T&L 5XX
Specialized Methods – Science
Fall 2018

Instructor: Ryan Summers, Ph.D.
Office: Education 338
Office hours: TBD
E-mail: ryan.summers@und.edu
Location: Online
Class meetings: Asynchronous

Understanding By Design Stage 1 – Desired Results

COURSE DESCRIPTION

T&L 5XX aims to provide prospective science teachers with a working knowledge of resources and materials, involve them in a variety of science teaching activities, and engage them in authentic science learning experiences across grades 5 through 12.

Coursework is designed for students who have previously earned a content area degree in science, who are enrolled in the Curriculum & Instruction track leading to initial teacher licensure.

COURSE ENDURING UNDERSTANDINGS

This course will address the following big ideas:

- How do the history and philosophy of science impact contemporary views of science teaching?
- What are the core science concepts covered in grades 5 through 12 and how can these concepts be communicated clearly to diverse learners?
- What are core instructional methods for designing and teaching developmentally appropriate high school programs?
- What constitutes high school curriculum and instruction?

***Please note: The syllabus is subject to change by your instructor as needed to enhance the learning of the students enrolled in the course.*

CONCEPTUAL FRAMEWORK:

The teacher education programs at the University of North Dakota are grounded on constructivist principles. Through our programs, we support the development of educators who:

- Are committed to the continuing process of learning about many things, especially about their content and learning to teach;
- Are able to take an active role in promoting the learning of all students;

Will advocate with and for students, parents, colleagues, school and community.

COURSE MATERIALS:

Course materials can be found online through Blackboard.

Resources available online:

National Research Council. *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: The National Academies Press, 2012. Retrieve from http://www.nap.edu/catalog.php?record_id=13165

National Research Council. *Developing Assessments for the Next Generation Science Standards*. Washington, DC: The National Academies Press, 2014. http://www.nap.edu/catalog/18409/developing-assessments-for-the-next-generation-sciencestandards

National Science Teachers Association NGSS Resources
http://www.ngss.nsta.org

Next Generation Science Standards
http://www.nextgenscience.org

***Please note: The syllabus is subject to change by your instructor as needed to enhance the learning of the students enrolled in the course.*

COURSE ESSENTIAL QUESTIONS: *Throughout this course, we will address the following questions:* • What are the (current and past) goals of science education? • What is meant by the "nature of science" and "science literacy"? • What are the *Next Generation Science Standards* and the 3-diminsional approach to science education? • How do students learn and how can teaching promote learning? • What resources do teachers use in planning and teaching? • What considerations are important for maintaining a safe science learning environment?	**COURSE OBJECTIVES:** *As a result of this course, students will be able to:* • Explore/investigate current theory and practices in teaching science in grades 5 through 12; • Articulate a grounded rationale for specific pedagogical practices; • Apply a variety of instructional approaches to science teaching, and address the needs of all students in grades 5-12; • Plan science lessons that are consistent with current trends in science education • Utilize a variety of media and resources in the teaching of science; • Develop an understanding of the impact of student diversity and diverse viewpoints on the teaching and learning of science;

***Please note: The syllabus is subject to change by your instructor as needed to enhance the learning of the students enrolled in the course.*

Understanding By Design Stage 2 – Assessment Evidence
MAJOR ASSESSMENT #1: Lesson plan (30%) You will develop and deliver a lesson plan that aligns with the content and philosophy of the *Next Generation Science Standards*. The idea is to deliver the first lesson and collect feedback to inform the instruction that follows. You will be required to turn in a developed lesson plan prior to the microteaching activity. Following the teaching, you will be required to watch your teaching, revise the teaching lesson and critically reflect on the process.
MAJOR ASSESSMENT #2: Unit plan (30%) You will develop a high school unit in your content area. This unit plan can be any content that you want but you will need to make certain that it aligns with the Next Generation Science Standards (all three dimensions).

