

<p style="text-align: center;">Science Education 480 Science Methods and Curriculum for the Elementary School <i>Preparing thoughtful, knowledgeable, and effective educators for a diverse society.</i></p>
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When:	Winter 2008, M/W 8 – 9:50, F 9-10
Where:	SL230
Credit Hours:	5 credits
Prerequisite:	12 credits in natural sciences, GUR in mathematics and El Ed 370
Instructors:	Don Burgess, SMATE 250C; 650-2482 don.burgess@wwu.edu Alejandro Acevedo-Gutierrez, BI 309; 650-3653 alejandro.acevedo-gutierrez@wwu.edu
Course information:	available on Blackboard services (<i>My Western</i>)

Text: Readings as assigned. Most course materials are available through Blackboard Services My Western or on reserve in SMATE LRC 220. Required: *Science K-10 Grade Level Expectations: a new level of specificity, EALR's* (available at the bookstore).

Course Description: Classroom/laboratory study of theory, curriculum, science content, processes and effective teaching methods in the context of national and Washington state standards in science including activities appropriate for the elementary classroom. To be taken in sequence with SCED 490 (enroll one quarter prior to registering for SCED 490).

General Considerations: Science Education 480 demands active participation and a willingness to learn and explore new areas of science. It is an investigation-intensive class and will require all students to be prepared each day, ready to experience the richness and excitement of science and the natural world. Excellent attendance is essential for success in this course. You will learn to inspire students through science education.

Goals & Outcomes

1. 480 Student will demonstrate dispositions to teach science.
 - a. 480 Student will describe nature of science and its importance in science instruction
 - b. 480 Student will identify how scientific inquiry is important and useful to their students' understanding of nature and participation in society
 - c. 480 Student will understand and implement strategies to ensure that all students learn.
2. 480 Student will understand how students learn science and how to design appropriate learning environment
 - a. 480 Student will identify and address student ideas about science
 - b. 480 Student will identify process skills in science incorporate them into instruction
 - c. 480 Student will choose teaching strategies to accomplish specific learning goals
 - i. learning cycle
 - ii. conceptual change models
 - iii. sheltered instruction

- iv. questioning strategies
 - v. curricular integration
 - vi. process skills
 - d. 480 Student will identify and address needs of individual learners
 - e. 480 Student will develop understanding of how content, learning and pedagogy are related in science learning.
- 3. 480 Student will understand and develop assessments that support and document Student understanding
 - a. pre-assessment
 - i. for misconceptions
 - ii. for development of learning and teaching elements
 - iii. to gauge what Students learn
 - b. formative assessment
 - c. summative assessment that includes elements of content, process & NOS
- 4. 480 Student will understand national and state standards for science learning
 - a. Student will identify appropriate content for K8 classrooms
 - b. Student will identify similarities and differences between NSES, Benchmarks and EALRs

Student Evaluation:

1) Essay or Debate	20
2) Class Participation and Discussion	20
3) Curriculum Review	20
4) Science Curriculum Topic Study	
a) Identify Adult Content Knowledge	20
b) Examine Research on Student Learning	20
c) Examine Coherency and Articulation	20
d) Provide References and Key	10
e) CTS Poster	20
5) Lesson Plans	
a) Learning Cycle Lesson	20
b) Conceptual Change Lesson	20
c) <u>Sheltered Instruction</u>	20
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Grades: The grading scale is as follows:

A 94-100%	A- 90-93%	B+ 87-89%	B 84-86%	B- 80-83%
C+ 77-79%	C 74-76%	C- 70-73%	D+ 67-69%	D 64-66%
D- 60-63%	F <60%			

Assignments: All assignments are due at the beginning of class on the last meeting day of the week unless otherwise stated. Late work will not be accepted unless cleared by the instructor.

