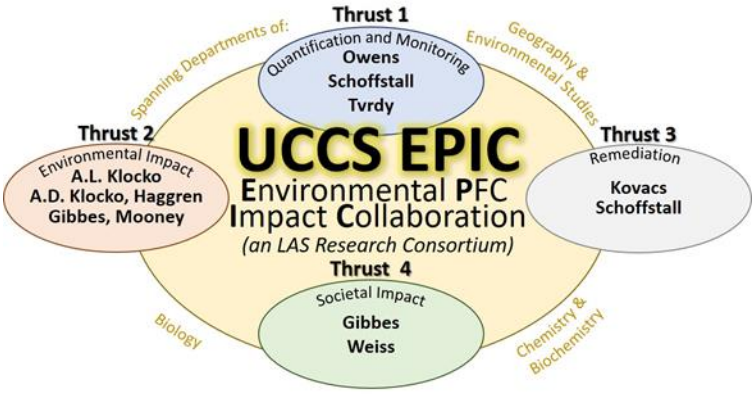


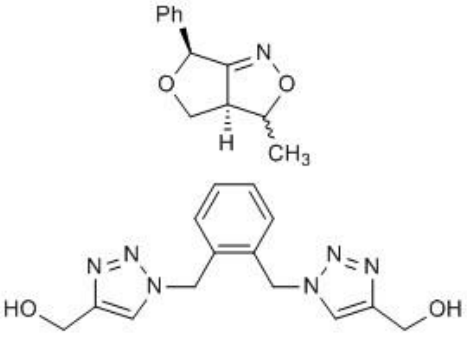
Below, please find a description of research opportunities by discipline and PI (principal investigator) within the Department of Chemistry and Biochemistry. In addition to the research projects that are described below, several of our faculty members are collaborators on a program called **Environmental PFC Impact Collaboration (EPIC) in the Fountain Creek Watershed: Determining the Environmental, Ecological, and Societal Impact of PFCs**. This is an interdisciplinary research study of the prevalence and impact of perfluorinated compounds (PFCs) in southern Colorado. Along with faculty members in the Departments of Biology (Drs. Amy Klocko and Emily Mooney) and Geography and Environmental Studies (Dr. Cerian Gibbes), researchers are striving to understand the long-term and comprehensive impact of PFCs on our community. Undergraduate researchers are encouraged to talk to participating faculty members, which include the following:

Participating Faculty Members (listed alphabetically with email contact)	**Research Goals**	**Years participating (includes summer)**
Dr. Cerian Gibbes (cgibbes@uccs.edu)	Assess impact of PFC load on riparian ecosystems (with Dr. Emily Mooney); and Examine PFC pollution in hydrosocial cycle	2018, 2019, and 2020
Dr. Wendy Haggren (whaggren@uccs.edu)	Assess PFC impact on soil microbial communities (with Dr. Andy Klocko)	2018, 2019, and 2020
Dr. Amy Klocko (aklocko2@uccs.edu)	Determine PFC bioconcentration and vegetative growth impacts	2019 and 2020
Dr. Andy Klocko (aklocko@uccs.edu)	Assess PFC impact on soil microbial communities (with Dr. Wendy Haggren)	2018, 2019, and 2020
Dr. James Kovacs (jkovacs2@uccs.edu)	Assess alternative remediation strategies for PFC removal using enzymes	2019 and 2020
Dr. Emily Mooney (emooney@uccs.edu)	Assess impact of PFC load on riparian ecosystems (with Dr. Cerian Gibbes)	2018, 2019, and 2020
Dr. Janel Owens (jowens2@uccs.edu)	Quantify & monitor PFC concentrations in water, sediment, and soil	2018, 2019, and 2020
Dr. Allen Schoffstall (aschoffs@uccs.edu)	Use ^{19}F NMR analyses in health mitigation of PFCs in drinking water	2019 and 2020
Dr. Kevin Tvrdy (ktvrdy@uccs.edu)	Develop diffusion & kinetic models to determine extent and rate of PFC spread	2019 and 2020
Dr. David Weiss (dweiss@uccs.edu)	Active learning in General Chemistry by incorporating PFC research into the lecture	2018, 2019, and 2020

RESEARCH GROUPS BY DISCIPLINE:

Organic: Dr. Allen Schoffstall

Schoffstall Group (aschoffs@uccs.edu)



Dr. Schoffstall's lab research is in the area of synthetic organic chemistry that features modern methodologies directed towards heterocyclic targets. One goal is to produce synthetic medicinal analogs with the potential for application to new routes to prepare candidate compounds as pharmaceuticals. Another is to use scaffolding methodologies to prepare more complex target molecules.

