Utah State University

POSTERS *on the* HILL

2003

Welcome!

On Behalf of Utah State University, I welcome you to "Posters on the Hill: A Celebration of Undergraduate Research." We want you to see firsthand the work of some of our finest students. These students--from throughout Utah--are available in the Rotunda to discuss their research projects and share information about their unique educational experiences and opportunities at Utah State University.

As a land-grant university, Utah State has a covenant with the people of Utah that originates in the mid-1800s through the Morrill Act. What is the covenant? That our nation's land-grant universities

- Provide access to higher education for all citizens,
- Focus on research that benefits our communities and our states, and
- Are governed publicly and openly.

Since Utah State University opened its doors in 1890 to 139 students, it has been engaged in developing citizen-scholars and problem solvers, who compete successfully in the work force and who provide a reservoir of human capital on which the development of our state depends. The tradition of hard-working students over more than a century has fueled the unprecedented economic success of Utah. We are justifiably proud of our students, past and present.

Many of these students you meet today as well as many more on campus present their research at national conferences in addition to our annual spring Student Showcase.

Thank you for taking time out of a very busy schedule to visit with these stellar students. We appreciate your support of Utah State University.

Go Aggies!

Sincerely,

Kermit L. Hall
President

Greetings!

In my role as Vice President for Research I am proud to acknowledge the long tradition of research at Utah State University. We have led in innovation in agricultural sciences, ranging from the Agricultural Experiment Station's "lecture train" of 1904 to reach farmers and ranchers in Utah and Idaho, to being known as world authorities in several areas of irrigation engineering. Because of the cooperative work between universities and farmers, American agriculture is second to none. But USU has become much more than an agricultural and engineering college. Proud of our roots, we have extended our reach to quality of life issues in the social, biological, and physical sciences, as well as to education and health, natural resources, national security, space exploration, and the arts.

America's universities are a unique national resource, providing expertise and innovation to virtually every sector of the economy. One-half of the nation's basic research is carried out at universities. The future of our national and state economies is inextricably linked with the future of our research universities. Research universities, such as Utah State University:

- Promote economic development and technological leadership;
- Educate a knowledge-based workforce;
- Conquer disease and resolve public health challenges; and
- Bolster national security in an uncertain world.

Our faculty and students are in partnership to continue the USU tradition started over a century ago of engaging in research that benefits our communities, our state, and our world. The Carnegie Research Foundation ranks USU in the top 4% of educational institutions in the country for research excellence. Research developed at USU is applied all over the world.

Teaching, research, and service go hand-in-hand at USU. Thank you for your interest in our USU students' involvement in research.

Sincerely,

Brent C. Miller
Vice President for Research

About Undergraduate Research at Utah State University

USU is strongly committed to promoting opportunities for students to work with scholars engaged in research. By *research*, we mean not only the laboratory science but also scholarship and creative activity. In brief, any student in any discipline may engage in research. Why do we believe research is so important to a student's intellectual development and growth?

Working on research projects helps students develop skills in problem solving, communication, teamwork, and technology. Not only are students becoming adept at the methods of inquiry in their own disciplines, they may also investigate new areas of study. The Undergraduate Research and Creative Opportunities (URCO) Grant program--funded by the Vice President for Research Office--supports students' independent research.

Students who complete research projects have opportunities to present their work at the annual on-campus *Student Showcase*, the National Conference on Undergraduate Research and at professional meetings. Some of USU's students' projects are published in professional journals. Scholarly work of this caliber positions students well for employment, further professional education, and graduate school.

Utah State University students had a number of notable achievements over the last year.

At Utah State University, we celebrate and promote undergraduate student achievement. We are proud to shine the spotlight on these students who were nominated and selected to participate in our third "Posters on the Hill."

Sincerely,

Joyce Kinkead
Vice Provost for Undergraduate Studies and Research

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STUDENT ABSTRACTS

RESEARCH AT UTAH STATE

Biconformal Supergravity

LARA ANDERSON
North Logan, Utah
Student Researcher

JAMES T. WHEELER
Department of Physics
Faculty Mentor

In this project we employed the Orthosymplectic group (Osp) to create a conformal gravity model. The representation of osp(4,2,C) was doubled to identify a local isomorphism between the algebras osp(4,2) and usp(8,4) (the unitary symplectic algebra). This isomorphism made it possible to create a compact internal symmetry. In addition, we investigated spinor representations of the conformal subgroup (O(4,2)) of Osp(4,2) by studying the automorphism group of the clifford algebra defined with the O(3,1) metric. Using this spinor representation and suitable gauging, it was possible to develop a well defined differential geometry over a supermanifold. We will present findings on supervolume forms including fermionic differential forms and produce several four dimensional scale-invariant gravity actions that are linear in the curvatures. These actions are shown to reproduce general relativity when reduced to the bosonic sector (this is possible due to the unique properties of the biconformal gauging of O(4,2)). In addition, the spinor components of the action are shown to produce Dirac-type field equations. The results of this work should be of interest in quantum field theory, general relativity and supersymmetry.