On-line References:

Benchmarks for Science Literacy (AAAS Project 2061), Oxford (1993) [Benchmarks]

<http://www.project2061.org/tools/benchol/bolintro.htm>

Science for All Americans (AAAS Project 2061), Oxford (1990) [SFAA]

<http://www.project2061.org/tools/sfaaol/sfaatoc.htm>

Essential Academic Learning Requirements for Washington [EALRs, Science]

<http://www.k12.wa.us/curriculumInstruct/science/ealrs.aspx>

National Science Education Standards, National Academy Press (1996) [NSES]

<http://www.nap.edu/readingroom/books/nses/>

Inquiry and the National Science Education Standards: A Guide for Teaching and Learning,

National Academy Press (2000) [INSES] http://books.nap.edu/html/inquiry_addendum

National Science Teachers Association: <http://www.nsta.org/>

Hard-copy References in Learning Resource Center, SMATE

AAAS (2001). *Atlas of Science Literacy*. New York: Oxford University Press.

Driver, R., Guesne, E. & Tiberghien, A. (1985). *Children's Ideas in Science*. Philadelphia: Open University Press.

Driver, R., Squires, A, Rushworth, P. & Wood-Robinson, V. (1994). *Making Sense of Secondary Science: Research into Children's Ideas*. New York: Routledge.

Keely, P. (2005). *Science Curriculum Topic Study*. Thousand Oaks: Corwin Press.

National Academy of Sciences. (1997). *Science for All Children: A Guide for Improving Science education in Your School District*. Washington, D.C.: National Academy Press.

Naylor, S. and Keogh, B. (2000). *Concept Cartoons*. Cheshire: Milgate House.

Academic Dishonesty Policy

Western Washington University Students are responsible for reading, understanding, and following the policy and procedures regarding academic dishonesty as set forth in the *WWU Academic Dishonesty Policy and Procedure* (see Appendix D of the University Bulletin).

Reasonable Accommodation Policy

It is the policy of Western Washington University to provide reasonable accommodation to the known physical, sensory, or mental limitations of qualified individuals except where such accommodation would impose undue hardship on the institution. To request accommodation, Students must contact WWU disability Resources for Students at 360-650-3844 or www.wvu.edu/depts/drs/

Class schedule (subject to change)

Week	Date	Science Topic:	Teaching/ Pedagogy	Homework/ Assignments	Reading (Friday)
1	January W2 F4	Nature of Science (NOS) What did you notice?	Introductions Pre-assessment Questionnaire Nature of Science: Concept Map	F - WASL: Grass is Greener	Reading 1 No discussion (Friday: grade test) FAQ for WASL
2	January M7 W9 F11	Assessment Inquiry	WASL w/Roy Bevin SMATE Scavenger Hunt Science Process Skills	M - 2 Questions W Choose curric. F - Curriculum Review	Reading 2 <i>Discussion Cards</i>
3	January M14 W16 F18	NOS	M - How People Learn Preconceptions Private universe Share Curriculum W - NOS: Mystery Boxes	M W Choose FOSS in class	Reading 3 <i>Discussion Cards</i>
4	January M(MLK 21) W23 F25	Scientific Inquiry Communication	W-Notebooks w/Mike DeHondt		Reading 4 <i>Discussion Cards</i>
5	January M28 W30 F Feb. 1		M-Curriculum Topic Study Intro. W- CTS work day		Reading 5 <i>Discussion Cards</i>
6	Feb. M4 W6 F8	Science Process Skills: Measurement Variables	M-Introduction Straws W-Swingers LAZER Templates	F - CTS 4a,b	Reading 6 <i>Discussion Cards</i>
7	Feb. M11 W13 F15	Electrical Circuits	Assessment: Formative/Summative Concept Cartoons, Kit Exploration, Probes	F - CTS 4c, d	Reading 7 <i>Discussion Cards</i>
8	Feb. M(Vet. 18) W20 F22	Air and Weather Solids and Liquids	Learning Cycle	W - CTS 4e Poster	Reading 8 <i>Discussion Cards</i>
9	Feb. M25 W27 F29	Phase change Boiling water Dry Ice	Conceptual Change WASL Better Boiling	F - Learning Cycle Lesson due	Reading 9 <i>Discussion Cards</i>
10	March M3 W5 F7	Life science	M - Observation "Each one teach one" W - Learner Differences Sheltered Instruction Integration—Writing Reading	F - Conceptual Change Lesson	Reading 10 <i>Discussion Cards</i>
11	March M10 W12 F14		Teach/Share lessons		NOS website in class
12	March M17 W19 F21		Debates	F – Sheltered Lesson	
13		FINALS	FINALS	Essay due	FINALS

