Stanford
GRADUATE SCHOOL OF
EDUCATION

EDUC 267C: Curriculum & Instruction in Science

Winter Quarter 2026
Class Syllabus

Course Information
Curriculum and Instruction in Science Education Tuesdays 3:15pm - 6:00pm Course Website: http://canvas.stanford.edu Class Location: Raikes 111
Instructor Information
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Course Description

In the Summer quarter, we discussed the importance of knowing your content, your context, and your students. As Dr. Brown mentioned, "You don't teach science; you teach students science." In the Fall quarter, we began to build goal-driven and iterative lesson segments and lesson plans, and considered the tenets of social justice science lessons. Collectively, these two quarters have helped establish the foundation for how to teach science effectively for your specific students.

The Winter quarter of Curriculum and Instruction in Science will extend on these themes and work from and build upon four main perspectives:

1. **Your Context**: What are the specific issues to *your* own teaching context that shape *your* teaching and help *your* students in *your* school make progress and achieve in science?
2. **The Big Questions of Science Education**: "Why science education?" We'll discuss how this question relates to your classroom but we'll also challenge you to consider national – and international – arguments about why we teach science and what it should look like in secondary classrooms.
3. **Your Science Story**: Whether you recognize it or not, your lessons and units tell a story. In the design of your course, what story are you telling about science?

4. **Sensemaking with Science Ideas & Practices**: What opportunities exist for your students to engage in sensemaking about science? How do you integrate the Science and Engineering Practices into your planning, instruction, and assessment?

Course Goals

The above perspectives manifest as several course goals for the Winter quarter.

Course Outcomes	Assessment of Course Outcomes
SWBAT plan a coherent and effective unit plan, which supports students in making sense of an anchoring phenomenon.	Unit Plan Development
SWBAT design and use both formative and summative assessments, including an analysis of results, to improve curriculum, instruction, and assessment.	Unit Plan Development
SWBAT engage students in lessons that emphasize the NGSS practices.	NGSS Practice: Planning and NGSS Practice: Artifact (Parts A & B)
SWBAT explain how the ideas from science education research inform effective instructional and assessment practices.	Readings and Reading Responses
SWBAT reflect meaningfully on their planning, instruction, and assessment to better realize their vision of science education for their students.	Vision of Science Education (Parts A & B)

Our Course Sessions

In order to achieve the course outcomes, our sessions will highlight a particular aspect of science teaching, with a specific emphasis on unit planning. Collectively, we will explore the theory underlying and supporting this aspect and discuss strategies you can use in your placements (and beyond). Over the course of the quarter, **you will develop a unit plan** that follows the principles of Understanding by Design (Wiggins and

McTighe, 2005) and supports students in using the science and engineering practices to make sense of an anchoring phenomenon.

As part of this process, we will explore the Scientific and Engineering Practices. These practices are:

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

In addition to unpacking the practices, discussing what they might look like in your classroom, our science time will be used to model an example of both how lessons might flow together and how a specific NGSS practice could be modified.

Finally, we believe that you become a better teacher by becoming a **reflective practitioner** (see Schön, 1987). Reflective practice is enhanced by sharing your challenges with others, reflecting on them, and learning from your mistakes. Not only will you be able to share your individual work, but collectively, we will also reflect on the shared example during science time.

With these aims in mind, most sessions will follow the same basic routine:

- Discuss a specific element of unit planning;
- Explore one of the NGSS practices, including reflecting on a shared example, as well as your own efforts towards implementing the NGSS practices;
- Examine a strategy that might better support the implementation of the NGSS practices;
- Design parts of your own NGSS-aligned unit plan; and
- Compare and contrast your vision of science education with current literature on science teaching and learning.

Course Expectations

What do we expect of you?

