

# SCAS

South Carolina Academy of Science



# 2012 MEETING PROGRAM

SOUTH CAROLINA ACADEMY OF SCIENCE  
EIGHTY-FIFTH ANNUAL MEETING

SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE

SOUTH CAROLINA BRANCH OF THE AMERICAN  
SOCIETY FOR MICROBIOLOGY



UNIVERSITY OF  
**SOUTH CAROLINA**  
AIKEN



**SRNL**<sup>TM</sup>

SAVANNAH RIVER NATIONAL LABORATORY  
Operated by Savannah River Nuclear Solutions, LLC

**We Put Science To Work**

## TABLE OF CONTENTS

	<u>Page</u>
<b>Welcome from SCAS President-Elect Robin Brigmon</b>	<b>2</b>
<b>SC Branch of the American Society for Microbiology (SCASM)</b>	<b>4</b>
<b>Schedule of Events (Meeting Schedule)</b>	<b>6 - 8</b>
<b>TRAC and Hydrogen Vehicle Display</b>	<b>9</b>
<b>Plenary and Keynote Speaker Biosketches</b>	<b>10</b>
<b>SCBASM Speaker Abstracts</b>	<b>14</b>
<b>Savannah River Topical Session Abstracts (Friday)</b>	<b>15</b>
<b>SCAS Topical Sessions (Oral Presentations)</b>	<b>18</b>
<b>Poster Presentations</b>	<b>22</b>
<b>SCAS Abstracts</b>	<b>25 - 49</b>
<b>SC Junior Academy of Science (SCJAS)</b>	<b>50 – 119</b>
SCJAS Meeting Schedule	50
SCJAS Awards Ceremony Schedule	51
Awards and Sponsors	51
SCJAS Judges	52
SCJAS Oral Presentation Sessions	54 - 66
Student Board Officers	66
Regional Science Fair Winners Poster Session (time and location)	66
SCJAS Abstracts (Alphabetical by first author)	67 - 119
<b>Dwight Camper Undergraduate Award in Plant Medicine or Natural Products Research</b>	<b>120</b>
<b>South Carolina Academy of Science 2013 Meeting</b>	<b>Inside back cover</b>
<b>Sponsors</b>	<b>Cover, Back cover and on Page 50</b>

**Welcome to the South Carolina Academy of  
Science  
2012 Annual Meeting**

Dear Fellow Scientists,

It is awesome to see that over 500 high school, undergraduate, and graduate students as well as teachers, faculty, parents, are here at University of South Carolina Aiken to be a part of the 2012 SCAS and SCJAS Annual Meeting. I know you are all exceptionally interested in learning about scientific research and the possible applications. The conference program will consist of two full days of exciting scientific presentations, tours, workshops, and poster sessions. We welcome the South Carolina Branch of the American Society for Microbiology that is having their Annual Meeting with us as well. We are honored to have three keynote distinguished speakers who will share their world-class experience and ideas. Dr. Terry A. Michalske, Director of the Savannah River National Laboratory, will give an update on cutting edge energy research at the Department of Energy Savannah River Site. We welcome Dr. Nicholas Rigas, Director of Renewable Energy Programs at the Clemson University Restoration Institute, who will discuss new sustainable technologies into the energy market. We are also fortunate to have Dr. Ferran Garcia-Pichel, a Microbiology Professor at Arizona State University, Tempe, give a seminar on microbial adaptations in biological soil crusts, of critical interest to ecologists in many fields. These three invited lecturers will give us knowledge and insight as there are still many key scientific challenges for the future.



As you may be aware there is a critical need for the nation to develop a skilled work force with not only great scientific and engineering training but the ability to innovate and develop new technologies. Our nation's greatest technological needs include energy supplies. While there have been many current advances in nuclear, wind, biomass, and solar energy, all the experts indicate we will need far more for the future. Energy is one area that South Carolina can play an increasingly important role by educating and training a highly skilled work force that can help develop that technology. We look to you, the students and leaders of tomorrow, to help partner and create that future by making a difference.

This meeting – and truly, most of the SC Academy of Science activities – would not be possible without the dedication and efforts of numerous volunteers, most

importantly the Academy's President, Dr. Judith Salley; Past President, Dr. Justin Wyatt; Professors Tom Reeves, Tammy Taylor, Bill Pirkle, David Ferris, and Mr. Vernon Beaty along with many others. They have generously donated their time, expertise, resources, and effort to making this meeting possible. The Academy, all professional educators, work tirelessly to making a difference in the science education of South Carolina students. We are truly blessed to have such dedicated South Carolina educators and teachers that consistently strive for excellence. We thank the parents and other supporters who of course help make this possible.

During these challenging times, when the Academy (as all educational institutions) faces serious budget concerns, the help of our many sponsors, members, and donors, is most important and very much appreciated.

To all of you in attendance today, I hope that today is filled with enthusiasm as you express your scientific skills and achievements. Please take the time to listen to each other, ask questions, share ideas, and learn to collaborate, because it is only when we work together that can we create a better future.

A handwritten signature in cursive script that reads "Robin L. Brigmon". The signature is written in black ink on a white background.

Robin L. Brigmon, PhD  
President Elect, South Carolina Academy of Science



## MEETING ANNOUNCEMENT



### South Carolina ASM Branch Meeting April 13-14, 2012 Aiken, SC

The South Carolina Branch of the American Society for Microbiology (SCBASM) invites you to attend its Annual Spring Meeting to be held on Friday and Saturday, April 13-14, 2012, on the University of South Carolina-Aiken campus in Aiken, SC. On Friday, April 13, the meeting will start at 8:00 AM with a tour of the Savannah River Site (SRS; <http://www.srs.gov>) followed by a luncheon at 11:30 AM with our ASM Foundation Speaker, **Dr. Ferran Garcia-Pichel**, Arizona State University. If attending the April 13 SRS tour, please immediately contact Dr. Sean Norman ([rsnorman@sc.edu](mailto:rsnorman@sc.edu)) for more information. The afternoon program from 1:00-5:15 PM will be composed of talks from researchers from the Savannah River National Lab (SRNL; <http://srnl.doe.gov/>) and will include sessions on energy and environmental topics.

On Saturday, April 14<sup>th</sup>, the spring meeting will be held jointly with the South Carolina Academy of Science (SCAS) at the University of South Carolina-Aiken (<http://web.usca.edu/>). We will have the privilege to hear talks from **Dr. Nikolaos Rigas**, Clemson University Restoration Institute (<http://www.clemson.edu/restoration/leadership/rigas.html>) and **Dr. Ferran Garcia-Pichel**, Arizona State University (<http://www.public.asu.edu/~ferran/>). Dr. Rigas has been leading projects to examine the bio-energy potential of the state, promote the development of biofuels and create an understanding and public acceptance of the coastal and offshore wind power in the state. In addition, he is analyzing the use of energy within the state to better understand its economic impact and identify the resource gaps that prohibit development of these resources.

Dr. Garcia-Pichel's research includes studies on the diversity and distribution of bacteria in natural communities, such as microbial mats and biological soil crusts, where he is examining biological adaptations to extreme environments studied at the physiological and biochemical level. He will be giving a talk entitled "Microbial Adaptations in Biological Soil Crusts, Earth's Most Extensive Biofilms" where he will review the basic ecology and environmental relevance of biological soil crusts and adaptive strategies that allow their dominant microbes to thrive. The afternoon session will include invited talks by microbiologists from throughout South Carolina. **Dr. Hal May**, Medical University of South Carolina, will talk about "Applying Electrochemistry to Microbial Degradation and Bioenergy", **Dr. Richard Long**, University of South Carolina, will talk about "Pelagic Marine Microbial Hotspots", **Dr. Yong-Mei Zhang**, Medical University of South Carolina, will talk about "Taking on the social network: biochemical studies of quinolone signaling in *Pseudomonas aeruginosa*", and **Dr. Garriet Smith**, University of South Carolina-Aiken, will talk about "Microbes and Coral Diseases".

We hope that you, your colleagues, and laboratory will recognize this as an excellent opportunity to meet, network and support the American Society for Microbiology within South Carolina and encourage you

and your students (undergraduate and graduate) and post-docs to submit abstracts for **poster presentations**. The SCBASM Branch Meeting is free for Undergraduate Students attending with a SC-Branch Member in good standing. The registration fee for Faculty, Principal Scientist, Post-Doctoral Fellow, or Technicians is \$20.00 for Branch Members and \$40.00 for non-members. The fee for Graduate Students is \$10. All registration fees include continental breakfast, lunch, and coffee breaks. Membership dues are \$15 for non-student members and free for students

The mission of the South Carolina Branch of the American Society for Microbiology is to serve as a professional networking venue for like-minded scientists within a limited geographic area in order to facilitate discussions, foster collaborations, education, and help students acquaint themselves with the mechanics of a scientific meeting.

*Registration and abstract submission deadline is April 2, 2012.*

The link for registration and abstract submission is <http://www.asm.org/branch/brscar/html/registration.html>.

Please check the website for the final program and updates.

We look forward to seeing you at the meeting.

Regards,



Sean Norman  
President, ASM SC Branch

Additional questions should be addressed to:

Sean Norman  
President, ASM SC Branch  
University of South Carolina  
Public Health Research Center, Suite 401  
921 Assembly Street  
Columbia, SC 29208  
Phone (803)-777-0940  
E-Mail: [rsnorman@sc.edu](mailto:rsnorman@sc.edu)

Curtrice Zeigler  
Secretary-Treasurer, ASM SC Branch  
BD Diagnostics - Preanalytical Systems  
1575 Airport Rd.  
Sumter, SC 29153  
TEL: (803) 469-1774  
E-Mail: [Curtrice\\_Zeigler@bd.com](mailto:Curtrice_Zeigler@bd.com)

## SCHEDULE OF EVENTS

### Friday, April 13th

**8:00 AM**                                      **Savannah River Site Tours**                                      SRS Badge Office  
*Tours for pre-registered visitors only*

**1:00 PM-5:15 PM**                                      **Savannah River Site Section**                                      B&E Room 140

TRAC and Hydrogen Vehicle Displays.....In front of B&E Building

1:00 PM - 3:10 PM ..... B&E Room 140

Welcome and Introduction of Speakers, Dr. Robin Brigmon

#### **Energy Topical Session:**

Dr. Bond Calloway, "*Renewable Energy Research at the Savannah River National Laboratory*"

Dr. Hector Colon Mercado, "*Hydrogen Fuel Cells- Fundamentals, Challenges and Research*"

Dr. Joseph Cordaro, "*Data Acquisition Systems for the Clemson Drive Train Test Facility*"

Mr. Ralph Nichols, "*Spatial and Temporal Variability of Wind Resources Off the Coast of South Carolina, USA*"

3:30 PM - 5:15 PM

**Environmental Topical Session**..... B&E Room 140

Dr. Dan Kaplan, "*Transformations of Radioiodine Species and the Implications on the Migration through an Aquifer at the Savannah River Site, SC*"

Dr. Charles Turick, "*Microbial Melanin as an Electroactive Bio-Material*"

Dr. John Seaman, "*In-Situ Chemical Oxidation to Address Residual VOC Plumes on the SRS*"

Dr. Christopher Bagwell and Christopher Berry, "*Biogeochemical Evolution of Spent Nuclear Fuel in Long-Term Storage Facilities*"

Dr. Anna Knox, "*Remediation of Contaminated Sediments – Active Capping Technology*"

**5:30 PM**                                      **SCAS Council Dinner**  
Exhibit Hall, Ruth Patrick Sci. Education Center

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Building Names and abbreviations:  
*B&E - Business & Education Center*  
*H&SS - Humanities & Social Sciences*  
Please see the inside front cover for a campus map.

*(Schedule continued on next page)*

## SCHEDULE OF EVENTS

### Saturday, April 14th

**7:30 AM - 1:00 PM**                      **Registration**                      Etherridge Center Lobby  
**SCAS, SCJAS, and SCBASM**  
**SCBASM Meeting Room**                      **Room 201 H&SS**

TRAC and Hydrogen Vehicle Displays.....In front of B&E Building

**8:30 AM**                                      **Plenary Session I**                      Etherridge Center

Welcome                                      Chancellor Tom Hallman

Introduction of Speaker                      Dr. Justin Wyatt (COC, Past President SCAS)

Savannah River National                      Dr. Terry Michalskie (SRNL Director)  
Lab President

Introduction of Speaker                      Dr. Robin Brigmon (SRNL, President Elect SCAS)

*Keynote Presentation*                      Dr. Nikolaos Rigas  
(Clemson University Restoration Institute)

**9:45 AM - 11:45 AM**                      **Morning Sessions**                      Humanities & Social Sci. Bldg.

Chemistry I ..... Room 210 H&SS

Chemistry II..... Room 209 H&SS

Integrative Biology ..... Room 103 H&SS

Health Sciences..... Room 202 H&SS

Mathematics ..... Room 109 H&SS

Molecular Biology ..... Room 215 H&SS

Physics/Astronomy/Meteorology ..... Room 111 H&SS

**9:45 AM**                                      **Poster Presentations**                      B&E Building  
2nd floor Gym

SCAS Posters

SCJAS Posters

American Society For Microbiology

Regional Science Fair Winners

**10:30 AM – 11:15 AM**                      **USC Aiken Tours**                      Etherridge Center Lobby  
Sign-up sheets available in lobby

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Judge's Rooms:  
SCAS - H&SS 207  
SCJAS - B&E 122  
SCBASM - H&SS 201



## SCHEDULE OF EVENTS

### Saturday, April 14th

**11:30 AM - 1:30 PM**

**Lunch**

USCA Cafeteria in the Student Activities Center

**1:00-2:15 pm**

**Plenary Session II**      Etherridge Ctr. Auditorium

SCAS Awards  
Presentation

Dr. Judith Salley, (SCSU, President SCAS)

ASM Awards  
Presentation

Dr. Curtrice Zeigler (SCBASM)

Introduction of Speaker

Dr. Sean Norman (USC, President of SCBASM)

Second Keynote Speaker      Dr. Ferran Garcia-Pichel (ASM)

**2:30-4:30 pm**

**Afternoon Sessions**

Undergraduate Presentations .....1st & 2nd Floor of the B&E

Savannah River Ecology Lab Presentations ..... Science Building, Room 327

SCABSM Presentations .....106 H&SS

**2:30 PM – 5:00 PM**

**SCJAS Events**

Please see the detailed SCAS schedule on page 50

## Overview

The TRAC (Tracking Radioactive Atmospheric Contaminants) vehicle is a mobile laboratory that can be used for nuclear emergency response and nuclear material detection and identification roles. It is 34' long and mounted on a 25,500 GVWM chassis. The vehicle contains an array of fixed and portable radiation detection and measurement systems used for real-time monitoring and sample analysis. In case of a radiological incident, the TRAC would be used to search for and locate aerosol plumes or ground contamination, provide radionuclide identification, and measure activity levels and dose rates.



## Capabilities

Continuous monitoring of neutron and gamma radiation to:

- ♦ monitor the movement of nuclear materials through choke points
- ♦ track the movement of radiological shipments and detect fixed nuclear sources
- ♦ survey roadbeds for radioactive contamination
- ♦ survey general areas following widespread contamination incidents

Real-time or near real-time monitoring of airborne releases:

- ♦ reactor fuel failure (short-lived fission products)
- ♦ spent nuclear fuel shipments (transuranics, noble gases)
- ♦ terrorist incidents (RDD, nuclear detonation)
- ♦ loss of control/containment of medical or industrial sources

Serve as a portable laboratory for on-location analyses to:

- ♦ assess the impact of radiological releases to the public
- ♦ identify and quantify contamination after transport accidents
- ♦ provide analysis support following radioactive liquid releases
- ♦ assist in the identification of smuggled nuclear material

Contact: Ron Schroder, 803-725-8348, [ronald.schroder@srs.gov](mailto:ronald.schroder@srs.gov)

Plenary Session I Speaker  
Dr. Terry Michalskie

Savannah River Nuclear Solutions Executive Vice-President  
Director, Savannah River National Laboratory

## PERSPECTIVE ON INNOVATION

The Savannah River National Laboratory has a 60-year history of innovation within the Savannah River Site and within the larger scientific and technical community. Today, SRNL research and innovation has a day to day impact that is recognized throughout the world, through avenues that include the annual R&D 100 competition, the Council for Chemical Research awards, the Director of National Intelligence and others.

Through the Enterprise SRS vision, the Savannah River National Laboratory is a hub for mission development activities that capitalize on historic SRS competencies and facilities. Today, SRNL is completely aligned with the three primary mission areas of SRS - National Security, Clean Energy and Environmental Stewardship - and is at the forefront of efforts ranging from the facilitation of small modular reactor deployment to the remediation of the damaged Fukushima Daiichi nuclear plant. The Lab continues to execute nationally recognized work for a growing number of key clients outside of the SRS customer base.

As a key asset to the regional economy, SRNL continues to focus on building strong partnerships with industry, academia and others, believing that strong partnerships are one of the keys to a sustainable future.



## Terry A. Michalske, PhD

*Executive Vice President and  
Director, Savannah River National Laboratory  
Savannah River Nuclear Solutions, LLC*

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### EDUCATION

*Alfred University  
PhD, Ceramic Science*

*Alfred University  
Bachelor of Science, Ceramic Engineering*

### EXPERIENCE

Dr. Terry A. Michalske is Savannah River Nuclear Solutions (SRNS), LLC, Executive Vice President and Director of the U. S. Department of Energy's (DOE) Savannah River National Laboratory (SRNL), operated by SRNS. In this position, he is responsible for the management, operations and planned growth of the laboratory. Currently, the laboratory has approximately 900 employees and conducts research and development (R&D) on a diversified portfolio of projects in the areas of Environmental Management, National Security and Energy Security.

Dr. Michalske has more than 30 years of experience in the fields of energy science, solar energy, nanotechnology and biomolecular analysis, principally for Sandia National Laboratories. Most recently at Sandia, he was the Director of Energy and Security Systems, focusing on energy science and technology, systems modeling and optimization, and vulnerability and consequence management for major DOE, Department of Homeland Security and Department of Defense programs.

Dr. Michalske held a number of key positions at Sandia including Director for Biological and Energy Sciences, Director for the DOE Combustion Research Facility, and founding Director of the DOE Center for Integrated Nanotechnologies.

Dr. Michalske has testified before the U.S. Senate and the state legislatures of California and New Mexico, serves as a Trustee of Alfred University, and served as Chairman of the Board of Directors for the Joint BioEnergy Institute. He is a Fellow of the American Ceramic Society and of the American Vacuum Society.

Dr. Michalske has a Ph.D. in Ceramic Science from Alfred University. He holds seven patents, has authored 90 journal publications, and has been a collaborator on several books. He is a member of several technical societies, panels, and advisory boards and has chaired numerous technical workshops and symposia.

Dr. Michalske's research awards include the Orton Lecture Award; an R&D 100 award (Interfacial Force Microscope); the Woldemar A. Weyl International Glass Science Award from the International Congress on Glass; and the Ross Coffin Purdy Award from the American Ceramic Society. He was a two-time winner of the DOE/BES Materials Science Award for Outstanding Technological Accomplishment.

January 25, 2012

Plenary Session I *Keynote Speaker*  
Dr. Nicholas C. Rigas

ACCELERATING NEW SUSTAINABLE  
TECHNOLOGIES INTO THE ENERGY  
MARKET AND EDUCATING THE  
WORKFORCE OF THE FUTURE

Energy is one of the most important issues facing society over the next 50 years. Security, Economic Sustainability and Environmental Responsibility will be drivers that help shape the energy infrastructure of the future. The rapid growth of the distributed energy, renewable energy, energy efficiency, energy storage and smart grid markets has opened up opportunities for innovations that require rapid development, testing and certification prior to market introduction as well as an educated workforce. Clemson University is developing public/private partnerships to help address these industry needs opening up new interdisciplinary opportunities in research, development and system level testing.



Dr. Nicholas C. Rigas is a Senior Scientist at Clemson University and Director of Renewable Energy Programs at the Clemson University Restoration Institute. He is (1) overseeing the design, construction, commissioning and certification of the US DOE EERE funded wind turbine drivetrain testing facility, (2) directing the development of a 15 MW Hardware-in-the-loop Grid Simulator Center and (3) managing other related projects in collaboration with private industry that will help accelerate the commercialization of new clean energy technologies into the market. Prior to this appointment, he served as Vice President at EcoEnergy LLC and was responsible for the development of wind power, biomass, solar and energy storage projects throughout the Upper Midwest and Arizona. He served as the Director of the South Carolina Institute for Energy Studies at Clemson University where he managed the US DOE NTL gas turbine program, served as Chair of the South Carolina Biomass Council, chaired the South Carolina Tactical Research on Energy Independence Council, and hosted the Southeast Regional Offshore Wind Power Symposium in Charleston. Prior to joining Clemson University, Dr. Rigas was with the Lithium Division at FMC Corporation for 15 years where he served as Manufacturing and Technology Director, Plant Manager and Operations Manager. He holds a Doctoral Degree in Chemical Engineering from Washington University in St. Louis, a Masters Degree in Chemical Engineering from Kansas State University and Bachelors in Chemical Engineering from the University of Missouri-Rolla.

Plenary Session II *Keynote  
Speaker*

Dr. Ferran Garcia-Pichel  
Arizona State University,  
Tempe, Arizona

MICROBIAL ADAPTATIONS IN  
BIOLOGICAL SOIL CRUSTS,  
EARTH'S MOST EXTENSIVE  
BIOFILMS



Biological soil crusts from arid lands are extensive but little known microbial ecosystems subject to a variety of environmental extremes. We review their basic ecology, focusing then on an evaluation of adaptive strategies that allow their dominant microbes to thrive.

Dr. Garcia-Pichel earned a Bachelor's degree in Science (1986) from the Autonomous University of Barcelona (Spain) and Master's (1988) and Ph.D. (2002) Degrees in Biology (Microbiology) from the University of Oregon. He worked as a researcher at the Max Planck Institute for Marine Microbiology during the Nineties, and joined Arizona State University (ASU) at the turn of the Millennium, where he is now Professor and Associate Dean of the School of Life Sciences, and where he chairs the University-wide graduate program in Microbiology. He has been a Fulbright Scholar, named an ASU Faculty Exemplar, and is a past president of the Arizona/Southern Nevada Branch of ASM. His research, supported largely by the NSF, USDA and NASA, focuses on the microbial ecology and geomicrobiology of cyanobacteria and the microbial communities these phototrophs support. Together with his associates, he approaches scientific problems in an integrated manner that involves biogeochemistry, microbial physiology and molecular genetics. His main research foci involve microbial and community adaptations to extreme or stressful conditions such as excessive solar radiation, high salt concentrations and desiccation, and the ability of microbes to form or destroy mineral substrates. He is proud to have trained a group of graduate students who are now themselves accomplished scientists and academicians.

## SCBASM SPEAKERS:

APPLYING ELECTROCHEMISTRY TO MICROBIAL DEGRADATION AND BIOENERGY  
Harold May, Professor, Marine Biomedicine & Environmental Science Center, Department of  
Microbiology & Immunology, Medical University of South Carolina

Microorganisms have been transforming compounds for eons and humans have been leveraging those reactions, for good and evil, for millennia. Today, more than ever, we need to understand how microbes cycle natural and anthropogenic compounds in the environment and how we may use or avoid those reactions for our benefit. My career has been dedicated to the microbial production of fuels and the biodegradation of pollutants. These areas of research may appear to be disparate, but from a microbial standpoint they are not. It all has to do with which way the electrons go, or microbial electrochemistry, our latest research endeavor. I will present a synopsis of what we have done on bioremediation and bioenergy and where we intend to go. This path includes investigations on the physiology, diversity, electrochemistry, and now metagenomics of environmental microbes including those from marine and coastal environments

### PELAGIC MARINE MICROBIAL HOTSPOTS

Richard Long, Assistant Professor, Department of Biological Sciences, University of South Carolina

Pelagic marine environments are replete with microbial hotspots that range from the meter and kilometer size scale for icebergs, plankton patches and macroalgal mats to the micro and millimeter scale for detrital particles and marine snow. In the Sargasso Sea (SS) and Gulf of Mexico (GoM), extensive floating raft of pelagic brown macroalgae, *Sargassum*, cover areas the surface at densities greater than 700 kg wet weight km<sup>-2</sup> and have an annual standing stock ranging from 2 to 11 million metric tons. *Sargassum* is known to sustain macrofaunal communities in the open ocean. Further, epiphytes associated with *Sargassum* have been found to contribute to primary production and nitrogen fixation, yet its contribution to pelagic microbial dynamics is relatively unstudied. In a set of microcosm experiments, *we tested the hypothesis that Sargassum, via the release of dissolved organic matter (DOM), supports robust growth of pelagic bacteria, including copiotrophic bacteria.* Our results show that the abundance of natural bacterial assemblages increase approximately 5-fold in microcosms containing *Sargassum* compared to controls incubated in only surface seawater. Bacterial secondary production also increases between 5 and over 700-fold. Community composition analysis revealed an outgrowth of a subpopulation of bacteria.

### TAKING ON THE SOCIAL NETWORK: BIOCHEMICAL STUDIES OF QUINOLONE SIGNALING IN *PSEUDOMONAS AERUGINOSA*

Yong-Mei Zhang, Department of Biochemistry and Molecular Biology, Medical University of  
South Carolina

*Pseudomonas aeruginosa* (*Pa*) is a versatile opportunistic pathogen. Quorum sensing (QS) is essential for *Pa* pathogenicity by activating virulence factor production. Among the three known QS systems in *Pa*, *Pseudomonas* Quinolone Signal (PQS) is an alkyquinolone, one of >50 quinolone compounds in *Pa* that differ in alkyl chain length and desaturation. PQS signaling regulates the production of pyocyanin, lectins, and elastases, which are required for *Pa* to cause infections. Thus, quinolone signaling has been recognized as a target for new anti-*Pa* therapies. Although the importance of the quinolone signals in *Pa* pathogenicity is well established, some key steps of their biosynthesis and regulation are not determined. Using methods of biochemical analysis, bacterial genetics, and structural biology, we characterized the activity of PqsD, an essential enzyme for PQS signal formation. Structure-based *in silico* screening of PqsD inhibitor was performed and top-scoring compounds were analyzed using *in vitro* activity assays. Findings from these studies will be discussed.

