



Dates of undergraduate research opportunities: **January 2019 – October 2023**

Location: **Cannon Hall, Wesley College, Dover, DE**

Number of positions available: **2-4** (*Wesley College undergraduates preferred*)

Faculty Mentor: **Malcolm J. D'Souza, PhD**

Professional Staff Mentor: **Kristopher Roeske, MS**

Project Titles:

1. STEM Education: Engaging students in STEM and retaining interest
2. Chemical Kinetics: Computational and laboratory approaches to the bond-making and bond-breaking processes

Research Description:

1. STEM Education: The Wesley College undergraduate population is immensely diverse. Our main goal is to develop inquiry-based capacity building initiatives to foster long-term student-learning, persistence and success in the STEM areas. We strongly believe that diverse students benefit when instruction incorporates interdisciplinary project-based courses that develop critical thinking skills, integrity, and oral/written communication training. As a result, to attempt engaging initiatives that build instructor rapport with students, each summer, we will host a 3-week residential Success in STEM (SIS) summer bridge program for incoming freshmen and rising high school seniors.
2. Chemical Kinetics: Water is the most common polar protic solvent with a high dielectric polarization property and is used in tandem with other organic solvents to study solubility, differential stabilization of reactants and products, and chemical reactivity. Solvent studies (solvolysis) optimize the amount or rate of formation of a given product by altering reaction conditions on the basis of kinetic and thermodynamic control.

Our research characterizes the fate and bioavailability of common organic contaminants containing halogens, S, N, and P. Furthermore, using experimental (analytical) data and computational tools, we can measure and predict their ecotoxicological effects on ecosystems and human health. The basic knowledge of molecular level intermolecular (solvent) interactions and new ideas generated from such research efforts will find many ready applications in separations technologies, solvent substitution processes, carbon management and environmental remediation.

Research Questions:

STEM Education:

1. How does an undergraduate institution create a challenging (not overwhelming) and supporting learning environment?



2. How does this learning environment actively cultivate models that influence connections between STEM course content and STEM careers?

Chemical Kinetics:

1. How are compound structure, chemical reactivity, and solvent effects correlated?
2. In correlation studies, when using theoretical chemistry approaches and wet-laboratory procedures, (a) what are the resultant molecular details and (b) are there any differences?

Student Learning Objectives: Professional and Research Skills

This internship focuses on the development of the following professional and scientific skills.

Broad Professional Skills	Specific Skills
Planning and time management	Ability to set and complete specific goals of varying scope
Work independently	Independent work ethic - work independently to problem-solve
Collaborative skills	Learning to complete tasks efficiently and effectively with others
Express ideas in writing and verbally	Communicate with diverse audiences - Development of impactful poster and oral presentations. Honing ability to deliver scientific results/impacts to people of interdisciplinary background.
Broad Scientific Research Skills	Specific Skills
Understand scientific terms	<ul style="list-style-type: none"> • STEM Education pedagogical content • Mechanistic and applied concepts in general, organic/bio-organic, physical, and analytical chemistry
Literature analysis	Ability to effectively find and utilize scientific manuscripts related to STEM-education and chemistry
Use scientific tools	In the chemistry project, students will be trained in small-molecule synthesis, wet chemical analysis, chemical kinetics, thermodynamics, chemometrics, data-mining, (Q)SAR modeling and in the use of GC, GC-MS, HPLC, AA, UV, IR, FTIR, and NMR techniques
Recognize simple patterns in research data and data analysis	<ul style="list-style-type: none"> • Discover solutions to issues in educational research, assessment, and program evaluation through measurement, evaluation, and statistics • Correlation analysis in chemistry using Excel • Cheminformatics
Understand, apply, and explain scientific concepts and theories	Freedom to form questions and plan methods for addressing challenges. Learning to effectively communicate results through oral presentations and manuscript writing

Prerequisites:



STEM major with an introductory experience with chemistry and students should have completed Pre-Calc. I.

Work Environment and Expectations:

Laboratory environment: Cannon Hall, Wesley College. Hours are flexibly determined between student and mentor. Students will work part time during the fall and spring semesters, and full time during the summer internship program, June 3-August 9, 2019. Students are required to register for 1-2 Directed Research Credits (CH265/365) and will also participate in a retreat, communications workshop, Scholars Day, and end of summer-internship symposium.

Stipend:

\$5,000 in summer; \$10/hour during the academic year. Direct deposit is required.

Funding Source:

National Science Foundation, Delaware EPSCoR Track II

How to apply: <https://wesley.edu/academics/undergrad-research> (EPSCoR link) or email: Malcolm.Dsouza@Wesley.Edu.