***Please note: The syllabus is subject to change by your instructor as needed to enhance the learning of the students enrolled in the course.*

Course Outline

(Note: Each module will include a combination of readings and active learning contributions with minor assessments embedded. Students will complete each module on a 2-week timeline, and successful completion of the course requires all modules to be completed during the 16-week semester.)

Module	Topic(s)	Readings and Activities
1	**Contemporary Science Education** • Goals of science education: Past and present • Scientific Literacy • Nature of Science (NOS) • The Next Generation Science Standards (NGSS)	*Framework*, pp. 7-37 Krajcik, J. (2015). Three-dimensional instruction. *The Science Teacher*. *SFAA* Chapter 1 – Nature of Science http://www.project2061.org/publications/sfaa/online/sfaatoc.htm NGSS Appendix H – Understanding the Scientific Enterprise: The Nature of Science in the NGSS
2	**Supporting Students in Meaning-Making** • Models of Constructivism in Science Education • Learning as Conceptual Change • Discrepant Events and Paradigm Shifts • Encouraging Productive Student Talk through Questioning	Thompson & Logue (2006). Basis for student misconceptions in science. Duncan, R. G., & Hmelo-Silver, C. (2009). Journal of Research in Science Teaching (Special issue on learning progressions), 46(6), 606. Keeley, P. (2015) How does linking assessment, instruction, and learning support conceptual understanding? In R. Konicek-Moran and P. Keeley (Eds.) *Teaching for Conceptual Understanding in Science*. NSTA Press: Arlington, VA. Milne, C. (2008). In praise of questions: Elevating the role of questions for inquiry in secondary school science. How Can I Get My Students to Learn Science by Productively Talking with Each Other? http://stemteachingtools.org/brief/6

***Please note: The syllabus is subject to change by your instructor as needed to enhance the learning of the students enrolled in the course.*

		Developing and Using Models of Electrical Interactions: What NGSS Looks Like in the Classroom https://www.youtube.com/watch?v=BANW37RM6JM
3	**Pedagogical Content Knowledge (PCK)** • Teaching Controversial Topics in Middle and High School • Conflicting viewpoints in the classroom: Evolution as an example • Evidence-based Reasoning and Argumentation in Science	BPT Chapter 12, pp. 164-171 Duschl, R. (2012, February). *The second dimension: Cross-cutting concepts*. NSTA. National Center for Science Education (NCSE). "How to and Training" Retrieved from https://ncse.com/take-action Baze, C. L., & Gray, R. (2018). Modeling Tiktaalik: Using a Model-Based Inquiry Approach to Engage Community College Students in the Practices of Science During an Evolution Unit. *Journal of College Science Teaching*, *47*(4). Is it important to distinguish between the explanation and argumentation practices in the classroom? http://stemteachingtools.org/brief/1
4	**Science Lesson Planning, Part 1** • Instructional outcomes and objectives • The role of Phenomena in NGSS Storylines • Distinguishing investigative and anchor phenomena • Characteristics of good phenomena	*BPT* Chapter 9, 132-139 *BPT* Chapter 13, pp. 176-182 Bergman, A. (2013). What teachers do to engage their students in learning. In *Science for the next generation: Preparing for the new standards*. NSTA Press: Arlington, VA. "Qualities of a good anchor phenomena" "Heuristic for developing productive phenomena" Beyond the Written C-E-R: Supporting Classroom Argumentative Talk about Investigations http://stemteachingtools.org/brief/17

***Please note: The syllabus is subject to change by your instructor as needed to enhance the learning of the students enrolled in the course.*

