

**SCIENCE EDUCATION 481 – Fundamentals of Teaching Science**  
**Fall 2020 – Tuesdays 3-5 pm**  
**Dr. Sue DeBari**

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Office Hours: Monday 1:30-3:30, Th 12-1. Or by appt.

**Course Description:**

*Study of key topics related to teaching science including nature of science, constructivism, science standards, preconceptions, and assessment for learning.*

The main purpose of this course is to introduce prospective science teachers to key ideas associated with teaching science at the secondary level, but is also relevant for any form of science teaching (undergraduate, informal education, etc.). Teaching science effectively requires that educators attend to the prior ideas that students bring with them into the classroom, that they provide experiences that allow students to construct their own knowledge, and that they pay careful attention to state/national or other guidelines about what needs to be taught. This course will introduce you to these fundamentals as a foundation for your professional education program including methods courses and teaching practica.

This introductory course is closely aligned with the Secondary Science Methods course SCED 491. In the present course, we will mostly discuss the fundamental ideas behind teaching science. All of the topics we cover will be developed in more detail in SCED 491, but that class will cover more of the “nuts-and-bolts” of teaching science (managing labs, practicing inquiry, doing demos, science assessment, etc.).

The format of this course is a mixture of lecture/activity and discussion. During the first hour of the class, we will often have an activity centered on that day’s topic. The second hour of the class will be devoted to student-led discussion of the readings for that day. It is imperative that you come to class having done the readings.

**Prerequisites:** CHEM 163 or CHEM 225 or GEOL 212 or BIOL 206 or PHYS 163

**Course Outcomes and Goals:** The major goals of this course are:

- (1) to develop a better understanding of the nature of science
- (2) to explore current research on how people learn
- (3) to become acquainted with the Next Generation Science Standards and their role in creating meaningful learning experiences
- (4) to become well-versed on the research behind, and practices of, effective science teaching and learning, including development of an equitable classroom

These goals will be accomplished in a variety of ways including: (1) class discussions on issues related to science instruction, e.g., processes of science, constructivism, formative assessment, etc., (2) review and application of the [\*Next Generation Science Standards\*](#), (3) review of existing science curricula, and (4) exploring and adapting a science lesson appropriate within the 6-12 grade range that incorporates all the key elements of effective science teaching.

**Texts:**

Although there are no “textbooks” in the traditional sense for this course, there is one book that you could consider purchasing. The reading assignments from this text will be posted as PDFs on canvas, but if you like to have your own hard copy of the text, here is the reference:

- *Teaching High School Science Through Inquiry and Argumentation* (Llewellyn, 2013; Corwin Press).

Throughout the quarter, readings will be assigned from this book and from other materials, all of which will be linked to the Canvas course. Each of the reading assignments will be tied to a discussion. This Llewellyn book will be used again in SCED491.

Another highly influential book that has been the foundation of inclusive science teaching practice is the following:

- *How People Learn: Bridging Research and Practice* (National Academy Press, 1999) (available online).
- You also need to become familiar with Next Generation Science Standards.  
<http://www.nextgenscience.org/next-generation-science-standards>.

## Requirements

Science Education 481 demands active participation and a willingness to learn and explore teaching and learning science. It is an investigation-intensive class and will require all students to be prepared each day. Attendance for all 10 class meetings is essential for success in this course, not only for your learning but for the learning of others.

## Assignments and Assessments (and grading):

You will have a number of different assignments over the quarter. Most are due one week after they are assigned.

- Discussion Questions (7.5%)/Reading Summary (7.5%): You are responsible for two things related to the weekly readings. 1) Write a brief (<1 page) summary of each week's readings to submit on Canvas, and 2) submit online discussion questions/comments for each week's reading to help the discussion leaders frame the class discussion. You will post your questions and comments on a Canvas discussion board before 5 pm the night before class.
- Discussion Leader (5%): You will be responsible for leading two class discussions with a partner. You will need to work with your partner to decide on a discussion protocol and review the online comments/questions from your classmates to develop good discussion prompts.
- Attendance and Participation (10%): Science Education 481 demands active participation and a willingness to learn and explore teaching and learning science. It is an investigation-intensive class and it will only succeed if all students are prepared each day. The class will become what you make of it. Participation grade is based on your preparedness and contributions during class. Since we only have 10 meetings, missing class without a valid excuse (such as illness or other emergency) will significantly impact your participation grade.
- SCED 20x Observation (or other constructivist science class with permission) (10%)  
You will do 2 hours of observation of one of the **SCED 20X** classes (two different class meetings for an hour each), using an observation protocol that I will share in class. This quarter that includes only **SCED 201 (physics)**. Other quarters biology, chemistry, and geology are taught in this same student-centered manner, so if you want to learn more about the other courses, contact me!
  - **Schedule your observations with instructors in advance. Do NOT wait until the last minute to schedule an observation.** Ask the instructor which unit and module they will be working on that day, and I will share that module with you in advance. You can either join one group or visit with multiple groups. Definitely interact with the students!
  - The curriculum is the same in each of the three sections, but different instructors. I highly

encourage you to visit a different instructor for each of your visits.