SSP Typing of Class I and Class II HLA Alleles from Amplified DNA of Subjects with Autism

DAVID C. ADAMS
Midvale, Utah
Student Researcher

BRENT BEDKE
Student Researcher

ANTHONY R. TORRES
Department of Biology
Faculty Mentor

We have recently linked the HLA-DRâ1-04 allele to subjects with autism spectrum disorder (AR Torres, 2002). An important extension of this work is to HLA type DNA from archival blood spots taken from newborn infants who are later diagnosed with autism. Minimizing the amount of sample used for DNA analysis is critical as the spots are valuable for many types of analysis. Generally, a DNA amplification step will be required as very small amounts of DNA are obtained from such blood spots. Here we describe our approach for typing of class I and class II alleles from samples with limited DNA using a new DNA amplification system, designated Multiple Displacement Amplification (MDA). MDA differs from other amplification methods, such as degenerate-oligonucleotide- primer PCR (DOP-PCR) or primer-extension preamplification (PEP), in that human genomic DNA can be amplified extensively (10,000-100,000 fold) without significant genetic bias or allele loss (F.

Dean et al., PNAS, in press). Another advantage of MDA over DOP-PCR or PEP is that the average size of the amplified DNA fragments exceeds 12 kb in length. Recently, 10 ng of DNA from each of 20 previously typed samples were amplified by MDA to approximately 20 ìg of DNA as determined by PicoGreen dsDNA quantitation. Agarose gel electrophoresis of the samples showed diffuse heavy bands about 20 kb for all but one sample. In our present study, we have been able to extract 1 ng of DNA from a minute fraction of a blood spot which was amplified by MDA to approximately 20 ìg of DNA as determined by PicoGreen dsDNA quantitation. At the present time we have HLA-typed amplified DNA from the 1 ng sample, however we are working to make the procedure more robust. This study will result in the ability to genotype archived blood samples in large numbers of subjects in a protocol that does not require the time and expense of patients.

Automatic Tracking System for Digital Satellite Television

AARON BUNKER
Orem, Utah
Student Researcher

DAN CHIVERS
Aurora, Utah
Student Researcher

STEVE HSIUNG
Department of
Industrial Technology and Education
Faculty Mentor

WARD BELLISTON
Department of
Industrial Technology and Education
Faculty Mentor

ENGINEERING

To track a geo-synchronous satellite from a moving vehicle, you must first find the satellite. In this case we will be looking for the two satellites used by the United States, located at 101 and 109 degrees on the same axis along the horizon. First we will position the pitch of the dish using a G.P.S. Receiver board to get a proper angle for the dish's attitude and altitude. To find the peak signal of both satellites, the use of an RSSI (receive signal strength indicator), and a shaft encoder, we will be able to record the locations, using that information to lock in on the next pass. Once the locations of the satellites are known, we will lock down on the designated satellite and begin to track. This is to be accomplished with the use of an accelerometer and an electronic gyroscope, one assigned to each axis (or motor). As the direction of the vehicle changes, the accelerometer and gyro will send signals through a micro-controller to compensate, thus maintaining signal integrity.

Cardiac RGS Protein Structural Determinants & Function

STEPHANIE CHAMBERS
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Faculty Mentor

Contractions of the heart are triggered by calcium ions (Ca) entering heart cells through L-type Ca channels. The activity of L-type channels (and thereby Ca influx) is modulated by cell surface receptors that couple to intracellular molecular switches known as “G proteins” (for GTP-binding protein). G proteins, in turn, are regulated by a newly-discovered family of proteins called RGS (for regulator of G protein signaling). RGS proteins speed the hydrolysis of GTP by G proteins, and thereby control the strength and duration of G protein-mediated signals. Several RGS proteins are expressed in heart, but their physiological significance is currently unknown. In the present study, we explored the structure/function relationships of two cardiac RGS proteins, RGS2 and RGS4. We used the polymerase chain reaction (PCR) to construct mutant RGS proteins lacking the amino-terminus, the carboxyl-terminus, or both. These mutant RGS proteins were expressed in a cell line and their abilities to influence L-type Ca channel activity were determined in electrophysiological experiments. This study reveals new insights into the functions of RGS2 and RGS4. These insights may be helpful in understanding the molecular basis of certain cardiovascular diseases.

Unraveling the Past: The Knitting Mills of Logan, Utah Circa 1904

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Department of English
Faculty Mentor

The project is an introspective study of how historical research is shaped by the researcher's personal experience as well as the presence and the absence of certain historical artifacts. Using the knitting mills of early 20th century Logan as a case study, the author explores the photographs, buildings, papers, and other original documents which attempt to preserve the past of the Logan knitting industry. However, rather than recovering the past, the project concludes that one can only reconstruct an understanding of the past through the lens of personal ideology. Therefore, it is impossible to truly recover the past. However, that does not mean this kind of research and introspection is of no value. On the contrary, this nontraditional approach to historical research is a powerful method of understanding ourselves and exploring the questions of where we came from and what value the preservation of the past has for us.

