Student Abstracts based on Summer Research 2001

BARKER, KATIE. Interactions between actin and proteins involved in translation. (advisor Kim Kandl).
Many studies have implicated a role for actin in translation, and actin and actin binding proteins are known to interact with proteins involved in translation. For example, eukaryotic elongation factor 1A (eEF1A) has been found to bundle actin in vitro (Yang et al., 1990). Furthermore, Sla1p, an actin-binding protein, has been found to interact with the eukaryotic release factor (eRF3) in yeast (Bailleul 1999). We want to study actin in yeast because yeast serve as a very useful model for other eukaryotic cells. This summer we set out to investigate 2 things. The first project investigated the interaction of actin and elongation factors. It is known that actin and the charged aminoacyl tRNA (aa-tRNA) compete for binding to eEF1A (Liu et al., 1996), and that eukaryotic elongation factor 1B (eEF1B-a) and aa-tRNA compete for binding to eEF1A. We did experiments to see if there was a competition between eEF1B-a and actin for binding to eEF1A. The second project looked at actin's involvement with eRF3. An HA epitope tag was added to eRF3 and anti-HA antibodies were used to determine whether actin co-precipitates. Progress was made on both of these projects, but further work needs to be done.

BERGE, TAMARA. Habitat preferences and nesting success of the Eastern Bluebird (*Sialia sialis*) along the St. Olaf nest box trail. (advisor: Gene Bakko)
The St. Olaf College nest box trail was set up, like many others around the nation, in order to help re-establish nesting sites for the Eastern Bluebird. Data was collected and analyzed from previous years to look for patterns in the Eastern Bluebirds' nesting site choices along the trail. This study also looked to see if there were any patterns associated with the nesting sites and predation. Measurements of grass height, distance from trees, and distance from mowed grass were taken around all the sites on the trail. It was found that bluebirds most often make their nests in boxes that are surrounded by grass measuring between 0.5M and 1.0M, that are 1.0M to 5.0M away from trees, and that are 0.0M to 10.0M away from areas of mowed grass. No pattern was found between the nesting sites and predation. From these findings, preliminary ideas for expanding and changing the nest box trail have been determined.

BONGARD, MIKE. A safer day at the Molbeam. (advisors Jim Cederberg, David Nitz and Duane Olson) With St. Olaf Molecular Beam group: E. Frodermann, K. Huber and H. Tollerud
This past summer has marked the conclusion of several years of work on a new safety system for the St. Olaf Molecular Beam Spectrometer, known as the Molbeam. This system, called PUMPS, is comprised of two parts – a physical control box and software to control it. My work focused on the programming and implementation of the controlling software, as well as testing the control box. Since its completion, the Molbeam runs safely for days without operator intervention. In addition to the work with PUMPS, I have also begun work on a new data collection program that will replace the program currently in use. This new program, called WinBeam, will allow future

Molbeam groups to remotely access the spectrometer controls and view a data set from anywhere on the Internet.

BREEN, EMILY. Developing chemical profiles of freshwater wetlands. (advisor Paul Jackson)
How does one determine wetland health? The overall goal of this summer's research was to discover organic and inorganic chemical indicators of wetland health. In consultation with the St. Olaf College Curator of Natural Lands, we specifically collected and developed a baseline data resource related to pH, dissolved oxygen, conductivity, water temperature, water depth, topography, and terrain for Skoglund pond. For comparison purposes, we sampled from three other wetlands in Rice County: Hidden Valley pond, R.J. Lick Wildlife Management Area (WMA), and Boyd WMA. The same Fish and Wildlife Service classification, type 4, was applied to the four wetlands but each was located in different surroundings. Consequently, we expected to observe some chemical differences. On average, the WMAs were higher in pH (0.3 to 1.5 higher), dissolved oxygen (1 to 5 ppm higher), alkalinity (1000 to 2000 μeq/L higher), and conductivity (100 to 170 μS higher) than Hidden Valley and Skoglund. We believe these differences are geo-chemically derived; the WMAs are in a rural lake setting whereas the other two are in more urban river valley areas.

