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C&I 404.01: Teaching Science K-8

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University of Montana
C & I 404: Teaching Science K-8
Spring 2008

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Take Chances! Make Mistakes! Get Messy! – Ms. Frizzle

Required Reading Materials:

- Membership in the National Science Teachers Association. Membership includes a subscription to Science and Children, Science Scope or Science Teacher and online access to all journal archives.Visit http://www.nsta.org/ to register.

- Keeley, Eberle, & Tugel (2005). Uncovering student ideas in science. NSTA Press: Arlington, VA. (Volume I or II). Order from NSTA or amazon.com.

- One Engineering Is Elementary Teaching Guide of your choice: 1) Catching the Wind: Designing Windmills; 2) To Get to the Other Side: Designing Bridges; 3) Water, Water Everywhere: Designing Water Filters; 4) A Sticky Situation: Designing Walls; 5) The Best of Bugs: Designing Hand Pollinators; 6) An Alarming Idea: Designing Alarm Circuits; 7) Sounds Like Fun: Seeing Animal Sounds; 8) Marvelous Machines: Making Work Easier; 9) Just Passing Through: Designing Model Membranes; 10) The Attraction is Obvious: Designing Maglev Systems; 11) A Work in Progress: Improving a Play Dough Process; 12) A Stick in the Mud: Evaluating a Landscape; 13) Thinking Inside the Box: Designing Plant Packages. Order from the Boston Science of Museum: http://www.eiestore.com/cuma.html.

Course Description

Welcome to Methods of Teaching Elementary Science! How do K-8 students construct science understandings? Which classroom conditions foster opportunities for students to learn and enjoy science? What teaching strategies engage students in doing and understanding science? These questions will be the guiding framework for this course. You will explore these questions by reflecting on your own and others' science learning and teaching, and through reading and discussing research about science teaching and learning. We will pay particular attention to the inquiry approach modeled by the National Science Education Standards. Class experiences are designed to help you be able to:

1. Present and defend your beliefs about elementary science teaching and learning;
2. Explain how students' science ideas influence learning and use questioning strategies to reveal students' science understandings;
3. Differentiate between elementary science experiences which teach both content and inquiry from those that do not;
4. Use teaching strategies that facilitate student interest and learning in science, are consistent with an inquiry teaching/learning model;
5. Plan learning sequences which integrate science across the curriculum using a model of conceptual change teaching;
6. Apply research to the selection, comparison, and implementation of elementary science curriculum;
7. Understand how technology can be used as a tool in the science classroom;

8. Develop a knowledge of controversial issues in science;
9. Understand ways to assess student learning in science; and,
10. Reflect upon your science teaching, noting areas of mastery and areas of emerging growth.

Expectations

This is a course in which all students will be active participants. You must be more than physically present—you must make positive contributions to the ongoing learning of others. Students are responsible for class preparation and discussions during the class period. Preparing for class will involve reading the assigned materials, as well as identifying and reading additional resources. Regular attendance is expected. Due to the nature of the course, attendance, participation, and discussion are crucial components in achieving the course objectives. Absentees are responsible for any in-class announcements, changes in the syllabus, and material discussed in class.

Assignments are due in class on the dates listed. Late assignments will not be accepted unless prior arrangements have been made with the instructor. Assignments will be graded using criterion-referenced methods, i.e., a specific set of standards. As a general guide, a "C" grade represents average work. It means that all assignments are done as described. A "B" grade represents above average work. It indicates that self-initiative has been taken to research topics and bring more to the assignment than just required. An "A" grade represents a high level of mastery with evidence of reflection and research as well as personal innovation, relevant applications, and extensions. **Should you have any questions concerning a grade, I am always happy to discuss them but ask that you make an appointment so I can give the matter careful consideration and maintain confidentiality.**

It is important to remember that effort alone does not necessarily guarantee above average grades; rather, high quality thought and products ensure above average grades. To meet professional presentation standards required of practicing teachers, your assignments must be word-processed, concisely written, fully referenced, and stapled.

A final note, I know the block schedule is tight, so eating in class is hard to avoid. If you bring food and drink with you, please be sure to dispose of it appropriately. Also, because this is a large group in such a small space, please remember to show respect for your fellow classmates. Outside conversations, newspapers in class, cell phones, and tardiness are a real distraction to other students.

Sequence of Topics & Evaluation

Part I: **Topics:** The nature of science, science standards, inquiry, process skills
Assessment: Science Around Us Photoessay**;** Standards Paper; Formative Assessment Probes; Learning Blog

Part II: **Topics:** Students' science ideas, teaching for conceptual understanding, 5E's, Science Fair, Science Olympiad, and Invention Convention
Assessment: Science Lesson & Concept Analysis using Wikispace; Science Olympiad Circus and Science Fair Judging; Learning Blog

Part III: **Topics:** Integrating science; culturally responsive science curricula; assessment
Assessment: Google Earth Tour; Engineering is Elementary**,** Learning Blog; Thematic Unit

Part IV: **Topics:** Spatial Literacy
Assessment: AEJEE and GPS Drawing Assignment

Course Assignments

Participation/In-class Activities: This is due daily or as announced. Your attendance and participation are highly valued. I will take roll each class session and give one point for each full class attended.

