University of Manitoba | Faculty of Science

Department of Chemistry

Available Undergrad Research Award (URA) supervisors (Alphabetical by sub-discipline, researcher surname)

Analytical chemistry

Name: Sabine Kuss

Contact information: sabine.kuss@umanitoba.ca

Website: www.bioanalyticschemistry.com

Description of research: Our research focuses on electrochemistry and its application to biological systems in the fields of endocrinological diseases, antibiotic drug resistance, mitochondrial dysfunctions and cancer development. The high sensitivity of electrochemical methods, such as scanning electrochemical microscopy, allows us to quantify the interaction of specific redox active molecules with single biological cells. Targets of investigation in our group are the detection of diseases, quantification of cell membrane receptor activity and position, monitoring the correlation of membrane pumps with feature activity, and the development of electrochemical biosensors.

Name: Gregg Tomy

Contact information: Gregg.tomy@umanitoba.ca

Website: www.cograd.ca

Description of research: Our research is geared towards unearthing new chemicals in the Canadian environment as a result of oil- and gas-related activities and understanding the persistence, bioaccumulation and ecotoxicity of these chemicals. Students will have an opportunity to work with state-of-the-art analytical instrumentation like gas- and liquid-chromatographs and mass spectrometers. Furthermore, students will benefit from working in an ISO-accredited laboratory and be trained using guidelines established for generating analytical data that is complaint with international regulatory standards.

Biochemistry

Name: Ned Budisa

Contact information: nediljko.budisa@umanitoba.ca

Website: www.chemsynbio.com

Description of research: Our mission is to preform engineering and control of cellular processes in a chemical way, through synthetic chemistry, genetic code engineering and the directed evolution of enzymes and cells. Synthetic chemistry focuses on various organic syntheses, mainly bioorthogonal amino acids, and examines their effects on model peptides, proteins, protein-based complex scaffolds, and whole cells (populations). Many useful applications including the creation of non-invasive tools for academic and medical research, cells for soil and water remediation, 'bio- batteries' as renewable energy sources or scaffolds for complement electronic and computational devices etc. are envisioned. Students joining the group can expect to gain expertise in most advanced methods of synthetic biology, biological and bioorganic chemistry.

Name: Mazdak Khajehpour

Contact information: Mazdak.Khajehpour@umanitoba.ca

Website: http://www.sci.umanitoba.ca/chemistry/profiles/mazdakkhajehpour

Description of research: Our research focuses on understanding interactions that cause proteins to fold correctly. Most proteins function in a soup of co-solvents that stabilize the protein fold and influence their dynamics. It is the role of that these co-solvents play in the kinetics and thermodynamics of folding that is the focus of our studies. The tools we use include steady-state and time-resolved fluorescence spectroscopy, stopped flow methods, temperature jump spectroscopy and differential scanning calorimetry.

Name: Ute Kothe

Contact information: ute.kothe@umanitoba.ca

Website: https://kothegroup.ca/

Description of research: In the Kothe group, we are interested in understanding how functional RNAs are generated focusing on RNA modification, RNA folding and RNA processing. We investigate structure-function relationships of RNAs and proteins aiding in RNA biosynthesis with the aim to understand fundamental processes in life as well as molecular causes of diseases such as cancer and inherited syndromes. Our special focus lies on studying tRNA

biosynthesis as well as ribosome biogenesis. To address our research questions, we apply a combination of techniques in biochemistry, biophysics, molecular biology, and genetics using bacterial, yeast and human cells.

Name: Sean McKenna

Contact information: sean.mckenna@umanitoba.ca

Website: https://home.cc.umanitoba.ca/~mckenna/

Description of research: Originally thought to be only an intermediary between DNA and proteins, RNA has now emerged as key regulatory molecule in diverse cellular processes. Not surprisingly, aberrant RNA-protein interactions play a key role in a number of disease states. We provide an understanding of the structural features required for RNA recognition by cellular proteins, and correlate this information with biological function in the context of both oncogenic transformation (cancer) and the response of the immune system to viral infection. Students joining the group can expect to gain expertise in structural biology, biochemistry, and molecular/cellular biology approaches.

