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Undergraduate Research Opportunities Program 2010

University of Nevada, Las Vegas

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University of Nevada, Las Vegas

UNLV

UNIVERSITY OF NEVADA LAS VEGAS

2010

College of Sciences

Undergraduate Research Opportunities Program (UROP)

http://sciences.unlv.edu/urop/

Compiled and Edited

By

Carl Reiber, Associate Dean, College of Sciences
Photo Caption, Cover.

**Front Row (left to right):** Saju Varghese, UNLV; Harrison Ruiz, Mt. San Antonio College; Ashwitha Francis, UNLV; Theresa Schill, UNLV; Shruti Patel, UNLV; Alexandra Leandre, Bennett College; Brittany Morgan, Seattle University; Kristie Canaday, Austin Peay State University/Fisk University; Kristoffer Dean, UNLV;

**Middle row (left to right):** Corbin Benally, UNLV; Joseph Wray, UNLV; Daniella Sandoval, UNLV; Norris Lam, UNLV; Bryan Penalosa, UNLV; Valerie Tu, UNLV; Jennifer Wojno, University of Louisville, Kentucky; Brittany Radke, UNLV; Gregory Harding, Harvey Mudd College; James Benaventre UNLV; Dylan Wood, Vanderbilt University/ Fisk University; Tim Howell, UNLV;

**Back Row (left to right):** Juan Duhart UNLV; Christopher Salvo, California State University, San Marcos; Adam Hammounda, Kalamazoo College; Joseph Lussier, University of San Francisco; Michael Rodriguez, California Lutheran University; Andrew Alexander, Truman State University; Brandon Eisinger, UNLV; Andrew Mohrland, UNLV;

**Not Pictured:** INBRE: Bradley Davey, UNLV; Adesha McGee, UNLV; NSF EPSCoR: Mark Burger, UNLV; Michael Ulrich, UNLV; Supplemental: Jason Jaacks, UNLV; Alex Jacobson, UNLV; Natiera Magnuson, UNLV; Nathan Viloria, UNLV; Nick Egan, UNLV; Kayla McDonald, UNLV
Acknowledgements

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Special thanks are offered to the following individuals for their support and encouragement of this program:

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Faculty mentors from UNLV, the Desert Research Institute, and the Nevada Cancer Institute are deserving of particular thanks. These mentors devoted their time and expertise to work with UROP students. Without mentors this program would not be possible. Lastly, we would like to thank Ms. Nicholle Booker for her tireless efforts and organizational skills, and her constant efforts to improve and enhance our students’ experience at UNLV.
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University of Nevada, Las Vegas

2010

College of Sciences

Undergraduate Research Opportunities Program

Summer Poster Session

August 3, 2010
UNLV Student Union Ball Room

7:30 a.m. – 9:00 a.m.  Poster Installation
9:00 a.m. – 12:00 p.m.  Public Viewing
12:00 p.m. – 12:15 p.m.  Welcome Professor Carl Reiber
12:30 – 1:00 p.m.  Luncheon
1:00 - p.m.  Acknowledgements (Professor Carl Reiber)
National Institutes of Health (NIH) IDeA Network of Biomedical Research Excellence Program (INBRE) Undergraduate Research Program

Nevada INBRE sponsors 15 undergraduate research scholarships each year. Students selected for the program conduct a lab research project in a faculty mentor's laboratory. Summer research opportunities often lead to longer-term collaborations between students and faculty, publishable research, and careers in medicine or biomedical research. Opportunities are available for research in emerging areas such as genomics, proteomics, molecular modeling, imaging, and bioinformatics. However, any area of research that might be supported by the NIH is appropriate.

Students are selected in a statewide, merit-based competition. As part of the application process, students are required to identify a faculty mentor at UNR, UNSOM, UNLV, or the Nevada Cancer Institute with whom they are interested in conducting research.

Nevada INBRE is a network of physical and human resources available to scientists in Nevada. Its mission is to provide infrastructure that enables investigators to successfully win research funding. INBRE research facilities provide research support services, training, and equipment for Nevada's biomedical investigators. Nevada INBRE also sponsors research, scholarships and training opportunities for faculty members and students.

The National Center Research Resources (NCRR) Institutional Development Award (IDeA) program broadens the geographic distribution of NIH funding for biomedical and behavioral research. The program fosters health-related research and enhances the competitiveness of investigators at institutions located in states in which the aggregate success rate for applications to NIH has historically been low. Supported by the NCRR Division of Research Infrastructure, the IDeA program increases the competitiveness of investigators by supporting faculty development and research infrastructure enhancement at institutions in 23 states and Puerto Rico.

IDeA Networks of Biomedical Research Excellence (INBRE) enhance biomedical research capacity, expand and strengthen the research capabilities of biomedical faculty, and provide access to biomedical resources for promising undergraduate students throughout the eligible states. INBRE implements the IDeA approach at the state level by enhancing research infrastructure through support of a network of institutions with a multidisciplinary, thematic scientific focus. INBRE is the second phase of the Biomedical Research Infrastructure Networks (BRIN) program, which began by providing planning grants in 2001.
Centers of Biomedical Research Excellence (COBRE) augment and strengthen institutional biomedical research capabilities by expanding and developing biomedical faculty research capability through support of a multidisciplinary center, led by a peer-reviewed, NIH-funded investigator with expertise central to theme of the grant proposal.

The IDeA program also supports IDeANet, an Internet-based network providing connectivity for high-bandwidth science applications. IDeANet will enable collaboration among institutions, ultimately supporting all participants in the IDeA program, as well as participants in the Research Centers in Minority Institutions (RCMI) program and other NCRR-supported networks.

**Front Row (left to right):** Daniella Sandoval, UNLV; Norris Lam, UNLV; Theresa Schill, UNLV; Shruti Patel, UNLV; **Back Row (left to right):** Joseph Wray, UNLV; Juan Duhart, UNLV; Bryan Penalosa, UNLV; Kristoffer Dean, UNLV; **Not Pictured:** Bradley Davey, UNLV; Adesha McGee, UNLV
Nevada National Sciences Foundation (NSF)  
Experimental Program to Stimulate Competitive Research (EPSCoR)

The Undergraduate Research component of the current NSF EPSCoR award provides lab and field research experiences, through summer scholarship programs and annual fellowship opportunities, to full-time NSHE undergraduate students. These programs fund eligible students either majoring in mathematics, science, or engineering, or majoring in education and specializing in teaching K-12 in the fields of mathematics, science, or technology. Research is conducted under the guidance of NSHE faculty mentors. The hands-on experience gained through these programs has proven to supplement classroom learning and serve as gateways to new and exciting opportunities for all participants.

EPSCoR - Experimental Program to Stimulate Competitive Research  
NSF, the federal agency that first developed EPSCoR programs, sponsored the first EPSCoR program in Nevada. Since 1985, NSHE institutions have received more than $41 million in federal funds from NSF EPSCoR, together with non-federal matching funds.

(Left to right): Ashwitha Francis UNLV; Corbin Benally UNLV; Valerie Tu UNLV; Not Pictured: Mark Burger UNLV; Michael Ulrich UNLV
National Science Foundation Research Experience for Undergraduates Program (NSF REU)

REU PHYSICS AND ASTRONOMY
The Research Experience for Undergraduates (REU) program is a program of the National Science Foundation to give undergraduate students an experience in performing research.

Most of a student's career consists of classroom lectures. The REU program is intended to benefit students by offering experiences that go beyond the classroom. The UNLV Physics Department has had a successful REU program since 1987. Initially the program was limited to UNLV students. Beginning in 1992, the program was open to non-UNLV students as well. Students participate in research projects in the summer with follow-up activity during the academic year.

