

In Celebration of Academic  
Achievement for Undergraduate  
Students at the University of  
Vermont!



Wednesday, April 11, 2007  
1:30 - 4 PM  
Billings North Lounge

Planned, coordinated and hosted by the UVM McNair Scholars Program.  
Sponsored by the Office of the Provost, the Office of the Vice President for  
Research & Graduate Studies, and the Living / Learning Center.



## **SURF UVM 2007 Student Participants: Abstracts follow**

### **John Austin**

Anthropology Major '07, UVM McNair Scholar, Mentor: Jennifer Dickinson

Poster Title: *Japanese Language and Gender Convergence Theory*

### **Lynn Baker**

Radiation Therapy Major '08, Independent Researcher, Mentor: Ahmad Chaudhry

Poster Title: *Assessment of Genomic DNA Methylation in Human Cells Exposed to Ionizing Radiation*

### **Mike Bower**

Environmental Science major '07, A&S Senior Thesis, APLE, Mentor: Gregory Druschel

Poster Title: *Quantifying Arsenic Speciation in Natural Waters Using Gold and Glassy Carbon Microelectrodes*

### **Mandy Cheung**

Radiation Therapy Major '08, Independent Researcher, Mentor: George Osol

Poster Title: *Immunohistochemistry of VEGF receptors R1 and R2 in the Uterine Circulation*

### **Chase Collins**

Classics Major '07, A&S College Honors, Mentor: Barbara Taylor-Rodgers

Poster Title: *The Theban Sacred Band: A Symbol of Fourth-Century Millitary Innovation*

### **John Contompasis**

Biology Major '09, Interdisciplinary Math & Bio Program, URECA, Mentor: Jim Vigoreaux

Poster Title: *Biomechanical Comparison of Wild-Type and Flightin-Null Thick Filaments from Drosophila Flight Muscle*

### **Amanda Daly**

Environmental Science '07, John Dewey Honors, A&S Honors, HELiX, Mentor: Sara Helms Cahan

Poster Title: *Can Larval Metabolic Rates Explain Colony Growth Rate Differences Among Harvester Ant Species?*

### **Lee Dorf**

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Poster Title: *Sulforaphane is cytotoxic to neuroblastoma both in vitro and in vivo*

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Poster Title: *Sulfur-Utilizing Bacteria in the Frasassi Cave System, Italy*

### **Virginia Foster**

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Poster Title: *Folk Divination Customs in Contemporary Czech Culture*

### **Lauren Gilligan**

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### **Willow Holden**

Classics & English Major '07, McNair Scholar, Mentor: Wolfgang Mieder

Poster Title: *Awakening Sleeping Beauty An Exploration in Theme, Interpretation, and History*

### **Jaime LeClerc**

Nutrition Science '08, McNair Scholar, HELiX, Mentor: Feng Qi Zhao

Poster Title: *Effect of Omega-3 and Omega-6 Polyunsaturated Fatty Acids on Glucose Transporter Expression in Breast Cancer Cells*

### **Song Nguyen**

Human Development & Family Studies Major '08, McNair Scholars, Mentor: Cynthia Gerstyl-Pepin

Poster Title: *No Child Left Behind: Poverty and Achievement Inequity in Burlington, Vermont*

**Henrietta Oakley**

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Poster Title: *Effects of Altered Temperature and Summer Precipitation on Microbial Activity in Soils Associated with Biological Crusts*

**Kevin O'Connor**

Biology Major '07, APLE, Ronald Suiter Award, Mentor: Sara Helms Cahan

Poster Title: *Primary Polygyny in the Desert Seed-Harvester Ant, *Messor pergandei**

**Anna Olson**

German & European Studies '07, Independent Researcher, Mentor: Dennis Mahoney

Poster Title: *The 2006 World Cup as a Crystallization Point for Renewed National Pride in Germany*

**Haddon Pantel**

Biology Major '07, APLE, College Honors, HELiX, Mentor: Judith VanHouten

Poster Title: *The role of PKA in chemoresponse to glutamate in Paramecium*

**Jessica Pearson**

Biology Major '08, Independent Researcher, Mentor: Douglas Johnson

Poster Title: *The effects of Inhibitory Small Molecules on Bio film Formation in Candida albicans*

**Nicole Podnecky**

Microbiology '07, CALS DUR Project, Mentors: Doug Johnson and Joyce Oetjen

Poster Title: *Validation of the Real-Time PCR Diagnostic Assay for Bordetella pertussis*

**Kesha Ram**

Natural Resources & Political Science '08, McNair Scholar, Udall Scholar, Truman Scholar

Mentor: Clare Ginger

Poster Title: *Case Studies of State and Local Environmental Justice Policy in California and Vermont*

**Christopher Rivard**

Dietetics Major '07, Bickford Keystone Award, Mentor: Stephen Pintauro

Poster Title: *Development and Evaluation of an Advanced Nutrition Virtual Learning Environment*

**Calsey Rowell**

Biology Major '07, College Honors, HELiX, URECA, Mentor: C. William Kilpatrick

Poster Title: *The Aging of Little Brown Bats *Myotis lucifugis* by Telomere Length*

**Natasha Sadoff**

Environmental Studies '07, URECA, Mentor: Saleem Ali

Poster Title: *Local Environmental & Community Stability: A Case Study of les Abricots, Haiti*

**Eugene Scharf**

Post-Bacc Premed '07, HELiX, Mentors: Victor May and Yang Mao-Draayer

Poster Title: *PACAP Family Neuropeptide effects on murine neural stem cell proliferation and differentiation*

**Lydia Smith**

Geology Major '07, Hawley-Mudge Scholarship, Mentor: Gregory Druschel

Poster Title: *Geochemical Sulfur Cycling at Meromictic Green Lake, NY*

**Alea Tuttle**

Environmental Science '08, Independent Researcher, Mentor: John Todd

Poster Title: *Utilization of Economically Significant Crops in the Design of a Municipal Waste Water Treatment Facility and Education Center in Zanzibar, Tanzania*

**Vasilis Varsakopoulos**

Business Administration '10, Independent Researcher, Mentor: Christopher Huston

Poster Title: *In Vivo expression of fluorescent proteins in anaerobic *Entamoeba histolytica**

**Laura Vogric**

Political Science and French Double Major '08, Independent Researcher, Mentor: Emily Manetta

Poster Title: *Scrambling in Hindi-Urdu*

## **John Austin**

Anthropology Major '07, UVM McNair Scholar

Future Goals: MBA and PhD in linguistic anthropology

Hometown: Houston, Texas

About John: He spent 2 years in Japan and speaks Japanese. He's played jazz for 12 years and is the vice-president of UVM Tae Kwon-Do.

