EDUC 267B
Science Education Curriculum & Instruction

Science Education Curriculum & Instruction
2020

Course Information
Curriculum and Instruction in Science Education Tuesdays CERAS STEP Library Course Website: http://canvas.stanford.edu 3:00pm- 5:00pm

Instructor Information	
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COURSE GOALS

This course will focus on preparing pre-service teachers to plan learning segments and curricular units to be used for science teaching. The course is designed to achieve the following goals:

- To prepare all students to design learning segments based on their understanding of students' skills, backgrounds and needs,
- To prepare all pre-service teachers to design lesson plans, learning segments, and curricular units that create deeply integrated learning segments that enable students to understand and apply their conceptual understanding, and
- To prepare all students to analyze and assess the impact of their planning strategies on student learning in an effort to revise and improve their instructional performance.

COURSE OVERVIEW

The process of teaching is more complicated than it may appear. Very few of the intricate details of teaching are visible to the common observer. Teachers make hundreds of decisions everyday. As a science teacher you will develop a theoretical framework for effective science teaching and learn how to translate that framework into instructional decisions. The summer quarter of C&I series placed an emphasis on planning for instruction. This quarter will focus on creating learning segments especially designed for your students. During this quarter, we will work between theory and practice, and between individual aspects of teaching and the whole group learning.

In this way, the fall quarter differs from traditional science courses where you "finish" a topic and move on. During this quarter, you will explore the iterative process that is teaching and learning. We will focus on the iterative process of teaching by planning learning segments and revising them as we come to understand their effectiveness. We will also learn new concepts and revisit them as we come across alternative understandings. In this sense, our planning and learning will involve constant revision and reflection on new concepts and instructional strategies. This approach is designed to model the instructional cycle that includes *Planning, Teaching, Analyzing, Adjusting, and Reevaluating*.

Using this cyclical instructional approach will enable us to truly integrate our learning experiences with the experiences we are gaining as interns. Our weekly working sessions will enable us to build a strong connection between our practical and theoretical education. To highlight this process we have implemented four themes for our course:

Theme #1: *Teaching as Cycles*
Teaching is a nested set of teaching cycles where you plan, teach and assess, analyze, and adjust, and plan again.

Theme #2: *The Planning Junction*
Decisions about teaching require an interrelated knowledge of students, subject matter, and logistics.

Theme #3: *Meaningful Participation*
Successful science teaching requires the development of a classroom culture that promotes participation in meaningful ways.

Theme #4: *Iterative Science Instruction*
Science is an iterative process of observing/taking data, finding patterns in the observations, and explaining the patterns (*see the theme diagrams below*).

Reviewing these themes suggests that successful teaching requires development of a balance of knowing **what** to teach, knowing **how** to teach, and knowing **how to assess** students' learning. In order to accomplish this, teachers must develop a dynamic understanding of classroom learning that integrates knowing the subject matter, skillfully using assessment, and creating productive learning communities.

Knowing subject matters and how to teach them

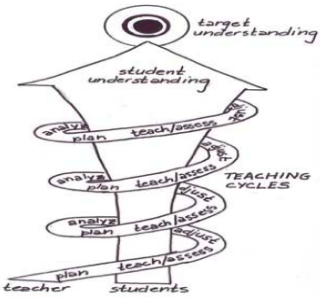
We review this issue of identifying what big ideas of science you will choose to teach and how you can have students apply these ideas. In doing this you may find yourselves reorganizing your own understanding of science so that it is more useful for you as a teacher. Then we will consider how to teach. You will have many opportunities to work through teaching cycles where you plan, teach and assess, then reflect and adjust your teaching. In this course our semester will be centered on planning a single unit.

Assessing and working with students

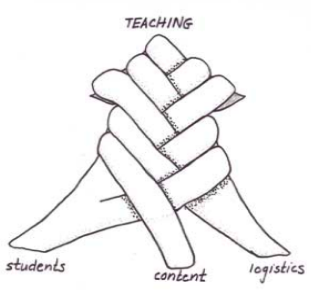
Through your field experience, you will have opportunities to work with many students, many of whom will be different from the student that you were. You will learn how to assess students' understanding every time you teach and how to plan lessons taking into account how and what students are learning. You will have to observe individual students and gain insight about their understanding of science and what their social issues are.