### MICROBES AND CORAL DISEASES

Dr. Garriet Smith, Department of Biology and Geology, University of South Carolina-Aiken

**SAVANNAH RIVER SITE TOPICAL SESSION**  
**Friday, April 13, 2012**  
USCA Room 140 Business & Education Center (B&E)

**Energy Session**

**Renewable Energy Research at the Savannah River National Laboratory**

Don Anton & Bond Calloway  
Savannah River National Laboratory, Aiken, SC, 29808, USA

Savannah River National Laboratory (SRNL), a research and development laboratory at the Department of Energy's Savannah River Site serves the nation in three primary areas: Clean Energy; Homeland Security and Defense; and Environmental Solutions. The laboratory was established in 1951 with the mission of supporting the development and production of nuclear weapons materials for national defense. The laboratory's mission has expanded over the years to meet the changing needs of our nation and is rapidly expanding its role in the homeland and energy security fields. SRNL has over 80 hydrogen scientists and engineers who are actively involved in both nuclear and energy related hydrogen research. SRNL is also actively researching and expanding research partnerships in grid simulation, wind, solar, biofuels, and carbon capture and storage.

SRNL's Renewable Energy programs were originally started as a result of over 50 years in tritium related research and have expanded into non-nuclear hydrogen storage, separation and production, fuel cells and automotive material characterization. SRNL currently is one of the project leaders for an international consortium of countries developing an advanced fusion reactor to be located in France.

An overview of the current Renewable Energy research projects being conducted by the SRNL will be presented. Bench scale development of new hydrogen storage materials, trace gas effects on fuel cells, and hydrogen production projects will be emphasized. SRNL is the lead laboratory in the Department of Energy Office of Energy Efficiency and Renewable Energy's Hydrogen Storage Engineering Center of Excellence which is a five year 40 million dollar project to advance on board hydrogen storage systems for automotive applications.

**Hydrogen Fuel Cells- Fundamentals, Challenges and Research**

Hector Colon Mercado  
Savannah River National Laboratory, Aiken, SC, 29808, USA

Proton exchange membrane fuel cells (PEMFCs) are in the forefront of electrochemical energy conversion devices for automotive applications. Despite the significant advances over the past decades, electrocatalyst activity and stability remain key challenges for widespread commercialization. Because of the use of precious metals, research has focused on the reduction of the use of precious metal catalysts while increasing the catalyst activity and stability. In addition hydrogen used in PEMFC systems must contain low levels of impurities to minimize performance degradation that can shorten their lifetime. Setting hydrogen fuel standards as a part of the foundation for a hydrogen economy requires balancing fuel cell system degradation with the costs for hydrogen purification and certification. In this presentation, an overview of PEMFC fundamentals, challenges and research will be presented.

**Data Acquisition Systems for the Clemson Drive Train Test Facility**

Joseph V. Cordaro, John McIntosh, George Reeves, Andrew Kruzner  
Savannah River National Laboratory, Aiken, SC, 29808, USA

A Drive Train Test Facility (DTTF) is being built at the Clemson University Research Institute in North Charleston at the old Navy Base. The facility is presently planning to test wind turbine nacelle's (includes the generator and the gearing that would connect to the wind turbine blades) rated up to 15 Mega Watts. The DTTF will be the only facility in the world with the capacity to test large offshore wind turbines. The DTTF will be operated by Clemson University. Large wind turbine manufacturers will buy time in the DTTF to certify or evaluate prototype nacelle's.

The Savannah River National Laboratory has the responsibility for the design of the data acquisition system, vibration analysis system, and electrical grid monitoring system. These systems will combine high speed and low speed data into an integrated time synchronized data base. A short facility overview will be presented followed by a review of the design of the data acquisition systems and project status.



## **Spatial and Temporal Variability of Wind Resources Off the Coast of South Carolina, USA.**

Ralph L. Nichols<sup>1</sup>, Joel L. Kohn<sup>1</sup>, Paul Gayes<sup>2</sup>, Len Pietrafesa<sup>2</sup>, Kehui Xu<sup>2</sup>, Yanxia Ma<sup>2</sup>,  
Elizabeth Kress<sup>3</sup>, Eric Boessneck<sup>3</sup>, Nick Rigas<sup>4</sup>

<sup>1</sup>Savannah River National Laboratory, <sup>2</sup>Coastal Carolina University, <sup>3</sup>Santee Cooper

<sup>4</sup>Clemson University Restoration Institute

The South Atlantic Bight, is a region of the Atlantic seaboard of the United State sharing common oceanographic and meteorological conditions extending roughly from Cape Hatteras, NC to West Palm Beach, FL. The National Renewable Energy Laboratory (NREL) estimated this region to have over 134 GW of wind resource potential in waters less than 30 m deep-approximately 25% of the east coast's total potential in those depths. Development of offshore renewable energy resources requires cost effective solutions for assessing the temporal and spatial availability of energy in the offshore environment. Traditional techniques for assessing wind resources such as meteorological towers are expensive to use offshore and provide limited information on the spatial variability of wind. The Palmetto Wind Project was developed by a team of scientists, engineers, and regulators in South Carolina to assemble an integrated suite of tools to prospect more cost effectively for offshore wind farm locations. The tools will also be capable of supporting wind farm operations following construction. A network of buoys, meteorological towers, sonar, and atmospheric computers model was assembled for this study. The computer simulations were performed using actively coupled models of the atmospheres and ocean. Ocean data from the monitoring network was used to initialize the models and wind speed data was used to validate the model. Model output for specific locations was then processed to characterize the wind resource estimate potential energy generation from wind turbines. Finally, energy generation data was used in marginal energy cost analysis for the public utility providing electricity to coastal communities in the vicinity of the simulated offshore wind farm. The paper presents data from the offshore monitoring network, results from atmospheric modeling performed using public domain models, and preliminary analysis of energy production based on model output.

## **Environmental Session**

### **Biogeochemical Evolution of Spent Nuclear Fuel in Long-Term Storage Facilities**

Christopher Berry, P. E., and Christopher Bagwell, PhD

Savannah River National Laboratory, Aiken, SC, 29808, USA

The Savannah River Site's L Basin was originally constructed as a disassembly basin to receive spent nuclear fuel and target assemblies discharged from one of the Savannah River Site's five production reactors. Today, the L Basin operates as an underwater storage facility receiving uranium spent fuel from international facilities and research reactors. L Basin maintains approximately 3.4 million gallons of ultrapure water (pH 6 – 6.5), which functions to cool spent fuel and shield workers from radiation exposure. This water is continuously recirculated through sand filters, to remove suspended solids, and a deionizer, to eliminate radioactive and nonradioactive ions.

The focus of this talk will center on recent developments in L Basin, describing the characterization of anomalous "streamers" and 'films' observed throughout L Basin. Preliminary sampling was suggestive of the possibility that these structures may be, at least partially, biological in origin. A comprehensive sampling campaign has been deployed; the results from combined microbiological, chemical, and elemental analyses will be presented, and the potential implications of these findings discussed.

### **Transformations of Radioiodine Species and the Implications on the Migration through an Aquifer at the Savannah River Site, SC**

Daniel I. Kaplan<sup>a</sup>, Chen Xu<sup>b</sup>, Saijin Zhang<sup>b</sup>, Hsiu-Ping Li<sup>b</sup>, Yi-Fang Ho<sup>b</sup>, Kathleen A. Schwehr<sup>b</sup>, Kimberly A. Roberts<sup>a</sup>, Robin Brinkmeyer<sup>b</sup>, Chris M. Yeager<sup>a</sup>, Peter H. Santschi<sup>b</sup>

<sup>a</sup> Savannah River National Laboratory, <sup>b</sup> Laboratory for Environmental and Oceanographic Research, Department of Marine Sciences, Texas A&M University

<sup>129</sup>Iodine is among the key risk drivers at all Department of Energy subsurface nuclear disposal facilities because <sup>129</sup>I has a long half-life (16 million years), high toxicity (90% of the body's iodine accumulates in the thyroid), high inventory, and perceived high mobility in the subsurface environment. Another reason that <sup>129</sup>I is a key risk driver is that there is a large amount of uncertainty regarding its environmental fate and transport. This uncertainty results in elevating disposal and environmental remediation costs. Finally, the world wide inventory of <sup>129</sup>I continues to increase at a rather sharp rate: 1 Ci <sup>129</sup>I is a by-product per gigawatt of electricity produced by nuclear power. As more nuclear power is produced, more waste and <sup>129</sup>I will be produced; the U.S. has 18 new nuclear reactor applications, India has 20 to 30 new reactors, and China has 30 new reactors planned by 2030. Field studies were conducted at the Savannah River Site, South Carolina that demonstrated that <sup>129</sup>I does not exist solely as iodide, I<sup>-</sup>, as thermodynamically predicted. Instead, <sup>129</sup>I speciation, including iodate, IO<sub>3</sub><sup>-</sup>, and organo-I, varies systematically with groundwater chemistry, especially dissolved organic carbon concentrations (and DOC's degree of aromaticity), pH, and Eh. Microbial oxidation of iodide (to iodate and other forms of iodine) by wetland and vadose zone isolates were identified. Understanding radioiodine biogeochemistry, including the complex processes introduced in this work, is being incorporated into numerical models to help minimize uncertainty associated with the movement of radioiodine in the environment.

### **Microbial Melanin as an Electroactive Bio-Material**

Charles E. Turick

Savannah River National Laboratory

Electroactive polymers produced by naturally occurring microorganisms enhance metal-oxide reduction and provide resistance to ionizing radiation for various organisms in the environment. These polymers are various forms of melanin pigments and confer electron-shuttling capabilities. For instance, one type of melanin, pyromelanin, enhances electron transfer from metal-reducing bacteria to metal oxides and thus increases microbial growth rates. The redox-cycling capacity of pyromelanin can also be used to increase current production when bacteria are grown on electrodes, such as microbial fuel cells. Microbial fuel cells offer potential as alternative energy sources, especially in remote areas. Another example involves melanin-producing fungal isolates from the Chernobyl nuclear facility that demonstrate enhanced growth in ionizing radiation fields. In this case Eumelanin, another type of melanin pigment, provides a means to quench harmful oxidizing effects of gamma radiation. However, melanin can only react for a finite time in a high radiation field before it is completely oxidized (bleached), unless electrons can be delivered to counter oxidation. Mechanisms linked to this self-healing property of eumelanin by microorganisms may also be linked to physiological strategies for enhanced growth in ionizing radiation fields as well as bio-materials for radiation protection.

### **In-Situ Chemical Oxidation to Address Residual VOC Plumes on the SRS**

John C. Seaman

Savannah River Ecology Laboratory, University of Georgia

Groundwater plumes containing volatile organic contaminants (VOCs) such as trichloroethylene (TCE) remain a major groundwater remediation challenge. Therefore, a field-scale technology demonstration was conducted to evaluate the utility of in situ chemical oxidation (ISCO) using persulfate to address residual VOC contamination on the SRS. The demonstration site was located within an area with an extensive VOC plume with a TCE concentration ranging from 10 to 40 ppm. The test site consisted of an injection well and three observation wells. The persulfate reactant was injected intermittently over a ten day period (230 g/L Na-persulfate) totaling 18,168 L. After injection, the observation wells were sampled periodically with the pH, electrical conductivity (EC) and ORP determined in the field, and samples were collected for VOC, persulfate, chloride, sulfate, and metals analyses. Persulfate was detected in OW1 approximately two weeks after injection, peaking at  $\approx 150$  ppm and then slowly decreasing over the 295 days of monitoring. Injectate breakthrough in OW1 was also evident in the EC and Na, with ORP increasing initially and then becoming more variable with continued monitoring. TCE and PCE concentrations in OW1 were much lower than observed in OW2 and OW3 throughout the duration of the study. Although some dilution is inherent in the in situ chemical treatment of aqueous phase contaminants, elevated concentrations of Cl and SO<sub>4</sub> observed in OW1 are indicative of VOC destruction resulting from chemical oxidation.

### **REMEDIATION OF CONTAMINATED SEDIMENTS – ACTIVE CAPPING TECHNOLOGY**

Anna Sophia Knox

Savannah River National Laboratory

Active capping is a relatively new approach for treating contaminated sediments. It involves applying chemically reactive amendments to the sediment surface. The main role of active caps is to stabilize contaminants in contaminated sediments, lower the bioavailable pool of contaminants, and reduce the release of contaminants to the water column. In addition, downward migration of the amendments used in active caps can neutralize contaminants located deeper in the sediment profile; i.e. in the zone of influence (ZOI).

Metals are common contaminants in many marine and fresh water environments as a result of industrial and military activities. The mobile, soluble forms of metals are generally considered toxic. Induced chemical precipitation of these metals can shift toxic metals from the aqueous phase to a solid, precipitated phase which is often less bioavailable. This approach can be achieved through application of sequestering agents such as rock phosphates, organoclays, zeolites, clay minerals, and biopolymers (e.g., chitosan) in active capping technology. Active capping holds great potential for a more permanent solution that avoids residual risks resulting from contaminant migration through the cap or breaching of the cap. In addition to identifying superior active capping agents, research is needed to optimize application techniques, application rates, and amendment combinations that maximize sequestration of contaminants. A selected set of active capping treatment technologies has been demonstrated at a few sites, including a field demonstration at the Savannah River Site, Aiken, SC. This demonstration has provided useful information on the effects of sequestering agents on metal immobilization, bioavailability, toxicity, and resistance to mechanical disturbance.

## TOPICAL SESSIONS - SCAS

Saturday, April 14th

### CHEMISTRY I

ROOM 210 H&SS

SESSION MODERATOR: DR. RALPH STEINHAUS, USC AIKEN

- 9:45 A SYNTHETIC MODEL OF TYPE-2 COPPER NITRITE REDUCTASE BASED ON A BULKY TRIS(PYRAZOLYL)BORATE LIGAND  
Alexander Brugh and Gerard Rowe
- 10:00 FORMATION OF A PUTATIVE COPPER-OXYGEN SPECIES SUPPORTED BY AN N-HETEROCYCLIC CARBENE LIGAND  
Stephanie Hawkins and Gerard Rowe
- 10:15 A SYNTHETIC MODEL OF TYPE-2 COPPER NITRITE REDUCTASE BASED ON A BULKY TRIS(TRIAZOLYL)BORATE LIGAND  
Sarah Weaver and Gerard Rowe
- 10:30 SYNTHESIS OF A MICROSOMAL TRIGLYCERIDE TRANSFER PROTEIN INHIBITOR  
James McEachern and Dr. D. Magnin\*
- 10:45 COMPARATIVE SUCCINATION OF PROTEINS BY ENDOGENOUS FUMARATE AND ALKYL FUMARATE PHARMACEUTICALS.  
Allison M. Manuel and Norma Frizzell
- 11:00 PREPARATION OF *N*-(1-OXO-3-PHENYLISOQUINOLIN-2(1*H*)-YL)BENZAMIDES [BENZAMIDO-ISOCARBOSTYRILS], *N*-(1-OXO-3-PHENYLISOQUINOLIN-2(1*H*)-YL)BENZENESULFONAMIDES [BENZENESULFONAMIDE-ISOCARBOSTYRILS] AND RELATED ISOCARBOSTYRILS FROM THE CONDENSATION-CYCLIZATION OF SEVERAL TYPES OF TRILITHIATED 2-METHYLBENZOIC ACID HYDRAZIDES AND SELECT ESTERS  
Philip J. Mabe, William G. Shuler, Sarah S. Carlisle, Clyde R. Metz, William T. Pennington, Donald G. VanDerveer, and Charles F. Beam
- 11:15 *EXPANDED TITLE:* PREPARATION OF UNSYMMETRICAL 1,3,5-PENTANETRIONES AND 6-CHLORO-2-(2-OXO-2-PHENYLETHYL)QUINOLIN-4(1*H*)-ONE FROM 1-BENZOYLACETONE, TWO STRONG BASES, LHMDS AND LDA, SELECT AROMATIC ESTERS AND 5-CHLOROISATOIC ANHYDRIDE  
William G. Shuler, Philip J. Mabe, Sarah S. Carlisle, Clyde R. Metz, William T. Pennington, Donald G. VanDerveer, and Charles F. Beam

### CHEMISTRY II

ROOM 209 H&SS

SESSION MODERATOR: DR. MONTY FETTEROLF, USC AIKEN

- 9:45 EVALUATION OF CATIO<sub>3</sub> ON THE PHOTOCATALYTIC DEGRADATION OF METHYLENE BLUE  
Glory Zhou, Cynthia Tamboue, and Samuel Darko

- 10:00 EVALUATION OF THE ADSORPTIVE PROPERTIES OF CaCO<sub>3</sub> AND CaO SYNTHESIZED FROM WASTE EGGSHELLS  
Faith Kibuye, Cynthia Tamboue, and Samuel Darko
- 10:15 SOLVENT-INDUCED RAMAN PEAK SHIFTS IN ANALOGS OF ETHYL-DIMETHYLAMINO BENZOATE  
Raymond Belliveau and Monty Fetterolf
- 10:30 ALDOL-TYPE CONDENSATION PROCESSES INVOLVING 1-BENZOYLACETONE LITHIUM HEXAMETHYLDISILAZIDE (LHMDS) OR LITHIUM DIISOPROPYLAMIDE (LDA), SELECT CARBONYL COMPOUNDS AND AN OCCASIONAL CYCLIZATION OF INTERMEDIATE COMPOUNDS CONTAINING AN *ORTHO*-ANILINO OR *ORTHO*-PHENOLIC FUNCTIONAL GROUP  
Sarah S. Carlisle, Philip J. Mabe, William G. Shuler, Clyde R. Metz, William T. Pennington, Donald G. VanDerveer, and Charles F. Beam
- 10:45 CONJUGATED BIS(DIOXABOROLE)S FOR OPTICAL SENSING OF LEWIS BASES BY AN INTEGRAL MAIN-CHAIN SENSORY APPROACH  
Min Cai and John J. Lavigne
- 11:00 A FACILE METHOD FOR TUNING THE STABILITY OF POLYDIOXABOROLANES  
Shakena L. Daniel and Dr. John Lavigne
- 11:15 NEW CLASS OF GREEN CHEMISTRY SURFACE ACTIVE MATERIALS BASED ON NATURAL POLYOLS FOR USE IN RIGID AND FLEXIBLE POLYURETHANE FOAMS  
Patrick Coterillo and Neal Tonks
- 11:30 *Presentation of the Dwight Camper Undergraduate Award (TBA)*

## INTEGRATIVE BIOLOGY

### ROOM 103 H&SS

#### SESSION MODERATOR: PROF. BRAD REINHART, USC AIKEN

- 9:45 THE DISTRIBUTION OF PSEUDO-NITZSCHIA SPP. ACROSS THE SOUTHEASTERN U.S. DURING MAY-JUNE, 2011  
Angela M Dapremont
- 10:00 INFLUENCE OF GROWING SEASON LENGTH ON GERMINATION SUPPRESSION IN AEGILOPS TRIUNCIALIS  
Deanna DuBose
- 10:15 GERMINATION OF *SPONGILLA LACUSTRIS* (L.) IN A LABORATORY SETTING  
Sarah Retherford and Kristen van den Meiracker
- 10:30 INFLUENCE OF SPECIES AND GENDER ON EXPRESSION OF INHIBIN B LEVELS IN THE SEA URCHIN  
Shanetta J. Wilkoins and William E. Roudebush
- 10:45 REPRODUCTIVE PROTEIN HORMONES: MUSIC'S EFFECTS ON REPRODUCTIVE HORMONES IN GOLDFISH (*CARASSIUS AURATUS*)  
Jordan M. Hairr and William E. Roudebush
- 11:00 THE EFFECT OF LIGHT QUALITY ON ACROPORA CERVICORNIS TISSUE REGNERATION  
Aposia J. Singleton, James Nicholson, Sylvia B. Galloway, Thomas Bartlett, Carl Miller, and Cheryl M. Woodley
- 11:15 ENVIRONMENTAL ELICITATION OF ACID STRESS RESPONSE IN *VIBRIO CHOLERAE*  
Gabriel J. Swenson and Richard A. Long
- 11:30 EXTERNAL ELECTRIC FIELDS CAN PREVENT BIOFILM FORMATION BY BACTERIA  
Mansueta Harris and Aloke Kumar

**HEALTH SCIENCES**  
**ROOM 202 H&SS**  
**SESSION MODERATOR: DR. ED CALLEN, USC AIKEN**

- 9:45 THE EFFECT OF ACIDITY OF SPORTS DRINK ON MICE  
Jazra' Gibson-Jackson, Annesha Byrd, William McAmis, Samuel Darko, and Samir Raychoudhury
- 10:00 PROGRESS TOWARD IODINE-LABELED POLY(EPSILON-CAPROLACTONE) FOR X-RAY IMAGING APPLICATIONS  
Brooke A. Van Horn and Caroline C. Duncan
- 10:15 FOURIER ANALYSIS OF PHASE RESETTING CURVES OF TYPE II OSCILLATORS  
Robert A. Raidt and Sorinel A. Oprisan
- 10:30 EXPONENTIAL FUNCTIONS IN DRUG METABOLISM  
Duanquira Myers, Naima Naheed, Nailong Guo and Mostafizur Rahman
- 10:45 EFFECTS OF TAMOXIFEN, BENZO-A-PYRENE, AND PAHS ON GALECTIN-3 EXPRESSION IN HUMAN BREAST CARCINOMA CELLS  
Feven Mulu, Bill McAmis, and Samir Raychoudhury
- 11:00 THE EFFECTS OF SRT1720 ON LIVER REGENERATION AFTER PARTIAL LIVER TRANSPLANTATION  
Rhonda Hook and Zhi Zhong
- 11:15 PROGRESS TOWARD ALKENE-CONTAINING POLY(EPSILON-CAPROLACTONE) AND THIOL-ENE FUNCTIONALIZATIONS  
Brooke A. Van Horn and Marcus J. Henderson
- 11:30 DETERMINATION OF POLYHEXAMETHYLENE BIGUANIDE IN CONTACT LENS SOLUTIONS USING ULTRA PERFORMANCE LIQUID CHROMATOGRAPHY  
Brandon L. Thompson, Sandra K. Wheeler, Anne D. Lucas, Kenneth S. Phillips, and John F. Wheeler

**MATHEMATICS**  
**ROOM 109 H&SS**  
**SESSION MODERATOR: DR. MOHAMMAD HAILAT, USC AIKEN**

- 9:45 ANALYSIS OF TRAFFIC PATTERNS USING THE TIME SPACE DIAGRAM  
Jaime Thrift
- 10:00 CONNECTIONS BETWEEN FIBONACCI NUMBERS AND LUCAS NUMBERS  
Shannon Michaels Areford
- 10:15 APPLICATIONS OF COMPUTATIONAL STOCHASTIC GEOMETRY TO THE DETERMINATION OF CLOUD STRUCTURE  
Clarissa A Briner and Michael L. Larsen
- 10:30 DIFFERENCE EQUATIONS AND THEIR APPLICATION IN MORTGAGE CALCULATION  
Hardin Carrington, Nailong Guo, Naima Naheed, and Woon-Kwan Lam
- 10:45 CURVE OF PURSUIT AND TRAJECTORY  
Sajan Shrestha
- 11:00 SPATIAL STATISTICS THROUGH A 1D LENS  
Michael L. Larsen

**MOLECULAR BIOLOGY**  
**ROOM 215 H&SS**  
**SESSION MODERATOR: DR. BILL JACKSON, USC AIKEN**

- 9:45 ANALYSIS AND CHARACTERIZATION OF INTERCALATIVE AND COVALENT INTERACTIONS OF [CR(DIIMINE)<sub>3</sub>]<sup>3+</sup> COMPLEXES WITH DNA  
Kristen E Watts, Richard E. Graybill, James H. Wade, Sandra K. Wheeler, Noel A. P. Kane-Maguire, and John F. Wheeler
- 10:00 ANALYSIS OF HAMMERHEAD RIBOZYME-MEDIATED DOWN-REGULATION OF THE HIV-1 TRANSACTIVATOR OF TRANSCRIPTION  
Alex S. Jureka and William H Jackson, Jr.
- 10:15 COMPARATIVE STUDY OF HIV-1 INDUCED APOPTOSIS BY EXPRESSION OF PRO-APOPTOTIC BAX AND TBID  
Priscilla S. Simon and William H. Jackson, Jr.
- 10:30 AMH EXPRESSION IN EPITHELIAL CELLS OF OVARIAN CANCER  
Christo Yarina and Dr. William Roudebush
- 10:45 PERSISTENT ALTERATIONS IN DOPAMINERGIC MARKERS IN ADOLESCENT HIV-1 TRANSGENIC RATS  
L.M. Moran, R.M. Booze, K.M. Webb, M.Y. Aksenov, M.V. Aksenova, and C.F. Mactutus
- 11:00 ISOLATION OF PUTATIVE OSMOREGULATORY GENES IN AN OLIGOHALINE CRAB  
Crystal O. Barra, Kelsey L. Metz, Karan J. Patel, Stephen A. Borgianini, and Giuliana Gusmaroli