Front Row (left to right): Harrison Ruiz, Mt. San Antonio College; Kristie Canaday, Austin Peay State University/Fisk University; Alexandra Leandre, Bennett College; Brittany Morgan, Seattle University; Middle Row (left to right): Dylan Wood, Vanderbilt University/Fisk; Jennifer Wojno, University of Louisville, Kentucky; James Benaventre, UNLV; Gregory Harding, Harvey Mudd College; Back Row (left to right): Christopher Salvo, California State University, San Marcos; Adam Hammounda, Kalamazoo College; Joseph Lussier, University of San Francisco; Michael Rodriguez, California Lutheran University; Andrew Alexander, Truman State University; Not Pictured: Brittany Radke, UNLV
National Aeronautics and Space Administration (NASA)  
Experimental Program to Stimulate Competitive Research (EPSCoR)

The NASA Experimental Program to Stimulate Competitive Research (EPSCoR), strengthens the research capabilities of jurisdictions that have not in the past participated equally in competitive aerospace and aerospace-related research activities. EPSCoR provides eligible jurisdictions with funding to develop a more competitive research base within their jurisdiction and member academic institutions. Seven federal agencies conduct EPSCoR programs. The two main components of NASA EPSCoR are:

NASA EPSCoR Research Infrastructure Development Cooperative Agreement Notice. The Research Infrastructure Development (RID) component enables jurisdictions to build and strengthen relationships with NASA researchers. The RID has a three-year base period of performance with a potential single, two-year renewable period of performance. Awards are $125,000 per year. A one-to-one match (cash or in-kind) is required for every NASA dollar awarded. The most recent RID was announced and awarded in 2007. NASA intends to announce the RID opportunity every three to five years, pending funding availability.

NASA EPSCoR Research CAN. The NASA EPSCoR CAN for Research Awards solicits topic-specific proposals addressing high-priority NASA research and technology development needs. Awards are up to $750,000 for a three-year performance period. A one-to-one match (cash or in-kind) is required for every NASA dollar awarded. NASA intends to announce the EPSCoR CAN for Research Awards yearly, pending funding availability.

NASA Research Opportunities

Supporting research in science and technology is an important part of NASA's overall mission. NASA solicits this research through the release of various research announcements in a wide range of science and technology disciplines. NASA uses a peer review process to evaluate and select research proposals submitted in response to these research announcements. Researchers can help NASA achieve national research objectives by submitting research proposals and conducting awarded research.

University and industry research institutions are important NASA partners in many areas of science and technology. As part of its broadening focus on advancing the field of distributed heterogeneous computing, NASA supports ongoing research efforts in a number of disciplines through the grant process.
Grant Supported Students and Independent Study Programs

Undergraduate research programs are a valued component of the College of Sciences. Independent research activities mentored by our research active faculty cultivate and support research partnerships and invite undergraduates to work as junior colleagues in a laboratory. These programs offer the opportunity to work on cutting edge research. Continuing students, undergraduates, and high school students engage in each phase of standard research activity: developing research plans, writing proposals, conducting research, analyzing data, and presenting research results in oral and written form.

Research activities can take place over the summer or during the regular academic terms and are available in both academic departments and interdisciplinary laboratories. Projects may require an entire semester, and many continue for a year or more. Students use their experiences to become familiar with faculty members, learn about potential majors, and investigate areas of interest.

Participants gain practical skills and knowledge they apply to careers after graduation or as graduate students. Most importantly, they become involved in state-of-the-art research. The School of Life Sciences and the Department of Physics and Astronomy are active participants in this year’s summer UROP program with students working in state of the art research laboratories on project ranging from honeybee genomics to extra galactic x-ray bursts.

Front row (left to right): Saju Varghese, UNLV; Brittany Radke, UNLV; Back Row (left to right): Andrew Mohrland, UNLV; Brandon Eisinger, UNLV; Tim Howell, UNLV; Not Pictured: Jason Jaacks, UNLV; Alex Jacobson, UNLV; Natiera Magnuson, UNLV; Nathan Viloria, UNLV; Nick Egan, UNLV; Kayla McDonald, UNLV
School of Life Sciences

The School of Life Sciences (SoLS) is one of the largest academic units on the UNLV campus, with 28 full-time faculty members, 15 adjunct and research faculty, and approximately 1,200 undergraduate majors and 60 graduate students. Our enthusiastic faculty is committed to advancing scientific knowledge and to educating, training, and fostering the career development of undergraduate and graduate students. We offer undergraduate concentrations in Biotechnology, Comprehensive Studies, Ecology and Evolutionary Biology, Education, Cell and Molecular Biology, Microbiology, Integrative Physiology, Preprofessional Studies, and Urban Horticulture.

The School has well-equipped laboratories to support research. These facilities are enhanced through access to a number of specialized scientific resources, including the Nevada Genomics Center and DNA Sequencing Facility, the Nevada Center for Biological Imaging, the Ecophysiological Research facility, an animal care facility; and regional natural history collections, including those of the Wesley E. Niles Herbarium and the Marjorie Barrick Museum. Investigators from the Nevada System of Higher Education’s Desert Research Institute also contribute to our graduate program. Prospective students should make contact with one or more faculty members to familiarize themselves with their current research interests, opportunities for conducting research projects, and funding availability.
Department of Physics and Astronomy

The Department of Physics and Astronomy offers Bachelor of Science degrees in Physics, Applied Physics, and Computational Physics, as well as a minor in Physics. For additional information please visit:

http://www.physics.unlv.edu/

During the summer, a Research Experience for Undergraduate (REU) program supports undergraduates and provides research opportunities during a 10-week period. The REU program is funded by a grant from the National Science Foundation. Students should apply by February or March for the following summer.

A chapter of the Society of Physics Students (SPS), including both graduate and undergraduate students, welcomes student participation.
Desert Research Institute (DRI)

**Education & Outreach:** For higher education students, DRI provides a learning environment strongly focused on collaborative, interdisciplinary research. DRI faculty members participate in Atmospheric and Hydrologic Science academic programs with the University of Nevada, Reno, University of Nevada, Las Vegas, and Nevada State College. Students conduct their research at DRI while earning their degrees through the universities. DRI is also committed to Nevada's K-12 education system and the professional development of its teachers. DRI emphasizes "teaching the teachers" so they can bring real world knowledge back into their classrooms.

**Educational Programs**

**Atmospheric Sciences Graduate Program:** Students in the Atmospheric Sciences Graduate Program study dynamic meteorology, atmospheric physics, mesoscale modeling, fire weather and climate, atmospheric chemistry and instrument development.

**Hydrologic Sciences Graduate Program:** Consistently ranked in the top 10 by U.S. News & World Report, the Hydrologic Sciences Graduate Program offers M.S. and Ph.D. degrees in both Hydrology and Hydrogeology.

**GreenPower Program**

The GreenPower Program supports non-fossil fuel energy demonstration projects and education at Nevada schools. The program involves partnerships in both northern and southern Nevada with NV Energy, their customers, and school districts.

**Storm Peak Lab Programs:** Educational programs at Storm Peak Lab include graduate field work in Atmospheric Sciences, the Geoscience Research at Storm Peak (GRASP) program providing field research experiences for diverse undergraduate students, and a 5th and 6th grade weather and climate program.
Radio-Chemistry Summer Program
Nuclear Forensics Summer School

Developed by Los Alamos National Laboratory, Livermore National Laboratory, University of Nevada, Las Vegas and Washington State University.

Dates: May 24, 2010 to June 18, 2010

Instructor: Associate Professor Ken Czerwinski

The goal of summer program is to develop, initiate, and implement a comprehensive, experimental, hands-on training curriculum in topics essential to nuclear forensics as a means of attracting students to pursue graduate studies in technical fields relevant to nuclear forensics.

Course Outcomes
◦ Understand and utilize the chart of the nuclides
◦ Comprehend the different modes of radioactive decay
◦ Understand the components of the nucleus and how it influences nuclear properties
◦ Understand how fission is induced and the resulting products
◦ Understand and apply radiation detection or mass spectroscopy to determine isotope concentration or ratios
◦ Understand fundamental components and chemistry in the nuclear fuel cycle
◦ Understand the chemistry of key radionuclides in application important to nuclear forensics
◦ Understand the application of analytical methods in characterizing materials
◦ Knowledge of contemporary issues in nuclear forensics

Radiochemistry Fuel Cycle Summer School

Sponsored by the Department of Energy-Nuclear Energy and organized by the Radiochemistry Program at the University of Nevada, Las Vegas.

