussion associated with your microteaching activities.

#### Effective Classroom and Materials Management:

Understanding and using effective classroom management skills such as assertive discipline, positive self-esteem building, team and seating arrangements, ordering and management of supplies and equipment; grouping for equal access to science; and safety. Links to resources on these topics and a possible guest speaker will address this topic.

#### Reading Materials

Reading materials will be provided periodically and posted on Blackboard. The Textbook will be "Teaching Secondary School Science: Strategies for Developing Scientific Literacy." Bybee, Powell, and Trowbridge. Ninth Edition

### Grading:

It is fully anticipated that each and every one of you should do well in this course as you are now professional educators, albeit in the early stages. Participation, active leadership, organization and delivery of lessons, contributions of materials and lessons to the MERLOT digital library, and creation of a comprehensive unit plan will form the basis of the final grade. There will be 2 term papers assigned and there will be on take home final exam based upon synthesis of readings The papers will be valued at 100 points each and the final at 150 points. A complete unit of instruction (with lessons to be posted on MERLOT) will be valued at 250. Total points possible= 500.

Plagiarism/Cheating: I follow and implement student discipline procedures relating to cheating, plagiarism and other problems as noted under sections 41301 through 41304 of the California State University, Fresno General Catalog. Please review. The penalty for either plagiarism or cheating is an automatic failing grade for the course. *It also leaves a very bad impression of you as a person and future professional*

Special Needs Students: Please identify yourself to the instructor as soon as possible so that accommodations may be made. For more information, contact Student Services with Disabilities in the Library (278-2811).

## **Daily Schedule**

### **Day 1**

**Objective:** Introduce course and syllabus, have students each learn about each others preservice teaching experience(s) to date and do a presentation on the objectives of science teaching from Chapter 7 (The Goals of Science Teaching) and Chapter 8 (The Objectives of Science Teaching) from the Text "Teaching Secondary School Science":Strategies for Developing Scientific Literacy. Rodger Bybee, Janet Carlson Powell, and Leslie Trowbridge.

**Activities:** Students will complete Activity 7-1 and 7-2 and 7-4 in class followed by full class discussion of results. In addition, students will complete (in-class) Activity 8-1 with discussion following. Students will compare answers.

**Assignment:** Purchase textbook and read Textbook Chapter 1 including doing Activity 1-1, 1-2, 1-3, 1-4, 1-5.

### **Day 2**

**Objective:** *Students will explore a range of activities in Environmental Education through training in Project WILD.*

**Activities:** Students will receive training in Project WILD at the Fresno County Office of Education Outdoor Environmental Education Facility at Scout Island on the San Joaquin River.

**Assignment:** Chapter 20: *Teaching Science for Differences: Gender and Culture. Teaching Secondary School Science. Strategies for Developing Scientific Literacy. 9<sup>th</sup> Edition*

### Day 3

**Objective:** *Students will identify and practice strategies for modifying the teaching/learning process in science to meet the needs of linguistically diverse learners (CTC Standard 13, 25, TPE 4,)*

**Activities:** There will be a 30-40 minute presentation on and Small Group Discussion Session based upon assigned readings. Discussion will include the importance of grouping students to promote access to Content (i.e. peer tutoring, etc); grouping students to promote equal access to science content; grouping students to promote success in science for all students. Discussion of teacher bias, course material bias, parental bias, adding ethnicity and culture to the mix, implications for instruction, and providing equal opportunities and expectations. Students will also discuss identifying multi-cultural curriculum materials designed to promote and enhance cross-cultural understanding and will investigate other ways that they can make their curriculum more multi-cultural in content and perspective (CTC Standard 25,31, TPE 4,5). Discussion will also include the identification of curriculum materials that enhance cultural understandings; cultural resources from the community; the importance of valuing diversity in the classroom and in the community; and presenting content from a multi-cultural perspective.

**Assessment:** Students will list products from group presentation and explain their significance through group break out reporting.

**Assignment:** Produce a 5 page 1.5 space paper on teaching science for English Language Learners using the California Journal of Science Education compendium of articles on EL Learners in science teaching. Students will include discussion linked to adaptations of the science curriculum, instructional materials, and technology for teaching science to students whose English is limited. (CTC Standard 12). Topics to be included in the paper will include Using Content Area Materials to Further English Language Development; Allowing Students to Express Meaning in a Variety of Way Using Media and Technology; Using Strategies to Integrate Language and Content Objectives. Paper will also discuss identifying and describing effective strategies for meeting the needs of a wide range of learners whether we are dealing with ethnically, cognitively, culturally, or linguistically diverse learners. Hands-on science can be effective for enhancing the success of all learners (building self esteem) in your classroom. Creation and /or selection of hands-on, inquiry-based science lessons appropriate for all learners will enhance this teaching skill. (CTC Standard 31, TPE 4, 8).