Description of Assignments

Assignment 1: Science Teaching Essay

Write an essay or letter of application for a teaching position or scholarship. (3-5 pages)

Consider these kinds of questions. A consideration of the **questions IN BOLD** are strongly suggested:

- a) What is the role of the teacher and Student?
- b) What are the goals and outcomes of your science program?
- c) **What is the role of scientific processes?**
- d) What content should be taught?
- e) **What is the role of scientific investigations in elementary science classes?**
- f) What kind of materials and equipment will you use?
- g) How involved will children get in their own learning?
- h) How will children achieve involvement?
- i) **How will children learn to value science?**
- j) **How will you assess Student progress?**
- k) **Why should science be taught?**
- l) **Should science be integrated with other subjects?**
- m) **How would you address the “achievement gap” in your classes?**

The statement should be a well thought out synthesis of your own thinking about your own teaching of science – NOT a compilation of answers to the above questions. The questions are offered merely to stimulate your thinking. You will use this statement to guide your own thinking and questioning about quality elementary science education. Your paper will take the form of a letter of application for a teaching position or scholarship.

<i>0-5 points</i>	<i>6-10 points</i>	<i>11-15 points</i>	<i>16 – 20 points</i>
<ul style="list-style-type: none"> • questions are not addressed • Detail is lacking. Points are not well-supported <ul style="list-style-type: none"> • Personal beliefs/statements are not supported by references 	<ul style="list-style-type: none"> • A few important questions are addressed • Most points include details that support the answers • A few references are made to sources beyond personal opinion 	<ul style="list-style-type: none"> • Most important questions are addressed • Answers include details that support the answers • References complete but lack APA format 	<ul style="list-style-type: none"> • All questions addressed • Answers include more than personal opinion – answers should cite material from readings, class discussions as well as experience • References complete and consistent with APA format

Assignment 2: Class Participation and Discussion

Classroom Discussion Instructions 2007-08

Objective: To lead a class discussion centered on the class work, homework and reading assignments and to have active discussions by the whole class.

Rationale: To make use of insights of both you and your classmates to bring out the relevant aspects of the reading assignments.

Description: Each Friday we will have a discussion centered on the readings for the week. During these discussions, you will either be a class leader or a participant. Every student in the class will have an opportunity to be a class leader (there will be a sign-up sheet so you can pick the day in advance).

Discussion Participants

- a. Complete the reading assignment prior to the discussion day.
- b. Come to class having written down 3-5 items from the course work and or reading assignment on a 3 x 5 card that you would like to become part of the discussion. These ideas need to be your own. Examples include, but are not limited to:
 - i. ideas that you found to be very interesting or relevant
 - ii. An idea that you haven't encountered elsewhere (not encountered in another course or something that is an issue that arises when teaching science)
 - iii. An idea that is so important that it needs to be emphasized and shared with the group
 - iv. Something that you didn't understand
 - v. Something that concerns you
 - vi. Something that you don't agree with
 - vii. An additional idea that you think would add to the discussion
- c. At the beginning of class, hand in your 3 x 5 card to the discussion leaders for that day.