Dates: June 6, 2010 to July 16, 2010

Description
This summer school focuses on training undergraduates in chemistry, physics, health physics, or nuclear engineering. in the fundamentals of radiochemistry with an emphasis on the nuclear fuel cycle. The six week summer school is an intensive course in radiochemistry with a focus on the nuclear fuel cycle. Radiochemistry is introduced through the physics of radioactive decay and chemistry of radioelements, providing an intellectual intersection of the periodic table and chart of the nuclides. The course begins with a description of the chart of the nuclides, detailing the information, concepts, and data used as a foundation for exploring isotopes. Details on alpha decay, beta decay, gamma
decay, and fission are presented. The methods and data from the investigation of nuclear properties, nuclear forces and nuclear structure are described. The fundamental chemical properties in radiation and radiochemistry, including the relationship between speciation, kinetics and thermodynamics, the influence of radiolysis on chemistry, radioisotope production and separations will be explored. The use of radiochemistry in research and technology is explored with attention given to the nuclear fuel cycle. The modern nuclear fuel cycle is presented from fundamental chemistry to engineering applications. Textbooks and published literature are used as reading material.

Course Outcomes
• Understand, utilize, and apply the chart of the nuclides to radiochemistry and nuclear technology
• Understand the fundamentals of nuclear structure
• Understand chemical properties of radioelements
• Comprehend and evaluate nuclear reactions and the production of isotopes
• Comprehend types and descriptions of radioactive decay
• Utilization of radiochemistry in research
• Investigate modern topics relating radiochemistry to the nuclear fuel cycle

Format

Nuclear Fuel Cycle
Nuclear Forensics

Front row (left to right): Dr. Ken Czerwinski, Radiochemistry Program Director; Wendee Johns, Program Coordinator; Second row (left to right): Amber Sue Donley, University of Michigan; Jessica Paul, University of Florida; Dylon Wegner, University of Florida; Third row (left to right): Allison Goodsell, University of California; Berkeley, Dana Walkenhurst, Loyola University; Fourth row (left to right): John Ready, University of California, Berkeley; Audrey Roman, UNLV Doctoral Student; Christine Wallace, University of Notre Dame; Fifth row (left to right): Matt Gott, Tennessee Tech University; Hunter Fontenot, Loyola University; Rebecca Dirks, Washington University; William Kerlin, UNLV Doctoral Student

Nuclear Fuel Cycle

Front row (left to right): Wendee Johns, Program Coordinator; Brian Jennings, Rensselaer Polytechnic Institute; Alex Vai, (MIT) Massachusetts Institute of Technology; Ken Czerwinski, Radiochemistry Program Director; Second row (left to right): Danielle Zigon, Purdue University; Audrey Roman, UNLV Doctoral Student; Kyle Hartig, Oregon State; Alex Salazar, (MIT) Massachusetts Institute of Technology; Third row (left to right): Kevin Higgins, Rensselaer Polytechnic Institute; Jacqueline Dorhout, University of Massachusetts, Amherst; Steven Jones, Ohio State University; Fourth row (left to right): Suzanne Nguyen, University of Portland; Brandon Georgetown, Texas Southern, Houston; Fifth row (left to right): Matt Campbell, Rensselaer Polytechnic Institute; William Kerlin, UNLV Doctoral Student; Adam Weltz, Rensselaer Polytechnic Institute
HiPSEC focuses on properties of materials relevant to the National Nuclear Security Administration's (NNSA) Stockpile Stewardship Program. High priority is given to measuring static and dynamic high-pressure studies for validating and improving computational models over a largely unexplored range of very high pressures and temperatures. Materials under study include d- and f-band metals, energetic materials and their detonation products, foams, and hydrogen and other and low-Z elements and their compounds.

HiPSEC staff measure equilibrium thermochemical properties, mechanical properties, reaction kinetics, and reaction products at static pressures using in situ X-ray diffraction; absorption, emission, light-scattering spectroscopy from infrared to X-ray wavelengths; and other chemical and physical methods.

Its mission also encompasses shock experiments at NNSA's Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratory, Scientists recoveri samples from these experiments for chemical, physical, and mechanical analysis.

Theoretical and computational studies focus on highly correlated and "warm" condensed matter systems. Under the Department of Defense's MURI program, HiPSEC scientists are studying effect of defects on the mechanisms of initiation and energy release in energetic molecular crystals.

Collaboration: This integration of high-pressure science programs in Nevada with programs at NNSA's National Laboratories, DOD Research Laboratories, and other university laboratories aims to enhance Nevada's scientific and educational infrastructure, while developing focused high-pressure research programs relevant to the missions of DOE and DOD. HiPSEC is a member of the High Pressure Collaborative Access Team (HPCAT) at the Advanced Photon Source of Argonne National Laboratory.

In addition to HPCAT facilities at the Advanced Photon Source, HiPSEC has materials science laboratories on the UNLV campus for crystallography, solid-state spectroscopy, cryogenic studies, and synthesizing and characterizing foams. HiPSEC also maintains computational centers for engineering and solid-state theory on the UNLV campus.
Introduction to Scientific Studies (SCI 101)

Science 101 is now required for all newly admitted students in the UNLV College of Sciences. College students who take courses like this are more likely to graduate in four years, less likely to enroll in the wrong class, less likely to flunk a course, less likely to get into trouble for plagiarism, more likely to have clear career plans, and more likely to graduate with the right degree for their career. One benefit of taking SCIENCE 101 as a senior in high school is that students whose current GPA is between 2.75 and 3.0 and who pass this course will be considered for an alternate admission to UNLV. Another benefit is that students who take this class are more likely to graduate from college in four years.

Course Objectives:
1. To provide an orientation to the nature, the functions, and the resources of the University most relevant to science majors.
2. To help students develop and use specific study methods, practice time management, acquire deeper critical thinking skills, and produce clear reports and presentations following the norms of the scientific research community.
3. To help students develop and use their abilities to find, evaluate and use information effectively and ethically.
4. To identify and discuss individual learning styles, motivations and competencies as they relate to academic and professional goals.
5. To engage the imagination and the intellect of students with the excitement and rewards of scientific discovery.
Background information of the compound

Approximately 60,000 Americans die every year from Colon and Renal cancers. In addition, drug resistance is resulting in numerous cancers becoming resistant to conventional chemotherapeutic regimens. Methods to uncover new anticancer agents are therefore of the utmost importance. Recent research shows a class of compounds, known as quinols, as having potent in vitro antitumor activity in colon and renal cancer cell lines, although the mechanism of this activity is currently unknown. The purpose of this project would be to further the research into the synthesis of heteroaromatic quinols and their selective activities against colon and renal cancers.

Quinols are a class of compounds that are derived from the partial reduction of quinones, in which one of the ketone functional groups is reduced to an alcohol. In this project, we are interested in using heteroaromatic quinols, which contain a conjugated atom within the cyclic structure that is not carbon. Common heteroaromatic compounds consist of sulfur and nitrogen atoms within the aromatic structure. This research would focus on the synthesis of a benzothiazole, as shown below.

![Chemical structure of the target molecule](image)

Grignard reactions and reagents were discovered by the French chemist François Auguste Victor Grignard (University of Nancy, France) who was awarded the Nobel Prize in Chemistry in 1912. Grignard reagents are prepared by treating a halogen containing compound with magnesium metal in ether solution and are perhaps some of the most widely used reagents in organic chemistry, resulting in an enormous amount of organic syntheses.

Grignard reagents react by addition of the alkyl substituent (R'MgX+) to electrophilic centers, or by deprotonating acidic molecules. In addition to their laboratory use, they are also one of the most important reactions for undergraduates to master if they are to be successful in their studies. Thus, not only is this research important in its potential of furthering the chemistry of anticancer agents, but it also will provide me with a practical application of concepts learned in CHEM 241 and 242 at UNLV.

Although Grignard reagents are significant in the synthesis of organic compounds, they have limitations because they are extremely reactive in the presence of other electrophiles. Consequently, organometallic compounds often react in a way that produces a non-desired product if the proper steps to protect reactive groups are not taken. However, given the proper route, a Grignard reaction is very practical for the desired product in this research, resulting in the desired product in only three steps.