Learning Blog: Each student will complete weekly blog entries related to course readings or explorations as a tool for reflection, self-guided learning, collaboration, and building community. The url address for the learning blog is: http://spring2008elementaryblock.blogspot.com/. Details for completion of the weekly blog entries will be provided in class.

Science Around Us PhotoEssay: How do you launch a science classroom rich in inquiry opportunities? First, students need to learn how to ask a testable question. You and a partner will develop and share a ten slide powerpoint which includes ten images and at least fifteen testable questions. The slideshow should represent a complete science content domain (Biology, Physical Science and Earth/ Space Science) and include images from, home, school, and issues in the local and national news.

Standards Paper: Schools across the nation are reviewing their curriculum to ensure that it aligns with the *National Science Education Standards*. It is important for you to understand what the standards define as best practice and be able to identify non-example and example best-practice science lessons. In this paper, you will identify and print one best-practice science lesson (this lesson must come from one of the following sources: Science Scope or Science and Children; the journal must be dated 1996 or later) and one science lesson that does not model best science practices (this may come from textbooks, curriculum modules, internet, etc.). Your discussion section will provide evidence from the research for your choices, discuss where the lesson is aligned with the NSES content standards, and provide adaptations for the non-example to align it with the standards.

Using Formative Assessment Probes: Assessment dominates today's educational landscape. In this assignment, you will work with a team to present a 15 minute formative assessment probe. Your team will collect data to examine students' science ideas. Based on this data, your team will identify and submit an appropriate lesson plan, including a rationale for your choice that could be used to develop students' conceptual understanding.

Science Lesson & Concept Analysis: "Let's do it again!" Those four words are a strong indication that your students are engaged. Mastery of facilitating meaningful science learning opportunities for your students can best be measured by performance. This assignment will have several parts, each designed to familiarize you with the components of a science lesson based on teaching for conceptual understanding.

For your first step, you and your partner will identify your science topic area and science concept to be taught. Your cooperating teacher will help you with the concept selection. After selecting your science concept to be taught, you will need to learn as much as you can about the concept. The second part of the assignment will be to develop a 5 E's science lesson plan to teach to elementary students as part of your field experience. A detailed lesson plan format will be provided in class. A draft lesson plan will be developed and reviewed with your instructor during **a 20 minute private conference that your team schedules with me during week five**. The draft should be as complete as possible.

Effective science teaching requires that students first be made aware of their existing science ideas. As part of your science lesson you teach in the field, you and your partner will develop a strategy to reveal students' pre-existing science ideas. This may be a student drawing, concept map, prediction sheet, etc. You will ask students to revisit these at the end of your lesson and reflect on their current science understandings. **Your science lesson must be taught during week six**. **Your lesson plan will be shared with your classmates using wikespaces during week seven.**

In the third part of this assignment, you and your partner will complete a teaching analysis of the science lesson. In your analysis you will report on your assessment of the students' understanding of the science

concept based on the data you collected when revealing students' science ideas. A detailed outline of analysis expectations will be provided in class. **The concept analysis is due week seven.**

Science Fair Judging: We have been asked to help out two local schools with their science fair judging. This will require either a Friday morning, afternoon, or evening spent in the schools. You may be responsible for hosting a science fair someday so this is an excellent opportunity to see how it's done! The first science fair will be held on Friday, **February 29th** at Washington Middle School from 2:00- 7:00 PM. The second one will be held at Hellgate Elementary on Friday, April TBA from 8:45-11:15. You are required to attend one of these science fairs and encouraged to attend both.

Thematic Unit Plan. When you begin classroom science teaching, a primary task you will face is developing curriculum in the form of units. For this major course assignment, you will work with a partner to design and implement a series of lessons at a local elementary school. This assignment is an integral part of your field experience and is described in depth in your field experience seminar. **Your thematic unit must include at least one integrated science lesson plan using the 5 E's format.**

Geospatial Technology Workshop: As part of this class, you will receive a two-week inservice in geospatial technology: Google Earth, GIS and GPS. Geotechnologies integrate science, social studies, math, technology and literacy. GIS is a powerful data analysis tool used for organizing, manipulating, creating, analyzing, and mapping data. To receive full credit, you must attend all of the sessions and complete the GeoSpatial Literacy Assignment (a detailed assignment outline will be provided in class).

Accommodations

Please contact me following the first class meeting to arrange any teaching/learning accommodations you require.