Changes in weather can also affect wetland chemistry. The start of the summer was rather wet followed by a hot, 17-day, dry spell. The conductivity and alkalinity increased noticeably during the dry spell. For Skoglund, the average conductivity for a day went from 123.675 μS to 176.366 μS, and average alkalinity for a day went from 1089.705 μeq/L to 1239.070 μeq/L. The evaporation of water leaves dissolved ions behind, increasing the concentration of those ions, which causes the conductivity and alkalinity reading to increase as well. Additional work focused specifically on the Skoglund pond. Surface area and volume calculations as well as the local watershed area were determined using topographic maps. The local watershed area for Skoglund pond is approximately 277,902.560 sq. meters. The pond area is approximately 37,858.442 sq. meters, with an avg. depth of about 2 meters. Land use in the local watershed is 13.6% water, 19.8% hard surfaces, and 66.6% soil.

BRIES, STACIE. The nonsense-mediated mRNA decay pathway affects wild-type *CTF13* mRNA accumulation in *Saccharomyces cerevisiae.* (advisor Jeff Dahlseid)
The nonsense-mediated mRNA decay (NMD) pathway regulates wild-type gene expression by accelerating the degradation of select wild-type mRNAs. Three proteins, Upf1p, Upf2p, and Upf3p are required for NMD. In the absence of NMD, wild-type *CTF13* mRNA accumulates. The *CTF13* gene codes for an essential protein subunit of the kinetochore in *Saccharomyces cerevisiae*. Our hypothesis is that *CTF13* mRNA accumulation is due to a direct affect of NMD upon *CTF13* mRNA stability. We constructed DNAs that allow control of *CTF13* transcription through changes in carbon source (i.e. glucose versus galactose) in the growth media. Our experiments show that *CTF13* expression from these DNAs is galactose dependent and *CTF13* mRNA accumulates in *upf* mutant yeast strains relative to wild-type, suggesting that the stability of *CTF13* mRNA may be controlled by NMD. We plan to use galactose-induced

expression of *CTF13* mRNA followed by inhibition of transcription using glucose-containing media to measure the rate of *CTF13* mRNA decay.

CHRISTIANSON, MATTHEW. Synthesis of fullerene and amino acid complexes with Molybdenum. (advisor Gary Miessler)
The transition metal molybdenum (Mo) is found in the active sites of approximately 30 enzymes that catalyze key reaction in the metabolism of carbon, nitrogen and sulfur by micro-organisms, plants, and animals. Also, the coordination of cysteine to Mo is a characteristic of the sulfite oxidase family of molybdoenzymes. Observations from reaction of $Mo(CO)_6$ and a cysteine ester in acetonitrile indicates that coordination between Mo and the cysteine ester occur.

DABNEY, KAREN. Using GUDs to assess the effects of roadways on the foraging of small mammals. (advisor Diane Angell)
Aspects of foraging, such as searching and quitting times, are implied by a specific patch's giving-up density. Foraging habits are proven to be flexible and constantly in transition in accordance with rules of rate maximization which balance predation risk with energy intake. Roadways present a predation risk. By acquiring giving-up densities at varying distances from two types of roads in either exposed or covered areas, I concluded that distance is not a significant factor in the foraging of small mammals near roads. The type of roadway and degree of cover are both significant factors in the foraging of small mammals near roads. I find that it is traffic volume and road maintenance, not nearness to roads, which determines the foraging habits of small mammals along roadways.

DICKSON, MATT. Purine metabolite release from rabbit myocardium following repetitive ischemic episodes: effects of adenosine deaminase and adenosine kinase inhibition. (advisor Dave Van Wylen)
Surgery was performed on adult, male New Zealand white rabbits prior to mounting the isolated hearts on a Langendorff apparatus where global hemodynamic parameters were continually monitored. Hearts were perfused with Krebs-Henseleit buffer for a stabilization period and then given Krebs-Henseleit buffer with one of 4 drug regimens: no additional drugs, 2 μM 5-Iodotubercidin, 10 μM EHNA, or 2 μM 5-Iodotubercidin along with 10 μM EHNA. After another stabilization period for the new buffer, 3 global ischemic episodes of 5 minutes duration were each followed by 10 minutes of buffer reperfusion. Effluent samples were collected during these reperfusion periods at regular intervals. Each of the effluent samples was analyzed using high performance liquid chromatography (HPLC) and compared to known standards in order to quantify the concentrations of several purine metabolites, most notably hypoxanthine, inosine, and adenosine. Metabolite concentration data from the reperfusion periods were fitted for washout curves with a dual exponential decay function and subsequently integrated. Intragroup purine metabolite attenuation was measured by one-way ANOVA of the integrals, and intergroup variation within each perfusion period was determined by unpaired, two-tailed Student's t-tests. The results for EHNA vs. control hearts are consistent with a "true" energy-sparing preconditioning effect, but unexpectedly, the results for 5-Iodotubercidin vs. control hearts may suggest either that 5-Iodotubercidin plays a role as an enhancer of preconditioning, that it affects cardiomyocyte metabolism

in as yet enigmatic ways, or that there are problems with the drug or its vehicle (in this case, DMSO). Tentative results notwithstanding, therefore, conclusive analysis about purine metabolite release during repetitive ischemic episodes remains pending as further data accumulates.

