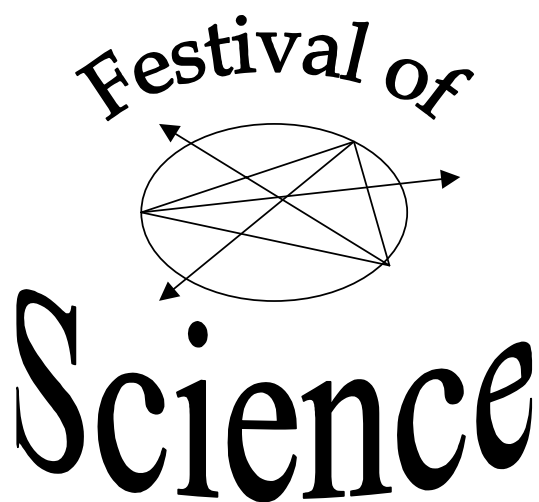


St. Lawrence University



Friday, April 23, 2004

2:00 – 6:00 pm

St. Lawrence University Student Center

The Festival of Science Student Symposium

The Student Symposium during the annual Festival of Science (FOS) is a successful, valued, and growing opportunity for SLU undergraduates to share the results of their research with the campus community. Together with the annual FOS Romer Lecture, the Student Symposium has become an effective showcase of some of the exciting progress in the sciences. The opportunity to formally present creative work is an invaluable culminating experience for students who have collaborated with faculty on original research projects. Not only do such students educate faculty and fellow students about their original work, these students also apply and hone their communication skills and gain exposure to the format of professional research conferences. Since its inception in 1996, the FOS has become institutionalized to the point where it is now a central focal point of most student research projects in the sciences.

Co-Chairs

**Jeffery Greathouse, Chemistry Dept.
Artur Poczwardowski, Psychology Dept.**

Committee Members

**Karin Bodensteiner, Biology Dept.
Wil Rivers, Biology Dept.
Stephen Robinson, Geology Dept.
Michael Shuckers, Mathematics, Computer Science and Statistics Dept.**

The planning committee would like to thank Margaret Kent Bass, Associate Dean for Faculty Affairs, for providing financial support for this event.

Festival of Science logo by Ellen Galo

Schedule of Events

Session 1: Oral Presentations.....2:00 – 2:45 P.M.

Refreshments Break2:45 – 3:00 P.M.

Session 2: Oral Presentations.....3:00 – 3:45 P.M.

Session 3: Poster Presentations3:45 – 5:45 P.M.

ABSTRACTS

ORAL PRESENTATIONS

Dr. Aileen O'Donoghue, presiding

2:00-2:15 Towards a more family-friendly St. Lawrence: A comparative analysis of policies and practices of St. Lawrence University, Colgate University and Hobart and William Smith Colleges

Emily Hunt

Advisor: Dr. Patrice LeClerc

The research presented in this paper examines the family environment for faculty and administrative staff at St. Lawrence University (SLU), located in Canton, NY. Interviews were conducted with faculty and administrative staff at SLU as part of the SLU Summer Fellows Program. Interviews were conducted with senior level administrators to obtain factual regarding the policies and practices of the university as well as the policy creation process. Interviews were conducted with representatives of Colgate University and Hobart and William Smith Colleges to obtain information regarding policies and practices of the two institutions and provide the basis for a comparative analysis. The most prominent finding resulting from the individual interviews at SLU is that the university is doing many things to be family-friendly but more can always be done. Based on this finding, the administrative interviews were pursued in order to answer questions about development and implementation and clarify any misconceptions and unclear policies. In the comparative analysis, there are some aspects at which SLU is better and others where SLU could use improvement. The recommendations to the administration and policy making bodies of SLU appear in the final chapter. The recommendations seek to create a friendlier environment for families at SLU. Examples of the recommendations include extending parental and maternity leave policies to all employee classes; continuing support of Canton Day Care Center; create a pamphlet for distribution to faculty and staff about childcare options; examine different course schedules that create more flexibility for meetings; continue to support families within the academic setting.

2:15-2:30 *Investigations into home-range size and selective winter-feeding in North American Porcupines (Erethizon dorsatum)*

William (Liam) S. Kean

Advisor: Dr. Erika Barthelmess

This series of studies focused on a population of North American Porcupines (*Erethizon dorsatum*), which inhabit the St. Lawrence University Kip Tract. The first set of studies used radio-telemetry equipment to try and quantify home-range size for five radio-collared porcupines between the months of October 2003 and February 2004. I collected data with homing procedures, and then I used GIS data analysis techniques to calculate home-range sizes. Due to the relatively high population density of porcupines on the Kip Tract, I predicted that home-range sizes would be smaller than published values of home-range sizes for other porcupines in other environments. The second set of experiments investigated whether porcupines show selective feeding on sugar maple trees (*Acer saccharum*). Initial observations on the Kip Tract seemed to suggest that porcupines showed feeding preference for specific sugar maple trees over other sugar maple trees within the same geographic area. I conducted a paired experiment in which I compared aspects of plant chemistry between feeding and non-feeding trees, pairing each feeding tree with a non-feeding tree. Then I used a series of chemical analyses on the tree bark from these feeding and non-feeding trees to compare the samples and investigate reasons for selectivity. Among some of the tests performed on the tree bark samples, I tested for water content and pH.

2:30-2:45 *Predicting positive perceptions of coaching behaviors from athlete individual difference variables*

Barat Wolfe

Advisor: Dr. Artur Poczwardowski

An athlete's perceptions of coaching behaviors are fundamental in how they respond to communicative situations and relationships, in turn affecting the coach-athlete dyad, team dynamics, individual performance, and team performance (Cox, 2002). This study examined a total of 22 variables (e.g., self-confidence, anxiety, coach-athlete compatibility, fear of failure, satisfaction, cohesion, demographics, and win-loss record) that were hypothesized to influence an athlete's perceptions of coaching behaviors. Twenty-four female, Division I hockey players participated in the study. Testing took place three times during the season: emotionally neutral (a game early in the season), positive (a winning streak), and negative (losing a big game). Multiple linear regressions for the three sampled times yielded optimal models for predicting positive perceptions of coaching behaviors. For the neutral time, the model included three variables: task compatibility ($r=-.766$, $p<.05$), self-confidence ($r=-.245$, $p<.05$), and satisfaction with

playing time ($r=-.345$, $p<.05$) and accounted for 78.4% of the total variance in the criterion scores ($R^2=.784$; $p<.05$). For the positive time, the model ($R^2=.839$; $p<.05$) included personal compatibility ($r=-.728$, $p<.05$), individual attraction to group as a measure of task cohesion ($r=-.561$, $p<.05$), and self-confidence ($r=-.351$, $p<.05$). For the negative time, the model ($R^2=.943$; $p<.05$) included athlete satisfaction ($r=-.796$, $p<.05$), personal compatibility ($r=-.757$, $p<.05$), cognitive anxiety ($r=0.229$, $p<.05$), and group integration as a measure of task cohesion ($r=-.513$, $p<.05$). The results suggest that athletes who are compatible with their coach, have positive cognitions about team cohesion, are satisfied, self-confident, and less anxious will perceive their coach's behaviors more positively.

