Elementary School Science Methods

EDCI 553

Summer 2004, Mondays
A 412 Robinson Hall

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Course Description. EDCI 553 is a course designed for the students in the part-time elementary cohort. The course is designed to build fundamental knowledge of elementary 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, using educational technologies to support science lessons, integrating other subject matter areas with science, designing lessons that include all students in learning science, and assessing student understanding of science and the nature of science. The teachers will plan and teach lessons for students to learn science, observe students learning, and conduct research on student learning. Field experience in the summer science camp is a required part of this course.

Texts:

- EDCI 553 Course Pack, available in GMU bookstore

Supplies: 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:

- Explore science from a student-relevant and integrated perspective that spans the traditional disciplinary boundaries in science (chemistry, life science, Earth/space science, and physical science) and connects with other subject areas.
• Build a repertoire of science teaching and assessment strategies by reading, writing, observing, participating in, and reflecting on the teaching and learning of science in elementary school;
• Develop strategies to move elementary students toward scientific literacy, thinking critically and creatively, understanding the nature of science, and seeing 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;
• Experience contemporary student-focused methodologies through both instructor- and student-led teaching experiences including individual and cooperative learning strategies and employing a range of technologies from overheads to more advanced technologies such as Web searching and probeware.
• Develop an understanding of science safety fundamentals and management strategies;
• Work collaboratively with peers to teach and discuss science and science teaching.

**Relationship to Program Goals and Professional Organizations:** EDUC 553 is designed for students seeking an elementary school teaching license. It focuses on the teaching of elementary science as called for by state (VA SOLs) and national science standards (NSES) 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 553 builds a repertoire of elementary science teaching and assessment strategies to facilitate student learning.

**Nature of Course Delivery:** Most class sessions start with approximately 30 minutes of cooperative or collaborative group activities based on the project that is due that day or on assigned readings. This is an opportunity to share what you have developed or learned and to expand your repertoire. During the rest of class, a variety of teaching strategies will be used to explore the themes of the day. 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.

**GSE Statements of Expectations.** The Graduate School of Education (GSE) expects that all students abide by the following:
• Students are expected to exhibit professional behavior and dispositions. See gse.gmu.edu for a listing of these dispositions.
• Students must follow the guidelines of the University Honor Code. See http://www.gmu.edu/catalog/apolicies/#TOC_H12 for the full honor code.
• Students must agree to abide by the university policy for Responsible Use of Computing. See http://mail.gmu.edu and click on Responsible Use of Computing at the bottom of the screen.
• Students with disabilities who seek accommodations in a course must be registered with the GMU Disability Resource Center (DRC) and inform the instructor, in
writing, at the beginning of the semester. See www.gmu.edu/student/drc or call 703-993-2474 to access the DRC.

General Course Guidelines

Class Schedule and Attendance: Class meets at scheduled times. 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.

Due Dates & Assignment Points Breakdown (Course Assts. = 1000 points)

<table>
<thead>
<tr>
<th>Item</th>
<th>Due When?</th>
<th>What’s It Worth (pts.)?</th>
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</thead>
<tbody>
<tr>
<td>Science Autobiography</td>
<td>6/9</td>
<td>40</td>
</tr>
<tr>
<td>Web Activity Analysis</td>
<td>6/14</td>
<td>40</td>
</tr>
<tr>
<td>Rubric</td>
<td>6/16</td>
<td>-</td>
</tr>
<tr>
<td>Science Lesson Plan</td>
<td>6/21</td>
<td>40</td>
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<tr>
<td>Science Circus</td>
<td>6/23 or camp days</td>
<td>100</td>
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<tr>
<td>Science Camp Teaching</td>
<td>3 days of camp</td>
<td>150</td>
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<tr>
<td>Science Camp Teaching Presentation</td>
<td>7/12 or 7/14</td>
<td>-</td>
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<tr>
<td>Annual Plan</td>
<td>7/7</td>
<td>100</td>
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<tr>
<td>Module</td>
<td>7/19</td>
<td>200</td>
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<tr>
<td>Science in the News</td>
<td>7/21</td>
<td>40</td>
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<tr>
<td>Female/Minority Scientist</td>
<td>7/21</td>
<td>40</td>
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<tr>
<td>Rationale</td>
<td>7/26</td>
<td>150</td>
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<tr>
<td>In-class Credit</td>
<td>varies depending on item</td>
<td>50</td>
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<tr>
<td>Final Reflection</td>
<td>7/28</td>
<td>50</td>
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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 major 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.