GIS and Remote Sensing to Advance Soil Mapping

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Plants, Soils and Biometeorology
Faculty Mentor

Vast areas of the western United States are in need of new or updated soil survey data. Geographic Information Systems (GIS) and Remote Sensing (RS) are tools that will greatly increase the speed and accuracy with which a soil survey can be completed. A pilot project is underway in Johnson County, Wyoming, using advanced methods to predict and map soils. In this project, GIS and RS are being used to develop landscape models. The GIS allows the users to compile useful data about a landscape in a visual format and query those data to create maps reflecting properties inherent to that landscape. Digital elevation models (DEMs), slope, aspect, climatology, geology and vegetation maps are used in this process. Satellite-derived remotely sensed spectral data are used to quantify vegetation in a given area, as well as detect changes in soils and surface rock. These parameters can be combined to develop a conceptual and semi-quantitative model predicting soil distribution on the landscape. This model is tested by observing soil properties in the field. The model is further refined using an iterative process, resulting in a map of soil distribution on the landscape. Technologically advanced tools like GIS, used in conjunction with traditional field methods, make it possible to map soils on large tracts of land quickly, accurately, and for less cost.

Results of Oxygen Levels in Welding Sanitary Stainless Steel Tubing

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Faculty Mentor

MARK BAUGH
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Industrial Technology and Education
Faculty Mentor

Oxygen contamination in argon-purge gas used in stainless welding causes what is referred to in sanitary industry as sugar or dross, an oxide layer on the ID surface of the weld bead that is rough, pitted, and porous. This oxide layer can trap product and weaken the pipe strength by buildup and contamination. This study consisted of GTA welding square butt grooves of 0.083" thick 4" OD Type304 stainless steel tube, in conformance with AWS D18.1. Argon with a varying percentage of oxygen was used to purge the inside surface of the tube. Tensile tests, weld discoloration comparisons, and surface roughness measurements of the weld joints were performed. When the oxygen level in the argon purge was increased above 0.1 vol. %, a dross oxide layer began to form. Tensile strength of the joints was not significantly affected by dross formation. However, the joint ductility (reduction of area and elongation) consistently decreased for joints welded with a purge gas containing 0.1 vol. % oxygen and greater. Young's modulus of the joints also showed a similar reduction with a purge gas of 0.1 vol. % oxygen. In conclusion, to successfully weld sanitary Type304 tube and maintain properties close to the base metal, the argon purge must *contain 0.1% or less volume of oxygen.*

Triangulation Supports Positive Effects of Wraparound Services for Utah Youth with Serious Emotional Disturbances

KELLY DOUGLAS
North Logan, Utah
Student Researcher

GLENNA BOYCE
Department of Psychology
Faculty Mentor

The Utah Frontiers Project, a Community Mental Health Services grantee, uses a system-of-care approach called "wraparound" to provide services for youth experiencing serious emotional disturbances in rural communities of Utah. This research, useful for both policy makers and practitioners, is examining changes over time in child functioning, child behavior problems, and caregiver stress scores. Statistically significant findings indicate child functioning and behaviors have improved, and caregiver stress has decreased. Especially noteworthy is that these positive indicators of improvement in family well-being have been obtained from three different sources: the youth, his or her caregiver, and the clinician. This triangulation lends strong support for the success of the wraparound process.

Activating Plant Reporter Genes as a Natural Defense Mechanism

BRANDT ESPLIN
Spanish Fork, Utah
Student Researcher

ANNE ANDERSON
Department of Chemistry
Faculty Mentor

A common aspect of many higher organisms, including plants and animals, is that of physiological response to stress stimuli. These responses may help the organism to overcome the challenge, such as invasion by a pathogenic microbe. In agriculture, there is a need for new strategies that do not rely on toxic chemicals to protect plants from pathogenic microbes. Activation of the plant's defense mechanisms is one such strategy. Defense genes can be activated by chemicals and by certain microbes. I will study the mechanism by which a potential plant defense gene is activated. I will use a model system involving a plant transformed with a fusion of a defense gene promoter and a reporter gene. The plant defense gene encodes a copper-binding protein of as yet unknown function. I am monitoring induced expression of the promoter by measuring the activity of the reporter system to identify chemicals and microbes that could activate plant defenses. These studies may help the integration of alternative sustainable and eco-compatible methods of plant disease control into agriculture.

Appropriate Behavior in Inappropriate Settings: Altering Orphaned Horse Behavior with Positive Reinforcement

KELLI FIFE
North Logan, Utah
Student Reseacher

CARL CHENEY
Department of Psychology
Faculty Mentor

This case involves a horse, orphaned at twelve hours old. There are statistics regarding the survivability of horses orphaned at this age, primarily because the probability is so low. In this case, no nurse mare was available to raise the orphan. The horse was raised by humans from twelve hours old. This male colt exhibited normal behavior patterns, including interacting with his human caretakers as he would interact with other members of a herd. Several of these fixed action patterns had the potential for being physically dangerous to his caretakers as well as decreasing the probability of performing the normally expected tasks of an adult horse. First, young horses practice their horse prowess with their mothers and other baby horses by biting back and forth with each other. Secondly, after the biting resolves or fails to establish “a winner” the behavior progresses to rearing and striking out at the opponent. In normal herd dynamics it is not unusual for baby horses to spend several hours a day in these types of activities. To ensure the long-term survivability and productivity of this horse, it was necessary to allow him behaviors typical of his species, but teach him that his surrogate “herd” had limitations. In addition to the fixed action patterns identified for modification, the colt exhibited annoyance by pounding the ground with his front foot. These behaviors were identified and a course of action utilizing positive reinforcement for alternative behavior was undertaken. The program was successful in completely alleviating the biting and rearing in the presence of humans. The ground pounding has been reduced by about fifty-percent.