DURAND, DAVID. Membrane surface activity of (*E*)-dihydrowyrone and its synthetic analogs. (advisor Gary Spessard and Anne Walter)
Several researchers have attempted to explain how phytoalexins (antibiotic compounds produced by plants) exert their influence in warding off fungal infections. Previous works focused on the lipophilicity of these molecules and found that they interact with membrane bilayers. Spessard et al. found that polar, protic functional groups and a relatively large hydrophobic area are necessary for proper interaction of phytoalexins at lipid bilayers. In this study, we were interested in determining the anti-fungal ability of the natural phytoalexin (*E*)-dihydrowyrone by synthesizing new analogs with differing polar chemical moieties. We then characterized these compounds by studying their interactions with liposomes of various lipid compositions. The results indicate that the dihydrowyrone molecule does not induce permeabilization of the membrane by creating large holes (>13-15Å), but rather partitions into the membrane in a dose-dependent manner. As such, dihydrowyrone causes the bilayer to become "tighter" and more constricted.

DVORAK, LEAH AND KRISTINA HOUSER. Reconstructing the paleoecological history of the Big Woods area though sediment analysis. (advisor: Charles Umbanhowar Jr.)
The Big Woods region was a large expanse of land that encompassed much of south-central Minnesota. Over the past 12,000 years it has transformed from woodland to prairie and back. These transformations are believed to be caused by the interactions among vegetation, fire and climate. In this investigation the paleoecological history of the former Big Woods area was reconstructed using biogenic silica, charcoal, pollen, and magnetic proxies to determine how these interactions affected this area. This study was conducted on sediment cores from two lakes in south-central Minnesota (Kimble and Sharkey). Biogenic silica analysis revealed that lake productivity was higher between the years of 4700-8200 BP, indicating a transition to the prairie period. Magnetic testing revealed a simultaneous rise in magnetic susceptibility of the sediment, which again suggests a prairie transition. We believe that a rise in charcoal accumulation should also be seen during this period, however, accumulation rates are lower than expected. This could possibly be the result of changing sedimentation rates. Pollen data coincides with these results and suggests that vegetation was similar across many lakes in this area.

ENGLE, ROBERT AND PETER PEARSON. Radar studies of englacial water in a polythermal glacier*. (advisor: Robert Jacobel) Center for Geophysical Studies of Ice and Climate, Department of Physics
Glaciers outside of the polar regions are sensitive indicators of climate change, and water at the base of such glaciers is the key to ice motion. To better understand the behavior of englacial water transport from the ice surface to the bed, it is important to have a clear picture of the transport structures themselves. We studied Storglaciaren in arctic Sweden using both high and low frequency radar systems to determine the distribution of

englacial water and to look for discreet conduits. Using various filtering and migration routines, we examined the electromagnetic velocity profile of the ice which is a function of the amount of water present. We also identified several reflectors as potential englacial conduits.
*This research is supported by grants from the National Science Foundation Office of Polar Programs

FLYNN, MAREN. Determination of the acid dissociation constants of fatty acid monolayers. (advisor Mary Walczak and Anne Walter)
Long chain ω-carboxyalkanethiols spontaneously form monolayers on gold surfaces. Previous studies using atomic force microscopy, theoretical models and contact angle titrations have shown a 3-5 unit increase in pKa for carboxylic acids aggregated in this kind of monolayer. Several ideas have been proposed to explain the increase: hydrogen bonds between head groups, electrostatic repulsion of ionized head groups and nonaqueous dielectric medium. This project uses a spectroscopic technique to probe the pKa of acid-terminated thiolate monolayers. The spectral properties of acid/base indicator dyes can be used to measure the pH of an aqueous solution in contact with the monolayer. This pH reflects the amount of acid dissociation of the monolayer surface. A measure of the monolayer surface coverage using reductive desorption electrochemistry in combination with the pH information is used to solve a simultaneous equilibrium problem and thus determine the monolayer pKa.