**Reaction Scheme**

For the preparation of the benzothiazole the following reaction will be used as follows:

If time permits, naphthalene and benzene (designated as R) will also be tested for antitumor activity:

The chemical structure of each resulting product will be confirmed with various forms of tests, such as Infrared Spectroscopy (IR), ¹H NMR, ¹³C NMR, and possibly other tests (viscosity, melting point, boiling point, etc.). The products will then be studied more in-depth in Dr. Bryan L. Spangelo’s laboratory at UNLV to find their anticancer properties by using different cell lines.
Kristoffer Dean  
Mentor – Dr. David Lee  
University of Nevada Las Vegas – School of Life Sciences  

Animal models have been widely used to study the pathogenesis of OA (Osteoarthritis). The guinea pig knee model has been utilized to investigate the biochemical and structural changes due to OA in order to help us better understand human OA. However the creation of an accurate model has been hampered by the inability to efficiently track musculoskeletal movement. All previous models rely on static measurements and have never been combined with measurements of joint function. In order to effectively track the displacement of bone, muscle, and connective tissue XROMM technology will be utilized. XROMM is a technique that combines 3D models of bones and joints with dual axis X-ray video. The video is taken of the limbs, during locomotion, to create a dynamic 3D reconstruction of bone and joint movement (Brainerd, 2010). High-resolution bone imaging techniques are required to create the first accurate 3D models. These models will provide vital insight to the cause of OA.
**Title:** Characterization of the molecular mechanism by which VirB affects the expression of icsP.

*Shigella* species are gram-negative, rod-shaped bacteria that are closely related to *Escherichia coli*. Virulent *Shigella* spp. are intracellular pathogens that invade, replicate and spread through epithelial cells of the lower intestine and cause bacillary dysentery in humans. This disease is characterized by a robust inflammatory response that results in fever, abdominal pain, vomiting and bloody diarrhea (3). According to the CDC, approximately 14,000 cases are reported each year in the United States alone. This number however, does not reflect the actual incidence of this disease as many cases go unreported.

The molecular pathogenesis of these bacteria lies in the large virulence plasmid (~230-kb) that is found in all virulent *Shigella* spp. Two key virulence determinants include the ability to invade colonic epithelia (mediated by the *ipa-mxi-spa* gene locus) and the ability to spread to adjacent cells, a process known as actin-based-motility (mediated and controlled by icsA and icsP respectively). These events are largely regulated by VirB, a transcription factor (2, 3).

Canonically, transcription factors are known to bind sequences proximal to the transcriptional start site (within 200-bp). Recent work focused on the regulation of icsP (a membrane-bound protease) by VirB has shed light on a novel regulatory strategy, whereby VirB regulates the activation of icsP from sites located more than 1-kb upstream of the transcriptional start site (1). Nine putative VirB binding sites have been found upstream of the icsP gene. Truncation analysis of the icsP promoter region suggests that five of those binding sites are required for VirB-dependent regulation of the icsP promoter. In the absence of those five binding sites, promoter activity is similar to wild-type for both virB*+* Shigella strains and virB*−* mutants. Additionally, truncation analysis and site directed mutagenesis confirm that the two most distal VirB binding sites (between -1144 and -1130) are essential for VirB-mediated regulation of the icsP promoter (1). This work seeks to characterize the role played by three of these putative VirB binding sites (located at +1, -166, and -258 relative to the transcriptional start site) in VirB-dependent regulation of icsP.
Norris Lamb  
Mentor – Dr. Jeff Shen  
University of Nevada Las Vegas – School of Life Sciences

*L. tridentata*, or desert creosote bush, is a xerophytic C₃ plant native to the American Southwest, and is known to have evolutionarily developed sophisticated cellular mechanisms to deal with periods of intense abiotic stress. Particularly, complex signaling pathways in *L. tridentata* allow it to survive in periods of severe water deficiency. Through the findings of Zou et al. [5,6], LtWRKY21 synergistically works with abscisic acid (ABA) to transactivate both ABA-inducible *HVA1* and *HVA22* promoters. In addition, as ABA and gibberellic acid (GA) pathways are known to act antagonistically. Expectedly, the findings of Zou et al. suggest that LtWRKY21 activates ABA signaling pathways and represses GA signaling pathways [5,6]. More importantly, the LtWRKY21 transcription factor’s synergy with ABA is directly linked to some remarkable molecular adaptations of *L. tridentata*, some of which include stomatal closure to prevent transpiration, and slowing down gene expression to withstand dehydration [6]. To examine some of these mechanisms, the model plant *Arabidopsis thaliana* will be transformed with the LtWRKY21 coding region via *Agrobacterium*-mediated transformation. Successful transformants will be selected and the subsequent generation of transgenic plants will be assayed. Both phenotypic (screening) and genotypic (qRT-PCR and Southern Blot) examination will allow the function and expression patterns of LtWRKY21 to be elucidated under simulated drought. In order for LtWRKY21 to be successfully transformed into *Arabidopsis*, a tumor-inducing (T₅) plasmid must be engineered to carry LtWRKY21.
Adesha McGee  
Mentor – Dr. Michelle Elekonich & Dr. David Lee  
University of Nevada Las Vegas – School of Life Sciences

**Title:** The Endosymbiotic Relationship of Leguminosae (Fabaceae) and Rhizobium

**Abstract:**
College of Southern Nevada, INBRE PIPELINE PROGRAM  
Sabrina McGee, Dolores Maceda, Maria Bustos, Maryknoll Palisoc, Rachel Dahl

This project will look at The Endosymbiotic Relationship of Leguminosae (Fabaceae) and Rhizobium. Endosymbiosis Theory is the concept that mitochondria and chloroplasts are the result of years of evolution initiated by the endocytosis, (the process by which cells absorb material through their cell membrane) of bacteria and algae which, instead of becoming digested, became symbiotic. The mitochondria of eukaryotes evolved from aerobic bacteria, probably *rickettsias*, living within their host cell and the chloroplasts from cyanobacteria, also known as blue-green algae. Endosymbiosis is a type of symbiosis in which one organism lives inside the body of another and both function as a single organism. comes from a Greek word meaning "inside," "with," and "living." Endosymbiosis in biology is a subdivision of the more general concept, symbiosis, which refers to living beings of different species living together for most of the life history of a member of at least one of those species. *Rickettsia bacteria cause diseases such as typhus and Rocky Mt Spotted Fever.*
Many bacterial species including those in the Bacilli group form spores as a mechanism to survive harsh conditions such as extreme temperature, radiation, chemicals, and nutrient starvation. By forming spores, they can remain metabolically dormant for an extended period of time and revert back to their vegetative form when environment becomes favorable. This resumption of metabolism and growth is marked by a process called germination which is triggered by exogenous nutrients such as amino acids and sugars. The germination receptors that respond to these germinants reside in the inner membrane surrounding the spore protoplast and, in the case of B. subtilis and B. megaterium, are a complex of at least three different proteins transcribed from the same operon. While similar in gene arrangement and protein complex formation, these two Bacilli sp. respond to different germinants. This experiment examines the germination receptors of B. subtilis and B. megaterium to determine the binding region of the germinants in the receptor complex. We examined the tricistronic operon gerA of B. subtilis and gerU of B. megaterium that encode proteins A, B, and C which make up the germination receptor. Based on the amino acid sequence, proteins A and B are most likely transmembrane proteins, whereas protein C is a cytosolic protein. To determine the location of the germinant binding sites, we genetically constructed gene arrangements to generate different chimeric protein complexes. Strains carrying these chimeric protein complexes will be tested for germination in the presence of different germinants. These studies will provide insights into how bacteria sense their environment and possible strategies to control and prevent growth.
Melanoma is the most rapidly increasing malignancy among young people in the United States. If detected early, the disease is easily treated; however, once the disease has metastasized it is largely refractory to conventional therapies and is associated with a high mortality rate. The development of human cancer from a pre-malignant primary tumor to a metastatic lesion that develops at secondary sites is thought to be a multi-step process, requiring many genetic and epigenetic events that provide a growth advantage to cells. It is still unclear which of the many genetic changes in human cancers are required for metastasis. Therefore, it is critical to evaluate each step in the metastatic process. To this end, we will generate novel lentiviral vectors containing fluorescent reporter genes to better understand the metastatic potential of melanoma cells. Vectors containing green fluorescent protein (GFP) have already been generated while vectors containing red fluorescent protein (RFP) and yellow fluorescent protein (YFP) will be cloned. Viruses will be generated and used to infect syngeneic explanted tumor cells. Since each vector will be marked with a reporter gene of a different color, we will be able to track the movement of these cells in vivo and determine the source of each metastatic tumor. Whole body fluorescence will be detected using the FluorVivo Imaging System (INDEC BioSystems, Santa Clara, CA). The experiments proposed will contribute to an increased understanding of the biology of melanoma, which has the potential to identify specific molecular targets and promote the development of more effective therapies for advanced stages of this disease.
Daniella Sandoval
Mentor – Dr. Bryan Spangalo
University of Nevada Las Vegas – Department of Chemistry

