

Private Tutor

Dr. Christopher Fjeld Carnahan

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Professional Summary

Experienced educator with a strong foundation in biophysics and over eight years of experience as a private tutor and teaching assistant in STEM subjects. Skilled at translating complex scientific concepts into accessible lessons for diverse learners, both one-on-one and in classroom settings. Provided academic support in physics, biology, and quantitative methods, fostering critical thinking and problem-solving skills. Background includes hands-on research in membrane biophysics, microscopy, and microfluidics, bringing real-world scientific applications into teaching. Proficient in MatLab, R, ImageJ, and data analysis, with the ability to integrate computational tools into educational content.

EDUCATION

Ph.D., Biophysics, University of California, Davis, CA **March 2025**
Dissertation: *Biophysics of Synthetic Model Cells: Molecule-Membrane Interactions Inducing Asymmetry*
Advisors: Dr. Atul Parikh, Dr John Voss, Dr. Matthew Coleman

B.S., Physics, California State University, Sacramento, CA **July 2021**
Senior Project: *Analyzing Membraneless Structures in Artificial Biological cells*
Advisors: Dr. Mikkel H Jensen, Dr. Eliza Morris

Teaching Experience

Graduate Teaching Assistant, Biophysics Graduate Group, University of California, Davis
Developed and delivered lectures on biomolecule and membrane interactions for a class of early Ph.D. students. Stimulated discussion and inquiry into possible mechanisms behind membrane deformation, phase separation and artificial model cell synthesis. Held office hours for 1-on-1 discussion and questions from Ph.D. students pertaining to content including and beyond the scope of the course. Graded assignments and prepared reports for the course professor.

Private Tutor – Math, Physics and Biology

Provided individualized tutoring in math, physics, and biology to middle school, high school, and college students over 8 years. Designed customized lesson plans to meet each student's needs, adapting explanations and problem-solving approaches to suit diverse learning styles. Supported students in mastering course content, improving academic performance, and preparing for standardized tests such as the SAT, ACT, and AP exams. Focus on building effective, long term study habits.

Research Experience

Doctoral Research, UC Davis **September 2021 – March 2025**

Characterized & synthesized artificial model cells to study protein-membrane interactions, including key molecules (e.g., Apolipoproteins, Synucleins, Amyloids, Cyclodextrins) related to cardiovascular disease, Parkinson's, Dementia and targeted drug delivery to:

- 1) Quantitatively characterize the morphological transformations of the parent lipid *en route* to the reconstitution of membrane structures *in vivo* as a means to better understand molecule characteristics relevant to therapeutic usage.
- 2) Produce synthetic compositional membrane asymmetry suitable for insertion of complex transmembrane proteins.

Produced Nanolipoprotein Particles (NLPs) from tailor-made membranes of GUVs utilizing the biologically fundamental proteins (ApoA-I, ApoE-3 & ApoE-4) that compose HDL and LDL to:

- 1) Characterize membrane transformation induced by the exchange of lipids and sterols between lipoproteins and parent membranes.
- 2) Quantify leakage of solute and solvent from GUVs through membrane pores formed by the generation of membrane tension.
- 3) Induce membrane phase separation through altering the cholesterol content within the membrane.

Investigated synthetic, membraneless organelles (Poly[ethylene-glycol] and Dextran systems), exploring phase behavior interactions with complex coacervation of Adenosine 5'-triphosphate (ATP) and Poly-L-Lysine to:

- 1) Explore how each affect the other in biologically relevant conditions, mimicking characteristics of novel membraneless organelles within eucaryotic cells
- 2) Explain how complex coacervate can dictate the where in the phase space ATPS resides through pH-dependent polymer-polymer interactions.

PI: Dr. Atul Parikh

Publications and Presentations

Publications:

Apolipoprotein interaction induces shape remodeling and lipid phase separation in giant unilamellar vesicles. **Christopher F. Carnahan**, Wei He, Yaqing Wang, Viviane N Ngassame, Aleksandr Noy, Tim Carpenter, John C. Voss, Matthew A. Coleman, Atul N. Parikh. <https://doi.org/10.1101/2025.04.10.648283>

Membrane Tubule Generation Through Asymmetric Methyl- β -cyclodextrin Lipid Exchange (In Progress)
Christopher F. Carnahan, Atul N. Parikh (In Progress)

Regulating biocondensates within synthetic cells via segregative phase separation
Chang Chen, Caroline M. Love, **Christopher F. Carnahan**, Ketan A. Ganar, Atul N. Parikh, Siddharth Deshpande. <https://doi.org/10.1021/acsnano.4c18971>

A New Means to Generate Liposomes by Rehydrating Engineered Lipid Nanoconstructs
Yuqi Huang, Ziqian Xu, Umit Celik, **Christopher F. Carnahan**, Roland Faller, Atul N. Parikh, Gang-yu Liu. <https://doi.org/10.3390/mi16020138>

Presentations:

BPS Los Angeles Conference Presentation (2025)
ACS New Orleans Conference Presentation (2024)
CSUS NSM Student Research Symposium (2020)
32nd Annual California State University Biotechnology Symposium (2020)
CSUS Student Research & Creative Activity Fall Forum (2019)
CSUS NSM Student Research Symposium (2019)

Honors and Awards

Responsible Conduct in Research Certification (2023)
CSUS Physics & Astronomy Dept. Patrovi Summer Undergraduate Research Experience Scholarship (2020)
CSUS NSM Summer Undergraduate Research Experience Scholarship (2019)
President's Honors (4.0GPA) & Dean's Honors (2018)