SPECIAL ISSUE
SUMMER RESEARCH 2009
IN THE ST. OLAF FNSM

APPLICATION DEADLINE IS February 13
PLEASE CHECK BACK FOR ADDITIONAL PROJECTS
NOTE: Please check with individual faculty about project(s)

BIOLOGY Department

Pat Ceas -- Surveying northern Minnesota lakes, and using the longear sunfish as a biological indicator.

We know that human-altered lakeshores result in the decrease/loss of sensitive aquatic species and degradation of our waters, yet few studies have focused on Minnesota waters. The goal of this project is to demonstrate that the longear sunfish (listed as a species in greatest conservation need [SGCN] in Minnesota) is an ideal "poster child" and indicator species for lakeshore conservation and improvement projects. We will focus on two overlapping efforts: (1) continue the work of the past three summers by sampling additional waters throughout northern Minnesota to better understand the distribution and ecology of the longear sunfish; and (2) conduct detailed shoreline/habitat surveys so that we will better understand the habitat needs of this and other sensitive MN fishes. The specific goal of item #2 is to help the Minnesota Department of Natural Resources Shoreland Habitat Program develop and disseminate information to the public so that watershed users will better understand the importance of maintaining or improving shoreland conditions. I am looking for two students who are eager to spend long days in the field (in all kinds of weather), as we survey the lakes and streams of northern Minnesota (on weekends you will be back in Northfield). In addition to learning about fishes and other aquatic organisms you will gain a deeper understanding and appreciation of our northern ecosystems and the main environmental threats to these areas. There are any number of possible Independent Research projects that could be developed from this work, ranging from organismal to GIS/landscape ecology-related to conservation/public education.

Eric Cole – Cell Biology And Genetics Of *Tetrahymena Thermophila*

Team Tetrahymena will be conducting further inquiries into the cell biology and genetics of *Tetrahymena thermophila,* a tiny freshwater protist with an extraordinary life history. Currently we are using a wide variety of techniques to explore the function of a newly discovered organelle, the "conjusome". These include cellular fractionation, protein isolation, mass spectrometry (through collaboration with Doug Beussman), gene cloning, gene tagging (with GFP) and live cell imaging with fluorescence microscopy. In particular, we are testing the hypothesis that the conjusome is involved in RNAi-mediated remodelling of the sexually recombinant genome.

Kevin Crisp and Ted Johnson – Microglia Activation During Immune Challenge in Earthworms

Small, migratory macrophages called microglia become activated in response to nervous system damage, such as a mechanical crush. While their role in inflammatory processes makes their activation detrimental in vertebrates, in the invertebrate nervous system, they appear to be vital for repair processes. Microglia have been shown to migrate to sites of central nervous system (CNS) injury in the earthworm, which is an important model system in which to study neuronal repair due to its impressive regenerative capacity and the presence of myelinated axons and microvasculature within the CNS. Preliminary evidence suggests that peripheral inflammation correlates with the activation of microglia in undamaged CNS, raising the possibility that immune signals in earthworm body fluids also activate microglia in the CNS. A student working on this project will collect and examine evidence for immune system activation of CNS microglia by exposing earthworms to a variety of immune challenges, such as xenografts, endotoxins, lipopolysaccharide, etc. Techniques used will include dissection, wax histology, microscopy and statistical analysis.

Steve Freedberg - Sex-ratio Evolution in Reptiles.

I am interested in the evolutionary dynamics of sex ratios and sex determining systems. For instance, species with environmental sex determination (ESD) may be subject to large sex ratio fluctuations over time due to periodic climatic shifts. Because sex ratio fluctuations are predicted to lower the effective population size, and consequently, genetic diversity, there is an expectation of lower genetic variation in ESD populations. Reptiles provide an ideal system to examine this issue because there are several species with ESD that are closely related to species with genetic sex determination. In order to address this question, we can analyze genetic sequence data from three sources: 1) "mining" genetic data banks, 2) analysis of preserved museum specimens, and 3) tissue collection from turtles housed here at St. Olaf and collected from the wild. I am looking for students who would be interested in laboratory molecular analysis and/or writing code for sorting through genetic sequence databases.