**PHYSICS/ASTRONOMY/METEOROLOGY**  
**ROOM 111 H&SS**  
**SESSION MODERATOR: DR. MIKHAIL AGREST, COLLEGE OF CHARLESTON**

- 9:45 ATMOSPHERIC CIRCULATION PATTERNS, HURRICANE IRENE, AND POTENTIAL HISTORIC ANALOGS  
Paul Huff, Cary Mock, and Lesley-Ann Dupigny-Giroux
- 10:00 ATMOSPHERIC CIRCULATIONS INFLUENCING UNITED STATES LANDFALLING TROPICAL CYCLONES  
Justin Rawley and Cary J. Mock
- 10:15 ABSORPTION AND SCATTING IN CORRELATED RANDOM MEDIA  
Philip Boehner and Dr. Mike Larsen
- 10:30 INVESTIGATION OF HIGH-RESOLUTION IMAGING WITH THE COFC TELESCOPE  
Andrei Zorilescu
- 10:45 A MONTE CARLO POPULATION STUDY OF EXOPLANET COMPANIONS OF HIGH MASS [A,B] STARS  
Jessica L Trucks
- 11:00 MOVING TOWARDS RADIATION: MAGNETICALLY ARRESTED ACCRETION  
Anna Gillespie and P. Chris Fragile Author
- 11:15 HIGH RATE TENSILE TESTING OF NICKEL 270  
Oliver Holmes and Donald L. Erdman III
- 11:30 PHOTOELECTRIC EFFECT. TEACHING AND LEARNING.  
Mikhail M. Agrest

**POSTER PRESENTATIONS**  
**2ND FLOOR GYM, B&E BLDG**

- 1** INVESTIGATION OF THE THERMODYNAMICS OF BINDING BETWEEN POTENTIAL ANTI-TUMOR AGENT RAC-[CR(DIP)2(DPPZ)]<sup>3+</sup> AND DNA  
Andrew G. Kantor, Brandon L. Thompson, Kristen E. Watts, BaoTran T. Le, Morgan M. Sprinkle, Noel A.P. Kane-Maguire, Sandra K. Wheeler, and John F. Wheeler
- 2** ISOLATING THE ANTI-ESTROGENIC COMPONENTS OF *PRUNELLA VULGARIS* USING MULTIPLE SOLID-PHASE EXTRACTION METHODS AND HPLC  
Fred D.C David, Richard M. Graybill, Cierra M. Kingsley, Eli V. Hestermann, Sandra K. Wheeler and John F. Wheeler
- 3** STUDYING COALESCENCE EVENTS DURING THE LATE STAGE OF PHASE SEPARATION  
Cathleen A. Wise, Ana Oprisan, Carole Lecoutre, John J. Hegseth, Yves Garrabos, and Daniel Beysens<sup>4</sup>
- 4** IMMOBILIZATION OF RUTHENIUM FLUOROPHORES IN SELF ASSEMBLED MONOLAYERS  
Ben L. Wise, Summer Arrowood, and Dr. Laura Wright
- 5** THE TEMPERATURE DEPENDENCE OF THE VISIBLE ABSORPTION OF METHYLENE VIOLET IN DIFFERENT SOLVENTS  
Ashleigh Kimberlin and Monty Fetterolf
- 6** LOW-COST SYNTHESIS OF POTASSIUM ALUM WITH CHEAP HOUSEHOLD CHEMICALS  
Chris Rufty
- 7** BATHYMETRIC ANALYSIS OF AXIAL SEAMOUNT, JUAN DE FUCA RIDGE  
Ahmed A. Nayel, Willie Edwards, Dr. Leslie Sautter
- 8** BATHYMETRIC ANALYSIS OF A COMPLEX PROMONTORY EXTENDING INTO THE GULF STREAM OFF CHARLESTON, SC: BENTHIC HABITATS OF BULLS SCARP  
M. Grace Smythe, Peter J. Bierce, Leslie R. Sautter, and M. Scott Harris
- 9** MULTIBEAM SONAR ANALYSIS OF MARINE HABITATS IN THE DRY TORTUGAS  
Alicia Raimann, Katherine Johnson, and Leslie Sautter
- 10** BATHYMETRIC AND MORPHOLOGIC ANALYSIS OF IMPORTANT SHELF-EDGE FISH HABITATS OFF THE COAST OF CHARLESTON, SOUTH CAROLINA  
Cooper Smith, Kayla Johnson, and Dr. Leslie Sautter
- 11** MULTIBEAM ANALYSIS OF U.S. ATLANTIC CONTINENTAL MARGIN SLUMP AND SUBMARINE LANDSLIDE MORPHOLOGY  
Nick C. Guzzardo, Gabrielle Byrd, and Dr. Leslie Sautter
- 12** TEMPORAL VARIATIONS IN BATHYMETRY AND MORPHOLOGY AT GRAY'S REEF NATIONAL MARINE SANCTUARY  
Joseph R Rembert, Jim Niergarth, Greg McFall, and Leslie R. Sautter
- 13** COMPARISON OF SUBMARINE CANYON MORPHOLOGY OFF THE U.S. EAST COAST  
Veronica R. Holton, Megan R. Arnett, and Leslie R. Sautter
- 14** PALEOKARST IN THE UPPER COASTAL PLAIN OF GEORGIA AND SOUTH CAROLINA  
Virginia G. Goodyear, Frank Syms, William Pirkle, and Alexia Helsley
- 32** SUPPRESSING THE LARGE OSCILLATIONS OF A SPRING-MASS SYSTEM  
Kristopher Liggins, Fereshtah Zahed, and Naima Naheed

- 21 WOMEN'S PERCEPTIONS OF HOW HAVING A CHILD AS A TEENAGE HAS IMPACTED THEIR LIVES  
Rebekah L. LeMay and Keri Weed
- 32 EFFECTS OF LIFESTYLE ON COGNITION AND AGING  
Karla Rombaldi-Smith, Alexis Harley, Christa Armfield, and Echo Leaver
- 23 AGE-RELATED CHANGES IN REWARD-SEEKING AND COGNITIVE STRATEGY  
Echo Leaver
- 14 MOSQUITO SURVEY OF SALUDA SHOALS PARK  
Lou Rigley, Janette Wells, and Chris Evans
- 15 THE IMPACT OF POINT-SOURCE POLLUTION ON THE CONCENTRATION AND DISTRIBUTION OF *ESCHERICHIA COLI* IN A STREAM DRAINING AN URBAN WAT  
Grace L. McKnight, Dr. Min-Ken Liao, Brent Anderson, and Steve McCauley
- 16 DETERMINING THE SOURCE OF POLLUTION AT FILBIN CREEK, SOUTH CAROLINA  
Lydia B Nickolas and Vijay Vulava
- 17 DISTRIBUTION AND HABITAT CHARACTERISTICS OF THE GREEN-FLY ORCHID (*EPIDENDRUM MAGNOLIAE*) IN FOUR COASTAL PLAIN COUNTIES OF SOUTH CAROLINA  
Marvin E. Brown and Eran S. Kilpatrick
- 18 DEVELOPMENT OF BIRD SONG ALONG AN URBAN-TO-RURAL GRADIENT  
Caitlin E. Black, Dr. Paul M. Nolan, Dr. Kevin J. McGraw and Mathieu Giraudeau
- 19 DECLINING POPULATIONS OF AN ENDANGERED PLANT, WHITE IRISSETTE (*SISYRINCHIUM DICHOTOMUM*): RESULTS OF A LONG-TERM FIELD STUDY  
Nathan W Redding, Douglas A. Rayner, Polly D. Ketcham, and A. G. B. Revels
- 20 EVALUATION OF ANURAN SPECIES DETECTION AND SITE OCCUPANCY IN THE SOUTH CAROLINA COASTAL PLAIN USING THE NORTH AMERICAN AMPHIBIAN MONITORING PROGRAM  
Paul P. Thomas Jr.<sup>1</sup> and Eran S. Kilpatrick<sup>2</sup>
- 25 SHALLOW MARINE LIONFISH HABITAT CHARACTERIZATION OF ONSLOW BAY, NC  
Jennifer K Kist, Emily B Osborne, Leslie R. Sautter, and Dr. Paula Whitfield<sup>1</sup>
- 26 INVESTIGATION OF COMMON BOTTLENOSE DOLPHIN (*TURSIOPS TRUNCATUS*) DEPREDATION ON RECREATIONAL FISHERIES IN CHARLESTON AND HILTON HEAD  
Katie F. Williams, Elise Kohli, and Wayne E. McFee
- 24 BATHYMETRIC ANALYSIS OF PTERIOS VOLITANS SHELF-EDGE HABITATS, ONSLOW BAY N.C.  
Ralph M. Morris, Christian K Hartmann, Dr. Leslie R Sautter
- 28 SEARCHING FOR PROPHYLACTIC BACTERIOPHAGES THAT INFECT AND LYSE *STAPHYLOCOCCUS AUREUS* OR *ESCHERCHIA COLI*  
Ina R. Troutman, Riane Petersman, and Paul Richardson
- 29 EVALUATION OF THE IMPACT OF YEAST ON FLORAL SCENT IN *SILENE CAROLINIANA*  
Jonathan Freeman, Bettie Obi Johnson, Annette Golonka
- 30 THE EFFECTS OF SALINITY, PH, AND DISSOLVED OXYGEN ON THE SENSITIVITY OF PCR  
Joseph Cannon and Dr. Paul Richardson



- 27** GENETIC FINGERPRINTING OF T4 BACTERIOPHAGE  
Sean M Gilroy and David Walling
- 31** IMPROVING THE MPING YEAST TRANSPOSITION ASSAY  
Ashley E. Strother, Courtney Burckhalter, Tyler Shealy, Wes Tindall, and C. Nathan Hancock
- 35** STARS SLC ACTIVITIES AT SC STATE – SUCCESS AND LESSONS LEARNED  
Kevin Freeman, Terrell Perrotti, Luis Figueroa, Nikunja Swain, Cynithia Davis, Brandon Shields, David Moore, Evangeline Pointer, Kwaku Ofori-Marfoh, Julius Ellison, Tempestt Neal, and Shilindria Rivers
- 36** DETERMINING THE PREVALENCE OF THE IMPROPER USE OF CITATIONS AND SOURCES AT REGIONAL SCIENCE FAIRS  
Brittany Cheeks and Michelle Vieyra
- 37** THE SUMMER CAMP SETTING FOR PROMOTING PHYSICAL ACTIVITY: AN OBSERVATION OF SOUTH CAROLINA SUMMER DAY CAMPS  
Brittany Skiles, Carl Sorensen, and Nicole Zarrett
- 38** SELF-REGULATION, MATH ANXIETY, AND MATH PERFORMANCE  
Karlin-Rae M. Cummings and Keri Weed

# SOUTH CAROLINA ACADEMY OF SCIENCE ABSTRACTS

## PHOTOELECTRIC EFFECT. TEACHING AND LEARNING.

Mikhail M. Agrest  
College of Charleston

The purpose of the Introductory Physics courses is to expose the great concepts of Physics. The educational value of the Photoelectric Effect is undoubted. The great beauty and simplicity of the Photoelectric Effect model was the result of very precise and beautifully designed and performed experiment. In theory, there is no discrepancy between theory and practice, but in practice, there is always some discrepancy. The sources vary. One of the possible causes could be the fact that in the teachers are limited in their use of the tools and supplies. While in an Advanced Experimental Physics Lab this situation could be used a teaching tool, it could be just a destructing element in the practice of teaching an Introductory Physics course. Influence of the imperfection instruments' sensitivity and dispersion of the spectra of light used in the Photoelectric Effect lab of an Introductory Physics will be discussed

## CONNECTIONS BETWEEN FIBONACCI NUMBERS AND LUCAS NUMBERS

Shannon Michaels Areford  
University of South Carolina Sumter

I will discuss some properties of Fibonacci numbers. I will prove an identity that shows the difference between two Fibonacci squares is a Lucas number.

## ISOLATION OF PUTATIVE OSMOREGULATORY GENES IN AN OLIGOHALINE CRAB

Crystal O. Barra, Kelsey L. Metz, Karan J. Patel, Stephen A. Borgianini, and Giuliana Gusmaroli  
Dept. of Biology, University of South Carolina Beaufort

Estuarine species experience significant physiological stresses in response to constantly changing salinity. Those species exhibiting the least tolerance for fluctuating salinities are typically found lower in the estuary where the magnitude of salinity fluctuation is lowest. By contrast, *Uca minax* (the red-jointed fiddler crab) has the unusual ability to survive in a wide spectrum of salinity conditions. Indeed large population of this fiddler crab are common in marshes, swamps and flood plain forests adjoining tidally influenced freshwater river systems along the Atlantic and Gulf coasts of the United States, where salinity usually ranges between 0 – 20 ppt. On the other hand, upriver populations live their entire juvenile and adult lives in freshwater and are able to reproduce successfully even with the putative requirement for increased energy expenditure due to the need to constantly osmoregulate. As such we are particularly interested in understanding the molecular mechanisms responsible for *U. minax* adaptability to these diverse habitats. Several recent studies have indicated that regulation of transport protein expression, in response to salinity and other environmental signals, is a widespread mechanism in both invertebrates and lower vertebrates. For instance, preliminary studies in selected euryhaline crustaceans suggest that several enzymes involved in the process of ion exchange/uptake across epithelial membranes, including Na<sup>+</sup>/K<sup>+</sup> ATPase, V-type H<sup>+</sup> ATPase, and Na<sup>+</sup> K<sup>+</sup> 2Cl<sup>-</sup> co-transporter and Carbonic Anhydrase are differentially expressed in response to salinity fluctuation. Similar results were found in some freshwater (*Tilapia* sp.) and anadromous (*Morone saxatilis*) teleosts. To investigate the molecular mechanisms of osmoregulation in *U. minax*, we performed phylogenetic comparative analyses using the Basic Local Alignment Search Tool (BLASTn) and Clustal W algorithms in order to identify conserved regions in the genes encoding for the Na<sup>+</sup> K<sup>+</sup> ATPase, Carbonic Anhydrase, V-type H<sup>+</sup> ATPase and others. A series of degenerated primers were designed and used to clone the corresponding sequences by RT-PCR, from total RNAs prepared from several tissues, including anterior and posterior gills. So far we have obtained the full coding sequence of the Na<sup>+</sup> K<sup>+</sup> ATPase and the partial coding sequence of the Carbonic Anhydrase, while the identification of others is still in progress. Gene-specific primers for these candidate genes will subsequently be used in order to evaluate the tissue-specific regulation of these genes in different organs and developmental stages. In addition, quantitative RT-PCR analyses will be used to assess possible changes in the transcriptional regulation of the same genes in naturally occurring estuarine and freshwater populations exposed to a variety of salinity conditions. This will allow us to obtain a detailed picture of the transcriptional regulation of ion transporters and ion transport-related enzymes in this species, providing new insight into the molecular mechanisms possibly responsible for the above-mentioned unusual ability of *Uca minax* to inhabit such a diverse range of aquatic environments.

## SOLVENT-INDUCED RAMAN PEAK SHIFTS IN ANALOGS OF ETHYL-DIMETHYLAMINO BENZOATE

Raymond Belliveau and Monty Fetterolf  
Dept. of Chemistry and Physics, University of South Carolina Aiken

The solute molecule ethyl-4-dimethylaminobenzoate (EDAB) displays shifts of several wavenumbers in Raman peak locations in response to changes in solvent. The vibrations associated most closely with the ester functionality are those that undergo these shifts. We have explored analogs of EDAB, specifically dimethylaniline (DMA) and ethylbenzoate (EB), for solvent activity in their Raman spectra. We will present an analysis of the spectra from the three solute molecules dissolved in several different solvents with an eye towards a deeper insight into the solute/solvent interactions that occur.

DEVELOPMENT OF BIRD SONG ALONG AN URBAN-TO-RURAL GRADIENT  
Caitlin E. Black<sup>1</sup>, Dr. Paul M. Nolan<sup>2</sup>, Dr. Kevin J. McGraw<sup>3</sup> and Mathieu Giraudeau<sup>3</sup>  
<sup>1</sup>Dept. of Biology, College of Charleston; <sup>2</sup>The Citadel; <sup>3</sup>Arizona State University

Urban environments pose more challenges to wildlife than do rural areas, including extensive noise pollution. Young animals there also face the demands of developing traits, such as songs, used later when attracting mates. We tested the previously unstudied hypothesis that house finch song development is influenced by environmental factors that vary along an urban-to-rural gradient, and predicted a shift in the fundamental frequency, length, and complexity of their songs. We recorded 6+ songs from each of 9+ birds at each of six sites in the Phoenix, Arizona area, ranging from urban downtown Phoenix to a rural desert park. We used ANOVAs and post-hoc t-tests to identify differences in song characteristics between the sites. Relative to urban birds, rural birds developed songs with lower frequencies and wider frequency ranges, and also showed changes in their song length. We conclude that previously observed differences in adult song along this gradient develop early in the bird's life.

SIMULATIONS OF RADIATIVE TRANSFER IN STRICTLY ABSORBING ATMOSPHERIC MEDIA  
Philip Boehner and Dr. Mike Larsen  
Dept. of Physics and Astronomy, College of Charleston

As of now, transmission of light through clouds is poorly understood. Although radiative transmission through perfectly random (a.k.a. Poisson) media is well understood both theoretically and computationally, work over the last 15 years has revealed that cloud microstructure (the distribution of cloud droplets within a cloud) does not follow this "perfectly random" theoretical description. In an effort to identify the extent to which the Beer-Lambert law of exponential attenuation in perfectly random media is violated in realistic cloud volumes, we have developed a first-principles scattering and absorption numerical model that actually simulates and resolves the positions of every droplet within a cloud. After cloud volume generation, "ballistic photons" are used to simulate radiative transfer through the cloud volume, allowing us to generalize the radiative properties of the cloud based on the interactions these photons have with the individual particles that make up the cloud volume. This presentation will give a basic overview of the relevant atmospheric science, logic behind the numerical simulation technique, and results from radiative absorption in volumes with known properties based on simulations from a number of different computer architectures.

APPLICATIONS OF COMPUTATIONAL STOCHASTIC GEOMETRY TO THE DETERMINATION OF CLOUD  
STRUCTURE  
Clarissa A Briner and Michael L. Larsen  
Dept. of Physics and Astronomy, College of Charleston

In the study of stochastic geometry, or spatial point processes, perfectly random spatial distributions, which are neither too clumped nor too organized, are called Poisson distributions. As most systems in nature are not perfectly random, models of natural processes usually include deviations from the Poisson distributions. In particular, the presence of a particle in one position can affect the probability of the presence of another particle at a certain distance from the first (this corresponds to a non-zero pair correlation function), or position can affect the probability of the presence of a particle (a statistically inhomogeneous distribution).

The internal structure of clouds is still subject to much debate in the atmospheric science community. Sampling of clouds is typically done in one dimension (an airplane flies through a cloud and records the presence or absence of a particle at each point). This data is then used to extrapolate the three-dimensional structure of the cloud.

However, this method is the assumption that the distribution of particles is isotropic, which may not be the case for statistically inhomogeneous distributions of particles. We will attempt to demonstrate this, using computational methods, by analyzing various different distributions of particles in three dimensions, and comparing these analyses to one-dimensional "pencil beams" randomly selected from the initial data.

DISTRIBUTION AND HABITAT CHARACTERISTICS OF THE GREEN-FLY ORCHID (*EPIDENDRUM MAGNOLIAE*) IN  
FOUR COASTAL PLAIN COUNTIES OF SOUTH CAROLINA  
Marvin E. Brown<sup>1</sup> and Eran S. Kilpatrick<sup>2</sup>

<sup>1</sup>Dept. of Biology, University of South Carolina Beaufort  
<sup>2</sup>Division of Math and Science University of South Carolina Salkehatchie

The green-fly orchid (*Epidendrum magnoliae*) is the only epiphytic orchid found outside of Florida in the continental U.S. and is considered rare or uncommon in South Carolina. From May – August 2011 green-fly orchid searches were performed in Allendale, Bamberg, Colleton, and Jasper Counties, South Carolina within the Ashepoo, Coosawhatchie, Edisto, and Savannah River watersheds. Multiple habitat variables were measured at host trees and along transects within each study site. A total of 363 colonies were recorded on 51 different host trees. Green-fly orchids were found on eight different tree species with 94% of colonies occurring on water elm (*Planera aquatica*), water tupelo (*Nyssa aquatica*), swamp tupelo (*Nyssa biflora*), and bald cypress (*Taxodium distichum*). Host trees had an average height of 17.6m and average dbh of 47.1cm. The average colony height across sites was 6.8m with smaller heights recorded near the margins of oxbow lakes and larger heights recorded within cypress tupelo swamp forests. Bryophytes were observed in 29% of colonies with resurrection fern (*Pleopeltis*

*polypodioides*) and Spanish moss (*Tillandsia usneoides*) observed as commensals with 19% and 14.6% of colonies, respectively. Colonies occurred at various orientations on subcanopy trees with a northward orientation observed most frequently for colonies in canopy trees. This study produced two county records (Bamberg and Jasper) for the green-fly orchid and added three locality records for Allendale and Colleton Counties. Mature stands of swamp forest should be maintained in the Coastal Plain to sustain epiphytic orchid populations which could serve to recolonize regeneration in harvested stands.

#### A SYNTHETIC MODEL OF TYPE-2 COPPER NITRITE REDUCTASE BASED ON A BULKY TRIS(PYRAZOLYL)BORATE LIGAND

Alexander Brugh and Gerard Rowe  
Dept. of Chemistry, University of South Carolina Aiken

Type-2 copper-containing nitrite reductase is an enzyme that catalyzes the 1-electron, 2-proton mediated reduction of nitrite (NO<sub>2</sub><sup>-</sup>) to nitric oxide (NO). One noteworthy aspect of the enzyme's active site is a carboxylic acid group that is in close proximity to the copper, but cannot directly interact with the metal atom. Instead, this acidic group acts as a proton donor to a copper-bound nitrite group, and is believed to facilitate the rapid reduction of the nitrite to nitric oxide.

In order to investigate the role of an acidic group kept close to a copper center like that in nitrite reductase, we have designed and synthesized a sterically bulky tris(pyrazolyl)borate ligand that incorporates an acidic group that we expect to mimic the carboxylic acid found in the enzyme's active site. This will be assessed through reactivity studies that expose the copper compounds to reaction conditions similar to those found in the enzyme (i.e., nitrite, a source of protons, and a source of electrons).

#### CONJUGATED BIS(DIOXABOROLE)S FOR OPTICAL SENSING OF LEWIS BASES BY AN INTEGRAL MAIN-CHAIN SENSORY APPROACH

Min Cai and John J. Lavigne  
Dept. of Chemistry, University of South Carolina Columbia

Conjugated polymers have been investigated for sensing, in large part due to their signal amplification. Within the sensors, the recognition motifs can be pendent on the side-chain or embedded in the main-chain of conjugated polymers, the latter of which has been rarely studied. Poly(borane)s, with Lewis acidic boron centers in the main-chain, have been applied as recognition elements to detect Lewis bases, such as fluoride, cyanide, or amines. However, the often difficult synthesis, hydrolytic and oxidative instability, and the incorporated bulky substituents required of boranes are of great concern for sensing applications. We reasoned that the borole linkage could be incorporated into a polymer main-chain and these materials used as optical sensors. Boronate ester formation, with its covalent yet reversible nature, provides advantages including facile synthesis, good stability and extended  $\pi$ -conjugation for the creation of sensitive conjugated polymer sensors. Herein, bis(dioxaborole)s were used as models for poly(dioxaborole)s, creating an integral sensory approach for elucidating the mechanism of binding and signal transduction based on optically sensing fluoride. This sensing mechanism was intensively studied by UV-Vis, fluorescence, NMR spectroscopy as well as computational methods. It was found that the recognition of fluoride by bis(dioxaborole)s was sensitive, reversible and cross-reactive with other Lewis bases. These results provide insights into the design of a sensor array to distinguish Lewis bases, and the development of conjugated poly(dioxaborole)s further amplifying the optical signals to increase sensitivity.

#### THE EFFECTS OF SALINITY, PH, AND DISSOLVED OXYGEN ON THE SENSITIVITY OF PCR

Joseph Cannon and Dr. Paul Richardson  
Dept. of Biochemistry, Coastal Carolina University

Identification of the T4 Bacteriophage in Estuarine Water. Bacteriophages have been used as indicators to predict the presence of pathogenic bacteria in drinking, waste and recreational waters. They have also shown potential in limiting aquatic bacteria population through their lytic properties. While an excellent bacterial pollution indicator in drinking and waste water settings, little is known about the survival and persistence of bacteriophages in the harsher saline environments of sea water. The lower number of bacteriophage present in the saline environment requires a sensitive detection method to be an effective indicator. A polymerase chain reaction (PCR) protocol has been developed for identifying bacteriophage under ideal conditions in a laboratory and has shown that as little as five viral particles can be detected with this method. This study evaluates whether the properties of seawater (salinity, pH and dissolved oxygen content) affect the sensitivity of the method used to identify bacteriophages in water samples. Samples of coliform bacteriophage were incubated in various saltwater samples drawn from two tidal estuaries and their associated brackish water ponds. The effect of the different water characteristics on the sensitivity of the PCR identification of virus particles is analyzed to determine what sensitivity levels bacteriophage can be detected in these environmental samples with respect to each water property.

