

EDUC 267C: CURRICULUM & INSTRUCTION IN SCIENCE
WINTER 2021
CLASS SYLLABUS

Course Information	
Curriculum and Instruction in Science Education	
Tuesdays 3:00pm - 5:50pm	
Course Website: http://canvas.stanford.edu Class Location: Zoom room near you!	
Instructor Information	
Matt Wilsey <i>Ph.D. Candidate in Science Education</i> mwilsey@stanford.edu Office Hours: by appointment	Sara Dozier <i>Ph.D. Candidate in Science Education</i> dozier@stanford.edu Office Hours: by appointment

COURSE DESCRIPTION

In the Summer quarter, we discussed the importance of knowing your content, your context, and your students. In the Fall quarter, we began to build iterative lesson segments and lesson plans, and considered Doug Larkin's ideas of teaching science in diverse classrooms. Collectively, these two quarters have helped established the foundation for how to teach science effectively for your specific students.

This 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 individual issues of *your* own teaching context, shaping *your* teaching, to help *your* students, in *your* school, to make progress and to achieve in science?
2. **The Big Questions of Science Education:** "Why science education?" This question moves beyond your own classroom, and challenges you to consider national – and even international arguments – as *you* become a leader in the world of science education.
3. **Your Science Story:** How you structure your lessons and units tells a story of your discipline. In the design of your course, what story are *you* telling?
4. **The Practices:** What opportunities exist for your students to engage in 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 plan effective uses of both formative and summative assessments, including an analysis of results to improve curriculum, instruction, and assessment.	Unit Plan Development
SWBAT engage their students in a lesson that emphasizes at least one of the NGSS practices.	NGSS Practice: Planning and NGSS Practice: Artifact
SWBAT explain the underlying empirical research for the best instructional and assessment practices.	Readings and Reading Summary
SWBAT reflect meaningfully on their planning, instruction, and assessment to better realize their vision of science education for their students.	Vision of Science Education

OUR COURSE SESSIONS

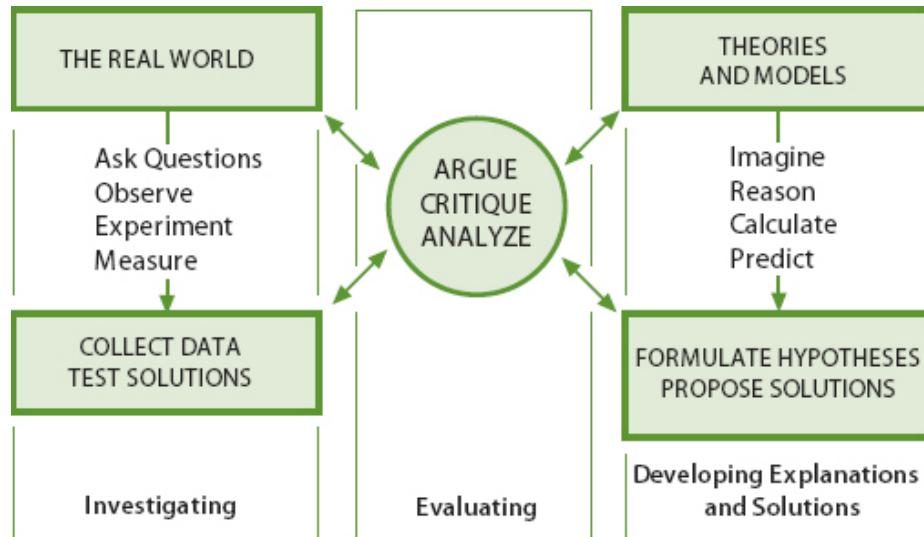
In order to achieve the course outcomes, our sessions will highlight a particular aspect of science teaching, with a specific emphasis on unit planning. Collectively, we will explore the theory underlying and supporting this aspect and discuss strategies you can use in your placements (and beyond). Over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



Quinn, H., Schweingruber, H., & Keller, T. (2012). *A framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. National Academies Press.

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 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.

SUPPORT

Students who may need an 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

Regular attendance in class is expected. If you are going to be absent, please let us both know in advance via email (mwilsey@stanford.edu and dozier@stanford.edu).

You should assume you have an A in this course, which is to say that the A is yours to lose. 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.

With the exception of your Vision of Science Education: Part B and the Final Unit Plan, all assignments are due before the start of class on the date specified.

The grade for the course will be assigned on the basis of assignments as detailed below.