Jean Porterfield - Freshwater Fish Hybridization

In general, I study the evolutionary biology of freshwater fishes. Specifically, my work with St. Olaf students has focused mainly on the use of molecular genetic data to investigate broader questions (like behavior, geographic distribution, and genetic relationships). I would like to work with one student in Summer 2009 on a research project involving both field work and molecular genetics lab work and analysis to investigate hybridization in fish taxa. We will be working on two different systems: longear sunfish from Minnesota, and darters from the southeastern United States. The longear sunfish project is in collaboration with Dr. Patrick Ceas (also at St. Olaf) and focuses on the extent and direction of hybridization between the less common non-game longear sunfish with its larger and more common relative the pumpkinseed sunfish (check out the poster outside RNS 428). Work on this project will likely include field trips with Dr. Ceas' research team to collect sunfish in the northern half of Minnesota. The darter project investigates the potential role of hybridization in explaining a curious genetic relationship that is at odds with conventional hypotheses of relationship in this group. In my lab we currently use two methods to assess genetic diversity: sequencing of mitochondrial DNA, and genotyping of nuclear microsatellite loci (microsatellites are sequences of repetitive DNA like "CACA…CA" that are usually quite variable in repeat size, even within

populations). I'd like my summer student to consider continuing the genetics work in Fall 2009 by registering for an Independent Research course (Biology 398). If you think you would enjoy some rigorous fish sampling field work, as well as detailed molecular genetics techniques, please come talk to me and find out more about the research!

John Schade – *The Polaris Project: Rising Stars in the Arctic*
The Polaris Project is a multifaceted effort that includes a field course and research experience for undergraduate students (rising stars) in the Siberian Arctic; several new arctic-focused undergraduate courses taught by project Co-PIs (also rising stars) at their respective colleges across the United States and in Russia; the opportunity for Co-PIs to initiate research programs in the Siberian Arctic; and a wide range of outreach activities. The unifying scientific theme of the Polaris Project will be the transport and cycling of carbon and nutrients as they move with water from terrestrial uplands to the Arctic Ocean. I am looking for 1 student to travel to the Northeast Science Station in Cherskiy in the Siberian Arctic for three weeks in July. In addition, this student will have the opportunity to work with me to develop a research project and curriculum materials during the month of June to prepare for the field course. This student must be enrolled in BIO 391: **Arctic Ecosystems: An Analysis of Global Change** to attend the field course. In addition, interested students must discuss this opportunity with me and must complete a separate application (see www.thepolarisproject.org for more information).

Stephanie Schmidt – Impaired waters: The role of biogeochemical, ecological, and hydrological processes that influence stream water quality
Nutrient loading from agricultural practices often results in degraded water quality in aquatic ecosystems. Research this past fall revealed drastic differences in nitrate (NO_3) concentrations in two watersheds (located in southern Minnesota) of varying land-use practices. Unexpectedly, the agricultural watershed had the lowest nitrate concentrations while the more forested watershed had the highest. Determining the exact cause of this trend is important for managers interested in improving water quality. It is therefore necessary to understand the biogeochemical, ecological, and hydrological processes that could influence nutrient cycling across the landscape. To help resolve this I am looking for 1 or 2 students interested in following-up these unexpected results with further sampling and research. Students working on this project will gain valuable field and laboratory experience, as well as some GIS experience. Fieldwork will involve collection of water, algae, and stream macroinvertebrate samples for nutrient (NO_3, PO_4, NH_4) and stable isotope ($\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$) analysis. We will use GIS to characterize land-use and watershed hydrology (Note: Prior GIS experience is not necessary). Nutrient and stable isotope analysis will help us identify processes involved in nutrient transformations across the landscape. Interested students will also have the opportunity to work with collaborators at the Cannon River Watershed Partnership.

