

Institute for Biomolecular Sciences Faculty Research Interests



Dr. Mike Abler, **Genetics**

Students in my lab use *Arabidopsis thaliana* as a model system to investigate the role of **RNA-degrading enzymes** in plant growth, development, and responses to the environment. Current projects include the genetic mapping of *arp* (altered RNase profile) mutations, cloning of mapped genes, the biochemical isolation and characterization of nucleases, and a project investigating ways to increase the frost tolerance of plants. Students use cutting edge techniques for mapping and cloning mutant genes, transforming (genetically engineering) plants, and characterizing proteins.

For more information contact abler.mich@uwlax.edu



Dr. Bonnie Bratina, **Microbial Ecology**

My research interests center around looking at community diversity and interactions. Currently my lab is studying **nitrification** and **denitrification** in the sediments of the Upper Mississippi River in conjunction with the Upper Midwest Environmental Sciences Center and examining microbial interactions with the manganese biogeochemical cycle in temperate and Antarctic lakes. Organisms involved in these processes are identified using molecular phylogenetic analysis based on 16S rRNA sequence.

For more information contact: bratina.boni@uwlax.edu



Dr. Scott Cooper, **Molecular Biology**

My research focuses on using molecular techniques to understand the effects of **hibernation on blood clotting** - ground squirrels that hibernate have increased blood clotting times to prevent clots from forming as their hearts slow and blood pressure drops. We are trying to understand how the squirrels regulate primary and secondary hemostasis to accomplish this.

Another project involves screening fungal extracts for **inhibitors of platelet aggregation** - to prevent blood clots from forming.

In collaboration with Mark Sandheinrich other students are measuring the molecular effects of **methylmercury on fish reproduction**.

For more information contact cooper.scot@uwlax.edu

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Dr. Nick Downey, **Molecular Biology**

My research focuses on the **parasite** *Trypanosoma brucei*. Trypanosomes have only one mitochondrion and the **mitochondrial DNA** (mtDNA) is attached to the flagellum of the cell. In my lab we are trying to understand the connection between the flagellum and this mtDNA. The link is proposed to be the method used by the trypanosome to segregate its mitochondrial genome (and its mitochondrion). My students and I use **bioinformatic** approaches to identify candidate proteins that may be involved in mitochondrial segregation and mtDNA replication. We express candidates as fusion proteins and observed their localization using **fluorescence microscopy**. Finally we disrupt gene expression with RNA interference and infer protein function from the phenotype of the cell. We hope this will identify new approaches to develop effective anti-trypanosomal drugs.

For more information contact downey.nich@uwlax.edu



Dr. Anne Galbraith, **Genetics**

My lab studies the roles of certain genes in **yeast meiosis**, the same process by which humans produce egg and sperm cells. In order for meiosis to occur properly, whether it is in yeast or humans, hundreds of genes must perform their functions in concert with one another. If a single gene is mutated, the entire process of meiosis can be disrupted resulting in infertility, birth defects, and some types of cancer in humans. My lab studies two genes that function in yeast meiosis called *CDC7* and *DBF4*. Recently, a human version of *CDC7* was discovered to be expressed in greater than normal amounts in tumor cells, implicating a potential role for this gene in **human cancer**. Studying the functions of these genes in the simple yeast will allow us to make predictions about what the genes might be doing in the more complex human. We perform experiments in yeast genetics, molecular biology, cell biology, and biochemistry to understand the roles of these two genes in yeast meiosis.

For more information contact galbrait.anne@uwlax.edu



Dr. Sandra Grunwald, **Biochemistry**

I am a biochemist whose main scholarship program focuses on the **scholarship of biochemistry teaching and learning**. Since starting my career in academia, I have taken a special interest in student learning, focusing specifically on students' conceptual weaknesses in certain biochemical areas. Two areas that I have studied are: Project 1 - student understanding of how enzyme kinetics is used to study enzyme function and Project 2 - student understanding of how experimental variables influence experimental results. I enjoy including student researchers, especially **secondary education science majors**, in these projects.