**Assessment:** Paper will be score based upon ability to effectively cite references, transitions, logical sequence of ideas, grammar, and presentation of key ideas from readings.

**Assignment:** Read Chapter 18: Educational Technology in the Science Classroom. In addition, all students are to log onto the MERLOT Digital Library and join and develop an individual profile for the next class.

#### Day 4

**Objectives:** *Students will develop a familiarity of and facility with a range of online learning resources including the MERLOT Digital Library and the MERLOT Science Education Commons (developed by the CSU Technology Center for Science Education Excellence (TechCSEE)).*

**Activities:** Students working in pairs will search through online data bases in the National Science Digital Library, NASA, and similar sites and develop a 5 item personal collection of online resources in their MERLOT profile. These resources will be later be included in their microteaching of lessons to the class and in their units of instruction due at the end of the semester. Laptop computers (provided by each student for the class) will be needed.

**Assessment:** In class and extended through the next two weeks, students will peer review each others contributions and make comments online regarding the quality and utility of each others contributions. The instructor will review in upcoming classes contribution made by students as well as associated lesson plans linked to the resources. The assessment will include completeness of the personal collection, completeness of the lesson plans in terms of being standards-based, grade level appropriate, infusion of technology, strategies for working with a range of learner abilities, etc.

**Assignment:** Students are required to read the learning guide for use of the MERLOT Content Builder and the tutorial on the MERLOT Content Builder for the next class meeting.

#### Day 5

**Objectives:** *Students will learn how to effectively use the MERLOT Content Builder online resource. This powerful online resource will help them become very organized. It is expected that all instructional units (a unit of instruction is the culmination requirement for this course) will be placed onto the MERLOT Content Builder and ultimately shared with other students who will have access to the unit online.*

**Activity:** Students will be trained on how to use the MERLOT Content Builder and upon completion of training will work independently to create their own Website as a beginning point in the use of the MERLOT Content Builder.

**Assessment:** Students will be assessed based upon the completion of a comprehensive science teaching individual Website . Assessment will be based upon inclusion of all elements required in each section of the Website development protocol.

**Assignment:** Students will have two weeks to develop a 5 page (1.5 spaced) paper on the many faces of assessment. The focus of the paper will be on how they will develop a comprehensive assessment program for their own science classroom. The readings assigned for this paper are included in the California Journal of Science Education Volume V. Issue 1, Fall, 2004 as follows:

*"A Brief History of Recent Trends in Large-Scale Assessment"* - Laura Hamilton and Daniel M. Koretz



"Bringing the Science Assessment Standards into the Classroom". Audrey Champagne and Sherwood.

"New Jersey Science Curriculum Framework: Assessing Science Learning"

"Appropriate Use of High-Stakes Testing in Our Nation's Schools". American Psychological Association Online.

"Valid Uses of Student Teaching as Part of Authentic and Comprehensive Student Assessment, School Report, and School System Accountability". William J. Grobe and Douglas McCall.

"What Wrong with Teaching to the Test?" Dave Posner.

"NCLB and High Stakes Accountability" A Cure? Or a Symptom of the Disease?" William J. Mathis

"Pencils Down! How Decontextualized Standardized Testing Can Destroy Education." David Thornburg

"Nine Principles of Good Practice for Assessing Student Learning". American Association for High Education (AAHE) Assessment Forum.

"The Human Face of the High Stakes Testing Story". Linda Nathan

**Assessment:** Paper will (as all papers in this course) will be graded on level of inclusion of key points from each of the papers included in the journal, logical sequence of thought, grammar, and original thought.

**Assignment:** The assignment for the next class meeting is to read Chapter 21 from the text "Teaching Secondary School Science". The Chapter Title is "Classroom Management and Conflict Resolution"

### Day 6

**Objectives:** Students will become familiar with aspects of effective classroom management. The section will be taught by a guest instructor from the local school district (FUSD). Students will learn elements of effective conflict resolution and organization of a science classroom hands-on lab work, etc.

**Activities:** Students will work in small groups and discuss points from the assigned reading. The discussion will include conflict resolution in science laboratories; classroom management in multi-cultural science classrooms; journals and portfolios as a means of understanding students; effective strategies for classroom management; using classroom organization that promotes interaction among students and between teacher and student. Each group will report out products of their discussion.

**Assessment:** Students will produce (in class) a one page paper on how they would each deal with classroom scenarios that focus on handling conflict resolution in the classroom. The paper will be graded based upon organization of thought and inclusion of strategies presented in class.

**Assignment:** In preparation for a series of class meetings that allow students to each microteach a 30 minute lesson, students are expected to create a lesson plan and read assigned chapters from the text on lesson plan design. The lesson is to be emailed to the instructor for comment. 4 students will be expected to begin the microteaching (30 minutes each followed by 10 minutes of microteaching assessment discussion). The number of evenings required will be a function of the size of the class. An average of 4 days is anticipated.