Discussion Leaders

- a. Do all of the items above listed for a participant.
- b. Prior to the start of the discussion, obtain the 3 x 5 cards that were produced by your classmates.
- c. Use the first five minutes of class to quickly review the cards and pick out important ideas, common themes, repeated questions, etc.
- d. Construct 3-5 questions that incorporate these points. Write these questions on the board and describe them to the group.

- e.** Class will be divided into small groups; each will include a discussion leader to moderate the discussion.
To help ensure an effective discussion, the moderator keeps the discussion on-track, ensures all voices are heard, and monitors time so all questions can be addressed in the time given.
- f.** Discussions should be lively: if the group appears to be getting bogged down, don't be afraid to ask further questions or to move on to the next topic.
- g.** Following approximately 20 minutes of small group discussion, leaders will facilitate a discussion with the entire group for the remainder of the class time (at least 10 minutes). In this larger group format, leaders are encouraged to ask groups to paraphrase interesting points discussed, further questions raised, and how these topics relate to the nature of science, as appropriate.
- h.** At the end of the discussion, the 3 x 5 cards will be collected by your instructor.
- i.** Evaluation for this element of the course will be based on completeness of assignments, the quality of your written comments, your class participation, and your ability to lead a fruitful discussion.
- Attendance (5pt)
 - Note card submission (5pt)
 - Discussion leadership (5pt)
 - Weekly participation (5pt)

9. Responds to children’s individual differences in ability, development and learning styles.	5 4 3 2 1
10. Integrates science across subject areas.	5 4 3 2 1
11. *Engages children in discussions and conversations that challenge their thinking and help them construct understanding.	5 4 3 2 1
12. Stresses skills such as observing, inferring, measuring and predicting (process skills).	5 4 3 2 1
13. *Uses a variety of assessment strategies that fit the objectives.	5 4 3 2 1
14. Stresses depth and exploration over breadth of coverage	5 4 3 2 1
15. Lessons fit what we know of a student’s mathematical development for certain grade levels.	5 4 3 2 1
16. *Obvious connections to guiding documents (State Standards, AAAS Benchmarks or NSES Standards).	5 4 3 2 1
17. *Safety concerns are noted and emphasized through the curriculum.	5 4 3 2 1
18. Suggested questions have a range of goals and represent convergent and divergent questioning strategies.	5 4 3 2 1
19. Historical and cultural contexts are included.	5 4 3 2 1
20. The materials build conceptual understanding.	5 4 3 2 1
*21 - 25. YOUR OWN CRITERIA: Attach five criteria that you would include in the evaluation form (i.e. Address possible modifications and/or adaptations for diverse learners including those with special needs, connections to GLE’s, misconceptions, etc.).	5 4 3 2 1

Assignment 4a-e: Science Curriculum Topic Study

Curriculum topic study (CTS) is a systematic process for bringing together standards (national and state), content knowledge and research on student learning surrounding a specific curriculum topic. You will study and reflect on the prescreened readings to improve your understanding of teaching and learning related to a science topic. You may work singly or in pairs.

“CTS is not a replacement for formal science content coursework, but it can help teachers learn content at the same time that they are studying the pedagogical implications of teaching that content. This can be particularly helpful to elementary teachers, who are expected to teach all content areas and seldom have substantive coursework in all the sciences. CTS can also help teachers translate formal science course content into content that is appropriate for students at different grade levels, an essential step for teachers that content courses often overlook” (Keeley, p. 3).

1. **Select CTS Guide:** You will select one of the 147 CTS guides in Chapter 6 of Science Curriculum Topic Study (Keeley, p. 113). Choose one that aligns well with your research-based curriculum (FOSS or STC kit). You will use the CTS guides to begin to answer two key questions: *“What does it take to be effective in this new vision of science teaching?”* and *“What do teachers need to know and to be able to do to be effective?”*

“Each CTS guide lists relevant professional readings from sources that include national standards documents, documents, trade books, written by scientists, research summaries, k-12 conceptual strand maps. The CTS web site provides additional materials www.curriculumtopicstudy.org (Keeley, p. 2).