- You will use a classroom observation protocol for your observation
- Choose from the following sections (all taught in SL240N)

**SCED 201 Matter and Energy in Physical Systems**

1. MWF 10:00-11:50 am (Dr. Norda Stephenson, [stephen2@wwu.edu](mailto:stephen2@wwu.edu) )
2. MWF 12:00-1:50 pm (Dr. Andrew Boudreaux; [boudrea@wwu.edu](mailto:boudrea@wwu.edu) )
3. MWF 02:00-03:50 pm (Dr. Emily Borda; [bordae@wwu.edu](mailto:bordae@wwu.edu) )

- Standards Assignment (7%): You will explore the Next Generation Science Standards for your unit/concept of choice. This topic will be the focus of several assignments in this course.
- Preconceptions (7%): You will use different sources to identify common prior ideas for a topic of your choice.
- Learning Progression (10%): You will construct a learning progression about a science unit/concept of your choice.
- Probe (6%): You will develop a probe that assesses for common prior ideas for a concept of your choice.
- Lesson Plan (15%): You will develop one lesson on your concept (could be a lesson from a larger unit) and address the important aspects of teaching science OR you will find one standard lesson on your topic and revise it to address the important aspects of teaching science. You may use a Woodring lesson plan format if you choose, but not necessary.
- Reflective Paper (15%): You will write a reflective essay due during finals week. This is meant to be a broad essay about the teaching of science and should be ~5 pages long, double-spaced, using 12 point font. If you keep a journal each week of your learning, this will make the writing easier!

**Grading:**

93-100% A	83-86.9% B	73-76.9% C	63-66.9% D
90-92.9% A-	80-82.9% B-	70-72.9% C-	60-62.9% D-
87-89.9% B+	77-79.9% C+	67-69.9% D+	< 60% F

*I am committed to establishing and maintaining a classroom climate that is inclusive and respectful for all students. Learning includes being able to voice a variety of perspectives, and classroom discussion is encouraged. While students' expressed ideas may vary and/or be opposed to one another, it is important for all of us to listen and engage respectfully with each other.*

**Course Relationship to Teacher Preparation Standards (Woodring College of Education):**

Content Pedagogy: *The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and can create meaningful experiences that make these aspects of subject matter meaningful to students.*

Diverse Learners: *The teacher understands how students differ in their approaches to learning and creates instructional opportunities that are adapted to diverse learners.*

Communication and Technology: *The teacher-in-training uses knowledge of effective verbal, nonverbal and media communication techniques to foster active inquiry, collaboration and supportive interaction in the classroom.*

Planning: *The teacher plans instruction based upon knowledge of subject matter, students, the community, and curriculum goals.*

## Other Important Notes

### Disability, equitable access, and special accommodations

- This course is intended for all WWU students, including those with visible or invisible disabilities. Students with disabilities will be provided equitable access to educational experiences and opportunities. If, at any point in the quarter, you find yourself not able to fully access the space, content, and experience of this course, please first contact the Disability Access Center (DAC) to discuss potential accommodations. Faculty and staff partner with the DAC in the implementation of accommodations.
- If you already have accommodations set up through the DAC, please be sure to send your Faculty Notification Letter via the myDAC portal, and reach out to the DAC so they can discuss how your approved accommodations apply to this course.
- If you are unsure if accommodations are appropriate for you, contact the DAC for more information, temporary assistance, or connections to other resources: <https://disability.wvu.edu> or 360-650-3083.

### Student Services

Western encourages students to seek assistance and support at the onset of an illness, difficulty, or crisis.

- In the case of a medical concern or question, please contact the Health Center: 650-3400 or <http://studenthealth.wvu.edu>
- In the case of an emotional or psychological concern or question, please contact the Counseling and Wellness Center: 650-3400 or <http://cwc.wvu.edu>
- In the case of a health and safety concern, please contact the Department of Public Safety: 650-3555 or <https://www.wvu.edu/department-public-safety>
- In the case of a family or personal crisis or emergency, please contact the Office of Student Life: 650-3706 or <https://osl.wvu.edu>
- To seek confidential support related to sexual violence, please see resources here <https://crtc.wvu.edu/compliance/sexual-violence> or the Student health Center, and/or the Counseling Center. To report sexual violence, please contact University Police, Bellingham Police, and/or the Domestic Violence and Sexual Assault Services of Whatcom County (DVSAS) 360-715-1563

Integrity: As a community, Western is committed to integrity in all aspects of academic and campus life. An excellent resource for guiding students is Western's Integrity website. (See <http://www.wvu.edu/integrity/> ) This site is a clearinghouse of resources that encourages and educates about integrity. Besides covering more common problems related to academic integrity, such as plagiarism and cheating on exams, it also addresses ambiguous areas, such as collaborative work, the use of language translators, and submitting the same paper in different classes. In addition to this site, the University Catalog in Appendix D—Academic Honesty Policy and Procedure—delineates rights and responsibilities. (<http://catalog.wvu.edu/content.php?catoid=10&navoid=1794> )