Cultural Identity in Huanchaco, Peru: Documenting Change and Transition

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Student Researcher

CHRISTINA DIRAIMO
Student Researcher

BONNIE GLASS-COFFIN
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Faculty Mentor

Huanchaco is a fishing village of approximately 50,000 residents located on the coast of Peru, near the northern capital of Trujillo. As Huanchaco remakes itself as a regional tourist attraction, this once sleepy village is undergoing rapid change. The totora reed fishing boats for which the village is famous are in danger of disappearing as urbanization and new roads encroach on the wetlands surrounding the area where the totora reed has been harvested for generations. Changing weather patterns, overfishing, and the lure of better-paying jobs have also contributed to decrease in fishing as a subsistence activity. Now, it is common to see surfers from as far away as San Diego and Melbourne sharing the waves with local fishermen. Utah State University students have joined with local hotel owners, surfers, artisans and fishermen to question if and how tourism and the traditional fishing industry can co-exist as development continues.

Clarifications on the Type A Behavior Pattern: A Theoretical Perspective

N. DAREN HAWS
North Logan, Utah
Student Researcher

KEN BARTKUS
Department of Business
Faculty Mentor

The Type A Behavior Pattern (TABP) has received considerable attention in social science and business literature due to its presumed influence on work-related performance. The study argues that research in this area has been hampered by a lack of theoretical documentation.

First, the hypothesized relationship between achievement striving and impatience-irritability has been based almost entirely on clinical observation and empirical regularities rather than theoretical rationale. Second, the hypothesis that impatience-irritability does not influence work-related performance outcomes is counter-intuitive and atheoretical. Using developments in the areas of perfectionism and negative affect, this study proposes to bridge the theoretical gap in traditional TABP/Work-performance research by presenting a revised model that has important implications for the development of a TABP theory.

Examining the Chelungpu Fault: Implications for Understanding Fault Structure, Displacement, and Ground Motion

ANGELA ISSACS
Student Researcher

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Department of Geology
Faculty Mentor

On September 21, 1999, the Chelungpu fault of Taiwan ruptured producing a 7.6 M_w earthquake and a 90km fault scarp. In February 2002, three sites along this fault scarp were studied in detail. Transects were made from the 1999 scarp into the hanging wall. From this work, as well as previous studies, it is apparent that the characteristics of the Chelungpu fault vary greatly along the fault trace. Northern rupture sites show much greater offset and less high-frequency ground motion than southern sites. Slip along the northern part of the fault appears localized on discrete slip surfaces indicated by an isolated, narrow clay gouge zone. Slip on the southern portion of the fault is diffused into a very wide damage zone of fractured and deformed shale with many clay gouge surfaces. Clay mineralogy and microstructural analysis of field samples aids in a better understanding of the structural differences between the northern and southern ends of the Chelungpu fault. Smectite/Illite trends and reactions were studied, as well as deformation in thin sections. Studies such as these are important in contributing to the understanding of fault structure and corresponding displacement and ground motion. Such understanding will help us to interpret areas of greatest risk and most importantly reduce earthquake fatalities.

Relationship Between Near Surface Geologic Conditions and Fault Scarp Dimensions: Implication for Seismic Hazards Analysis

NATALIE JORGENSEN
Glenwood, Utah
Student Researcher

JIM EVANS
Department of Geology
Faculty Mentor

Active thrust faults pose a significant destructive threat in zones of crustal shortening. Many thrust-type seismic events do not produce fault scarps, and post/rupture erosion makes recognition of earthquake hazards difficult. We examine how near-surface geologic material and structure is related to the amount of offset and magnitude of thrusting events. We queried thrust/reverse earthquakes documented by Lettis et al.1 for: moment magnitude, fault location, geologic material and structure, surface displacement; and have analyzed 16 events to date. The events that occurred in sedimentary rock oriented sub-parallel to faulting show significant offsets at moment magnitudes greater than 7. In contrast, most of the events in crystalline rock and/or those whose faults are buried by 10's to 100's of meters of unconsolidated material show no surficial offset. The data show that possibly all thrust/reverse events in convergent margins that produce surficial offset occur in sedimentary rock lying sub-parallel to faulting with moment magnitudes greater than 6.5. Earthquakes that occur within crystalline rock rarely, if ever, result in a fault scarp. We interpret these results to show that faults in crystalline rocks may have higher coefficients of friction than sedimentary rocks, and therefore do not generate much slip. These results indicate that mechanical properties, geologic structure and composition are important to fault propagation. These results have significant implications for paleoseismicity and seismic hazards analyses.