2. **Create your study guide:** Choose one of the guiding questions (p. 37-39) for each section to stimulate your thinking. You will use the specified prescreened readings to sequentially create your study guide. You will research each of the six sections to create your guide. See examples on Blackboard. There are six CTS “Sections and Outcomes” ;*adult content knowledge, instructional implications, concepts and specific ideas, research on student learning, coherency and articulation, state standards.* See page 22 for links between outcomes and source material for each section. Each CTS guide is divided into two corresponding parts: “Sections and Outcomes” and “Selected Resources and Readings for Study and Reflection”.
3. **Reflection:** After completing **each** CTS section you will **reflect** on the prescreened readings to improve your understanding of teaching and learning related to your topic. Use one of the guiding questions (p. 37-39) for each section to stimulate your thinking
4. **Lessons:** Toward the end of the course, you will use this research to construct science lesson plans.

Science Curriculum Topic Study Rubric

Criteria for reflections:

1. Selects appropriate quotes from readings related to the guiding question
2. Provides strong rationale for selection
3. Responds to reflection question with evidence of critical thinking /synthesis/evaluation
4. Provides examples that link research with kit content

Points:

0-5 points, accomplishes 0-1 of criteria

6-10 points, accomplishes 2 criteria

11-15 points, accomplishes 3 criteria

16-20 points, accomplishes 4 criteria

Assignment 4a: Identify Adult Content Knowledge

20 points _____

Select quotes that identify what all adults (including teachers) should know and be able to do to be considered literate in science. Also provide explanations of science ideas encountered in the media, public issues, and other popular science venues.

Through reflection address guiding question and how the adult content knowledge will inform your teaching. Provide specific examples that link your understanding of the content with pedagogy.

Assignment 4b: Examine Research on Student Learning

20 points _____

Identify relevant research that allows you to examine developmental considerations, possible misconceptions and their sources, intuitive ideas and lines of reasoning. Include difficulties encountered by students in understanding the specific ideas within the topic.

Demonstrate a coherent comparison between the concepts addressed in section 4 and your chosen curriculum. Indicate how the developmental considerations and misconceptions are addressed in the curriculum and identify those that are missing. Provide examples

Assignment 4c: Examine Coherency and Articulation

20 points _____

Examine the K-12 conceptual growth in understanding as a coherent flow of ideas that builds on sophistication over time. Study the K-12 growth of understanding and identify important prerequisites. Through reflection connect your examination of coherency and articulation to your specific curriculum. Address how it will inform your teaching. Provide specific examples indicating how your connections will promote student understanding.

Assignment 4d: References and Key

10 points _____

0	2	4	6	8	10
Not Present	Some listed	Some listed, incomplete citations	All citations. Some incomplete	All citations listed, key missing	Full citation with key (if needed)

Assignment 4e: Poster

20 points _____

0	4	8	12	16	20
Not Present	Sections missing	Guiding question w/ Evidence showing weak links to Strategies	Guiding question w/ Evidence showing average link to Strategies	Guiding question w/ Evidence indicating strong links to Strategies	Engaging and appealing presentation

Curriculum Topic Study: Rubric for Assignments 3a,b,c					
	5	4	3	2	1
Use of Quotations from reading	Selected quotes clearly relate to guiding question. Guiding question is concise and well formed.	Quotes are adequate, but guiding question is absent or poorly formed	No guiding question, quotes are present but brief	No guiding question, poor use of quotes	Quotes are inappropriate to the topic or absent. Guiding question is absent
Rationale	Rationale is well-reasoned and relevant to the assignment	Rationale is incomplete or contains gaps in logical reasoning	Rationale is incomplete and/or illogical. Opinions are not supported by references.	Rationale is incomplete and/or illogical. Is not relevant to the assignment	No rationale for inclusion of concepts.
Response to reflection question	Response to reflection question displays clear evidence of critical thinking (e.g. disparate ideas are synthesized or implications are analyzed)	Response show some evidence of critical thinking but could be analyzed further	Response shows little evidence of analysis or synthesis. Personal opinions are not supported by references.	Ideas in response are poorly linked and/or lack detail	Response is absent or not appropriate to the topic
Examples	Examples clearly link scholarly research with the content of the kit	Some examples lack clear link between research and kit content	Examples do not conclusively demonstrate link between research and content	Examples fail to link research and the content of the kit or do not cite research	Section is absent or not appropriate to the assignment