HARRIS, SCOTT. An explanation of Radarsat and Landsat remote sensing of the West Antarctic ice sheet*. (advisors: Robert Jacobel, Brian Welch) Center for Geophysical Studies of Ice and Climate, Department of Physics
Satellite imagery is finding increasing use as a tool for studying ice. Landsat and Radarsat images can be used to produce mosaic maps, and feature tracking and radar interferometry are now commonly used for obtaining surface velocities. Our research group is involved with the International Trans-Antarctic Science Expedition (ITASE), whose mission is to study recent climate change in Antarctica. I produced a mosaic map of the 2001 ITASE traverse route by geolocating and combining 25 Radarsat scenes, and an additional 10 Landsat scenes. These Radarsat scenes complement the ice-penetrating radar data, which will be acquired by our group during the traverse. As a part of this project, I explored the differences between Radarsat and Landsat images as described in the poster below.
*This research is supported by grants from the National Science Foundation Office of Polar Programs and the National Aeronautics and Space Administration

HENRY, ANNA AND MEGHAN SONSTEGARD. Investigating DNA concentration and cell size in the diploid/tetraploid species pair: *Hyla chrysoscelis* and *Hyla versicolor*. (advisor: Dan Meinhardt)
Identification based on advertisement call and morphological differences of the diploid-tetraploid species pair Hyla chrysoscelis and Hyla versicolor is difficult and has beena subject of study for years. We set out to investigate further ways to distinguish between these two species. This study focused on measuring the concentration of DNA in erythrocyte cell nuclei using cytophotometry in order to determine which species we were observing. However, in this study of very aged, preserved specimens, we found that cytophotometry did not prove to be an accurate way of identifying preserved specimens.

HILL, MIKE, MIKE MENSINK AND SARAH STRAND. Investigative psychophysiology laboratory experiences in college and high school. (advisor Howard Thorsheim; high school consultant Phillip Marino)
This summer, research funded by the National Science Foundation, involved the phenomena and theory of neuroscience, methodology, and the technology of psychophysiology. Physiological theory was explored through experiments using electrocculography, electromyography, facial muscle and emotion, olfaction, working memory, electroencephalography, laughter and touch. Pilot projects have been worked on for Emotional Imagery and Facial muscle response using EMG and for the Physiological Effects of Olfactory Stimulus using ECG, GSR, and respiration monitors. The lab the researchers built is for a national model, which included 10 BioPac workstations with the capability of measuring various physiological reactions. The physical equipment set-up, the spatial design of the room, and methodology was used to help build the psychophysiology lab. The research team located and evaluated exemplary practices of both nationally and internationally psychophysiology neuroscience. The researchers linked internationally with Dr. Wolfram Boucsein and nationally with Dr. John Cacioppo. The lab workstations all have faces on them representing different important psychophysiologists, from Copernicus to Patricia Cowings who works for NASA. Outreach introduced psychophysiology to the Upward Bound high school students. The researchers then adapted and implemented that exemplary practice in three ways: as a theme in beginning middle and advanced St. Olaf curriculum, in student research, and as a national model in outreach to other colleges and to high schools.

HUBER, KATIE. A closer look at nuclear structure using electric resonance molecular beam spectroscopy. (advisors: Jim Cederberg, David Nitz and Duane Olson) With St. Olaf Molecular Beam Group: M. Bongard, E. Frodermann and H. Tollerud
This summer the Molecular Beam Spectroscopy group of St. Olaf College studied the nuclear structures of RbBr, RbF, and KF. This was done by the use of an electric resonance molecular beam spectrometer operating in the radio frequency range. These frequencies cause transitions in the hyperfine structure of the molecule. Studying these changes has allowed our group to experimentally develop molecular constants describing the nuclear shape and its interactions. The data we collected made it possible for us to revise our predictions for transitions and further our work towards the calculations of the molecular constants of RbF. Many alterations were made to the beam process this summer including new data analysis techniques, the implication of new computer programs and modifications of the RF system. The changes will help in the process of data collection along with data analysis.