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.

All written assignments are to be word-processed. 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.

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.

*The *science autobiography* is a 300- to 400-word description of what you remember about your experiences in elementary school science. We will take some time in class to discuss our memories together prior to the assignment. If you have difficulty remembering elementary science, then write what you CAN remember and add what you remember about the next few years, in the middle grades. For the next class, be prepared to talk with your classmates about possible implications for elementary school science. Also, be prepared to imagine what your (future) students’ science memories will be – what’s the best possible outcome you can think of?

**Science in the News (independent)** is a 300-400 word mini research assignment 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 upper elementary students. For this mini project, you will read a 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 will be provided. You will investigate a female and/or minority scientist, 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 each 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.

The **Web Activity (independent)** project involves you in searching out a science activity on the Internet. There are three parts to the assignment, with the third part completed after a lesson on rubrics. (1) You will critique the activity for aspects of inquiry as defined by the National Science Education Standards, referencing at least two areas within the NSES content standards and one other area (e.g., assessment). This paper should be about 300-400 words. (2) The second part of the assignment consists of demonstrating the activity to your classmates. (3) After class discussion on rubric construction, you will develop a rubric to evaluate your “Web Activity” write-up.

The **Science Lesson Plan (independent).** Your science lesson plan is an introduction to use of the learning cycle for planning instruction. For this lesson plan, you will use a part of the learning cycle, with the assumption that you would complete the learning cycle in a subsequent lesson. You must include in the Instructional Plan two of the five learning cycle steps: “Explore”
Adapted from Sterling, D, and Varrella, G, syllabi, 2002.

and “Explain”. You will include all supporting materials and notes as described on the second page of the lesson plan template in your science course pack. You may use materials you have prepared for Dr. Shana Barr’s class as the basis for this assignment. Where these materials are already part of the packet you have prepared for Dr. Barr, be sure to indicate this, and include all materials with the packet submitted for the science lesson plan assignment.

The Science Circus (collaborative). In Chapter Four of Science Stories, Janice Koch introduces the idea of a science circus for elementary science instruction. Science circuses provide a rich set of experiences about a science topic. Your science circus will consist of four or more activities focused on a science topic, and also of your plan for questions that should lead to the construction of better understanding about the topic. Use the Science Standards of Learning CurriculumFramework as a reference for sub-topics that support the main science topic of the circus. Your group will stage the circus for your classmates or for the campers in science camp, and will lead a class discussion following the circus. You will prepare packets of student activity cards and teacher cards for all members of our class and will bring those to class for distribution to your classmates. These will be due on the day your team presents its video vignette and reflections on teaching science camp.

Turn in two copies of your packet to me, one for me to grade and one for the class circus collection.

The Annual Planning Project (independent) is a three-part project that includes an annual plan, semester projects, and lesson plan for the first day you teach science. This project supports the massive planning effort that you have in the beginning years of teaching. For a grade level you hope to teach, plot on monthly planning schedules/calendars the science units of study including weekly topics. Then develop semester projects that your students will do. Lastly, create a daily lesson plan for the first day of science class that you will teach.

The annual plan is an outline of your plans for teaching science for the year. For each science unit of study, indicate the length of time each unit will take and weekly science topic. 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 Framework.

For the two semester projects, you will design a student project for each semester that provides students with a unifying experience for the semester. Briefly describe each semester project in one to three sentences. 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. The projects should relate to the topics being studied during each semester and should include a variety of learning strategies such as individual work and group presentations.

Conclude this project by planning the first day of science class for the year using the daily lesson plan guide in your course pack.