ASSIGNMENTS - OVERVIEW

#	NAME	DESCRIPTION	EVAL. TYPE	%	DUE DATE(S)
1	Readings and Reading Summary	<p>Readings: Each week there will be assigned reading(s). It is your responsibility to come to class prepared to discuss these readings.</p> <p>Summary: For <i>one</i> of the weeks readings, you will be responsible for summarizing the big ideas of the article(s). Additionally, you will be asked to identify: 1) the part of the paper that resonates most strongly with your teaching; and 3) a lingering question. Each summary will be added to a shared class document.</p>	Credit/ No Credit	10%	Ongoing
2	Vision of Science Education	<p>Part A: As part of an in-class activity, you will be asked for your vision of an effective science classroom. For this assignment, you will write a 250-500-word statement about your vision, and respond to specific prompts.</p> <p>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.</p>	Credit / No Credit	10% Total 5% Each	Part A: 1/19/21 Part B: 3/16/21^
3	NGSS Practice: Artifact Reflection	Working in trios, you will review an artifact of practice teaching (e.g. video, student work, lesson plan, etc.). 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 1: 2/9/21 Part 2: Meet between 2/10/21 – 2/19/21 Part 3: 2/23/21
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	Credit/ No Credit	10%	

		<p>be expected to incorporate into your final unit submission (see below).</p> <p>Check-Point 1: Unit overview, performance expectations, anchoring phenomenon, essential questions, and SEPs, DCIs, and CCCs.</p> <p>Check-Point 2: Pre-Assessment Task</p> <p>Check-Point 3: Performance Task</p> <p>Check-Point 4: Lesson Sequences</p> <p>Check-Point 5: Full Lesson Plan for one of the Lesson Sequences</p> <p>Check-Point 6: Class Presentation</p>			<p>Check 1: 1/26/21</p> <p>Check 2: 2/2/21</p> <p>Check 3: 2/16/21</p> <p>Check 4: 3/2/21</p> <p>Check 5: 3/9/21</p> <p>Check 6: 3/16/21</p>
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	50%	3/18/21^

[^]Indicates that the assignment is NOT due prior to the start of class.

ASSIGNMENTS - FULL DESCRIPTION

1. Readings & Reading Summary (10%)

Readings: Due Weekly; Reading Summary: See the Chart Below

- Each week there will be assigned readings(s). As class discussions will reference the ideas in these readings, it is your responsibility to come to class prepared to discuss them.
- Once during the quarter, you will be responsible for writing a summary of the major ideas of the article. The summary is meant to be brief (200 words).

Additionally, you will be asked respond to two questions:

- a. Which part of the paper or which idea most resonated with your teaching. Explain. (75-100 words)
 - 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 about the results, about the translation between theory and practice, what this might look like your classroom do you still have? (75-100 words)

Note: If there is more than one reading for a week, please only summarize the reading with the asterisk (*). Additionally, please pay attention to the specific pages for each reading!

- How to submit: Add entry to shared Google spreadsheet. Upload spreadsheet link to Canvas.

Week	Reading Summary Person
2 – Jan 19 th	Oliver Yang
3 – Jan 26 th	Elyse Rankey
4 – Feb 2 nd	Hannah Korslund
5 – Feb 9 th	Phil Hopkins
6 – Feb 16 th	Tiffany Huynh
7 – Feb 23 rd	Sesha McMinn
8 – Mar 2 nd	César Moreno
9 – Mar 9 th	Kelly Wilson
10 – Mar 16 th	Haley Blackwell

2. Vision of Science Education (10% Total – 5% each for Part A and B)

Part A: Due before class, 1/19/21

- *PART A:* During our first class, you will sketch your vision for effective science teaching. Based on this in-class activity, write a reflection (250-500 words) in which you:
 - Briefly explain your vision;
 - Reflect on how you have enacted aspects of your vision so far this year; and
 - Target one aspect of your vision to make a goal for this quarter.
- How to submit: Word document to Canvas

Part B: Due by 11:59pm after class on 3/16/21

- *PART B:* During our final class, you will reflect on your initial vision for effective science teaching and explain (250-500 words):
 - How has your vision changed, if at all, based on this past quarter;
 - What progress did you make toward your goal; and
 - How might you hold yourself accountable for reflecting on this vision when no longer in STEP?

- How to submit: Word document to Canvas

Note: This assignment is NOT due prior to the final class. You will have some work time for this assignment during class. It is due by 11:59pm PT on Tuesday following our class.