Our goal is for this course to be a collegial space where we can all learn from and with each other. To that end, we expect that you will be present in class and that you will

come prepared to engage in discussions with curiosity, actively challenge your own understandings, and be respectful of the diversity of experiences and identities expressed by your colleagues. There are four expectations that we want to highlight:

- *Participation:* Our collective engagement in class is essential for your learning and the learning of others. While participation will look and sound different for each of you, I expect for everyone to monitor their airtime, stepping back to create space for others or speaking up to share your ideas.
- *Communication:* We live in an unpredictable world; things happen. Please communicate with us via email if you need to be late or absent *before* the session if possible.
- *Digital Tools:* We live in a digital world. We'll use digital tools in class to support our learning. When these tools are not central to our learning, we ask that you set them aside, including your personal devices.
- *Professionalism:* As a teacher, you will need to come prepared to class everyday for your students. You would never show up to your job without being prepared and we expect you to exhibit this same professionalism by turning your work in on time. However, we understand that individual circumstances may prevent this from happening. As such, we ask that if you are unable to turn in an assignment by the due date, that you **email both instructors prior to the deadline** and ask for an extension of no more than two weeks after the due date has passed. This policy is meant to keep you up-to-date with our learning topics and prevent you from feeling overwhelmed at the end of the quarter.

What can you expect of us?

You can expect that we will work to get to know you as a student and, more importantly, as a human. We will strive to create a collaborative and equitable learning environment where each of you feels comfortable sharing what you've learned, challenging other's ideas, and wrestling through your own uncertainties. We will work to build trust with you and amongst our community of learners. We will provide you with timely feedback and will do our best to be available to meet with you when you need it. We will do our best to be responsive to your needs.

Support

Students who may need academic accommodation based on the impact of a disability must initiate the request with the Student Disability Resource Center (SDRC) located within the Office of Accessible Education (OAE). SDRC staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is

being made. Students should contact the SDRC as soon as possible since timely notice is needed to coordinate accommodations.

Preferred Name & Preferred Gender Pronouns

Class rosters are provided to the instructors with the student's legal name and gender designation; these records might not correspond to the name and gender pronouns you use. We will gladly honor your request to address you by your preferred name and pronouns. Please also let us know if these change at any point.

Stanford Honor Code

You are expected to follow the Stanford Honor Code. If you have any questions about how it applies to a particular assignment, please ask.

For an explanation of the Honor Code, please go to:
https://communitystandards.stanford.edu/policies-and-guidance/honor-code

Grading

Our philosophy is to prioritize timely and specific feedback. This acknowledges that:

- You are each here to gain as much understanding and skill as you can;
- You learn at different rates and in different chunks; and
- You will have each gained at least the fundamental understandings and skills that we intend by course end.

The grade for the course will be assigned on the basis of assignments as detailed below. If you are adhering to the above expectations and making sincere efforts to fully participate in assigned tasks during and outside of class, you can expect an A.

Assignments - Overview

Unless otherwise noted, assignments should be submitted to Canvas and are due before class begins.

#	NAME	DESCRIPTION	EVAL. TYPE	%	DUE DATE(S)
1	**Readings & Reading Summary**	**Readings:** Each week there will be assigned reading(s). It is your responsibility to come to class prepared to discuss these readings.	Credit/ No Credit	15%	Ongoing

		Summary: For each reading, you will submit a 2 to 3 minute audio recording or short paragraph of the big ideas from the readings and how you see it connecting to teaching and learning. You will be required to submit a reading summary for 7 of the 9 weeks.			
2	**Vision of Science Education**	**Part A**: As part of an in-class activity, you will be asked for your vision of an **inclusive, joyful, and social-justice oriented science classroom**. For this assignment, you will write a 250-500-word statement about your vision, and respond to specific prompts. **Part B**: At the conclusion of the course, you will be asked to reflect on your initial vision and how it has changed, if at all, moving forward, and respond to specific prompts.	Credit / No Credit	15% Total 7.5% Each	Part A: 1/13/26 Part B: 3/10/26^
3	**NGSS Practice: Artifact Reflection**	Working in duos, you will review an artifact of practice teaching (e.g. video, student work, lesson plan, etc.) and reflect on your teaching: What opportunities did you provide for students to engage in the NGSS practice most appropriate to your lesson objective? After sharing and discussing your artifact with your partner, you will submit a longer reflection addressing specific prompts.	Credit/ No Credit	20%	Part A: 2/3/26 Part B: 2/10/26
4	**Development of Unit Plan: Check-Points**	Over the course of the class, you will design a full unit. This assignment will be broken down into specific check-points. At each check-point, you will receive feedback, which you will be expected to incorporate into your final unit submission (see below). Check-Point 1: Unit overview, performance expectations, anchoring phenomenon, essential questions, and SEPs, DCIs, and CCCs.	Credit/ No Credit	10%	Check 1: 1/27/26