### Days 7, 8, 9, and 10

**Objective:** *Each and every student will be provided an opportunity to teach a science lesson to their peers. The purpose will be for each student to experience the delivery of a lesson and to receive peer and instructor feedback immediately upon completion of the lesson.*

**Activities:** Four students will each conduct a 30 minute science lesson with the remainder of students as the audience. The lessons will be based upon a pre-circulated lesson plan. The microteaching lessons can be on any science (standards-based) lesson topic from grade 7-12 in any science discipline.

**Assessment:** Upon completion of the microteaching experience, each student who has presented will self reflect and self critique on their perception of the lesson just presented. In addition, students in the class will comment and provide constructive feedback to the presenter as will the class instructor. Feedback will be based upon observation protocol used in the EHD 155 A and EHD 155B. Assessment discussion will include all elements of successful teaching including, effective questioning for high level thinking (Bloom's Taxonomy) , use formative and summative assessments, standards-based instructional objectives, circulation while teaching, management of laboratory activities, classroom management, grade level appropriate academic language, strategies for EL students in the science classroom, effective grouping of students, safety in science teaching, and related items.

**Assignment:** Throughout the microteaching period of days in the semester, all remaining chapters of the text are to completed and including chapter end activities to be turned in for evaluation.

### Day 11

**Objective:** *Presentation on Misconceptions in the Science Classroom (using the "Private Universe" series) followed by small group discussions. The purpose will be for students to better understand the important role of the science teacher in helping students to work out of their alternative conceptions of the natural world.*

**Activities:** Students will view "A Private Universe" and complete activities in class associated with the area of misconceptions in science. In addition, they will break into small groups and discussion articles from the California Journal of Science Education Misconception series.

**Assignment:** Read Unit 5 in the Textbook and prepare for discussion on unit assignment at the next class meeting.

### Day 12

**Objective** Students will understand the nature and structure of a unit of instruction as, in small groups they discuss Models of Effective Science Teaching (Chapter 13) from the text with an emphasis on the 5-E's model of teaching science through inquiry and details of a unit of instruction in Chapter 14 of the text (Planning for Effective Science Teaching).

**Activities:** Working in groups, student will craft an overall outline of an instructional unit with special attention to the checklist of requirements for the Science Unit provided on pages 194-195 in the text. The unit will be based upon the 5-E Inquiry approach to teaching and learning science.

**Assignment:** A the major assignment for this course, each student will construct a unit of instruction based upon the elements provided by the textbook provided in Chapter 14/15. The California Standards-Based unit must be for any grade in 7-12 and consist of a thematically linked set of lesson plans with all associated resources. The unit of instruction will be placed onto the MERLOT Content Builder and will include all resources, assessments, online resource links, and strategies for diverse learners.

**Assessment:** Assessment will directly linked to the “checklist” (essential a rubric) of materials included in Chapter 14 and inclusion of all essential elements of the 5 E’s Model of Inquiry Teaching. This assignment must be completed by the final exam day. The final exam day will be used to allow each student a chance to share their planned units with their peers.

**Assignment:** Assignments for the remainder of the semester are for all students to continue to work on the unit of instruction and master the MERLOT Content Builder as the online resource to house and organize the unit.

### Day 13

**Objective:** Students will become familiar with strategies for safety in teaching science as established by the State of California and certain professional societies.

**Activity:** A guest speaker (Ms. Jean Pennycook) annually presents this session on safety in science and uses videos provided by Flynn Scientific, Inc as a teaching tool. Students leave with a host of materials on safety in science teaching.

**Assessment:** Students will complete a pre-and post-test on safety practices in teaching science in the secondary school classroom.

### Day 14

**Objective:** Students will visit the Lawrence Livermore National Lab and (subject to scheduling) the Lawrence Hall of Science. The purpose of the visit will be for students to see “big science” and to learn about summer research opportunities for science teachers. At the Lawrence Hall of Science, they will learn about the many curriculum development projects for science teaching that have come out of the Hall over the past several years.

**Activity:** A full day (possibly a Friday) field trip to Livermore and Berkeley.

**Assessment:** Students will write a report on the field trip and discuss those elements of the trip that will help their teaching of science in the years ahead.

**Day 15**  
**GUEST SPEAKER NIGHT**

**This evening is devoted to bringing in a distinguished scientist or science educator to talk about the importance to science learning to students (K-12). The event will generally be open to a range of students at the university.**

**Day 16**

**Objective:** Students will learn what other students have created for their individual units of instruction and learn how they will be able to use each other's products through the online resource MERLOT Content Builder

**Activity:** Each Student will share his or her unit of instruction with others in the class and provide details of each lesson included in the unit.

**Assessment:** The unit of instruction will be graded based upon the rubric of completeness provided in the textbook.