Charles Umbanhowar – Climate change and responses of Manitoba tundra lakes
This project is focused on understanding lake and terrestrial responses to climate change in the low arctic tundra. In particular we are interested how bogs and other wetlands surrounding a lake modify lake response to climate change through the export of dissolved organic carbon which can color water. Work in 2008 resulted in collection of water and sediment from 39 lakes. The students working with me this year will be responsible for extracting Ca, Mg, Fe, C, N and P from these lake sediments, and will analyze these sediments using our Flow Injection Analyzer, Element Analyzer, and ICP. One student will travel to northern Manitoba for three weeks of field work in July. Field

work will again include water and sediment sampling, but will focus on vegetation and soils sampling. The student who goes up north must be willing to fly in float planes, work long hours and deal abundant biting flies and insects. Preference will be given to students having at least one year of chemistry (and preferably analytical). Completion of Ecological Principles is desirable but not mandatory.

CHEMISTRY Department

Doug Beussman – Summer 2009 research opportunities
All projects will rely to a large extent on the use of mass spectrometry, as well as on various separation methods.

Tetrahymena Proteomics - This project includes collaborating with Dr. Cole in the Biology Department and a research group at Drake University on the identification of proteins isolated from *Tetrahymena thermophila*, using proteomic methods. Isolated proteins will be digested and analyzed using mass spectrometry techniques with the MALDI-TOF/TOF instrument and screened against a database of proteins predicted to exist based on the genome. Peptides from potentially identified proteins will be fragmented in the mass spectrometer in order to sequence the peptides for confirmation of protein identification.

Date-Rape Drug Detection - A second opportunity for summer research involves developing sensitive and selective forensic science methods for the analysis of date rape drugs (including rohypnol, GHB and extacy) in beverage residues, using mass spectrometry. These residues may be the final few drops of liquid in the bottom of a glass, or the dried remains of these drops. This project will use the LC-MS to attempt to identify and quantitate different drug residues from a variety of beverage samples. Statistical analysis of the resulting data will be performed in order to determine the smallest amount of drug we can accurately detect.

Bob Hanson – Quaternions
Working in collaboration with Andrew Hanson (Department of Computer Science, University of Indiana), this student will explore the application of uaternions to the study of protein and nucleic acid structure and folding. I'm looking for a student who is either a double major in chemistry and either mathematics or computer science, or a biology or chemistry major with a strong interest in mathematics, or a mathematics or computer science major with an interest in applying mathematics to the area of structural biology.

Paul Jackson – Green Chemistry
During the summer of 2009 there is the possibility for green chemistry related development and implementation work in our upper level chemistry labs. Building on previous results the researcher will work with Dr. Jackson and consult with other faculty on experiments suitable for analytical and physical chemistry lab courses. The work will range from identify aspects of green chemistry that apply to these laboratory settings, applying appropriate green chemistry metrics, adapting green experiments already developed elsewhere, and inventing new experiments utilizing green chemistry. Use of HPLC, GC-MS, ICP-atomic emission spectroscopy and AAS in analysis of environmental surface water samples will be our primary tools. We will also develop a strategy for examining

hazardous waste generation in Regents Hall during the 2009-10 academic year. Undergraduates interested in this work should have completed either physical chemistry lab, analytical chemistry lab or bioanalytical lab by the summer of 2009.

Gary Miessler: Transition Metal Dithiolene Complexes and Clusters

My main research interests are in the organometallic chemistry of molybdenum and tungsten. For example, I hope to develop syntheses of new compounds of these metals that contain dithiolene ligands (bidentate ligands coordinating to metals through two sulfur atoms) in addition to organic ligands such as CO and η^5-C_5H_5. Some important molybdenum- and tungsten-containing enzymes have dithiolene ligands, and I hope to prepare compounds that might serve as models for the metal sites.

