

january 26, 2006:



# Research

on capitol hill

**UtahState**  
UNIVERSITY



Welcome!

On behalf of Utah State University, I welcome you to 2006's Research on Capitol Hill. Each year, students from throughout Utah gather at the state capitol to share a year's worth of hard work and discovery with their peers and the rest of the state. These students truly represent the finest young minds in Utah.



I invite you to experience firsthand the outstanding effort of these students. Their interests are diverse, yet each of their projects contributes to our collective body of knowledge and our ability to address real-life issues.

The findings of these projects will be far-reaching. Some of them will be published in academic journals, while others will be presented at research conferences throughout the country. Many of them will be used to solve practical problems by guiding action on community and state issues.

At the same time, these students have been well-primed to achieve even greater intellectual, practical, and personal accomplishments in the future. By honing their inquisitive instincts and scientific skills, they will be prepared to make significant contributions to Utah's economy and intellectual capital.

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

Sincerely,

A handwritten signature in cursive script that reads "Stan L. Albrecht". The ink is dark and the signature is fluid and legible.

Stan L. Albrecht  
President

welcome:

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Greetings!

What does undergraduate research do for Utah? Students who participate in research projects are better learners, better citizens, and better contributors to Utah's future workforce. The skills they gain translate not just to their field of study but to broader analytical, leadership, and teamwork situations.

While undergraduate research helps students "get an edge" in their education, the students, in turn, use their skills to help solve some of the world's basic, persistent problems. As you will see, their efforts are having a global impact.

For example, in this year's Research on Capitol Hill, you'll see student members of the USU chapter of Engineers without Borders who have worked to create unique housing and water solutions for developing areas of the world, including China, Tibet, Peru, and Uganda. The results of their efforts will benefit communities throughout the world and may also create the blueprint for larger efforts.

We are extremely proud of our undergraduate students' accomplishments and invite you to get to know them and their extraordinary projects through Research on Capitol Hill.

Thank you for your interest in our students' research.

Best Regards,

A handwritten signature in black ink that reads "Brent C. Miller" with a long, sweeping underline.

Brent C. Miller, PhD  
Vice President for Research

Welcome to Research on Capitol Hill!

When we think about undergraduate research at Utah State, we think *invaluable*. Utah State University is a national leader in undergraduate research by providing hands-on learning opportunities for students for over a century. Amanda Mortensen works with Dr. Butch Brodie on co-evolutionary relationships between snakes and poisonous newts. As a sophomore she will be first author on a research article. Brianne Bartlett, Elementary Education major, works with Professor Scott Allgood on a project focusing on advanced readers. Brianne has already presented her research at a national professional conference. Grayson Weeks spent the summer working in Washington, D.C. at the Center for Civic Education. Grayson is committed to helping students K-12 understand the democratic process. Kristen Mortensen, works with Dr. Barton Smith in his fluid dynamics lab. She knows that this work will help her in biomedical heart research after graduation.



Undergraduate research means laboratory science, scholarship and creative activity. Students with a research track record are more competitive for graduate school fellowships and career opportunities.

*Invaluable?* Yes. At Utah State, we are asking questions, addressing problems, and preparing the next generation of leaders.

Sincerely,

A handwritten signature in cursive script that reads "Joyce Kinkead". The signature is written in dark ink on a white background.

Joyce Kinkead, PhD  
Vice Provost for Undergraduate Studies and  
Research

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## Do Job Titles Matter? A Content Analysis and Survey of Consumer Perceptions



**Zachary Ames**

Taylorsville, Utah  
Student Researcher



**Kenneth Bartkus**

Business Administration  
Faculty Mentor



**Stacey Hills**

Business Administration  
Faculty Mentor

Good brand names should be short, easy to pronounce and remember, and provide the correct connotation for the brand. It is important to regularly monitor consumer perceptions in order to ensure that names remain relevant and effective. These principles appear applicable to job titles as well. The titles that organizations use to identify job positions can be considered a type of branding. The job title “stewardess” has been replaced with flight attendant; “mailman” has been replaced with postal or mail carrier; auto “mechanics” are now sometimes referred to as auto technicians. Walmart and Disneyland have historically referred to their employees as “associates” and “cast members.” This

study examines the variance in job titles for individuals working in sales at automotive dealerships. Using a two-stage process, business cards are first collected from a representative sample of automobile dealerships in the Salt Lake metropolitan and surrounding areas. The data are then coded and evaluated. The main purpose is to examine the types of job titles used. In the second stage, we conduct a consumer perception survey of the two most common job titles to examine if alternative job titles elicit different connotations in consumers’ memory. Implications will be provided for future research as well as for organizations considering changes in job titles.

## Enhanced Adhesion of Insulin-Secreting Cell Lines to Polysulfone with Collagen IV



**Ryan Angus**  
Vernal, Utah  
Student Researcher



**Kytai Nguyen**  
Biological & Irrigation Engineering  
Faculty Mentor

Type 1 diabetes is a growing health problem. This auto immune disease results in the destruction of insulin-secreting beta cells in the pancreas, leading to devastating conditions such as renal disease, blindness, heart failure, amputation, and ketoacidosis. One approach to treat these disorders is the encapsulation of insulin-producing cells in a biocompatible polymer that provides mechanical support for cell growth and immunoprotection. However, these particular cell types often appear

in clusters and do not adhere well to most polymer surfaces. This often results in cell death due to limited nutrient diffusion into the cell mass. The purpose of this research is to investigate strategies that enhance the viability of insulin-secreting cells within polysulfone membranes. Strategies to decrease cell-to-cell adhesion and maintain normal cell activities, including insulin production while protecting the cells from the immune system of the patient, are presented.