		Check-Point 2: Pre-Assessment Task Check-Point 3: Performance Task Check-Point 4: Lesson Sequences Check-Point 5: Full Lesson Plan for one of the Lesson Sequences Check-Point 6: Class Presentation			Check 2: 2/3/26 Check 3: 2/17/26 Check 4: 2/24/26 Check 5: 3/3/26 Check 6: 3/10/26
5	**Final Unit Plan**	You will submit your final unit, which includes all of the parts above and incorporates the feedback given over the course of the class.	Criterion Graded	40%	3/3/25 - 3/15/26^*

^Indicates that the assignment is **NOT** due prior to the start of class.
***Indicates that this assignment is a flexible due date and may be submitted anytime within the time frame**

ASSIGNMENTS - FULL DESCRIPTION

1. **<u>Readings & Reading Response (15%)</u>**
   Readings & Reading Response: Due Weekly Monday (11:59pm) Before Class Each Week

   Each week there will be assigned reading(s). As class discussions will reference the ideas in these readings, it is your responsibility to come to class prepared to discuss them. After completing all the readings for the week, you will submit a short (*no more than 5 minute*) audio recording or a 4-sentence summary of the big ideas from each of the reading and how you see it connecting to teaching and learning. ***To get credit for these reading responses, you will need to read and submit a reading response on Canvas for seven of the nine weeks (a total of 21pts out of a possible 27pts).***

   Be sure to answer both of the questions below in your Reading Response:
   a. Which part of the paper or which idea most resonated with your teaching.
      i. This could be something that you want to try (or have tried) in your classroom; something that excites you about the reading; or something that surprised you. The prompt is intentionally broad.

b. What questions do you have about the results, about the translation between theory and practice, and/or what this might look like in your classroom do you still have?

2. **<u>Vision of Science Education (15% Total – 7.5% each for Part A and B)</u>**
   Part A: Due before class, 1/13/26

   During our first class, you will sketch your vision (or a pinterest board, Canva, etc) for effective science teaching. Based on this in-class activity, write a reflection (250-500 words) in which you:
   a. Briefly explain your vision;
   b. Reflect on how you have enacted aspects of your vision so far; and
   c. Target one aspect of your vision to make a goal for this quarter.

- **How to submit**: Word document/Google Sheet to Canvas

Part B: Due by 11:59 pm after class on 3/10/26
During our final class, you will reflect on your initial vision for effective science teaching and explain (250-500 words):
a. How has your vision changed, if at all, based on this past quarter;
b. What progress did you make toward your goal; and
c. How might you hold yourself accountable for reflecting on this vision when no longer in STEP?

- **How to submit**: Word document/Google Sheet to Canvas
  Note: You will have some work time for this assignment during class. It is due by 11:59pm PT following our class.

3. **<u>NGSS Practice: Artifact Reflection (20%)</u>**
   Part A (Artifact & Discussion): Copy posted to Canvas before class and bring your artifact to class on 2/3/26
   Part B (Individual Reflection): Due before class, 2/10/26

   Part of being a good teacher is reflecting on our practice. Working in pairs, you will each share an artifact of your practice that emphasizes the NGSS practices and discuss the artifact in light of the following questions:

a. **Central Focus:** What is the goal for the lesson? How does your artifact help students understand relationships between scientific concepts, scientific practices, and the phenomenon in the unit? Identify an aspect of your artifact that is designed to support student learning and engagement with a specific NGSS practice. (It might be helpful to review Appendix F.)
b. **Knowledge of Students:** How did your knowledge of your students shape how you designed or adapted this artifact? Consider what your students know and can do, as well as their personal, cultural, and community assets.
c. **Adapting Instruction:** What changes would you make to your instruction next time and why?
d. **Your own specific question:** This question will be discussed with your partners when you share your artifact in advance of your meeting.