A more recent interest is cluster chemistry. For example, a molybdenum dithiolene complex and $Ru_3(CO)_{12}$ react to generate a variety of clusters in which sulfur forms bridges between different metals. These clusters have very interesting symmetries—visually appealing, at least to a chemist! I would like to have students explore reactions using different CO complexes to examine how broad this range of chemistry might be and how far the "isolobal analogy," which can be used to draw analogies between inorganic and organic chemistry, can be carried in understanding this chemistry.

Students participating in this work will gain experience in vacuum line synthesis and purification techniques and will also use a variety of spectroscopic methods, especially NMR, mass spec (APCI and MALDI), IR, and UV-vis. Crystal structures of new compounds will be determined by the University of Minnesota X-ray crystallography lab.

Greg Muth – Biochemistry and Biophysical summer research opportunities

Gene Regulation by RNA Riboswitches

Recent advances in genomics, the mapping of genes and their functions, have provided a wealth of information for researchers. One of the areas that has benefited is the study of gene regulation, the ability of an organism to selectively turn off and on certain genes in response to environmental conditions or at specific times during its lifecycle. Of particular interests are short sequences of mRNA upstream of some genes that are sensitive to the intercellular concentration of certain metabolites. The metabolites appear to bind to and alter the structure of the mRNA. This conformational change affects the transcription and or translation process thus switching the gene either on or off. To better understand the details of these RNA "riboswitches", we are studying the purine riboswitch using a variety of biochemical and biophysical techniques.

The project utilizes interdisciplinary techniques from biochemistry, microbiology, genetics, cell biology and bioinformatics. We will be working jointly with members of Prof. Schwinefus's team.

Enzymology

The bacterial enzyme Cystathionine β-lyase (CBL) catalyzes the penultimate step in the pyridoxyl 5'-phosphate (PLP) dependent hydrolysis of L-cystathionine to L-homocysteine, pyruvate and ammonia. Bacteria require L-cystathionine as a substrate in the production of methionine, an essential amino acid in protein synthesis. Because the synthesis of sulfur containing amino acids is unique to bacteria and plants, knowledge of the structure and function of enzymes involved in these pathways can lead to novel antibiotics and antifungals. There is also a strong clinical correlation

between defects in the mammalian homologue, cystathionine γ-lyase, and cystathiuoneuria a condition characterized by elevated homocysteine. Elevated levels of homocysteine have been correlated to cardiovascular disease, diabetes, Down's syndrome, neuroblastoma, hepatoblastoma and celaic disease. This connection makes our study of the bacterial system interesting as we apply, in principle, what we learn to a pertinent problem in current clinical biochemistry. Using a combination of functional kinetics, quaternary structure mapping and biophysical analysis we hope to unlock the mystery of how site-specific functional groups at the subunit interface contribute to the catalytic mechanism.

The project utilizes interdisciplinary techniques from biochemistry, biophysical chemistry and molecular biology.

Janice Pellino – Characterization of Bacterial Small RNAs

RNAs are key molecules in many cellular processes, acting as information carriers, structural scaffolds, and even catalysts. The recent discovery of a set of gene control pathways that respond to non-coding RNA has revolutionized the way many of us do and think about science. However, many questions remain regarding these small non-coding RNAs, particularly in bacteria. Recent computational studies have identified hundreds of small non-coding RNAs (sRNAs) in bacterial genomes. In the bacterium *Escherichia coli* (*E. coli*) alone, close to 100 small RNAs have been identified, however, the function of the majority of these sRNAs remains unknown. A greater understanding of how these sRNAs regulate gene expression in *E. coli*, and by extension the closely related bacterium *Salmonella typhimurium*, could provide insight into these bacteria's mechanisms of survival and infectivity. I am studying several bacterial small RNAs to characterize their structures, how they interact with their targets, and their cellular roles. This project combines techniques in biochemistry, molecular biology, biophysics, and genetics.

Jeff Schwinefus – Summer 2009 Research Opportunities.