3. NGSS Practice: Artifact Reflection (20%)

Part 1: Email due to your partners before class on 2/9/21

Part 2: No submission, but meet between 2/10/21-2/19/21

Part 3: Due before class, 2/23/21

- Part of being a good teacher is reflecting on our practice. Working in trios, you will each share an artifact of your practice and discuss the artifact in light of the following questions:
 - a. What was the goal for the lesson?
 - b. Which NGSS practice is either part of the lesson goal or aligns most closely with it?
 - c. Identify an aspect of your artifact that supported student learning *and* engagement in the specific NGSS practice. (It might be helpful to review Appendix F.)
 - d. What is at least one concrete way you could modify this lesson based on your students' engagement to better support them in the NGSS practice?
 - e. Your own specific question. This question will be shared with your partner when you share your artifact in advance of your meeting.

After your discussion (~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: This assignment has multiple steps and due dates. The 3 parts are: 1) Share your artifact and specific question in advance of your meeting; 2) Plan and conduct a video meeting; and 3) Submit your individual reflection.
Part 1: Email your partners, Sara, and Matt with your artifact and specific question for feedback. This is due before class on 2/9/21.
Part 2: On your own, set up and conduct a video meeting. This meeting should occur between 2/10/21 and 2/19/21. There is no submission for this part of the assignment.
Part 3: Before class on 2-23-21 upload your Word document to Canvas.

Partners:

Group 1 (HS Physical Science/Chemistry): Hannah, Oliver, & Phil;

Group 2 (HS Biology): César, Sesha, & Kelly

Group 3 (MS): Tiffany, Haley, and Elyse

4. Unit Plan Development (10%)

Check-Points: Due before class; See the Chart Below for Specific Due Dates

- In this assignment, you will design a unit plan according 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? Design the pre-assessment that you would use with your students.
- **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 Sequences:** In the Summer and Fall quarters, we developed lesson segments and lesson plans. Some of these lessons were on the same idea/topic, and even though they had their own lesson objective and assessment, they were part of the same sequence. Here you will describe the focus of 4-6 lesson sequences (roughly 2-3 days of instruction) and the specific lesson objectives. The lesson objectives should draw upon the NGSS, and make clear what DCIs will be included, what SEPs will be addressed, and any CCCs that will be assessed. 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 Sequence Slides completed

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

- a. **One Complete Lesson Sequence:** For one of your lesson sequences (it does not have to be the first one), you will draft each of the 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 assignment, please choose a Lesson Sequence with 3 Lessons.

- 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 needed.

5. Final Unit Plan (50%)

- 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.
- 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 11 th	<p>Introduction to the Winter Quarter <i>Planning Focus:</i> Phenomenon & Big Ideas <i>NGSS Practice Focus:</i> Framework & Appendix F</p> <p>Reading(s):</p> <ul style="list-style-type: none"> - NGSS Appendix F (p. 1-3; Skim 4-33: the practices) - Lowell, B. R., & McNeill, K. L. (2019). Keeping critical thinking afloat. <i>Science Scope</i>, (August), 64–69. - Osborne, J. (2014). Teaching scientific practices: Meeting the challenge of change. <i>Journal of Science Teacher Education</i>, 25(2), 177–196. https://doi.org/10.1007/s10972-014-9384-1 	No assignment due, other than readings
2 – Jan 19 th	<p>Planning for Engagement <i>Planning Focus:</i> Big Ideas, Sequencing Lessons, & Performance Assessments <i>NGSS Practice Focus:</i> Framework & Appendix F</p> <ul style="list-style-type: none"> - Windschitl, M., Thompson, J., & Braaten, M. (2018). <i>Ambitious science teaching</i>. Harvard Education Press: Cambridge, MA. (p. 1-12; 25-36) - Emerling, B., & Graff-Emerling, G. (2016). Every lesson needs a Storyline. <i>Educational Leadership</i>. ASCD. 	Assignment 1: Vision of Science Education – Part A Reading Summary: Oliver Yang