5	**Science Lesson Planning, Part 2** • Models of Effective Instruction • Problem- and Project-Based Models: Science and Engineering • Understanding by Design • Assessment of Student Learning	The vision of Ambitious Science Teaching http://ambitiousscienceteaching.org/get-started/ Learning STEM Through Design: Students Benefit from Expanding What Counts as "Engineering" http://stemteachingtools.org/brief/7 Russell & Airasian (2011). Lesson planning and assessment objectives (Chapter 3). Ruiz-Primo, M. A., & Furtak, E. M. (2006). Informal formative assessment and scientific inquiry: Exploring teachers' practices and student learning. *Educational Assessment, 11*(3 & 4), 205-235. Huinker, D., & Freckmann, J. (2009). Linking principles of formative assessment to classroom practice. *Wisconsin Teacher of Mathematics, 60*(2), 6-11. ***Major Assessment #1 Due**
6	**Safety in the Science Classroom and Lab Setting** • Introduction to Laboratory Safety • Legality of Lab Safety and Teacher's Duty of Care • Chemical Storage and Disposal • Biological and Environmental Science Hazards	Flinn Laboratory Safety Chapter 1 Definition of "chemical hygiene plan" (see ACS Chemical Safety in Secondary Schools, p. 42) NSTA Position Statement "Safety and School Science Instruction" Flinn Laboratory Safety, Chapters 2, 3, 5, 7, and 10 American Association of Chemistry Teachers "Managing Chemical Wastes in the High School Lab" "Identifying Unknown Chemicals Guide" NSTA Position Statement "Responsible Use of Live Animals and Dissection in the Science Classroom"

***Please note: The syllabus is subject to change by your instructor as needed to enhance the learning of the students enrolled in the course.*

7	**Unit Planning, Part 1** • Backward Design • Exploring NGSS aligned assessments • Integrated approaches to science curricula • Storylines and Lesson Plan Bundles	Black, P., & Wiliam, D. (2010). Inside the black box: Raising standards through classroom assessment. *Kappan Classic*. Roth, K., & colleagues. (2009). Coherence and science content storylines in science teaching: Evidence of neglect? Evidence of effect?
8	Unit Planning, Part 2 • Sequencing and Designing Effective Science Curriculum • Evaluating Existing Curricular Materials • Selecting Materials to Support Instruction • Resources to Support Science Teachers	Evaluating Curriculum Materials for Alignment with the New Vision for K-12 Science Education http://stemteachingtools.org/brief/23 Resources for constructing curriculum http://ngss.nsta.org/Curriculum-Planning.aspx NSTA Lab Out Loud http://www.nsta.org/publications/laboutloud.aspx ***Major Assessment #2 Due**

***Please note: The syllabus is subject to change by your instructor as needed to enhance the learning of the students enrolled in the course.*

Course Assessments (Details)

MAJOR ASSESSMENT #1: Lesson Plan Components and Details

The lesson plan should have the level of detail necessary for a substitute teacher to be able to effectively deliver the planned lesson. Include time estimates for major elements.

The lesson plan should include the following elements:

Objectives. Instructional objectives for both content (i.e. NGSS), and practices and skills are included. The objectives specify student outcomes in behavioral terms. At least one objective targets students' thinking skills. Language that communicates expected student thinking is employed.

Introduction. An overview of the lesson is presented. This is not a statement of the topic of the lesson. The overview presents one or more of the following: The context of the lesson (what the teacher and the students will be doing during the lesson), a brief review of previous content and/or links to previous concepts, and a set induction (e.g., an advance organizer, demonstration).

Body of the lesson. Include the following:

- Outline of the science content to be covered in the lesson. The plan communicates the nature of the content clearly (avoiding excessive jargon). The content should be integrated into the instructional sequence and not listed separately.
- Plans for student involvement. The plan communicates directions for students (e.g., conducting an investigation, safety procedures, etc.), planned questions and expected answers, and checks for student understandings.
- Instructional logistics: The plan communicates what the teacher and the student will be doing during an instructional activity or sequence.
- Copies of all materials needed for instruction (e.g., presentation, handouts, worksheets, etc.), planned questions, assessment materials, and descriptions of non-attachable materials are provided (e.g., lab materials).

Assessment. This section communicates the plans for formative and summative assessments. (*Note* The lesson should exhibit an alignment between instructional objectives, instructional activities, and evaluation plans.)