After your discussion (~15-20 min each; ~60 min total), you will each submit a reflection (750 words) based on your conversation. Your reflection should address:

a. Brief Overview: What is the artifact? What was the lesson objective? What was the focal NGSS practice?
b. Area of Strength: What was at least one way that you provided an opportunity for students to engage in the specific NGSS practice? (Be specific; cite details from the artifact.)
c. Area of Growth: Based on your conversation, what is one *concrete* way you could modify this lesson moving forward to better support students in the NGSS practice? (Avoid generalities; "Add more scaffolding.")
d. Partner Insight: What was the most valuable insight shared by one of your partners? How will you operationalize this insight in your teaching?
e. Vision of Science Teaching: How does this artifact support your target for your vision of effective science teaching? (If it doesn't, what is an additional change you could make?)

- **How to submit**: For Part A, upload a Word document/Google Sheet to Canvas before class *and* bring the artifact with you to class. For Part B, Word document/Google sheet to Canvas.

4. <u>Unit Plan Development (10%)</u>

Check-Points: Due before class; See the Chart Below for Specific Due Dates
In this assignment, you will design a unit plan according to the model developed by Wiggins and McTighe (2005) and the Ambitious Science Teaching Framework (Windschitl et al., 2018). The unit plan development is the major assignment of the Winter quarter; however, the construction of the unit will be scaffolded with "check-points."

After each check-point, you will receive feedback that will later be incorporated into your final unit submission. In this way, this assignment is both a learning and assessment task. We will use a unit template for this assignment.

Note: This is meant to be a planning exercise. While you can choose a unit that you will teach this quarter, it should come after you've had a chance to plan (~late Feb/early March).

Unit Plan: Check-Point 1: The first aspect of the unit construction contains the big picture ideas for the unit. Using the planning template, please complete:

a. **Unit overview:** This set of two slides includes a description of the learning context that addresses both the students and the science content you will address; an explanation of who your students are; the teacher rationale for why you believe students should learn this material; and the student rationale for why you think students would be excited to learn this material and how it is relevant to their lives.
b. **Performance expectations:** This slide lists all performance expectations you intend to assess over the course of the unit and the associated foundation boxes.
c. **Anchoring phenomenon:** The phenomenon that students will *explore throughout the unit.* Phenomena are observable and can arise from either a natural or designed system.
    i. More detail about Anchoring Phenomena.
d. **Phenomenon-driven question:** The question students will be able to answer at the end of the unit, related to the phenomenon and includes both an SEP and DCI.
e. **Essential question:** It is important that your unit addresses a question designed to "guide student inquiry toward a deeper understanding of a big idea" (Wiggins & McTighe, 2005, p. 116) and whose answer will be understood by studying your unit. This question should be central to science and promote inquiry. Students' answers to this question at the end of the unit will shed light on their learning related to the enduring understandings.

f. **20 sec Story/Enduring Understandings:** Based on the DCIs, SEPs, and CCCs for your unit, what do you want students to remember in 20 years? In other words, what is your 20 sec story? While this could be part of your anchoring phenomenon, it does not have to be.

- **How to submit**: Upload your Planning Template link to Canvas

Unit Plan: Check-Point 2: Using the planning template, please complete:

a. **Pre-Assessment Plan**: How will you assess students' prior knowledge of the Anchoring Phenomenon or Essential Question?

- **How to submit:** Upload your Planning Template link to Canvas, with your Pre-Assessment linked on the correct slide.

Unit Plan: Check-Point 3: Using the planning template, please complete:

a. **Performance Assessment Task**: How will you know what students know and are able to do at the end of the unit? Develop a unit – sometimes called a summative or performance – assessment. This submission should include the student-facing prompt and a draft of a rubric. Draw on discussions from the Summer and Fall for expanded notions of what counts as assessment.

- **How to submit**: Upload your Planning Template link to Canvas, with your Performance Assessment linked on the correct slide.