Graduate Students

All graduate students must complete a graduate increment for this course. As an individual or in a team, research an area of science education that you believe is important to effective science teaching (It may be helpful to refer to the 2007 Handbook of Research on Science Education. Develop a 20 minute powerpoint that will be presented during the final exam time listed in the course syllabus. Your powerpoint will be evaluated using the criteria outlined below:

- Clear introduction to the topic is present. The topic is selected from an area of science education research that clearly supports or informs effective science teaching. A rational for topic selection is delineated.
- Well-organized progression of information is provided with research from the following refereed science education journals: Science Education and Journal of Research in Science Teaching and one other refereed journal of your choice.
- Plan for three talking points within the presentation where dialogue and discussion with the class is encouraged, present, and effective.
- Connections to central issues framing the teaching of elementary science are identified.
- Three recommendations for teaching science are provided. These recommendations are thoughtful, reasonable, and research based.
- Annotated bibliography of at resources is included and contains at least five citations.

Academic Misconduct

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. The Code is available for review online at http://www.umt.edu/SA/VPSA/index.cfm/page/1321.

Tentative Course Schedule

Week 1

8/27 THE NATURE OF SCIENCE: What is science and why teach it?

8/29 THE NATURE OF SCIENCE cont'd

Week 2

9/4

9/5 SCIENCE STANDARDS: How do I know what/how to teach?

Week 3

9/10 SCIENCE AND INQUIRY: Defining inquiry and process skills (Inquiry ≠ hands-on)

9/12 SCIENCE, DESIGN, AND INQUIRY cont'd: Exploring force and motion using the SAE curriculum.

Week 4

9/17 MEETING THE "JET TOY DESIGN CHALLENGE"
Reading: Robertson, W. (2002). Stop Faking It: Force and Motion. NSTA Press: Arlington, VA.

9/19 CHILDREN'S SCIENCE IDEAS: How do children's science ideas influence learning? The Private Universe.
Reading: 1) Keeley, Eberle, & Farrin (Jan. 2005). *Formative assessment probes: Uncovering students' ideas in science*. Science Scope. 2) Nam-Hwa Kang & Howren (Sept. 2004). *Teaching for conceptual understanding.* Science and Children.

Week 5

9/24 ASSESSING MENTAL MODELS: How do you reveal children's ideas about science? How can I develop a productive questioning strategy to help students plan investigations?
Readings: Furtak & Ruiz-Primo (January 2005). *Making students' thinking explicit during scientific inquiry.* Science Scope.

9/25 LESSON CONFERENCES

Week 6

10/1 **TEACHING MATH, SCIENCE, & SOCIAL STUDIES LESSONS IN THE SCHOOLS!!**

10/3 **TEACHING MATH, SCIENCE, & SOCIAL STUDIES LESSONS IN THE SCHOOLS!!**

Week 7

10/8

10/10

Week 8

10/15 SCIENCE, DESIGN & TECHNOLOGY: Integrating technology and design into the science classroom.

Readings: jet toy

10/17 SCIENCE & TECHNOLOGY cont'd
Readings: jet toy

Week 9
10/22 CULTURALLY RESPONSIVE SCIENCE CURRICULUM: What is it and how can I use it to support Native knowledge systems?
Readings: TBA

10/24 CULTURALLY RESPONSIVE SCIENCE CURRICULUM cont'd

Week 10
10/29 SCIENCE-LITERACY CONNECTIONS: Integrating science into your literacy program.
Readings: Miller, R. (Nov/Dec 2004). *Making thinking visible.* Science and Children
Assignment: Learning Journal

10/31 SCIENCE ASSESSMENT How do you assess students' ability to do inquiry? To understand and apply science concepts?
Readings: 1) National Science Standards, Chapter 5.

Week 11
11/5

11/7

Week 12
11/12 **THEMATIC WORK SESSION**

11/14 **THEMATIC TEACHING!**

Week 13
11/19 **THEMATIC TEACHING!**

11/21 **THEMATIC TEACHING!**

Week 14
11/26 GEOSPATIAL TECHNOLOGY Workshop (AEJEE)

11/28 GEOSPATIAL TECHNOLOGY Workshop (AEJEE)

Week 15
12/3 GEOSPATIAL TECHNOLOGY Workshop (GPS Scavenger Hunt)

12/5 GEOSPATIAL TECHNOLOGY Workshop (GPS Drawing)

Week 16
Final Exam Meeting Times: Section One:
Section Two:

Grading Policy

Final grades will be calculated based on the following percentages of total points:

A	95-100
A-	92-94
B+	90-91
B	87-89
B-	84-86
C+	81-83
C	78-80
C-	76-77
D	68-75
F	Below 68

Assignment	Value
Participation	%
Learning Blog	%
Science Around Us Photoessay	
Formative Assessment Probe	%
Lesson Plan on Wikispace	
Standards Paper	%
Science Lesson Concept Analysis	%
Science Fair Judging	
Design Notebook on Wikispace	
Geospatial Technology Project	%
Thematic Unit Plan	%

Please note that this document serves as a guide for course content and student evaluation. I welcome student input and reserve the right to be a learner as well as a facilitator. Thus, I may adjust this guide as the semester proceeds. Any changes will be announced in class.