Do you have an interest in biochemistry, physical chemistry, or computational biology? Want to learn more about one or more of these scientific fields? If so, then I just may have a project you will be interested in. This research project is appropriate for biology, chemistry, computer science or physics students that have completed the Chem121/123/126, Chem 125/126, or CH/BI 125/126/127 introductory course sequences. I am on sabbatical this academic year, so if you want to talk further, do not hesitate to email or call me with questions or to schedule an appointment.

Cosolute Interactions with Nucleic Acids

For several years Professor Greg Muth and I have collaborated to explore the stability of folded nucleic acids, from simple, short DNA duplexes to complex RNA structures. Much of our effort has focused on the role that neutral organic molecules like urea or amino acids (which we generically call cosolutes) have in lowering the stability of folded nucleic acid structures. Using UV-absorbance, differential scanning calorimetry, and vapor pressure osmometry, we have been able to calculate 1.) the excess (or deficiency) of these cosolutes in a local domain near the surface of a nucleic acid relative to bulk solution, 2.) the amount of cosolute at the newly exposed surface area of an unfolded nucleic acid structure, and 3.) the hydration of nucleic acids. All of these calculations are important (especially 2.) to rationalize why these cosolutes destabilize nucleic acid folded structures. However, thermodynamic measurements do not provide information about specific

interactions between cosolute and nucleic acid. What specific chemical functional groups on the nucleic acid do these cosolutes interact with? How do these cosolutes affect nucleic acid hydration?

To answer these questions, students working with me will simulate nucleic acids, from nucleotide monophosphates to DNA and RNA duplexes to larger RNA structures, in aqueous solutions using Amber, a molecular dynamics software package. Molecular dynamics simulates atomic motion as a function of time for all of the water, nucleic acid, and cosolute atoms in the simulation. These simulations have the benefit of allowing us to visualize interactions between water, cosolute, and nucleic acid as well as calculate the lifetime of these interactions to provide a molecular basis for our experimental measurements.

MSCS Department

Dick Brown Beowulf cluster computing.
A Beowulf cluster consists of numerous commodity computers that are networked together in order to perform high-performance computations. St. Olaf's Beowulf cluster project supported numerous research initiatives in the biological sciences, physics, computer science, mathematics, and chemistry (see http://www.cs.stolaf.edu/projects/beowulf). We seek students to continue this work during Summer 2009. Goals include: interdisciplinary applications of map-reduce and other computational techniques; installation and testing of software systems that take advantage of cluster technology; creation of "HiPerCiC" user interfaces enabling persons who are not cluster programmers to access the results of cluster computations; and design and implementation of improvements in St. Olaf's three clusters. Students with Software Design backgrounds are encouraged to apply; "core" CS courses, CS 300, and background in the natural sciences are assets.

Olaf Hall-Holt: The Palantir Project
Are you interested in graphics, 3D visualization, and measurement sensors? Do you have some familiarity with the C++ programming language? The Palantir project is an on-going team effort that is currently focused on extracting 3D information from video sequences. Given digital video clips taken with two synchronized cameras, our challenge is to find patterns in the data that allow us to infer information about the shape and position of objects in the scene. We will build on work from last summer on calibration and the new Eriol image segmentation program. This is a joint project with Gary Muir in psychology, who will be applying the new tools to study the way that rats navigate through space.

Steve McKelvey – Sudden Oak Death (SOD)
Sudden Oak Death (SOD) is a serious disease, recently introduced to North America, that has the potential to destroy most of the oak forests in the United States. For the moment, the organism that causes the disease, Phytophora ramorum, appears to be isolated to the Pacific coastal forests, areas west of the Cascade and Sierra Nevada mountains. With possible funding from the USDA Forest Service, this mathematical modeling project supports federal efforts to prevent the spread of this organism to eastern oak forests. Mathematical ideas that will be important to this project include probability, optimization, stochastic simulation, network flow analysis and possibly differential equations. I do not expect summer researchers to be experienced in all, or even some, of these areas.

What I will be looking for is someone well along in the mathematics major, with demonstrated interest in applied mathematics, whose academic record indicates an ability to learn new ideas quickly. Computer programming experience of any type is a plus, but not required.