Mentor: Jennifer Dickinson

Poster Title: *Japanese Language and Gender Convergence Theory*

Abstract: Through research such as Laura Miller, Yoshiko Matsumoto, and Benedict Anderson, it has been argued that a convergence between the genders for Japanese speakers has occurred during the past 20 years. Japanese definition of femininity is evolving but not necessarily outwardly towards hyper-traditional femininity. Instead we see examples of how women have begun to incorporate masculine tagged phrases and incorporate them into their own speech patterns. Gender language in Japanese society are merging, creating different standards for what is considered feminine and what in turn is created masculine. Through this change we can observe the way that people's concepts of societal norms are changing. Japanese language standards can actually indicate the cultural shift between the minimizing disparities between Japanese men and women. In my poster presentation I plan to present data about how overseas Japanese nationals are affected, if at all, by this transition to more neutral terms. By interviewing local Japanese immigrants, and by analyzing their sentence structure and use of language I will impart my findings the way that Japanese men and women who immigrated to the United States use their language to perform gendered identities. I believe that due to the foreign conditions that the Japanese find in the United States that the Japanese living in the United States will actually exhibit less gendered ways of speaking. The study will be conducted around 15-20 people. In this way they can assert their solidarity between the two genders which would not usually be witnessed in Japan. Due to the environment, where few Americans are able to relate culturally to those who immigrated, men and women will find more stability in their co-patriots through less gendered forms of speech. Testing of this theory through my research and determining actual Japanese linguistic patterns in relation to gendered stylistic sentence final particles employed will be presented on the poster.

## **Lynn Baker**

Radiation Therapy Major '08, Independent Researcher

Future Goals: To receive an MD in Radiation Oncology

Hometown: Cheshire, Connecticut

Mentor: Ahmad Chaudhry

Poster Title: *Assessment of Genomic DNA Methylation in Human Cells Exposed to Ionizing Radiation*

Abstract: DNA methylation is indisputably one of the most important epigenetic events contributing to human carcinogenesis. The genomic methylation changes that occur in cancer cells following radiation therapy are not known. We hypothesized that ionizing radiation alters genomic methylation pattern. To test this hypothesis we assessed the ionizing radiation-induced changes in the genomic DNA methylation in human cancer cells exposed to ionizing radiation. The cells were harvested at 4, 8, 12 and 24 hours after exposure to 3 Gy of  $\gamma$ -radiation, along with a 0 and 24 hour control shams. The DNA was isolated from these cells and subjected to methylation sensitive and methylation resistant restriction enzymatic digestion. We employed combinations of specific restriction enzymes; *RsaI* (to generate shorter DNA fragments), *RsaI* + *HpaII* (methylation sensitive) and *RsaI* + *MspI* (methylation resistant). The DNA samples were subjected to methylation specific PCR amplification using a methylation-sensitive arbitrarily primed polymerase chain reaction (AP-PCR). The PCR amplification products from methylation sensitive and methylation resistant DNA samples from irradiated to control cells were compared to examine the methylation alterations. These studies will lead to a better understanding of radiation therapy in the treatment of cancer.

## **Mike Bower**

Environmental Science major '07, A&S Senior Thesis, APLE

Future Goals: Graduate Studies, location undecided

Hometown: Francess town, New Hampshire

Mentor: Gregory Druschel

Poster Title: Quantifying Arsenic Speciation in Natural Waters Using Gold and Glassy Carbon Microelectrodes

Abstract: The release of arsenic from arsenic-bearing aquifer sediments is one particular contaminate that has polluted more than three million wells and has had major impacts on around 70 million people in Bangladesh (Lepkowski, 1999). This project has focused on new, and potentially improved, methods of quantifying arsenic

levels *in situ* and under acidic conditions. This analytical research project uses a voltammetric method, which involves a three-electrode system consisting of a working, reference, and counter electrode to voltammetrically quantify specific chemical species. The new microelectrodes being evaluated have been gold (Au) and glassy-carbon electrodes. The construction of the microelectrodes has been a major component of the research process, contributing new results to chemical detection, especially for arsenic. The gold electrodes have shown to be responsive in the detection of not only As<sup>III</sup>(OH)<sub>3</sub>, but other complexes, including potentially As(V) which has previously been shown to be electro-inactive (Kumaresan and Riyazuddin, 2001). The glassy-carbon electrodes have not been responsive to As(III) at neutral pH's, but further investigation with the microelectrodes at lower pH's and with different chemical species present, such as Fe(II) and Fe(III), is currently under investigation. The development of new methods and instruments to investigate arsenic chemistry and its interactions with other chemical species, which have a major role in arsenic mobility, such as iron and sulfur, will contribute to a better understanding of environmental arsenic chemistry. Through better understanding of arsenic *in situ*, it will help to combat arsenic poisoning, and recognize contaminants in human water sources to minimize health concerns surrounding a necessary resource that is consumed daily.

## **Mandy Cheung**

Radiation Therapy Major '08, Independent Researcher

Future Goals: Medical school

Hometown: Sharon, Massachusetts

About Mandy: Would like to travel to a 3rd world country and put her education to good use

Mentor: George Osol

Poster Title: *Immunohistochemistry of VEGF receptors R1 and R2 in the Uterine Circulation*

Abstract: VEGF (Vascular Endothelial Growth Factor) and PlGF (Placental Growth Factor) belong to a family of angiogenic growth factors involved in vascular regulation and homeostasis. Receptors of this angiogenic family are known as VEGFR-1 and VEGFR-2. VEGF is known to bind with receptors VEGFR-1 and VEGFR-2 to initiate a cascade of other signals leading to vasodilation, vessel enlargement, as well as remodeling of the systemic vasculature. Studies from other laboratories have suggested that aberrations in VEGF and PlGF signaling may be involved in pathologic conditions such as cancer and pre-eclampsia. This project is designed to determine the location of VEGFR-1 and VEGFR-2 through immunohistochemistry and imaging techniques. Tagging the receptors with specific primary antibodies that are able to respond to a second fluorescent antibody will allow a clear indication of where the locations of the receptors are. Images obtained will define the location of receptors VEGFR-1 and VEGFR-2. Further studies will then be performed based on results. To understand the roles PlGF and VEGF play in pregnancy, it will be helpful to determine which cells VEGFR-1/VEGFR-2 reside: endothelial cells found in the tunica intima versus smooth muscle cells found in the tunica media. This information will help doctors understand how to promote vasculature growth without PlGF to maintain a normal pregnancy.