Science Camp Teaching. A special feature of the EDCI 553 class in the summer is the science camp teaching (collaborative) experience that is part of the CREST summer science
camp. Your team will be responsible for leading 15 hours of camp activities. During this time, your team will design and deliver lessons that will be videotaped. You will review the tapes from your first day of teaching, make adjustments and teach the *same* campers another lesson. The second day and third days of lessons will also be videotaped. The class will view team-selected sections of the tapes after this experience is completed. Your team will lead a brief discussion on the teaching and changes evidenced on the tape. Students will use other external analysis tools for self-analysis and team reflection (see the Burry-Stock rubric in your coursepak for ideas). On the day you present your science camp teaching analysis to the class – *before you do your presentation*, turn in a final copy of your science camp lesson plans, your goals (see coursepak for more information), and your science circus (two copies) to Dr. Matkins. Also, include a 300-word reflection (each team member) on the science camp teaching experience with the packet of materials you submit to Dr. Matkins.

**The Module (collaborative or 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 your coursepak. This should be a product that you will teach someday, perhaps during student teaching or even during science camp!

These learning events must be integrated, connecting more than one area of science at the grade level of your choice. If you do your project solo, aim for at least 3 “days” (~ 150 minutes) of detailed learning events, which are part of your 2-week long module plan. If you do it as a team, (i.e., co-develop the module) you will multiply the number of team members x 2 (i.e., 2 person/team = 6 days of lessons and a 4-week plan for instruction, 3 person/team = 9 days of detailed lessons and a 6-week plan for instruction). Safety considerations, learning cycle approach, nature of science, inquiry-based activities, inclusion of technology(ies) and “connectivity” are a must. Detailed guidelines and a rubric for grading the module are provided in the coursepak.

Turn in two copies of your module – one for grading and a second for the class module collection.

**The Rationale (Independent).** Your rationale is a personal statement of who you are/will be as a teacher, based upon the information you have read in this class and other education classes. It is a statement of your synthesis of the practical and the theoretical. 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.? 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. By expressing your personal synthesis of the ideas from this class and other classes, you strengthen your foundation as an elementary teacher of science. Detailed guidelines and a rubric for grading the rationale are provided in the coursepak.