γ-Aminobutyric Acid Inhibits Synergistic Interleukin-6 Release and Increases Intracellular Cytokine Content in C6 Astrocytoma Cells In Vitro
Daniella Sandoval¹, Becky M. Hess¹, Bryan L. Spangelo¹
¹University of Nevada, Las Vegas, NV

Abstract:
Alzheimer’s disease (AD) is a neurodegenerative disorder that is characterized by memory loss and is the most common cause of dementia. It is hypothesized that pro-inflammatory cytokines induce the inflammation that is believed to be the cause of the neuronal death that is associated with AD. γ-aminobutyric acid (GABA) is a major inhibitory neurotransmitter in the Central Nervous System possessing membrane hyperpolarization or depolarization activities. A decline in GABA may enhance cytokine release in Alzheimer’s disease resulting in neuroinflammation. Therefore, we investigated the GABA-mediated suppression of the synergistic release of interleukin-6 (IL-6) induced by interleukin 1-β (IL-1β) and tumor necrosis factor α (TNF-α). In this study our aim was to determine the sub-cellular location of the accumulated IL-6 within Rat C6 astrocytoma cells and to determine the receptor through which GABA is acting to cause the intracellular accumulation of IL-6. We hypothesize that the accumulation occurs within the Golgi apparatus and that the GABA$_B$ receptor is acted upon to inhibit the release of IL-6.
THERESA SCHILL
Mentor – Dr. David Lee
University of Nevada Las Vegas – School of Life Sciences

Title: The Effects of the Ground Reaction Force on the Muscle-Tendon Systems about Guinea Pig Joints

Abstract
Each limb of the limb joints of a quadruped is used differently during locomotion, and it is necessary to recognize the mechanical role each plays. The effects of the ground reaction force on the ankle, knee, and hip joints of Hartley albino guinea pigs were studied to determine the spring-like capacity of the muscle-tendon systems that act about the limb joints. Eight guinea pigs ran on a track inside an enclosure which housed four force plates and a dual axis X-ray system to capture 3D motion. The x-rays allowed two high-speed cameras to record videos of the guinea pigs over the force plates. Movements in the x, y, and z directions were recorded for analysis with the videos. The force and X-ray motion are used together to determine joint moments. The product of joint moment and joint angular velocity yields joint power and the area under the power-time curve gives joint work during each footfall. The joints can be modeled as actuated by a spring (tendon) and motor (muscle) to determine the capacity for elastic energy storage and the spring constants (stiffness) that minimize work done by the motors. By understanding the movements of the guinea pigs’ joints, the findings can be used when looking at the effects of uphill and downhill versus level locomotion and later to assess mechanical joint function in animals with weight bearing versus non-weight bearing exercise. These results will help characterize joint dysfunction in osteoarthritis and lead to improved prevention, treatment and management.
Abstract

Alzheimer's Disease is now one of the most common diseases affecting the elderly population. Recently, bis-styrylbenzene derivatives have been shown to reduce the formation of Beta-amyloid plaques in the brain which are profoundly correlated with this disease. Finding new materials which can reduce or prevent Alzheimer's Disease has drawn much attention over the past few decades. In this project, a new bis-styrylbenzene derivative will be synthesized via the Wittig-Horner reaction tailored to select for the trans-alkene product. The (trans,trans)-1,3-bis-3'-hydroxy-4'-methoxystyrylbenzene was selected because of its ability to shift the equilibrium of multimeric Beta-amyloid pathogenic oligomer formation and lower cell cytotoxicity of its closest known derivative, (trans,trans)-1,3-bis-3'-methoxy-4'-hydroxystyrylbenzene, which showed the best combination of inhibitory activity and compound cytotoxicity. Its chemical structure will be determined by a number of experimental techniques such as FT-IR, NMR, elemental analysis and GC-MS.
Abstract:
The correlation between temperature and carbon dioxide concentration in the past one hundred years is studied. Separate graphs containing data from Vostok, Antarctica and the Mojave desert/mountain west (Nevada region) are presented. Using data obtained from these graphs, an attempt is made to explain the results and investigate the similarity of these results for Antarctica and Nevada. The importance of this study lies in the fact that if data show the same trend in the two regions, many findings for climate change in Antarctica may readily be validated and employed for Nevada.
Mark Burger
Mentor – Dr. Frank van Breukelen
University of Nevada Las Vegas – School of Life Sciences

Abstract
Metabolism is derived from the Greek word metabole which translates to change. Metabolism is the sum total of chemical reactions that take place in an organism. Some reactions are exothermic (heat-producing) whereas others are endothermic (heat-absorbing). By measuring heat production (calorimetry), one can estimate metabolic rate. Historically, such measurements of direct calorimetry were difficult. As a result, most studies utilize indirect calorimetry wherein oxygen consumption and/or carbon dioxide production are measured. One limitation to this approach is that anaerobic metabolism is ignored.
No commercially-available calorimeter is available for whole animal metabolic studies. We hypothesized that small rodent hibernators may experience significant anaerobic metabolism. In order to empirically determine the relative contributions of anaerobic and aerobic metabolism to a hibernator’s overall energetic budget, we built our own calorimeter.
Ashwitha Francis  
Mentor – Dr. Brett Riddle  
University of Nevada Las Vegas – School of Life Sciences

Abstract:  
This study examines the impact of historical climate change on the genetic structure of the Great Basin Pocket Mouse, *Perognathus parvus*, which is a relatively abundant mammal that occurs in the sagebrush-steppe habitat within the Great Basin and Columbia Plateau. I am testing the hypothesis that the climate during the last glacial cycle resulted in isolated refugia throughout the Great Basin and Columbia Plateau for *Perognathus parvus*, leading to geographically structured genetic diversity. I further hypothesize that arid expansion of the Great Basin and Columbia Plateau since the Last Glacial Maximum has caused rapid expansion of *P. parvus* populations, resulting in low genetic diversity between populations that expanded from the same refugium. To test these hypotheses, I am in the process of extracting DNA and sequencing three genes in 183 previously collected samples from across the species’ range.
Valerie Tu  
Mentor – Dr. Elizabeth Hausrath  
University of Nevada Las Vegas – Department of Geoscience

Abstract:
Anti-pollution measures which remove CO2 from the atmosphere are becoming increasingly important for resolving global climate change. In this study we will conduct mineralogical and chemical analyses to examine natural weathering of serpentinite soils. Quantifying dissolution rates of serpentine minerals could contribute to an understanding of weathering processes and the potential to accelerate them in industrial mineral carbonation. Mineralogical and chemical analyses include characterization of weathered material using XRD (Xray Diffraction), XRF (X-ray Fluorescence), SEM (Scanning Electron Microscopy), EDS (Energy Dispersive Spectrometry) as well as IRB-BARTS (Iron Related Biological Activity Reaction Test), and pore water chemistry. Although ultramafic rocks occur throughout the world, one locality, the Klamath Mountains in California, contain extensive serpentine deposits. A better understanding of serpentine mineral dissolution limits may have important implications for their use in mineral carbonation and their contributions to the carbon cycle.
Michael Ulrich  
Mentor – Dr. Frank van Breukelen  
University of Nevada Las Vegas – School of Life Sciences  

Abstract:  
Wood frogs (Rana sylvatica) freeze during the winter. One might presume that homeostatic processes like protein synthesis and degradation cease during freezing. However, few data are available. In collaboration with Dr. Ken Storey (Carelton University, Canada), we will investigate the primary mode of proteolysis in wood frogs representing different points of the freeze-thaw cycle.  

