

School of Education  
University of Puget Sound  
Fall 2008

Monday-Thursday, 11:00 a.m.-12:50 p.m.  
Howarth 214

**Education 618C**  
**Learning and Teaching in the Subject Area**  
**Mathematics and Science**

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“ . . . when the textbook is used as the sole source of education, students are often turned off by its stale, static, impersonal and, often unreachable presentation.” Tarry Lindquist

“Math is hard. What is it used for? If I don’t see the purpose, I won’t get it. I say what are we going to use it for? They should apply and implement it to some actual need.” Lincoln High School Senior

“Chemistry—learning all the different elements and how they react with each other. We do a lot in the book, but no experiments—experiments would help. Lincoln High School Senior

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## **COURSE DESCRIPTION**

This 2-unit course aims to develop professional knowledge and a reflective stance toward teaching in secondary content area classrooms. It focuses on understanding various ways in which adolescents might engage with content area learning, and it engages teaching candidates in questions, stances, practices, and tensions involved in teaching particular subjects. Students in the course will generate instructional units and assessments, enact teaching both on campus and in school-based settings, examine teaching artifacts from local classrooms, and investigate the work of exemplary teachers. The course aims to involve students in a continual juxtaposition of planning, teaching, and reflective thinking. Rather than simply learning to implement given best practices, students in this course will become problem posers, challenging and considering the pros and cons of assumed practices.

By the end of the course, you will understand and be able to navigate three tensions.

Tension 1: Teachers are implementers of curriculum and pedagogical problem-posers. Teachers face the dilemma of honoring children’s logic/thinking and teaching conventional knowledge.

Tension 2: Teachers are disciplinary experts (e.g. mathematicians, scientists, writers) and human beings in a constant journey of learning. Teaching and learning occur within disciplinary communities in schools, across disciplines, and throughout the world in which we live.

Tension 3: Teachers are accountable to both public expectations and students’ diverse experiences and perspectives. Teachers navigate the space between schools as they are and schools as they might be.

## **COURSE OBJECTIVES**

You will become agile pedagogical thinkers who:

- Through reviewing artifacts and writing reflections will learn to analyze teaching and student thinking.
- By writing lesson and unit plans will learn to create classroom environments that engage, challenge, and support students.
- By engaging in the process of planning and teaching will learn to productively utilize the process of questioning, planning, doing, assessing, and reflecting.

## **M.A.T. PROGRAM GOALS**

To prepare teachers who: (bold indicates goals emphasized in this course)

- 1) Have deep understanding of subject matter and pedagogies that teach for understanding**
- 2) Have ability to manage the complexities of teaching**
- 3) Promote student learning of challenging content**
- 4) Have ability to reflect on one's own practice, to look for principles underlying what "works" or "does not work" and to persist in determining one's own appropriate practice**
- 5) Have commitment to serving everyone's children, particularly those who historically have not been well-served by traditional schooling
- 6) Have ability to learn and work in collaborative fashion, and to create settings in which others can learn and work
- 7) Have capacity to engage in the remaking of the profession and the renewal of schools with understanding of the social and cultural context in which students live and learn

## **WASHINGTON ADMINISTRATIVE CODE (W.A.C.) TOPICS**

The Washington Administrative Code (W.A.C.) identifies three knowledge and skill areas for teacher certification (1. foundational knowledge, 2. effective teaching, 3. professional development) and lists specific topics of study. Many of the items we explore in this course are given complementary coverage in additional MAT courses. We often treat important topics in a spiral fashion, raising them more than once during your coursework to place them in a broader, more meaningful context. The following W.A.C. topics are incorporated in this course:

### **Foundational Knowledge**

- (a) The state learning goals and essential academic learning requirements.
- (b) The subject matter content for the area(s) they teach, including relevant methods course work and the knowledge and skills for each endorsement area for which the candidate is applying.