Recreation in the Montane Streams of the Puerto Rican Rainforest

SUMMER KARTCHNER
Student Researcher

MARK BRUNSON
Department of
Forest, Range, and Wildlife Sciences
Faculty Mentor

The Caribbean National Forest in Puerto Rico is unique within the national forest system in several ways. Because it is the only national forest located outside the 50 United States, visitors may differ in significant ways from those who are typical of other national forests. Also, as the only rainforest in the national forest system, its terrestrial and aquatic ecosystems may be affected by human uses in ways that are not typical of national forests. Recreational use of the montane streams and rivers of Puerto Rico's rainforests is increasing with the island's rapid population growth. Forest managers must strive to more fully understand recreation trends in order to make effective management decisions to protect the streams while meeting public needs. Knowledge is needed about the demographics of recreationists and other stream users, how often they visit the rivers, what activities they participate in once they are there, users' knowledge of the stream systems, and opinions about government involvement in stream protection. This poster describes an exploratory study of these factors. On-site interviews were conducted in June-August 2001 of approximately 175 recreation visitors and 25 shrimp fishermen using two streams that rise in the Caribbean National Forest. Survey sites include two sites on the national forest and two downstream public access sites. Results show that shrimp fishing is both a traditional use and a recreation activity that has potential to affect aquatic ecosystems by removing significant numbers of shrimp from streams. Other recreation uses similarly have characteristics both of traditional uses and contemporary public land recreation activities. For management efforts to be successful, forest managers must recognize the unique interrelationships between rainforest users and the aquatic and forest ecosystems of Puerto Rico.

Ammonia Oxidizing Bacteria

JUSTIN MELLOTT
Morgan, Utah
Student Researcher

JEANETTE NORTON
Department of
Plants, Soils, and Biometeorology
Faculty Mentor

Ammonia oxidizing bacteria (AOB) play an important role in the first steps of nitrification which is a major process in the soil nitrogen cycle. Some bacteria are able to use urea as a source of ammonium by means of the urease enzyme. My project specifically has been with Nitrosolobus multiformis, an AOB that is able to use urea as a source of ammonium. We have been trying to better understand this process and have successfully sequenced a section of the urease operon. This is an ongoing project to sequence urease genes from several AOB isolated from different environments.

Design and Construction of a Flow-Through Thermoacoustic Cooler

CHRISTINE MERRILL
Heber, Utah
Student Researcher

MARRINER MERRILL
Provo, Utah
Student Researcher

J. CLAIR BATTY
Department of
Mechanical and Aerospace Engineering
Faculty Mentor

Christine and Marriner are both members of a five-member undergraduate research team that has accepted an extremely challenging task. This team is designing, building, and testing a laboratory experiment with an objective that has, to the best of our knowledge, never been attempted or achieved. That objective is to build an air chiller with no moving mechanical parts and no working fluid other than the atmospheric air being chilled. The concept is to use ordinary radio speakers to introduce acoustic sound waves into an open tube containing atmospheric air. Then using known principles of thermoacoustics and a carefully designed and strategically positioned air passageway called a stack, it is theoretically possible to reduce the temperature of the exiting air. To date the team has been successful in obtaining a temperature drop of 47 degrees Farenheit across a stack crafted of plastic overhead projector sheets, fishing line and glue. The long-range objective of this research is to investigate the economic feasibility of air-conditioners that cost less to manufacture than the complicated vapor compression systems now in use and require no refrigerant or other working fluids to potentially damage the environment.

Quality and Distribution of Soil Organic Carbon in Rangeland and Forest Soils: Implications for Global Change

JULIA NIELSEN
Taylorsville, Utah
Student Researcher

MICHELLE BAKER
Department of Biology
Faculty Mentor

Sequestration of carbon (C) by soil organic matter (SOM) in terrestrial ecosystems may slow anthropogenic atmospheric CO2 increases. We studied the quality and distribution of SOM in rangeland and forest soils. Soil samples were collected from sagebrush, conifer, and aspen ecosystems. C content and quality was measured in the lab. SOM was low in sagebrush soils and high in conifer and aspen soils. Labile (biologically available) carbon was highest in conifer forests. SUVA values increased with depth markedly in conifer and aspen soils. Vegetative communities appear to have intrinsic differences in SOC dynamics. SOM and SUVA data suggest sagebrush soils may be significant players in carbon sequestration.

A Profile of Consumer Bankruptcy Petitioners

TIFFANY SHERWIN
Student Researcher

JEAN LOWN
Department of
Family and Human Development
Faculty Mentor

Utah ranks first in the nation in the number of consumer bankruptcies per household. This study 2,567 Chapter 7 and Chapter 13 cases filed in the U.S. Bankruptcy Court for Utah in Median debt level was $31,981 for Chapter 7 and $41,626 for Chapter 13 cases. While boasting a high proportion of Chapter 13 repayment plans, only 102 (10.8%) of these cases successfully completed them. Another 126 cases (13.4%) were still active in repayment plans, for a total of 228 (24.2%) successful outcomes. Debtors tend to be young, single, and have dependents and short jobs. Low per capita income and large families contribute to Utah's high bankruptcy rate. Characteristics of bankruptcy filers will be helpful to financial educators, the legal community, and policy makers, especially under the shadow of the proposed reform legislation.