NOVEL ALDOL-TYPE CONDENSATION PROCESSES INVOLVING  
1-BENZOYLACETONE, TWO STRONG BASES, AND SELECT CARBONYL COMPOUNDS

Sarah S. Carlisle<sup>1</sup>, Philip J. Mabe<sup>1</sup>, William G. Shuler<sup>1</sup>, Clyde R. Metz<sup>1</sup>, William T. Pennington<sup>2</sup>, Donald G. VanDerveer<sup>2</sup>, and Charles F. Beam<sup>1</sup>

<sup>1</sup>Department of Chemistry and Biochemistry, College of Charleston

<sup>2</sup>Department of Chemistry, Clemson University

Lithium diisopropylamide (LDA) or lithium hexamethyldisilazide (LHMDS) were used to form dilithiated (dianion type) or anion type complex with 1-benzoylacetone. These activated intermediates were condensed with a variety of aldehydes or ketones to afford hydroxyl intermediates that could be isolated after protonation when electron withdrawing groups were in a resonance position on a ring bonded to the carbonyl carbon. When electron donating groups were in a resonance position, linear dehydration occurred, and the tautomer that resulted underwent X-ray crystal analysis. Theoretical stability calculations of the possible tautomeric products were undertaken. The lithiated complex (or dianion) resulting from treatment of 1-benzoylacetone with LHMDS was condensed with 2-hydroxy-1-naphthaldehyde, a new naphthopyranlidene resulted. The confirmation of its structure is also being done by X-ray crystal analysis. When the activated 1-benzoylacetone system, dianion-type or anion complex, was condensed with 2-aminoacetophenone, the hydroxyl intermediate underwent two dehydration processes, linear dehydration followed by cyclodehydration to form the substituted quinoline.

DIFFERENCE EQUATIONS AND THEIR APPLICATION IN MORTGAGE CALCULATION

Hardin Carrington, Nailong Guo, Naima Naheed, and Woon-Kwan Lam  
Benedict College

The main purpose of this project is to show how the change in interest rate affects our house price. This project applies difference equations to a 30-year mortgage. Our project includes how to refinance the loan, which demonstrates how to make a choice among the combination of different lengths of the loan and different mortgage interest rates. In addition to that recasting will also be considered. Our project shows that difference equations are a powerful but still simple tool for mortgage calculation.

DETERMINING THE PREVALENCE OF THE IMPROPER USE OF CITATIONS AND SOURCES AT REGIONAL  
SCIENCE FAIRS

Brittany Cheeks and Michelle Vieyra  
Dept. of Biology, University of South Carolina Aiken

The purpose of this research is to determine the prevalence of plagiarism at regional science fairs in the Southeastern US. Plagiarism is defined as "literary theft"; the process of taking ideas and writing from a source without giving credit to the original author. The reasons for plagiarism include lack of time, lack of knowledge and lack of care in approaching research. There are two forms of plagiarism that should be taken into account when assessing middle and high school student research papers. One form is intentional where a student will knowingly avoid proper citation as a way to pass it off as the student's own work. This is a type of academic dishonesty that should not be permitted in any form of learning environment. The second form of plagiarism is unintentional but is often handled as punitively as the intentional form. Unintentional plagiarism is when there is an error in the way students comprehend citation, have trouble evaluating the quality of their sources and are unaware of the inaccuracies they commit. Both forms of plagiarism, if not addressed early, follow the students into undergraduate and graduate level schooling and are perceived by the student as an appropriate approach towards research. For the purpose of this project, research reports at regional science fairs in several Southeastern states will be examined for citation errors and use of sources. In particular they will be assessed for presence and appropriate use of citations within the text, presence and proper citation of sources at the end of the paper and types of sources used. Based on the prevalence of plagiarism noted in freshman college classes, it is expected that there will be citation, paraphrasing and quotation errors in the research reports of the middle and high school science fair participants. Although the guidelines for participation at the regional science fairs specifically mention plagiarism, errors are likely due to incomplete instruction on research assignments at the middle and high school level. Quantifying the incidence of plagiarism at this level may help middle and high school teachers to be more aware of the problem and revise instruction.

SELF-REGULATION, MATH ANXIETY, AND MATH PERFORMANCE

Karlin-Rae M. Cummings and Keri Weed  
Dept. of Psychology, University of South Carolina Aiken

Relationships between self-regulation, math anxiety, and math skills were examined in a sample of 33 college students. Participants provided information about their GPA, math courses taken, approximate grades in those courses, credit hours completed, and age. The math subtest of the Kaufman Functional Academic Skills Test (Kaufman & Kaufman, 1994) was administered as an assessment of math skills. Next, participants completed the Short Mathematics Anxiety Rating Scale (Alexander & Martray, 1989), a self-report measure of math anxiety, and the Motivated Strategies for Learning Questionnaire (Pintrich & deGroot, 1990) that measured strategies students use as they work math problems. Finally, participants completed a series of computerized tasks that assessed abilities in mental calculations and working memory (n-back). A significantly negative relationship was found between math anxiety and math ability that indicated that higher math anxiety is associated with math skills and between math anxiety and GPA. A positive correlation was also found between self-

regulation and GPA that indicated that greater self-regulation is associated with higher GPA, but self-regulation was not significantly related to math ability. Relationships between math anxiety, self-regulation, working memory and mental calculations are currently being analyzed. Since this study was correlational it is impossible to determine if poor math skills cause math anxiety or if math anxiety causes poor math skills, or if both are associated with something not measured in this study. However, many college students may benefit from interventions aimed at reducing their anxiety associated with math courses.

#### A FACILE METHOD FOR TUNING THE STABILITY OF POLYDIOXABOROLANES

Shakena L. Daniel and Dr. John Lavigne  
Dept. of Chemistry, University of South Carolina Columbia

The advantage and disadvantage of using conventional polymers (i.e. polystyrene, polyethylene glycol) to make disposable materials is that these materials are extremely stable under ambient conditions. Being able to tune the degradability of a polymer is one way to create materials that are more environmentally friendly. By having the polymer's backbone connected through a covalent, yet reversible boronate ester linkage, it is possible to tune the stability of the polymer. Presented will be the synthesis of polydioxaborolanes using a simple step growth polymerization, which upon analysis by gel permeation chromatography (GPC) showed an unusually low molecular weight for film growth. Monitoring the mass and the molecular weight of the films after being exposed to aqueous conditions showed the stability of the polymers. In certain polydioxaborolanes, the stability of the film was shown to persist for several weeks. This property was shown to be tunable upon monomer choice. Depending upon monomers used during the polymerization, results have shown that the stability of the polymer can be tuned for as little as 24 hours to as long as a month. The tunability provides opportunities to make new disposable materials from these polymers that can be easily degraded after they have been used.

#### THE DISTRIBUTION OF PSEUDO-NITZSCHIA SPP. ACROSS THE SOUTHEASTERN U.S. DURING MAY-JUNE, 2011

Angela M Dapremont  
Dept. of Environmental Science, College of Charleston

This study further investigated the geographic distribution of *Pseudo-nitzschia* spp. in the southeastern U.S., and determined whether the environmental parameters of salinity (ppt), chlorophyll a ( $\mu\text{g/L}$ ), surface water temperature ( $^{\circ}\text{C}$ ), and distance from shore (km) were associated with its presence. Whole water (live) samples, as well as concentrated preserved (using Lugol's iodine) samples were collected from ongoing fish survey cruises (MARMAP and SEAMAP), and DNR shore work. Slightly less than half of all collected samples were positive for *Pseudo-nitzschia* presence. When live and preserved samples were tested (using a binary logistic regression) against *Pseudo-nitzschia* presence, no significant relationship resulted from salinity (ppt), chlorophyll a ( $\mu\text{g/L}$ ), or surface water temperature ( $^{\circ}\text{C}$ ). However, distance from shore (km) yielded a significant value, leading to the conclusion that as distance from shore increases, the probability of finding *Pseudo-nitzschia* decreases. Geographic distribution was attained using GIS ArcMap software, which displayed the presence or absence of *Pseudo-nitzschia* among inshore and offshore samples. The study also found that the interaction between certain environmental parameters (e.g. latitude and distance from shore, salinity and surface water temperature) may affect *Pseudo-nitzschia* presence. Therefore, the relationship between combined (more than one) environmental variables and *Pseudo-nitzschia* presence can be studied further.

#### ISOLATING THE ANTI-ESTROGENIC COMPONENTS OF *PRUNELLA VULGARIS* USING MULTIPLE SOLID-PHASE EXTRACTION METHODS AND HPLC

Fred D.C David, Richard M. Graybill, Cierra M. Kingsley<sup>1</sup>, Eli V. Hestermann<sup>1</sup>, Sandra K. Wheeler and John F. Wheeler  
Dept. of Chemistry, Furman University  
<sup>1</sup>Converse College

Prior studies have shown that the Chinese herb *Prunella vulgaris* (PV) has significant medical potential and is currently under investigation for antioxidant, antimicrobial, and anti-HIV activity. Our focus has been to determine what active compounds or group of agents within the herb are responsible for possible anti-estrogenic activity. The fractions obtained from Solid Phase Extractions (SPE) utilizing C18 cartridges were examined using T47D breast cancer cells and it appears the anti-estrogenic are contained within the more polar constituents of the sample. We have since then gathered preliminary data that suggests the possible anti-estrogenic activity of *Prunella vulgaris* utilizing Weak Anion Exchange (WAX) NH<sub>2</sub> as the extraction media to further separate the polar components of the tea. High Performance Liquid Chromatography (HPLC) has been utilized in conjunction with SPE and WAX methods in order to precisely separate the compounds of interest.

#### INFLUENCE OF GROWING SEASON LENGTH ON GERMINATION SUPPRESSION IN *AEGILOPS TRIUNCIALIS*

Deanna DuBose and Andy Dyer  
Dept. of Biology, University of South Carolina Aiken

*Aegilops triuncialis* is a non-native, winter annual grass that has invaded California rangelands due to its rapid growth and low palatability to grazing animals. Its invasiveness is also attributed to easily dispersed spikelets containing two dimorphic seeds. The large seed germinates quickly, but the small seed can be suppressed by a water soluble chemical present on

spikelet tissues produced by the maternal plant. The strength of maternal suppression may be related to the environmental conditions in the year the seeds are produced. Three *A. triuncialis* populations from northern to southern California experienced longer-than-normal growing seasons in 2011. Spikelets from each population were planted to determine differences in the strength of the maternal effect between populations. Maternal suppression of the small seed was greatest in the population that experienced the highest rainfall and longest growing season and weakest in the population that received the least rainfall. These data test the hypothesis that a longer growing season allows *A. triuncialis* plants to produce more of the suppressing chemical in comparison to short and more stressful growing seasons. This induced dormancy allows *A. triuncialis* to develop a seed bank in the soil. By knowing more about the conditions that favor the seed bank, *A. triuncialis* management strategies may be modified to be more effective at controlling this weedy invasive.

#### EVALUATION OF THE IMPACT OF YEAST ON FLORAL SCENT IN SILENE CAROLINIANA

Jonathan Freeman, Bettie Obi Johnson, Annette Golonka  
Dept. of Chemistry, University of South Carolina Lancaster

Plants within the genus *Silene* (Caryophyllaceae) have been well studied for pollination biology, microbe-host interactions, and scent compounds. The South Carolina plant species *Silene caroliniana* has not been well studied. Floral scent often plays an important role in pollination of insect-pollinated plants. This insect-pollinated plant species is host to a variety of microorganisms including nectar-associated *Metschnikowia* species that may have an impact on floral scent. In this study, solid phase microextraction and gas chromatography-mass spectrometry (SPME-GC-MS) were used to characterize volatile organic compounds from *Silene caroliniana* nectar. Headspace SPME-GC-MS analysis of nectar from pollinator visited flowers indicated yeast species growing in nectar produced yeastlike odor compounds including ethanol, 2-methyl-1-propanol, 2-methyl-2-propanol, 2-methyl-1-butanol, 3-methyl-1-butanol, and other less common volatile compounds. These compounds have detectable scents that potentially impact overall floral scent. Yeast species grown in pseudoneectar and sterile nectar confirmed that yeasts associated with this plant produced scented volatile organic compounds. These results indicate a potential impact of yeasts on pollination dynamics in *S. caroliniana*.

#### STARS SLC ACTIVITIES AT SC STATE – SUCCESS AND LESSONS LEARNED

Kevin Freeman, Terrell Perrotti, Luis Figueroa, Nikunja Swain, Cynithia Davis, Brandon Shields, David Moore, Evangeline Pointer, Kwaku Ofori-Marfoh, Julius Ellison, Tempestt Neal, and Shilindria Rivers  
Dept. of Computer Science, South Carolina State University

The STARS Leadership Corps (SLC) is a multi-year experience providing students with support throughout their academic journey. The Corps fosters an extended student community among academia, industry, and the community through civic engagement, mentoring, and professional development and/or research experiences to promote recruitment and leadership development through service learning. The Corps has been implemented with the following central values that have been shown to be effective for recruiting and graduating under-represented students in computing. The mission of the STARS (Students & Technology in Academia, Research & Service) Alliance is to increase the participation of women, under-represented minorities, and persons with disabilities in computing disciplines through multi-faceted interventions. The interventions focus on the influx and progression of students from middle school through graduate school in programs that lead to computing careers. The Alliance is organized as a national constellation of regional stars that include research universities, minority and women's universities and colleges, K-12 educators, industry, professional organizations, and community groups.

SC State's STARS SLC is designed to increase awareness about computational thinking in K-12 schools through hands on activities such as designing effective presentations, web design, robotics exercises, algorithmic thinking through the use of Flowchart software Raptor and number systems games. The hope is that these activities will enhance participation of women, under-represented minorities, and persons with disabilities in computing discipline and hence mission of STARS Alliance. SC State's STARS SLC aims to encourage and inform students at all levels on the various computing careers that are available to them. The objective of this poster presentation is to share our STARS SLC outreach and other activities, its success and lessons learned with the engineering, science, and computing community.

#### MOVING TOWARDS RADIATION: MAGNETICALLY ARRESTED ACCRETION

Anna Gillespie and P. Chris Fragile Author  
College of Charleston

Modeling the radiation generated by accreting matter is an important step towards realistic simulations of black hole accretion disks, especially at high accretion rates. To this end, we have recently added radiation transport to the existing general relativistic magnetohydrodynamic code, *Cosmos++*. Before attempting to model radiative accretion disks, we have tested the new code using a series of shock tube and Bondi (spherical inflow) problems. From there, we began work on a problem similar to the Bondi problem that also included some angular momentum, based on work by Proga (2005). The addition of angular momentum makes the problem of symmetric accretion much more realistic. However, in the process, we discovered that our new simulations were interesting even without the addition of radiation. The infalling gas appears to be experiencing magnetically arrested accretion, causing spikes in the accretion rates. The period and duration of these spikes seem to have some dependence on the spin of the black hole.

### THE EFFECT OF ACIDITY OF SPORTS DRINK ON MICE

Jazra' Gibson-Jackson, Annesha Byrd, William McAmis, Samuel Darko, and Samir Raychoudhury  
Dept. of Biology, Chemistry, and Environmental Health Science, Benedict College

In this research we tested the hypothesis that constant exposure of acidic sports drinks can cause problems to the digestive organs in athletes. Over the lifespan of their careers, athletes are compelled to consume large quantities of sports drinks that are designed to enable them replace electrolytes and other nutrients into their bodies. However, tests have shown that the pH of these drinks are very acidic and must have some negative effects on them. Although this research will benefit humans, the choice to use mice as experimental model is based on the biological similarities with the humans and the simplicity to study, collect and manage data. Adult mice were maintained in cages with regular Teckland rodent diet and given water alone (group I), 50% Gatorade (50% water; group II) and 100% Gatorade (group III) for drinking over a period of eight weeks. Body weights and food consumption were monitored every week. Organs were removed surgically, and liver, spleen, kidney, heart and pancreas were collected for histological examination. Dissected organ pieces were immersed in 4% paraformaldehyde for 24 hours, embedded in paraffin and cut into 5  $\mu$ m sections, which were mounted on precleaned glass slides. Slides were stained with hematoxylin and eosin and observed under a Zeiss Axioscope II microscope. At this time we are reporting data from the spleen, especially the macrophages, which are phagocytic cells that participate in all phases of immune response. Macrophages, through their secretory products, control inflammation, changes in the composition of the extracellular matrix, tissue reorganization and other processes. The objective of this study was to use F4/80 antibody to detect EGF-like molecule containing mucin-like hormone receptor 1 on the surface of macrophage in mouse spleen. For immunohistochemistry, F4/80 primary antibody was used (Serotec, Oxford, UK). Staining procedures were carried out at room temperature according to the manufacturer's instructions in the Vectastain ABC peroxidase standard kit (Vector laboratories, Inc. Burlingame, CA). Our preliminary results showed that the staining was localized in the macrophages of the spleen. We observed increased staining intensity in the macrophages from group II and III mice when compared with the mice from group I. This may suggest that long-term Gatorade drink changes the biochemical activities of macrophages from mouse spleen.

### GENETIC FINGERPRINTING OF T4 BACTERIOPHAGE

Sean M Gilroy and David Walling  
Dept. of Biochemistry, Coastal Carolina University

The purpose of this experiment was to successfully create a set of protocols to isolate and purify the genetic material, Deoxyribonucleic acid, of the virus known as T4 Bacteriophages. As a secondary objective the purified DNA was to be fingerprinted through digestion Electrophoresis. The isolation and purification of DNA in viruses can sometimes prove difficult due to the heavy concentration of host genetic material in the sample. Through different extraction and purification methods, for example enzyme degradation, centrifugation, and phenol/chloroform/isoamyl alcohol extraction, an effective set of protocols were derived that purified phage DNA. The viral DNA was then fingerprinted which can be used for genotyping the various strains of T4 Bacteriophages. These procedures will be used in the future to help identify Bacteriophages collected from various environments.

### PALEOKARST IN THE UPPER COASTAL PLAIN OF GEORGIA AND SOUTH CAROLINA

Virginia G. Goodyear<sup>1</sup>, Frank Syms<sup>2</sup>, William Pirkle<sup>1</sup>, and Alexia Helsley<sup>3</sup>

<sup>1</sup>Dept. of Geology, University of South Carolina Aiken

<sup>2</sup>Lettis Consultants International Inc.

<sup>3</sup>Dept. of History, University of South Carolina Aiken

Karst conditions in the upper coastal plain of South Carolina and Georgia are known to exist, however the upper limit is less defined based on actual data. The USGS National Karst Map (2008) presents karst data at a scale of 1:7.5 million making the resolution for the karst zone boundary in the upper Coastal Plain highly uncertain. Recent large excavations in central eastern Georgia and LiDAR acquisition over the Department of Energy Savannah River Site in South Carolina have provided direct observations of karst conditions which are located outside of the upper boundary of the USGS National Karst Map. Empirical observations from the large excavations in western Georgia as well as the Savannah River Site in South Carolina were used to evaluate the geomorphic expression of sinkholes on the topography. The pre-excavation topography was correlated to actual karst conditions noted in the large excavations including open caves and collapse structures. Historical data acquired from the Caroliniana Library newspaper archives, from residents of the former Dunbarton Community, and from the US Corps of Engineers at the Savannah River Site, as well as LiDAR imagery, were used to locate two actual sink holes. Using this geomorphic expression from the pre-construction topography and the LiDAR imagery from SRS as a baseline, similar surface features were mapped using the LiDAR imagery in ArcGIS. These features were then evaluated against published carbonate lithologic maps in the region (Colquhoun et al., 1983; Harris et al. 1997) to evaluate the distribution of features along regional strike and dip. These data provide local control to better establish the boundary of karst conditions in the upper Coastal Plain of eastern Georgia and western South Carolina.



## MULTIBEAM ANALYSIS OF U.S. ATLANTIC CONTINENTAL MARGIN SLUMP AND SUBMARINE LANDSLIDE MORPHOLOGY

Nick C. Guzzardo, Gabrielle Byrd, and Dr. Leslie Sautter  
Dept. of Geology, College of Charleston

Focusing on the U.S. Atlantic Continental margins of the Delmarva Peninsula, New Jersey, Rhode Island, and Georges Bank, analysis of slump characteristics and features was conducted in order to hypothesize potential slope-sourced triggers of submarine landslides and tsunamis. Using Reson multibeam sonar data collected by the U.S. Geological Survey aboard the NOAA ship Ronald H. Brown in 2009, CARIS HIPS and SIPS 7.1 was utilized to determine specific slump features such as existing slope gradient above the scarp, depth of slump detachment, morphologic comparison of composite material at the base of the scarp to that of materials found above the scarp, as well as sediment types and features. By generating profiles of the slump depths ranging from 200 to 3000 m, gradients and slope angles were calculated and used for determining which areas are more subject to failure. Angular Response Analysis (ARA) was used to provide sediment analysis of type and density by using the angular dependencies of backscatter to project a prediction of seafloor properties. Feature types were compared to evaluate possible submarine landslide and tsunami trigger sites. The downslope gravitational stress may be determined through software analysis of slope angle, sediment density, and a hypothesized ratio of sheer stress to vertical load based on past tsunami trigger sites as well as slump characteristics quantified in this 2009 dataset. This research may provide an in depth characterization of slump features which will allow for improved accuracy to identify potential tsunami and submarine landslide sites.

## REPRODUCTIVE PROTEIN HORMONES: MUSIC'S EFFECTS ON REPRODUCTIVE HORMONES IN GOLDFISH (*CARASSIUS AURATUS*)

Jordan M. Hairr and William E. Roudebush  
Dept. of Biology, Charleston Southern University

The human interaction in the aquatic ecosystems causes widespread effect, which can be beneficial and detrimental. As humans interact with aqueous ecosystems, sound inevitably becomes a factor. The goldfish anatomy contains a lateral line, which allows them to feel the movements of water and react appropriately and also assists them in balance in the water. Adding acoustic sound waves into the water would cause a shift in the natural movement of the water and the natural stimulation of the lateral line. By measuring hormones in the goldfishes' blood, specifically the protein based reproductive hormones anti-mullerian hormone (AMH) and Inhibin B, an accurate measurement of the effects of acoustics on the reproduction in the aqueous ecosystem can be obtained. AMH and Inhibin B are both glycoprotein hormones. They fall under the transforming growth factor – beta superfamily. These hormones perform various physiological functions and the levels of AMH and Inhibin B have been presented as effective biomarkers for gonadal function and reproductive potential. The main objective of this study is to determine the effect of acoustics on AMH and Inhibin B levels in goldfish.

## EXTERNAL ELECTRIC FIELDS CAN PREVENT BIOFILM FORMATION BY BACTERIA

Mansueta Harris and Alope Kumar  
Morris College  
Oak Ridge National Laboratory

Biofilms are three-dimensional microbial aggregations encased by extracellular polymeric substances (EPS); they adhere to solid surfaces. Biofilms are more resistant than free-floating bacteria to antimicrobial agents. They can also be difficult to remove using mechanical mechanisms. However, electric fields can affect bacteria, and earlier studies at Oak Ridge National Laboratory (ORNL) on one species of bacteria – *E.coli* 042 strain – showed that external electric fields can reduce biofilm formation and cause free-floating *E.coli* 042 to flocculate, facilitating its removal from water. Electric field technology could reduce biofouling and infections associated with medical devices such as catheters. To extend the previous study, we examined the effects of electric fields on two species of bacteria – *B. subtilis* and *Pseudomonas fluorescens*. Studies of both bacteria focused on biofilm formation in response to the amplitude and frequency of an applied electric field. For *B.subtilis*, standard Luria-Bertani (LB) medium was used to grow cultures overnight. Inocula were prepared in modified LB medium. A culture chamber with electrodes was placed in an incubator at 30 °C; an external power source supplied voltage to the electrodes. A similar procedure was used for *P. fluorescens*. We found that the external electric fields. Caused the surface to decrease and that biofilm was both amplitude- and frequency-dependent. Increasing the voltage decreased the surface coverage. External electric fields appear to be an effective technique for countering biofilm formation and even high-frequency, AC fields were effective at preventing biofilm formation.

## NATIONAL SECURITY PROGRAMS AT THE SAVANNAH RIVER NATIONAL LABORATORY

David Hathcock  
Savannah River National Laboratory

The Savannah River National Laboratory provides vital support for a variety of national security efforts through tritium research and development, safe handling and disposition of plutonium and spent nuclear fuel to advance the nation's nuclear nonproliferation goals. Additionally SRNL supports wide a range of homeland security programs by providing technologies, training and consultation for a variety of national, regional and local homeland security and law enforcement needs. SRNL

provides support to NNSA and other government departments and agencies for their participation in the interagency process that develops U.S. positions on the Nuclear Nonproliferation Treaty, the Fissile Material Cutoff Treaty, the Comprehensive Test Ban, the START Follow-On treaty, as well as the 123 Agreements required for nuclear trade with other countries. SRNL also supports DOE nonproliferation efforts across a wide range of activities, including support for work on Part 810 evaluations, the Nuclear Interdiction Advisory Group, the Missile Technology Advisory Group, Shield, the International Nonproliferation Export Control Program, the Global Initiative for Proliferation Prevention, and the Nuclear Materials Information Program.

#### FORMATION OF A PUTATIVE COPPER-OXYGEN SPECIES SUPPORTED BY AN N-HETEROCYCLIC CARBENE LIGAND

Stephanie Hawkins and Gerard Rowe  
Dept. of Chemistry, University of South Carolina Aiken

Copper-oxygen species are thought to play a role in many oxygenase enzymes that carry out particularly challenging oxidation reactions, such as the oxidation of methane to methanol in methane monooxygenase. Since their first isolation in the late 1990s by Stack and coworkers, many synthetic copper-oxygen compounds have been synthesized, and even crystallographically characterized. Most of these copper-oxygen species were supported by ligand frameworks that contain only nitrogen-donor atoms.

In our lab, we have synthesized a series of N-heterocyclic carbene (NHC) pincer ligands that contain nitrogen-donor arms in an attempt to synthesize copper-oxygen species supported by a ligand that contains a metal-carbon bond. Using one NHC ligand with sterically bulky amine-containing arms, we have found spectroscopic evidence that an intermediate species is formed when a solution of the Cu-NHC compound is exposed to oxygen gas at low temperatures (-50C to -70C) that is not observed when oxygen is bubbled through the room temperature solutions. We believe this to be a copper-oxygen species similar to those observed with compounds containing only nitrogen-donor atoms.