3:00-3:15 *World literature's missing daughters: Folk tales, quantitative methods and the nature and nurture of gender*

Presenters: Christine Callanan, Kristen Manganini, Kimberly Parker, Adam Tapply, Christopher Wall, and Alexis Webb

Advisor: Jon Gottschall

This paper presents results of four studies based on content analyses of two large sources of literary data: 2,731 folktales from 40 collections representing a diversity of historical periods, geographical regions, and levels of cultural complexity; and 44 “Cliffs Notes” summaries of nineteenth century British novels. Novels and folktales were content analyzed using computer analysis software, multiple human coders, and methods that included human and computer components. The first project, “World Literature’s Missing Daughters,” conceptually replicates work conducted by this research group in previous semesters suggesting that an overall scarcity of female relative to male literary characters may be universal in world folktales and, perhaps, other literary genres. The second study, “The Beauty Double Standard,” tests the common idea that the ostensibly greater emphasis on female relative to male attractiveness in western societies is an outgrowth of socio-cultural pressures particular to western societies. The third study uses folktale data to test the argument, current among many humanists and social scientists, that “romantic love,” as we experience it today, was “invented” by westerners sometime in the middle ages. The fourth study tests “strong social constructivist” arguments by comparing certain broad patterns of male-female characterization and behavior in the British novels to those encountered in world folktales. In opposition to the expectations of strong constructivist models—which predict massive flux as we move among very different types of societies—we find substantial regularity in most dimensions of male-female behavior and characterization. All four studies address important questions in psychology and literary study, and all are relevant to debates over the nature and nurture of gender.

3:15-3:30 Surface plasmon resonance in thin metal films

Todd Falleen

Advisor: Catherine Jahncke

Surface plasmon resonance can be understood as a charge density wave or as an interference effect in a thin metal film. The wave is excited by laser light, and it exists at a particular critical angle for a given wavelength. We excite and measure surface plasmon resonance in silver, gold and aluminum thin films using a total internal reflection geometry. These measurements are made with a simple apparatus using a differential gear box which will be described. The surface plasmon resonances are compared with theoretical calculations for different film thicknesses and materials. In addition, experiments are conducted see if this apparatus could be used to study lipid bilayer membranes. The results of these experiments will be shown.

3:30-3:45 An inquiry into the Philosophy of Mathematics and its implications in Quantum Mechanics.

Sarah Post

Advisors: Dr.'s Maegan Bos and Mike Sheard

In this project, I investigate the philosophy of mathematics in general and in relation to the application of mathematics in science, using the specific example of the mathematical foundations of quantum theory. I first give an overview and criticism of the classical schools of thought in the philosophy of mathematics: Platonism, logicism, and formalism. I then describe new theories which take into account the linguistic and socially constructed nature of mathematics and which are more congenial to current trends in philosophy in general and in the philosophy of science in particular. From these theories, I draw out the philosophical implications, most importantly those pertaining to epistemology, of the prevalence of mathematics in science. I argue that as mathematics is a socially constructed representation of structures through a specific and highly logically based manifestation of human reason. This philosophical description of mathematics questions the ontological priority given to mathematics reasoning and also the epistemological certainty given to mathematical formulations of reality, inline with current trends in the philosophy of science. I then give a brief introduction to the foundations of Quantum mechanics and the Dirac formalism in particular and discuss the implications of such a view of mathematics to that of philosophy of science. It is my hope that such an investigation offers a philosophical understanding that is more nuanced than the previous absolutist views and which highlights the importance of creativity in both the practice of pure mathematics and its applications in science.

POSTER PRESENTATIONS

1. Does habitat fragmentation alter space use patterns in deer mice (*Peromyscus maniculatus*)?

Sarah Webster

Advisor: Erika L. Barthelmess

A significant threat to biodiversity is habitat fragmentation. As urbanization increases, semi-natural landscapes like golf courses are becoming more important as green spaces for wildlife. Golf courses are, however, fragmented landscapes. We utilized the St. Lawrence University golf course to study whether habitat fragmentation alters space use patterns in deer mice (*Peromyscus maniculatus*). We established small mammal live-trapping grids on forested golf course “islands.” Each was paired with a similar grid in a nearby unfragmented woodland. We trapped the grids for 8 weeks during the summer. Animals were marked and their identification and trap location were recorded with every capture. We used ArcView 3.3 software to calculate home ranges for each animal captured at least three times. We compared home range sizes, the degree of homerange overlap and the degree of “crowding” for animals from both the golf course “islands” and the woodland patches. In general, home ranges were larger on fragmented than unfragmented patches. On fragmented patches, home range size increased with increased patch size, though a similar trend was not shown for animals on unfragmented patches. Males on both fragmented and unfragmented patches had larger home ranges than females. On fragmented patches, males and females shared their home range areas with other mice, whereas on the unfragmented patches, males were less likely to share space with other mice. Mice inhabiting the fragmented patches appeared to share their home ranges with a larger number of individuals (i.e. experienced more crowding) than did mice living in the unfragmented patches.

2. Simultaneity overpowers the effects of color on memory conjunction errors for paired faces

Adam E. Christensen

Advisors: Dr. Alan Searleman & Dr. Sharon Hannigan

People sometimes make **Memory Conjunction Errors**, mistakenly perceiving a new face as being one previously seen if it consists of features that occurred in two faces seen earlier. A *within-pair conjunction* occurs when the features of the new face are created using a combination of features within the same pair, while a *between-pair conjunction* occurs when the new face is a combination of features from faces in different pairs. The present study tested 108 participants and attempted to manipulate the number and type of memory conjunction errors made by adding color to some of the faces. It was

thought that within-pair errors might increase and between-pair errors decrease when pairs of faces were tinted the same color. Conversely, it was predicted that within-pair errors would decrease and between-pair errors increase when the faces in each pair were tinted different colors. During the test phase participants viewed 8 black and white faces consisting of 2 new faces, 2 old faces, 2 within-pair conjunction faces, and 2 between-pair conjunction faces. The participants were asked to determine if each face was either “OLD” or “NEW” and rate their confidence on a scale of 1-5. The results indicated that there were highly significant main effects for Type of Face for both accuracy and confidence. It was also observed that in terms of accuracy color was not able to significantly alter the ratio of within to between memory conjunction errors. However, color was shown to have a significant effect on the confidence ratings of participants.

3. Ranked feeding preferences of the sea urchins, *Lytechinus variegatus* and *Arbacia punctulata*.

Courtney Saltonstall

Advisor: Dr. Brad Baldwin

Understanding the dietary preferences of sea urchins can provide us with key information about their possible role in the environment. The two sea urchins, *Lytechinus variegatus* and *Arbacia punctulata*, from the Gulf coast of Florida were tested in the lab at SLU, for their feeding preferences for various plant and animal foods. Preferences were determined by presenting each urchin with two food types simultaneously. The short distance chemosensory abilities of the urchins were also tested by offering the urchins paper tabs soaked with ground food, and tabs not soaked with food. *Sargassum sp.* was the most preferred by *Lytechinus*, followed by shrimp, *Ceramium sp.*, *Laminaria sp.*, *Halymenia sp.*, *Thalassia testudinum*, *Halimeda sp.*, and *Ulva lactuca*. After various chemosensory treatments an average of 84% of *Lytechinus* were attracted to the food soaked tabs. *Halymenia* and *Halimeda* were most preferred by *Arbacia*, followed by shrimp, bread and butter sponge, *Ulva lactuca*, and *Sargassum sp.* However, more feeding trials need to be conducted to better establish the preferences of *Arbacia*. An average of 70% *Arbacia* chose food soaked paper tabs. These results may provide insight into the physiological and nutritional requirements of these two urchins. Furthermore, the urchins’ ability to detect the chemical nature of their food and discriminate between different foods suggests that they may have a role in shaping the algal and benthic communities in which they exist. Given the results, we may be underestimating *Lytechinus*’s scavenging role as well as the control it has over brown algae such as, *Sargassum*.