ISON, JENNIFER. Effects of soil treatments of plant restoration. (advisor Joel Olfelt)
We tested methods of reintroducing *Danthonia spicata* and *Potentilla tridentata* to severely trampled areas of Shovel Point in Tettegouche State Park. We planted 450 of each species into plots with five different treatments and a no-soil amendment treatment. The five treatments were hydrogel, sterile soil, sterile plus local soil, fertilizer and woodchips. We evaluated the success of the treatments by counting the stems of the all

the plants. After five weeks we found that the hydrogel treatment was significantly more successful than the other treatments. However, these results are preliminary and we plan on collecting data in mid-September 2001 and during spring of 2002.

JACOBSON, AMANDA. The effects of the DNA synthesis inhibitor, aphidicolin, on the abortive conjugation of *Tetrahymena thermophila*. (advisor Eric Cole)
Abortive conjugation results when one partner of conjugating *Tetrahymena* cells fail to complete nuclear selection. This most likely is the result of DNA damage which inhibits the selection process. The effect of aphidicolin (APD), a DNA synthesis inhibitor, on the abortive conjugal pathway of *Tetrahymena thermophila* was studied using star cell lines, UV-damaged pairs and Rad51 knockouts, all of which contain broken chromosomes. In star cells, successful conjugation resulted in the presence of APD, whereas the number of cells going to endpoint in diploid pairs decreased. Aphidicolin did not aid UV-damaged conjugating pairs in achieving endpoint. No conclusion was obtained concerning APD and Rad51 knockouts. Our hypothesis that DNA synthesis is required for the abort signal of conjugation was supported in some aspect but was also challenged with the development of new questions investigating the role of DNA synthesis in the abort signal.

JOHNSON, JULIA AND MOLLY SHEPARD. Development of vocalization and song in house wren (*Troglodytes aedon*) chicks. (advisor Henry Kermott)
For most birds, singing is only partly instinctive; song must be learned and developed. The purpose of this experiment is to determine the vocalization abilities of house wren chicks and chart their vocal development. The chicks' vocalization was predicted to increase in complexity, differentiation and frequency with age. This is based on the idea that with growth and practice the chicks are physically and mentally more capable to produce advanced sounds. Data was collected with a small microphone inserted inside the nest box for a recording time of 30 minutes per session. Many wren boxes were used to take recordings from all fifteen days of development in the boxes from hatching to fledging days. The recordings will be analyzed qualitatively using a voice analyzing computer program, Signalyze, by creating spectrograms of the vocalizations. The chick spectrograms will then be compared with spectrograms of adult song and chatter to determine the chick's vocalization and song development. Aside from the thorough spectrogram analysis to be conducted this fall, we observed the chicks' vocalizations change from a constant, high frequency, low amplitude peep in exclusively single-syllable phrases to multiple-syllable, overtone-heavy phrases of high amplitude, low frequency chirps. Also, the chicks became more discriminating in eliciting their vocal (begging) response to stimuli as they matured, and at its most mature stage prior to fledging, chick call closely resembled the House Wren chatter – an alarm mechanism.

LARSON, MEREDITH. Mononuclear assessment of reproductive success in aneuploid cell lines of *Tetrahymena thermophila*. (advisor: Eric Cole)
The unicellular ciliate *Tetrahymena thermophila* sexually reproduces by a mechanism named conjugation. Star cell strains exhibit reduced conjugal success as matings involving the aneuploid cells tend to terminate prematurely. This study investigated the effects of fragmented micronuclear chromosome conditions on conjugal success rates. By crossing a diploid cell with a star cell, we built the CU 428* cell line in hopes to show that its broken micronuclear chromosomes would cause subsequent conjugal endeavors to

abort. Cytology revealed that the constructed cells' micronuclei were composed of a haploid amount of DNA plus a small quantity of relic star cell micronuclear DNA. The CU 428* construct also demonstrated diminished conjugal success. These data indicate that damaged star micronuclear DNA is cause for abortive conjugation. Such results serve as groundwork for elucidating the specific interactions of fragmented chromosomes during meiosis.

MALENKE, JAEL. The effect of selection for short-term heat tolerance on heterozygote versus homozygote macronuclei in *Tetrahymena thermophila*. (advisor Eric Cole)
Fully homozygous and heterozygous populations of *Tetrahymena thermophila* were mutagenized with nitrosoguanadine and exposed to 45°C, a lethal temperature for increasing periods of time. The cultures that lived the longest were selected, regrown and re-exposed to the lethal temperature. Four rounds of selection were completed before the heat tolerance phenotype was characterized and compared to selected and unselected control heterozygotes and homozygotes. The mutant homozygote strains selected at 45°C showed an increased tolerance, routinely surviving 5 minutes at 45°C while the mutant heterozygotes and the selected homozygotes and heterozygotes showed no increase in tolerance from the unselected controls, which survived between three and four minutes. The growth rates of the mutant and control (selected and unselected) lines were monitored over 5 hours at 30°C, 35°C and 40°C. There was no difference in doubling times implying that the heat-tolerant mutant homozygotes had an expanded range of survival.