Name: Helene Perreault

Contact information: Helene.Perreault@umanitoba.ca

Website: home.cc.umanitoba.ca\~perreau\

Description of research: This summer research project will consist of developing a quantitative method to determine the abundance of subclasses of antibodies in porcine serum samples. The research assistant will synthesize small peptides which correspond to amino acid segments unique to each subclass (e.g. IgG1, IgG2) and use these for quantitation. This project is part of a collaboration with the Université de Nantes (France) on xenotransplantation, i.e. the possibility of using animal-to- human grafts in cases where no compatible donor is available. Antibodies are at the heart of these studies.

Name: Joerg Stetefeld

Contact information: Jorg.Stetefeld@umanitoba.ca

Website: https://stetefeldlab.ca

Description of research: The primary goal of our research is to understand in detail the structure- property relationship of proteins as dynamic systems. We are broadly interested in extracellular cell surface receptors and their interactions with various ligand molecules and we

aim to obtain a mechanistic understanding of S-layer coiled-coil assemblies from extremophilic archaea bacteria. Our principal goal is to gain molecular insights into receptor-ligand interactions to therapeutically impact human disease and to apply our molecular information about S-layer proteins to develop biotechnological applications.

Name: Zev Ripstein

Contact information: zev.ripstein@umanitoba.ca

Website: https://www.ripsteinlab.org/

Description of research: Protein degradation plays a central role in cellular physiology, regulating the timing of cell division, controlling stress responses, and ensuring the timely removal of damaged or aberrantly folded proteins. We are a new research group studying the structure and function of large biomolecular assemblies involved in protein degradation. Specifically, we are looking at proteases in the pathogen Mycobacterium tuberculosis and their involvement in virulence and pathogen survival. To gain deep molecular insights into how these protease machines work, we utilize a combination of electron cryomicroscopy (cryoEM), biochemical, and biophysical techniques.

Inorganic and materials chemistry

Name: Mario Bieringer

Contact information: mario.bieringer@umanitoba.ca

Website: https://home.cc.umanitoba.ca/~bieringe/

Description of research: The Bieringer solid-state inorganic materials chemistry research group focuses on alternative energy related (Solid State Fuel Cells) and magnetic (magnetic sensing and interactions) materials with special emphasis on the formation and the stability of the next generation high-performance materials. Typical research projects start out with materials synthesis in the laboratory and progress to structure determination, reactivity studies and physical property measurements including X-ray and neutron diffraction, spectroscopic experiments, ion conduction and magnetic measurements among others.

Name: David Herbert

Contact information: david.herbert@umanitoba.ca

Website: http://home.cc.umanitoba.ca/~dherbert/

Description of research: Our research focuses on using synthetic chemistry to increase sustainability functional molecular materials. Student research projects are available making molecules and materials for applications in renewable energy (solar light harvesting), functional materials (emissive compounds, sensors) and chemical catalysis (solar fuels and chemicals from CO2). Student researchers in the group learn how to carry out air/moisture sensitive reactions using glovebox and vacuum line techniques, NMR spectroscopy, single-crystal X-Ray diffraction, electrochemistry and a host of other cutting-edge techniques.

Name: Scott Kroeker

Contact information: scott.kroeker@umanitoba.ca

Website: https://sci.umanitoba.ca/chemistry/profiles/scottkroeker

Description of research: Research in the Kroeker lab focuses on inorganic materials such as bioactive glasses, nuclear-waste matrices, and carbon-capture polymers. Solid-state nuclear magnetic resonance (NMR) spectroscopy is used to understand the molecular-level structural origins of desirable materials properties so as to improve performance and extend applicability. Projects typically involve glass- making, electron microscopy, x-ray diffraction and durability tests.

Name: Christian Kuss

Contact information: christian.kuss@umanitoba.ca

Website: https://kussmaterials.com

Description of research: Rechargeable batteries have made mobile technology possible. Now they are needed again to enable the renewable energy revolution. We work on the development of new battery materials for Li-ion, Na-ion, and all-solid-state battery technology, to improve battery capacity, charging time, safety and cost. Undergraduate students will synthesize materials, perform characterization in our lab or at the Manitoba Institute for Materials, fabricate electrodes and button cells, and test those batteries.

