

PSCB90H3 Physical Sciences Research Experience – Winter 2023



This course provides an opportunity for students to work with a faculty member and carry out original research. Students will provide assistance with one of the faculty member's research projects, while also earning credit. Students will gain first-hand exposure to current research methods, and share in the excitement of discovery of knowledge acquisition. Progress will be monitored by regular meetings with the faculty member and through a reflective journal. Final results will be presented in a written report and/or a presentation at the end of the term. Approximately 120 hours of work is expected for the course.

Prerequisite: Permission of the Course Coordinator (Dr. Kris Kim, kris.kim@utoronto.ca)

Recommended Preparation: Completion of at least 4.0 credits in a relevant discipline.

Breadth Requirements: Natural Sciences

Link to UTSC Timetable: <https://utsc.calendar.utoronto.ca/section/physical-sciences>

Note: It is the student's responsibility to contact potential supervisors to discuss and confirm project details in advance of the Winter enrolment deadline (**December 20th**). Once students have confirmed a project with a faculty supervisor, students must reach out to the course coordinator (Dr. Kris Kim, kris.kim@utoronto.ca) to request for a supervised study form that will be submitted to the Office of the Registrar. Typically, students enrolled in a program offered by the Department of Physical and Environmental Sciences and students who have a CGPA of at least 2.5 or higher are granted admission.

Please see below for list of projects.

Chemistry Projects

Project 1 (Chemistry)

Supervisor: Prof. Shadi Dalili (sdalili@utsc.utoronto.ca)

Title: Developing New Tutorial Material for CHMB41H

Project Description: Students involved in this project will be expected to develop new tutorial worksheets and quizzes based on current CHMB41H course content, using reputable scientific resources and textbooks. Students in this placement will work with the course instructor to select appropriate questions and exercises from the chemistry education literature, textbooks, and online resources to prepare tutorial material and quizzes, along with demonstrator notes. Students will learn skills such as literature searching and analysis, and proper design of problem sets and questionnaires. Students will also develop written scientific and communication skills through developing problem sets, quizzes, and TA documents for each tutorial section.

Qualifications: Completion of CHMB42 with a minimum course grade of B+.

Number of Positions: 1-2 students

Additional Application Instructions: Please send updated resume and transcript to sh.dalili@utoronto.ca

Project 2 (Chemistry)

Supervisor: Prof. Shadi Dalili (sdalili@utsc.utoronto.ca)

Title: Developing New Lab Material for CHMB41H

Project Description: Students involved in this project will be expected to develop and modify new laboratory experiments for Introductory Organic Chemistry I (CHMB41H). Students will work with the course instructor to select new experiments from the chemistry education literature, test the experiments, and prepare accompanying lab manual instructions and demonstrator notes. Students will learn skills such as literature searching and analysis, and utilize essential lab techniques such as extraction, distillation, recrystallization, reflux, etc. to develop new labs for the course. Students will also develop written scientific and communication skills through preparing lab manual writeups, quizzes, and TA documents for each experiment developed.

Qualifications: Completion of CHMB42 with a minimum course grade of B+ and lab grade of A.

Number of Positions: 1-2 students

Additional Application Instructions: Please send updated resume and transcript to sh.dalili@utoronto.ca

Project 3 (Chemistry)

Supervisor: Prof. Effie Sauer (effie.sauer@utoronto.ca)

Title: Development of New Laboratory Experiments for CHMB42

Project Description: Students involved in this project will work closely with the faculty supervisor to research, test and troubleshoot new experiments for use in Organic Chemistry II (CHMB42). New experiments will be evaluated for safety, reliability, and alignment with key course topics. In addition to testing and troubleshooting the experiments, students will participate in the development of accompanying lab materials including lab manual pages, demonstrator notes and quiz questions.

Qualifications: Completion of CHMB42 with a minimum course grade of B+ and minimum lab grade of A.

Number of Positions: 1-2 students

Additional Application Instructions: Please send updated resume and transcript to effie.sauer@utoronto.ca

Project 4 (Chemistry)

Supervisor: Prof. Effie Sauer (effie.sauer@utoronto.ca)

Title: Development of Online Learning Aids for CHMB42

Project Description: The student involved in this project will work closely with the course instructor to prepare online resources to support student learning in Organic Chemistry. In particular, three sets of online practice tests will be created, one for each term test and another for the final exam. These quizzes will be designed to help students practice answering questions which are pulled from various topics in the course (a notable challenge for many students). Online quiz questions will be drafted to include feedback for wrong answers. Time permitting, the students will also be involved in the creation of online modules to support students in writing up their formal lab reports.

Qualifications: Completion of CHMB42 with a minimum course grade of A-.