MIDDLEMAN, ALICIA AND MARA SEDLINS. Prevalence and usefulness of number forms. (advisor Bonnie Sherman)
One goal of the current study was to develop a questionnaire that elicits honest and unbiased responses to questions about number forms. It was created and tested as a tool to find subjects with number forms. Subjects were invited to participate in an additional component of the study in which they were individually interviewed and asked to perform a numerical task involving addition and comparison. A second goal of the study was to determine if having a number form affects the subjects' reaction times for the task. The researchers hypothesize that there will be a difference in reaction times between subjects with number forms and subjects without number forms. Data analysis has not been completed so no conclusions can be drawn at this time.

MURAKAMI, MARK. A protocol for the enrichment of a 64 kD protein in cortical fractions of the ciliated protist *Tetrahymena thermophila*. (advisor Eric Cole)
The nuclear exchange junction in conjugating *Tetrahymena thermophila* cells is the site of significant cellular activity and involves the action of a host of associated proteins. Nelsen *et al*. (1994) reported the discovery of one such protein, called fenestrin, due to its decoration of the exchange junction and other cell fenestrations. Fenestrin has yet to be characterized in depth, however. Here we report our progress in developing a protocol for the enrichment of fenestrin in cortical fractions of conjugating *Tetrahymena* cells. We have encountered several hindrances to our research, including the small quantity of fenestrin present in *Tetrahymena* cells and the need for a very sensitive immunoblotting

visualization substrate, but our work is ongoing. The enrichment of fenestrin may make possible the creation of a monoclonal cell line producing a ready supply of fenestrin antibody. Such antibody would facilitate the detailed characterization of the fenestrin protein that is currently lacking.

NELSON, CHRIS. Of mice and men: Surveying small mammal populations on the St. Olaf natural lands. (advisor: Gene Bakko)

This study was undertaken for the purpose of identifying small mammal species on St. Olaf natural lands. Data were also gathered on times of greatest activity, habitat comparisons, and trap effectiveness by type. Population studies were done on the meadow vole (*Microtus pennsylvanicus*) and mice in the genus *Peromyscus*. Mark, release, and recapture sampling was done with live traps, and various estimation methods were used. For the voles, the simple Lincoln-Peterson methods, Chapman's modified Lincoln-Peterson method, and Schnabel's method were utilized. A Jolly-Seber analysis using the computer program POPAN-5 was done on the *Peromyscus* population. The survey showed all of the expected small mammal species excepting the southern red-backed vole in the study area. The vole population where sampled contained 80-100 individuals/5000 m^2. The *Peromyscus* population in another area was smaller, estimated at around 5-10/2500 m^2. Both surveys were plagued with error due mostly to tag loss. A tentative correlation was found between denser grass and greater trap success, and voles were found more active at night than during the day. Sherman box traps (3"x3.5"x9") were seen as more successful than the PVC tube traps.

OLSON, DAVID. Synthesis and characterization of molybdenum-tungsten heterodimers bridged by the dithiolene ligand $S_2C_2(CF_3)_2$. (advisor Gary Miessler)

The molybdenum homo-dimer complex $[(\eta\text{-}C_5H_5)Mo(\mu\text{-}S_2C_2(CF_3)_2)]_2$ was first synthesized and characterized by ^1H and ^{19}F NMR spectroscopy in 1986. Since that time, interest has grown in attempting to synthesize the molybdenum-tungsten hetero-dimer complex $[(\eta\text{-}C_5H_5)\ (\mu\text{-}S_2C_2(CF_3)_2)W\text{-}Mo(\mu\text{-}S_2C_2(CF_3)_2)\ (\eta\text{-}C_5H_5)]$. The synthesis involves two steps. In the first step, the compound $[(\eta\text{-}C_5H_5)\ (CO)_3Mo\text{-}W(CO)_3(\eta\text{-}C_5H_5)]$ (1) was prepared by exposing an equal molar solution of $[(\eta\text{-}C_5H_5)Mo(CO)_3]_2$ and $[(\eta\text{-}C_5H_5)W(CO)_3]_2$ in toluene to sunlight for 20 minutes. Compound 1 was characterized by ^1H NMR spectroscopy. Compound 1 was then reacted with the bidentate $S_2C_2(CF_3)_2$ (*tfd*) ligand. The resulting solution was found to contain a mixture of at least seven different compounds. Work will be continued in purifying and identifying these compounds.

