Pathways to Scientific Teaching
UCSD
Postdoctoral Fellows in Biological Sciences

19 January to 23 March 2027

Location: Muir Biology 1138
Time: Tuesdays 11:30 am – 1:30 pm

Instructor:
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Seminar Overview: I enthusiastically invite postdoctoral fellows in the biological sciences to learn to develop and implement state-of-the-art learner-centered instructional materials and teaching strategies for both large and small enrollment undergraduate STEM courses. During this seminar, we will use *scientific teaching* to actively engage postdocs in evidence-based instructional methods shown to be effective in helping all students learn core disciplinary ideas by using science practices -- so it is not only what students learn, but how they use knowledge. Importantly, the pathway to scientific teaching fully integrates the biological research model that scientists use every day into a teaching approach by using science practices desired for all students, such as working with data, creating descriptive and predictive models, reasoning analytically, constructing scientific arguments, and working collaboratively. Postdocs will gain experience in developing a course framework and class lessons, instructional strategies, and assessments that reveal students' working knowledge of biology. Participants will select one or two core concepts from a scientific paper of interest in their sub-field of biology and develop an instructional lesson that is suitable for implementation in an introductory biology course taught at the freshman or sophomore level, and/or for a job interview that requests a teaching demonstration.

Course Format: The seminar meets in-person in 1138 Muir Biology weekly, Mondays, 11:30 am – 1:30 pm, beginning on January 19, 2027 and continuing weekly until March 23 (schedule below). I encourage you to consider enrolling with another person from your lab group. This is not required, but just as in science, effective collaborative teams are productive and enjoyable. Topics in the seminar are intended to promote and build learner-centered instruction in undergraduate science courses. Participants will practice inquiry-based, active learning throughout the seminar. I believe authentic learner-centered teaching is key to my philosophy that ALL students can learn science by doing science - hence, an active, learner-centered classroom is, by definition, inclusive of all students.

Upon completion of the seminar, Postdoctoral Scholars will earn a certificate from the Dean of the Division of Graduate Education and Postdoctoral Scholar Affairs, Dean Judy Kim that is citable on your CV.

Technology Platforms:
I look forward to teaching this seminar in person and we will use technology throughout the course. You will access course materials, including class meeting notes, homework assignments, supplemental readings, and additional

resources on Google and Canvas, the latter because you should gain experience using an LMS -- learning management system.

Readings: Assigned during the seminar and BEFORE we begin on January 19 for which I'll send two short articles for you to read in preparation for the first class meeting.

Evaluation: Instructional lessons are assessed using criteria developed for Volume 2 of *Pathways to Scientific Teaching*. Volume 2 is now available as an ebook – you will have access to this new book.

Goals and Impact of Course: Participants will

- Demonstrate how and why to create inclusive, learner-centered courses in STEM – based on how students learn.
- Practice how to actively engage all students in cooperative work and science practice-based activities to learn in all types of classroom environments.
- Construct a lesson in which objectives, assessments and instruction are aligned based on 3-dimensional learning.
- Create learning objectives and assessments for course lessons that enable students to demonstrate interconnected understanding of core ideas and concepts in biology by using science practices (e.g., modeling, arguments, data analysis).
- Use Chat GPT support to support 3-dimensional learning and assessment.
- Analyze assessment data to inform and modify instruction.
- Participate in planning and teaching a class session (or even an entire course) in introductory biology or any other STEM course.

Pathways to Scientific Teaching
Weekly plan

Class # Date	Topics	Driving questions	Readings
Pre-class Reading	Scientific Teaching and Learning	What is scientific teaching and how does it help students learn?	*Prior to Class* (Handelsman et al 2004 Cooper et al 2015)
1 Jan 19	Establishing a learning community	Who are we? Who are your students? What are your teaching and mentoring philosophies? How do people learn?	Vision & Change (Ch 1, 2)
2 Jan 26	What is active learning?	What does active learning really mean? 3-Dimensional Learning (3-DL)	Cooper and Klymkowsky 2024
3 Feb 2	Course frameworks and objectives (1)	What should we teach? What do students need to learn? What are the core concepts in biology?	Canning et al 2019
4 Feb 9	Course frameworks and objectives (2)	Objectives - what are they, who are they for?	Long et al 2014
5 Feb 16	Science practices	What scientific practices will students use to learn/connect concepts?	Laverty et al 2016
6 Feb 23	Assessment of Learning	How will you know that students have learned? What evidence will you accept and in what form?	Tanner 2010
7 March 2	Assessment of learning Cooperative Lng	How do we create meaningful assessments (e.g., exam questions)?	Theobold et al 2017
8 March 9	Instructional design: actively learning with science practices	How do we score and evaluate students' work? Use of AI – what to do with the data? .	Freeman et al 2014
9 March 16	Practice Instruction	How does active learning promote inclusivity? What about student motivation? How do you include	Handelsman et al 2022 Canning et al 2019

		diversity and scientific teaching in your teaching philosophy?	
10 March 23	Practice Instruction	How do we evaluate teaching? What are the criteria? Peer review and feedback.	Uminski 2025