## **Chase Collins**

Classics Major '07, A&S College Honors

Future Goals: Masters in Education then a PhD

Hometown: Chester, Vermont

Mentor: Barbara Taylor-Rodgers

Poster Title: *The Theban Sacred Band: A Symbol of Fourth-Century Military Innovation*

Abstract: This project is a study of the Theban Sacred Band, a regiment in the Boiotian military, made up of 150 pairs of male lovers. In the beginning of its formation it acted as the "cutting edge" of the frontline of the Boiotians' army, and later became a mobile tactical unit for special maneuvers during battle. The military actions of the Theban Sacred Band were used in various ways for 44 years from 382 BCE – 338 BCE; their importance is not only represented in their defeat of Sparta, whose military dominance over the past two centuries was unmatched, but also in Theban hegemony. In what context should we view their creation, how did they move of the battlefield, in what way was the Sacred Band equipped, and how do they represent fourth-century Greek culture? This project attempts to answer these questions by positing the Theban Sacred Band as a paradigmatic representation of fourth-century Greek culture and sexuality, politics, and military tactics. I primarily used the ancient sources, among which I found five authors who discuss the wars and battles the Sacred Band was involved in: Pausanias, Plutarch, Xenophon, Diodorus Siculus, and Polyaeus; also, I have found inscriptions and brief passages in Greek that may have useful information. After making my own conclusions on the subject, I consulted the secondary sources on the history of Greek military tactics, pedagogy and pederasty, homosexuality in the military, and the philosophical and educational importance represented by the Sacred Band. It was paramount for my research to include the Carthaginian Sacred Band and the mythological significance of the Myrmidons in Homer's *Iliad*. I have concluded that the Theban Sacred Band was deployed in conjunction with a cavalry unit: the horsemen broke the line, while the Sacred Band, following

close behind, entered the gaps. The Sacred Band was designed by Gorgidas in a time of much political upheaval, and created for the purpose of defending the Cadmea at Thebes once the Spartan garrison had left. The Sacred Band was also lightly armed so as to move quickly across the battlefield and keep pace with the cavalry whom they were tailing. The Theban Sacred Band equipped themselves in a similar fashion to other light-armed troops, and wore a Boiotian helmet similar to that of the cavalry. I have also found that there was a close relationship between the terms used for the Sacred Band and chariots or horsemen, for in each pair there were two names given: the charioteer and the crewman.

### **John Contompasis**

Biology Major '09, Interdisciplinary Math & Bio Program, URECA

Hometown: Burlington, Vermont

About John: a sophomore in the Honors College and member of the Varsity Track team

Mentor: Jim Vigoreaux

Poster Title: *Biomechanical Comparison of Wild-Type and Flightin-Null Thick Filaments from Drosophila Flight Muscle*

Abstract: Insect Indirect Flight Muscle (IFM), responsible for wing movement, is widely considered among the most powerful muscles in the animal kingdom. The power output of the IFM is reliant on the wing beat frequency and the stiffness of the flight system (cuticle and flight muscles). *Drosophila* IFM contains flightin, a myosin rod binding protein that we hypothesize contributes to thick filament stiffness and high power output. We compare thick filaments from wild-type flies to thick filaments from mutant flies lacking flightin (*fln0*) to determine differences in stiffness. Atomic Force Microscopy is used to image the thick filaments under physiological conditions. From these images, persistence length values can be calculated to quantify the stiffness of these filaments. A comparison of the wild-type and *fln0* thick filaments will show if flightin is increasing the stiffness of these components of the IFM.

### **Amanda Daly**

Environmental Science '07, John Dewey Honors, A&S Honors, HELiX

Future Goals: Ecology, Evolution or Behavioral Ecology

Hometown: Moretown, Vermont

About Amanda: She's involved with WRUV 90.1FM

Mentor: Sara Helms Cahan

Poster Title: Can Larval Metabolic Rates Explain Colony Growth Rate Differences Among Harvester Ant Species?

Abstract: High growth rate can increase a social insect colony's ability to dominate natural resources, significantly increasing its fitness in environments where these resources are limited. Several species of *Pogonomyrmex* harvester ant of interspecific hybrid origin tend to have higher colony-level growth rates than their parent species. Such differences may be caused by differences in larval metabolic rates. I measured the metabolic rates of individual larvae from the two parental species, *P. rugosus* and *P. barbatus*, and four species of hybrid origin, H1, H2, J1 and J2. Flow-through respirometry was used to measure metabolic rate as the amount of carbon dioxide larvae produced per unit time. No significant differences in larval metabolic rate were found between species, and no overall difference between hybrid versus parental groups could be detected. Therefore, any colony growth rate differences between these species must be due to some other factor, such as the queens' egg-laying rate, the proportion of eggs that successfully develop to adults, the time that offspring spend in each stage of development, or the final size of offspring produced.

### **Lee Dorf**

Biological Sciences Major '09, Independent Research at the VT Cancer Center

Future Goals: Medical school

Hometown: Bronx, New York

About Lee: Has been working on neuroblastoma research since January 2006

Mentor: Giselle Sholler

Poster Title: *Sulforaphane is cytotoxic to neuroblastoma both in vitro and in vivo*

Abstract: Neuroblastoma (NB) is a tumor which grows aggressively, metastasizes, and is resistant to multimodal therapy. Developments of novel therapeutic strategies are needed. In search of safe therapeutic agents for the pediatric population, we screened dietary derived sulforaphane for in vitro and in vivo cytotoxicity to neuroblastoma cells. To determine the cytotoxicity of sulforaphane to neuroblastoma cells in vitro and in vivo and to understand the signaling pathways involved in the mechanism of action of sulforaphane.

Design/Methods: NB cells SMS KCNR, SY5Y, SKNSH and IMR32 were treated with 0-100  $\mu$ M of Sulforaphane, for 48 hours. Cytotoxicity was assessed by MTS assay. Apoptosis was evaluated by DNA fragmentation analysis and by immunoblot analysis of caspases 3,8,9, PARP and Bcl-2. The signaling pathways were assessed by western blot analysis of MAPK p42/44, p38 and AKT. Xenograft models were used to investigate the effects of Sulforaphane on NB. Nude mice were injected with  $10^7$  SMSKCNR cells and fed food with or without 2mg of Sulforaphane daily for 28 days. The resected tumors were analyzed with immunohistochemistry stains Ki67, CD31 and neuron-specific enolase (NSE).