### **Effective Teaching**

- (l) Research and experience-based principles of effective practice for encouraging the intellectual, social, and personal development of students.
- (o) Effective instructional strategies for students at all levels of academic abilities and talents with an awareness of the influence of culture and gender on student learning.
- (p) Instructional strategies for developing reading, writing, critical thinking, and problem solving skills.
- (s) Planning and management of instruction based on knowledge of the content area, the community, and curriculum goals.
- (t) Formal and informal assessment strategies for evaluating and ensuring the continuous intellectual, social, and physical development of the learner.

### **Professional Development**

- (w) The opportunity for candidates to reflect on their teaching and its effects on student growth and learning.

## OUTLINE OF CONTENT AND SCHEDULE OF COURSEWORK

Monday	Tuesday	Wednesday	Thursday
<b>MIDDLE SCHOOL: DOCUMENTING</b>			
What is going on? How is time used? What are the strengths and weaknesses of what is going on? What are the constraining/expanding forces?			
<b>Time, Routines, &amp; Pedagogical Flow</b>			
9/8 Pedagogical Flow	9/9 Reading Discussion Video: TIMMS	9/10 Workshop TIMMS vs. Textbook	9/11 Sharing Reflective Writing
<b>Nature &amp; Quality of Learning Tasks</b>			
9/15 Task: Border Problem Reading Discussion	9/16 Task: Temperature Inv. Reading Discussion	9/17 Workshop Reform Trends	9/18 Sharing Reflective Writing
<b>Relating Learning Tasks to Standards</b>			
9/22 Artifact Sharing (math) Examining Standards	9/23 Artifact Sharing (sci) Examining Standards	9/24 Workshop National Standards	9/25 Sharing Reflective Writing
<b>Taking a Read (Dip sticking as Assessment)</b>			
9/29 Task: Design Reading Discussion	9/30 Task: Data Analysis	10/1 Workshop Task and Interview Data	10/2 Sharing Reflective Writing
<b>MIDDLE SCHOOL: ANALYSIS &amp; DESIGN</b>			
What was highly productive? What was of marginal value? How might I alter the use of time and resources? What other resources might I seek out?			
<b>Enduring Understandings and Supporting Knowledge</b>			
10/6 Assessing the Chapter Reading Discussion	10/7 Enduring Understandings Reading Discussion	10/8 <b>Due: Classroom Analysis</b> Workshop Modalities vs. Textbook	10/9 Sharing Reflective Writing
<b>Backward Design: Designing Assessments</b>			
10/13 Criterion Assessment Reading Discussion	10/14 Performance Assessment Reading Discussion	10/15 Workshop Design Assessments	10/16 Sharing Reflective Writing
<b>Backward Design: Designing Assessments</b>			
10/20 Holiday-Fall Break	10/21 Holiday-Fall Break	10/22 Workshop Refine Assessments	10/23 <b>Due: Unit Framework and Assessments</b> Sharing Midway Evaluation