In this course, students are held responsible for upholding all aspects of this honesty policy and the [Student Rights and Responsibilities Code](#)

A condensed list of essential policies written for WWU students can be found here: [syllabi@wvu.edu](mailto:syllabi@wvu.edu)

***This syllabus is subject to change. Changes, if any, will be announced in class and on Canvas. Students will be held responsible for all changes shared this way.***

When	Topic	Activity for today	Reading Assignments due on this date: on Canvas	Assignments Due on this date
WEEK 1 Sept 27	Nature of Science	-Introductions - Science Practices -Inclusive classrooms		
WEEK 2 Oct 4	Nature of Science	-Mystery cubes -Reading discussion	<ul style="list-style-type: none"> <li>AAAS Science for All Americans, Ch. 1 &amp; 12 (<a href="http://www.project2061.org/publications/sfaa/online/sfaatoc.htm">http://www.project2061.org/publications/sfaa/online/sfaatoc.htm</a>)</li> <li>National Academy Press (2012): Framework for K-12 p. 41-52 and 78-79. Optional: p. 53-77 for more depth.</li> </ul>	
WEEK 3 Oct 11	How People Learn	-Pendulum -Reading discussion	<ul style="list-style-type: none"> <li>National Academy Press (1999): How People Learn: Bridging Research and Practice, Ch 1&amp;2</li> <li>Banilower (2010) Effective Science Instruction p. 1-14</li> </ul>	
WEEK 4 Oct 18	Science Standards and Big Ideas in Science #1	-NGSS tour of tools. -Reading discussion -Compass points	<ul style="list-style-type: none"> <li>Next Generation Science Standards – Front Matter and Structure <a href="http://www.nextgenscience.org/sites/default/files/Final%20Release%20NGSS%20Front%20Matter%20-%206.17.13%20Update_0.pdf">http://www.nextgenscience.org/sites/default/files/Final%20Release%20NGSS%20Front%20Matter%20-%206.17.13%20Update_0.pdf</a></li> <li>Choose one disciplinary NGSS reading <ul style="list-style-type: none"> <li>Cooper, MM (2013) Chemistry</li> <li>Wyssession (2013) Earth Science</li> <li>Bybee (2013) Life Science</li> </ul> </li> </ul>	Choose topic for assignments (this will be done in class)
WEEK 5 Oct 25	Accessing Student Prior Knowledge	-Private Universe videos -Reading discussion	<ul style="list-style-type: none"> <li>Making Sense of Secondary Science (Driver et al.) Introduction</li> <li>Primer – Eliciting Student Ideas</li> <li>Coley and Tanner (2012) (Biology) or other discipline based reading: <ul style="list-style-type: none"> <li>Zhou et al. (2008) (Physics).</li> <li>Francek (2013) (Geoscience) OR Guffey &amp; Slater (2020)</li> <li>Garnett et al (2015) (Chemistry)</li> </ul> </li> </ul>	NGSS standards Assignment due
WEEK 6 Nov 1	Big Ideas in Science #2 and Learning Progressions	-Presentation on Big Ideas and Learning Progressions -Reading discussion	<ul style="list-style-type: none"> <li>Project 2061 Designs for Scientific Literacy, Ch. 7 – Unburdening the Curriculum</li> <li>Popham: Learning Progressions</li> <li>Wiggins (2010) Big Ideas</li> <li>Optional but recommended: Olson (2008): Concept-Focused Teaching</li> </ul>	Preconception s Assignment due <b>Latest date for Observation</b>
WEEK 7 Nov 8	Formative Assessment	-Presentation on probes. -Practice -Reading discussion	<ul style="list-style-type: none"> <li>Stiggins video on Assessment for Learning (<a href="https://www.youtube.com/watch?v=EDVHuHyCGmg">https://www.youtube.com/watch?v=EDVHuHyCGmg</a>)</li> <li>Creighton et al.: What is Formative Assessment</li> <li>Tweed (2009) book: p. 88-99</li> </ul>	Learning Progression due
WEEK 8 Nov 15	Teaching with Inquiry	-Review curricula/work time -Reading discussion	<ul style="list-style-type: none"> <li>Teaching High School Science Through Inquiry and Argumentation (Llwellyn) Ch. 1 &amp; 5</li> <li>Banilower (2010) p. 15-30 (analysis)</li> </ul>	Assessment Probe due
WEEK 9 Nov 22	Teaching with Inquiry/Engineering	-Pendulum challenge -Reading discussion	<ul style="list-style-type: none"> <li>Teaching High School Science Through Inquiry and Argumentation (Llwellyn) Ch. 6&amp;7</li> <li>Other reading TBA</li> </ul>	
WEEK 10 Nov 29	Inclusive classrooms ; Wrap up	-Reading discussion -Jamboard wrap up	<ul style="list-style-type: none"> <li>Chapter 4, Inclusive Classrooms from Anne Tweed’s book</li> <li>Universal Design for Learning. Watch 2 introductory videos and explore the UDL website</li> </ul>	Lesson Plan due
Finals week. Dec. 5			No class meeting	Reflective Essay due