#### HIGH RATE TENSILE TESTING OF NICKEL 270

Oliver Holmes and Donald L. Erdman III  
Morris College

Nickel 270 is the highest purity of the nickel alloys. It has a low base hardness and high ductility. In this study, it is tested at room temperature as a precursor to Iridium at high temperatures (1500C). The main focus points of the tests are the ultimate tensile strength, strain to failure and material yield points. Tensile testing was the method used throughout the project. The material was EDM (Electro-discharge Machining) cut into dog bone shaped samples and tested. Tests were conducted at 4 different rates, 1, 10, 100, and 500 inches per second ips on a custom-designed servo-hydraulic machine. Three (3) samples were tested under each speed. The load washer was used to obtain the load value at a speed of lips. The imaging system used to analyze the displacement of the gage section records video of the specimen surface at up to 300,000 images per second. As a precursor for Iridium Nickel 270 exhibited increased tensile strength at higher strain rates of 1, 10, 100 and 500 ips and work hardening without noticeable change of elongation when strain rate was increased. This property makes it possible to use the Iridium to counter the high temperature of the encased fuel on satellites by withstanding the heat and still performing properly.

#### COMPARISON OF SUBMARINE CANYON MORPHOLOGY OFF THE U.S. EAST COAST

Veronica R. Holton, Megan R. Arnett, and Leslie R. Sautter  
Dept. of Geology, College of Charleston

Using multibeam sonar data collected in 2009 by the U.S. Geological Survey from the NOAA Ship Ronald H. Brown, submarine canyon morphologies from several parts of the Mid-Atlantic and northern East coast of the United States will be studied and compared. Bathymetric data will be processed using the software CARIS HIPS and SIPS 7.1. Canyons have been classified based on different characteristics, ranging from degree of sinuosity, gradient, general shape and orientation of the canyon, the amount of meandering paths, or tributaries and distributaries, etc. The amount of incision and depth of each canyon has been analyzed and could potentially be used to indicate the ages of the canyons relative to one another. These characteristics have been used to define different canyon morphologies, allowing them to be compared to each other as well as other canyons in the area that are not a part of the 2009 data.

#### THE EFFECTS OF SRT1720 ON LIVER REGENERATION AFTER PARTIAL LIVER TRANSPLANTATION

Rhonda Hook and Zhi Zhong  
Morris College

To alleviate the severe shortage of donor livers, partial liver grafts are being used more than ever. Small-for-size liver grafts often fail after liver transplantation due to poor mitochondrial function and inhibition of liver regeneration. Energy supply is essential for liver regeneration and graft survival. In this pilot study, we tested the hypothesis that stimulation of mitochondrial biogenesis could improve mitochondrial function and stimulate liver regeneration. Livers of C57BL/6 male mice were reduced to 50% (HSG) and 30% (TSG) of original size, explanted and then stored in Lactated Ringers' solution at 0-1°C

for 2 hours. Full-size grafts (FSG), HSG and TSG were implanted into recipients. SRT1720 (2 mg/kg, ip), a stimulator of mitochondrial biogenesis, was injected after implantation.

ATP synthase- $\beta$  and NADH dehydrogenase-3 (mitochondrial oxidative phosphorylation proteins) were detected by Western blotting. To assess liver regeneration, BrdU incorporation was detected immunohistochemically. Mitotic cells were counted in H+E stained slides, and PCNA expression was detected by Western blotting. Results, show Mitotic cells were rare in sham-operated livers and FSG but increased to 23.6/high power field (hpf) in HSG. In TSG there were more cell death and little to no mitosis. In contrast, SRT1720 treatment increased mitotic cells to 34/hpf in TSG.

#### ATMOSPHERIC CIRCULATION PATTERNS, HURRICANE IRENE, AND POTENTIAL HISTORIC ANALOGS

Paul Huff, Cary Mock, and Lesley-Ann Dupigny-Giroux<sup>1</sup>  
Dept. of Geography, University of South Carolina Columbia  
<sup>1</sup>Dept. of Geography, University of Vermont

This study examined synoptic weather patterns that influenced the path of Hurricane Irene in August 2011. Daily composite maps of surface sea-level pressure, 500-mb heights, precipitable water, and vector winds preceding Hurricane Irene landfall in New England by several days and lasting a day after landfall were constructed using the NCEP/NCAR Reanalysis database, made available by the NOAA's Earth System Research Laboratory. Results show that Irene moved between two anomalous high pressure zones located in the middle Atlantic and in the central United States, corresponding with an upper-level trough in the polar jet stream that helped steer the tropical storm northward from the North Carolina coast through Vermont. High precipitation rates with record flood stages were observed in southern Vermont; however, the extent of the flood damage in this region is likely due to the high soil moisture content prior to the storm's arrival given composite maps of Irene did not significantly differ compared to climatology. Potential historic analogs to Irene were examined and include the August of 1893 hurricane, Tropical Storm Doria (1971), Hurricane Gloria (1985), and the August hurricane of 1827. The 1827 hurricane is likely the closest analog, considering hurricane intensity, size, and track.

#### ANALYSIS OF HAMMERHEAD RIBOZYME-MEDIATED DOWN-REGULATION OF THE HIV-1 TRANSACTIVATOR OF TRANSCRIPTION

Alex S. Jureka and William H Jackson, Jr.  
Dept. of Biology, University of South Carolina Aiken

Human Immunodeficiency Virus type 1 (HIV-1) is the etiological agent of the AIDS epidemic, and is classified as a lentivirus in the family Retroviridae. The primary target for this virus is the CD4+ population of T Helper lymphocytes. These cells provide overall control of the immune system, and their loss due to HIV-1 pathogenesis, results in the progressive impairment of the immune response and AIDS. Successful HIV-1 replication depends on expression of a small regulatory gene termed tat (trans-activator of transcription). Tat functions to enhance elongation of HIV-1 transcripts by binding to the trans-activating response element (TAR) sequence which is located within the U5 region of the viral long terminal repeat and, when transcribed, forms a stem loop structure on all nascent viral mRNAs. One mechanism of attacking tat may be to use antisense reagents that specifically target and inhibit mRNA function. Hammerhead ribozymes are small catalytic RNAs that can be designed to target and cleave tat mRNAs and have been shown to greatly reduce or inhibit viral replication. Previously our lab has designed and cloned anti-tat hammerhead ribozymes targeted to three pGUA sequences, located at nucleotides 5840, 5895, and 5910 within the HIV-1 NL43 genome (Accession number M19921). In addition, a non-catalytic control version of each ribozyme was created by altering a conserved nucleotide within the catalytic core. Each ribozyme has been shown, by in vitro cleavage assays, to cleave tat at the targeted location. To study the ability of these ribozymes to function within a cellular environment, each catalytic and non-catalytic ribozyme

#### INVESTIGATION OF THE THERMODYNAMICS OF BINDING BETWEEN POTENTIAL ANTI-TUMOR AGENT RAC-[CR(DIP)2(DPPZ)]3+ AND DNA

Andrew G. Kantor, Brandon L. Thompson, Kristen E. Watts, BaoTran T. Le, Morgan M. Sprinkle, Noel A.P. Kane-Maguire, Sandra K. Wheeler, and John F. Wheeler  
Dept. of Chemistry, Furman University

For many years, our group has pursued an interest in the interaction of Cr(III) complexes containing intercalating ligands with DNA. These Cr(III) complexes have demonstrated the oxidizing capacity to cleave DNA and/or form permanent adducts with DNA when photoexcited at 350 nm, thus making these Cr(III) complexes potentially valuable as anti-tumor agents. Recently, we have investigated [Cr(DIP)2(DPPZ)]<sup>3+</sup>, where DPPZ is dipyrrophenazine, an intercalating ligand, and DIP is 4,7-diphenyl-1,10-phenanthroline, an ancillary ligand associated with stereoselectivity and major and minor groove binding. Inclusion of DPPZ has previously demonstrated enhanced values for DNA binding (KDNA) and increased oxidizing power of the Cr(diimine)<sup>3+</sup> system. The thermodynamic properties of binding (.H, .S, and KDNA) were investigated using equilibrium dialysis, spectrophotometric titrations, and isothermal titration calorimetry (ITC). ITC data has shown that two binding sites occur: a primary, endothermic binding site, which is entropically driven, and a secondary, exothermic binding site, which is enthalpically driven.

## EVALUATION OF THE ADSORPTIVE PROPERTIES OF CaCO<sub>3</sub> AND CaO SYNTHESIZED FROM WASTE EGGSHELLS

Faith Kibuye, Cynthia Tamboue, and Samuel Darko  
Dept. of Biology, Chemistry, and Environmental Health Science, Benedict College

In this preliminary and ongoing study, crystalline CaO was synthesized from CaCO<sub>3</sub> obtained from recycled eggshells, through calcinations and mechanochemical processes. Adsorption properties of both CaO and CaCO<sub>3</sub> were analyzed on the environmental remediation of several different pollutants commonly found in drinking water such as antibiotics and heavy metals. The effects of operating parameters such as, contact time and dosage of adsorbent were investigated. It was noted that the higher the amount of adsorbent used and the longer the contact time between the contaminant and adsorbent, the better the adsorption rate. A 99% removal of lead (Pb) and tetracycline (TC) was noted with CaCO<sub>3</sub>, while Pb and TC had a 61% and 99% removal with CaO respectively. The determination of crystalline structure, consistency, and elemental composition texture, porosity, surface area and morphology of synthesized CaO and CaCO<sub>3</sub> was performed via XRD, TGA, BET, and SEM, respectively.

## THE TEMPERATURE DEPENDENCE OF THE VISIBLE ABSORPTION OF METHYLENE VIOLET IN DIFFERENT SOLVENTS

Ashleigh Kimberlin and Monty Fetterolf  
University of South Carolina Aiken, Dept. of Chemistry and Physics

Although methylene violet displays a solvatochromic shift in its visible absorption that ranges approximately 90 nm when changing solvents from water to diethyl ether, the effect in alcoholic solvents is more subtle. It appears that changing these solvents increases the intensity of one peak relative to the other giving the appearance of a modest shift in the maximum absorption wavelength. It is possible that an equilibrium between two different solvated forms of the ground state methylene violet molecule, similar to that which occurs for an acid/base indicator, may be responsible. If such an equilibrium exists, temperature may disturb the relative concentrations of each form giving an associated change in the absorption intensities of each. We will report the response of visible absorption to temperature changes of methylene violet dissolved in water, ethanol and acetonitrile. There appears to be evidence to support the existence of a ground-state equilibrium.

## SHALLOW MARINE LIONFISH HABITAT CHARACTERIZATION OF ONSLOW BAY, NC

Jennifer K Kist, Emily B Osborne, Leslie R. Sautter, and Dr. Paula Whitfield<sup>1</sup>  
Dept. of Geology, College of Charleston

<sup>1</sup>NOAA Center for Coastal Fisheries and Habitat Research (CCFHR) Beaufort Lab (NC)

The genus *Pterois* is a group of venomous fish, collectively known as Lionfish, that is presently a prominent invasive species found along the eastern coast of North America. Several studies have been conducted to determine the northern most extent that these organisms can inhabit in an attempt to identify the ideal Lionfish habitat. A large number of Lionfish sightings have been documented in the Onslow Bay area and it is therefore an ideal region of study to identify preferential Lionfish habitats. Onslow Bay is a broad crescent-shaped embayment located along the central North Carolina coast and is bordered by two cape promontories. Seven hydrographic surveys were conducted between water depths of 20-40 meters between the years of 2007-2009 using a Kongsberg EM1002 multibeam system aboard the NOAA Ship Nancy Foster. These surveys were conducted in order to characterize rocky outcrops and ledges where Lionfish have been sighted. Hydrographic data was collected by the Center for Coastal Fisheries and Habitat Research (CCFHR) Beaufort Lab in North Carolina lead by Dr. Paula Whitfield. There are two quasi transect lines across the continental shelf within the study area in the northern and southern regions of the bay and one inner shelf site between the two transect lines. CARIS HIPS & SIPS 7.1 was used to process the multibeam data by producing base surfaces. These base surfaces will be used to geologically characterize substrates and to determine the suitability of Onslow Bay for Lionfish.

## SPATIAL STATISTICS THROUGH A 1D LENS

Michael L. Larsen  
Dept. of Physics and Astronomy, College of Charleston

The statistical study of randomly distributed particulates in two or three dimensions is important in many diverse fields. Everything from the positions of tree trunks in a forest to the statistical structure of cellular colonies, and from the statistics associated with raindrops arriving on the ground to the general spatial structure of galaxy distributions often rely on similar - if not identical - spatial statistical description methodologies. A common task is to try and infer statistically relevant spatial information about a 2 or 3 dimensional system with a 1-dimensional spatial or temporal data-set. This work uses computational simulation to explore the capabilities of using 1-dimensional information to successfully capture embedded statistical structure in multi-dimensional systems with statistical isotropy. Implications of this work on instrument design and theoretical considerations are also discussed.

## AGE-RELATED CHANGES IN REWARD-SEEKING AND COGNITIVE STRATEGY

Echo Leaver

Dept. of Psychology, University of South Carolina Aiken

The aging process has been associated with a variety of marked biological and behavioral changes. Of particular interest in this study is the neurotransmitter dopamine, which is known to deteriorate in aging adults (Marschner et al., 2005). Dopamine plays an important role in executive functioning, fine motor control, and emotional processing (including reward seeking behavior and addiction). Recent research suggests that OAs may exhibit diminished reward seeking behavior. Further, researchers have found that OAs activate the dopamine pathway to a lesser extent when engaging in rewarding behavior (Dreher et al., 2008). Given evidence of age-related changes in the dopamine response to reward, it is likely that OAs may experience behavioral changes in reward-seeking behavior. The current study investigated reward-seeking behavior in older (OAs) and younger (YAs) adults. Baseline sensation-seeking tendencies were measured via the Arnett Inventory of Sensation Seeking (AISS). We then utilized a behavioral manipulation to “prime” 24 YAs and 24 OAs for reward-seeking behavior. This was accomplished by having the participants solve a word scramble task. Half of the participants in each age group were given neutral words in their scramble task (control condition) while the other half received reward-related words in their scramble (reward condition). We were interested in the effectiveness of this priming task to encourage risky decision making on the Iowa Gambling Task (IGT). OAs exhibited significantly lower “sensation-seeking” scores than YAs on the AISS. Further, YAs showed a significant effect of reward-priming while OAs did not.

## WOMEN'S PERCEPTIONS OF HOW HAVING A CHILD AS A TEENAGE HAS IMPACTED THEIR LIVES

Rebekah L. LeMay and Keri Weed

Dept. of Psychology, University of South Carolina Aiken

Although the adolescent pregnancy rate in the U.S. has declined, approximately 70 of every 1,000 adolescent girls aged 15 to 19 became pregnant in 2005 (Guttmacher, 2010). Teens get pregnant for a number of different reasons, and even though most may be unintentional, some teens may actually want to get pregnant. Research by Afable-Munsuz, Speizer, Magnus, & Kendall (2006) suggested that teens that had most positive attitudes about pregnancy were more likely to get pregnant. Reasons for positive attitudes included the belief that pregnancy would improve relationships with boyfriends and may provide opportunity to assert responsibility, and others. The current study used data collected from a longitudinal study of adolescent mothers and their children to explore perceptions of teen mothers who were now between the ages of 35 and 38. The hypothesis was that adolescents who were struggling more with academics and social functioning would perceive more positive impact from the early pregnancy than teens who were doing better in school and social functioning. One-hundred ten mothers completed a survey that assessed how being a young mother affected their education, work life, finances and relationships. Data collected while these women were still teenagers about academic and social success will be used to predict their perceptions about the impact of the pregnancy on their lives. Efforts to reduce the rates of teenage pregnancy need to consider that some teens may perceive pregnancy in a positive way.

## SUPPRESSING THE LARGE OSCILLATIONS OF A SPRING-MASS SYSTEM

Kristopher Liggins, Fereshthah Zahed, and Naima Naheed

Benedict College

A differential equation describing the oscillations of a spring-mass system was chosen. The purpose of this study was to suppress the large oscillations of a system using Fourier Series. After computing the natural frequency of the spring, the frequencies of the first six non-zero normal modes of the spring were calculated. The dominating normal mode of the steady-state solution was determined. The input function  $F(t)$  was modified to control the size of the oscillation of the steady-state solution.

## PREPARATION OF ISOQUINOLINONES FROM TRILITHIATED 2-METHYLBENZOIC ACID HYDRAZIDES AND SELECT ESTERS

Philip J. Mabe<sup>1</sup>, William G. Shuler<sup>1</sup>, Sarah S. Carlisle<sup>1</sup>, Clyde R. Metz<sup>1</sup>,

William T. Pennington<sup>2</sup>, Donald G. VanDerveer<sup>2</sup>, and Charles F. Beam<sup>1</sup>

<sup>1</sup>Department of Chemistry and Biochemistry, College of Charleston

<sup>2</sup>Department of Chemistry, Clemson University

The entry compounds, 2-methylbenzoic acid hydrazides prepared by the straightforward condensation of 2-methylbenzoic acid chloride with either benzoylhydrazine, benzenesulfonylhydrazine or phenylhydrazine have received limited study, and they have been used in limited investigations, with none of these involving strong base metalation followed by condensation with electrophilic reagents. During our series of recent studies, the three substituted carboxylic acid hydrazides were trilithiated with lithium diisopropylamide to form trilithiated intermediates that were successfully condensed with a variety on substituted aromatic esters ranging from methyl dimethylaminobenzoate to methyl 4-methoxybenzoate to afford C-acylated intermediates that were at times isolated and immediately acid cyclized to the targeted isoquinolinone. In an initial instance, an N-acylated hydrazone was isolated, whose structure was confirmed by X-ray crystal analysis. The structures of several other substituted isoquinolinones were also confirmed with X-ray single crystal analysis. Several additional N-acylated hydrides have also been isolated.

## COMPARATIVE SUCCINATION OF PROTEINS BY ENDOGENOUS FUMARATE AND ALKYL FUMARATE PHARMACEUTICALS.

Allison M. Manuel and Norma Frizzell

Dept. of Pharmacology, Physiology, and Neuroscience University of South Carolina School of Medicine

**Aims:** Succination, the modification of thiol groups in protein by reaction with fumarate, producing S-(2-succino)cysteine (2SC) is increased in diabetes, in adipocytes grown in high glucose medium, and by mitochondrial dysfunction in encephalopathies. Alkyl fumarates are used for treatments of many mitochondrial diseases, including Parkinson's syndrome. The purpose of this study is to compare the reaction of fumarate, monomethylfumarate (MMF) and dimethylfumarate (DMF) with adipocyte proteins and glutathione.

**Methods:** Adipocytes grown in 5mM or 30mM glucose or in 5mM glucose treated with 500uM fumarate, MMF or DMF. MMF- and DMF-modified proteins were treated by saponification with 0.1 M KOH to expose protein succination. Western blotting with anti-2SC antibody was used for detection of succinated proteins. Glutathione (GSH) was measured using a fluorescence assay.

**Results:** Succination was increased ~10-fold in adipocytes grown in 30 mM vs.

**Conclusion:** MMF and DMF are more reactive than fumarate with thiol groups in protein. Saponification of MMF- and DMF-modified proteins increased detection of protein succination. The methyl esters of MMF and DMF modified proteins are stable in the cell, but can be exposed by saponification. MMF and DMF, but not fumarate, produced a significant decrease in cellular GSH concentration. Similar patterns of protein succination were detected with all reagents.

## SYNTHESIS OF A MICROSOMAL TRIGLYCERIDE TRANSFER PROTEIN INHIBITOR

James McEachern and Dr. D. Magnin\*

Division of Natural Sciences and Mathematics, Morris College

Microsomal Triglyceride Transfer Protein (MTP) is a lipid transfer protein localized in enterocytes and hepatocytes. Defects in MTP have been shown to be responsible for abetalipoproteinemia, a condition in which the production of VLDL and chylomicrons is disrupted. Individuals with this genetic abnormality have plasma cholesterol levels that are unusually low (@ 40 mg/dl). By analogy, disruption of the normal process of chylomicron and VLDL assembly through MTP inhibition should lead to reduced plasma cholesterol levels. Wetterau and Biller reported findings along these lines by means of a very potent inhibitor of MTP. As anticipated, the compound was effective in lowering cholesterol levels through disruption of the lipoprotein pathway. Unfortunately, no chemical synthesis of the compound was published. Herein we disclose a very efficient convergent synthesis of the MTP inhibitor. This synthesis is should allow for rapid generation of the target for those individuals looking deeper into the role of cholesterol, lipoprotein metabolism and heart disease.

## THE IMPACT OF POINT-SOURCE POLLUTION ON THE CONCENTRATION AND DISTRIBUTION OF ESCHERICHIA COLI IN A STREAM DRAINING AN URBAN WAT

Grace L. McKnight, Dr. Min-Ken Liao, Brent Anderson, and Steve McCauley

Dept. of Biology, Furman University

This study is part of a larger, ongoing study investigating the effects of point source pollution on the concentration and distribution of *Escherichia coli* in an urban stream in Greenville, SC. Our first hypothesis was that the effluent from House of Raeford's Columbia Farms poultry processing plant would lead to an increase in the concentration of total coliform and *E. coli* downstream from the point of discharge. To determine these concentrations, we collected water samples from upstream and downstream of the effluent input at nine locations. The concentrations of total coliform and *E. coli* were determined using IDEXX and the EPA standard filter membrane method. We also hypothesized that the *E. coli* populations up- and downstream of the discharge pipe would be genetically different. Additionally, "free-living" *E. coli* populations found in surface water and "attached" *E. coli* populations found on rocks in the stream would also be different. We tested these by determining the distribution of *E. coli* phylogenetic groups (ECOR type A, B1, B2, and D) in these populations. IDEXX results for samples collected on June 13th, 2011 showed an increased concentration of total coliform (120,980 cells/100 mL) at point of discharge, the concentrations tapered off downstream (34,355 cells/100mL). Concentrations of *E. coli* showed a similar trend. IDEXX results for samples collected on June 23rd, 2011 showed higher concentrations of total coliform (=483,920 cells/100 mL) at the 5 downstream sample areas. Concentrations of *E. coli* showed elevated levels at 34 and 154 meters downstream from the discharge pipe. This may be attributed to sewer overflow that occurred due to storms in the area the night before samples were collected. The results of the distributions of ECOR type

## PERSISTENT ALTERATIONS IN DOPAMINERGIC MARKERS IN ADOLESCENT HIV-1 TRANSGENIC RATS

L.M. Moran<sup>1</sup>, R.M. Booze<sup>1</sup>, K.M. Webb<sup>2</sup>, M. Y. Aksenov<sup>1</sup>, M.V. Aksenova<sup>1</sup>, and C.F. Mactutus<sup>1</sup>

<sup>1</sup>Dept. of Psychology, University of South Carolina Columbia

<sup>2</sup>Dept. of Pharmacology, Physiology, and Neuroscience, University of South Carolina Columbia

HIV-1-associated neurocognitive disorders (HAND), including attention and memory deficits, occur in over a third of HIV-positive individuals, despite the success of combination antiretrovirals in diminishing the most severe forms of HAND. Basic and clinical studies implicate alterations in the dopaminergic (DA) system in HIV-1 infection. We used the Fisher-344 HIV-1

transgenic (HIV-1 Tg) rat, which expresses 7 of the 9 HIV-1 genes, to examine potential DA alterations in the preattentive process of sensorimotor gating. HIV-1 Tg rats and non-transgenic controls (ns=8) were studied beginning at 35 days of age. At 48 hr intervals, animals were administered a single dose of methamphetamine (METH)(0, 0.5, 1, 2.5 and 5 mg/kg/ml SC) and tested for prepulse inhibition (PPI), using an acoustic startling stimulus [100dB(A) broad-band noise stimulus] and an acoustic prepulse [85 dB(A) broad-band noise stimulus] in a sound-attenuating chamber with a continuous white noise 70dB(A) background. The protocol used a 5-min acclimation period, 6 startle trials, and 36 PPI trials [ISIs of 0, 8, 40, 80, 120, and 4000 ms, 6-trial blocks, Latin square design]. In both groups, PPI of the startle response decreased as the dose of METH increased. The HIV-1 Tg rats were significantly more responsive to the METH-induced disruption of PPI. Western blot analysis of midbrain extracts revealed lower tyrosine hydroxylase protein levels and higher monoamine oxidase A protein levels in HIV-1 Tg rats treated with METH compared to non-transgenic controls. Early-detected cognitive alterations in the preattentive process of sensorimotor gating may have significant predictive utility regarding the progression of DA alterations in HIV-1 infection.

#### BATHYMETRIC ANALYSIS OF PTERIOS VOLITANS SHELF-EDGE HABITATS, ONSLOW BAY N.C.

Ralph M. Morris, Christian K Hartmann, Dr. Leslie R Sautter  
Dept. of Geology, College of Charleston

In 1992 Hurricane Andrew devastated South Florida, killing as many as 15 people and causing billions in structural damage. A lesser known result of this event is that several aquaria and pet shops were destroyed, releasing many non-native species into the wild, including *Pterios volitans* more commonly known as the Lionfish. The Lionfish is known to inhabit warm tropical waters of the South Pacific and Indian Oceans. They can be found in waters up to 300m deep, but prefer hard bottom, mangroves, sea grass, coral, and artificial reefs. Since their introduction into the warm waters off Florida they have made their way into the Gulf Stream Current which has carried them as far north as Long Island, NY. Onslow Bay, NC has seen a dramatic increase in Lionfish populations over the last decade. Lionfish prey on economically and ecologically important native species and have quickly become one of the dominant predators in many of the coral reefs throughout the southeastern Atlantic coast. NOAA National Marine Fisheries has deemed their spread worrisome enough to gather bathymetric data to locate and identify future Lionfish habitats. Analysis will be based on bathymetric data collected by the NOAA ship Nancy Foster out of the NOAA Center for Coastal Fisheries and Habitat Research, Beaufort NC, during 2008-2009. Research will determine where hard bottom structures are located on the shelf-edge of Onslow Bay and through comparison with other previously mapped shelf-edge regions off the Carolinas whether they are current or potential Lionfish Habitats.