## **Advanced Readers' Perceptions of Interest, Challenge, Choice, and Enjoyment of Reading Instruction in their Classrooms**



**Brianne Bartlett**  
Hyrum, Utah  
Student Researcher



**Scott Hunsaker**  
Elementary Education  
Faculty Mentor

The failure to address the needs of advanced readers can result in declines in positive attitude toward reading. This is why The World Class Reader Model was created, which consists of: 1) Learning to Read; 2) Reading to Learn; 3) Reading for Leisure; and 4) Reading to Serve. During Learning to Read, students select broad-based literature, extend vocabulary study, consider important issues, and comprehend grammar development. Reading to Learn is where advanced readers understand interdisciplinary connections, use a variety of advanced inquiry skills to identify bias and extract relevant information from literature, and demonstrate proficiency in working with inference. Reading for Leisure is where students use reading to complete depth work in a self-selected area and make connections with self-

selected literature. Reading to Serve is where advanced readers apply reading skills in problem solving processes and use tools to analyze information that addresses community, national, or global issues. Advanced readers from selected Utah school districts were asked, at the beginning of the final semester of the school year, to assess their perceptions of reading instruction in their classrooms. The same survey was administered at the end of the school year. While fourth- and sixth-graders still showed decreases in positive feelings toward reading, fifth-graders unusually increased in the post-survey. This interruption of the pattern provides hope that the effect of the appropriate instruction for advanced readers over an entire school year could have a more dramatic effect.

## Reanalysis of the Enigmatic Late Triassic Reptile *Vancleavea campi*



**Bronson Barton**  
Panguitch, Utah  
Student Researcher



**W. David Liddell**  
Geology  
Faculty Mentor

The Late Triassic (225 to 208 million years ago) was a time of great change among land vertebrates: Mother Nature was experimenting with a variety of forms and types. The first mammals, turtles, crocodiles, pterosaurs (flying reptiles), and dinosaurs (including birds) evolved during this time, along with many now extinct “evolutionary experiments.” Indeed, the Late Triassic represents the single greatest diversification event of terrestrial tetrapods. Perhaps the most successful group of animals to evolve during this time was the Archosauriformes, or “ruling reptiles.” Dinosaurs, birds, and crocodiles all belong to this group, as well as many of the extinct groups. Among the experimental

forms that evolved during the Late Triassic is a strange armored reptile named *Vancleavea campi* from the southwestern United States. Resembling an odd mixture between an armadillo and an iguana, *V. campi* belongs to a relatively unknown – and unnamed – group of basal archosauriforms. Several new specimens of *Vancleavea* or *Vancleavea*-like animals have recently been discovered. Among these new specimens is PEFO 31202, a partial skeleton from Petrified Forest National Park, Arizona. PEFO 31202 is currently being prepared for study, and, along with other new discoveries, promises to shed some light on the origin and evolutionary success of the archosauriformes.

# Structural and Lithologic Characterization of the SAFOD Pilot Hole and Phase One Main Hole



**Daniel Barton**  
Hyrum, Utah  
Student Researcher



**James Evans**  
Geology  
Faculty Mentor

The San Andreas Observatory at Depth was developed to answer questions pertaining to the physical and chemical processes controlling faulting and earthquake generation within a major plate-bounding fault. A zone of repeating micro-earthquakes was targeted, and an inclined borehole was drilled, intersecting the targeted zone at a depth of 3.2 km (10,100 ft). Petrological and microstructural analyses of drill cuttings were conducted for the SAFOD Pilot Hole and Main Hole projects. Grain mounts were produced at ~30 m (100 ft) intervals from drill cuttings collected from the individual holes. Thin-section grain mount analysis included identification of mineral composition, alteration, and deformation within individual grains. Lithologic features in sedimentary deposits of both the Pilot Hole and Main Hole include fine-grained, thinly

bedded sediments with clasts of fine-grained volcanic groundmass. Deformation mechanisms observed within cuttings of granitic rock include intracrystalline plasticity and cataclasis. Regions within both drill holes where cataclasite abundances range from 20-30 weight percent are interpreted as shear zones. Shear zones identified in the Pilot Hole correlate to geophysical data obtained in 2004. The shear zones identified in the Pilot Hole are interpreted to be offset from shear zones identified in the Phase 1 Main Hole. If this is the case, it can be explained by steeply dipping subsidiary fault zones, likely associated with the San Andreas Fault system. The identification of shear zones utilizing drill cuttings can be used to validate hypotheses pertaining to faulting and earthquake generation in the San Andreas Fault zone.