Fungicidal Activity of Ice-Nucleation and Artificial Snow Bacterium

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North Logan, Utah
Student Researcher

AL BURNS
Student Researcher

JOHN TAKEMOTO
Department of Biology
Faculty Mentor

The ice-nucleating plant bacterium, *Pseudomonas syringae* strain 31R, is the basic ingredient of products currently used for large-scale artificial snow production in the ski industry. Since production of antifungal cyclic lipopeptides is a common property of *P. syringae* species, the ability of strain 31R to produce these compounds was studied. Culture filtrates of strain 31R grown in potato dextrose medium were found to have striking inhibitory activity against the yeast fungus, *Rhodotorula pilimanae*. Extracts obtained after acetone extraction of cell cultures of strain 31R also displayed strong fungicidal activity against *R. pilimanae*. A variety of tests that included measurement of pH and heat stabilities and chromatographic properties indicated that the fungicidal activity was due to the production of cyclic lipodepsipeptides - compounds that were previously shown to possess potent fungicidal activities. Several other fungi were inhibited by the extracts. Chemical structure determination of the extracted and purified fungicidal material is currently underway. These observations suggest that strain 31R based commercial materials used to make artificial snow (e.g. Snomax) have fungicidal properties, and they raise the possibility that such use impacts the microbial ecology of the land areas exposed to these materials.

With a Joint View to the Entertainment and Information of Mankind

SARAH WEGENER
Sandy, Utah
Student Researcher

NORM JONES
Department of History
Faculty Mentor

Synthesis of Trehalose Based Anti-Tubercular Agents: An Application of Rational Drug Design

JOHN WENNERGREN
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Student Researcher

TOM CHANG
Department of
Chemistry and Biochemistry
Faculty Mentor

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Department of
Chemistry and Biochemistry
Graduate Advisor

Tuberculosis (TB) has been documented throughout human history and still is the leading cause of death from a single infectious disease. It is calculated that TB infected an estimated 1.7 billion individuals worldwide with a fatality rate of approximately 2-3 million every year. Recent research has identified a potential target for the development of new anti-tubercular drugs. Three homologous proteins (antigen 85A, B and C), which posses mycolyltransferase activity, are responsible for the biosynthesis of TDM (6,6'-dimycolytrehalose), which in turn is responsible for the formation of the outermost layer of the bacterial membrane of mycobacterium. Today detailed structures of antigen 85 have been identified using x-ray crystallography. We predict that the lipophilic side chain will be crucial for the binding affinity of trehalose derivatives with antigen 85. We have completed the synthesis of a series of trehalose derivatives. Most of them have been assayed against *Mycobacterium smegmatis*, a non-pathogenic form of tuberculosis. We have surveyed several functionalities and found that a compound containing amide bondsat the carbon 6 position are most effective thus far.

The Efficient-Market Hypothesis

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Student Researcher

ALAN STEPHENS
Department of Business
Faculty Mentor

The Efficient-Market Hypothesis (EMH) states that an investor cannot consistently beat the market because stocks are priced to quickly reflect information about companies including expected returns and levels of risk. In the weakest form, the EMH says that it is impossible to use past stock market information to obtain returns in excess of what is expected on the basis of risk. The semi-strong version states that any piece of relevant information that becomes publicly available cannot be used to obtain excess returns. Finally, the strong form implies that not even insider information will result in excess returns because all relevant information is already impounded in the price. To test the EMH, the returns of the S&P 500 Index were compared with returns of portfolios of stocks chosen by students who used fundamental analysis to make a buy/no buy decision. Three portfolios were analyzed over separate periods of 98 days during market decline. In each case, the students' portfolio beat the market. While the results are not significant due to the small number of portfolios analyzed and the short holding periods, they could indicate that during a recessive market period financial analysts can apply financial analysis tools to outperform the market.

Research at Utah State Univerisity Building on a History and Tradition of Excellence

1888 Land-Grant College approved for Logan.

1890 Classes began at the Agricultural College with 139 students (coed); curriculum emphasized practical education as well as the classics and literature

1893 The Agricultural College of Utah won a bronze medal for its exhibits on field research at the Columbian Exposition, Chicago's World Fair

1896 Cazier-Act passed to fund Agriculture Experiment Station to hold an annual Farmers' Institute in each of the new state's 27 counties--Extension Service began

1903 State authorized establishment of six branch arid farms throughout the state to perfect dry-farm agriculture

1903 President Kerr advocated awarding of graduate research degrees

1904 "Lecture Train" featured whistle-stop teaching in Utah and Idaho with exhibits from the Experiment Station

1904 The AC won a gold medal for its research exhibits at the World's fair in St. Louis

1906 Extension department established

1908 First scientific studies to measure the application of water to crops and vegetables at Greenville Farm in North Logan