<b>HIGH SCHOOL: DOCUMENTING</b>			
What is going on? How is time used? What are the strengths and weaknesses of what is going on? What are the constraining/expanding forces? What are students learning? How do you know?			
<b>Time, Routines, &amp; Pedagogical Flow</b>			
10/27 WASL Tasks	10/28 WASL Tasks Task: Fraction Problem	10/29 Workshop State Standards	10/30 Sharing Reflective Writing
<b>Student Learning Up Close</b>			
11/3 Student Work Generosity/Skepticism	11/4 Designing Task/Interview	11/5 Workshop Refine Task	11/6 Sharing Reflective Writing
<b>Student Learning Up Close</b>			
11/10 Analyze Student Responses	11/11 Analyze Student Responses	11/12 Workshop Naming Patterns	11/13 <b>Due: Student Learning Analysis</b> Computer Session Uploading Evidence
<b>HIGH SCHOOL: ANALYSIS &amp; DESIGN</b>			
What was highly productive? What was of marginal value? How might I alter the use of time and resources? What other resources might I seek out?			
<b>Enduring Understandings and Supporting Knowledge</b>			
11/17 Assessing the Chapter	11/18 Enduring Understandings	11/19 Workshop Enduring Understandings	11/20 Workshop Anchor Lessons
<b>Designing Assessments</b>			
11/24 Designing Unit Performance Assessment Refining Anchor Lessons	11/25 Workshop Unit and Assessments <b>Due: Draft Unit Framework and Assessments</b>	11/26 Holiday Travel Day	11/27 Holiday Thanksgiving
<b>HIGH SCHOOL: ADAPTATION &amp; ENACTMENT</b>			
What further alterations might I make? How might I engage student ideas?			
<b>Designing Lessons</b>			
12/1 Lesson Design: Whole Class Discussion	12/2 Lesson Design: Whole Class Discussion	12/3 Workshop Revising Lessons	12/4 Sharing Reflective Writing Course Evaluation
<b>Teaching and Revising</b>			
12/8 Teaching & Feedback	12/9 Teaching & Feedback	12/10 Teaching & Feedback	
TBA <b>Due: Unit FINAL:</b> Presentation Computer Session Uploading Evidence			

## STUDENT REQUIREMENTS AND EVALUATION

Assignment expectations and deadlines will be distributed and discussed in class. Assignments must be submitted at the beginning of class on the date they are due. You will make an appointment with the professor in the event that you must submit late work. Late work will not be credited at full value. These assessments are designed to make public the practices of planning, instructing, assessing, reflecting, and applying.

**Reflective Writing**—Throughout the course of the semester you will write reflective commentaries to help you make sense of and draw connections between course experiences, assigned readings, and/or your school-based placements. Reflective writing both records and gives meaning to classroom routines, curriculum, and student and teacher experiences. (15% of seminar grade)

**Middle School Classroom Analysis**—You and your school-based experience partner will write a middle school classroom analysis in which you share reflective commentary on the routines, quality of tasks, connection of classroom tasks to standards, and student understanding. (10% of seminar grade)

**Middle School Unit Framework and Assessments**—You and your subject matter colleagues will develop a unit framework and assessments for an assigned text chapter. (15% of seminar grade)

**High School Student Learning Analysis**—You and your school-based experience partner will conduct a case study by taking a close-up look at how students interact with representations in your discipline. You will interview 2-4 students to learn more about their meaning-making in your discipline. You will identify patterns in student responses and suggest implications for your unit plan. (15% of seminar grade)

**High School Unit of Instruction**—You and your school-based experience partner will develop a unit that is focused on a topic, theme, or issue that is central to your discipline and is related to a unit of study observed in your placement classroom. You will create a unit framework and assessments, design two anchor lessons, and teach one lesson and make revisions based on feedback. (25% of seminar grade)

**Participation, Attendance, and Punctuality**—You will take multiple roles in class by engaging in activities such as: completing in-class writing assignments, participating in discussions, sharing insights from school-based experiences, teaching lessons, evaluating the teaching of others, and participating as a positive and productive community member. Interpersonal skills (e.g., actively working to build relationships with others, considering other points of view, and considering the time and needs of others), problem solving (e.g., considering multiple perspectives, responding positively to feedback, and asking questions), and work ethic (e.g., consistent attendance, completing work by deadlines, and flexibility) are critical to your development as a professional. You will self assess your participation and the professors will assess your participation. (20% of seminar grade)

## Required Texts

A course reader contains required articles and book chapters.