# USU Small Satellite Program: TOMographic Remote Observer of Ionospheric Disturbances (TOROID)

**Program Manager**

Jared Clements

**Systems Manager**

Matthew Carney

**Attitude Determination  
& Control**

Scott Jensen

Urmila Prakash

**Command & Data  
Handling**

Jon Nielson

Dan Zundel

Sam Nay

**Communications**

Matthew Carney

Doug Daines

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Patrick York

Trevor Foust

**Mechanisms**

Dan Swenson

Travis Moesser

**Ground Station**

Ryan Vansickle

Nathan Crookston

Karl Burk

**Power**

Ratnesh Muchhal

Brok Thayn

Travis Fisher

TOROID is Utah State University's entry into the University Nanosatellite Competition. This student satellite program is in a competition with teams from 10 other universities. The winner, as judged by a panel from the Air Force, NASA, and industry, will be given a flight opportunity in 2007-2008. TOROID will record variations and fluctuations in night-side Far UV emissions in the ionosphere from

185 km to 1,000 km altitude to aid in further understanding space weather/ionospheric interactions. TOROID will also demonstrate several technologies and design approaches intended to enable low-cost, short lead time satellite production. TOROID's modular platform has been designed with three points in mind: manufacturing, ease of integration and testing, and

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**Optics**

John Salmon

**Software**

Joseph Graham

Mike Larson

**Structure**

Josh George

Richard Wilson

David Walk

Cormac McCarthy

**Harness**

Amy Hazen

**Thermal Control**

Jared Clements

**Ground Support  
Control**

Jonathon Howell



affordability. The design revolves around a modular concept. Modules on the platform consist of pre-assembled subsystem components. They can be attached and pre-wired to a structure panel which can then be attached to the rest of the satellite.

The TOROID design team is made up of 30 undergraduate and graduate students. The entire design process is managed by students.

The program manager, systems engineer, and subsystem leads are all university students. In addition to managerial experience, students specialize and get design experience building to exacting requirements and aerospace specifications.

## Groundwater Development for Rural Peruvian Communities



**Brian Crookston**  
Logan, Utah  
Student Researcher



**Mat Hebdon**  
Paradise, Utah  
Student Researcher



**Jesse Neilson**  
Salt Lake City, Utah  
Student Researcher

A team of undergraduate students from the Utah State University chapter of Engineers Without Borders traveled to rural communities in northern Peru to conduct research on public health issues. After arriving in Lima, the capital of Peru, the team traveled 10 hours by bus to the district of Monsefu. There, the students visited several small communities to assess some possibilities that

could improve the quality of life for the residents of this region. Based on visits with residents from different communities, it was evident that there is one fundamental desire: water. Currently, water is taken from irrigation canals, which are shared by the livestock. Women spend the majority of their day carrying heavy buckets of water, often several miles, for their families. Modern



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Logan, Utah  
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**William Grenney**  
Civil & Environmental  
Engineering  
Faculty Mentor



**Ryan Dupont**  
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Faculty Mentor

equipment used to test aquifer capabilities was taken to the area in question, where data were recorded from several locations. After analysis of the collected data, it was determined that the aquifer could sustain several wells in the area. An elevated storage tank and network of pipes could then be constructed to provide potable water in an accessible

manner.

The objective of this research is to develop methods to construct sustainable wells in an efficient, economic, and safe manner with the resources that are available in this region. This would drastically affect the standard of living of these people by providing them with clean running water.

## Water and Soil Conditions in Bira, Uganda



**Ryan Davies**  
Orem, Utah  
Student Researcher



**Hailey Ferrara**  
Logan, Utah  
Student Researcher



**Lisa Ferrara**  
Logan, Utah  
Student Researcher



**Josh Hirschi**  
North Logan, Utah  
Student Researcher

A team of undergraduate students from the Utah State University Student Chapter of Engineers Without Borders has been developing a project in the village of Bira, Uganda. This village has an orphanage of 150 children. Due to a lack of bathrooms, its water sources may be contaminated. This project has been focused on researching sustainable designs and options for sanitation and methods to improve water quality. A team of four students and one professor are traveling to this vil-

lage in Uganda on December 13th to December 23rd, 2005 in order to assess the current situation. The team will test the drinking water from the current wells and springs to determine its condition at several nearby villages. The team will also be gathering GPS surveying data in order to ascertain altitude, slope, aspect, and coordinates of the villages in correspondence with water draining patterns. The data collected from this trip will allow for further research and preparation for an implementation



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**John Sapp**  
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**Mac McKee**  
Civil & Environmental  
Engineering  
Faculty Mentor

preparation for an implementation trip next summer, where the project plans will be instigated to help the communities have safe drinking water and proper sanitation. In preparation for this trip, training and preliminary research have been done to find alternative, sustainable, and low-cost methods for solving the problems experienced in Bira, Uganda. The team has also worked closely with professors from Utah State University to properly perform the

procedures and tests that they will do in the villages. Further development and research with these field techniques have allowed them to customize the procedures to Ugandan terrain and climate limitations. The members of the project have worked hard to become prepared to do the necessary testing in the most efficient manner possible and look forward to the data they will gather.

## Designing and Testing Unique Structures for Developing Countries



**Gregory Day**  
Ogden, Utah  
Student Researcher



**Carolyn Hizer**  
Tremonton, Utah  
Student Researcher



**John Hizer**  
Tremonton, Utah  
Student Researcher



**Cody Moultrie**  
Morgan, Utah  
Student Researcher



**Cristina Nelson**  
Woods Cross, Utah  
Student Researcher



**Steve Theurer**  
Providence, Utah  
Student Researcher

Adequate family housing is a major problem in many developing countries and in some areas in the U.S. The problem is particularly severe in cold climates. For example, there are areas in Northern China at elevations above 11,500 feet where the temperature for the winter period from November through March averages between 53° and 8° F, sometimes reaching -20° F. Precipitation averages less than 1 inch per month, and solar radiation averages about 250

hours per month. An 8 x 8-foot room may sleep as many as four. Construction materials are very limited. Timber is no longer available in the region. Concrete blocks are very expensive, and even construction stones must be purchased. After considerable research, a student team from the Utah State University Chapter of Engineers without Borders came up with the idea of adapting soil-bag construction to the situation. Although these structures have



**William Grenney**  
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**Laurie McNeill**  
Civil & Environmental  
Engineering  
Faculty Mentor

been used in the U.S. and other parts of the world, the team modified the standard design to incorporate passive solar heat. A small-scale prototype was constructed by the students near the USU campus. The prototype can be monitored over the winter months to evaluate the effectiveness of the approach. In addition to the solar heat feature, the team is testing three kinds of exterior coatings: 1) chicken wire-reinforced soil plaster, 2) plaster

over tar, and 3) tar over plaster.