	<ul style="list-style-type: none"> - *Stoll, L., & Schultz, S. (2019). How to Design a Performance Task. <i>Science Scope</i>, 042(07), 40–45. https://doi.org/10.2505/4/ss19_042_07_40 - Skim Part A of the Next Gen Science Storylines: What is a NextGen Storyline? 	
3 – Jan 26 th	<p>Eliciting Student Ideas: Pre-Assessment <i>Planning Focus:</i> Students' Prior Knowledge <i>NGSS Practice Focus:</i> Asking Questions & Planning Investigations</p> <ul style="list-style-type: none"> - Larkin, D. (2012). Misconceptions about "misconceptions": Preservice secondary science teachers' views on the value and role of student ideas. <i>Science Education</i>, 96(5), 927-959. (Read 927-934; Skim the rest) 	Unit Planning: Part 1 Reading Summary: Elyse Rankey
4 – Feb 2 nd	<p>Eliciting Student Ideas: Modeling <i>Planning Focus:</i> Growth in Student Ideas <i>NGSS Practice Focus:</i> Developing Models</p> <ul style="list-style-type: none"> - Windschitl, M., & Thompson, J. (2013). The modeling toolkit: Making student thinking visible with public representations. <i>The Science Teacher</i>, 80(6), 63-69 	Unit Planning: Part 2 Reading Summary: Hannah Korslund
5 – Feb 9 th	<p>Supporting Ongoing Changes: Activities <i>Planning Focus:</i> Adapting Instruction <i>NGSS Practice Focus:</i> Analyzing and Interpreting Data; Using Math</p> <ul style="list-style-type: none"> - *Mestad, I., & Kolstø, S. D. (2014). Using the concept of zone of proximal development to explore the challenges of and opportunities in designing discourse activities based on practical work. <i>Science Education</i>, 98(6), 1054–1076. https://doi.org/10.1002/sce.21139 (Read 1054-58 and 1071-72; Skim the rest) 	NGSS Practice: Artifact Reflection – Part 1 Reading Summary: Phil Hopkins

	<ul style="list-style-type: none"> - <u>I Can Use the Identify and Interpret (i2) Strategy.</u> (2012) BSCS. 	
6 – Feb 16 th	<p>Supporting Ongoing Changes: Collective Understanding</p> <p><i>Planning Focus:</i> Pulling Ideas Together</p> <p><i>NGSS Practice Focus:</i> Obtaining, Evaluating, and Communicating Information</p> <ul style="list-style-type: none"> - Windschitl, M., Thompson, J., & Braaten, M. (2018). <i>Ambitious science teaching</i>. Harvard Education Press: Cambridge, MA. (p. 187-97) 	<p>Unit Planning: Part 3</p> <p>Reading Summary: Tiffany Huynh</p>
7 – Feb 23 rd	<p>Making and Justifying Claims</p> <p><i>Planning Focus:</i> Productive Talk</p> <p><i>NGSS Practice Focus:</i> Arguing from Evidence</p> <ul style="list-style-type: none"> - Osborne, J. (2010). Arguing to Learn in Science: The Role of Collaborative, Critical Discourse. <i>Science</i>, 328, 463-466. 	<p>NGSS Practice: Artifact Reflection – Part 3</p> <p>(Note: There is no submission for Part 2)</p> <p>Reading Summary: Sesha McMinn</p>
8 – Mar 2 nd	<p>Evidence-Based Explanations</p> <p><i>Planning Focus:</i> Scientific Explanations</p> <p><i>NGSS Practice Focus:</i> Constructing Explanations</p> <ul style="list-style-type: none"> - Berland, L. K., & Reiser, B. J. (2009). Making sense of argumentation and explanation. <i>Science education</i>, 93(1), 26-55 (Read p. 26-35) 	<p>Unit Planning: Part 4</p> <p>Reading Summary: César Moreno</p>
9 – Mar 9 th	<p>Assessment</p> <p><i>Planning Focus:</i> Dimension of Effective Science Assessment</p> <p><i>NGSS Practice Focus:</i> Designing Solutions</p> <ul style="list-style-type: none"> - Kloster, M., Borko, H., Martinez, J. F., Stecher, B., & Luskin, R. (2017). Evidence of Middle School 	<p>Unit Planning: Part 5</p> <p>Reading Summary: Kelly Wilson</p>

	Science Assessment Practice From Classroom-Based Portfolios. <i>Science Education</i> , 101(2), 209-231. (Read p. 211-215: Background Literature)	
10 – Mar 16 th Pulling it All Together	Looking Forward <i>Planning Focus:</i> Backwards Design & AST Framework <i>NGSS Practice Focus:</i> Framework; Appendix F - Patterson, A., & Gray, S. (2019). Teaching to transform: (W)holistic science pedagogy. Theory Into Practice, 0(0), 1–10. https://doi.org/10.1080/00405841.2019.1626616	Unit Planning: Part 6 Reading Summary: Haley Blackwell

Note: Assignment 5 – Final Unit is due March 18, 2021 by 12pm after the final class.