4. Power to bind: the effects of color on within-pair memory conjunction errors

Courtney E. Wheeler

Advisors: Dr. Sharon Hannigan and Dr. Alan Searleman

Memory conjunction errors are the miscombination of features from different sources resulting in a false memory of a stimulus that hadn't been previously viewed. A within-pair conjunction occurs when the features of the new face are made from a combination of features within the same pair, whereas a between-pair conjunction occurs when the new face is created by features of faces from different pairs. The present study investigated how color could influence memory conjunction errors for faces. The No Color condition consisted of pairs of black and white faces. The Different Color condition consisted of pairs of faces in which one face was tinted red and the other green. In the Same Color condition, both faces were tinted either blue, red, or green. The 108 participants first viewed 3 pairs of faces and later received a recognition test that consisted of 8 test faces (2 old, 2 new, 2 within-pair conjunction, and 2 between-pair conjunction) in black and white. The task was to indicate whether the face was "OLD" or "NEW" and state their confidence on a scale of 1 to 5. Significant main effects for Type of Face were observed for both accuracy and confidence. Of particular interest, for within-pair conjunction errors there were significantly more errors made in the Same Color condition than in both the No Color and Different Color conditions. This suggests that when both faces within a pair are tinted the same color, the color later acts as a binding force to disrupt memory.

5. Sleep, risk perception and involvement in encouraged and discouraged risky activities in early adolescence

Angela Nortz

Advisor: Dr. James Wallace

Are sleep-deprived children more susceptible to participation in risky activities? Seventy-five students from the fourth, sixth and eighth grades completed two questionnaires: One determined the participant's regular sleep patterns and the other asked about involvement in thirteen social and school-related activities. Six of the activities were likely to be encouraged, and seven were likely to be discouraged by parents. Correlation analyses found significant, but weak, relationships between total sleep time and frequency of involvement in four of the risky activities, and there were similar results for the relationships between total sleep time and risk perception in six of the risky activities. Stepwise multiple regression analyses (in which the prediction of risk participation was the dependent measure, and 12 variables were potential predictors) indicated that sleep time contributed to the prediction of two of the discouraged risks. Specifically, the more sleep deprived children were more apt to skip doing homework

and to skip classes. The findings suggest that sleep time may be a factor that contributes to involvement in some risky activities in early adolescence. However, more research will have to be done on this topic to determine the extent and strength of the influence.

6. Families coping with mother-loss: The relationship between family structure, social support and adolescent adjustment.

Sara Goodnow

Advisors: Dr. Cathy Crosby-Currie and Dr. Steve Horwitz

The purpose of this study is to examine how the psychological adjustment of an adolescent after the loss of a mother is mediated by the time allocation decision making of the surviving father. In addition, the loss of a mother is also a loss of resources for the family, and the surviving parent may be forced to alter his traditional role to compensate for the loss of resources. Based on previous literature, we hypothesize that these time allocation choices would also be influenced by the family's social support network, the father's romantic relationship status, and the father's job structure. In sum, the goal of this project is to create a model of the relationship between time allocation decisions and the resiliency—positive outcomes despite the presence of a major stress—of adolescents coping with mother loss. We are also interested in how social support, the type of job the surviving father has, and his history and current romantic relationship status relate to the success of his time allocation choices. A qualitative methodology has been chosen due to the lack of previous literature on parental loss and economic consideration. The study, which is currently in the data collection stage, employs semi-structured interviews that have the flexibility and openness to explore other issues to inform our model.

7. Olfactory recognition in canines: Do common scents matter?

Diana Puchalski

Advisor: Dr. David E. Hornung

The overall objective of this work was to assess the specificity of the olfactory cues that canines use when identifying humans. That is, once a dog is trained to identify the smell of a human (the target), will the dog be confused by the smell of other people who use the target's soap or deodorant? A 1-year-old golden retriever was trained to pick her owner's scent out of three possible choices. After a trial had been initiated by "go" the dog would smell each of three boxes containing T-shirts impregnated with human scent. The target was randomly assigned to one of the boxes. The boxes were constructed such that the dog could not use visual cues. The dog signaled recognition of the target's smell by a sit/stay response. The dog was trained to correctly identify the target over 90%

of the time. When there was no target present the dog would repeatedly sample the three boxes and 80% of the time give no recognition signal. The dog was rewarded only for correct target responses. Probe trials consisting of the scent of non-related humans who had used the soap and/or deodorant of the target were inserted into the testing sessions. There was no reward given during a probe trial. When the scent of non-related humans who used the soap or the deodorant of the target was inserted as a probe trial the dog gave no recognition signal. This result suggests that added smells have no bearing on canine olfactory recognition of humans.

8. Ontogeny of Basement Membrane Protein Expression in Rat Ovarian Follicles

Tommy Scott

Advisor: Dr. Karin J. Bodensteiner

The ovarian follicle is the primary unit of the female reproductive system, containing the oocyte, layers of granulosa cells, and thecal cells in larger follicles. Surrounding the layers of granulosa cells is the follicular basement membrane (BM), made up of proteins such as collagen type IV, laminin, and fibronectin. The BM is involved in cellular proliferation, differentiation, and migration and is essential for normal follicular development. The BM is also responsible for maintaining the shape of the follicle in vitro and knowledge of BM protein expression is necessary for follicular culture. Immunohistochemistry was used to localize expression of BM proteins in the ovaries of neonatal (4 and 7 days old), prepubertal (23 days old), and adult (60-90 days old) rats. Ovaries were fixed in 4% paraformaldehyde and sections were cut at 8 μm . Laminin was specific to the BM at all ages and in all types of follicles. Collagen type IV was present in ovaries at all ages, but only appeared to be specific to the BM of primordial and pre-antral follicles in neonatal rats. In older rats, collagen was localized to the BM of antral and atretic follicles. Fibronectin was not successfully localized to the BM at any age or at any stage of follicular development. While previous research has demonstrated the presence of all three proteins in the BM, the current study provides evidence that localization of collagen type IV in rat ovarian follicles would appear to be dependent upon age. Reasons for this discrepancy are unknown and warrant further investigation.

9. Computer simulation of uranyl smectite clays: Effect of tetrahedral charge on interfacial structure

Hannah StellaLevinsohn

Advisor: Dr. Jeffery Greathouse

Smectite clays are naturally occurring clay minerals. An understanding of the clay-water interface is important to many areas of geochemical interest. Montmorillonite and vermiculite are common clay minerals in the Nevada Yucca Mountain region, so a detailed picture of mineral-water interactions is important to understand the fate of radionuclides in groundwater. Negative charge sites in the tetrahedral layer of montmorillonite and vermiculite are due to substitution of Al^{3+} for Si^{4+} . The cations in the aqueous region balance the negative charge in the system. By examining the effects of the tetrahedral Al charge on interlayer structure of sodium clays, we developed a more accurate model of clay-solution interactions. In our model, the charge on the tetrahedral Al is delocalized among surrounding oxygen atoms. The Molecular dynamics program DL_POLY¹ will allow equilibrated Monte Carlo clay-water configurations to be simulated with a flexible molecule force field. The equilibrated system from the Monte Carlo simulations will be then converted into a file that can be read by DL_POLY. The flexible model force fields are important when investigating the surface relaxation at the tetrahedral charge site, and when looking at the movement clay OH group. The molecular dynamic simulations will be run to obtain adsorption energies and an understanding of the migratory tendencies of the uranyl ion.