Perhaps the greatest contribution from the project is the design and construction manual that has been produced by the team. This manual details a systematic approach to construction that has not been available in the past. It includes tables and computer software for estimating time and materials. The manual will provide a practical guide for construction in this and other parts of the world.

## Evaluating a Wellness Intervention for Social Work Practicum Students



**Anna Evans**  
Hyde Park, Utah  
Student Researcher



**Terry Peak**  
Sociology, Social Work &  
Anthropology  
Faculty Mentor

The proposed research project will evaluate a wellness workshop for social work practicum students that will test if teaching stress management and health prevention using a holistic approach will enhance participant understanding of stress and determine if strategies for coping with stressful situations can improve overall wellness and prevent burnout. Along with the lack of research studies on the issues of stress and burnout prevention among social work professionals, there is a lack of preventive programs/training available for social work students as they transition into the helping profession. This research project is modeled after the Pretest/Posttest Control-Group Design. The practicum class will be randomly assigned to three different groups, two of which will

go through the workshop (at two separate times), while the third will not, in order to control for extraneous variables. The entire class will receive a pretest that measures competency in the area of stress; prevention and intervention methods; overall stress and personal wellness. The intervention will then be introduced to Group One. At the completion of the workshop, the same test will be administered to the entire class to compare any disparities between groups. Group Two would then participate in the intervention. Upon completion of the second workshop, the same test will again be administered to the entire class along with an evaluation of the workshop that will be completed by participants.

## Egypt in a Box



**Amanda Groth**  
Pleasant Grove, Utah  
Student Researcher



**Bonnie Pitblado**  
Sociology, Social Work &  
Anthropology  
Faculty Mentor

Utah State University's Museum of Anthropology created an Egypt-themed teaching trunk for the students of Northern Utah. The teaching trunk helps students to learn about Anthropology and its

four fields with examples from Egypt. The trunk contains many activities, varying from an Egyptian dig to new studies on Tutankhamen.

## Analysis of Chance Gulch Stone Tools



**Kathryn Harris**  
Huntsville, Utah  
Student Researcher



**Bonnie Pitblado**  
Sociology, Social Work &  
Anthropology  
Faculty Mentor

My poster presents my analyses of 8,000-year-old chipped stone tools from the Chance Gulch archaeological site in southwestern Colorado. I will first explore the issue of what stone tools, like scrapers and graters, can tell us about prehistoric behavior: how, for example, we can infer how early people made a living by examining the form of their tools; and how we can trace where people went on a landscape by pinpointing the geological sources of the stone they used to make their tools.

Although my poster will focus on stone tools, and particularly on my own analyses of a suite of about fifty such specimens, I will also show that the products of tool manufacture—the “left-overs”—are likewise important

sources of information about how prehistoric people lived their lives. For example, small waste flakes can reveal how tools were made, whether tools were reused and recycled, and whether tools were refurbished to create other, entirely different ones. My poster will explore all of the aforementioned issues in detail. I will illustrate with images abstract principles of stone tool analysis because, for most people, a picture really is worth a thousand words. The most important aspect of my poster will be a presentation of the data I derived from my investigation of Chance Gulch implements. I will outline my analytical techniques, and I will specify the conclusions I draw about residents of Chance Gulch 8,000 years ago—based only on the stone tools they left behind.

## Encroachment of Annual Bluegrass on Creeping Bentgrass Greens



**Paul Harris**  
Cedar Hills, Utah  
Student Researcher



**Paul Johnson**  
Plants, Soils &  
Biometeorology  
Faculty Mentor

The purpose of this study was to evaluate how annual bluegrass (*Poa annua*) competes with creeping bentgrass (*Agrostis stolonifera*) under a golf course green setting. In a nutrient study, creeping bentgrass out-competed annual bluegrass when excessive

fertilizer was applied. Of the three different varieties of *Poa annua* that were evaluated, neither one appeared to thrive more than the other in the creeping bentgrass. Soil moisture level had little effect on the spread of the annual bluegrass.

## Evaluating Water Supplies for Tibetan Nomad Communities



**Carolyn Hizer**  
Tremonton, Utah  
Student Researcher



**Cody Moultrie**  
Morgan, Utah  
Student Researcher



**Josh Wilde**  
Taylorsville, Utah  
Student Researcher



**Cristina Nelson**  
Woods Cross, Utah  
Student Researcher



**Steve Theurer**  
Providence, Utah  
Student Researcher

A team of undergraduate students from the Utah State University Student Chapter of Engineers Without Borders traveled to Tibetan nomad villages in order to conduct research on the causes of public health hazards. After arriving at the international airport at Chengdu, China, the team traveled for 12 hours into the mountains by bus to Hongyuan where they established their temporary headquarters. From there, they

made daily excursions by mini-van to outlying small villages located from 17 to 160 kilometers away. The team evaluated drinking water quality by measuring the concentrations of six constituents at each site in addition to preserving water samples for later analysis at the Utah Water Research Laboratory. In all, over 300 individual constituent concentrations were measured.