Introduction: Rana sylvatica has the ability to remain frozen for as many as 11 days at -4°C with 100% survivorship. An increase of blood glucose and glycerol concentrations allows the frogs to withdraw water from cells thereby minimizing the effects of ice crystal formation (Storey and Storey, 1986). The cells, in effect, desiccate. Few data are available on the fate of essential homeostatic processes like protein synthesis and degradation.  

Ubiquitin dependant proteolysis is responsible for as much as 80-90% of cytosolic protein degradation (reviewed in Velickovska and van Breukelen 2007). Ubiquitin is conjugated to target proteins (proteins that are to be degraded as a function of normal cellular turnover) and marks those proteins for degradation. Conjugation of ubiquitin makes that target protein a highly attractive substrate for the 26S proteasome where the target protein is degraded into peptide fragments and free amino acids. Ubiquitin dependant proteolysis is essential for the turnover of protein pools but is also critical in how a cell responds to cellular stress and protein damage.
Andrew Alexander  
Mentor – Dr. Victor Kwong  
Truman State University  

Abstract:  
Experimental Determination of Ion Trap Stability Boundary  

When using an RF quadrupole ion trap, only certain potentials applied to the trap will lead to stable ion trajectories. Through varying the applied potential to a cylindrical ion trap, we were able to experimentally determine the boundary between stable and unstable ion trapping parameters. Two approaches were used for this determination. The first approach creates the ions while the trapping parameters are near the boundary. The second created the ions in a spherically symmetric pseudo potential well and then the parameters are brought near the boundary. We then compare experimental results to theoretical and simulated models.
Adam Hammounda  
Mentor – Dr. David Shelton  
Kalamazoo College

Abstract:  
We are exploring the feasibility of producing thin film optical filters whose refractive index can be arbitrarily varied ('rugate filters') using reactive magnetron sputter deposition. Currently we have been satisfied with the reproducibility of high and low refractive index materials with arbitrary thickness and have proceeded to explore the fabrication of more complex optical devices.
Gregory Harding  
Mentor – Dr. Andrew Cornelius  
Harvey Mudd College  

Abstract:  
Titanium dihydride has the potential to play an important role in the efficiency of high density hydrogen storage. The characterization of the structure of TiH2 under high-pressure is also interesting since this system possesses a structural instability. A sample of TiH2 was placed in a diamond anvil cell and studied from ambient pressure up to 51 GPa using in situ synchrotron x-ray diffraction at the Advanced Photon Source (APS) of Argonne National Laboratory (Sector 16, HPCAT). From data of the evolution of the structure with pressure, an equation of state was obtained to model the behavior of the unit cell of TiH2 between 0 and 51 GPa. This statement should be a concise description of the research plan intended for completion during the Summer 2010 term (June - August). It should contain sufficient detail to indicate the scope of the work to be accomplished; it need not be inclusive of all possible research directions.
Kristie Canaday  
Mentor – Dr. Ravhi Kumar  
Austin Peay State University

Title: High Pressure Structural Studies on EuS Nanoparticles

Abstract:
Crystal size reduction in bulk materials changes the structural and magnetic properties considerably. More importantly the transition pressure is strongly influenced by temperature, pressure, and the crystallite size effect. Rare earth europium chalcogenides crystallize in the NaCl (rock salt) type structure. The interest in Eu nanomaterials is motivated by the possibility of their use in magnetic devices. Recent studies suggest that europium chalcogenide nanocrystals exhibit significant changes in their structural and magnetic properties, compared to bulk chalcogenides, when the nanocrystal diameter decreases. The crystal structure and phase transition behavior of EuS nanoparticles have been investigated and compared as a function of pressure with the bulk material.
Alexandra Leandre, Joseph Lussier, Brittany Morgan, and Michael Rodriquez
Mentor – Dr. John Farley & Brian D. Hosterman
Bennett College, University of San Francisco, Seattle University, and California Lutheran University

Abstract:
Raman microscopy was performed on synthesized spinel powders of solid solution Fe\textsubscript{x}Cr\textsubscript{3-x}O\textsubscript{4} to determine the dependence of the vibrational modes upon the metal cations. The powders were synthesized in a combustion reaction using metal nitrates and urea. Afterwards, the oxide powders were reduced in a hydrogen/argon gas flow at high temperature. X-ray diffraction data showed that the powders were of the spinel structure.
Abstract:
Raman spectra were taken of olivine for analysis of vibrational energy intensity ratios. This allowed for determination of its crystal orientation. Garnet inclusions in peridotite were mapped and Raman spectra were taken for these as well. The inclusions were not identified, and data from the Raman spectra proved inconclusive due to difficulty in removing background signal.
Harrison Ruiz  
Mentor – Dr. Michael Pravica  
Mt. San Antonio College

Abstract

We are studying the effects of pressure on HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine) using infrared spectroscopy. HMX is used in a variety of applications, although it is almost exclusively used in military applications as a secondary explosive. The sample is put under pressure using a diamond anvil cell at ambient temperature, data is collected at the National Synchrotron Light Source in Brookhaven National Laboratory. In analyzing this data, we hope to learn more about the molecular vibrations as the molecule bends and deforms under pressure. Such understanding could aid in determining new safety standards or more efficient ways of using HMX. In future studies, we intend to include the aspect of temperature in addition to pressure, with the goal of describing the molecule in a phase diagram.
Abstract:
The purpose of this research is to study the hydrostatic limits of pressure transmitting media such as 4:1 Methanol:Ethanol and Silicone Fluid. This will be done using a Merrill-Bassett diamond anvil cell (DAC) placed inside of a cryostat capable of reaching temperatures as low as 30 Kelvin. For this experiment, pressures up to 20 GPa will be reached and will be measured using the ruby R1 line. This statement should be a concise description of the research plan intended for completion during the Summer 2010 term (June - August). It should contain sufficient detail to indicate the scope of the work to be accomplished; it need not be inclusive of all possible research directions.
Abstract
We are studying the effects of pressure on HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine) using infrared spectroscopy. HMX is used in a variety of applications, although it is almost exclusively used in military applications as a secondary explosive. The sample is put under pressure using a diamond anvil cell at ambient temperature, data is collected at the National Synchrotron Light Source in Brookhaven National Laboratory. In analyzing this data, we hope to learn more about the molecular vibrations as the molecule bends and deforms under pressure. Such understanding could aid in determining new safety standards or more efficient ways of using HMX. In future studies, we intend to include the aspect of temperature in addition to pressure, with the goal of describing the molecule in a phase diagram.
Abstract:
High Pressure X-ray Diffraction Studies on ZrFe$_2$: A Potential Hydrogen Absorption Medium

The potential application of intermetallic compounds (IMC) under high hydrogen pressure in studies of hydrogen sorption properties is defined by two important properties. Intermetallics of Laves phases have a suitable binding energy for hydrogen, which allows its absorption or desorption near room temperature and atmospheric pressure. High pressures allow to efficiently interact hydrogen with intermetallics, which were considered nonhydride forming [1,2]. For example, ZrFe$_2$, ZrCo$_2$, and ZrFe$_2$ possess fairly high hydrogen absorption capacity at high pressures [3]. A nonactivated ZrFe$_2$ sample starts to interact with hydrogen only at 80 MPa, while equilibrium absorption and desorption pressures of the activated alloy on a plateau are 69 and 32.5 MPa, respectively. Even though ZrFe$_2$ and related Laves phases are subjected only to moderate hydrogen pressures during absorption and desorption, it is essential to understand the structural phase stability under variable pressure-temperature conditions. The present investigation is aimed to study the pressure induced structural changes in ZrFe$_2$ using synchrotron powder x-ray diffraction. High pressure structural studies were performed up to 50 GPa using a diamond anvil cell in the angle dispersion geometry.