¹Forester, T.R., and Smith, W., *DL_POLY User Manual* (CCLRC, Daresbury Laboratory, Warrington, UK, 1995).

10. Age related changes in olfactory perception

Emily Putney

Advisor: Dr. David Hornung

Although an age related decline in olfactory ability has been documented, the effect of aging specifically on odorant quality perception has been difficult to assess since there is an interaction between the intensity and quality components of olfactory perception. Thus, the present study was designed to test the hypothesis that aging changes olfactory quality perception independently of changes in odor intensity. For each participant who passed an initial screening of her/his ability to recognize odors, a psychophysical intensity curve was generated based on the averaged responses to six concentrations of four odors (rose, vanilla, rubbing alcohol and ammonia). From these curves, the concentrations that resulted in intensity ratings of 10 and 30 for each of the four odorants were determined for each subject. Young (18-25 yrs.) and elderly (≥ 65 yrs.) subjects were then given all combinations of two concentrations of four odors in pairs

and asked to indicate, using the Green Scale, the dissimilarity rating for the two odors in each pair. These dissimilarity ratings were then subjected to Multi-dimensional Scaling Analysis to determine the location of the subjects relative to each other in psychophysical space. Since the young and the elderly seem to be located in different psychophysical spaces, the data is consistent with the hypothesis that in the elderly there is a change in olfactory perception that is independent of odorant intensity. An analysis of the psychophysical spaces for the individual odorants may provide some indication if this is primarily a change in olfactory or trigeminal perception.

11. METADISE simulations of various quartz surfaces

Megan Roppolo

Advisor: Dr. Jeff Greathouse

In this project, the surface energies for the (101), (100) and (010) quartz surfaces were studied. Bulk quartz was created and flexible surfaces were cleaved and minimized using the METADISE program with two-dimensional, periodic boundary conditions. Energy minimizations were performed for pure and hydroxylated surfaces. A hydroxylated surface was created by dissociatively adsorbing one water molecule per unit cell:



The flexible portion of the surface remains in contact with a rigid bulk portion of quartz.

Calculations were also performed on quartz slabs, in which two flexible surfaces are joined. Slabs can then be used for molecular dynamics simulations using three-dimensional, periodic boundary conditions.

Surface calculations were found to be in agreement with those found by Parker and DeLeeuw. These surfaces and surface energies were studied for various models, including the shell, clayff, and Van Beest models.

12. Kinship recognition through olfaction in a canine

Amanda Leitch

Advisor: Dr. David Hornung

The overall objective of this study was to assess the specificity of the olfactory cues that canines use when identifying humans. That is, once a dog is trained to identify the smell of a human (the target), will the dog be confused by the smell of the target's siblings? A 1-year-old golden retriever was trained to pick her owner's scent out of three

possible choices. After a trial had been initiated by “go” the dog would smell each of three boxes containing T-shirts impregnated with human scent. The target was randomly assigned to one of the boxes. The boxes were constructed such that the dog could not use visual cues. The dog signaled recognition of the target’s smell by a sit/stay response. The dog was trained to correctly identify the target over 90% of the time. When there was no target present the dog would repeatedly sample the three boxes and 80% of the time would not give the recognition signal. The dog was rewarded only for correct target responses. Probe trials consisting of the scent of the target’s siblings and no target scent were randomly inserted throughout the testing sessions. There was no reward given during a probe trial. Despite what other studies have shown, the dog did not give the recognition response more often to the smell of the target’s siblings as compared to the smell of non-related humans. Further testing is necessary to determine if there is any link between genetics (for instance HLA typing) and scent.

13. Approximate confidence interval estimation for beta-binomial proportions of biometric identification devices

Travis Atkinson

Advisor: Dr. Michael Schuckers

The goal of this project was to determine the performance of confidence interval estimation using the methodology of Agresti and Coull (1998) on proportions from a Beta-binomial distribution. Agresti and Coull applied their approach to the binomial distribution, specifically for estimation proportions. In this research we tried determine the appropriate manner in which to extend that work to proportions from a Beta-binomial distribution. In particular we were interested in applying such a methodology to data from biometric identification devices such as fingerprint scanners or iris recognitions systems. The approach we took was to simulate data from a variety of Beta-binomial distributions and compare the performance of the augmented approach of Agresti and Coull to more traditional approaches to interval estimation. Specifically we considered four ways to extend this work. For the binomial n independent binary observations are augmented with 2 successes and two failures. For the Beta-binomial we have k individuals with m binary observations each. To augment the Beta-binomial data, we first considered adding 2 successes and 2 failures to a single individual. Second we considered adding a success and a failure to the counts for 2 individuals. Third we considered adding 1 success to the data from each of 2 individuals and 1 failure to the data for 2 different individuals. Last we considered adding a new individual $n+1$ who was given 2 successes and 2 failures. We used a Monte Carlo approach for evaluating the performance of these four augmented approaches.

14. Effects of inhibition of Sphingosine Kinase with Dimethylsphingosine and dihydrosphingosine on calcium signaling in Jurkat T-cells

Jane W. Mutoru

Advisor: Dr. Nadia Marano

Sphingosine Kinase (SK) plays a significant role in Ca^{2+} signaling in T-cells. During T-cell activation the enzyme catalyzes the phosphorylation of Sphingosine (S) to Sphingosine 1-Phosphate (S1P) using Adenosine Triphosphate (ATP) as the phosphate donor. This important function of sphingosine kinase can be inhibited by such inhibitors as dimethylsphingosine (dimethyl-S) and dihydrosphingosine (dihydro-S), which compete for the active site of the substrate, Sphingosine. Consequently, impeding the production of S1P, hindering Ca^{2+} signaling and inhibiting the generation of cytokine genes. Consistence with this was the main objective of our study: to determine the effect inhibition of SK with dimethyl-S and dihydro-S on Ca^{2+} signaling, cell viability and cell apoptosis using Jurkat helper T-cells. Our results, though not conclusive, suggest that high concentrations of the inhibitors have some effect in lowering Ca^{2+} concentrations and also exhibit increased toxicity that lead to low cell viabilities.

15. The physical attractiveness stereotype in cross-cultural folk tales

Adam J. Tapply

Advisor: Jonathan Gottschall

Is the physical attractiveness stereotype a cross-cultural phenomenon with roots in universal aspects of human psychology or is it a product of socialization environments particular to individual societies or types of societies? This study was based on a multi-coder quantitative content analysis of random samples of 658 folk tales from 48 culture areas and of 240 summaries of plot and character information from works of western canonical literature. It tested the prediction generated from theory and research on the physical attractiveness stereotype: protagonist characters will be both more likely to be portrayed as physically attractive, and less likely to be portrayed as physically unattractive, than antagonists. The assumption inherent in this prediction is that protagonist characters will be, as a general rule, far more likely to be portrayed as “good” than antagonist characters. Our main finding is that there is solid statistical evidence for the existence of a physical attractiveness stereotype across two large and culturally diverse literature samples. The prediction of this research was supported: across centuries and regions of the world, protagonist characters were both more likely to be defined as attractive than were antagonist characters and less likely to be defined as unattractive. Our findings suggest that the physical attractiveness stereotype is not limited to western societies, but is a cross-cultural phenomenon present even in pre-state societies. If this is true, then it is possible that the physical attractiveness stereotype is a

prejudice people are born with rather than an arbitrary product of particular socialization environments

16. Promoter activity of the human chromosome 17p13.1 12-Lipoxygenase gene in cancer cells.

Matthew Benard

Advisor: Dr. Michael Temkin

12-Lipoxygenase (12-LOX) is one of several enzymes responsible for the metabolism of arachidonic acid (AA). While biologically necessary, the metabolites generated in this process have been found to have roles in the development and metastasis of several types of cancers including breast, lung, prostate, and colorectal. The promoter for the gene that codes for this enzyme has not been definitively identified, partially due to the lack of typically found consensus sequences such as the TATA and CCAAT boxes. A 1083 base pair and a 551 base pair sequence upstream of the 5' end of the gene were individually cloned into a reporter vector containing the Green Fluorescent Protein (GFP) gene. Jurkat (human leukemia) cells transfected with the reporter plasmid were cultured and the activity of the promoter was quantified via confocal microscopy and fluorometry.