**Laurie McNeill**  
Civil & Environmental  
Engineering  
Faculty Mentor



**William Grenney**  
Civil & Environmental  
Engineering  
Faculty Mentor

The analysis of the water samples exposes excessive amount of arsenic near the intake for one of the sites. However, the most important finding may be the significant levels of Strontium (Sr) at all of the sites. Although the concentrations are well below the EPA standards for drinking water, it nonetheless stands out because of its prevalence throughout the area. Residents in the area have been plagued for years by a

malady they refer to as “Big Bone disease.” Years of research by numerous investigators have focused on the presence of arsenic and the absence of selenium/iodine as the possible causes, but no definitive answers have been found. Strontium accumulates in the body and would be present in the vegetation and meat in the area. This may provide a new clue in the search for a remedy.

## Lithic Analysis of the Chance Gulch Site



**Patrick Johnson**  
Cedar City, Utah  
Student Researcher



**James Meservy**  
Herriman, Utah  
Student Researcher



**Bonnie Pitblado**  
Sociology, Social Work &  
Anthropology  
Faculty Mentor

In collaboration with the Utah Bureau of Land Management, Dr. Bonnie Pitblado of the Anthropology program excavated the 8,000-year-old Chance Gulch Site from 1999 until 2002. Located in a high mountain basin in Colorado, the site has produced over 30,000 pieces of chipped stone—the remnants of prehistoric manufacture of tools like projectile points and scrapers. We are currently analyzing the last few thousand of those chipped stone fragments to complete a database that will help us interpret the lifestyles of people who lived at the Chance Gulch site so long ago. Although they are humble—the garbage, really—of the prehistoric people who made them, waste flakes

can provide an array of information about where people moved on the landscape (based on the types of stone present) and what people ate (based on the kinds of tools they made). In our poster, we will (a) explain how stone flakes can be analyzed to yield rich interpretations of prehistoric life ways (i.e., the sorts of qualitative and quantitative observations we are making and recording); (b) overview the general nature of interpretations of human behavior that can be drawn from chipped stone assemblages; (c) present the findings of our analyses of Chance Gulch chipped stone; and (d) discuss the interpretations we can draw from our analyses.

## Mechanistic Analysis of the Degradation of Bluetongue Viral mRNA by qRT-PCR



**Uyen Lam**  
Logan, Utah  
Student Researcher



**Janette Starks**  
Smithfield, Utah  
Student Researcher



**Joseph Li**  
Biology  
Faculty Mentor

The Bluetongue Virus (BTV) is transmitted by the biting midge to sheep, cattle and other wild ruminants. Fever, blue discoloration of the tongue, fetal malformation and death are some symptoms of the disease. The purpose of this research was to discover the degradation of BTV mRNA transcripts in infected cells. The transcripts that encode structural proteins, VP2 and VP5, and nonstructural proteins, NS2 and NS3, were analyzed. The structural protein, VP2, is encoded by the L2 transcript. The glycosylated structural protein, VP5, is encoded by the M2 transcript. The single-stranded RNA binding protein, NS2, is encoded by the S2 transcript. NS3 is believed to aid in viral release and is encoded by the S4 transcript. To analyze the 3' end, the middle and the 5' end, primers were designed for these locations

of L2, M2, S2 and S4 BTV transcripts. Polymerase Chain Reaction (PCR) confirmed that the correct viral fragments were amplified. Relative Expression Ratios of the mRNA transcripts were then analyzed by quantitative Real Time Polymerase Chain Reaction (qRT-PCR) which has higher sensitivity than the standard PCR. We found differences in the degradation of these BTV mRNA transcripts at the 3' end, the middle and the 5' end locations. The degradation of the L2 and M2 transcripts was initiated by exonuclease activity at the 3' end followed by decapping of the 5' end. Degradation of the S2 and S4 transcripts started at the middle portion potentially by cellular endonucleases. These results revealed the potential mechanisms of degradation of viral mRNAs in BTV-infected BHK-21 cells and other eukaryotic cells.

## Investigation of Pathogenic DNA by Electrochemical



**Gerald McEwen**  
St. George, Utah  
Student Researcher



**Anhong Zhou**  
Biological & Irrigation  
Engineering  
Faculty Mentor

Three different electrochemical methods were used to probe the interaction of pathogenic, *Cryptosporidium parvum*, DNA on gold electrode surfaces. Cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS), utilized the intercalating agent, methylene blue, to amplify the binding signal. Results indicated that the electron transfer of redox couples  $\text{Fe}(\text{CN})_6^{3-/4-}$  on the ssDNA immobilized or dsDNA hybridized gold electrode were inhibited, compared to the bare electrode. It was also found that peak potentials of the  $\text{Fe}(\text{CN})_6^{3-/4-}$  redox reaction on the MB-intercalated ssDNA and MB-intercalated dsDNA modified electrode were very close to those on a bare electrode. It was

also found that the electrochemical intercalation of MB in the DNA modified gold electrode was an adsorption-controlled process. These results indicate that the MB molecules can bind tightly to both ssDNA and dsDNA modified electrode surfaces, and furthermore this binding will facilitate the electron transfer for the  $\text{Fe}(\text{CN})_6^{3-/4-}$  redox reaction on the DNA modified gold electrode. Real time, label-free measurement using surface plasmon resonance (SPR) detection of ssDNA immobilization and subsequent tDNA hybridization showed that there was a general increase in the refractive index unit (RIU) as the target ssDNA concentration were increased.