Abstract:
The small regulatory RNA RyhB regulates icsA expression in Shigella flexneri. Shigella flexneri is a gram negative non-motile, non-spore forming, rod-shaped bacterium responsible for bacillary dysentery in humans. The master regulator, VirF, initiates a cascade of virulence gene activation by acting as a transcription factor for the gene encoding the global regulator, VirB (Alder et al., 1989). Production of VirB is also negatively regulated by the regulatory small RNA (sRNA), RyhB (Murphy & Payne, 2007). Regulatory sRNAs are untranslated RNA molecules involved in the regulation of both transcription and translation. RyhB, a 90 nt sRNA, was first identified in E. coli and subsequently found in all Shigella species. In Shigella this sRNA is maximally expressed in response to iron depletion and is responsible for the reduced expression of many virulence genes in Shigella flexneri by downregulating virB (Murphy & Payne, 2007). A key feature of Shigella flexneri virulence is the actin-based mobility of the bacterium which allows bacterial dissemination from one infected cell to another. This process is mediated by the outer membrane protein, IcsA, which polymerizes the host cell actin into a propulsive tail on the bacterial pole (Bernardini et al., 1989). IcsA is directly activated by VirF and therefore is not expected to be affected by RyhB, which is predicted to solely modulate VirB levels. Using beta-galactosidase assays to measure icsA promoter activity and Western blot analyses to measure IcsA protein production, we have demonstrated that RyhB does indeed reduce icsA transcription, which also contributes to a reduction in the formation of the IcsA protein. This work raises the possibility that RyhB may contribute to the regulation of other virulence genes and not just through the reduction of virB transcription.
Brandon Eisinger  
**Mentor – Dr. Eduardo Robleto**  
**University of Nevada Las Vegas – School of Life Sciences**

**Abstract:**

Bacterial cells under conditions of starvation or prolonged non-lethal selective pressures accumulate mutations in highly transcribed genes. This process is part of cellular programs to increase genetic diversity in conditions of stress, also known as stationary phase or stress-induced mutagenesis. This experiment investigates mutation frequencies for antibiotic resistance as affected by the stringent response. The stringent response is a global cellular process that initiates at the cessation of growth and mediates changes in gene expression that repress synthesis of ribosome components. We used *Bacillus subtilis* strains which differed in RelA proficiency. The *relA* gene controls the synthesis of (p)ppGpp, the signaling molecule which mediates the stringent response. Since genes involved in protein synthesis are repressed during the stringent response, we hypothesize that relaxed mutants express a higher accumulation of mutations that confer resistance to tetracycline than cells that become stringent. Resistance to tetracycline may be acquired by altering components of the small subunit of bacterial ribosomes. Utilizing an overlay procedure and increasing times of incubation under nutritional stress, stationary cells were prompted for resistance to tetracycline. Our results show that *relA*<sup>-</sup> cells express a higher accumulation of Tc<sup>+</sup> mutations than what was observed in wild type cells. These results provide evidence that transcriptional derepression in cells under non-lethal stress mediates mutagenic events. Implications in antibiotic resistance are further discussed.
Tim Howell  
Mentor – Dr. Jean Cline  
University of Nevada Las Vegas – Department of Geoscience  

The Location of Gold and other Metals in Ore Samples from the Getchell Carlin-Type Gold Deposit, Humboldt County, Nevada  

Abstract  
Carlin-type gold deposits of Northern Nevada are unique because the mineral pyrite hosts gold and other trace metals. The presence of gold in pyrite is a key characteristic of these deposits. The metals that are present with gold in pyrite are interpreted to have been transported with gold, by the hydrothermal fluid, to the deposit.  

We have samples of ore from the Getchell Carlin-type gold deposit for which the entire rock samples have been analyzed, and these samples contain metals that are not typically present in these deposits. For example, in some samples, silver, which is typically very minor in these deposits, is as abundant as gold. It is currently unclear if this silver is in the pyrite with the gold and other hydrothermally transported metals, or if the silver is in other minerals in the rock, which would indicate another source for the silver. In this study we will conduct petrographic examinations and chemical analyses of pyrites to quantify gold and other metals. We expect to see a suite of elements typical of the Carlin-type systems, such as: Au, Sb, Hg, As, Cu, and Tl in the pyrites. Our study will determine the chemistry of the pyrite that contains the gold, and will indicate whether or not silver and other metals that are not part of the typical suite, are present in the pyrites, or are present in
Abstract:
Recent upgrades to the Hubble Space Telescope have given observers their deepest look into our Universe yet, seeing nearly 13 billion years into the past. This new observational data has presented those of us that use simulations to study the early Universe a benchmark opportunity to evaluate the ability of these codes to reproduce the photometric properties being observed. Establishing this agreement allows us to probe deeper into the physical properties such as mass, star formation histories and star formation rates of these early galaxies. This research lays the ground work for examining the contribution of primordial galaxies to the re-ionization of the Universe. I am responsible for extracting, processing and assembling data from cosmological simulations for interpretation.
Natiera Magnuson  
Mentor – Dr. Helen Wing  
University of Nevada Las Vegas – School of Life Sciences  

Abstract:  
Modifying the Amino Acid Sequence in the Surface-Exposed Loops of the Omptin Family of Proteins to Determine Their Effect on Function  

Natiera Magnuson, Eun-Hae Kim*, Helen J Wing  
University of Nevada, Las Vegas  
*University of Arizona  

The omptin family of proteins consists of proteases which lie in the outer membrane of some gram-negative, pathogenic bacteria such as Escherichia coli (OmpT), Shigella flexneri (IcsP), Salmonella typhimurium (PgtE), and Yersinia pestis (Pla). These proteases are highly conserved, sharing approximately 50% sequence identity and a β-barrel shape. The differences in the structure of these four proteins are in the surface-exposed loop region surrounding the active site, but not in the active site itself (Kukkonen & Korhonen, 2004). These proteases are important for the virulence of many bacteria. For example, OmpT of E. coli cleaves protamine P1, an antimicrobial peptide secreted by epithelial cells of the urinary tract (Marrs et. al., 2001); IcsP of S. flexneri regulates IcsA, which uses the host’s actin to allow motility of the bacterium (Steinhauer et. al., 1999); PgtE of S. typhimurium helps the bacterium evade the immune system by cleaving the α-helical cationic antimicrobial peptides, CAMPs (Guina et. al., 2007); and, Pla of Y. pestis enhances bacterial migration through tissue barriers by cleaving plasminogen, activating it into plasmin which degrades the extracellular matrices and fibrin clots (Kukkonen & Korhonen, 2004). Previous work (Kim, 2004) has shown that the omptin proteins of E. coli, S. typhimurium, and Y. pestis do not cleave IcsA in the same manner as IcsP in S. flexneri. Differences in the cleavage of IcsA may be due to the differences in surface-exposed loops of the protease or in its LPS binding motif (Kim, 2004). The objective of this work is to conclude whether or not the differences in the amino acid sequence of the surface-exposed loops of OmpT, PgtE, Pla, and IcsP allow for differential cleavage of IcsA. Site directed mutagenesis was used to change key nucleotides leading to a change in the amino acid sequence. Cleavage of IcsA will be determined using a western blot analysis. The expected result of this experiment is for the modified protein to show a function similar to the protein it was mutated to resemble. Determining whether the surface-exposed loops of a protein affects its function could lead to a better understanding of this protein’s function and how it has evolved to serve different functions in different bacterial pathogens.
Title: Structural and magnetic properties of iron clusters: A first-principles study

Abstract:
Electronic, magnetic, and chemical properties of Fe nanoparticles are of particular interest for materials science, engineering, and metallurgical applications, including biomedical applications (e.g., medical imaging, cancer treatment, etc.). In this study we search for the stablest geometries of the Fe clusters up to n=7. We perform ab-initio calculations to investigate the properties of small iron clusters (n<8) using the spin-polarized density functional theory implemented in the Vienna Ab-Initio Simulation Package (VASP) program. The exchange correlation energy was calculated using the generalized gradient approximation (GGA) with the parametrization of Perdew and Wang (PW91).