1909 Ground-breaking research on spread of plant disease by insects

1910 Dry Farming, by John A. Widstoe, an agricultural classic, published

1911 First County Agent in Utah and in the West--Luther M. Winsor--placed in Vernal

1913 Branch agricultural college established at Cedar City Normal School

1914 First master's degree graduated

1920s Farmers and homemakers encampment-- "Tent City"-- on the Quad every summer

1923 First winter snow surveys used to predict irrigation water supplies

1924 National Summer School established, featuring distinguished scholars

1926 Department of Rural Sociology founded to study community life and rural home conditions

1929 Agricultural College of Utah renamed Utah State Agricultural College

1931 First new plant variety developed specifically for Utah farmers: “Relief” winter wheat

1934 Intermountain Herbarium established

1934 May Swenson, noted poet, graduated from USAC

1936 Forestry Camp established in Logan Canyon to serve as off-campus laboratory

1938 National History Field Expedition to conduct studies in southern Utah

1939 Utah State faculty advised Iran on water, soils, and crop management

1947 Research Foundation established; Graduate School founded

1949 Utah State faculty increased international involvement, administering President Truman’s Point IV programs in Iran and participating in Greece, Turkey, and Lebanon

1950 First Ph.D. candidate graduated

1951 Branch agricultural college established at Snow College in Ephraim (until 1966)

1954 Utah Botanical Center established to demonstrate and practice sustainable principles to reduce impact on the land and its valuable resources

1955 Division of Research is created; headed by D. Wynne Thorne, also Director of the Agricultural Experiment Station

1957 The Utah State Agricultural College granted university status

1959 Electro-Dynamics Lab established

1960s Development of Trackmaster Snowcats and spin-off of Logan Manufacturing Company; commercialization of Wescor for soil sciences applications and medical devises for blood serum testing

1965 President Glen L. Taggart established office of Vice President for Research, filled by D. Wynne Thorne

1965 Utah Water Research Lab established--one of the largest hydraulic research laboratories of its kind in the U.S.

1967 Continuing Education Center established at Uintah Basin

1967 Ecology Center established; studies include brine shrimp, Antarctic ozone hole effect on plant DNA, mountain lion and Grizzly Bear populations and habitat

1967 Influential *Economics of Range Improvements* published

1969 Space Science Laboratory and Center for Research in Aeronomy established-now called The Center for Atmospheric and Space Sciences (CASS)

1970 Space Measurements Laboratory established

1972 Center for Persons with Disabilities established

1975 SKI*HI Institute established to help children with sensory impairments

1976 USU begins work on NASA Get-Away Special (GAS) and becomes the #1 University with GAS payloads

1979 Rick Bass, noted nature writer, graduated from USU

1982 First student-generated space project from USU and the world orbited on the Space Shuttle

1982 Early Intervention Research Institute established in College of Education

1985 USU alumna Dr. Mary Cleave, a Shuttle crew member, carried on-board a USU Centennial Banner

1986 Research and Technology Park established

1986 Biotechnology Center established

1986 USU hosted its first annual Small Satellite Conference, which continues in 2003

1987 Utah State University ranked first on a per capita basis for its work in international development

1988 Space Dynamics Laboratory evolved from earlier aeronautical labs founded in 1959; more than 400 research payloads in a 40 year history; a world leader in sensor systems

1988 Western Dairy Center establishes a consortium of researchers and universities dedicated to understanding the complexities of milk and to developing new technologies and products from milk

1989 The Huntsman Environment Research Center established to engage in research in the key areas of recycling, degradability, improvement of air and water quality and conservation of trees

1990 U.S. Department of Defense listed USU as 6th largest university contractor; National Science Foundation ranks USU 61st among all universities for grants

1990 Engineering Education journal listed USU as #1 in the nation for research funds generated per faculty member

1990 *Great and Peculiar Beauty: A Utah Reader*, centennial anthology by editors Tom Lyon and Terry Tempest Williams

1991 Remote Sensing and GIS Laboratory established for application development and research

1992 Sorenson Vision commenced research into better ways to digitally store, receive and transmit high-resolution medical images, drawing on technology from Utah State University

1993 National Institutes of Health study on environmental and genetic determinants of dementia, especially Alzheimer's disease

1994 *Oxford History of the American West*, edited by Clyde Milner, II and Carol O'Connor, won the Western Heritage Award from the Cowboy Hall of Fame

1995 The National Center for Hearing Assessment and Management established at USU to oversee universal testing of newborns

1995 Social scientists Susan Dawson and Gary Madsen published groundbreaking work on the effects of uranium mining on Navajo families in the Four Corners

1995 Pathway to the Arts, an outdoor sculpture program, established

1996 Affiliated Research Center established with 8 other universities in the United States to perform state-of-the-art work in Remote Sensing, GIS and GPS areas

1997 Region VIII Head Start Disability Services Quality Improvement Center established

1997 National Institutes of Health grant to conduct statewide study of genetic and nutrition factors affecting hip fractures

1997 Applications of geographic information systems (GIS) in national resources management of farming

1998 The only cooperative program between the US Department of Defense and the Russian Ministry of defense (RAMOS) located in SDL at USU

1998 Emma Eccles Jones Early Childhood Center established

1999 Spider Lamb Syndrome on the road to elimination due to research by Noelle Cockett, a Fellow of the American Association for the Advancement of Science (awarded 2001)

1999 NASA named its first extension specialist--Phil Rasmussen--to help farmers and ranchers use satellite images to minimize environmental impacts while maximizing production

2000 USU's Space Dynamics Lab mapped global weather patterns, improving forecasts and tracking potentially deadly storms, through its new satellite-born sensor

2001 USU Research and Technology Park became "Innovation Campus"

2001 Janet Anderson's research of food preparation and safety publicized nationally on TV and radio and in the press.

2001 Jeanne Thomas and her students in the Folklore Program requested by the Library of Congress to collect and make sound recordings of Americans' accounts of and reactions to the terrorist attacks of September 11.