17. Ambient air quality study at SLU

Josh Onyan

Advisor: Dr. Ning Gao

Continuing studies are being conducted to develop an interactive computerized mass balance model of the Little River watershed using the STELLA computer software. Water samples at varying locations along the Little River and ambient air samples at a location close to the watershed will be collected and analyzed. The resulting monitoring data will be incorporated into the mass balance model. This study will facilitate the evaluation of the environmental quality of the watershed. To collect ambient air samples, an ambient air sampler needs to be created with existing technology. The apparatus consists of a cyclone, two denuders, and a filter pack. The cyclone device uses a set velocity of airflow to eliminate airborne particles larger than 2.5 μ m, which would not be of concern because they are too large to enter the respiratory system.¹ The two denuders, one which is coated with a basic substrate and the other that is coated with an acidic substrate allow the collection of acidic or basic gaseous species present in ambient air. The filter pack contains multiple filters used to collect the particles entering through the

cyclone and the two denuders.² Using gravimetric analysis, scanning electron microscopy, and ion chromatography, the airborne particle mass concentration, gaseous acidic and basic inorganic species, ionic species and trace elements on airborne particles could be determined.³ Thus an understanding on chemical composition and concentration levels of ambient air contaminants could be established.

18. The effects of pH on the accumulation of Zn and Cu in the common cattail (Typha latifolia)

Bryan Tolcser

Advisor: Wil Rivers

Approximately 1000 Superfund sites were identified by the EPA's National Priorities List of 1986, and 40% of them involve heavy metal contamination of some sort (Förstner, 1995). Extracting heavy metals via tolerant plants, a process called phytoextraction, is still in experimental stages. Unfortunately, most metal tolerant plants are small and slow growing, thus making the net worth of phytoextraction low. Current research is primarily focused upon increasing the accumulation per unit of biomass to make phytoextraction an economically worthwhile endeavor. Indications have been made in recent research (Shahandeh and Hossner, 2002; Manios, et al. 2003) that soil acidity increases the ability of tolerant plants to accumulate heavy metals. *Typha latifolia* rhizomes were collected from the St. Lawrence University Golf Course and were grown for 4 weeks in 15% Hoagland's Solution. Seedlings of like biomass were then grown in experimental solutions A - F containing 10 mg/L Zn (supplied as zinc sulfate) and 10 mg/L Cu (supplied as copper sulfate) for 14 days at pH's of 5.5, 6.0, or 6.5. Group Z was added as a control. Plants samples were then removed from solution and analyzed for heavy metal concentration with a Varian Atomic Absorption Spectrophotometer (AA-10). Those plants grown in low pH solutions are anticipated to have higher concentrations of heavy metals. This poster will present results showing mean heavy metal concentration for all experimental groups. An ANOVA test will be done to confirm or deny significance of pH on the accumulation of Zn and Cu in *T. latifolia*.

19. *Student partners in creating new science spaces*

Kelsey L. Hochstatter (On behalf of past student coordinators and the Student Committee)

Advisor: Thomas C. Greene (On behalf of the Executive Committee and Science Department Chairs)

A college building design that shortchanges student learning fails to meet its most important programming goal. Among the ways to improve the way spaces address student needs is to involve them in process of creating new ones. Like faculty, students are “using clients,” and they, rather than administrators or designers, are the natural partners of faculty in programming new space. This poster will visually document 5 years of student-faculty partnerships that will culminate in the construction of a \$60 Million science building beginning in April of next year.

20. *Subsurface investigation into the internal architecture of lacustrine strandline deposits, Northern New York*

Christopher W. Stevens

Advisor: Dr. Stephen Robinson

The retreat of the Laurentide Ice Sheet from the St. Lawrence Lowlands approximately 12,500 yr. B.P., combined with an ice-blocked outlet near Covey Hill, Quebec led to the development of Glacial Lake Iroquois, in which the water-covered lowlands were continuous with the Lake Ontario basin. Fluctuations in this former water body left evidence for four significant lake stages, as defined by numerous strandlines of well-sorted delta and beach deposits in areas of New York north of the Adirondack Mountains. Owing to post-glacial base level declines, these deltas are now deeply incised by the very rivers that formed them. Ground penetrating radar (GPR) surveys were conducted across four remnant deltas of two distinct lake stages, to map their internal architecture, depositional environment, thickness, and indications of post-depositional structures. Utilizing 50 and 100 MHz antennas, delta thickness were found to vary but are generally between 10 to >20 m. High-resolution (GPR) profiles exhibit variable reflector continuity, and are interpreted as showing the sedimentary facies of shifting channels, topset, foreset and bottomset bedding, along with erosional unconformities and potential failure planes. The presence of short-lived directions of deposition, varying lobes and zones of reworked homogeneous material suggests an environment of fluctuating energy and shifting channels. A significant number of scattered large boulders are interpreted to be present within the deltas, are interpreted as either dropstones or material transported by higher energy. These stranded deltas are well drained, coarse grained and easily accessible, making them ideal sites for GPR surveying.

21. Expression of sodium bicarbonate cotransporter genes during postnatal development of the rat medulla

Camille Michaud

Advisor: Dr. Michael Temkin

Astrocytes have been hypothesized to mediate neuron controlled changes in ventilation by regulating extracellular pH in CO₂-sensitive respiratory centers of the brainstem through the activity of the sodium bicarbonate cotransporter, NBC 1. According to the proposed hypothesis, NBC 1 molecules pump carbonate ions from the extracellular space into the cytoplasm of astrocytes. Removing carbonate ions from the extracellular space would cause a decrease in pH, stimulating neurons in the CO₂-sensitive respiratory centers. The goal of this study was to determine if astrocytes in the nucleus tractus solitarii (NTS), a CO₂-sensitive region of the brainstem, expresses NBC 1. In situ hybridization was used to detect the presence of NBC 1 and NBC 2 mRNAs, as well as the expression of the astrocyte specific genes, glial fibrillary acidic protein (GFAP) and glutamine synthetase (GS), and neuron specific gene neurofilament light (NFL) for comparison. Probes labeled with either fluorescein, Texas-red X, or 630-650 were visualized using either confocal or epifluorescent microscopy. The results of this study indicate that NBC 1 and NBC 2 mRNAs occur in a wide variety of cells within the brainstem and that astrocytes both inside and outside of CO₂-sensitive respiratory centers express NBC1.

22. Long and short sleepers: Impact of sleep on profiles of illness symptoms.

Lindsay Havlicek

Advisor: Dr. Pamela Thacher

Although many studies implicate shortened sleep as a possible cause of increased rates of illness, few studies have examined this link prospectively. In our study we examined the relationship between self-reports of sleep quantity and viral symptoms. 34 SLU students participated for \$10 or extra credit points for a psychology course. Symptom presence/severity were reported daily for one week via email messaging. Rating scales for symptoms ranged from 1-7 on a Likert scale. Subjects also kept daily sleep diaries to track bed times, wake times, sleep latency time and time up during the night to estimate total sleep time on each night of study participation. Several participants also wore an “actigraph” (a wristwatch like device) to detect motion which was used to validate self-report of sleep length. Participants also completed the Beck Depression Inventory, stress measures, and a measure of evening/morning activity preference.