PATCH, NATALIE. Overcompensation and *Andropogon scoparius*: the effect of varied defoliation on Little Bluestem heights and above-ground biomass production. (advisor Diane Angell)

This study dives into the controversial topic of compensatory plant growth, looking specifically at the effects of varied heights of defoliation and clipping frequencies on individual *Andropogon scoparius* bunches of the St. Olaf restored prairie in Northfield, MN. I was assigned experimental grass bunches clipping treatments of different heights, 5cm or 10 cm above the ground, and different frequencies, 10, 8, 6, 5, or 4 times throughout the 45-day study. Analysis of height and above-ground biomass production

data collected indicates that clipping at any level or frequency significantly increases the amount of height regrown by the bunches and does not significantly affect the total above-ground biomass produced by the bunches. Results support compensatory height growth, but not overcompensatory above-ground biomass production. Compensatory height produced when clipped may be in the plant's interest of setting seed by fall and lack of overcompensatory above-ground biomass production supports Little Bluestem's reputation as a range grass capable of withstanding defoliation.

SCHULZ, LUCAS. Investigation of Cell Cycle Dependent mRNA Expression. (advisor Jeff Dahlseid)

Many of the details of the cell cycle of yeast are well documented. Morphological changes and chemical regulators, called checkpoints, are just a few examples of well-studied intricacies of the cell cycle. In the *Saccharomyces cerevisiae* cell cycle, morphological changes distinguish the various stages. A requirement for these changes is a change in function of certain proteins. From the central dogma of gene expression, one might expect that these protein changes are a result of mRNA accumulation or degradation. In 1981, Hereford discovered that certain mRNAs vary in their concentration throughout the cell cycle (Hereford *et al*, 1981).

How does this periodical variation of mRNA amounts occur? Control of mRNA concentration can occur through either changes during transcription in the nucleus of the eukaryotic cell or through accumulation of mRNA. Changes in these factors can cause changes in the amount of mRNA available for protein production. We are interested in the contribution of mRNA decay to gene expression. One pathway for this occurrence is the nonsense mediated mRNA decay (NMD) pathway. This pathway eliminates mRNA with premature nonsense codons and, either directly or indirectly, decays the mRNA before an aberrant protein can be formed.

Ten genes have been selected based on their tendency to follow the NMD pathway: six genes that affect telomere function, and four genes that affect kinetochore function. It is my goal to determine which, if any, have cell cycle restricted mRNA expression. Another goal will be to determine if NMD causes a direct of indirect effect.

SENINGEN, JUSTIN. Investigating organic pollutants in the Cannon River. (advisor Paul Jackson)

In recent years, trace levels of human pharmaceutical residues have been discovered in freshwater and some of the biological impacts have been subsequently researched. A pharmaceutical pollution profile of the Cannon River (Southeastern Minnesota) has not been made; this work starts the process. One-Liter samples were collected in amber glass bottles 15cm below the river surface, both 1500m upstream and downstream of the Northfield Wastewater Treatment Facility (NWWTF). An aliquot of each sample was filtered through Pyrex Buchner funnels and then extracted through 3M Empore™ cartridges. Extracts were analyzed using High Performance Liquid Chromatography (HPLC) and compared with HPLC data from laboratory standard samples. Caffeine was identified in the river in the 500-1000 parts-per-trillion concentration range. The sample downstream of the NWWTF showed a caffeine concentration higher than the upstream

sample by a factor of 1.51. Caffeine is an indicator of pharmacological contamination, hence other anthropogenic organic pollutants likely exist in the river.