Organic chemistry

Name: Rebecca Davis

Contact information: Rebecca.Davis@umanitoba.ca

Website: http://home.cc.umanitoba.ca/~davisrl/

Description of research: The Davis group works to develop new methods for producing enantiopure, bioactive compounds relevant to the pharmaceutical and agrochemical industries. We design molecules to interact with proteins of interest and then develop methods to synthesize our molecules from cheap, abundant compounds (e.g. amino acids and petrochemicals). We accomplish this goal using a combination of advanced synthetic techniques, spectroscopic analysis, mechanistic studies and computational chemistry. As a part of the Davis group students will gain experience working in a fast- paced and exciting research environment.

Name: Frank Schweizer

Contact information: schweize@cc.umanitoba.ca

Website: home.cc.umanitoba.ca/~schweize/index.html

Description of research: Research in the Schweizer group focuses on the development of novel therapeutic approaches to treat multidrug-resistant bacterial infections and cancer. Students enrolled in an undergraduate research project will be trained in medicinal chemistry with the goal to develop novel antimicrobial/antitumor agents which can overcome current bacterial or cancer cell associated resistance mechanisms or delay resistance development. Besides chemical synthesis of new agents or chemical modifications of existing drugs, students will also probe or test how the newly synthesized agents interfere with growth or killing of bacteria/tumor cells alone or in combination with legacy drugs.

Name: John Sorensen

Contact information: John.Sorensen@umanitoba.ca

Website: http://home.cc.umanitoba.ca/~sorense0/

Description of research: My research program is interested in novel problems in the area of natural products chemistry with a strong focus on biosynthesis. Our attention is on small bioactive molecules that possess interesting biological activity. In particular we focus on linking the genes (and gene clusters) in the microorganism with the profile of small organic molecules that are produced by these organisms. We have been focusing on the polyphenolic natural products produced by lichen fungi. One of our ongoing interests is to be able to deduce the signals that are involved in triggering natural product biosynthesis in lichen and other fungi.

Name: Joshua C. Walsh

Contact information: Joshua.Walsh@umanitoba.ca

Website: https://walshchemistry.sites.umanitoba.ca/

Description of research: Our laboratory designs and synthesizes molecules for a wide range of applications in organic electronics. The research focus is centered on polycyclic aromatic hydrocarbons that address current problems in solar energy (singlet fission), miniaturization of technology (spintronics) and flexible devices (liquid chromophores).

Physical/computational chemistry

Name: Kathleen Gough

Contact information: Kathleen.Gough@umanitoba.ca

Website: http://home.cc.umanitoba.ca/~kmgough/index.htm

Description of research: Critical chemical interactions occur at the nanoscale but impact materials at every dimension. Research in my group is centered on vibrational spectroscopy, more specifically, spectrochemical imaging at micro- and nano-scales. Targets range from Arctic sea ice diatoms (climate change) and blood cells (cancer), to scar in post-infarct cardiac tissue (heart disease) and mechanically damaged collagen fibrils. Techniques include FTIR and Raman spectromicroscopy. Super-resolution experiments that break the infrared diffraction limit are done at the Advanced Light Source, Berkeley CA, allowing us to explore at the previously inaccessible nanoscale.

Name: Georg Schreckenbach

Contact information: schrecke@cc.umanitoba.ca

Website: http://home.cc.umanitoba.ca/~schrecke/

Description of research: Computational chemistry: We use computers to model chemistry and materials across the periodic table, often in collaboration with experimental researchers. Current topics include (i) the chemistry of the actinides (Ac, Th, U, Np, Pu and the rest of the 5f series), with applications for instance to radiotherapy, (ii) two-dimensional (2D) materials, (iii) conducting polymers, (iv) quantum-chemical method development, (v) solar energy conversion, among others. A detailed description specifically for undergraduate students is given on my webpages.