CTS Poster

Drawing on your CTS experience, represent strategies for lesson development on your poster. Provide example of how your CTS will inform or change the implementation of the curriculum. What important information do you want to share with your peers?

Grading

This assignment is worth twenty (20) points. To earn 20 points you must complete each of the following expectations:

Expectations:

1. Use minimum 2' x 3' poster paper/board, write large and clearly, and identify your Curriculum, CTS guide and three CTS sections.
2. Provide at least one guiding questions for each CTS heading.
3. Provide evidence and strategies (3+) that characterize your understanding of the effective teaching based on the evidence from CTS.
4. Provide strategies for how you will use the CTS to improve your teaching.

Assignment 4e: Poster

20 points _____

0	4	8	12	16	20
Not Present	Sections missing	Guiding question w/ Evidence showing weak links to Strategies	Guiding question w/ Evidence showing average link to Strategies	Guiding question w/ Evidence indicating strong links to Strategies	Engaging and appealing presentation

Sample Structure for Poster

<p>Foss Air and Weather 2nd grade By Don Burgess</p>		
<p><u>Adult Content Knowledge</u></p> <p>Guiding Question:</p> <p>Evidence:</p> <ol style="list-style-type: none"> 1. 2. 3. <p>Strategies:</p> <ol style="list-style-type: none"> 1. 2. 3. 	<p><u>Research on Student Learning</u></p> <p>Guiding Question:</p> <p>Evidence:</p> <ol style="list-style-type: none"> 1. 2. 3. <p>Strategies:</p> <ol style="list-style-type: none"> 1. 2. 3. 	<p><u>Coherency and Articulation</u></p> <p>Guiding Question:</p> <p>Evidence:</p> <ol style="list-style-type: none"> 1. 2. 3. <p>Strategies:</p> <ol style="list-style-type: none"> 1. 2. 3.

Assignment 5 a-c: Lesson Plans

Students should prepare three lessons, one from each category below. In addition, excluding the Pre-assessment lesson, each lesson must follow a Learning Cycle format.

a. Learning Cycle Lesson:

- *Lesson should include an exploration of the objective, concept development and application of the new concept.*

b. Conceptual Change Lesson:

- *Identify a possible misconception and structure the lesson to address.*
 - include an individual commitment to an outcome or explanation,
 - a sharing of ideas
 - a test, investigation, activity, or discrepant event that confronts student ideas (cognitive dissonance)
 - resolve new information/concept development, accommodation
 - apply or extend new concept

c. Sheltered Lesson:

- *Lesson should incorporate three techniques that improve science understanding by students who have limited proficiency in English. These include but are not limited to:*
 - enhanced visuals (posters, video, pictures, etc),
 - contextualized content (make connections of the content to real-life),
 - demonstrations, “science kit inventory,” advanced organizers,
 - “hands-on” experiences, etc.

Each of the three lessons must also include elements of effective practice:

- **Inquiry based:** Your lessons should involve significant effort to include inquiry at level 3 on Inquiry Matrix.
- **Lesson Objectives and assessments:** Each lesson should have two objectives (one process and one content) with an assessment of the objectives.
- **Process Skills:** Each lesson should identify and teach one process skill
- **Questions:** Each lesson should include a balance between *lower and higher order questions* (e.g., Bloom’s taxonomy). They should be built into the lesson not attached to the end of the lesson as a list.