## Antipredator Behavior in a Toxic Salamander



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Student Researcher



**Edmund Brodie Jr.**  
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Faculty Mentor

Newts of the genus *Taricha* exhibit an antipredator defense posture commonly known as the “unken reflex.” Animals display an elevated head and tail, with outstretched forelimbs and hindlimbs often lifted above the ground; this reveals the orange ventral surface. The degree of intensity of this behavior varies among individuals and populations. Operational definitions for each aspect of the behavior allow us to quantify them for study. The behavior was scored by a variety of factors, including measuring the angle of elevation of the head and tail, the position of the limbs on or off the ground, and degree of coil in the tail. In the population studied, tail coil was not seen; however,

it is present in other localities. We gathered behavioral data from *Taricha torosa* (N = 217) by “attacking” with a pair of forceps, grasping a limb or midsection to mimic a predator. The data were compared to other known traits in *Taricha*, such as high levels of tetrodotoxin (another antipredator defense) and also used to examine variation seen in different populations, and between sexes. There was a significant difference found in the intensity between males and females, with females having a higher behavior score in every field. When the behavior scores were compared to the levels of tetrodotoxin found in the newts, there was not a significant correlation.

## Use of Statistical Analysis to Integrate Gene Expression Analysis and Metabolism



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Many genes within the genome are linked to metabolic reactions of organisms. The understanding of gene expression data is greatly facilitated by appropriate statistical analysis in concordance with ways to efficiently display data. The display of gene expression data over time from a time series experiment is critical for the biologist to quickly visualize the directions in which whole pathways progress in response to time and other physiological factors, such as metabolite or stress. As

most gene expression analyses culminate in little more than a list of significant genes, physical mapping of expression data to pathways is non-trivial. Here we show that analytical tools built from resources available in the public domain can be used to meaningfully depict pathways and gene expression data in concordance with the appropriate statistical analysis. Tools for statistical analysis of gene expression data in a time series were developed using R and Bioconductor, and interfaces



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Faculty Mentor

were created that were accessible through a bioinformatics computing cluster. Bioconductor was also used to draw gene expression maps that were overlaid on pathways from PathwayTools, using Perl to integrate the pathways and heat maps. These integrated tools were then used to create an explorable HTML interface that combined diagrams of each of the organism's metabolic pathways, as well as a graphical depiction of each gene's expression changes over time. The relevant statistics

of each gene were also made available in an interactive fashion. This workflow also generates a Microsoft Word document containing the pathway and expression images, allowing the researcher to easily create presentations and publications based on the data. We show that this tool greatly facilitates analyzing, displaying, manipulating and understanding microarray data more conveniently for the biologist.

# The Impact of Earnings Management on Firm Performance



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A wave of accounting scandals broke out in the United States beginning in the year 2000. Companies such as Enron, Tyco, WorldCom, and AOL have admitted to misstating their financial statements, giving a misleading impression of their financial health. A series of investigations launched by the Securities and Exchange Commission (SEC) showed that many such practices were not only unethical but illegal. Analysts' earnings forecasts and management's expectations address a high-profile component of firm performance, earnings available to shareholders. The pressure to meet earnings expectations is particularly intense and may be the primary incentive for leading managers to engage in earnings management practices. A Financial Executives International (FEI) study, for example, found

that improper revenue recognition practices were responsible for one-third of all voluntary or forced restatements of income filed with the SEC. This research investigates the impact of earnings management on firm performance. To measure earnings management, we use an extension of the cross-sectional Jones (1991) model developed by Teoh, Welch, and Wong (1998). Five conventional performance measures – return on assets (ROA), return on invested capital (ROIC), return on equity (ROE), economic value added (EVA), and stock returns – are employed to evaluate firm performance in relation to earnings management. The results of this research are expected to suggest how investors should react to earnings management and how managers should ethically and legally run their companies.

## Determination of Haplotypes using Double PCR-SSP Analysis



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The determination of haplotypes--the tying of genetic alleles to one chromosome-- is problematic. Individuals inherit one haploid chromosome from each parent, and typical genotyping cannot distinguish which chromosome to assign an allele. A simple approach is to genotype DNA from subject and both parents to attempt to assign inheritance. This approach works well for genetic loci with numerous alleles, but often fails for loci with single nucleotide polymorphisms (SNP). In addition, typing father, mother and offspring is expensive, and DNA from parents is not always available. We are employing a developing technique to determine haplotypes of 353 autistic

cases and controls from the same geographical region in California. This technique only requires DNA from a single subject. The process of using PCR-SSP is relatively simple, but requires precise laboratory techniques. Standard PCR-SSP interrogates one SNP at the 3' end of the forward primer. If the SNP is a mismatch sequence, polymerization does not occur. The reverse primer always amplifies in the standard PCR reaction as it hybridizes to consensus DNA sequences. The haplotypes PCR-SSP technique interrogates SNPs at both 3' ends, meaning that polymerization can only occur if both SNPs are on the same chromosome.

## **Excavations at Two Wickiup Sites: Dugway Proving Ground and West Tavaputs Plateau**



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We report investigation at two wickiup sites. One is on the West Tavaputs Plateau, northeast of Price, Utah. It contains two wickiups marked by structural remnants. The other site is on the Dugway Proving Ground in northwestern Utah. It contains no apparent structural remains, but excavation located two

wickiups. These sites suggest the various guises of “wickiup sites.” Excavation of these kinds of sites improves our methods for locating lightly-built housing when it is not immediately evident. It also aids the interpretation of sites that upon initial inspection may only appear to be “diffuse lithic scatters.”