Paul Roback – Statistical Modeling and the Tuberculosis Genome
The prediction of operons (sets of genes that function together) in *Mycobacterium tuberculosis* (MTB) is a first step toward understanding the regulatory network of this pathogen. Along with researchers from the University of Seattle, we are developing statistical models to predict operons in MTB, using information such as intergenic distance, promoter and terminator indicators, and gene expression data from nearly 900 microarray experiments with MTB RNA. Our goal is to build an improved genome map for this human pathogen. Funding is available for two students to work on statistical aspects of this project this summer; ideal candidates would have taken Statistical Modeling (Stats 272), be working toward a statistics concentration, and have interest in genetics (and potentially even relevant coursework in biology).

PHYSICS Department

Brian Borovsky – The Molecular Origins of Friction - A study across velocity regimes of phosphonate monolayers on alternative MEMS-type surfaces.
I am interested in studying what gives rise to the force of friction. What are the microscopic interactions that determine the frictional force opposing the sliding of one surface over another? How does this force generate heat at the interface? By pressing a high-resolution force probe onto a vibrating surface, we create a microscopic high-speed contact subject to friction. The speeds and contact sizes involved are the same as those encountered in working devices such as computer hard drives and micromachines. My research group is embarking on a collaborative effort, with investigators from Luther College and Auburn University, to investigate a class of monolayers called alkanephosphonates that may be effective coatings for micromachines assembled from metal oxides rather than silicon. We will be studying lubricant films consisting of a single layer of chain-like hydrocarbon molecules. Our goal is to determine how the length of the lubricant molecules and the choice of substrate affect the levels of friction. Current models point to the importance of mutual interactions among the molecules in establishing a well-ordered layer with a minimum number of pathways for energy dissipation. This summer, I have two positions open for student researchers, funded by the National Science Foundation. **Anticipated start date: June 1, 2009*

James Cederberg – Molecular beam spectroscopy.
The molecular beam spectrometer still located in SC150-152 was obtained from Harvard University in 1981, and has been in use here at St. Olaf ever since. The project involves using the spectrometer to record data on the molecules, and developing and using software for the analysis of the data. The purpose is to measure molecular properties that quantify the interactions between the molecular and external electric and magnetic fields and the nuclear spins.

During the summer of 2008 two students, Bjorn Paulson and Chris Conklin, began an investigation of RbI that is now fitting together nicely. With this work we should be able to add five significant figures to the parameters beyond what was known from previous measurements elsewhere. They

may present their work at the annual International Symposium on Molecular Spectroscopy at Ohio State in June.

For the summer of 2009 two students can decide how to finish up work that others had begun earlier on RbBr and RbOH, or tackle a new molecule. The students are colleagues in the whole process, helping to decide what molecules to examine and what data to take, analyzing the data, maintaining the apparatus, writing software, and writing the papers for publication. In so doing they can learn about the quantum mechanics of molecular structure, vacuum techniques, electronic interfacing and control, programming in Visual C++, and the statistical analysis of data. Following the summer of 2009 the spectrometer will be decommissioned in preparation for the remodeling of the old science center. One possibility is for it to be passed on to another researcher, a chemistry faculty member in Kentucky, who is considering joining the project here for the summer to learn more about it.

Jason Engbrecht – Positron Research Group

The St. Olaf Positron Group will be continuing the construction of the world's first low energy Positronium Beam. The purpose of this beam will be to study atomic collisions and in particular to resolve a long standing discrepancy between theory and experiment. This project has been ongoing for two years and we anticipate the completion of the apparatus this summer and hopefully the first acquired data. Students involved in this project will be involved in all aspect of the building the apparatus including design and construction as well as data acquisition. There will likely be funding for one new student on the project.

Robert Jacobel - Summer Research with the Center for Geophysical Studies of Ice & Climate (CEGSIC)

The world's glaciers and ice sheets are a critical element in the global climate system now undergoing major change. Our group uses ice-penetrating radar and satellite imagery to examine the surface, interior and base of ice sheets and glaciers. The characteristics of internal ice layers and basal geology that we measure with the radar give us information about the evolution of the ice and enable us to study the relationship between ice flow and climate change.