23. The ventilatory effects of sodium bicarbonate transport inhibition in the conscious rat.

Stephanie Murray and Michelle Zugermayr

Advisor: Dr. Joseph Erlichman

This study examines the ventilatory effects of selective inhibition of NBC in brainstem sites involved in central respiratory control, such as the NTS and the RTN. The NBC usually transports 2 HCO_3^- and 1 Na^+ into the cell when the cell is depolarized relative to the equilibrium potential for the transporter. Increased neuronal activity elevates extracellular potassium, depolarizing glia, and enhancing the inward movement of HCO_3^- and Na^+ , which alkalinizes the glia. The movement of HCO_3^- may effectively decrease the buffering power of the extracellular fluid, resulting in an acid shift. Since decreased pH effectively acidifies pHi, the activity of CO_2 chemosensory neurons will increase when NBC is active. It is our hypothesis that glial regulatory mechanisms alter the neuronal processing of chemosensory information. Eleven adult Sprague-Dawley rats of either sex weighing between 250 and 350g had a push-pull cannula placed into either of the two respiratory brainstem sites (5 RTN, 6 NTS), following surgical procedures. The NBC transport inhibitor DIDS 0.5mM was perfused into the NTS or RTN via the cannula, while ventilation was measured using a whole-body plethysmograph. The animal's response to CO_2 is evaluated by increasing the CO_2 concentration in the plethysmograph in 2% increments to a maximum of 8%, for 10 minutes at each increment. Results show that DIDS in the NTS caused a significant increase in ventilation ($n= 6$; $p< .05$). In the RTN however, ventilation is significantly depressed but only at a CO_2 concentration of 4%.

24. Water quality study and mass balance modeling for the Little River Watershed

Alexis Kostun

Advisor: Dr. Ning Gao

The concentrations of various ions and dissolved oxygen in river water is of great interest to environmental quality assessment. These concentration data can be used to create a mass balance model, specifically in this study of the Little River Watershed.

Vernier probes are used to monitor the concentrations of ammonium, calcium, and nitrate ions, dissolved oxygen, and pH of the water thereby yielding water quality data. The existing procedure will be refined to determine the necessary parameters to ensure reliable data. Another aspect of this project is to continue the development of a mass balance model for the Little Watershed to evaluate its overall environmental quality. My goal is to complete the necessary components of an existing, very simple mass balance model that had been constructed by a former student by using the STELLA

computer software and by generating my own field monitoring data and gathering additional data from other researchers on and off SLU campus. The combined environmental and hydrological data sets will be compiled into the mass balance model to test its performance. The refined mass balance model will then be used to predict what the steady state conditions would be for the Little River Watershed when the inputs and outputs of the various chemical constituents are altered. Various literature searches will be conducted to determine the necessary equations to be used in the mass balance model to account for ground water, sedimentation, and atmospheric deposition on the ion concentrations.

25. The physics of music: standing waves in musical instruments

Sandy Lampreda

Advisor: Dr. Catherine Jahncke

The purpose of this project was to find and reproduce class room demonstrations for an introductory level physics of music class. In addition I will present handouts and laboratory directions for students to accompany these demonstrations. I replicated three different demonstrations that dealt with both physics and music. For the first demonstration I built an amplifier to connect to a microphone and oscilloscope to demonstrate the different waveforms produced by different musical instruments and of different notes. I also captured these waveforms with a computer that performed a Fourier analysis so that the spectrum of the waveform could be studied. The second experiment concentrated on stringed musical instruments such as the guitar. The purpose of this experiment was to demonstrate standing waves on a lead filled hose to better understand the harmonic series and the working of many musical instruments. The third experiment was to build a wind chime. Using my knowledge about standing waves and music, I constructed a set of wind chimes in which each hanging rod produces a clear tone, and the combination of rods generates a chord.

26. Single beam holography

Scott P Cipriano

Advisor: Catherine Jahncke

The process of holography, as coined by the Hungarian physicist Dennis Gabor, was originally investigated in an attempt to increase the resolution of the current electron microscope. Gabor ended up using a light beam instead of a beam of electrons to make the first hologram, but it wasn't till 1960's when the LASER was invented that holography began to take off. Since Gabor's original design numerous processes have

developed that each create unique types of holograms. For the purposes of this project these different variations have been studied and several have been replicated.

27. Modeling disease: mathematics in epidemiology and applications to the SARS virus

Katie Livingstone

Advisor: Dr. Patti Frazer Lock

Epidemiology is a field of science that has made many significant advances in studies of the spread of disease. Studies of epidemics and disease spread have vast mathematical components. Epidemiological models are based on differential equations that provide the foundations for modeling change over time. These are useful in modeling rates of infection, rates of recovery, contact rates, birth and death rates, etc. Such models can predict the impact of a disease on a population and can suggest valuable strategies for its control. This study presented the most basic epidemiological model and examined the common uses and implications of certain features. It looked at several more complex models and explained how to modify a disease model according to the characteristics of a disease. Lastly, this study examined how researchers have modeled SARS, one of the most recent disease outbreaks, in three published articles.

28. Flux of cosmic ray muons at low energies

Jeremy Ouellette

Advisor: Daniel Koon

Muons are one the more easily observed fundamental particles. Created in the upper atmosphere due to collisions of cosmic protons and atmospheric nuclei, they come streaking down to earth at a wide variety of energies. The number of muons (flux) present at high energies is well known, but low energy measurements have been more difficult to find. At these low energies, local atmospheric conditions such as humidity and air pressure may have a much larger effect on these particles. Extrapolation from the well known high energy data allow us to create a simple theoretical model of the low energy muon flux, and the effect of atmospheric conditions on this spectrum can be experimentally tested using a simple apparatus. The theory, experimental apparatus, analysis, and results will be discussed.

29. Group theory and crystals: factor group analysis and Raman spectroscopy

Sarah Post

Advisor: Dr. Catherine Jahnce

In this project I use the methods of group theory and symmetry groups to describe the optically active modes of vibration, specifically those which are Raman active, and verify these results through the testing of several crystal spectra. Raman spectroscopy is accomplished by directing a laser beam at a sample and looking at the scattered light through a spectrometer with a very sensitive detector. The energy from the laser can interact with the crystal in two ways; it can either scatter with the same incident energy or be shifted by a factor corresponding to the vibrational energy of the crystal.

In order to predict the number of Raman active vibrations it is necessary to apply group theory to the crystal structure in the form of a factor group analysis, which describes the correlation between site symmetries and point groups. This method gives a way of determining the optically active modes of vibration and the types of spectra involved, ie. Raman or Infra Red. I then follow this analysis for Diamond, Sapphire (Al_2O_3), Rutile and Anatase (TiO_2) and Salt crystals and verify these results through an analysis of their spectra as obtained using the Raman spectrometer. From these results, I determine the validity of the factor group analysis of crystal spectra and suggest a possible application of determining differences in crystal structure of the same molecular composition from the case of a difference in number of Raman active modes.