## State Standards

Office of Superintendent of Public Instruction (OSPI). (2005). *Science K-10 grade level expectations*, Document Number 04-0051. Olympia, WA: OSPI. (distributed in class)

Office of Superintendent of Public Instruction (OSPI). (2008). *High school mathematics standards* (under review). Olympia, WA: OSPI. (available at <http://www.k12.wa.us/curriculumInstruct/mathematics/RevisedStandards.aspx>)

## 9/9 (Tuesday)—Inquiry and Group Work

Windschitl, M. (2007). What is inquiry? A framework for thinking about authentic scientific practice in the classroom? In J. Luft, R. L. Bell, & J. Gess-Newsome (Eds.) *Science as inquiry in the secondary setting*. (pp. 1-20). Arlington, VA: National Science Teachers Association.

Gibbs, J. (2000). Ch. 4, What tribes are and how they work & Ch. 5, Creating the learning community. In *Tribes: A new way of learning and being together*. (pp. 71-103). Sausalito, California: Center Source Systems.

## 9/16 (Tuesday)—Defining Inquiry

Windschitl, M. (2006). Why we can't talk to one another about science education reform. *Phi Delta Kappan*. 87 (5), 349-355.

Martin-Hansen, L. (2002). Defining inquiry: Exploring the many types of inquiry in the science classroom. *The Science Teacher*, 69(2), 34-37.

Ryken, A. E., Otto, P., Pritchard, K., & Owens, K. (2007). *Field investigations: Using outdoor environments to foster student learning of scientific processes*. (pp. 1-40) Olympia, WA: Pacific Education Institute.

## 9/17 (Wednesday)—Trends in Math/Science Education Reform

Ball, D. L., Lubineski, S. T., & Mewborn, D. S. (2001). Research on teaching mathematics: The unsolved problem of teachers' mathematical knowledge. In V. Richardson (Ed.) *Handbook of research on teaching*, 4<sup>th</sup> edition. (pp. 433-456). Washington, D.C.: American Educational Research Association.

White, R. (2001). The revolution in research on science teaching. In V. Richardson (Ed.) *Handbook of research on teaching*, 4<sup>th</sup> edition. (pp. 457-471). Washington, D.C.: American Educational Research Association.

## 9/29 (Monday)—Examining Student Work

Kersaint, G. & Chapell, M.F. (2004). What do you see?: A case for examining students' work. *Mathematics Teacher*, 97(2), 102-105.

### **10/6 (Monday)—Backward Design**

Tomlinson, C.A., & McTighe, J. (2006). What really matters in learning? (Content). In *Integrating differentiated instruction & understanding by design*. (pp. 24-37, 110-115). Alexandria, VA: Association for Supervision and Curriculum Development.

Wiggins, G. & McTighe, J. (1998). Ch. 1, What is backward design? In *Understanding by design*. (pp. 7-19). Alexandria, VA: Association for Supervision and Curriculum Development.

#### Textbook Chapters

Introduction to Algebra

Energy

### **10/9 (Thursday)—Connecting to Professional Resources**

Kieran, C. (1992). The learning and teaching of school algebra. In D. A. Grouws (Ed.), *Handbook on research on mathematics teaching and learning*. (pp. 390-419). New York: Macmillan Publishing Company.

Helgeson, S. L. (1994). Research on problem solving: Middle school. In D. L. Gabel (Ed.) *Handbook of research on science teaching and learning*. (pp. 248-268; 180-185). New York: Macmillan Publishing Company.

### **10/13 (Monday)—Assessment**

Wiggins, G. & McTighe, J. (1998). Ch. 5, Thinking like an assessor. In *Understanding by design*. (pp. 63-84). Alexandria, VA: Association for Supervision and Curriculum Development.

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In addition to these assigned readings you will seek out (and the professors will suggest) resources related to the content and teaching issues of concern to you and relevant to the context of your school-based placements. The following resources may be helpful to you as you develop lessons, units, classroom practices, and rich classroom environments.

#### Math Teaching Journals

The Mathematics Teacher

Mathematics: Teaching in Middle School

#### Science Teaching Journals

The Science Teacher

Science Scope

The American Biology Teacher

The Physics Teacher

Science Education

### National Standards

Carpenter, J & Gorg, S., (Eds.). (2000). *Principles and standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.