Creating and managing a learning community

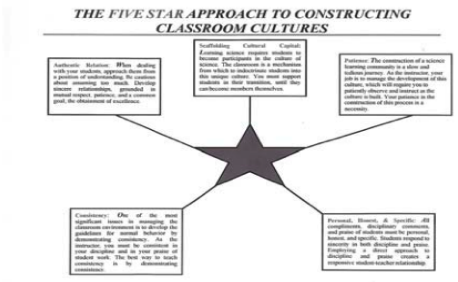
We will work on understanding what makes individual students tick and identify routines and policies that support a well-managed classroom. Management and motivation will be issues that we address every time we consider a new teaching technique. We will identify how many aspects of teaching affect management and the quality of a classroom learning community.



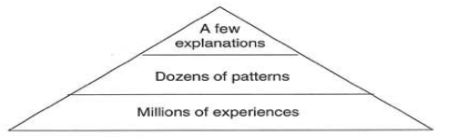
Teaching is a nested set of teaching cycles where you plan, teach and assess, analyze and adjust, and plan again. This approach requires more work than copycat teaching or teaching without planning, but it will enable you to learn from and adapt to any situation you encounter during your teaching career.



Decisions about teaching require knowledge of students, subject matter, and logistics. In your field and lab experiences, all three aspects are at play all of the time and you will learn how to look for each aspect. In class we will work on these aspects separately before you learn to weave them together.



Successful science teaching requires the **development of a classroom culture that promotes participation** in meaningful ways. The challenge of managing students' behavior, while nurturing a rich communicative environment becomes an important component of your instructional objectives. This complicated task requires a



Science is an iterative process of observing/taking data, finding patterns in the observations, and explaining the patterns. We need to teach all of the scientific process.

***Special Thanks to Dr. Joyce Parker & Dr. Any Anderson for the above images*

'Doing' towards understanding

In addition to our emphasis on these basic themes of teaching, we will organize this course around three basic tasks. First, you will continue to collect and use multiple sources of information to pre-

assess students in an order to design an effective student-learning environment. To do this you will complete a detailed analysis of your students that includes video-based analyses of students' engagement and students' learning.

Second, you will demonstrate your understanding of how to design learning segments by creating a detailed lesson plan for a single lesson plan. This lesson plan will be designed to reflect your students' interest, prior knowledge, and skills.

Third, you will design a complete unit plan that provides a detailed plan for an extended series of lesson plans. This unit plan will provide a detailed map of how to plan to engage students in fruitful learning activities that extend over several days of instruction.

ASSIGNMENTS AND EVALUATION

There are 7 assignments this quarter:

#	ASSIGNMENT NAME	DESCRIPTION	EVALUATION TYPE	% OF TOTAL
1	**Reading Assignments #1 & 2**	You will provide a series of analyses of the readings assigned to you. You will be required to complete different reading tasks due in weeks 2 & 3.	Credit / No Credit	**10%**
2	**Understanding Your Students**	You will provide a 2-page analysis of your students. You will analyze both the entire class and select 2 students to focus on. You will provide a description of how you will design instruction to meet the needs of all of your students.	Credit / No Credit	**15%**
3	**Video Analysis: Engagement vs. Learning**	You will record an episode of a learning activity where your students are engaged in an activity. The video episode is no longer than 5 minutes long and must focus on what the students are doing.	Credit / No Credit (Complete the analysis form)	**10%**
4	**Practicum Task A: Guided Inquiry**	You will design a brief (15 min) learning segment that provides an opportunity for students to engage in a structured inquiry activity.	Credit / No Credit (Complete the analysis form)	**10%**
5	**Practicum Task B: Data Logging**	You will engage the entire class in a data collection activity. During this process, your students will publicly log their data to contrast, identify mean/average scores, and error calculations.	Credit / No Credit (Complete the analysis form)	**10%**
6	**Plan for a Single Learning Segment**	You will design a complete lesson plan for a single learning segment.	Graded by Rubric	**15%**
7	**Series of Lesson Plans**	You will design a series of learning segments to be	Graded by Rubric	**30%**

		taught over the course of an extended period of time.		