Results: Sulforaphane induces apoptosis in neuroblastoma cells SY5Y, SKNSH, SMSKCNR and IMR32. Apoptosis induced by Sulforaphane in SMSKCNR cells was confirmed by fragmentation of genomic DNA. Sulforaphane induced activation of caspase 9 (intrinsic pathway) and caspase-3. Sulforaphane lead to the inactivation of PARP-1 and decreased expression of Bcl-2. Sulforaphane reduced the phosphorylation of survival signaling mediated by ERK1/2 and AKT in a dose-dependent manner. The mice xenograft model showed a decrease in tumor proliferation and angiogenesis based on Ki67 and CD31staining respectively with treatment. Tumor weights showed no significant correlation with treatment but a decrease in NSE tumor marker and an increase in hemorrhage was found within the treated tumors.

Conclusions: Sulforaphane is a potent apoptotic drug which is cytotoxic to NB. Sulforaphane inhibits the survival and chemo-resistance signals AKT and ERK1/2. In vivo, sulforaphane decreases cellular proliferation and angiogenesis. Thus, safe phyto-pharmaceuticals such as Sulforaphane deserve further research as therapeutic agents for NB.

### **Danielle Eastman**

Geology Major '07, Barrett Scholarship, Hawley Mudge Foundation

Future Goals: Year off then graduate study in chemical cycling in the natural environment

Hometown: Woodsville, New Hampshire

Mentor: Gregory Druschel

Poster Title: *Sulfur-Utilizing Bacteria in the Frasassi Cave System, Italy*

Abstract: The Frasassi Cave System, located in the Marche Region of Central Italy, is forming in Jurassic aged Calcarea Massiccio limestone of the Apennine Mountains. Research on this karst system focuses on its sulfur chemistry and on the microbes that inhabit its aqueous sub-environments. Microbial communities of sulfur-reducing and sulfur-oxidizing organisms in the aqueous regions of the Frasassi caves, as well as on the walls and ceilings, are catalysts for the majority of the oxidation-reduction reactions involved in sulfur cycling through the caves. These reactions fuel sulfuric acid production and represent a biological feedback to sulfuric acid speleogenesis. Using electrochemical techniques, specifically voltammetry, we were able to identify the chemical differences between microbial communities. The comparison of a number of cave sites and ecosystems provides unique information to better understand the pathways through which sulfur is oxidized, the rate at which this happens, and the chemical parameters specific to each microbial niche. The understanding of chemical cycling through these simple aqueous environments can be applied to the investigation of sulfuric acid speleogenesis as well as to more complex environments.

### **Virginia Foster**

Anthropology Major '07

Mentor: Jennifer Dickinson

Poster Title: *Folk Divination Customs in Contemporary Czech Culture*

Abstract: This project investigates Czech cultural traditions that involve superstition and divination. The Czech Republic has gone through centuries of occupation and rule by foreign authorities, from the Austro-Hungarian Empire to Communist Russia. Today it has its own government and is in the process of entering fully into the European Union. Yet through all of this change, they have maintained a unique Czech identity and retained many of their cultural traditions. I am investigating how contemporary Czechs view these traditions and whether such traditions have been or are an integral part of the Czech identity in the past and today and whether this will affect their retention into the future. Using interviews of contemporary Czech populations in the Czech Republic as well as some in Burlington, Vermont, I am categorizing the customs I have collected and am conducting further analysis on them. I am using approaches from the disciplines of anthropology and folklore to guide my collection and analysis. The background research I have done on the various types of divination and fortune-telling traditions from around the world has provided insight in analyzing the customs I encountered in the Czech Republic. I have also conducted research in the general area of folklore, in order to apply current theory in folklore to this research. I am hoping to provide the scholarly community not only with a collection of these unique customs, but with an understanding of the attitudes towards them in contemporary Czech culture.

## **Lauren Gilligan**

Biology Major '08, Interdisciplinary Math & Bio Program, APLE, URECA

Future Goals: Medical school

Hometown: Rutland, Vermont

Mentor: Lori Stevens

Poster Title: *Microsatellites Reveal High Population Structure in a Chagas Disease transmission vector in Chuquisaca, Bolivia*

Abstract: *Triatoma infestans* is the most concerning transmission vector of *Trypanosoma cruzi*, a parasite that causes Chagas Disease. Chagas is the most important parasitic disease in the Americas, as it infects 16 to 18 million persons per year throughout Central and South America. Since there is no cure or vaccine, preventative infection measures are important to maintain by eliminating *T. infestans*. Information on the population genetic structure of *T. infestans* provides important information on how the vector is moving, thus targeting the sites of reinfestation after residual insecticide spraying. In this research, microsatellite markers were used to determine the population structure of *T. infestans* in Chuquisaca, Bolivia, where infection rates are high. A new method for simultaneously analyzing ten previously published microsatellite markers in a single PCR was created. In analyzing the microsatellite data of 230 *Triatoma infestans* a high population structure was revealed, meaning that the insects are colonizing. This information will help to target reinfesting colonies for spraying. Also, the methodology used here may be applied to further studies that contribute to reducing disease risk associated with this vector.

## **Willow Holden**

Classics & English Major '07, McNair Scholar

Future Goals: Graduate studies

Hometown: Saxtons River, Vermont

Mentor: Wolfgang Mieder

Poster Title: *Awakening Sleeping Beauty An Exploration in Theme, Interpretation, and History*

Abstract: Fairy tales have been widely distributed over the space of hundreds and hundreds of years. These tales provide children and adults with entertainment, hope, escape, and guidance. Originally, fairy tales were oral stories told to groups of listeners who probably interacted with the teller. The tales were constantly changing in detail, design, and use of symbol. However, it is doubtful that the narrations shifted much in meaning, due to the fact that these tales were constructed for a specific reason—in order to provide listeners with valuable information on various situations they would encounter within their lives. *Sleeping Beauty* is a fairy tale that has been passed down through many generations, evolving and growing with every generation that makes use of the tale. It is a story that is well known to children and adults, and yet has received little attention from folklore scholars. Unlike many fairy tales, *Sleeping Beauty*, or *Dornröschen* in German, is a tale with a fairly clear interpretation. This interpretation is generally accepted as relating to prepubescent and pubescent fears of the growing child and their parents. However, there are many layers within the story, and accepting only one interpretation would limit folklorists and what the tale itself can offer.