We have recently synthesized a number of pyrazine, quinoxaline, isoxazole and 1*H*-1,2,3-triazole heterocycles purposes of biological testing with medical collaborators in Denver. One of the lead fragments we have been using is a substituted pyridine, which when attached to the heterocycles (listed above), is predicted to give promising drug candidates. One of our previously made pyridyl 1*H*-1,2,3-triazole derivatives has shown good inhibition in tests against colon cancer cells.

Students who have an interest in making new organic compounds for various purposes are encouraged to consider joining our group. We currently have eight active undergraduate researchers in our group here. Each of our participants will be presenting his/her work at regional/national American Chemical Society meetings as well as at campus and local events. We are always looking for additional, well-motivated students to join our group. We also work with collaborators at the U. S. Air Force Academy, Anschutz Medical Center and the National Jewish Hospital.

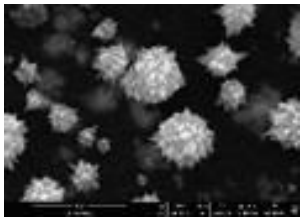
Analytical: Dr. Janel Owens, Dr. Janak Paudyal, Dr. David Weiss

Owens Group (jowens2@uccs.edu)

My research goals are focused on developing extraction protocols using so-called “green” chemistry principles to reduce the use of solvents and laboratory supplies in the investigation of fate and transport mechanisms of environmental contaminants, which include perfluorinated chemicals and brominated flame retardants. A second area of research interest includes the validation of a new antioxidant assay to measure total antioxidant capacity in foods using silver nanoparticles. The third research aim is to use these green extraction protocols for the analysis of drugs of abuse (both illicit and pharmaceutical) in forensically-relevant samples. This third research aim has allowed for a strong collaboration with the El Paso County Coroner's Office Toxicology Laboratory where many of my students have completed an internship.

I have a large group with 5 MSc students and three undergraduate researchers. I am not currently taking any new students (graduate or undergraduate). For undergraduates who are interested in my research agenda, students need to be in the first semester of Analytical Chemistry I to be considered.

Paudyal Group (jpaudyal@uccs.edu)



My research is focused on (a) Development of new strategies for the size- and shape-controlled synthesis of noble metal nanoparticles; (b) Fabrication and characterization of thin films involving metal nanoparticles and their composite materials for sensing applications; and (c) Development of electrochemical sensors through modification of conventional electrodes or new electrodes using metal nanoparticles and their composite materials.

Weiss Group (dweiss@uccs.edu)

Dr. David Weiss is a bioanalytical chemist interested in chemical education research. Projects involve evaluating different active learning techniques for teaching chemistry, developing assessment techniques for evaluating faculty teaching effectiveness, peer-leader approaches to improve student learning in General Chemistry, and flipped classroom approaches for Instrumental Analysis. Students interested in chemistry and chemical education can do research starting in the freshman year in this group, and UCCSTeach students are particularly encouraged to participate in this group.

Physical: Dr. Kevin Tvrdy, Dr. Amanda Morgenstern

Tvrdy Group (ktvrdy@uccs.edu)

The Tvrdy lab focuses on the synthesis, characterization, and implementation of nanomaterials. There are three current projects that fit within this scope:

1. The study of interactions between Single Walled Carbon Nanotubes (SWNT) and hydrogels for the development and refinement of SWNT purification methods. This endeavor will further applicability of SWNT within nanoscale electronics, solar cells, and biological imaging.
2. The synthesis and characterization of nanoscale magnetic materials for use as contrast agents within MRI schemes while enabling simultaneous high-resolution spatial thermometry. Project in collaboration with UCCS BioFrontiers Center and UCCS Dept. of Physics and Energy Science.
3. Development of low computational cost methods to model both static and dynamic behavior of semiconducting quantum dots. In conjunction with in-house development experimental techniques to enable direct comparison between model predictions and experiment.

Additionally, the Tvrdy lab works collaboratively on the UCCS EPIC project to model the transport and fate of toxic perfluorinated compounds along the Fountain Creek watershed in southern Colorado Springs. Students working in the Tvrdy lab can expect to gain a range of experience, both experimental and computational; as well as develop extra-scientific skills such as notebook upkeep, scientific communication, and manuscript preparation.