Unit Plan: Check-Point 4: Using the planning template, please complete:

a. **Lesson Plans**: In the Summer and Fall quarters, we developed lesson segments and lesson plans. In the educational world, there is no consensus on how long a lesson should last (should it be designed for a single day of instruction? For three days?). Where there is consensus is that lesson plans should address a lesson objective and have a lesson assessment. For the purposes of this assignment, you will outline the objectives, the assessment, how many days you expect the lesson to take, and the major activities in the lesson plans for your unit.
Note: Keep in mind that how you sequence your lessons tells a narrative – what story are you telling?

- **How to submit**: Upload your Planning Template link to Canvas, with the Lesson Plans Slides completed

Unit Plan: Check-Point 5: Using the planning template, please complete:

a. **One Complete Lesson Plan**: For one of your lesson sequences (it does not have to be the first one), you will draft each of the daily lesson plans. Each lesson plan should include lesson timing; lesson topic; NGSS performance expectations addressed; lesson learning objectives; instructional resources; a timeline of instructional tasks with times, student actions, teacher actions, and opportunities for formative assessment; language demands; language supports; accommodations, modifications and scaffolds; and relevant theories.
Note: For this check-point, please choose a lesson plan that is more than one day of instruction.

- **How to submit**: Upload your Planning Template link to Canvas, with the one Lesson Series linked on the appropriate slide (from the Lesson Sequence overview)

Unit Plan: Check-Point 6: You will have 5-8 minutes to present your unit to your classmates. Focus on the big picture, rationales, phenomena, and how you will know what students have learned. Think of this as a way to help others in the group get creative teaching ideas.

- **How to submit**: No submission; however, please be prepared to share with the class.

5. **Final Unit Plan (40%)**
Due by 3pm on 3/15/26

The Check-Points are meant to be formative. As such, you should address comments in a different color font to see how your unit evolved during the quarter. We will co-create a rubric together using the tools and ideas learned from previous quarters.

- **How to submit**: Upload a link of your complete and modified Unit Plan with all components linked to Canvas

Weekly Assignments & Readings

Week	Focus & Reading(s)	Assignments Due

1 – Jan. 6	**Introduction to the Winter Quarter** *Planning Focus:* Phenomenon & Big Ideas *NGSS Practice Focus:* Framework & Appendix F Reading/Listening(s): ❖ NGSNavigators Podcast. Justice-Centered Science Pedagogy with Daniel Morales-Doyle. Link here. (Listen from 0:00 - 12:00) ➢ Spotify Link: Here Optional: ❖ Lowell, B. R., & McNeill, K. L. (2019). Keeping critical thinking afloat. Science Scope, (August), 64–69.	No assignment due, other than the podcast
2 – Jan. 13	**Planning for Engagement** *Planning Focus:* Big Ideas, Sequencing Lessons, & Performance Assessments *NGSS Practice Focus:* Framework & Appendix F ❖ Luehmann, A., Merliss, G., Campbell, T., Zhang, Y., Cooke, H., & Scipio, D. (2024). A Core Set of Practices for Justice-Centered Ambitious Science. In *Proceedings of the 18th International Conference of the Learning Sciences-ICLS 2024, pp. 1438-1441*. International Society of the Learning Sciences. https://repository.isls.org/handle/1/10719 ➢ PODCAST LINK ❖ Stoll, L., & Schultz, S. (2019). How to Design a Performance Task. Science Scope, 042(07), 40–45. https://doi.org/10.2505/4/ss19_042_07_40	Assignment 1: Vision of Science Education – Part A Reading Response #1
3 – Jan. 20	**Eliciting & Honoring Student Ideas: Pre-Assessment** *Planning Focus:* Students' Prior Knowledge *NGSS Practice Focus:* Asking Questions & Planning Investigations ❖ Lee, O. (2020). Making everyday phenomena phenomenal. Science and Children, 58(1), 56-61. https://www.jstor.org/stable/27045164	Reading Response #2