Currently we are involved in the third year of an Antarctic traverse project that is part of the International Polar Year (IPY), 2007-2009. Summer research in 2009 will focus on data analysis and interpretation from this traverse. We also may have funding for a continued geophysical study of the Mid-Continent Rift, a gravity and magnetic anomaly that traverses Wisconsin and Minnesota.

Students in our group work extensively with computers and software to analyze ice-penetrating radar data and satellite imagery as well as learn to write new code in Matlab. We also work with GPS, GIS, and remote sensing software/data to establish a spatial context for our radar results. Part of our summer research involves using radar and GPS in a local field setting so that all have the opportunity to acquire new data and work through the process from start to finish. We will read papers and proposals from our colleagues and present our own results to the community. Our research is supported by grants from the Office of Polar Programs, National Science Foundation.

Angie Reisetter - Particle Astrophysics

I work in a collaboration called the Cryogenic Dark Matter Search II and its next-generation version, SuperCDMS, which is one of the leading dark matter searches in the world. We're hoping to

discover what most of the matter making up the universe is. Dark matter is thought to be some kind of heavy particle that interacts weakly with normal matter, and we have a detector underground in the Soudan Underground Laboratory in northern Minnesota which will be able to identify it if we run into it. The background rate at the mine is about 1 Hz, and we have a few years of data, so there is quite a bit of work to sort out the backgrounds from any potential signal (the dark matter). The student working with me will spend 2 weeks in Soudan learning operations, i.e., how the experiment works, how to run a cryogenic fridge, and some outreach. The rest of the summer will be spent at St. Olaf doing analysis tasks they are interested in (there are many to choose from, since we have a lot of data to work with), and/or simulation studies, and/or a neutron counter project to study the backgrounds in the mine. Coding can be done in Matlab, a very simple language, or in more advanced languages (C++, perl) if the student desires. Please come talk to me if you are interested.

PSYCHOLOGY Department

Shelly Dickinson – aversive effects of alcohol in adolescent mice

Previous work in the lab using the place conditioning technique has determined that adolescent mice do not show a preference for environments associated with a moderate dose of alcohol, although adult animals do. In addition, sensitivity to alcohol's aversive effects seems to be different in adolescent mice. This summer's project will be to determine whether these findings hold for multiple procedures that supposedly measure the hedonic effects of drugs, including conditioned taste aversion in addition to place conditioning. In addition to looking at alcohol-related behaviors in adolescent mice, I'm interested in understanding the neurobiological differences between adolescents and adults that may be involved in the behavioral differences. To do this, we can use the technique of electrochemistry to determine the functionality of various transporter proteins in the brains of adolescent and adult mice, both under baseline conditions and after alcohol injection. Students will start at the beginning with experimental design and will learn animal handling and injection techniques, and will gain experience analyzing the data. Ideally some initial training would happen during the spring semester so that current students can pass on their wisdom. Participation beyond the summer is desired with regard to manuscript preparation, and continued work during the academic year doing independent research is possible.

Gary Muir – The Neural Basis of Spatial Navigation and Re-orientation

My research program is guided primarily by questions about the neural mechanisms of spatial cognition and navigation. The firing activity of "head direction" cells is thought to represent the animal's perceived "sense of direction," or orientation, but how is information contained in the firing activity of these cells used by the animal when solving a spatial task? I am also particularly interested in the role these cells play in enabling us to re-orient following a period of mis-orientation. To answer these questions, students will have the opportunity to observe a "behaving" brain in action by recording the activity of single neurons while freely moving rats perform spatial tasks. How does this neural activity relate to the animal's navigational decision-making behavior? Students will be involved in small animal handling, surgery, and behavioral training; single-unit electrophysiological data collection and analysis; and public presentation of the results. Students interested in continuing the project into the academic year as independent research are especially encouraged to apply.