MAJOR ASSESSMENT #2: Final Project Unit Plan

You will develop a complete unit plan that will be emailed to me, with all attachments and accompaniments, by 8 AM Tuesday, December 13. This unit plan can be any content that you want but you will need to make certain that it aligns with the Next Generation Science Standards (all three dimensions). If you can't identify standards that are addressed in meaningful ways for the topic that you pick, you need to rethink your unit choice.

[Unit Plan Title]

Introduction

A brief description of the unit (1 paragraph). This introduction should provide a description of the scope and sequence of the unit. Most units are ~10 lessons and cover between 4-6 weeks of instruction. Thinking about how another teacher might view your unit, consider foreshadowing some of the following:

- How is this unit attending to the needs of your students?
- You need to have here a detailed explanation of how you address the NGSS.
- How you integrate other core practices throughout your unit (scientific explanation, argumentation, communicating etc.).

Stage 1 – Desired Results

Content Standards/Goals

What relevant content standards or learning outcomes will this unit address? Connect lessons to as many standards or outcomes that apply. Include all three dimensions of NGSS (DCIs, Crosscutting Concepts, and Practices) as well any related understandings (see NGSS appendices).

Concept Map

Illustrate (and explain if needed) the connections between the big ideas and concepts addressed in your unit. This can connect the disciplinary core ideas, scientific practices and crosscutting concepts, and other learning goals and skills. What is the desired "conception" for students to hold?

Enduring Understandings

- Students will understand that . . .
- What are the big ideas?
- What specific understandings are desired?
- What misunderstandings are predictable?

Essential Questions

- What provocative questions will foster inquiry, understanding, and transfer of learning?
- Consider open-ended questions that promote active meaning making by learners about important ideas.
- Think about your anchoring phenomena...

Sequence of Lessons (Storyline)

Include a list, by day, with descriptive titles for all lessons (developed and undeveloped).

Stage 2 – Assessment Evidence

Assessment Plan

You will need to discuss both formative and summative assessment plans related to your unit. You will also need to consider an array of different measures, and include a minimum of 1 rubric that could be used for a specific evaluation. Assessment will need to align to the NGSS. (Minimum 1 page)

Stage 3 – Learning Plan

Preparation Prior to Teaching

Prior Learning

What would students be expected to know prior to this unit? What background experiences or prior understandings might be drawn upon to introduce this unit? (1 paragraph)

Differentiated Instruction

Consider how activities will be differentiated to accommodate for learners' academic, interest, cultural, and linguistic abilities. Address how you can differentiate "content" (RtI or academic level), "process" (experiences the students engage in) and/or "product" (showing what they know).

***Please note: The syllabus is subject to change by your instructor as needed to enhance the learning of the students enrolled in the course.*

Accommodations
Consider how activities will be include accommodations or adaptations needed to meet specific needs of all the diverse learners in the classroom, including students on IEP's or with special needs. (Minimum 1 page for differentiated instruction and accommodations)

Classroom management and safety plan.
This should be linked with examples to your unit. This can serve as the beginnings of your management philosophy and ideas for safety. You must be as explicit as possible. (Minimum 1 page)

Daily Lesson Plans
These lessons should be presented below in the intended order of delivery (Day 1, Day 2, etc.)

Undeveloped lesson plan descriptions should include (1 paragraph each):
- Learning objectives and assessment criteria
- A brief overview/description of the lesson (this would be the description of the activities covered in the lesson).

Developed lesson plans (2 total):
Objectives. Instructional objectives for both content (i.e. NGSS), and practices and skills are included. The objectives specify student outcomes in behavioral terms. At least one objective targets students' thinking skills. Language that communicates expected student thinking is employed.

Introduction. An overview of the lesson is presented. This is not a statement of the topic of the lesson. The overview presents one or more of the following: The context of the lesson (what the teacher and the students will be doing during the lesson), a brief review of previous content and/or links to previous concepts, and a set induction (e.g., an advance organizer, demonstration).