#### EFFECTS OF TAMOXIFEN, BENZO-A-PYRENE, AND PAHS ON GALECTIN-3 EXPRESSION IN HUMAN BREAST CARCINOMA CELLS

Feven Mulu, Bill McAmis, and Samir Raychoudhury  
Dept. of Biology, Benedict College

Galectin-3 plays an important role in a number of disease processes including cancer. Concentrations of Galectin-3 increase in the bloodstream of patients with cancer, and galectin-3 also plays an important role in preventing cellular apoptosis. Cancer researchers have shown that galectin-3 is up regulated in cancer patients. The effects of Tamoxifen (TAM), Polycyclic Aromatic Hydrocarbons (PAHs) and Benzo-A-Pyrene (BAP) have been studied on breast cancer cells. Tamoxifen has been shown to have anti-estrogenic effect by blocking estrogen receptors. It has been used to treat cancer patients, while polycyclic Aromatic Hydrocarbons and Benzo-A-Pyrene are known as environmental pollutants and possible carcinogens. Moreover some PAHs have estrogenic effect. MDA-MB-231 human breast cancer cells were grown in 35mm dishes and maintained in RPMI 1640 medium containing 10% fetal bovine serum and 5% penicillin. When these cells were 90% confluent, they were exposed for 24 hours to Tamoxifen (5µg/ml and 500ng/ml), BAP (5µg/ml and 500ng/ml), or PAHs (5µg/ml and 500ng/ml). Protein was extracted by M-PER Protein Extraction Reagent and quantified by the protein assay kit using BSA as standard. Proteins were separated by SDS PAGE and subjected to western blot analysis. Immunodetection was carried out by using rabbit polyclonal galectin-3 primary antibody followed by incubation with goat anti-rabbit secondary antibody. After chemiluminescence detection, the proteins were visualized on X-ray film. The data showed that levels of galectin-3 were varied with different treatments, and especially with the high doses of BAP and TAM.

#### EXPONENTIAL FUNCTIONS IN DRUG METABOLISM

Duanquira Myers, Naima Naheed, Nailong Guo and Mostafizur Rahman  
Benedict College

Exponential function plays an important role in Pharmacokinetics. Most drugs are eliminated from the body by an exponential decay process. A constant proportion of the drug is eliminated from the body per unit time. Each drug has a half-life, but the half-life varies among individuals. In the present study, we investigated how the concentration of the drug in the bloodstream and the time between doses can be adjusted to maintain a precise and effective concentration of the drug in the blood.

## BATHYMETRIC ANALYSIS OF AXIAL SEAMOUNT, JUAN DE FUCA RIDGE

Ahmed A. Nayel, Willie Edwards, and Leslie Sautter  
Dept. of Geology and Environmental Geosciences, College of Charleston

Multibeam sonar data of an active undersea volcano, Axial Seamount were obtained by the University of Washington in 2008, 2010, and 2011 from aboard the R/V Thomas G. Thompson. Sonar surveys were conducted using a Kongsberg EM300 and EM302, and were processed using the CARIS HIPS & SIPS 7.1 software. Data analysis incorporates the interpretation of the deep-sea submarine volcanism and its associated lava flows. Axial Seamount is one of the model locations in the world to monitor active submarine volcanoes, it is currently being instrumented as a Regional Scale Nodes Cabled Observatory of the NSF Ocean Observatory Initiative, led by the University of Washington. The volcano's caldera is at a depth of approximately 1500 meters and experienced an eruption in April 2011. Seismic tomography and hydrophone arrays have detected a significant magma reservoir not far beneath Axial's summit caldera, leading to the belief that sufficient activity at this location is forthcoming. Furthermore, this area has an abundance of hydrothermal systems and venting sulfide chimneys that house local biota, and are comprised of many associated structural features such as a caldera, ponds and pillars, and a variation of lava flow types. Bathymetry and surface characteristics of the region have been analyzed to delineate the geological implications and processes associated with the region and underwater volcanism, as well as understand what happens to the surrounding terrain and the biosphere in the aftermath of these volcanic events. These initial seafloor maps and studies will provide a basis for

## DETERMINING THE SOURCE OF POLLUTION AT FILBIN CREEK, SOUTH CAROLINA

Lydia B Nickolas and Vijay Vulava  
Dept. of Geology, College of Charleston

Development in metropolitan areas has a strong potential to alter chemical compositions of urban catchments. The aim of this study was to extrapolate on the potential for runoff-transferred pollutants to impact Filbin Creek (an urban freshwater stream which discharges into a coastal estuary) by measuring the concentration ions and trace elements (commonly found as a result of industry, vehicle wear, or the use of fertilizers) present in rain and surface water and delineating the sources of input through the use of stable water isotopes. The ultimate hypothesis projected that runoff from surrounding highways and developments is capable of introducing pollutants into Filbin Creek and that storm events were the most significant contributors to stream volume. In this study, precipitation and surface water from area was collected and analyzed for ions, heavy metals, and stable isotopes. Results indicated an elevated level of various pollutants which exceeded SCDHEC standards (including Cr, Fe, NO<sub>3</sub><sup>-</sup>, PO<sub>4</sub><sup>3-</sup>, and Zn) in both precipitation and surface water, particularly following rain events. Most components measured presented a marked increase after rain events. Isotopic signatures suggested a high volume of input from isotopically depleted runoff and precipitation in comparison to the more isotopically enriched baseline of the surface water. The findings of this study signify a need for a more comprehensive assessment of the health of urban waterways like Filbin Creek.

## FOURIER ANALYSIS OF PHASE RESETTING CURVES OF TYPE II OSCILLATORS

Robert A. Raidt and Sorinel A. Oprisan  
College of Charleston

Neurons are complex biological cells specializing in information processing. These cells are either silent or generate brief spikes of electrical activity called action potentials. Some neurons are intrinsic bursters, meaning they fire regular action potentials with a relatively stable frequency. To encode information, these cells change their firing frequency proportional to inputs received from other neurons. These changes in frequency can be mapped graphically using a phase resetting curve (PRC). In addition to its application to investigating the mechanisms that allow the same neural network to generate multiple patterns of activities, such as the gait network can produce walk, trot, gallop, etc., the PRC can also predict the synchronous firing of a large network that occurs during epileptic seizures. Our work focused on investigating numerically the relationship between the PRC and biologically relevant control parameters. For this purpose, an isolated model neuron was used to map the effect of external perturbations, such as the amplitude and duration of inputs from other neurons, and intrinsic properties of the neurons, such as density of different ionic channels, on the PRC. The PRC was then numerically described and analyzed as a series of coefficient values using a Fourier analysis. Subsequently, we used the PRCs of isolated neurons to predict the phase-locked modes of the networks and compared the results against actual neural activity in the fully connected network. Our mathematical predictions were reasonably correct for networks of Type II, or bursting, neurons.

## MULTIBEAM SONAR ANALYSIS OF MARINE HABITATS IN THE DRY TORTUGAS

Alicia Raimann, Katherine Johnson, and Leslie Sautter  
Dept. of Geology, College of Charleston

The Dry Tortugas, a group of islands 70 miles west of Key West, Florida, is home to more than 450 species of fish, a diverse coral reef ecosystem, and a variety of endangered sea turtle species. The Dry Tortugas National Park is a known spawning ground for a multitude of fish including yellowtail and mutton snapper. The area has long been recognized as an area needing protection. The geomorphology of the Dry Tortugas, consisting of corals and carbonate sands, play a major role in the habitat in which these fish and other species live. This study will focus on what effect the underlying bathymetry has on the



ecosystem. Bathymetric data were collected in 2009 and 2011 by scientists from the NOAA Florida Keys National Marine Sanctuary with a Kongsberg EM1002 multibeam system from aboard the NOAA Ship Nancy Foster. Sonar data were analyzed using CARIS HIPS 7.1 software to create a CUBE bathymetric surface and a series of bathymetric profiles. These maps will be used as the primary tool to help understand what impact the structure of the seafloor surrounding the marine habitat has on marine organisms living in the Dry Tortugas.

#### ATMOSPHERIC CIRCULATIONS INFLUENCING UNITED STATES LANDFALLING TROPICAL CYCLONES

Justin Rawley and Cary J. Mock  
University of South Carolina Columbia

A ridge of high pressure situated over eastern Canada and New England has previously been shown to be correlated well with parameters of landfalling hurricane activity in the United States. This study expanded in more detail, examining NCEP/NCAR Reanalysis data from 1948 through 2010 that constructed a monthly average of geopotential heights at 500 mb in the region of 40-50°N, 65-76°W during the height of the hurricane season. Tropical cyclone track data from the North Atlantic Hurricane Database (HURDAT) were used to determine the number of tropical cyclone impacts affecting the United States. Linear regression models were constructed to determine the ability to predict tropical cyclone impacts in the United States from this dominant high pressure system. Results indicate that while an average of August-October 500 mb heights is a statistically significant predictor variable for tropical cyclone activity, September 500 mb heights alone are a more significant contributor to tropical cyclone impacts experienced in the United States. When 500 mb heights are anomalously high and strong in the area defined above, there are more landfalling tropical cyclones. These results provide a foundation for providing a seasonal forecast model to predict landfalling tropical cyclones up to several months in advance.

#### DECLINING POPULATIONS OF AN ENDANGERED PLANT, WHITE IRISSETTE (*SISYRINCHIUM DICHOTOMUM*): RESULTS OF A LONG-TERM FIELD STUDY

Nathan W. Redding, Douglas A. Rayner, Polly D. Ketcham, and A. G. B. Revels  
Dept. of Biology Wofford College

*Sisyrinchium dichotomum*, white irisette, is a federally listed endangered species and is known from just a few counties in the foothills of the Carolinas. In the fall of 1998 all plants in the populations at Chestnut Ridge (CR), SC (377 individuals) and the lower elevations of the Melrose Mtn. (MM), SC-NC (677 individuals) were pin flagged, categorized by size, and assessed for fruit production. Aspect and slope were also recorded for all colonies at each population (CR = 8 colonies; MM = 15 colonies) and, for each plant, four measurements were taken on soil and leaf litter depth. In a 2008 study, high mortality was reported for both CR (60.0%) and MM (65.2%). The study also documented an up and down fluctuation in total population counts over time at CR for the years 1998-2007. For years 1998-2011, we report 69.7% (55% if colony 6 is excluded) mortality for CR and 86.9% for MM. Our analysis of colony size using a standard least-squares model demonstrates a significant decline in colony size over time from 1998-2011 at both CR and MM. In addition to colony counts, we also document some discouraging observations in the early stages of a seed bank study at both sites. Data on colony size counts (1998-2011), seedling success, and recent observations on plant succession support our concern for the fate of the white irisette population at Melrose Mountain and our guarded optimism for the long-term survival of the Chestnut Ridge population.

#### TEMPORAL VARIATIONS IN BATHYMETRY AND MORPHOLOGY AT GRAY'S REEF NATIONAL MARINE SANCTUARY

Joseph R Rembert<sup>1</sup>, Jim Niergarth<sup>1</sup>, Greg McFall<sup>2</sup>, and Leslie R. Sautter<sup>1</sup>  
<sup>1</sup>Dept. of Geology, College of Charleston  
<sup>2</sup>Gray's Reef National Marine Sanctuary

NOAA's Gray's Reef National Marine Sanctuary, located on the mid-continental shelf off the Georgia coast (water depths ranging 14.8 to 22.0 m), was initially mapped in 2001, elucidating understanding of important marine habitats and providing means to conceptualize the recent and ancient geologic history of the southeastern United States continental shelf. New multi-beam data was collected during a 2011 research expedition on the NOAA Ship *Nancy Foster* and was compared with previously collected data to better understand how the bathymetry of Gray's Reef has changed over time. Three-dimensional imagery and data processing were performed using CARIS HIPS/SIPS software and backscatter data were analyzed when available to characterize bottom hardness and sediment texture. The reef consists of mostly low-relief sandy bottom sediment interspersed with rocky outcrops and emergent limestone. Sediments have been eroded into ledges and low-relief features populated by a diverse community of fish and marine invertebrates. Observing how the morphology of these features change over time aids long-term habitat characterization not only at Gray's Reef, but also at other physiographical and ecologically similar areas.

## GERMINATION OF *SPONGILLA LACUSTRIS* (L.) IN A LABORATORY SETTING

Sarah Retherford and Kristen van den Meiracker  
Dept. of Biology, North Greenville University

Due to specific habitat needs and temperamental growth patterns, research of freshwater sponges has been limited. Specifically, cultivating live sponge tissue in a laboratory setting has proven difficult and sponges tend to die quickly. Freshwater sponges occupy an important niche in freshwater ecology. Therefore, in this study, sponge growth was analyzed from four initial samples. Samples included sponge gemmules, sponge gemmules thawed for two days following freezing, sponge tissue free of gemmules, and sponge tissue containing gemmules. Each sample was frozen for four weeks and transferred to a tank with constant aeration. Three repetitions were performed and growth was measured after 25 days. It was determined that there was significantly more sponge growth in the initial samples that contained both sponge tissue and gemmules. This methodology for rearing freshwater sponges in the lab is vital for future research.

## MOSQUITO SURVEY OF SALUDA SHOALS PARK

Lou Rigley<sup>1</sup>, Janette Wells<sup>2</sup>, and Chris Evans<sup>3</sup>

<sup>1</sup>Dept. of Biology, Columbia College

<sup>2</sup>Saluda Shoals Park

<sup>3</sup>Dept. of Entomology, DHEC

Female Mosquitoes were trapped in 3 areas of the park designated A, B, C. Area A was the Wetlands, area B was the Saluda River and area C was the Woods. The project ran from Mid July through Mid August, 2011 The traps were standard mosquito traps, baited with dry-ice. The traps were set before sunset and collected after sunrise. Mosquitoes were kept frozen until identified by A Key to the Mosquitoes of North Carolina and the Mid-Atlantic States, by Agricultural Extension Service, North Carolina State University, Pub. AG-412. Six genera and twelve species were collected at the park, for a total of 1240 mosquitoes. The Wetlands yielded 38%, the Saluda River 28%, and the Woods 36% of the total number captured.

Anopheles mosquitoes were the most abundant mosquitoes collected during the survey at 50% of the mosquitoes collected. Aedes were the second abundant genus collected at 35%. More genera were collected at the Wetlands station than the River or Woods. The wet lands collection yielded 6 genera and 12 species. The most abundant species collected at all stations was Anopheles quadrimaculatus. References 1. A Key to the Mosquitoes of North Carolina and the Mid-Atlantic States, Agriculture Extension Service, North Carolina State University, Pub. AG-412

## WILDFIRE WIZARD - A TOOL TO HELP PROTECT YOUR HOME FROM WILDFIRE

Cassy Robinson

Savannah River National Laboratory

The WildFire Ignition Resistance Estimator Wizard (WildFIRE Wizard) is a software package that will allow homeowners to estimate the vulnerability of their homes to a wildfire based on specific features and characteristics of their home and yard. Many structural material features of the home interact in different ways with various wildfire ignition sources, such as windblown embers, radiant heat and direct flames. The program is focused upon reducing all of a home's vulnerabilities to wildfire, thus making it possible for the wildfire to pass the home and leave it unharmed. The software is available free of charge at [www.wildfirewizard.com](http://www.wildfirewizard.com).

## EFFECTS OF LIFESTYLE ON COGNITION AND AGING

Karla Rombaldi-Smith, Alexis Harley, Christa Armfield, and Echo Leaver

Dept. of Psychology, University of South Carolina Aiken

It is known that the aging process is associated with cognitive decline that is attributed, in part, to physiological changes in the brain, with the greatest cortical alterations occurring in the frontal lobes. Recent research suggests that certain lifestyle factors can mediate this cognitive decline to varying degrees. The current study explored the individual and interdependent effects of aerobic exercise, diet, and sleep habits on cognitive functioning in 40 community dwelling older adults (OA) and 40 younger adults (YA). Self-report questionnaires were used to assess the exercise, diet and sleep habits of the participants while neuropsychological tests were used to assess cognitive abilities in memory, strategy, mental flexibility, and executive function. It was found that OA who lead healthier lifestyles (are active, eat well, and have high-quality sleep) performed better on many of these tasks than those who engaged in a less healthy lifestyle. Interestingly, YA did not show this affect. That is, YA seem to exhibit high cognitive functioning regardless of their lifestyle. Results of this study suggest that diet, sleep, and exercise have important implications for cognitive vitality in aged adults.

## LOW-COST SYNTHESIS OF POTASSIUM ALUM WITH CHEAP HOUSEHOLD CHEMICALS

Chris Rufty and Li Cai

Dept of Chemistry, University of South Carolina Salkehatchie

Potassium alum, or alum, is hydrated potassium aluminum sulfate,  $KAl(SO_4)_4 \cdot 12H_2O$ . It is commonly used in water purification, leather tanning, fireproof textiles, and baking powder. It also has cosmetic uses as a deodorant and as an

aftershave treatment. Synthesis of alum represents a very popular general chemistry student lab since it gives student a broad view of multiple chemistry concepts, such as multistep synthesis, quantitative analysis, stoichiometry, and recrystallization, etc.

Here our experiment illustrates an interesting example that alum can be synthesized in every household with cheap and available chemicals, such as soap making potassium hydroxide, battery acid and Everclear 190-proof. In addition, we also demonstrate an example of reduction of environmental burden by using aluminum cans as the starting material. Two parallel experiments were conducted; one from pure aluminum foil and with lab chemicals and the other from aluminum cans with cheap household chemicals. The corresponding synthetic yields were compared. We hope this experiment intrigues and inspires junior chemists to invent more household projects, converting wastes to something valuable.

#### CURVE OF PURSUIT AND TRAJECTORY

Sajan Shrestha  
Benedict College

Curve of Pursuit is the path traced by the pursuer while attempting to catch its prey. Such a path might result from a dog pursuing a rabbit, or a missile seeking a moving target, or a coastal guard chasing a drug smuggler in the ocean etc. A trajectory is the path that a moving object follows through space as a function of time. A trajectory can be described mathematically either by the geometry of the path, or as the position of the object over time. In this project for Curve of Pursuit we have considered two situations. One is the situation in which there is a pursuer and a prey each moving at a constant speed. The other situation is the case of multiple pursuers and multiple preys moving at a constant speed. For the trajectory we considered a plane moving west with a constant speed under a wind blowing due north from a specified location to its intended destination. For the pursuit curve we were able to find the equation of the curve of pursuit and the conditions under which the pursuer catches its prey. We were also able to find the location where the pursuer catches its prey and also the time it takes to catch its prey under the given conditions. For the trajectory we have found the equation of the flight trajectory and conditions that guarantee that the plane reaches its destination. Our main tools are concepts from Calculus and Techniques of solving Differential equations.

#### STRONG-BASE PREPARATION OF UNSYMMETRICAL TRIKETONES AND SELECT HETEROCYCLIC COMPOUNDS FROM 1-BENZOYLACETONE

William G. Shuler<sup>1</sup>, Philip J. Mabe<sup>1</sup>, Sarah S. Carlisle<sup>1</sup>, Clyde R. Metz<sup>1</sup>,  
William T. Pennington<sup>2</sup>, Donald G. VanDerveer<sup>2</sup>, and Charles F. Beam<sup>1</sup>  
<sup>1</sup>Department of Chemistry and Biochemistry, College of Charleston  
<sup>2</sup>Department of Chemistry, Clemson University

Lithium hexamethyldisilazide (LHMDS) and lithium diisopropylamide (LDA) were used in a comparative study for the metalation of 1-benzoylacetone by the formation of a lithium anion type complex or a dilithiated dianion type intermediate, followed by the condensation with a variety of aromatic esters such as methyl 2-phenylquinoline-4-carboxylate and 5-chloroisatoic anhydride. The condensation of the 1-benzoylacetone anion type complex activated by LMDS proceeded to the unsymmetrical trione in high yield, ~95%, and the structure of tautomer obtained after recrystallization was confirmed by X-ray single crystal analysis. This was compared to theoretical stability calculations for all of the possible tautomeric products. Dilithiated 1-benzoylacetone prepared in excess LDA [diketone: LDA: anhydride, 1:3:1] was condensed with 5-chloroisatoic anhydride followed by acid cyclization of intermediate(s) that were not isolated to afford the quinoline type product, the 2-phenacylquinolinone and not the quinolinol. This was shown to be the tautomers based on proton NMR and X-ray structural analysis. Theoretical calculations concerning the stability of the possible tautomeric products were also undertaken.

#### COMPARATIVE STUDY OF HIV-1 INDUCED APOPTOSIS BY EXPRESSION OF PRO-APOPTOTIC BAX AND TBID

Priscilla S. Simon and William H. Jackson, Jr.  
Dept. of Biology, University of South Carolina Aiken

The Human Immunodeficiency Virus type 1 (HIV-1) is a lentivirus in the family Retroviridae that infects CD4+ T-Helper (TH) lymphocytes. Long-term HIV infection is associated with the loss of the TH lymphocyte population, progressive impairment of the immune response, and AIDS. We are currently studying methods to inhibit viral replication by inducing apoptosis in HIV-1 infected cells using pro-apoptotic gene expression. This strategy takes advantage of a distinctive characteristic of HIV-1 infected cells, which is based on the activity of the viral transactivator of transcription (tat). Tat binds to the viral transactivation response element (TAR), located within the first sixty nucleotides of all viral mRNAs, and recruits a number of host factors that act to hyperphosphorylate the C-terminal domain of RNA Polymerase II, which results in increased processivity and efficient transcription from the viral promoter/enhancer. This regulatory mechanism is the function of the U3R sequence that is located within the viral long terminal repeat (LTR). Because of this unique regulatory mechanism, heterologous genes expressed from the HIV-1 U3R promoter/enhancer should be up regulated in the presence of tat. To test this hypothesis, the plasmid pU3ReGFP was created. This plasmid contains the U3R promoter/enhancer region from the HIV-1 genomic clone NL43 (Accession number M19221) to drive expression of eGFP (enhanced Green Fluorescent Protein). Studies in 293T cells, co-transfected with pU3ReGFP and pCMV-Tat, indicated that GFP was expressed in a tat-dependent manner. To determine the ability of the pU3R plasmid to drive expression of pro-apoptotic genes, the eGFP sequence was replaced with either tBid or Bax, which are members of the Bcl-2

THE EFFECT OF LIGHT QUALITY ON ACROPORA CERVICORNIS TISSUE REGNERATION  
Aposia J. Singleton, James Nicholson, Sylvia B. Galloway, Thomas Bartlett, Carl Miller, and Cheryl M. Woodley  
Morris College

*Acropora cervicornis*, commonly called Staghorn coral, was once a dominant coral in the Caribbean, but has recently undergone a population collapse throughout its range due to human activity, diseases and climate change. Among the many recovery efforts is optimizing conditions for growth in cultured corals for restoration. Water quality, temperature, light and water motion are key parameters needed for coral growth. Since corals are symbiotic with unicellular algae (zooxanthellae), light is an essential growth factor to support photosynthesis and provide nutrients for coral growth. Light quality was hypothesized to affect tissue regeneration and growth rates. *Acropora cervicornis* fragments were exposed to 100 $\mu$ moles of light from two different light sources, 9 watt, 6500 °K compact fluorescent lights and LED (light-emitting diodes) lights containing equal numbers of (6:6) red-blue lights at 650nm and 450nm. Coral fragments were imaged daily using a fluorescent microscope and digital camera. Time lapse video was used to document the tissue regeneration process until polyps reached apparent maturity and zooxanthellae density appeared equivalent to the uncut surface. The results of this experiment suggest that individual variation plays a greater role than the difference in these two lights sources.

THE SUMMER CAMP SETTING FOR PROMOTING PHYSICAL ACTIVITY: AN OBSERVATION OF SOUTH CAROLINA  
SUMMER DAY CAMPS

Brittany Skiles, Carl Sorensen, and Nicole Zarrett  
Dept. of Psychology, University of South Carolina Columbia

There has been some support for intervention strategies to increase youth PA during the school day (Pate et al., 2006), however due to increasing demands on schools to provide basic education, and diminishing physical education programs, out-of-school time (OST) represents the greatest opportunity to increase youth PA. A review of non-curricular approaches for increasing PA in youth determined that summer day camps offer potential for increased activity (Jago & Baranowski, 2004). However, although summer day camps are a widely accepted OST activity, no studies, to date, have measured the amount of PA that kids engage in within the day camp setting, nor to what extent camp settings provide key social-motivational features important for promoting PA. The goal of this study is to identify the proportion of time youth engage in PA during the camp day, and the degree to which the context included important social climate features for promoting PA. This study will contribute to our understanding of the strengths and needs of summer camp programs within South Carolina, and can inform future intervention and policy statewide.

We used the Climate and Interaction Tool for Youth Settings (CITY Settings), a systematic observational tool for assessing the PA and motivational climate of youth settings derived from constructs central to Self-Determination Theory. Teams of two coders visited four SC summer camps (2 high-resourced, 2 under resourced) and observed daily activities (e.g. sports, lunch, field trips, crafts, free play) at each camp over a two week period. We assessed each summer camp on level of youth PA (e.g., sedentary, walking, vigorous), 8 staff interaction components (e.g., encourages child, demonstrates activity), and six climate components (e.g. inclusion, clarity of rules, fun). Descriptive analyses will report levels of PA and proportion of social-motivational climate features across and between camp settings. Analysis of Variance will examine differences in these constructs by gender and level of camp resources.