Morgenstern Group (amorgens@uccs.edu)

Research focuses on designing computer models to discover relationships between the structure of the electron charge density (a 3D-function) and properties of molecules, materials, and enzymes. There are three major project avenues:

1. Fundamental study of the charge density in small molecular systems and development of gradient bundle analysis (GBA). GBA is a method that uses differential geometry to study critical points, paths, and surfaces in the charge density to extract information that can be used to predict chemical properties such as reactivity.
2. Probing the charge density in the active sites of enzymes to understand how electrostatic preorganization influences catalytic efficiency and using these discoveries to improve the enzyme design process and create novel proteins with new functionality. This work is done in collaboration with an experimental group at the Swiss Federal Institute of Technology (ETH Zurich), and theoretical groups at UCLA and Colorado School of Mines.
3. Using *ab initio* modeling techniques to understand structure-property relationships in molecules, materials, and drugs with unique properties.

Students who have an interest in physical chemistry, computer modeling, and understanding chemical properties at a detailed atomic level are encouraged to contact Dr. Morgenstern to discuss possible research projects.

Biochemical: Dr. Andrew Klocko, Dr. James Kovacs, Dr. Wendy Haggren, Dr. Crystal Vander Zanden

Klocko Group (aklocko@uccs.edu)

The current research of the Klocko lab involves understanding the genome organization of the filamentous fungus *Neurospora crassa*. Of particular interest is identifying the biomolecules critical for forming this non-stochastic organization, in which heterochromatic (silent) regions of the genome strongly interact to form a heterochromatin bundle and euchromatic (active) regions of the genome loop out from this bundle. Also of interest is how this genome organization contributes to the regulation of gene expression, and in particular, how specific long-range contacts can temporally or spatially control transcription. Further, in collaboration with Dr. Wendy Haggren, the Klocko group is interested in examining soil microbial species that exhibit increased survivability upon exposure to perfluorinated compounds (PFCs); species are identified through high-throughput sequencing of amplified ribosomal DNA sequences.

Students who join the Klocko lab can expect to learn bioinformatic, genomic, molecular biological, and biochemical techniques, including chromosome conformation capture, as well as manuscript writing and primary literature review.

Interested students should contact Dr. Klocko and schedule a time to meet to discuss their expectations and future goals, as well as how research within Dr. Klocko's group can contribute and enhance those goals. For Fall 2019, the Klocko lab may accept only one exceptional student.

Kovacs Group (jkovacs2@uccs.edu)

My research lab is focused on understanding protein-protein interactions that drive normal immune responses and interactions that result in the infection of host cells by viruses. We employ a range of biophysical and structural methods to measure and probe these interactions *in vitro* and cell based assays. Students working in my lab can expect to gain a wide range of skills from molecular cloning and protein expression to molecular modeling and structure determination. Current directions in the lab are aimed at understanding Complement

Receptor 2 ligand interactions, a novel antibody therapeutic directed at the Complement system, protein engineering of novel immunogens against HIV-1, and a collaborative effort to engineer enzymes in order to mitigate perfluorinated compounds in the Fountain Creek watershed. Students interested in joining my lab should contact me and set up a time to talk about expectations and interests.

Haggren Group (whaggren@uccs.edu)

Biofuels: The yeast, *Saccharomyces cerevisiae*, has been used extensively to ferment ethanol from glucose derived from starchy field crops, in particular corn. We propose to use a unique starch source, the Buffalo Gourd root, to serve as a feedstock for yeast fermentations. A different strain of yeast, *S. diastaticus*, which naturally contains the starch digestive enzyme, glucoamylase, will be genetically modified to contain variable copy numbers of the alpha-amylase starch digestive enzyme to increase starch breakdown efficiency.

Magnetotactic bacterial cells: We are interested in engineering these bacterial cells to secrete anti-tumorigenic molecules when hypoxic conditions such as among the dying cells at the center of a tumor mass.

Vander Zanden Group

Our research focuses on learning more about how proteins modulate cell membrane structure to cause disease and regulate cell function. To explore these questions, we use *in vitro* biophysical methods and *in silico* molecular dynamics simulations to understand more about membrane structure and the impacts of protein interactions. We are currently focusing on two specific projects in the lab:

1. Understanding the molecular mechanisms of Alzheimer's disease – How do amyloid-beta peptide interactions with cell membranes lead to membrane permeabilization and eventually cell death?
2. Understanding cell communication – How do galectin proteins organize glycolipids to direct membrane structure changes involved in cell communication?

Inorganic: Dr. Ronald Ruminski

Ruminski Group

Current research work involves the synthesis and photophysical, electrochemical and NMR characterization of transition metal complexes that have overlapping properties in applications including photodynamic therapy, renewable energy resources and carbon sequestration. The majority of actual research time is spent in the synthesis and purification area. *Minimum prerequisites* include General Chemistry + at least 1 semester of Organic Chemistry and Organic Chemistry Lab.