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Dr. Mike Hoffman, **Virology**

Research in my laboratory focuses on two areas of virology - the replication of **human parainfluenza virus type 3** (HPIV3) and the characterization of **novel fish viruses**. Human parainfluenza virus type 3 infects children, causing lower respiratory tract infections such as croup, pneumonia and bronchiolitis. There are no effective vaccines or antiviral therapies. My particular research interests focus on several steps in the life cycle of HPIV3: replication of the viral genome and assembly/release of virus particles. Knowledge gained from this research can be applied to the development of vaccines and antiviral drugs against HPIV3. For the characterization of novel fish viruses my lab collaborates with the U.S. Fish and Wildlife Service - Fish Health Laboratory to characterize viruses that they have isolated, but are unable to identify. For both areas of research, we use a variety of techniques from molecular biology, biochemistry and immunology.

For more information contact hoffman.mic2@uwlax.edu



Dr. David Howard, **Cell Biology**

How do sperm swim? chromosomes move in mitosis? amoeba crawl? Research in my lab focuses on how organisms generate and control movements at the cellular level. Current projects investigate **flagellar motility** in the single-celled green algae *Chlamydomonas*. Defects in cilia and flagella cause numerous human diseases, but biologists still do not know much about how movements in cilia & flagella are controlled. We use *Chlamydomonas* as a model organism because it allows us to do experiments that cannot be done with other organisms like humans. At the present, students in my lab are using high speed digital video microscopy to analyze how different mutations in *Chlamydomonas* affect flagellar beating. In another project, students cloned a flagellar gene, and we are currently characterizing how the expressed protein works. Students also use image analysis, protein biochemistry, antibody techniques, and classical and molecular genetics.

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Dr. Tisha King-Heiden, **Physiology**

My research interests bring together a variety of disciplines: reproductive biology, developmental biology, endocrinology and toxicology. We study how exposure to endocrine disrupting compounds during early development influences health (primarily reproduction) later in life (**Developmental Basis for Adult Disease**), and strive to bridge the gap between ecotoxicology and human health. We use the zebrafish as a model organism as our findings are relevant to wild fish populations, as well as human health. Students in my lab have the opportunity to learn a variety of techniques (general physiology, microscopy, histology, and molecular techniques). Current projects include: (1) Effects of sublethal exposure to 2,3,7,8-TCDD (dioxin) on jaw development and feeding in larval zebrafish, (2) Transgenerational effects of 2,3,6,7,8-TCDD (dioxin) on gonad development, and (3) Latent reproductive toxicity caused by developmental exposure to anti-androgenic compounds.

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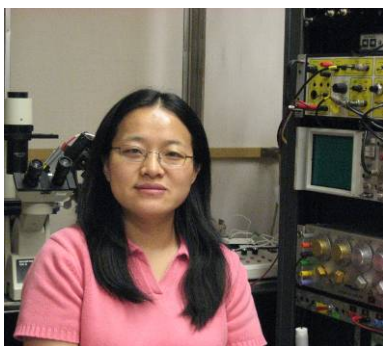
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Dr. Adrienne Loh, **Biophysical Chemistry**

My research program is centered on **peptide and protein structure and dynamics**. The way that a given protein functions is governed by its shape (its structure) and the way that it moves (its dynamics). We are using short helical peptides as models of large proteins. Students in my group have the opportunity to synthesize the molecules of interest, then characterize the structure and flexibility of their peptides using nuclear magnetic resonance (NMR) spectroscopy.

For more information, contact loh.adri@uwlax.edu or visit:
http://perth.uwlax.edu/faculty/loh/research_html/Lohresearch.htm



Dr. Sumei Liu, **Physiology**

My research focuses on understanding the **neurophysiological** control of gastrointestinal functions in health and disease states. Functions of the gastrointestinal tract are largely controlled by the enteric nervous system in concert with the input from the central nervous system. The enteric nervous system resides within the wall of the gastrointestinal tract. It is the intrinsic innervation of the bowel and the only part of the peripheral nervous system that is capable of mediating reflex behavior in the absence of input from the brain and spinal cord. My goals are to understand the organization of the enteric nervous system, and to determine how enteric microcircuits and the activity of individual neurons within these circuits control motility, secretion, and epithelial barrier function of the gut in health and disease states. Current research projects: (1) Role of enteric corticotropin-releasing factor (CRF) in **stress-related gastrointestinal dysfunction**; (2) Transient receptor potential channel in **excitatory neurotransmission** in the enteric nervous system.