Body of the lesson. Include the following:

- Outline of the science content to be covered in the lesson. The plan communicates the nature of the content clearly (avoiding excessive jargon). The content should be integrated into the instructional sequence and not listed separately.

- Plans for student involvement. The plan communicates directions for students (e.g., conducting an investigation, safety procedures, etc.), planned questions and expected answers, and checks for student understandings. Keep in mind how your lesson will Engage, allow students to Explore, allow the teacher to Explain, and create opportunities to Extend student learning (5E Model).
- Copies of all materials needed for instruction (e.g., presentation, handouts, worksheets, etc.), planned questions, assessment materials, and descriptions of non-attachable materials are provided (e.g., lab materials).

Assessment. This section communicates any plans for formative and summative assessments within the lesson.

(*Note* The lesson should exhibit an alignment between instructional objectives, instructional activities, and evaluation plans.)

Sources:
Give credit and list Internet and/or print sources for your unit.

Assessment #5 Grading Rubric

Component	Points Possible	Points Awarded	Comments
Unit Title	5		
Introduction	5		
Content Standards and Related Goals	10		
Concept Map	5		
Enduring Understandings	5		
Essential Questions	5		
Sequence of Lessons	5		
Assessment Plan	10		
Prior Learning	5		
Differentiated Instruction	5		
Accommodations	5		
Classroom Management and Safety Plan	5		
Undeveloped Lesson Plan Descriptions (6)	10		

Developed Lesson Plans and Materials (2)	20		
TOTAL	/100		

***Please note: The syllabus is subject to change by your instructor as needed to enhance the learning of the students enrolled in the course.*

INTASC Standards addressed in TL 5XX - Science:

Standard #1: Learner Development

The teacher understands how learners grow and develop, recognizing that patterns of learning and development vary individually within and across the cognitive, linguistic, social, emotional, and physical areas, and designs and implements developmentally appropriate and challenging learning experiences.

Standard #2: Learning Differences

The teacher uses understanding of individual differences and diverse cultures and communities to ensure inclusive learning environments that enable each learner to meet high standards.

Standard #3: Learning Environments

The teacher works with others to create environments that support individual and collaborative learning, and that encourage positive social interaction, active engagement in learning, and self motivation.

Standard #4: Content Knowledge

The teacher understands the central concepts, tools of inquiry, and structures of the

discipline(s) he or she teaches and creates learning experiences that make these aspects of the discipline accessible and meaningful for learners to assure mastery of the content.

Standard #5: Application of Content

The teacher understands how to connect concepts and use differing perspectives to engage learners in critical thinking, creativity, and collaborative problem solving related to authentic local and global issues.

Standard #6: Assessment

The teacher understands and uses multiple methods of assessment to engage learners in their own growth, to monitor learner progress, and to guide the teacher's and learner's decision making.

Standard #7: Planning for Instruction

The teacher plans instruction that supports every student in meeting rigorous learning goals by drawing upon knowledge of content areas, curriculum, cross-disciplinary skills, and pedagogy, as well as knowledge of learners and the community context.

Standard #8: Instructional Strategies

The teacher understands and uses a variety of instructional strategies to encourage learners to develop deep understanding of content areas and their connections, and to build skills to apply knowledge in meaningful ways.

Standard #9: Professional Learning and Ethical Practice

The teacher engages in ongoing professional learning and uses evidence to continually evaluate his/her practice, particularly the effects of his/her choices and actions on others (learners, families, other professionals, and the community), and adapts practice to meet the needs of each learner.

Standard #10: Leadership and Collaboration

The teacher seeks appropriate leadership roles and opportunities to take responsibility for student learning, to collaborate with learners, families, colleagues, other school professionals, and community members to ensure learner growth, and to advance the profession.

***Please note: The syllabus is subject to change by your instructor as needed to enhance the learning of the students enrolled in the course.*