Turn in two copies of your rationale – one for grading and a second for the class rationale collection.
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 teaching (what worked, what didn’t, and how to improve). In particular, discuss where you started in science 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.
<table>
<thead>
<tr>
<th>Date</th>
<th>Readings Due</th>
<th>Activities</th>
<th>Due</th>
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<tbody>
<tr>
<td>6/7</td>
<td>First Day – what have you read that might help?</td>
<td>√ Science Autobiography</td>
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<td></td>
<td>• House Keeping Part I – Roll (&amp; Role) Call</td>
<td>√ Web activity-surf discussion</td>
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<td></td>
<td>• House Keeping Part II – Who are we and what will we do this summer?</td>
<td>√ Overview of course</td>
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<td>√ Inquiry/The Learning Cycle</td>
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<td>√ Setting up summer camp schedule</td>
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<td>6/9</td>
<td>• Koch: Preface &amp; Ch. 1-3</td>
<td>√ Meet with FCPS teachers</td>
<td>Web activity demonstration</td>
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<td></td>
<td>• <a href="http://www.ascd.org/frameedlead.html">Website</a> — Using Rubrics to promote thinking and learning in Educational Leadership.</td>
<td>√ Intro to rubrics</td>
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<td>√ Basic Process Skills, observation, inference, prediction</td>
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<td>6/14</td>
<td>• Koch, Ch. 4</td>
<td>√ Science circuses</td>
<td>Web activity analysis due</td>
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<td>• Readings 5, 6, 7, 8 from e-reserves</td>
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<tr>
<td>6/16</td>
<td>• Koch Ch. 13 &amp; 14</td>
<td>√ Work with FCPS teachers</td>
<td>Rubric to evaluate the Web activity assignment</td>
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<td></td>
<td>• Readings 1, 2, 3, 4</td>
<td>√ Rubric Study/Exchange</td>
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<tr>
<td>6/21</td>
<td>• Koch, Ch. 11 &amp; 12</td>
<td>√ Lesson Plan Study/Exchange</td>
<td>Science lesson plan due</td>
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<td>• Readings 9, 10, 20</td>
<td>√ The Nature of Science</td>
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<td>√ Concept Mapping – Inspiration® program</td>
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<td>√ Kits, etc.</td>
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<td>6/23</td>
<td>• Koch, Ch. 5, 6, 7</td>
<td>√ Work with FCPS teachers</td>
<td>Science Circus Presentations (if not done as camp activity)</td>
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<tr>
<td></td>
<td>• Readings 11, 12, 13</td>
<td>√ Planning a year’s science</td>
<td></td>
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<td></td>
<td>• Virginia Science SOLs and Curriculum Framework</td>
<td>√ Module Discussion</td>
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<td>√ Loose ends, science camp</td>
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<tr>
<td>6/28</td>
<td>• Koch Ch. 8</td>
<td>√ The practice and art of questioning</td>
<td>Teaching science camp!</td>
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<td></td>
<td>• Readings 18, 19, 23</td>
<td>√ Safety in the Ele. School</td>
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<td></td>
<td>• Use this time to prepare camp lessons or other assignments</td>
<td>√ Science Camp Debrief and Preview</td>
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<tr>
<td>6/30</td>
<td>• Koch Ch. 9</td>
<td>√ Questions Review</td>
<td>Teaching science camp!</td>
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<td></td>
<td>• Readings 14, 15</td>
<td>√ Concept Maps</td>
<td></td>
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<td></td>
<td>• Use this time to prepare camp lessons or other assignments</td>
<td>√ STS, Learning Cycle, Connectivity! (modules)</td>
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</tbody>
</table>
| 7/7   | • Koch Ch. 10 | ✓ FCPS teachers – how is camp going?  
    |            | ✓ Review module collection!  
    |            | ✓ Integrated process skills | Annual Plan Due |
| 7/12  | • Readings 21 & 22  
    | • (use this time to catch up on your readings to help you write your research-based rationale paper!) | ✓ Integrated process skills  
    |            | ✓ The Scientific Method | Science Camp Teaching Presentations, 50% of Teams |
| 7/14  | • Koch: Ch. 15 (helpful for the module AND rationale)  
    | • National Science Education Standards (NSES) | ✓ FCPS teachers – how did camp end?  
    |            | ✓ NSES – Goodness of Fit  
    |            | ✓ Rationale topics – prepping for the last big assignment what are your learning goals for your students?!?! | Science Camp Teaching Presentations, 50% of Teams  
    |            | (Module 200 +15 pts) |
| 7/19  | • “Research Matters – to the Science Teacher” [insert link]  
    | • “Enhancing Learning Through Conceptual Change Teaching” | ✓ Private Universe  
    |            | ✓ Children’s Misconceptions  
    |            | ✓ Prior knowledge, conceptual change, generative learning | Module (200 pts) |
| 7/21  | • Readings 16 & 17 | ✓ Discussion of science in the news write-ups  
    |            | ✓ Discussion of scientist write-ups  
    |            | ✓ Equitable Science: Making science really “for all” | Science in the News Due  
    |            | Female/Minority Scientist Due |
| 7/26  | • Guest, ZPG  
    | • Readings as assigned | ✓ ZPG activities, integrated science lessons with an STS flavor. | Rationale due |
| 7/28  | • Readings as assigned  
    | • Last Class – Happy End of Term! | ✓ Hosted by collaborative teams  
    |            | ✓ Favorite AIMS, GEMS, ZPG, Project Wild and Aquatic Activities  
    |            | ✓ Loose Ends  
    |            | ✓ Congratulations All Around | AIMS, ZPG, GEMS, Project Wild, Aquatic Wild performance day  
    |            | Final Reflection |
Elementary School Science Methods Readings

EDCI 553
Summer 2004

ASSESSMENT


Authentic Learning & Problem Based Learning


Concept Maps (And Learning Theory)


Inquiry, Constructivism, and Curriculum Design


**Equity/Gender**

**Questions and Wait Time**

**The Nature of Science**

**Teaching, Et Al.**

**Safety**