SMITH, REBECCA. Is fluctuating asymmetry a useful tool for evaluating rare plant populations? (advisor Joel Olfelt)
Fluctuating asymmetry (FA) is increasingly used as an indicator of genetic and environmental stress in animals, but it is not often used in plant populations. We tested the correlation of FA in three populations of the rare and endangered plant, Leedy's roseroot (*Sedum integrifolium* ssp. *leedyi*), with demographic and genetic indicators in the same populations. Leaves were collected from plants growing in the field and from plants established from seeds growing in a common garden experiment. Leaves were measured for total FA, and total FA was compared to the demographic and genetic indicators of stress. The population that showed the lowest rate of flowering and lowest genetic variability, Whitewater Wildlife Management Area, showed the highest levels of asymmetry in both the field-collected and common garden leaves. Our conclusion is that there is a correlation between high levels of FA and high levels of genetic and environmental stress in a population.

STEFFEN, JOSH. Yeast elongation factor 1A, eEFIA, bundles mutant yeast actin. (advisor Kim Kandl)
My research has focused on elucidating the interaction between mutant actin (amino acids 80 and 81 are changed from aspartic acid to alanine) and elongation factor 1A (eEF1A) with a goal of improving our understanding of the role of actin in translation. To do this, I purified mutant actin and then used the mutant actin in cosedimentation assays. Under standard conditions the mutant actin pelleted on its own in cosedimentation assays; therefore, I sought suitable conditions for conducting successful biochemical assays with the mutant actin and eEF1A. My results show that HEPES pH 7.2 is an appropriate buffer for these assays; the mutant actin in the presence of eEF1A was bundled in a manner similar to wild type actin under the same conditions. To determine whether the mutant actin binds to eEF1A with greater or lesser affinity than wild type actin, I increased the salt concentration used. I found that mutant actin and eEF1A interact at concentrations of 100 mM NaCl and that preliminary results show that wild type actin and eEF1A do not interact at this salt concentration. Therefore, mutant actin may have a greater affinity for eEF1A than the wild type actin.

TEREBOVA, EKATERINA. Unlocking the secrets of phospholipase A2 activity based on the ionic strength dependence. (advisor Mary Walczak and Anne Walter)
Phospholipase A_2 cleaves phospholipids at the sn-2 fatty acyl bond, yielding fatty acids and lysolipids. PLA_2's activity was studied by the change of fluorescein-phophatidylethanolamine fluorescence in phospholipid vesicles. The activity of PLA_2 depends on calcium concentration. It is thought to bind with higher affinity to negatively-charged surfaces. The main experiments in this study concerned varying $[Ca^{2+}]$ lipid substrate and the presence or absence of salt, i.e., the ability of charges to detect each other. In particular, PLA_2's structural changes were monitored in the presence of high and low sodium and calcium concentrations using ANS fluorescence. The rates of PLA2 reactions with 50/50 and 25/75 PC/PS vesicles were detected and

evaluated versus the [Ca^{2+}]. Also, the F-PE assay was explored. A standard curve of F-PE fluorescence intensity as a function of mol% oleic acid+lysoPC incorporation in the vesicles was prepared. The excitation wavelength dependence was studied and found that the F_{495}/F_{460} ratio changed with product accumulation.

In conclusion—precision, understanding and fundamental knowledge of the assay is critical to the entire PLA2 project. For the study of ionic strength dependence and concentrations of the system's constituents are crucial to the detection of the system itself.

TOLLERUD, HEATHER. Analysis of molecular beam spectrometer data; a better understanding of Rubidium. (advisor: Jim Cederberg, David Nitz, Duane Olson) with Molecular Beam Spectromter group M. Bongard, E. Frodermann, and K. Huber

This summer the St. Olaf Molecular Beam Spectrometer group studied rubidium compounds in the alkali-halide series. The Molecular Beam Spectrometer, or MolBeam, examines molecules by looking at hyperfine transitions, transitions between quantum states which occur in the radio frequency range. Using the results from the spectrum of two common isotopes of rubidium with fluorine and applying several new constants which have a more reasonable physical basis, the Molbeam group made some preliminary improvements in the ratio between the the two Rb isotopes. These results are an improvement over data collected by previous MolBeam groups and will make analysis of Rb compounds more accurate in the future.

VOLKERS, PHILLIP. Developing a GC-MS instrument resource for environmental, analytical, and clinical applications. (advisor: Paul Jackson)

The separation and identification of a mixture of compounds constitutes an active area of science and is the vital basis to accurate drug testing. A staple instrument used for such purposes is the Gas Chromatograph-Mass Spectrometer, or GC-MS. My work this summer has involved setting up such instruments for the chemistry department and subsequently testing their qualitative and quantitative abilities for drug analysis.