Number of Positions: 1 student

Additional Application Instructions: Please send updated resume and transcript to effie.sauer@utoronto.ca

Project 5 (Chemistry)

Supervisor: Dr. Andre Simpson (andre.simpson@utoronto.ca)

Title: Lenz Lenses for the analysis of Tiny Biological Samples using Benchtop Nuclear Magnetic Resonance

Project Description: Students working with this project will develop Lenz Lenses for a benchtop Nuclear Magnetic Resonance (NMR) spectrometer using CNC micro-milling, to aid the development of fast NMR techniques. The objective of this project is to manufacture magnetic “Lenz lenses” to facilitate fast NMR techniques on very mass limited environmental samples. Students in this placement will work with the course instructor to design and manufacture magnetic “Lenz lenses” with a variety of geometries to accommodate extremely mass limited samples (e.g. eggs, seeds, cells). In addition to learning how to use Computer Assisted Design (CAD) software and CNC machining, students will also have the opportunity to explore and learn about fundamental and cutting-edge NMR techniques and experiments. Interested students will have the opportunity to work alongside the instructor on NMR spectrometers and become exposed to state of the art experiments and analytical instrumentation.

Qualifications: GPA 3.5 or higher, with a passion for biochemistry, chemistry, physics and the desire to learn world-class micro machining approaches and NMR spectroscopy. Full training will be provided no experience expected. Preference may be given to related sub-disciplines (ex: chemistry, physics, biochemistry).

Learning Skills: CAD usage, CNC Machining, Nuclear Magnetic Resonance.

Number of Positions: 1 student

Additional Application Instructions: Please send updated resume and transcript to andre.simpson@utoronto.ca

Project 6 (Chemistry)

Supervisor: Prof. N. Thavarajah (nirusha.thavarajah@utoronto.ca)

Title: Sustainable Agriculture: An Interdisciplinary and International Experiential Learning Project

Project Description: The purpose of this project is for the University of Toronto Scarborough (UTSC) chemistry students enrolled in the “Physical Sciences Research Experience (PSCB90H3)” course and students enrolled in a management course (MGHC23 or MGHC53) to engage in an international work-integrated learning (WIL) group project with faculty, students, and community partners from Ghana, Sri Lanka, and India to solve their current crisis in farming. This is a real-time crisis-management work-integrated experiential-learning team project for students. Interdisciplinary teams will collaborate to develop sustainable solutions to problems in farming using knowledge and skills gained from chemistry and human resource management curricula, respectively.

UTSC students will also work with a domestic community partner (i.e., Training in the Association for the Study of Medical Education’s (TASME) Women in STEM Leadership Program, a Toronto-based non-profit organization), international institutional partners (i.e., Eastern Universities of Sri Lanka and a USA-based non-profit organization, Care for Education) to build relations with the local Sri Lankan and Indian farming community.

Qualifications: Completion of CHMB42H3 with a minimum grade of B+.

Learning Skills: Literature search, critical thinking, problem-solving & scientific writing skills.

Number of Positions: 2 students

Additional Application Instructions: Please send an updated CV & transcript to nirusha.thavarajah@utoronto.ca

Project 7 (Chemistry)

Supervisor: Prof. N. Thavarajah (nirusha.thavarajah@utoronto.ca)

Title: Developing New Lab Materials for Introductory Chemistry Courses

Project Description: Students will develop new lab materials based on the existing CHMA10H3 & CHMA11H3 content, textbooks, and other reliable scientific resources. Students will work with the instructor to develop the lab manual, worksheets, quizzes, demonstration notes, and quizzes.

Qualifications: Completion of CHMB42H3 with a minimum grade of B+.

Learning Skills: Literature search, critical thinking, problem-solving & scientific writing skills.

Number of Positions: 2 students

Additional Application Instructions: Please send an updated CV & transcript to nirusha.thavarajah@utoronto.ca

Environmental Sciences Projects

Project 1 (Environmental Science)

Supervisor: Prof. Karen Smith (karen.smith@utoronto.ca)

Title: Exploring changes in the characteristics of extreme heat events in Toronto under climate change

Project Description: Students involved in this project will work closely with the faculty supervisor to analyze climate model projections of surface air temperature for the city of Toronto with the goal of quantifying changes in the frequency, intensity and duration of extreme heat events under different climate change scenarios. This project will support a larger U of T School of Cities project on the health impacts of extreme heat in Toronto. Students are expected to engage in weekly course materials and learn to use the Python programming language for data analysis.

Qualifications: Completion of EESA09 and/or EESB03 with a minimum grade of B+.

Number of Students: 1-2 students

Additional Application Instructions: Please send updated resume to karen.smith@utoronto.ca