30. Effects of maternal separation on subsequent maternal behavior in Sprague Dawley rats

Stephanie Miner

Advisors: Dr. Karin Bodensteiner and Dr. Loraina Ghiraldi

This study was designed to assess how early maternal care influences subsequent maternal behavior in rats. It was hypothesized that females separated from their mothers as pups would show deficits in maternal behavior as adults. Female Sprague-Dawley rats were separated from their mothers for 6-hr (long term/LT), 3-hr (short term/ST), or 0-hr (control/C). At maturity, subjects were mated. Litters were culled to 2 male and 2 female pups on postnatal (PN) Day 1. Maternal behavior testing began on PN Day 2 and continued for 16 days. Lactation performance (pup weight change), nest building, nest defense, hovering, and grouping were examined. Analysis of variance and t-tests revealed that LT rats used significantly more cotton and built higher quality nests than other groups. Also, LT subjects tended to take less time than C subjects to group their young ($p=0.074$). There was no effect of maternal separation on lactation performance, nest defense, or hovering, and, as expected, maternal behavior decreased across all variables as the postpartum period progressed. Additional analyses revealed that LT

females tended to begin estrous before C females ($p=0.071$) and to deliver more pups than C ($p=0.053$) and ST ($p=0.058$) females. Further research on these parameters is warranted. Contrary to the hypotheses, these results reveal that early maternal separation may enhance some aspects of maternal behavior. Research examining the effects of parity on the maternal behavior of previously separated pups is in progress.

31. Role of the Locus Coeruleus in ventilatory control in the conscious rat

Amanda Fix, Jess Kolling, Ryan Lawless, Stephanie Murray, and Michelle Zugermayr

Advisor: Dr. Joseph Erlichman

The LC has been implicated in physiological functions including arousal, anxiety, pain processing and more recently respiratory control. To evaluate the role of the LC in ventilatory control, we created bilateral lesions of the LC using kainic acid (KA). Ventilatory measurements were made using a whole-body plethysmograph 1-7 and 14 days after lesioning. Rats microinjected 5 mM KA in 100 nL showed a 15% decrease in minute ventilation (VE) during normocapnia and a 11% decrease during hypercapnia (8% CO₂) compared to artificial cerebral spinal fluid (aCSF) injected controls (n = 4 and n = 2, respectively, $p > 0.05$). In separate experiments, focal perfusion of hypercapnic aCSF, substance P, and norepinephrine unilaterally had no consistent effect on VE. To assess the effects of bilateral LC lesions on pain processing we measured tail flick latencies in rats injected bilaterally with KA before and 4 and 10 days post-lesion (n = 6). Tail flick latencies were significantly longer 4 days after lesion placement ($p < 0.05$), suggesting that the LC contributes little to respiratory control in the conscious rat, but plays an important role in descending pain control.

32. Computer simulations of smectite clay minerals

Matthew Thompson

Advisor: Jeffery Greathouse

The study of clay-water interfaces has many applications, such as nuclear waste disposal, ground water contamination removal, and catalysis. Smectite clays are inorganic polymer sheets composed of an alumina octahedral layer between silica tetrahedral layers. These clays are characterized by a permanent negative charge residing in either the octahedral or tetrahedral layers.

For our simulations there were two simulation methods employed. We first utilized a Monte Carlo technique in order to obtain a system that is equilibrated. The next step in the process is then to use molecular dynamics to continue the simulation from the

equilibrated systems. Thus far, our results with sodium cations in the aqueous layers are similar to that of the rigid model. More precisely – the sodium cations reside in the midplane of the aqueous layer and tend not to be attracted toward the surface of the clay.

33. Allelopathic effects of pale swallow-wort (*V. rossicum*) on Wisconsin fast plants (*Brassica rapa*)

Arthur Andrews

Advisor: Dr. Wil Rivers

This study examines the potential allelopathic effects of pale swallow-wort (*V. rossicum*), an invasive species now found in northern New York and Canada, on the seed germination of other plant species. Preliminary studies using the seeds of Wisconsin fast plants have demonstrated that 90% of the seeds germinate without pale swallow-wort extract, while only 53% germinate in the presence of the extract. As germination experiments continue, the results of the preliminary work suggest that an allelopathic response may be one explanation for the success of pale swallow-wort as an invasive species.

34. Ontogenetic changes in gene expression of glial cells and neurons demonstrated by RNase protection assays

Esther Ndungo

Advisor: Dr. Michael Temkin

The goals of this research project were 1) to develop protocols to use an RNase protection assay (RPA) to simultaneously measure levels of gene expression for glia, neuron, and key pH regulatory proteins of the rat brain, and 2) to follow the ontogenetic expression of these genes during postnatal development of rat by examining 11, 22 and 36 day old rats. The data from this project will be used to help evaluate the hypothesis that astrocytes in the medulla mediate ventilatory responses to CO₂ using pH regulatory molecules, including sodium bicarbonate cotransporter 1 (NBC1). Partial mRNA sequences for six different proteins, two pH regulators, NBC 1 and NBC 2, three astrocyte markers, glial fibrillary acidic protein α (GFAP α), GFAP δ , and glutamine synthetase (GS), and a neuronal marker, neurofilament light (NF-L) from the brainstem of 22 day old rats were obtained by reverse transcription-polymerase chain reaction (RT-PCR). RT-PCR products were cloned into a vector DNA and sequenced. Plasmid constructs were used as template for *in vitro* transcription reactions to generate antisense

RNA probes for RPA. RPA analysis was used to measure relative levels of gene expression in different regions of the medulla of rats of different ages.

35. Percent composition of zebra mussels (*Dreissena polymorpha*) and quagga mussels (*D. bugensis*) in the St. Lawrence River from Cape Vincent to Massena, NY.

Jonathan Redman

Advisor: Dr. Brad Baldwin

Freshwater mussels *Dreissena polymorpha* and *D. bugensis* populations were examined in the St. Lawrence River from Cape Vincent to Massena, NY. Navigational buoys were observed for surface area coverage of mussels, sampled for species composition and shell sizes of *D. polymorpha* and *D. bugensis*. There was a decline of the surface area of mussels on the buoys from 50% in Cape Vincent to less than 1% in Ogdensburg, NY. Of the samples processed thus far, there is a downstream trend of buoys dominated by *D. bugensis* with a range from 78.96% to 100% composition, and a decline in the composition of *D. polymorpha* (Cape Vincent 21.04% and Point Vivian 0%). The normal curve of the size frequency distribution suggested that there was one major reproductive cycle in the summer that produced an abundance of small mussels (3-5mm).

36. Campus tree inventory and GIS database for St. Lawrence University Campus

Josh Earl

Advisor: Dr. Wil Rivers

This study was designed to collect an inventory of the trees found in the “walking” part of campus. While this is not an exhaustive list of the trees found on St. Lawrence property, the main purpose of this study is to create a baseline GIS (Geographic Information System) of the distribution of tree species within several minutes of the science buildings. An inventory of trees on St. Lawrence campus compiled in a GIS will provide a visual groundwork for various future opportunities. Data includes genus species, DBH, and latitude/longitude coordinates for each tree in the study area. All data is collected with the Cybertracker unit. Differential correcting of the coordinates is acquired through the use of software online. Spatial representation of all data points are provided through ESRI’s Arcview 3.3 software.

Possible results of this project include further development of campus vegetation. Arboretums (a collection of woody plants representing the suite of a vegetative

community) are used across the world as an educational and aesthetic tool. Trees are strategically planted to provide food, habitat, and protection for numerous organisms which live in a forest community. Classes studying the importance of biodiversity, ecology, and general biology would all benefit from an arboretum. As this project involves finding the spatial representation of species diversity on campus, it would provide insight as to the best place an arboretum could be developed on this campus. In addition to the pedagogical benefits of an arboretum, the aesthetic benefit of is significant.