National Research Council. (1996). *National science education standards*. Washington, DC: National Academy Press.

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy*. New York: Oxford University Press.

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### Internet Resources

<b>Organization</b>	<b>Web Site</b>
<b>Math Resources</b>	
National Council of Teachers of Mathematics	<a href="http://www.nctm.org">www.nctm.org</a>
Washington State Mathematics Council	<a href="http://www.wsmc.net">www.wsmc.net</a>
Interactive Mathematics Project	<a href="http://www.mathimp.org">www.mathimp.org</a>
Eisenhower National Clearinghouse	<a href="http://www.enc.org">www.enc.org</a>
Math Forum	<a href="http://www.mathforum.org">www.mathforum.org</a>
<b>Science Resources</b>	
National Science Teachers Association	<a href="http://www.nsta.org">www.nsta.org</a>
Washington Science Teachers Association	<a href="http://www.wsta.net">www.wsta.net</a>
National Science Foundation	<a href="http://www.nsf.gov">www.nsf.gov</a>
American Association of Physics Teachers	<a href="http://www.aapt.org">www.aapt.org</a>
American Chemical Society	<a href="http://www.chemistry.org">www.chemistry.org</a>
National Association of Biology Teachers	<a href="http://www.nabt.org">www.nabt.org</a>
National Association of Geoscience Teachers	<a href="http://www.nagt.org">www.nagt.org</a>
North American Association for Environmental Education	<a href="http://www.naaee.org">www.naaee.org</a>
Environmental Education Association of Washington	<a href="http://www.eeaw.org">www.eeaw.org</a>
<b>General Resources</b>	
Washington State Essential Academic Learning Requirements (EALR's)	<a href="http://www.k12.wa.us/CurriculumInstruct/default.aspx">www.k12.wa.us/CurriculumInstruct/default.aspx</a>
Washington Assessment of Student Learning (WASL)	<a href="http://www.k12.wa.us/assessment/WASL/testquestions.aspx">http://www.k12.wa.us/assessment/WASL/testquestions.aspx</a>
Inside Teaching: A Living Archive of Practice The Carnegie Foundation for the Advancement of Teaching	<a href="http://gallery.carnegiefoundation.org/insideteaching/">http://gallery.carnegiefoundation.org/insideteaching/</a>

### **Professional Organizations**

Professional organizations are one way to get involved with a network of math and science educators and to have access to ongoing professional development opportunities. Two organizations you might consider joining are listed below:

**National Council of Teachers of Mathematics (NCTM)**, \$38/year (for students) entitles you to an online subscription to *Teaching Children Mathematics*. Apply online at [www.nctm.org](http://www.nctm.org) or call (800) 235-7566.

**National Science Teachers Association (NSTA)**, \$32/year (for students) entitles you to a monthly subscription to *Science and Children*. Apply online at [www.nsta.org](http://www.nsta.org) or call (800) 722-6782.

### **Upcoming Conferences**

Conferences are ideal for obtaining curriculum materials and for getting involved with other educators. Three conferences you might consider attending are listed below:

- **Washington State Mathematics Council  
47<sup>th</sup> Northwest Mathematics Conference  
October 9-11, 2008**  
Portland, OR  
\$40 for pre-service teachers to register  
See program and register at [www.wsmc.net/nwmc](http://www.wsmc.net/nwmc)
- **Washington Science Teachers Association Spring Conference  
Shifting Science Instruction  
March 19-21, 2009**  
Moses Lake, WA  
\$55 for pre-service teachers to register  
See program and register at [www.wsta.net](http://www.wsta.net)
- **National Science Teachers Association Area Conference  
Sustainable Science  
November 20-22, 2008**  
Portland, OR  
\$60 for pre-service teachers to register  
See program and register at <http://www.nsta.org/conferences/2008por/>