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## **Towards a Comprehensive Solution to the Question of the Emblem: Visual Identity Fragmentation and the International Red Cross**



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**Scott Savage**  
Smithfield, Utah  
Student Researcher



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Art  
Faculty Mentor

In the summer of 2005, graphic design students participating in the USU Summer Design Program in Switzerland were given the unique opportunity of evaluating the current dilemma facing the International Committee of the Red Cross (ICRC). For decades the movement has struggled to find a solution to the religious connotations often perceived in the emblem of the Red Cross; for example, many non-Christian societies reject the use of a Christian symbol. The ICRC has adopted alternate emblems such as the Red Crescent; however, these symbols threaten to undermine its protective function by multiplying the faces by which it is known and emphasizing differences within the movement. This is a unique dilemma in that the emblem used by the ICRC is not for commercial

use, but instead a symbol of humanitarian protection, relief, and aid. By allowing the proliferation of multiple emblems, the ICRC fails to remain neutral and loses its power to protect and assist. Student research concluded with a presentation of proposed solutions at the international headquarters of the Red Cross in Geneva, Switzerland. Five student-led presentations were given to various international executives within the Red Cross. The student research groups unanimously promoted the abandonment of a multiple emblem identity in favor of one singular unifying symbol and proposed five distinct solutions that could satisfy the demands of international use and solve the image fragmentation problem facing the Red Cross.

## Middle Cambrian Microbial Communities Along a Bathymetric Gradient



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Microbial communities within the uppermost part of the Middle Cambrian (Bolaspidella Zone) Wheeler Formation make up a distinctive and laterally-continuous horizon in the Drum Mountains of west-central Utah. These communities were originally described by Rees (1984). The microbial communities in the Drum Mountains display pronounced bathymetric-related changes in morphology and composition. Along a 2.5 km, NW (shallower) to SE (deeper) traverse, the following assemblages occur: 1) Laminar stromatolitic mats. 2) Tall (1 - 2 m), narrow (10 - 15 cm) stromatolitic columns. 3) Short (0.5 m), thick, teardrop-shaped (15 - 20 cm by 30 - 60 cm) stromatolitic columns showing pronounced current orientation with intercolumnar areas filled with oncoids, ooids and bioclastic debris. 4) Very large (10 m diameter, 3 m thickness)

biohermal mound complexes with up to 1 m synoptic relief. These comprise a variety of microbialites, including the calcimicrobes Renalcis and Epiphyton, as well as thrombolites and stromatolites. In places, the bioherms are cut by steep-sided tidal channels filled with ooids, oncoids and bioclastic materials. Small (10 - 20 cm diameter) thrombolite mounds occur at a stratigraphically-equivalent, deep ramp position 30 km to the SW in the more distal House Range. These microbial communities appear to have developed during the earliest transgressive stage of the carbonate platform and are overlain by deeper-water, late transgressive - early highstand facies. Thus, they occur just above a sequence boundary, roughly corresponding to the contact between the Wheeler Formation and the overlying Marjum/Pierson Cove Formations.



## Research at Utah State University: Building on a Tradition of Excellence

### 1888-1899

- 1888** Land-Grant College approved for Logan
- 1890** Classes begin at the Agricultural College with 139 students (coed); curriculum emphasizes practical education as well as the classics and literature
- 1893** The Agricultural College of Utah wins 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

### 1900-1919

- 1903** State authorizes establishment of six branch arid farms throughout the state to perfect dry-farm agriculture
- 1903** President Kerr advocates awarding of graduate research degrees
- 1904** "Lecture Train" features whistle-stop teaching in Utah and Idaho with exhibits from the Experiment Station
- 1904** The AC wins 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

## research at utah state:

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**1913** Branch agricultural college established at Cedar City Normal School

**1914** First master's degree graduates

### 1920s

**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

### 1930s

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

**1934** Intermountain Herbarium established

**1934** May Swenson, noted poet, graduates 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** USU faculty advised Iran on water, soils, and crop management

### 1940s

**1947** Research Foundation established; Graduate School founded

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

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## research on capitol hill

## 1950s

- 1950** First Ph.D. candidate graduates
- 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

- 1960s** Development of Trackmaster Snowcats and spin-off of Logan Manufacturing Company; commercialization of Wescor for soil sciences applications and medical devices 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)

## 1970s

- 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, graduates from USU

## 1980s

- 1982** First student-generated space project from USU and the world orbits on the Space Shuttle
- 1982** Early Intervention Research Institute established in College of Education
- 1982** Space Dynamics Laboratory evolves from earlier aeronautical labs founded in 1959; more than 400 research payloads in a 40 year history; a world leader in sensor systems
- 1985** USU alumna Dr. Mary Cleave, a Shuttle crew member, carries on-board a USU Centennial Banner
- 1986** Research and Technology Park established
- 1986** Biotechnology Center established
- 1986** USU hosts its first annual Small Satellite Conference, which continues in 2005
- 1987** Utah State University ranks first on a per capita basis for its work in international development
- 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

## research at utah state:

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- 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

### 1990s

- 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 commences 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, wins 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 publish 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

## research at utah state:

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

### 2000

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

### 2001

- 2001** USU Research and Technology Park becomes "Innovation Campus"
- 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