BATHYMETRIC AND MORPHOLOGIC ANALYSIS OF IMPORTANT SHELF-EDGE FISH HABITATS OFF THE COAST  
OF CHARLESTON, SOUTH CAROLINA

Cooper Smith, Kayla Johnson, and Dr. Leslie Sautter  
Dept. of Geology, College of Charleston

Bathymetric and Morphologic Analysis of Important Shelf-Edge Fish Habitats off the Coast of Charleston, South Carolina  
Cooper Smith, Kayla Johnson, Dr. Leslie Sautter Dept. Of Geology and Environmental Geosciences, College of Charleston  
Multibeam sonar analysis was used to map seafloor bathymetry and morphology of important fish habitats approximately 100 miles east of Charleston, South Carolina. The area of the shelf edge analyzed is a rocky reef habitat north of Bulls Scarp where many commercially important species of fish live, feed, and spawn. The Gulf Stream runs over these rocky reef habitats bringing warm water and nutrients from more tropical waters creating a habitat suitable for a very diverse population of tropical and sub-tropical and commercial species, including grouper, triggerfish, and snapper. CARIS HIPS & SIPS 7.1 software, was used to analyze multibeam sonar data acquired with a Kongsberg EM1002 aboard the NOAA Ship Nancy Foster. The shelf-edge rocky reef surveyed extends over a depth range of 40 to 200m, and includes a variety of ledges and other geologic structures that provide excellent fish habitats. Bathymetric data and morphology will be compared to adjacent shelf-edge areas mapped previously by the College of Charleston SeaMap Program and other investigators. Seafloor morphology will also be compared to submersible and ROV dive videos provided by the South Carolina Department of Natural Resources as part of their ongoing investigations of essential fish habitat seafloor sites to be considered for designation as Marine Protected Areas.

BATHYMETRIC ANALYSIS OF A COMPLEX PROMONTORY EXTENDING INTO THE GULF STREAM OFF  
CHARLESTON, SC: BENTHIC HABITATS OF BULLS SCARP

M. Grace Smythe, Peter J. Bierce, Leslie R. Sautter, and M. Scott Harris  
Dept. of Geology, College of Charleston

Bulls Scarp is a cape-like promontory located at the continental shelf edge, 100 km off the coast of Charleston, SC. Multibeam sonar data collected in July 2011 aboard the NOAA Ship Nancy Foster reveal a variety of complex bathymetric features. The 1.8 by 10.9 km survey area ranges in water depths from 40-210 m. Data were analyzed using CARIS HIPS and SIPS 7.1 software and reveal seafloor features including sand waves, current scours, depressions, a small canyon, multiple ledges and a possible iceberg plough mark--the southern-most feature of its kind identified in the western North Atlantic. This survey fills a gap along a 100 km section of the 50 m isobath of essential fish habitat within the South Atlantic Bight. Such bathymetric information is contributing to the designation of possible essential fish habitat and marine protected areas.

IMPROVING THE MPING YEAST TRANSPOSITION ASSAY

Ashley E. Strother, Courtney Burckhalter, Tyler Shealy, Wes Tindall, and C. Nathan Hancock  
Dept of Biology and Geology, University of South Carolina Aiken

DNA transposons are sequences that can move or “jump” within the genome of a cell through a “cut-and-paste” mechanism. Our goal is to study the transposition mechanism of *mPing*, a transposon naturally found in rice. *mPing* was introduced into yeast to facilitate this analysis. For the yeast transposition assay, *mPing* was placed into the *Ade2* gene, preventing the production of adenine. When *mPing* excises from the *Ade2* gene, the double stranded break can be repaired, allowing the cells to produce adenine. We want to improve this assay to make it faster, easier, and more sensitive, therefore giving us better results in less time. The first variable we tested was if providing a template for homologous repair of the *Ade2* gene would increase the frequency of *Ade2* revertant colonies obtained. Yeast prefer to repair double stranded breaks using the homologous recombination mechanism, but in the original assay there is no homologous template, so the yeast are forced to use non-homologous end joining to repair the break. However, non-homologous end joining is less exact than homologous recombination and often introduces mutations to the *Ade2* gene. We predicted that adding a homologous template would result in more colonies because homologous recombination should correctly repair the *Ade2* gene more frequently. To shorten the total procedure, we made a second modification to the assay by reducing the pre-selection phase and removing a laborious washing step. We hypothesized that as long as we use a small volume of the pre-selection culture, the small amount of pre-selection media would not interfere with transposition. The final variable tested was what carbon source to use for the selection step. Expression of the proteins required for transposition requires galactose; however yeast grow slowly on this sugar. To determine if other combinations of sugars will provide the faster results, we compared simultaneous assays performed on galactose, galactose and sucrose, galactose and raffinose, and dextrose.

The results of the modified yeast transposition assays indicate that some of the changes we tested have improved the sensitivity and speed of the assay. The modification to the pre-selection and removal of the wash step does not significantly change the results and is faster and easier. The yeast strain containing the template for homologous repair had significantly more colonies than the non-modified yeast, thus making the assay more sensitive. More transposition events were observed on the galactose alone suggesting that the limiting factor is expression of the transposase proteins, not the rate of yeast growth after transposition. Now that this assay has been optimized we plan to perform high through-put analysis of mutant forms of the transposon and transposase proteins to further understand the *mPing* transposition mechanism.

ENVIRONMENTAL ELICITATION OF ACID STRESS RESPONSE IN *VIBRIO CHOLERAE*

Gabriel J. Swenson<sup>1,2</sup> and Richard A. Long<sup>3</sup>

<sup>1</sup>Biological Sciences, University of South Carolina Columbia

<sup>2</sup>Biology Department, Paine College

<sup>3</sup>Marine Science Program, University of South Carolina Columbia

*Vibrio cholerae*, the causative agent of the diarrheal disease Cholera, is ubiquitously distributed in coastal and estuarine waters as well as in freshwater reservoirs within endemic regions. The infectious potential of this opportunistic enteric pathogen is hinged on its ability to survive the extreme pH of the mammalian host. The Acid Stress Response (ASR) is the phenomenon that facilitates survival which involves the rapid onset of physiological, biochemical and genetic variability when habituated to sub-lethal pH (pH 4.5-5.7) then subsequently exposed to extreme acidity (pH 3.5-4.5); *V. cholerae* ASR has predominantly been investigated in laboratory and *in vivo* conditions. Employing traditional culturing techniques and reverse-transcriptase polymerase chain reaction (RT-PCR), we sought to assess elicitation of ASR in the clinical strain, *V. cholerae* N16961 when pre-conditioned in laboratory and environmental conditions. Cells were habituated for 1.5 hours in one of the following treatments prior to acid shock: Luria Broth (LB; pH 5.7), organic acid amended LB (final pH 4.5), acidic tannin rich swamp water from Congaree National Park, South Carolina (SCSW; pH 5.7) and SCSW enriched with organic acids (final pH 4.5). After pre-conditioning, cultures were transferred to LB broth enriched with organic acids to a final pH of 3.5 and sub-sampled on LB plates along a 1 hour time course; sub-samples were also retained for molecular analysis of five previously identified ASR factors. Preliminary results suggest that *V. cholerae* is capable of robust ASR as measured by percent population survival when habituated in natural SCSW and organic acid enriched SCSW; mean population survival in both cases were similar to counts observed for cells adapted in organic acid enriched LB and much greater than population survival when habituated in LB without organic acids. These findings are complimented by the molecular analysis which reveals enhanced expression of ASR genes in response to organic acid enrichments. The present study is the first to

demonstrate elicitation of *V. cholerae* ASR in environmental conditions. As such, these results may aid in the development of improved predictive models and the identification of environmental 'hot spots' of pathogenicity, thereby advancing efforts in disease mitigation and prevention.

#### EVALUATION OF ANURAN SPECIES DETECTION AND SITE OCCUPANCY IN THE SOUTH CAROLINA COASTAL PLAIN USING THE NORTH AMERICAN AMPHIBIAN MONITORING PROGRAM

Paul P. Thomas Jr.<sup>1</sup> and Eran S. Kilpatrick<sup>2</sup>

<sup>1</sup>Dept. of Biology and Geology, University of South Carolina Aiken

<sup>2</sup>Division of Math and Science, University of South Carolina Salkehatchie

The North American Amphibian Monitoring Program (NAAMP) was established by USGS to monitor breeding anuran populations. NAMMP was implemented in South Carolina in 2008, and is a collaborative program drawing participation from a variety of public and private entities. This study investigated species detection and site occupancy along two NAAMP routes near Allendale and Grays, South Carolina. Both routes occur in the Coastal Plain, a region containing a diversity of wetlands providing breeding habitats for 26 anuran species. Calling anurans were sampled at 10 stops along each route from January 15 – February 28 (Window 1), March 15 – April 30 (Window 3), and May 15 – June 30 (Window 3). From 2008 – 2011, a total of 31 surveys were conducted along both routes, representing 310 five minute samples that detected 20 species. Eighteen species were detected on the Allendale route and 17 species were detected on the Grays route. Spring peepers (*Pseudacris crucifer*), southern cricket frogs (*Acris gryllus*), southern toads (*Anaxyrus terrestris*), Green treefrogs (*Hyla cinerea*) were detected most often. The oak toad (*Anaxyrus quercicus*) and pig frog (*Lithobates grylio*) were unique to the Allendale route while upland chorus frog (*Pseudacris feriarum*) and eastern spadefoot toad (*Scaphiopus holbrookii*) detections occurred only on the Grays route. The most diverse stops were proximal to open pond cypress ponds with dense herbaceous cover. Tupelo swamp forest and gum ponds were the least diverse habitats surveyed. NAAMP continues as a comprehensive statewide monitoring effort, providing an extensive database available to the public.

#### DETERMINATION OF POLYHEXAMETHYLENE BIGUANIDE IN CONTACT LENS SOLUTIONS USING ULTRA PERFORMANCE LIQUID CHROMATOGRAPHY

Brandon L. Thompson, Sandra K. Wheeler, Anne D. Lucas<sup>1</sup>, Kenneth S. Phillips<sup>1</sup>, and John F. Wheeler

Dept. of Chemistry, Furman University

<sup>1</sup>United States Food and Drug Administration

Polyhexamethylene Biguanide (PHMB) has been used in multipurpose contact lens solutions (MPS) for many years due to its effectiveness in inhibiting bacterial and fungal growth. Several keratitis outbreaks in the recent past, however, have necessitated re-examination of these solutions and their additives. As a result, a simple, sensitive, and reproducible analytical method capable of measuring sub-ppm concentrations of PHMB in commercially available MPS is greatly needed. By initially treating MPS with weak cation exchange solid phase extraction and then subjecting the samples to reversed phase ultra performance liquid chromatography (UPLC) and utilizing the method of standard additions, small concentrations of PHMB were reliably measured. After determining optimal conditions, this method facilitated PHMB measurements in several authentic MPS samples between 1.0-1.5 ppm and as low as 0.5 ppm. Recoveries were good at 0.5, 1.0 and 1.5 ppm, at 92.0, 91.3 and 97.7% respectively. The system reproducibility of stock solutions of PHMB produced a RSD of <1.73% and an overall method reproducibility RSD value of <1.69% for the calculated PHMB concentration in a given MPS. Further, when UPLC data was compared to that of independent analysis at the FDA using high performance liquid chromatography (HPLC) coupled with evaporative light scattering detection (ELSD) for the same samples, results correlated demonstrated high correlation. This consistency offers validation for UPLC as an appropriate method for the quantitation of PHMB in MPS.

#### ANALYSIS OF TRAFFIC PATTERNS USING THE TIME SPACE DIAGRAM

Jaime Thrift

Dept. of Physics and Astronomy, College of Charleston

This study focuses on traffic patterns at a four-way stop, one of the simplest of intersections. The four-way stop studied is especially interesting because the volume of traffic increases throughout the day and is in an area that is growing rapidly. Data and observation of this simple intersection provides enough insight to develop a better understanding of more complicated systems. More complicated systems would include busy multi-lane city streets and interstates, just to name a few. Time-mean speed and space-mean speed are calculated and used to produce a time-space diagram from the collected data. The time-space diagram has the ability to explain traffic patterns as well as the wave-like pattern of traffic movements. Knowledge of these traffic patterns is used by traffic engineers to improve an area of congestion or for areas that have become dangerous due to intersection safety inadequacies.

SEARCHING FOR PROPHYLACTIC BACTERIOPHAGES THAT INFECT AND LYSE *STAPHYLOCOCCUS AUREUS* OR  
*ESCHERCHIA COLI*

Ina R. Troutman, Riane Petersman, and Paul Richardson  
Dept. of Biochemistry, Coastal Carolina University

Bacteriophages (phages) are absolute parasites, or viruses, that solely infect and lyse bacteria. They are one of the most abundant entities on Earth and carry all the information needed to direct their own reproduction once introduced into a host cell. In the past phages were used as prophylactic and therapeutic agents against bacterial infections before the discovery of antibiotics. Since the commencement of antibiotics and their widespread use in fighting bacterial infections, there has been an emergence of evolved and resistance developed bacterial organisms. This has led to an inevitable augmentation in antibiotic production, which is both expensive and time consuming. Phages provide an alternative therapeutic agent against these evolving strains of bacteria due to the fact that they can simultaneously mutate with the bacteria. This concept is imperative due to the rapid evolution of bacteria and the unequivocal progression of antibiotics. This research could provide significant advancements in the prevention and treatment of infectious diseases through the bacteriolytic actions of phages. Not only will this research impact the innovation of medicine and the health of the society, but it will also improve agricultural settings and the safety of food production. The purpose of this study is to search for naturally occurring phages and test their ability to infect and lyse bacteria that could potentially be used as natural therapeutic agents with the ability to inhibit infectious diseases.

A MONTE CARLO POPULATION STUDY OF EXOPLANET COMPANIONS OF HIGH MASS [A,B] STARS

Jesica L Trucks  
Dept. of Astronomy, College of Charleston

With applications for the Subaru SEEDS Exoplanet survey, I developed Monte Carlo simulations to determine the population statistics of extrasolar planets around high mass A and B type stars, based on observational imaging data. The numerical codes also determine the probability of successfully imaging a planet around a star, as a function of planet temperature and orbital characteristics. For an example imaging data set, I performed a maximum likelihood analysis to determine the exoplanet frequencies most consistent with the observational results.

PROGRESS TOWARD IODINE-LABELED POLY(EPILON-CAPROLACTONE) FOR X-RAY IMAGING APPLICATIONS

Brooke A. Van Horn and Caroline C. Duncan  
Dept. of Chemistry and Biochemistry, College of Charleston

With two of the most common processes for imaging in the human body being general X-ray radiography and computed tomography (CT) technologies, scientists today are exploring and developing exciting new choices for imaging agents and moving beyond the traditional small molecule contrast agents. A biocompatible, biodegradable polymeric macromolecule with engineered radio-opacity (X-ray and CT contrast) and reactive groups would have similar imaging utility as the traditional systems with additional means to covalently link directing groups for specific cellular targets and therapeutic agents for delivery. Our research lab at College of Charleston is interested in the fundamental design, synthesis, and characterization of such nanoscale vessels for a variety of biomedical applications. Specifically, our lab has recently replicated the synthesis of linear (spaghetti-like) polyester polymer chains with built-in ketone functional groups. The polymer species were well characterized using proton and carbon nuclear magnetic resonance (NMR) and infrared (IR) spectroscopies for functional group and number averaged molecular weight calculations and were also evaluated with gel permeation chromatography (GPC) to determine polymer sample polydispersity. Using these ketone units as a chemically reactive handle, acid-catalysed ketoxime ether formation is possible for the reversible but covalent attachment of iodinated species, including the recently prepared O-(2-iodobenzyl)hydroxylamine small molecule, to impart tunable levels of radio-opacity to the polymeric material. We will present the current state of our project in the preparation of these novel modular polymer species and highlight our plans to translate this chemistry and our preliminary results to the formation of radio-opaque water-soluble nanoparticles.

PROGRESS TOWARD ALKENE-CONTAINING POLY(EPILON-CAPROLACTONE) AND THIOL-ENE  
FUNCTIONALIZATIONS

Brooke A. Van Horn and Marcus J. Henderson  
Dept. of Chemistry and Biochemistry, College of Charleston

With the growing need for improved means to deliver drugs and chemotherapy to specific tissues and cellular targets, scientists today are exploring and developing exciting nanoscale vessels and moving beyond the traditional unspecific small molecule, high dosage therapies. A biocompatible, biodegradable polymeric macromolecule with engineered immunological "stealth" character and surface-available reactive groups would potentially provide a means to covalently link directing groups for specific cellular targets and therapeutic agents to the vessel for timely and precise delivery. Our research lab at College of Charleston is interested in the fundamental design, synthesis, and characterization of such nanoscale vessels for a variety of biomedical applications.

Specifically, our lab has recently replicated the synthesis of linear(spaghetti-like) polyester polymer chains with built-in alkene functional groups through the incorporation of a synthetic 7-allyl epsilon-caprolactone monomer. The polymer species

were well characterized using proton and carbon nuclear magnetic resonance (NMR) and infrared (IR) spectroscopies for functional group and number averaged molecular weight calculations and were also evaluated with gel permeation chromatography (GPC) to determine polymer sample polydispersity. Using these allyl units as a chemically reactive handles, radical thiol-ene "click" chemistry was performed for the irreversible covalent attachment of various thiol species to the polymer chain. Our first studies were performed with a model thiol compound, methyl thioglycolate, to test the UV photoinitiated reaction conditions. Our subsequent experiments are geared to impart tunable levels of hydrophilicity to the polymeric material through the attachment of water-soluble thiol-terminated poly(ethylene oxide) (PEO-SH) chains. We will present the current state of our project in the preparation of these novel modular polymer species and highlight our plans to translate this chemistry and our preliminary results to the formation of water-soluble nanoparticles for various biomedical and imaging applications.

#### ANALYSIS AND CHARACTERIZATION OF INTERCALATIVE AND COVALENT INTERACTIONS OF [Cr(DIIMINE)<sub>3</sub>]<sup>3+</sup> COMPLEXES WITH DNA

Kristen E Watts, Richard E. Graybill, James H. Wade, Sandra K. Wheeler,  
Noel A. P. Kane-Maguire, and John F. Wheeler  
Dept. of Chemistry, Furman University

In recent years our lab has focused on the synthesis and characterization of a broad range of [Cr(diimine)<sub>3</sub>]<sup>3+</sup> complexes that may exhibit potential as chemotherapeutics owing to their unique properties of photoactivation, thereby offering enhanced pharmaceutical selectivity. Cr(III) complexes synthesized in the Wheeler/Kane-Maguire research labs have been shown to follow two potential pathways of interest in their interaction with DNA, 1) non-covalent intercalation which can be followed by photoexcitation and selective oxidation of the guanine base in DNA, and/or 2) photoactivation followed by the formation of a permanent DNA adduct. The mechanism of DNA photocleavage in these d3 systems is achieved as a result of their powerful 2Eg excited state, exhibiting oxidation capacities > 1.4 V. In order to enhance intercalation, the majority of our Cr(III) complexes have been prepared with established intercalators such as dipyridophenazine (DPPZ), e.g., [Cr(diimine)<sub>2</sub>DPPZ]<sup>3+</sup>. Spectrophotometric titrations, isothermal titration calorimetry, and equilibrium dialysis have been used to characterize non-covalent interactions, providing comparative thermodynamic association constants (K<sub>DNA</sub> values), *K*<sub>H</sub> and *K*<sub>S</sub> of binding, and an indication of binding specificity (e.g., minor groove, A-T selective). The mechanism of permanent adduct formation occurs through displacement of a sacrificial ligand (typically 1-methylimidazole) with a DNA nucleobase following exposure to UV radiation at 360 nm. Recent studies employing UPLC-MS, electrophoresis and RT-PCR have suggested that these adducts are not only irreversible, they are perhaps ultimately capable of interrupting DNA replication.

#### A SYNTHETIC MODEL OF TYPE-2 COPPER NITRITE REDUCTASE BASED ON A BULKY TRIS(TRIAZOLYL) BORATE LIGAND

Sarah Weaver and Gerard Rowe  
Dept. of Chemistry, University of South Carolina Aiken

Type-2 copper-containing nitrite reductase is an enzyme that catalyzes the 1-electron, 2-proton mediated reduction of nitrite (NO<sub>2</sub><sup>-</sup>) to nitric oxide (NO). One noteworthy aspect of the enzyme's active site is a carboxylic acid group that is in close proximity to the copper, but cannot directly interact with the metal atom. Instead, this acidic group acts as a proton donor to a copper-bound nitrite group, and is believed to facilitate the rapid reduction of the nitrite to nitric oxide. In addition to ongoing studies in our lab with tris(pyrazolyl)borate (Tp) ligands, we have also begun investigating the structurally similar tris(triazolyl)borate (Ttz) ligand framework for its potential to carry out the same reduction chemistry found in the enzymatic system. The 1,2,4-triazole rings of the Ttz ligand have an additional nitrogen atom in place of a carbon atom found in their pyrazole counterparts. The addition of this nitrogen produces a less electron-donating ligand framework, which may have effects on the reactivity of the copper Ttz compounds. Also, in contrast to Tp ligands, metal compounds made with Ttz ligands are water soluble, opening the door for catalytic reactions carried out in more biologically relevant aqueous solutions, rather than organic solvents necessitated by metal Tp compounds.

#### Influence of Species and Gender on Expression of Inhibin B Levels in the Sea URCHIN

Shanetta J. Wilkins and William E. Roudebush  
Dept. of Biology, Charleston Southern University

Human and environmental-caused stressors affect wildlife populations in a number of ways, e.g. fertility and reproduction. The effects of toxins on wildlife can be difficult to ascertain and, usually, harder to remedy. Once toxins enter the environment, they accumulate in the food chain, affecting all levels of the ecosystem. This is critical for endangered and other protected species, for scientists to understand whether reproduction is being impaired, and if it's possible to decrease the stressors that may be the cause of the impairment. Marine invertebrates, such as sea urchins, are time honored models for comparative investigations in reproductive and developmental biology. Inhibin-B is a protein hormone expressed by ovarian granulosa and has been shown to be vital in the regulation of ovarian function and is believed to be one of the autocrine factors regulating dominant follicle growth and development selection. As ovarian follicle cohort size decreases, which is expected as the female ages, a decrease in inhibin-B levels will be observed. In males, inhibin-B is expressed by Sertoli cells and plays a role in Leydig cell steroidogenesis, spermatogenesis and regulating follicle stimulating hormone (FSH) production. This fertility marker assay can be used to facilitate investigations into gonadal toxicity and even help assess reproductive



potential. The study objective was to determine if inhibin-B is present in the sea urchin and to see if differences exist between sexes in two species. A Total of 78 sea urchin samples were assayed for inhibin-B. Inhibin-B levels in male and females gametes for each species is as follows: *Strongylocentrotus purpuratus*, 0.020 pg/10<sup>6</sup> sperm cells, 0.057 pg/10<sup>6</sup> ova; *Lytechinus variegatus* 0.333 pg/10<sup>6</sup> sperm cells, 6.361 pg/10<sup>6</sup> ova. Analysis of variance revealed a significant (P<0.001) different in inhibin-B levels between all groups. The highest levels of inhibin-B were found in the *Lytechinus variegatus* ova group where the lowest levels in the *Strongylocentrotus purpuratus* group. Our initial findings verify the presence of inhibin-B in both male and female sea urchins. Additionally, significant differences exist between species in both sexes. Since each species is commonly found in different ecosystems, local conditions may affect inhibin-B levels. Additional studies are warranted to understand the role inhibin-B has in an invertebrate species and what factors affect levels.

#### INVESTIGATION OF COMMON BOTTLENOSE DOLPHIN (TURSIOPS TRUNCATUS) DEPREDAION ON RECREATIONAL FISHERIES IN CHARLESTON AND HILTON HEAD

Katie F. Williams, Elise Kohli, and Wayne E. McFee  
Dept. of Environmental Science, College of Charleston

Depredation occurs when a predator, such as a dolphin, steals or damages bait. This can lead to ingestion of lines or hooks, and entanglement. Studies in Sarasota, Florida have shown that deaths caused by this behavior are at such a high rate it could have negative effects on the resident population. Resident populations in Hilton Head Island, South Carolina and Charleston, South Carolina have yet to be studied; however, the stranding record shows that at least a few dolphins have ingested hooks or been entangled in monofilament line. If depredation is a problem at these two sites as well, it could have very negative implications for the survival of these two resident populations. The objective of the present study is to investigate populations of bottlenose dolphins through observation at designated recreational fishing piers in Charleston and Hilton Head Island, to assess the occurrence of depredation and illegal feeding, and conduct on site interviews with recreational fishers. Preliminary results found that dolphins frequent the piers regularly with or without the presence of anglers. Depredation appears low in these two locations near the fishing piers according to observation and survey data, however a few instances were noted. Presence of dolphins near the piers and close to the fishing lines increased in the colder months and during lower tides. This investigation is a starting point for further research to increase our understanding of the frequency at which depredation occurs in South Carolina between bottlenose dolphins and recreational and commercial fisheries.