ASSIGNMENT 1: 2 READING ASSIGNMENTS (5% per assignment)

For weeks 2 and 3, you will be asked to complete a reading assignment based on the information you gain from reading each of the articles assigned for class. These reading activities are based on the notion of developing understanding of a reading by processing the content in meaningful ways. To accomplish this, the second and third week of the course will involve a series of assignments. Once you complete the reading you will engage in the following exercises:

READING ACTIVITY 1 [Due: September 29, 2020]
Week 2: Reading "Reading" Research & Teaching Reading Comprehension
In response to the 3 readings from week 1 (Barton et al., Glynn & Muth; & O'Reily et al.) you will write a short document that explains your position on the role of reading in science teaching and learning. This document will also include a list of 6 reading activities that you can use to promote and enhance improved reading comprehension in your classroom. The document should include two parts: (1) a 1 page description of your position on the role of reading comprehension in science teaching and learning. This should reflect an understanding that you developed through the readings and (II) a list of 4 reading comprehension activities and descriptions of those activities that can be used in your classroom that reflect your understanding of reading comprehension in science. [This should be a maximum of 2 pages – Double Spaced]

READING ACTIVITY 2 [Due: October 6, 2020]
Week 3: Learning: Explain it So They Know
This series of articles explores a series of research discussing some basic principles about how students come to know. These learning articles provide a list of principles about how students come to understand phenomenon. In connection with the ideas associated with Metacognition, you will generate a newsletter that is to be distributed to the students you will be teaching next year. You will create a 1-2 page newsletter that explains some basic ideas about how they learn. This document will use references from the articles we read, explanations of key learning concepts, and descriptions of the knowledge derived from reading the articles. This will offer your students a simple introduction to how learning happens in your classroom. To provide them a sense of structure, your newsletter **must also explain** how what you have students do in class is connected to these theories of learning.

ASSIGNMENT 2: UNDERSTANDING YOUR STUDENTS

In line with our assumption that excellent teaching occurs in those situations where we truly understand our learners, this assignment involves your conducting a detailed analysis of your student population in order to design instruction to meet their specific needs. This assignment will require you to complete a 2-page analysis sheet that involves a series of questions associated with your students. Your analysis of your students will include a Macro-Level analysis **of all of your students**, as well as a Micro-Level analysis of **2-specific students**. This will provide you an opportunity to appraise what

works best for your entire student population while simultaneously focusing on specific students. We will use this document as a working-document throughout the quarter. The handout will be made available online.

[Due in class October 13, 2020]

ASSIGNMENT 3: VIDEO ANALYSIS: STUDENT ENGAGEMENT vs. LEARNING

You will record an episode of your students engaged in learning science. You are asked to bring a 3-5 minute video segment to C & I. This clip should be an unedited and continuous video clip of some of your students engaged in learning science. This may include small group interactions. Your goal is to identify episodes of students' interaction where they are "engaged" in an activity. You will also attempt to use the same clip to identify an instance where students are "learning" something. You will submit 1 video clip and a written analysis of the video. The question templates for the written analysis are available online.

[Due in class October 20, 2020]

ASSIGNMENT 4: PRACTICUM TASK A- GUIDED INQUIRY

In a short 5 to 15 minute activity students will be given a number of items that will be used to help them develop an understanding of some scientific phenomenon. The students will not be provided a set of step-wise instructions. Instead, the students are free to design a way to assess an understanding. Prior to engaging with the materials, the students will tell you what they know about the content prior to experiencing it. After engaging in the guided inquiry experience, students are to tell you what new understanding they have arrived at and how they have come to that understanding.

[Due in class October 27, 2020]

ASSIGNMENT 5: PRACTICUM TASK B – DATA LOGGING

A second type of practicum, or in school assignment, involves data logging. To provide students a clear understanding of the communal nature of scientific data, your students will share the individual (or small group) data on the chalkboard. Students will enter their individual data and the students will calculate mean scores, error, and examine trends and differences in the data. To analyze the results of this activity you will download an analysis form from the course website.