## **Jaime Leclerc**

Nutrition Science '08, McNair Scholar, HELiX

Future Goals: PhD

Hometown: Nashua, New Hampshire

About Jaime: Likes to play music in her own band named Eastern Blot

Mentor: Feng Qi Zhao

Poster Title: *Effect of Omega-3 and Omega-6 Polyunsaturated Fatty Acids on Glucose Transporter Expression in Breast Cancer Cells*

Abstract: Omega-3 polyunsaturated fatty acids (PUFA), mainly eicosapentanoic acid (EPA) and docosahexaenoic acid (DHA), are shown to play a significant role in suppression of cancer development, especially breast cancer (1-10). Inhibition of omega-3 fatty acids on breast cancer growth have been observed both *in vivo* and *in vitro* (2,11). In a recent study, both chemically-induced and transplanted breast tumors in rats showed a decrease in development as a result of omega-3 PUFA supplementation (11). Schley et al. showed a significant reduction in viable cells in a breast cancer line, MDA-MB-231, after treatment with omega-3 PUFA: 65% decrease by DHA treatment and 40% decrease by EPA compared to linoleic acid treated cells (10). Even though omega-3 PUFA have a detrimental affect on breast cancer cells, the molecularly similar omega-6 PUFA have an antagonistic affect compared to omega-3 PUFA on breast tumors by promoting growth of cancer cells. The primary human omega-6 PUFA, arachidonic acid, and has been shown to increase the mitogenic activity of breast cancer cells.<sup>4</sup> In conjunction, omega-3 PUFA and omega-6 PUFA may “directly and indirectly contribute to modulate functional parameters at the cellular level, such as receptor function, ion channels and gene expression” (4). As



a result of such interwoven yet competitive activity of the omega-3 and omega-6 PUFAs, it has been found that the ratio of omega-3 PUFA to omega-6 PUFA will greatly influence any biochemical consequences.

### **Song Nguyen**

Human Development & Family Studies Major '08, McNair Scholars

Future Goals: Graduate study in qualitative research for social change

Hometown: Essex, Vermont

Mentor: Cynthia Gerstl-Pepin

Poster Title: *No Child Left Behind: Poverty and Achievement Inequity in Burlington, Vermont*

Abstract: The concern for America's educational system continues to be a ceaseless matter, especially for our neediest children in disadvantaged schools. But, what influence do federal regulations like the No Child Left Behind Act have on our country's educational system? The No Child Left Behind Act (NCLB), of 2001, is a federal law which grants money to public schools, targeted to assist children from disadvantaged backgrounds in their academic standing. Though the NCLB Act attempts to foster schooling for underrepresented, low-income children, many children continue to be left behind in our educational system. Are disadvantaged children in low-income schools being chastised with this federal law? Could policies like NCLB be more punitive than helpful? Through semistructured interviews with members of the Burlington Equity Task Force and other Burlington community members, perceptions of the NCLB Act became more apparent. The main objective was to explore how NCLB influences our educational community of Burlington. Focusing largely on the two main underprivileged schools in the community, the realism and biases of the NCLB Act truly became overwhelming. Though federal administration of NCLB exists to be a complex debate, concerns at the local level expanded into the Burlington Equity Task Force. Comprised of a team of community members, the Burlington Equity Task Force functioned as compassionate people who truly strive to acknowledge the community concerns and strengthen our educational system, at the local level.

### **Henrietta Oakley**

Environmental Science Major '08

Hometown: Cambridge, Massachusetts

Mentor: Deborah Neher

Poster Title: *Effects of Altered Temperature and Summer Precipitation on Microbial Activity in Soils Associated with Biological Crusts*

Abstract: The purpose of this study was to determine the effects of climate change – an increase in temperature, precipitation, or both – on microbial activity in soils covered by biological crusts. Soil crusts are composed primarily of cyanobacteria, lichens, mosses and algae. These crusts play a critical role in physically stabilizing soil, and they provide a Nitrogen source for the vascular plants that inhabit the arid soils of the Colorado Plateau Desert. Changes in climate will be detrimental to the function of these fragile biological systems. Activity of eight extracellular enzymes was quantified to estimate the decomposition potential of each particular substrate, including amino acids, urea, cellulose, and lignin. The response of each substrate to the various conditions will provide insight on the decomposition process and how it will be altered as a whole. The effects of increased precipitation alone caused the greatest variance from the control in six of the eight substrates; activity increased and decreased based on both the sampling date and the substrate. Phenol oxidase and peroxidase – two lignin decomposers – showed an increase in activity with precipitation treatment for the first sampling date in March 2006, while all other substrates showed dramatic decreases in activity for the same time and treatment. Increase in temperature and increase in both temperature and precipitation led to some variation from the control, but this may have been due to sampling methods and experimental variation. The depth of the soil sample greatly affected the resulting biological activity; shallower samples (0-2 inches) had more activity than deeper ones (2-5 inches), but the impact of climate change on various depths is yet to be determined. There was much greater variation between treatments for samples taken in the spring, and very little variation between all treatments for samples taken the following fall; almost a year after the experiment began. The activity may be dependent on natural weather cycles, and continuation of this study will allow us to separate variation associated with season compared to permanent climate change.

### **Kevin O'Connor**

Biology Major '07, APLE, Ronald Suiter Award

Hometown: Brattleboro, Vermont

Mentor: Sara Helms Cahan

Poster Title: *Primary Polygyny in the Desert Seed-Harvester Ant, *Messor pergandei**

Abstract: Living in a social group can be both beneficial and costly for individuals, sometimes leading to social dominance and even lethal fighting. The desert seed-harvester ant *Messor pergandei* has long been used as a model system to study the adaptive value and dynamics of cooperation among queens during colony foundation. Previous studies in central Arizona suggested that young queens from cooperatively founded (pleometrotic) colonies always become aggressive soon after the colony is established, ultimately reducing to a single surviving queen. However, queens sampled from western Arizona and eastern California are significantly smaller in size, form much larger founding groups, and fail to show aggression in laboratory colonies, which together suggest that the queen aggression originally described may not occur in all pleometrotic populations. We tested whether multiple queens were retained past colony initiation in a western Arizona population by using microsatellites to determine if male and worker nest-mate genotypes were consistent with a single or multiple queens. Our analysis suggests that fatal queen fighting does not always occur, but rather pleometrotic queens from this area appear to coexist peacefully, sharing the colony and reproductive resources, a condition known as primary polygyny. The existence of geographic variation in aggressiveness among co-founding queens following worker emergence provides a unique comparative system to study the costs and benefits of social aggression.