Binding energies, magnetic moments, bond lengths, bond angles, and charge densities of clusters are computed and compared to the available experimental data. The various cluster isomers were examined energetically. We found that, in general, higher dimensional geometries are more stable than lower dimensions (i.e., 1-dimension or 2-dimension). Calculations for the Fe dimer yield a bond length of 1.98 angstroms, which appears to agree with experimental values (1.87 angstroms [Montano, et al]). The stablest Fe trimer isomer is an isosceles triangle. The stable geometry for n=4 is a tetrahedron. For Fe5 and Fe6, the stable geometries are trigonal bipyramidal and octahedron, respectively. The average magnetic moment per atom is 2.5-3.0 Bohr magnetons; this result is in agreement with previous theoretical results. Potential future work includes studies of Fe clusters with n>7, IR vibrational spectra calculations, and studies of Fe clusters encapsulated by C60 fullerene nanocontainers.
Saju Varghese  
Mentor – Dr. Kentaro Nagamine  
University of Nevada Las Vegas – Department of Physics and Astronomy

Abstract
Large-scale simulations are commonly used to model different aspects of the universe. A picture speaks a thousand words, and that is what my goal was for this summer: specifically, looking at galaxy mergers. The spikes in star formation rates that Jason Jaacks and Dr. Nagamine discovered when going through the simulations’ data raised a question about galaxy merger events during the span of the simulation. Viewing galaxy mergers allows us to observe the relationship between and flow of dark matter and gas during the mergers. Another aspect of my research is render the images of the simulation using VisIt (Visualize It), experimenting with which settings work best.
Nathan Viloria  
**Mentor – Dr. Dennis Bazylinski**  
**University of Nevada Las Vegas – School of Life Sciences**

**Abstract**  
The phylogeny and general relatedness of prokaryotes is determined by comparisons of the sequences of rRNA genes, most commonly the 16S rRNA gene. Comparisons between other gene sequences have been used for this purpose and some have supported conclusions from 16S rRNA genes while others have not. In this study, 13 new magnetospirilla were phylogenetically characterized using the sequences of the 16S rRNA gene as well as the genes for forms I and II ribulose-1,5-bisphosphate carboxylase/oxygenase (RubisCO) (\textit{cbbL} and \textit{cbbM}, respectively) and for two magnetosome membrane proteins unique to magnetotactic bacteria, \textit{mamJ} and \textit{mamK}. Polymerase chain reaction (PCR) with degenerate primers designed for the specific genes under study was used to amplify a large portion of the genes. PCR products were cloned and sequenced and used for the construction of phylogenetic trees. Based on 16S rRNA gene sequences, the magnetospirilla phylogenetically span, more as a continuum rather than as clearly delineated groups, over two genera based on the current accepted sequence divergence between organisms for genera (>5%). While almost all strains appear to fit into the genus \textit{Magnetospirillum}, strain LM-1 appears to represent a new genus. Phylogeny of these strains based on \textit{cbbM} sequences was reasonably consistent with that from 16S rRNA genes. The \textit{cbbL} gene was not a good choice for this study as most strains did not possess this gene. Relatedness and phylogeny of the strains based on \textit{mamJ} and \textit{mamK} sequences was more complex. Although our data set is not complete, some specific strains shown to be closely related by 16S rRNA gene sequence, also appeared to be closely related based on one or both of the \textit{mam} gene sequences (e.g., strains UT-1, LM-2 and \textit{M. gryphiswaldense} strain MSR-1). Other strains did not show this type of relationship. Because of these somewhat inconsistent results, those from \textit{mam} gene sequences might reflect evolution of the magnetosome gene island (MAI) in magnetospirilla rather than relatedness between strains.
Tara Edwards (UNLV graduate student)
Eric Wirthlin (DRI Reno and UNR graduate student)
Paula Matheus-Carnevali (DRI Reno and UNR graduate student)
Ryan Wahlenbrock (UNR graduate student)
Jeremy A. Dodsworth (UNLV postdoc)
Mentor – Dr. Brian P. Hedlund,
University of Nevada Las Vegas – School of Life Sciences

Title: Nitrogen Cycle in Great Basin Hot Springs

Abstract:
Nitrification and denitrification are two important steps in the nitrogen cycle. Nitrification, a two step process, leads to the production of nitrate. In the first step ammonia is oxidized to nitrite and in the second step nitrite is oxidized to nitrate. These two products of nitrification can be used by denitrifying microorganisms. Very little is known about nitrogen cycle processes in high temperature environments. In this study, we combined measurements of the natural oxidation state of inorganic nitrogen species along three hot spring outflows in the US Great Basin. In addition, we measured nitrate oxidation and denitrification along one of the outflows and isolated microorganisms capable of different steps of denitrification. Together, the work presented here shows that ammonia is oxidized to nitrite at temperatures above 70°C, whereas nitrite oxidation only occurs at temperatures below 70°C. Future lab and field experiments will aim to characterize nitrite oxidizers and denitrifiers and quantify them along hot spring outflows in order to understand the roles of specific microorganisms in these processes.
Title: Biogeochemical Investigation of Soda Lake

Abstract:
Big Soda Lake, Nevada, is a terminal, volcanic crater lake whose water level is maintained exclusively by groundwater. The crater is composed of volcanic, basaltic sand and the lake is ~60 m deep (Rush, 1972). The lake is meromictic with a distinct chemocline (Kimmel et al. 1978). The chemocline currently rests at ~40 m and is reflected in both specific conductivity and salinity measurements. Below the chemocline a redox gradient develops with highly reducing conditions. The pH is consistent throughout the depth of the lake at ~9.5, proving that it is alkaline in nature. It is further stratified by both a thermocline and oxycline. The existing conditions at Big Soda Lake make it the perfect setting for studying a diverse array of microbial activities and their interactions within a varying geochemical regime. Our goal was to perform an observational survey of Soda Lake to infer the inherent biogeochemical processes.
Title: Evaluating Snow Microbial Assemblages

Abstract:
Psychrophiles are organisms that grow optimally below 20°C. The US Great Basin is home to many mountain peaks with an abundance of alpine snow environments perfect for psychrophilic habitation. We analyzed samples from three different locations, Wheeler Peak, Pacific Crest Trail, and Mount Conness, characterizing and comparing the psychrophilic communities at varying depth intervals in the snow. Polymerase chain reaction (PCR) and denaturing gradient gel electrophoresis (DGGE) showed no notable difference in community structure with depth, but there was a distinct difference when comparing different snow environments (i.e. shaded vs. full sun exposure). The chlorophyll concentration decreased as the depth of the snow increased. By creating a clone library and utilizing DNA sequencing technology we were able to obtain 16S and 18S rRNA gene sequences from samples collected from Mount Conness, which allowed us to identify microbes living in the ecosystem. This information enabled us to produce bacterial and eukaryal phylogenetic trees, giving us a clear look into the diversity of this psychrophilic community. Out of seventy bacterial results there were fifty-three Betaproteobacteria, thirteen Sphingobacteria, three Actinobacteria, and one unclassified class of bacteria. The results of our project will guide us in our future plans for experimentation.
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Title: An Ethical View on Weapons of Mass Destruction

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Title: Sex Education: What Should We Teach?

Ryan Diel
Kendra Dettmer
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Title: Placebos: A Deceptive Trap or A Revolutionary Way to Study Medicine?

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Chris Ligon
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Title: Organ Transplantation: Altruism vs. Exploitation

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Title: The Ethics of Human Cloning
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Chelsea Corbett  
Mentor - Alicia Simon  
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Title: A Spoonful of Sugar…Is It Ethical to Use Placebos in Research Involving Terminal Illnesses?  

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Title: AIDS Denialism  

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Title: Organ Donations: Is It Right To Pay People For Their Organ?  

Aarin Elyse Kevorkian  
Peter Omosa  
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Title: Primates and Their Legal Rights: An Overview