[Due in class November 3, 2020]

ASSIGNMENT 6: PLAN FOR A SINGLE LESSON

You will write a single learning plan. This plan will include a detailed description of the plan for students' learning that will include three primary sections. You will have a section that focuses on identifying a. what students will come to understand, b. a section focusing on what students will do to gain that understanding, c. a section describing how you will assess how they are progressing, and d. a

detailed agenda and pacing guide. We will use a lesson planning template that is available on the courses' website on canvas. The following components must be present in each lesson plan:

Part 1: What will they come to understand:

(a) A Reference to state and content NGSS Standards
(b) A list of the goals for understanding for the learning segment [Objectives]
(c) A list of content and support vocabulary

Part 2: What will they do to get there:

(d) A list of activities to be engaged in during the lesson
(e) A list of resources needed

Part 3: How will I know what they understand:

(f) A description of a formative assessment plan
(g) A description of the final summative assessment plan

Part 4: A pacing guide

(h) An agenda of the time for the things to be done *(both teacher and student)*

[Due in class November 24, 2020]

ASSIGNMENT 7: SERIES OF LESSON PLANS

You will create the beginning of a curriculum unit patterned after the model developed by Wiggins and McTighe, both in process and in content. It will have the following components:

Context description This section provides a **detailed description** of the context of your learning environment. You will provide an explanation of *who* your students are and what broader *issues and resources* shape the teaching of this particular unit. This should include your *Rationale(s)* and any *data or information* that helped shape the unit plan in any way.

Learning Goals These will be presented as a set of science statements.

A final performance task This task would be administered and completed or due in a class 'hour' immediately following the lesson plan sequence. Feedback from it might be available to the students within 48 hours.

The assessment guide This pertains to the final performance assessment and will be both a grading scheme and the rationale for it, or a rubric of some sort that tells the students why they earn what on the task. It could involve

peer and/or self- assessment components as well as the teacher assessment.

An essential question(s) This could look like a "Unit Question" (see Wiggins and McTighe)

3 Lesson Plans You will provide 3- fully developed, sequential lesson plans, each for a single day of instruction. You can plan to use the typical 50-minute high school class period or the extended 90 to 100 minute version. One of the lesson plans must involve an investigation to generate knowledge claims/conclusions, i.e. some "inquiry."

Whatever format you use for the lesson plans, they must include the three key elements:

- They will come to understand that *(your goals):*
- To come to understand they will *(your activities):*
- I'll know they understand when they *(your assessment):*

You should provide all handouts that accompany the lesson plan and cite all resources that will not be included in the plans *(e.g. citing that students will read pages 10-14 from the Holt Chemistry* textbook).

[Due December 1, 2020]

DUE DATES OVERVIEW

WEEK #	DATE	ASSIGNMENT DUE
1	September 22, 2020	No Assignments Due
2	September 29, 2020	Reading Assignment #1
3	October 6, 2020	Reading Assignment #2
4	October 13, 2020	Understanding your students
5	October 20, 2020	Video Analysis A: Engagement vs. Learning
6	October 27, 2020	Practicum A: Guided Inquiry
7	November 3, 2020	Practicum B: Data Logging
8	November 10, 2020	No Assignments Due
9	November 24, 2020	Single Learning Plan
10	December 1, 2020	Series of Lesson Plans

No class for Thanksgiving holiday

COURSE READING

The following are the due dates for the readings.

9/22 READINGS FOR SESSION 2: Language and Literacy

Glynn & Muth (1994). *Reading and Writing to Learn Science: Achieving Scientific Literacy.* Journal of Research in Science Teaching, 31, 1057-1073.

O'Reilly, T.; & McNamara, D. (2007) *The impact of science knowledge, Reading Skill, and Reading Strategy Knowledge on More Traditional "High-Stakes" Measures of High School Students' Science Achievement*. American Educational Research Journal, 44, 161-196.

Barton, ML, Heidema, C., & Jordan, D. (2002). *Teaching reading in mathematics and science. Educational Leadership,* 60, 24-31.

10/29 READINGS FOR SESSION 3: Learning

Bransford, J. (2000) How People Learn (Chp 3.) Learning & Transfer. Washington, DC: National Academies Press.

Brown, J.; Collins, A.; & Duguid, P. (1989) Situated Cognition and the culture of learning. Educational Researchers, 18, 32-41.