### **Anna Olson**

German & European Studies '07, Independent Researcher

Future Goals: 6-month internship with an international company in Germany then graduate study in European history and language

Hometown: Manchester, New Hampshire

About Anna: She studied abroad in Augsburg, Germany for a full year and worked in the city tourism office during the 2006 Soccer World Cup

Mentor: Dennis Mahoney

Poster Title: *The 2006 World Cup as a Crystallization Point for Renewed National Pride in Germany*

Abstract: "Was ist deutsch?" "What is (typically) German?" In no other developed nation do people ask themselves the questions "Who are we?" and "What are we?" as frequently as in modern Germany. The cultural and political region that is known today as Germany has been one of the greatest contributors to Western culture, but is also the inheritor of a difficult history. Germany struggles today to define its own culture and be proud of it at the same time. The ghost of National Socialism lingers in public and private memory and remains the primary factor with which most outsiders identify Germany. As for Germans themselves, while regional and cultural patriotism are more readily accepted, to express pride in being German means to draw upon associations with aggressive nationalism, racism, and blind submission to authority. Yet today, many factors challenge previously held notions of what it means to be German: the reunification of East and West Germany in 1990, shifting demographics, Germany's membership and leading role in the European Union, and globalization in general. Over the past several years, a steady series of cultural phenomena such as films, pop music, and ad campaigns have appeared that suggest Germans are desperate to define a national pride of their own in the midst of all this change. Above all, it is young Germans who are in the middle of these more recent developments. As the future leaders of their country and as the primary consumers of popular culture, it is ultimately they who will define patriotism for a new Germany. No phenomenon of recent years has expressed the German search for identity quite as graphically as the 2006 World Cup soccer championship in 2006. During this time, the general mood in Germany could be described as no less than a national euphoria. The foreign and national media coverage pointed consistently to a positive new mood among the normally reserved Germans, especially among the young people, who were doing much of the celebrating. Energetic participation in watching the games, the display of the German national flag on everything from bodies to houses to cars to flowerpots, as well as openly displayed pride for the national team and the singing of the national anthem, attracted a great deal of attention. This behavior came to be called "party patriotism." Once the games were over, the flags all but disappeared from every surface they had adorned, and the normal pattern and concern of everyday life returned. Nevertheless, a number of major media organs continue to feature discussions on an emerging new German patriotism. Such discussions are by no means a recent phenomenon; the need to define what is German has in fact been around for centuries in various forms and expressions. The World Cup has above all served as a *crystallization point* for these discussions because, more than any other factor, this mass sporting event has brought questions about patriotism into mainstream culture, stressing the importance of reconciling national unity within the greater context of the European Union.

### **Haddon Pantel**

Biology Major '07, APLE, College Honors, HELiX

Hometown: Windsor, Vermont

Mentor: Judith VanHouten

Poster Title: *The role of PKA in chemoresponse to glutamate in Paramecium*

Abstract: The purpose of my proposed research is to investigate the role of protein kinase A (PKA) in the glutamate chemoresponse pathway in *Paramecium tetraurelia*. My hypothesis, which will be tested by my research, is that the binding of L-glutamate to cell surface receptors begins a chemical transduction pathway that will lead to PKA phosphorylation of K<sup>+</sup> channels and calcium pumps. This phosphorylation results in hyperpolarization of the cell through increased efflux of K<sup>+</sup> through ion channels and through activation of plasma membrane calcium pumps. I will be testing the first part of this hypothesis that the catalytic subunit of PKA (PKAc) is part of the glutamate chemoresponse pathway. There is preliminary evidence from our lab that there is a rapid rise in intracellular cAMP when *Paramecium* are stimulated with glutamate. When *Paramecium* are treated with a kinase inhibitor attraction to glutamate is blocked, and no other attraction is effected. I purpose to investigate whether the kinase involved in glutamate response is PKA because there can be alternative mechanisms for cAMP to act as a second messenger other than through PKA.

### **Jessica Pearson**

Biology Major '08, Independent Researcher

Hometown: Gorham, New Hampshire

Mentor: Douglas Johnson

Poster Title: The effects of Inhibitory Small Molecules on Bio film Formation in *Candida albicans*

Abstract: *Candida albicans* is a pathogenic yeast, with virulence that may be attributed to a morphological transition from budded-to-hyphal form. The hyphal form is essential for biofilm formation, which allows the yeast cell to bind and infect the host cell. *C. albicans* is usually a commensalistic organism, but in individuals with suppressed or compromised immune systems this yeast can cause fungal infections. Inhibitory small molecules identified in previous research have been shown to inhibit the budded-to-hyphal-form transition. Preliminary testing, using a 96-well format with these molecules, has shown that biofilm formation is indeed inhibited in the presence of these molecules. However, there has been difficulty with growing biofilms in the originally selected Calgary Biofilm Device, thus additional research will be done with a silicone filter device to study biofilm formation and inhibition.

### **Nicole Podnecky**

Microbiology '07, CALS DUR Project

Future Goals: PhD Program at Colorado State in microbiology

Hometown: Bridgewater Corners, Vermont

Mentors: Joyce Oetjen and Doug Johnson

Poster Title: *Validation of the Real-Time PCR Diagnostic Assay for Bordetella pertussis*

Abstract: *Bordetella pertussis* is the etiological agent of whooping cough, a dangerous and extremely contagious respiratory illness. Current diagnostic techniques are lacking, we are in the process of validating Real-Time PCR as a diagnostic tool. This process is necessary before real-time PCR can be used to diagnose patients in Vermont. Currently bacterial culture is used; it is 100% specific, but only 39% sensitive. This is because sample collection is difficult, as *B. pertussis* is only found on the ciliated epithelial cells of the nasopharynx, viable bacteria must be present on the sample, and *B. pertussis* is a finicky organism to culture. Culture technique takes 4-7 days to get results and, with such a contagious disease, it is important to diagnose cases quickly.