	❖ Larkin (2019) Teaching Science in Diverse Classrooms: "Real Science for Real Students." **Chapters 2 & 3, only** ➢ Listen: On Spotify or On Anchor (~16 min total)	
4 – Jan. 27	**Eliciting Student Ideas: Modeling** *Planning Focus:* Growth in Student Ideas *NGSS Practice Focus:* Developing Models ❖ Windschitl, M., & Thompson, J. (2013). The modeling toolkit: Making student thinking visible with public representations. *The Science Teacher*, *80*(6), 63-69. Optional: ❖ Matuk, C., Hurwich, T., Spiegel, A., & Diamond, J. (2019). How do teachers use comics to promote engagement, equity, and diversity in science classrooms?. Research in Science Education (p. 1-9).	Unit Planning: Part 1 Reading Response #3
5 – Feb. 3	**Supporting Ongoing Changes: Activities** *Planning Focus:* Adapting Instruction *NGSS Practice Focus:* Analyzing and Interpreting Data; Using Math ❖ Ambitious Science Teaching: Supporting Changes Primer (p. 1-8) ❖ Patterson, A. D. (2019). Equity in groupwork: The social process of creating justice in a science classroom. Cultural Studies of Science Education, 14(2), (read 361–364, skim 365-371, read 371-379 ➢ PODCAST LINK Optional: ❖ I Can Use the Identify and Interpret (i2) Strategy. (2012) BSCS.	Unit Planning: Part 2 NGSS Practice: Artifact Reflection – Part A Reading Response #4

6 – Feb. 10	**Supporting Ongoing Changes: Collective Understanding** *Planning Focus:* Pulling Ideas Together *NGSS Practice Focus:* Obtaining, Evaluating, and Communicating Information ❖ Windschitl, M., Thompson, J., & Braaten, M. (2018). *Ambitious science teaching*. Harvard Education Press: Cambridge, MA. (p. 187-97) ❖ *Emdin, C. (2011). Moving beyond the boat without a paddle: Reality pedagogy, Black youth, and urban science education. The Journal of Negro Education, 285-291. ➢ PODCAST LINK	NGSS Practice: Artifact Reflection - Part B Reading Response #5
7 – Feb. 17	**Making and Justifying Claims** *Planning Focus:* Productive Talk *NGSS Practice Focus:* Arguing from Evidence ❖ Osborne, J. (2010). Arguing to Learn in Science: The Role of Collaborative, Critical Discourse. Science, 328, 463-466. ❖ Michaels, S., & O'Connor, C. (2012). Talk science primer. Cambridge, MA: TERC. p. 10-20 ➢ PODCAST LINK	Unit Planning: Part 3 Reading Response #6
8 – Feb. 24	**Evidence-Based Explanations** *Planning Focus:* Scientific Explanations *NGSS Practice Focus:* Constructing Explanations ❖ Berland, L. K., & Reiser, B. J. (2009). Making sense of argumentation and explanation. *Science education*, *93*(1), 26-55 (Read p. 26-35) ➢ PODCAST LINK	Unit Planning: Part 4 Reading Response #7
	Assessment *Planning Focus:* Dimension of Effective Science Assessment *NGSS Practice Focus:* Designing Solutions	Unit Planning: Part 5 Reading Response #8

9 – Mar 3	❖ Lee, O., & Llosa, L. (2019). Broadening participation of English learners in science education in the era of new standards. *Educational Researcher, 48*(6), 395-400. ❖ Littrell & Williams. (2020) Achieving Equity Through Assessments. NSTA.	
10 – Mar. 10	**Looking Forward** *Planning Focus:* Backwards Design & AST Framework *NGSS Practice Focus:* Framework; Appendix F ❖ Hatt, B. (2012). Smartness as a cultural practice in schools. *American Educational Research Journal, 49*(3), 438-460. https://doi.org/10.3102/0002831211415661 ❖ Winn, M. T., Behizadeh, N., Duncan, G., Fine, M., & Gadsden, V. (2011). The right to be literate: Literacy, education, and the school-to-prison pipeline. *Review of Research in Education*, *35*, 147–173. https://www.jstor.org/stable/41349015	Unit Planning: Part 6 Reading Response #9