For more information contact liu.sume@uwlax.edu



Dr. Peg Maher, **Physiology**

The focus of my research is the **hormonal regulation of hunger and satiety** in humans with normal and disordered eating patterns and **eating and metabolic disorders**. My research group also studies how specific nutrients in foods affect the secretion of hormones that regulate appetite and energy expenditure. In my lab, students will learn and practice basic biochemistry, anthropometric, interviewing, survey, and nutrition assessment methods.

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<http://www.uwlax.edu/biology/faculty/maher/maher.htm>

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Dr. Jennifer Miskowski, Cell Biology

My research program focuses on the molecular basis of **development in *Caenorhabditis elegans***, a microscopic soil nematode that serves as a model organism. Many of the developmental processes that *C. elegans* undergoes are analogous to processes in higher organisms, like humans. In particular, my lab is interested in the protein signaling pathways by which cells communicate in a multicellular organism. In addition to understanding how multicellular organisms develop, we hope to learn how fundamental cellular processes are altered to cause human disease.

For more information contact miskowsk.jenn@uwlax.edu



Dr. Aaron Monte, Medicinal & Natural Products Chemistry

My research interests lie in two primary areas:

- 1. Discovery of Novel Drug Molecules from Natural Sources / Mycophyte Discovery Group.** In this area, we seek to extract, purify, and characterize the biologically active molecules (“drugs”) present in a variety of wild fungi and in green plants used in traditional medicine as “herbal remedies.” The ultimate goal here is to discover new **antibiotic therapies**, as well as other useful drugs. (Collaborative interdisciplinary research with Drs. Rott, Schwan (microbiology), and Volk (biology), among others.)
- 2. Structure-Activity Relationships (SAR) of Psychedelic Agents.** Novel drug molecules are designed and prepared as analogs of existing hallucinogens using standard synthetic organic chemistry methods. The primary aim of this research is to better understand the structure and function of serotonin receptor proteins and the roles that the neurotransmitter, **serotonin**, plays in normal brain biochemistry, mental dysfunction, and human consciousness in general.

For additional information, please contact: monte.aaro@uwlax.edu



Dr. Aric Opdahl, Chemistry

My research is centered on understanding structure-property relationships of bio-functionalized surfaces. One project line is focused on **DNA thin films**, similar to the types commonly used in genetic diagnostics. Objectives of this project are understanding how *surface interactions* affect the hybridization activity of short DNA probes (typically 10-30 nucleotides) attached to gold surfaces, and the stability of the resulting hybrids. A second project line is focused on **protein thin films**. An objective of this project is developing methods to control both the conformation and lateral spacing of protein molecules attached to the surface. The primary analytical technique used in all of our projects is **surface plasmon resonance (SPR)** imaging spectroscopy, which is a *label free* technique that can be used to quantitatively characterize molecular interactions at or near the surface of a gold coated slide.

For more information contact opdahl.aric@uwlax.edu

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Dr. Kathryn Perez, **Systematics**

Research in my lab uses molecular biology techniques to determine the **evolutionary** relationships in animal species. Students use DNA sequencing and bioinformatics to investigate the **phylogeny of land snails**. Because many of these snails are endangered and/or serve as reporter species for the health of an ecosystem, understanding the phylogenetic relationships between species is important for managing ecosystems. In addition, the taxonomy of many land snail groups is controversial, and students have the opportunity to clearly distinguish or even discover new species.

For more information contact perez.kath@uwlax.edu



Dr. Marc Rott, **Microbial Genetics**

When not fishing, my research currently focuses on identification and characterization of **novel antimicrobial compounds** from plants and fungi. Students prepare crude extracts from dried plant and fungal tissue and test these extracts in disk diffusion assays to identify extracts containing antimicrobial activity. In collaboration with Dr. Aaron Monte, a pharmacologist in the Chemistry Department, active extracts are separated and fractions are retested to identify pure active compounds. Once pure, compounds are characterized by assessing potency and spectrum of activity against a wide variety of microbes. Other recent projects include **genomic mapping** of bioluminescent bacterial species using pulsed-field electrophoresis and the development of **PCR-based assays** to detect *Mycplasma* ssp. thought to be involved in sexually transmitted disease.