### **Kesha Ram**

Natural Resources & Political Science '08, McNair Scholar, Udall Scholar, Truman Scholar

Future Goals: Law school for environmental / civil rights at Stanford or Berkeley

Hometown: Los Angeles, California

Mentor: Clare Ginger

Poster Title: *Case Studies of State and Local Environmental Justice Policy in California and Vermont*

Abstract: The environmental justice movement in the United States embodies the intersection between human health and the environment, identifying the greater harm suffered by low-income and minority citizens because of their disproportionate proximity to polluting facilities and lack of political and financial wherewithal to improve their situation. After gathering momentum from the first documented case of environmental injustice in 1982 to the National People of Color Environmental Leadership Summit in 1991, the movement gained a lot of clout when President Clinton put Executive Order (EO) 12898 into effect early in his presidential career. This EO was a big step for the federal government toward improved infrastructure and increased awareness in dealing with environmental injustice. However, as all levels of government implemented policies, obstructions to environmental equity arose. Title VI of the Civil Rights Act was a useful tool in environmental justice litigation, but it has since been nullified by certain high-profile federal court rulings. Some state and local governments picked up where the federal government left off, strengthening their environmental administrations and creating justice policies unique to their situation, while other states have done little to enforce and uphold the mandates

of Clinton's EO. California is among the states that responded to the environmental justice movement with the creation of numerous policy and infrastructure channels, whereas Vermont ranks among states that have not created any comprehensive plan for dealing with similar issues. This leaves many questions to be answered: Are the citizens of California seeing any benefits of environmental justice policy implementation? Is Vermont suffering from its lack of attention to the issues? Why are some states addressing environmental justice while others are not? While the answers are very complex, it is clear that policy implementation at the state and local level plays a large role in the strength of the environmental justice movement.

### **Christopher Rivard**

Dietetics Major '07, Bickford Keystone Award

Mentor: Stephen Pintaura

Poster Title: *Development and Evaluation of an Advanced Nutrition Virtual Learning Environment*

Abstract: Educational institutions have been increasing the use of online learning environments in course curricula. Yet, very little is known regarding how individual learning styles influence student success with online learning. Online learning has many advantages for both the learner and the instructor. The program can be accessed at anytime and allows for both asynchronous and synchronous learning. The instructor has the ability to update material when needed and also has the ability to determine the learner's needs and select the appropriate material to achieve the desired learning objectives. In addition, online learning can meet some of the challenges facing higher education such as, improving quality, increasing access and reducing costs. Despite the potential advantages of online learning, it may not be the ideal format for all learners. Individual students have different learning styles and the students' learning styles may influence their success with online learning environments. In the present study, an advanced nutrition online interactive multimedia program was developed on the topic of iron metabolism in the human body. This program was used as a tool to determine if learning styles have an impact on the cognitive gain of students when presented in an online environment.

### **Calsey Rowell**

Biology Major '07, College Honors, HELiX, URECA

Future Goals: Graduate Level Forensics

Hometown: St. Johnsbury, Vermont

Mentor: C. William Kilpatrick

Poster Title: *The Aging of Little Brown Bats *Myotis lucifugus* by Telomere Length*

Abstract: Mammals have been traditionally aged based on methods such as tooth eruption, tooth wear, growth rings and eye lens weights and protein content. Nearly all of these methods are highly invasive and generally are used to age animals after they have been killed. However, it may be possible to estimate an animal's age through DNA analysis. The ends of chromosomes of most eukaryotic organisms consist of telomeric DNA composed of a satellite DNA with a highly conserved motif. This telomeric DNA shortens with each replication of the DNA and thus has been shown to be a reliable method to age long lived species. For this study, genomic DNA was extracted from wing punches from little brown bats (*Myotis lucifugus*), digested with restriction endonucleases and separated by fragment size by agarose gel electrophoresis. Membranes from Southern blots were probed with a non-radioactive chemiluminescent telomeric probe specific for telomeric repeats to visualize the restriction fragments containing telomeric DNA. Variation observed in the mean telomeric restriction fragment among a sample of little brown bats of unknown ages indicates variation in the length of the telomeric DNA among individuals that is expected to be correlated with age. A sample of wing punches from known aged bats to be examined will allow the validation that the variation in telomeric fragment length is correlated with age and will be reflected in the construction of a calibration curve.

### **Natasha Sadoff**

Environmental Studies '07, URECA

Future Goals: Work in the non-profit sector, serve in the Peace Corps, eventually graduate studies.

Hometown: Columbus, Ohio

Mentor: Saleem Ali

Poster Title: *Local Environmental & Community Stability: A Case Study of les Abricots, Haiti*

Abstract: The majority of Haiti faces severe environmental degradation, social inequality, and constant political unrest. Only two percent of Haiti's forest cover remains, causing many agricultural fields and mountainsides to erode into the sea. Thousands of Haitians are unable to maintain their land-based livelihoods, and many become *environmental refugees*. Haiti is the most pertinent example of environmentally caused migration in the Western Hemisphere. The Dominican Republic is dealing with the consequences as thousands of Haitian refugees flee to their country and create trans-boundary conflicts such as job and natural resource competition. However, the small village of les Abricots defies the stereotypes as its forest cover is nearly 50% and its people

are able to rely on the environment for their livelihoods. No environmental refugees have left this area for over thirty years.

### **Eugene Scharf**

Post-Bacc Premed '07, HELiX

Future Goals: Medical School

Hometown: Rockford, Illinois

Mentors: Victor May and Yang Mao-Draayer

Poster Title: *PACAP Family Neuropeptide effects on murine neural stem cell proliferation and differentiation*

Abstract: Murine neural stem cell (mNSC) models may be used to pursue new methods of myelination for chronic demyelinating diseases. Previous literature has established a strong correlation between mNSC cultured in the presence of PACAP (pituitary adenylate cyclase activating polypeptide) family neuropeptides and stem cell proliferation. However, little is known concerning mNSC cultured with PACAP family neuropeptides and cell fate. We hypothesized that PACAP family neuropeptides may push stem cell differentiation down oligodendrocyte pathways and as such lead to remyelination. mNSC were cultured in the presence of neurobasal media with B27 and L-glutamine, with and without E/FGF (epidermal & fibroblastic growth factor). When cell growth reached ~80% confluence (3 days) the growth factor and media were withdrawn. Cultures were then supplemented with physiological doses of PACAP Family (PACAP 27, PACAP 38, and VIP). Cell survival was measured using a Calcein acetomethoxy assay. Cell proliferation was assayed with a bromodeoxyuridine fluoresced cell count. Cell specific cDNA was isolated using reverse transcriptase PCR with mRNA isolated from culture. The cDNA was subjected to real-time quantitative PCR to quantify gene expression for cell specific markers (e.g. NG2 & PDGFR $\alpha$  for oligodendrocytes). Calcein AM assay indicated increased cell survival in the presence of PACAP family when compared to the minimal control. PACAP family neuropeptides showed increased cell proliferation when compared to the minimal media control (no E/FGF). Finally, qPCR indicated that PACAP family neuropeptides had decreased gene expression for all three markers (neuron, oligodendrocyte, astrocyte) when compared to the control condition. The data indicate PACAP family neuropeptides may increase cell proliferation but also may downregulate gene expression categorically an indication of reduced cell differentiation.