### 2002

- 2002** A team of Utah State University undergraduates unveil their recreation of the original Wright flyer made with modern materials

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## research on capitol hill

## research at utah state:

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- 2002** Utah State's new Biotechnology and Genomic Research Center is established, bolstering Utah State's worldwide reputation in agricultural biotechnology, natural populations, and microbial genomics
- 2002** In November 2002, President Hall delivers 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

### 2003

- 2003** A Utah State University-University of Idaho research team is first in the world to clone a member of the horse family, a mule, which was named "Idaho Gem." After Idaho Gem's May 4 birth, the team also clones Utah Pioneer, born June 9, and Idaho Star, born on July 27. The project may provide new understanding of genetically-related problems for humans
- 2003** The Utah Veterinary Diagnostic Laboratory conducts all veterinary-related testing for West Nile virus and detects the first Utah occurrences in both birds and horses
- 2003** Researchers at USU's Institute for Antiviral Research search for drugs to control severe acute respiratory syndrome (SARS)

### 2004

- 2004** Gary Merkley's team provides irrigation management for the Dominican Republic.
- 2004** Jim McMahon is part of NEON, a team that received \$6 million to address issues of bioiversity, climate change, and others
- 2004** Maria Norton and JoAnn Tschanz study the epidemiology of Alzheimer's disease in a Cache Valley family-based cohort.
- 2004** Christine Hailey's team receive more than \$10 million to improve technology education in Utah's K-12 schools

# 2005 Research Highlights

## Animal Genomics

- Utah State University along with researchers from Australia, New Zealand and Great Britain and the United States have been working toward mapping the genome of sheep with the goal of improving meat and fiber production as well as animal health.

## Infectious Diseases

- Robert Sidwell is testing an anti-viral compound as a possible treatment for an avian flu pandemic, should it happen. He is injecting mice with an anti-viral compound to see if it increases their survival

## Assistive Technology

- Vladimir Kulyukin invented a one-of-a-kind robot which uses radio frequency to assist the visually impaired in busy areas such as grocery stores, malls and airports when traditional guide dogs cannot.

## Sensors in Space

- The Space Dynamics Laboratory (SDL) worked with NASA to launch a stratospheric balloon called Far-Infrared Spectroscopy of the Troposphere (FIRST). It is a prototype infrared sensor whose measurements of the cooling and heating of the atmosphere will help researchers learn more about how the Earth gains and loses energy.

## Nutrition & Obesity

- Tim Gilbertson is developing a scientific approach to fooling the body into eating less. This new research can potentially trick the body into thinking it's not hungry by suppressing the appetite by using microscopic structures called nanoparticles.

## Microbe Biotechnology

- Lance Seefeldt is studying samples of nitrogen to see if they can convert to a form from which plants and animals may benefit.

research at utah state:

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# Undergraduate Research at Utah State University

Utah State is committed to providing hands-on learning opportunities for its students. Students with a research track record are more competitive for graduate school fellowships and career opportunities.

Students can begin working on research projects with faculty mentors as early as their first year at Utah State, investigating topics as diverse as ceramics, cardiac protein structures, carbon in soils, consumer bankruptcy, and cloning. Undergraduate research interweaves classroom knowledge and application of that knowledge.

Undergraduate researchers are invited to submit proposals for the campus' Undergraduate Research and Creative Opportunities (URCO) Grant Program, which helps fund innovative projects.

And that's not all. Once the projects are completed, students often present the results at professional conferences and meetings. ASUSU—student government—invests in these students by supporting travel costs.

Utah State students annually present their research results at the Utah State Capitol as well as at venues such as the National Conference on





Undergraduate Research, the American Chemical Society, the Society of Range Management, and the American Microbiology Society.

Each April, the campus celebrates its undergraduates and research. One day is set aside for students to share their projects with the entire campus and community, Student Showcase.

Utah State offers over 100 research-related courses for students that include senior design and thesis options, independent study, Honors, and methodology. Annually, over 1,400 students conduct independent research projects to earn credit.

Utah State students carry out their investigations in the superb mountain environment of Logan, Utah, but they have also been known to explore globally, doing research on fish in Peru, rainforest ecology in Costa Rica, archaeological digs in the Southwest desert, and scholarly searches in the British Library.

# Facts of Interest

## General Facts

Enrollment	23,107
Faculty	864
Semester Tuition (in-state)	\$1,836
Semester Tuition (out-of-state)	\$5,308

Utah State University was named one of “America’s 100 Best College Buys” for the third year in a row, and *Consumer’s Digest* ranked it as sixth in the nation for quality and value. *The Princeton Review* named Utah State a “Best in the West University.”

## Research Facts

### Classification

Utah State University ranks 12th in the nation in total research expenditures among all non-medical, land-grant universities in the United States. USU also ranks 3rd in the nation in percent of federal engineering research funding among all major public universities in the nation.

2005 Sponsored Program Awards      \$122.1 million

## Revenues by Source, FY 2004

Source	Amount	% Total
Tuition and Fees	\$56,372,165	13.0%
Contracts, Grants & Federal Appropriations	\$170,681,145	39.3%
State Appropriations	\$125,802,220	28.9%
Private Gifts	\$11,013,826	2.5%
Auxiliary Enterprises	\$31,983,733	7.4%
Other Sources	\$38,771,860	8.9%
<b>Total USU</b>	<b>\$434,624,949</b>	<b>100%</b>



# Think



**UtahState**  
UNIVERSITY

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