Utah State University Research Highlights - 2002

INNOVATION CAMPUS

In 2002, Utah State's research park, Innovation Campus, dedicated the Space Dynamics Laboratory's Calibration and Optics Laboratory and the Smart Sites building, which will help coordinate Governor Leavitt's economic Smart Sites program. These two buildings and others in the works provide national exposure for the Innovation Campus.

GOVERNOR'S MEDAL

In May 2002, Dr. Steven Aust, professor of chemistry and biochemistry at Utah State, was awarded the Governor's Medal in Science and Technology, which is Utah's highest honor given to scientists.

WRIGHT FLYER

In August 2002, a team of Utah State University undergraduates, celebrating the 100-year anniversary of the Wright brothers' first flight, unveiled their re-creation of the original Wright flyer made with modern materials at the Logan/Cahce Airport. The team plans to take the flyer on a national tour during the summer of 2003.

BGRC RESEARCH CENTER

In September 2002, Utah State's new Biotechnology and Genomic Research Center was established, bolstering Utah State's worldwide reputation in agricultural biotechnology, natural populations, and microbial genomics.

WEST NILE VIRUS RESEARCH

In November 2002, representatives of Utah State's Institute for Antiviral Research (IAR) met with the National Institutes of Health (NIH) to discuss the IAR's efforts in developing a cure for West Nile Virus.

WATER INITIATIVE

In November 2002, President Hall delivered a charge to create a multidisciplinary water initiative that will address water concerns in Utah and create a world-renowned graduate program in this field.

Utah State University Student Research Profile

URCO GRANTS

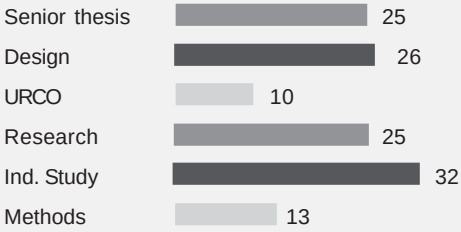
Each year, Utah State's Vice President for Research and each academic department provides grants for students to conduct their own research projects or creative works, called Undergraduate Research and Creative Opportunity (URCO) grants. The projects often create publishable results. Last year, 25 students conducted URCO research projects.

NATIONAL RECOGNITION

Every April, the USU Student Showcase highlights outstanding work done by students. Many of those students presented their work at national conferences in theri fields. Two student projects were also exhibited at Washington D.C.'s Undergraduate Posters on the Hill.

RESEARCH COURSES

USU students get an education with a practical emphasis. Utah State offers 131 undergraduate research-related courses.



1,400 students conducted their own research projects to earn course credit. Addtionally, Virtually all 3,587 graduate students attending USU in 2000-2001 actively conducted research projects of their own.

RESEARCH EMPLOYMENT

Last year, federal government and private businesses provided funding to pay 1,480 students to conduct or assist with research projects at USU. Most of those jobs were based in each student's educational major. Innovation Campus, Utah State's research park, also employs 900 students.

Utah State University
Facts of Interest

GENERAL FACTS

Enrollment	23,000
Faculty	790
Tuition (in-state)	$1,449
Tuition (out-of-state)	$4,100

Utah State University was named one of "America's 100 Best College Buys" for two years in a row with the 4th lowest in-state tuition and 12th lowest out-of-state tuition in the nation.

Financial Aid and Scholarships
Last year Utah State distributed more than $56 million in scholarships and federal aid to nearly 60 percent of enrolled students.

RESEARCH FACTS

Classification
Utah State University is classified as a Carnegie Foundation Doctoral Research University--Extensive, which is the highest possible. Only four percent of other higher education institutions share this top rank.

2002 Sponsored Program Awards $123,304,657

Utah State University is 12th in the nation in funding from the U.S. Department of Defense and receives 72 percent of research revenues from the federal government.

REVENUES by SOURCE, FY '01

Source	Amount	% Total
Tuition and Fees	$57,930,636	15.9%
Federal Appropriations	$4,311,520	1.2%
State Appropriations	$121,272,727	33.3%
Government Grants and Contracts	$107,524,221	29.5%
Private Gifts, Grants and Contracts	$22,284,916	6.1%
Endowment Income	$1,728,014	0.5%
Sales and Services of Educational Activities	$5,292,286	1.5%
Auxiliary Enterprises	$29,353,349	8.1%
Other Sources	$14,824,775	4.1%
Total USU	**$364,522,444**	**100.00%**

VICE PRESIDENT *for* RESEARCH

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