### **Lydia Smith**

Geology Major '07, Hawley-Mudge Scholarship

Future Goals: A Geology MS program, school undecided

Hometown: Huntington, Pennsylvania

Mentor: Gregory Druschel

Poster Title: *Geochemical Sulfur Cycling at Meromictic Green Lake, NY*

Abstract: Green Lake, located in Fayetteville, NY, is a meromictic lake with significant geochemically influenced microbial activity. The permanently stratified water column is characterized by the presence of an oxic/anoxic chemocline in which an abrupt chemical contrast provides potential energy for the microbial coupling of reduced/oxidized forms of sulfur intermediates (S, HS<sup>-</sup>, polysulfides, etc.), as well as C, N, and P. Two vertical profiles of *in situ* electrochemical data were compiled in the Fall of 2006. A solid state electrode system, consisting of PEEK working, reference, and counter electrodes, was weighted and lowered at 1 meter increments. Several cyclic and square wave voltammetry scans were run at each increment and recorded on the computer. The oxic/anoxic interface was determined to be at 21 meters below the surface based on increasing anoxic conditions with depth preceding abrupt sulfide peaks. Distinct sulfide peaks were observed as well as other unknown peaks of sulfur intermediates, presumably polysulfides. Water samples from this depth were obtained with a Niskin bottle and kept for lab experimentation. The water from this depth was pink because of abundant purple sulfur bacteria. To resolve the unknown voltammetry peaks, lab experimentation involved voltammetric analysis of each 10 $\mu$ m sulfide standard (.015M) addition to the Green Lake water. This data was used to build a calibration curve for the determination of sulfide concentrations in the chemocline. Polysulfide salts, NaS<sub>4</sub> and NaS<sub>5</sub> (S<sub>4</sub><sup>2-</sup> and S<sub>5</sub><sup>2-</sup>) were synthesized through the procedure published by Rosen and Tegman (1971) and calibration curves made in a similar manner. Sulfide additions to fresh Green Lake water samples resulted in a reaction that consumed the sulfide and formed a precipitate, likely S<sub>8</sub>. This reaction only occurred in scans run with fresh Green Lake water, before less recalcitrant organic molecules dissolved or broke down. This is indicative of a reaction between sulfide and DOM which has been linked to sulfur colloid precipitation by Heitmann and Blodau (2006).

## **Alea Tuttle**

Environmental Science '08, Independent Researcher

Future Goals: Continuation of her research project into graduate school

Hometown: Chapel Hill, North Carolina

Mentor: John Todd

Poster Title: *Utilization of Economically Significant Crops in the Design of a Municipal Waste Water Treatment Facility and Education Center in Zanzibar, Tanzania*

Abstract: Conditions in Stonetown, Zanzibar are favorable for the implementation of a long term study site devoted to assessing the suitability of a multi-staged hybrid constructed wetland system (one which combines horizontal and vertical subsurface flow as well as free water surface type wetland flow stages) populated with local economically significant macrophytes to improve the quality of storm-water and sewage effluent from municipal discharge sites. Hybrid constructed wetlands are efficient mechanisms to reduce the turbidity and nutrient content of municipal and domestic wastewater. They have also demonstrated the ability to significantly diminish populations of enteric pathogens, and remove many heavy metal and organic pollutants. The complete lack of water treatment in the Zanzibar archipelago is a stressor on the valuable ecological features that are already threatened by human development in the area.

## **Vasilis Varsakopoulos**

Business Administration '10, Independent Researcher

Hometown: Shelburne, Vermont

Mentor: Christopher Huston

Poster Title: *In Vivo* expression of fluorescent proteins in anaerobic *Entamoeba histolytica*

Abstract: *Entamoeba histolytica*, an anaerobic intestinal protozoan, causes invasive amebiasis, which is characterized by dysentery and abscesses in the liver. Studies to understand the cell biology of this parasite are a necessary first step for development of improved methods to treat and/or prevent *E. histolytica* infection. Fluorescent reporter proteins such as Green Fluorescent Protein (GFP) represent a state-of-the-art method for *in vivo* imaging of cells and tissues. However, the strict requirement for molecular oxygen as a cofactor for fluorescence of GFP and its derivatives limits its utility to studies in aerobic organisms. Recently, flavin mononucleotide based fluorescent proteins (FbFPs) have been developed by others as an oxygen independent alternative. We hypothesize that FbFPs can be adapted for use in *E. histolytica*, enabling future studies of chimeric proteins that can be tracked throughout the entire cell. We propose to clone the FbFPs into existing amebic expression vectors, and examine fluorescence under aerobic and anaerobic conditions. Fluorescence will be quantitated using a flow cytometer and compared to that of amebae expressing GFP. Finally, an endoplasmic reticulum (ER)-targeted fusion protein will be constructed, to enable studies of ER structure and dynamics in *E. histolytica*. Published data suggests that *Entamoeba* species lack a continuous ER compartment and we will test this hypothesis with *in vivo* imaging and photobleaching methods.

## **Laura Vogric**

Political Science and French Double Major '08, Independent Researcher

Future Goals: PhD in Linguistics

Hometown: Stony Brook, New York

Mentor: Emily Manetta

Poster Title: *Scrambling in Hindi-Urdu*

Abstract: The linguistic phenomenon of word-order scrambling in Hindi-Urdu is well known.

Some researchers (see Kidwai 2000) have compared scrambling with the leftward movement of topic NPs. In (2), the topic NP *roti* has moved to the left edge of the sentence. I will evaluate the opposing claim that topicalization is not scrambling; Saito (1989) claims that it is and Kidwai (2000) disagrees. In this poster I will argue, using evidence from Hindi-Urdu and Japanese that topicalization is scrambling (Saito 1989). I compare scrambling and leftward NP movement in Hindi-Urdu and Japanese to determine what constitutes acceptable scrambling and what movements are part of different phenomena. Through this comparison, I outline the restricted range of permissible scrambling. This poster serves to advance our understanding of scrambled sentences through a discussion of previous research comparing leftward NP movement, topicalization, and scrambling.