37. *The relationship between age, climate and tree ring width for Balsam Fir (Abies balsamea)*

Lucas Buckingham

Advisor: Dr. Stephen Robinson

A series of tree ring cores were collected from a stand of *Abies balsamea* (balsam fir) on Whiteface Mountain in Wilmington, New York. This stand is located on the edge of the Veteran's Memorial Highway at approximately 4000 feet above sea level, and about 600 feet below treeline. The aims of this study are to correlate annual tree ring data (width) with temperature and precipitation data, in hopes of extending the local climate measurement dataset back in time. The standard procedure involves the collection of core samples at 1.4 meters above ground level or approximately breast height. Twenty cores from live trees were collected in this manner in addition to 7 tree discs from dead trees to obtain a history that could extend further back in time than the cores. The cores and discs were then prepared so that they could be analyzed by DendroScan software, which allows the digital measurement of tree ring width. This data will be compiled with age to discern any trends with stand age, and the width of the tree rings will also be compared to temperature and precipitation to examine past climate variability.

38. *Examination of the viability of bioelectrical impedance analysis (BIA) to determine body condition in Erethizon dorsatum (the North American Porcupine)*

Ian Hubbard

Advisor: Dr. Erika Barthelmess

A study examining the viability of bioelectrical impedance analysis (BIA) as a means for monitoring body condition in the North American Porcupine (*Erethizon dorsatum*). This study calibrated RJL Systems portable bioelectrical impedance analysis monitoring equipment to provide accurate readings for total body fat in the North American Porcupine. In addition to calibrating BIA equipment for use in *Erethizon dorsatum*, researchers also collected a data pool of BIA readings for the population of

Erethizon dorsatum living in the St. Lawrence University Kip Tract natural area in the fall of 2003. From this data an understanding of body fat deposition trends was provided for the North American porcupine in the fall season.

39. *Discovery of large population of sea urchins, *Diadema a.* at San Salvador Island, Bahamas and community outreach efforts with local Bahamians.*

Woodward¹, E., Saltonstall¹, C., Krug¹, J., and Voegeli², S.

¹St. Lawrence University

²Gerace Research Center, San Salvador, Bahamas

Advisor: Dr. Brad Baldwin

Many studies indicate the important top-down role that the long-spined sea urchin (*Diadema anitllarum*) plays with respect to controlling populations of macroalgae on coral reefs. Populations of *Diadema* remain low on coral reefs along San Salvador Island, Bahamas. However, in January 2004 we discovered a relatively dense population (over 80 individuals total; up to 4 individuals /m²) of large (mean test diameter 9.1 cm) *Diadema* in a protected mangrove lagoon on San Salvador called Pigeon Creek. Very few juvenile urchins were found, suggesting infrequent recruitment to the lagoon. The density and diversity of macroalgae is lower in the lagoon as compared with that on near shore reefs where we conducted fish, soft coral and urchin snorkel and scuba surveys. We are planning reproductive studies with these *Diadema* to maintain and increase local populations. We are also in the process of documenting this important nursery area to help identify Pigeon Creek as a candidate for future marine protection. Educating local Bahamians about our research and the importance of these urchins is also vital to the recruitment and survival of the *Diadema* and surrounding coral reefs. We began this public outreach effort with local sixth and seventh grade classes on the island, and plan to continue it in the future.

40. *Does dam activity restrict gene flow?: a test using *E. complanata**

Brendan Michael Hayes

Advisor: Dr. Michael H. Temkin

The Raquette River is the second longest river in New York State, and has had its hydrology tremendously altered by human activity. The river has twenty-one main branch and three tributary dams built for either hydroelectric power generation or the creation of reservoirs. *Elliptio complanata*, a freshwater mussel ubiquitous in the St. Lawrence River basin, has provided preliminary evidence that it can be used to elucidate questions about flow changes and stream capture events using mtDNA. *E. complanata*

has a sedentary lifestyle, but does have an ecto-parasitic larval stage that relies on attachment to fish gills for dispersal. Raquette River dams were built without fish ladders making them potential sources of habitat fragmentation. Our question is to see if nuclear DNA could be used to analyze the impact that dam activity has on gene flow on the Raquette River.

During the summer of 2003 specimens of *E. complanata* were collected from sixteen sites on the main branch and eleven tributary sites in the Raquette River basin. DNA was isolated from mussel foot tissue in an attempt to identify patterns of gene flow by looking at polymorphic alleles in the Raquette River *E. complanata* population.

Although the use of RAPD proved problematic, micro-satellite primers fashioned for species of the *Lampsilis* genus have provided indications that they can be used to answer our questions regarding gene flow.

41. Hydrogeological assessment of the Little River drainage basin: comparison of river stage, groundwater flow, and precipitation

Brendan Lennon

Advisor: Dr. Stephen Robinson

This study expands on previous hydrogeological work on the Kip Tract piezometers transect located on the field at the Pike Street and Route 68 intersection, and the Little River. Head and stage are related to precipitation data downloaded from the weather station located in the field behind the St. Lawrence University physical plant. Data loggers were placed at three locations on the Little River, at the Pike Street Bridge, Park Street Bridge, and at the Little River and Grasse River Confluence. The Kip Tract transect consists of a suite of four piezometers, with each nest containing four piezometers, at depths of approximately 3,6,8 and 10 meters. Groundwater level was measured manually using a hand held meter, in addition to four loggers strategically placed along the transect. Data was organized and examined to investigate choice hydrological and hydrogeological properties of the area: baseflow drainage of the Little River after a rain event; lag time comparison of the transect and Little River; and to produce flownets of hydraulic conductivity of the transect using USGS groundflow modeling software. Following significant precipitation events, river stage responds with rapid rises in level followed by a slower decline to baseflow levels. In contrast, groundwater has a slightly longer lag-time and water levels remain high for longer duration, compared to stage. After a precipitation event of 45.77mm over 22hrs, head exhibits a lag-time almost double that of stage, and rises 2.34×10^{-3} m/hr faster than head. However, both reach maximum levels after approximately 60hrs, suggesting groundwater has a longer holding capacity in response to an event. Preliminary hydraulic conductivity studies suggest the majority of the groundwater is flowing through an extremely porous sand layer, which is sandwiched between less conductive clayey-silt on top, and an underlying till. Average hydraulic conductivity of the sand layer, based on slug tests and the Hvorslev method is 3.9×10^{-4} cm/s⁻¹.

42. Molecular dynamic simulations of water-quartz interactions on quartz surfaces

Robert Doran

Advisor: Dr. Jeffrey A. Greathouse

The objectives of this project are to explore the interactions involved in a quartz/water interface and the types of uranium surface complexes that form at this interface. The formation of complexes on inorganic surfaces as thin layers has applications in the field of synthetic bone material growth on medical implants¹. One kind of interaction is the adhesion of complexes onto inorganic surfaces. These interactions have similarities with the complexes formed by uranyl ions, UO_2^{2+} . Nuclear waste management is currently being debated at the Yucca Mountain site. One issue concerns the interactions between the radioactive uranyl ions and the surrounding inorganic materials of the mountain. Molecular Dynamic simulations are to be run to examine the possible interactions at the quartz/water surfaces. DL_POLY is the software that will be used to run each simulation. A flexible model for quartz² and the flexible SPC model for water³ are to be used in the simulations. The 001 and 101 surfaces of quartz are being examined.

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