Dr. Tony Sanderfoot, **Cell Biology**

My lab uses genetic, cell and molecular biological techniques to investigate the protein machinery involved in driving the **secretory pathway of green plants**. We use the flowering plant *Arabidopsis*, as well as the unicellular plant *Chlamydomonas* as model systems for identifying novel machinery and test beds for potential applications for crop plants. The lab also has an interest in the evolution and annotation of the protein machinery involved in vesicle trafficking, with a special interest in the novelty of the plant lineage as well as the conservation across all eukaryotes.

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Dr. Bill Schwann, **Pathogenic Bacteriology**

My research includes the study of **community-associated methicillin-resistant *Staphylococcus aureus***. We are looking at the evolution of this type of *S. aureus* and the virulence factors that may be contributing to the skin and lung infections caused by this subgroup of *S. aureus*. Another project is the **regulation of type 1 pili expression** in *Escherichia coli* that cause urinary tract infections. We are trying to elucidate what environmental cues may be influencing the expression of these structures on the bacteria both in a test tube, but also within a mouse or even human urinary tract. A third project is screening natural products for anti-bacterial activity against clinically relevant varieties of bacteria. We hope to discover new antibiotics in this project. Students pursuing research in my laboratory would learn a host of different molecular and genetic techniques as well as animal models of infection in the first two projects. In the last project, students would learn how to do anti-bacterial testing and natural product extraction procedures.

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Dr. Brad Seebach, **Neurobiology**

I am a developmental neurobiologist, interested in cellular **mechanisms of learning, formation and reconstruction of neuronal circuits**. Undergraduate research in my laboratory during the past several years has focused on either (1) culturing mammalian cell lines similar to neural stem cells, using a number of growth factors common to natural nervous tissue development, or (2) determining properties of mammalian spinal cord motor neurons during a critical, early stage of development using electrophysiological and histological research techniques. Expertise in both of these research tracks is necessary to study the successful reconstruction of damaged nervous tissue using cellular implantation techniques.

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Dr. Bernadette Taylor, **Immunology**

My background and research experience lie in immunology, in particular **bovine and sea otter immunology and infectious disease**. My work has especially involved monoclonal antibody production and development of ELISA's for various serologic tests and cellular immunology assays including tissue culture bioassays and flow cytometry. Current students in my laboratory are working on *Mycobacterium avium* subspecies *paratuberculosis* as a possible etiologic agent of **Crohn's disease**, testing of fungal extracts for immunosuppressive activity against T cells and comparing the human antibody and cellular immune response to a loose intradermal influenza vaccine versus standard intramuscular vaccine.

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Dr. Todd Weaver, **Biochemistry**

Research in my laboratory is focused in two main areas. The first area of research uses the hemolysin system from *Proteus mirabilis* to characterize the **activation of bacterial toxins** during pore formation. The overall goal of this project aims to characterize the structural differences between the secreted (active) and non-secreted (inactive) forms of hemolysin A. The second area of research aims to characterize the recruitment of low-barrier hydrogen bonds during **enzyme catalysis**. We have numerous mutant forms of fumarase C and in the process of collecting steady-state kinetic and X-ray diffraction data on each form.

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Dr. Michael Winfrey, **Microbial Physiology**

My current research currently focuses on the discovery of novel **antibacterial compounds from nut-bearing trees**. This involves extracting and identifying compounds from nuts and nut hulls that are inhibitory to a set of target bacterial strains. **This research has the potential to develop new antibacterial drugs to combat the growing problem of antibiotic resistant pathogenic bacteria.** A second project involves characterization of the **microbial community in kefir**, a traditional fermented milk product with probiotic characteristics. This involves cloning and sequencing 16SrRNA genes from the natural microbial community in kefir grains and using the Ribosomal RNA Database to identify the microbial species.

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