#### IMMOBILIZATION OF RUTHENIUM FLUOROPHORES IN SELF ASSEMBLED MONOLAYERS

Ben L. Wise, Summer Arrowood, and Dr. Laura Wright  
Dept of Chemistry, Furman University

There are many examples of fluorescent sensing molecules that change their properties when added to a solution containing specific substances. By fixing these molecules to a solid substrate a reusable sensor could potentially be made, which could simplify the use of these compounds as sensors. This presentation will discuss the methods and results from attempts to immobilize a ruthenium fluorophore on a variety of substrates via self assembly and photopolymerization. Modification of a Ru(II) trisdiimine complex by the addition of a 10,12-octadecadiyne tail on a phenanthroline allows for the investigation of the utility of intercalation and photo induced cross-linking as a method to immobilize molecules of interest on surfaces. Past work by our group has demonstrated that a self assembled monolayer (SAM) of 10, 12-octadecadiynethiol on atomically flat gold nanoplatforms and on spherical gold nanoparticles can immobilize the ruthenium fluorophore by intercalation of the tail of the fluorophore into the SAM. Photolysis of the resulting system induces cross linking of the tail diacetylene unit with the corresponding diacetylene units in the SAM such that the fluorophore is covalently bound to the SAM. Current work investigates the immobilization of the ruthenium fluorophore by intercalation into diacetylene thiol SAMs on amorphous gold coated glass slides and into analogous diacetylene carboxylic acid SAMs on mica. These systems were characterized using atomic force microscopy, fluorescence microscopy, and contact angle measurements.

#### STUDYING COALESCENCE EVENTS DURING THE LATE STAGE OF PHASE SEPARATION

Cathleen A. Wise<sup>1</sup>, Ana Oprisan<sup>1</sup>, Carole Lecoutre<sup>2</sup>, John J. Hegseth<sup>3</sup>,  
Yves Garrabos<sup>2</sup>, and Daniel Beysens<sup>4</sup>

<sup>1</sup>College of Charleston <sup>2</sup>University of Bordeaux

<sup>3</sup>University of New Orleans <sup>4</sup>University of Grenoble

To study phase separation in the pure fluid sulfur hexafluoride (SF<sub>6</sub>) near the liquid-gas critical point, a series of experiments were performed in microgravity using the Alice II instruments. Full view and microscopic view images were analyzed to determine the changes in the size distribution of droplets. For the first time, we provided experimental evidences regarding the existence of dimple and nose coalescence mechanisms in pure supercritical fluids under microgravity conditions. We recorded data for two different thermal quenches of 3.6 mK and 0.3 mK, respectively. Our results indicate that, during the late stage of phase separation, the number of the liquid clusters decreases due to the coalescence events. We estimated the power law growth of the droplets/clusters and fitted it to a universal curve.

#### AMH EXPRESSION IN EPITHELIAL CELLS OF OVARIAN CANCER

Christo Yarina and William Roudebush  
Dept. of Biology, Charleston Southern University

Ovarian cancer is one of the most common causes of cancer related deaths in women with the majority of the cancer cells presenting in the epithelial cells. The purpose of this study was to examine the expression levels of anti-mullerian hormone (AMH) and Inhibin B in malignant ovarian epithelial cells. Inhibin B and AMH Enzyme Linked Immuno-Sorbent Assay (ELISA) were performed on different ovarian cancer cell lines. Inhibin B was not found in any of the samples or control media while AMH was found in the epithelial cells (at different levels between the different cell lines) where it was previously thought to only occur in granulosa cells. These results raise questions as to why is AMH presenting in the epithelial cells and why are the different cancer cell lines presenting at different levels? Additional cancer cell line runs will be performed for more quantitative data as well as runs on normal epithelial cells to provide a baseline for comparison other than the control media. These preliminary results, if proved true, could prove to lead a diagnostic tool for the early detection of epithelial cell ovarian cancer to increase the life expectancy of ovarian cancer patients.

#### EVALUATION OF CaTiO<sub>3</sub> ON THE PHOTOCATALYTIC DEGRADATION OF METHYLENE BLUE

Glory Zhou, Cynthia Tamboue, and Samuel Darko  
Dept. of Environmental Science, Benedict College

The synthesis of calcium titanate (CaTiO<sub>3</sub>) was performed by mechanical activation and thermal treatment. Milling at two distinct times (2hrs and 5hrs) in a planetary ball mill mechanically activated an equimolar mixture of CaCO<sub>3</sub> obtained from recycled eggshells and commercial grade anatase TiO<sub>2</sub>. A small amount of the mechanically activated mixture was then sintered at 900°C and 1200°C. The effect of mechanical activation on the solid-state reaction was investigated using X-ray diffraction (XRD), Scanning electron microscopy (SEM) for the changes in morphology and particle size, while BET analysis was used to determine the porosity and specific surface area of the material. According to XRD patterns, the best crystalline CaTiO<sub>3</sub> was produced within 2hr milling and 900°C. Photocatalytic experiments with CaTiO<sub>3</sub> as catalyst yielded 90% removal of Methylene blue in aqueous solution. Further investigation on adsorptive removal of transition metals is ongoing.

#### INVESTIGATION OF HIGH-RESOLUTION IMAGING WITH THE COFC TELESCOPE

Andrei Zorilescu  
Dept. of Astronomy, College of Charleston

High resolution, image improvement codes offer the opportunity to improve the quality of astronomy images that have been degraded by problems such as poor telescope tracking, telescope vibrations, and blurring effects from the atmosphere. The Cassegrain Telescope at the College of Charleston (CofC) was used to snap images of an object in sets of different exposure times which were later analyzed for quality improvement. The purpose of this project was to show that images can be shifted and aligned to a certain point through software so that when the multiple images are combined, the effective resolution and overall image quality is substantially improved. The object of focus was the double binary system Epsilon Lyrae.

#### NEW CLASS OF GREEN CHEMISTRY SURFACE ACTIVE MATERIALS BASED ON NATURAL POLYOLS FOR USE IN RIGID AND FLEXIBLE POLYURETHANE FOAMS

Patrick Coterillo and Neal Tonks  
Dept of Chemistry and Biochemistry, College of Charleston

The primary goal of this research project is to synthesize a series of molecules utilizing poly functional alcohols, also known as polyols, and hydride substituted silicone oils to produce surfactants that will have surface active properties needed to improve foam formation in the production of polyurethane foams. This project is also heavily involved in the application of "green chemistry" and environmentally safe practices. Throughout the course of this project a series of nine polyol intermediates have been created, and then reacted with silicone oils to form surfactants. The next phase of the project will be to have them tested in the production of polyurethane foams. Future plans for this project involve the creation of new polyols with higher hydroxyl content.

END

SCAS 2012 ABSTRACTS

# SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE

## SCHEDULE OF EVENTS

### Saturday, April 14th

**7:30 AM- 9:00 AM** SCJAS Registration

**Lobby of Etheredge Center**

**8:30 AM**

**Welcome: Chancellor Tom Hallman**

**Etheredge Center Auditorium**

Introduction of Speaker:

Dr. Justin Wyatt (COC, Past President SCAS)

Sav. River National Lab President

Dr. Terry Michalskie (SRNL Director)

Introduction of Speaker:

Dr. Robin Brigmon (SRNL, President Elect SCAS)

Keynote Presentation:

Dr. Nikolaos Rigas (Clemson Univ Restoration Institute)

**8:00 AM - 12:30 PM , SCJAS Morning Sessions**

**Oral Presentations**

1st and 2nd floor of Business & Education Center (B&E)

**9:45 AM-11:45 AM Morning Session:**

2nd Floor Gym

Business & Education Center (B&E)

**Poster Presentations:**

- Regional Science Fair Winners Poster Presentations

**10:30 AM – 11:15 AM – USC Aiken Tours**

Meet in lobby of B & E Building at 10:15 AM

**10:30 AM -12:00 PM**

**Savannah River Ecology Lab Presentation**

Science Building Auditorium, Room 327

"Hidden Biodiversity of South Carolina" by Judy McCleod

**11:30 AM - 12:15 PM - Planetarium Show**

Ruth Patrick Science Center

*Meet in lobby of Ruth Patrick Center at 11:15 AM. Limit of 55 students, must have registered in advance for this tour*

**11:45 AM - 1:30 PM Lunch**

**USCA Cafeteria in Student Activities Center**

**1:00 PM - 4:30 PM, SCJAS Afternoon Sessions:**

**SCJAS Oral Presentations:**

1st and 2nd floor of

Business & Education Center (B&E)

**1:30 PM - 2:15 PM – USC Aiken Tours**

*Meet in lobby of Student Activities Center near the entrance to cafeteria at 1:15 PM*

**1:30 PM - 3:00 PM**

**Savannah River Ecology Lab Presentation**

Science Building Auditorium , Room 327

Hidden Biodiversity of South Carolina" by Judy McCleod

**2:30 PM - 3:15 PM - Planetarium Show**

Ruth Patrick Science Center

*Meet in lobby of Ruth Patrick Center at 2:15 PM. Limit of 55 students, must have registered in advance for this tour*

**3:30- 4:30 PM**

**Science and Engineering Career Seminar**

Science Building Auditorium, Room 327

Dr. Eugene Rhodes, Director of Savannah River Ecology laboratory

Careers in the Air Force , Mgst Keitho Williams

**4:30 PM - 5:00 PM, SCJAS Drawings for door prizes**

Gym, 2nd floor of B & E Building

**5:00 PM - SCJAS Award Ceremony**

Gym, 2nd floor of B & E Building

(See next page for award ceremony schedule)

## 2012 SCJAS Award Ceremony Schedule

**Welcome:** Dr. Tom Reeves, Midlands Technical College  
SCJAS Executive Director

**United States Air Force Scholarship Award**

Award amount: \$500 each for two students

Presenter: MSgt. Keitho D. Williams

**Southern Atlantic Coast Section of the American Association of Physics Teachers Award**

Award amount: \$100 for student winner and teacher sponsor

Presenter: Dr. Mikhail M. Agrest, Physics & Astronomy Dept. College of Charleston

**Chris Conner Memorial Award**

Award amount: \$50 for outstanding research related to marine science, limnology or fish biology, or research related to music or sound.

Presenter: Dr. Tom Reeves, Midlands Technical College

**The South Carolina Branch of American Society of Microbiology Award (SCBASM)**

Award Amount: \$50 in the category of Microbiology

Presenter: Representative from SCBASM

**SC State Faculty Research Awards**

Presenter: Dr. Judith Salley, SC State University

**SCAS-\$100.00**

President's Award – Best Overall Researcher – Dr. Judith D. Salley-Guydon

**SCJAS-\$50.00 (Award Categories and Sponsors)**

- 1) Zoology- Dr. Judith D. Salley-Guydon
- 2) Computer Science- Dr. Stevo M. Bozinovski
- 3) Microbiology- Dr. James B. Stukes
- 4) Biomedical Science- SC State Health Professions Society
- 5) Engineering
- 6) Engineering- Dr. Stanley Thekweazu
- 7) Outstanding Oral Presentation- SC State SCAMP
- 8) Johnnie J. Jenkins, Jr. Chemistry Award- Dr. Joe N. Emily
- 9) Outstanding Oral Presentation
- 10) Outstanding Oral Presentation- Mr. Johnny Funny
- 11) Material Science- Dr. Rhullah Massoudi
- 12) Biomedicine (Life Sciences) –Dr. Gnana Warshamana-Greene
- 13) Materials Nanoscience- Dr. Rahina Mahtab
- 14) Biochemistry- Dr. Mahtubbin Ahmed
- 15) Polymer Chemistry- Dr. Nasrollah Hamidi
- 16) Dr. Ruth Hodges Award-Informatics
- 17) Best Oral Presentation- Joseph Brandyburg
- 18) Dr. Ajoy G. Chakrabarti Award

**The American Association for Biochemistry & Molecular Biology (ASBMB) Award**

Award amount: \$50 each in Biochemistry and Molecular Biology category

Presenter: Dr. Tom Reeves, Midlands Technical College

**Winthrop University Behavioral Science Award**

Award Amount: \$50 each for oral presentation and written presentation participants in category of Psychology and Sociology

Presenter: Dr. Edna Steele, Converse College

**Winthrop University Excellence in Biology Award**

Award Amount: \$50 each for participant in category of Botany

Presenter: Dr. Edna Steele, Converse College

**Winthrop University Excellence in Environmental Science Award**

Award Amount: \$50 each for participant in category of Environmental Science  
Presenter: Dr. Edna Steele, Converse College

**South Carolina Bank & Trust Consumer Affairs Research Award**

Award Amount: \$50 each for oral presentation and written presentation  
participants in category of Consumer Affairs  
Presenter: Dr. Edna Steele, Converse College

**Nishie G's Physiology & Health Research Award**

Award Amount: \$50 each for participant in category of Physiology and Health  
Presenter: Dr. Edna Steele, Converse College

**Converse College Young Female Scientist Award**

Award Amount: \$50 for outstanding scientific research by a female  
Presenter: Dr. Edna Steele, Converse College

**South Carolina Section of the American Chemical Society**

Award Amount: \$100  
Presenter: Dr. Jim Privett, USC Sumter

**2012 SCJAS Written Presentations**

Presenter: Dr. Jim Privett, USC Sumter

**2011 SCJAS Oral Presentations**

Presenter: Dr. Edna Steele, Converse College

**2011 SCJAS Poster Sessions**

Presenter: Tammy Taylor, Midlands Technical College

**Nominations for 2013 AJAS Meeting,**

Boston, MA February 14-18, 2013  
Presenter: Tammy Taylor, Midlands Technical College

**Closing remarks:** Tammy Taylor, Midlands Technical College

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**2012 SCJAS JUDGES**

**Biochemistry(M)**

\*Dr. Gerard Rowe, Professor, University of South Carolina Aiken  
Md. Mostafizur Rahman, Assistant Professor of Chemistry, Benedict College

**Botany (M, NM)**

\*Dr. Henry Slone, Associate Professor of Biology, Francis Marion University  
Dr. Harry E. Shealy, Jr., Professor of Biology, University of South Carolina Aiken

**Cell &Molecular Biology (M)**

\*Dr. Nathan Hancock, Assistant Professor of Biology, University of South Carolina Aiken  
Dr. Jennifer Morgan, Instructor, York Technical College

**Chemistry (M, NM)**

\*Dr. Lisa Brodhacker, Assistant Professor of Organic Chemistry, Lander University  
Dr. Nandeo Choony, Assistant Professor of Chemistry, University of South Carolina Aiken

**Consumer Affairs**

\*Odysseas Kakaras, Instructor of Mathematics, University of South Carolina Sumter  
Dr. Naima Naheed, Assistant Professor, University of South Carolina

**Engineering (M,NM)**

\*Dr. Neil E. Miller, Instructor of Physics, University of South Carolina Aiken  
Dr. Thomas W. Simpson, Senior Instructor of Mathematics, University of South Carolina Union

**Environmental Science (M,NM)**

\*Dr. Austin Jenkins, Instructor of Biology, University of South Carolina Sumter  
Karin L. Willoughby, Senior Instructor, University of South Carolina Aiken

**Mathematics & Computer Science (M,NM)**

\*Dr. Rigo Florez, Assistant Professor of Mathematics, University of South Carolina Sumter  
Dr. Leandro Junes, Assistant Professor of Mathematics, University of South Carolina Sumter

**Microbiology (M,NM)**

\*Dr. Kajal Ghoshroy, Assistant Professor of Biology, University of South Carolina Sumter  
Dr. Venkatesh L. Hegde, Assistant Professor, USC School of Medicine

**Physics (NM)**

\*Dr. Robert Nerbun, Professor of Physics, University of South Carolina Sumter  
Dr. Brian Dominy, Assistant Professor of Chemistry, Clemson University

**Physiology and Health (NM)**

\*Dr. Ajoy Chakrabarti, Professor of Biology, South Carolina State University  
Dr. Michelle Vieyra, Assistant Professor, University of South Carolina Aiken

**Physiology and Health (M)**

\*Mr. Dan Kiernan, Dept. of Biology, University of South Carolina Sumter  
Ms. Beth. Wyatt, Instructor of Biology, York Technical College

**Psychology & Sociology (M, NM)**

\*Dr. Anisah Bagasra, Assistant Professor of Psychology, Claflin University  
Dr. Echo Leaver, Assistant Professor, University of South Carolina Aiken

**Zoology (M,NM)**

\*Ms. Sukla Chakrabarti, Retired Teacher  
Dr. Andrew R. Dyer, Associate Professor, University of South Carolina Aiken

\* Lead Judge

**SCJAS 2011 ANNUAL MEETING ORAL PRESENTATIONS  
UNIVERSITY OF SOUTH CAROLINA-AIKEN, APRIL 14, 2012**

**Session 1: Biochemistry/Non- Mentored, Room 135, B & E Building**

- 9:00 AM THE EFFECTS OF BOTH *SARGASSUM* AND *ASPERGILLUS NIGER* ON THE BIOSORPTION OF LEAD FROM WATER  
Himabindu Vinnakota, Spring Valley High School
- 9:15 AM THE EFFECT OF COOKING ON CATROTENONDS  
Stella Wang, Hammond School

**Session 2: Biochemistry/ Mentored, Room 135, B & E Building**

- 9:30 AM THE EFFECT OF CACHEXIA AND CANCER ON CARDIAC MUSCLE OXIDATIVE CAPACITY IN MALE APCMIN+/- MICE  
Kyle C. Brennan, South Carolina Governor's School for Science and Mathematics
- 9:45 AM THE PRODUCTION OF CYTOTOXIC ACETALDEHYDE THROUGH THE OXIDATION OF ETHANOL IN CULTURED MALE RAT HEPATOCYTES  
Kemper Fagan, South Carolina Governor's School for Science and Mathematics
- 10:00 AM ELECTROPHORETIC INVESTIGATIONS OF THE INTERACTION OF POTENTIAL CHROMIUM (III) ANTI-CANCER DRUGS WITH DNA  
Caitlin Keen, South Carolina Governor's School for Science and Mathematics
- 10:15 AM THE INTERACTION OF BIOLOGICAL TRANSITION METALS WITH THE CALCIUM DYE FLUO-5N  
Daniel Lamm, South Carolina Governor's School for Science and Mathematics
- 10:30 AM –Break
- 10:45 AM ROLE OF SRT1720 IN PREVENTION OF ACETAMINOPHEN-INDUCED HEPATIC INJURY IN THE MOUSE  
Allison Moore, South Carolina Governor's School for Science and Mathematics
- 11:00 AM BRAIN IRON ACCUMULATIONS WITH A MUTATED Fa2h GENE IN A MOUSE MODEL  
Emily Moore, South Carolina Governor's School for Science and Mathematics
- 11:15 AM STAPHYLOCOCCUS AUREUS IMMOBILIZATION ON ALLYLAMINE PLASMA GRAFTED POLYCAPROLACTONE NANOFIBER MESH  
Sahil Patel, South Carolina Governor's School for Science and Mathematics
- 11:30 AM THE ROLE AND INTERACTION OF ARMADILLO REPEAT VELO-CARDIO-FACIAL (ARVCF) SYNDROME PROTEIN IN THE NUCLEUS OF HUMAN KIDNEY CELLS  
Kiersten Rule, South Carolina Governor's School for Science and Mathematics
- 11:45 AM THE BIOENCAPSULATION OF ENZYMES THROUGH THE PROCESS OF SOL-GELS  
Jalen Benjamin, South Carolina Governor's School for Science and Mathematics
- 12:00 PM Quantitative and Qualitative analysis of cancer protein binding to nanoparticles  
Joshua Breece, South Carolina Governor's School for Science and Mathematics

**Session 1: Botany/ Mentored, Room 131, B & E Building**

- 9:15 AM TRANSFORMATION APPROACHES TO THE DEVELOPMENT OF DISEASE RESISTANT POPLAR TREES  
Jay Abbess, South Carolina Governor's School for Science and Mathematics
- 9:30 AM MAPPING OF ADVENTITIOUS ROOTING IN POTENTIAL PEACH [*PRUNUS PERSICA* (L.) BATSCH] SEMI-HARDWOOD CUTTINGS  
Lydia Colvin, South Carolina Governor's School for Science and Mathematics

**Session 2: Botany/ Non-Mentored, Room 131, B & E Building**

- 9:45AM THE TOXICITY OF CHLOROTHALONIL AND GASOLINE VAPOR TO THE GROWTH AND HEALTH OF BRASSICA OLERACEA  
Daniel Clements, Spring Valley High School
- 10:00AM MEDIATING THE YIELD OF BRASSICA RAPA AND PET RATE OF VIOLA X WITTROCKIANA THROUGH THE APPLICATION OF ASPARTIC AND GLUTAMIC ACID UNDER SALINITY STRESS  
Habiba Fayyaz, Spring Valley High School
- 10:15AM THE EFFECTS OF BIOCHAR AND GREEN WASTE ON SOIL PH, SOIL NITROGEN LEVELS, AND BIOMASS OF RAPHANUS SATIVUS  
Lance Murphy, Spring Valley High School
- 10:30AM- Break
- 10:45AM THE EFFECT OF SODIUM NITROPRUSSIDE AND NITRIC OXIDE ON THE GERMINATION RATE OF BRASSICA RAPA  
Keertana Nair, Spring Valley High School
- 11:00 AM A COMPARISON OF RHIZOBIUM LEGUMINOSARUM, AZOTOBACTER CHROOCOCUM, AND CALCIUM CARBONATE (CaCO<sub>3</sub>) ON NITROGEN FIXATION BY PHASEOLUS LUNATUS GROWN IN CLAY SOIL  
Amber Parnell, Spring Valley High School
- 11:15 AM COLORIMETRIC QUANTIFICATION OF FERMENTABLE SUGARS IN PUERARIA LOBATA FOLLOWING TREATMENT WITH DIFFERING LIGNOCELLULOSIC PRETREATMENT TECHNIQUES  
Bushra Islam, Spring Valley High School
- 11:30AM MICROWAVING PANSY PLANTS: ENVIRONMENTAL EFFECTS OF MICROWAVE RADIATION  
Abisshak Lakshman, Southside High School
- 11:45 AM ADSORBANCE OF Cr(VI) USING PUERARIA LOBATA LEAVES, SHREDDED PUERARIA LOBATA, AND PUERARIA LOBATA ASH  
Tina Monzavi, Spring Valley High School

**Session 1: Chemistry/ Non-Mentored, Room 136, B & E Building**

- 8:15 AM THE EFFECT OF pH ON THE CHEMICAL IDENTITY OF SOIL AS DEFINED BY NITRATE NITROGEN, PHOSPHORUS, POTASSIUM, HUMUS, CALCIUM, AND MAGNESIUM LEVELS  
Grace Smith, Heathwood Hall Episcopal School
- 8:30 AM THE EFFECT OF FOOD COLORING, HIGHLIGHTER DYE, AND SUBLIMATING DYES ON THE VISIBILITY OF LATENT FINGERPRINTS USING THE CYANOACRYLATE (SUPER GLUE) FUMING METHOD  
Allison Jones, Heathwood Hall Episcopal School
- 8:45AM THE DIFFUSIVE ESCAPE RATE OF ALBUMIN: LACTATED RINGER'S SOLUTIONS THROUGH SEMI-PERMEABLE MEMBRANES  
Rimel Mwamba, Spring Valley High School
- 9:00 AM A COMPARISON ON THE SWELLING AND MECHANICAL PROPERTIES OF A SUPERPOROUS HYDROGEL WITH VARYING POST-CROSSLINKER ION CONCENTRATIONS  
Courtney Noh, Spring Valley High School
- 9:15AM COMPARISON OF PHOTOCATALYSTS, TiO<sub>2</sub>, SrTiO<sub>3</sub>, AND ZnS IN PHOTOCATALYTIC WATER SPLITTING UNDER ULTRAVIOLET IRRADIATION  
David Hodge, Spring Valley High School



- 9:30AM THE UNDERWATER BREATHING MASK USING ELECTROLYSIS  
Rebeca Dominguez, Southside High School
- 9:45 AM EFFICIENCY OF GASOLINE AND BIO-FUELS  
Mahmood Syed, Southside High School
- 10:00 AM COMPARING THE EFFICIENCY OF SUNSCREENS AND CLOTHING FOR PROTECTION AGAINST UV-A AND UV-B EXPOSURE  
JJ Wheeler, Southside High School
- 10:15 AM TESTING THE EFFECTIVENESS OF DIFFERENT OILS IN SOAPS TO CLEAN DIRT AND OIL  
Maria Vu, Southside High School

**Session 2: Chemistry/ Mentored, Room 136, B & E Building**

- 10:45 AM PREPARATION & PROPERTIES OF SILVER-MOLTEN CARBONATE DUAL-PHASE MEMBRANE FOR CARBON DIOXIDE SEPARATION  
Max Franks, South Carolina Governor's School for Science and Mathematics
- 11: 00 AM REGIOSELECTIVE PHOTOOXIDATION OF ALKENES WITHIN THE CONFINED ENVIRONMENT OF A MACROCYCLE  
Tori Laird, South Carolina Governor's School for Science and Mathematics
- 11: 15 AM CRYSTAL GROWTH AND PHOTOLUMINESCENCE OF Gd<sub>1-x</sub>La<sub>x</sub>KNaNbO<sub>5</sub>  
Ryan J. Pubentz, South Carolina Governor's School for Science and Mathematics
- 11:30 AM EFFECTS OF TiO<sub>2</sub> ANATASE PARTICLE SIZE ON THE ELECTRO-CHEMICAL PERFORMANCE OF LI-ION BATTERIES  
Michael Tibbs, South Carolina Governor's School for Science and Mathematics
- 11:45 AM ANALYSIS OF AZO COMPOUNDS WITH ULTRAVIOLET-VISIBLE SPECTROSCOPY  
Charles Wang, South Carolina Governor's School for Science and Mathematics
- 12:00 PM SYNTHESIS OF A MORE COST-EFFICIENT, COMPOSTABLE, GREEN POLYMER INCORPORATING RECYCLED VEGETABLE OIL  
Zachary Z. Wang, Dutch Fork High School
- 12:15 PM IS IT POSSIBLE TO DIFFERENTIATE BETWEEN UNDYED AND DYED SAMPLES OF COTTON, NYLON, AND POLYESTER USING ATR-FTIR AND MULTIVARIATE STATISTICAL ANALYSIS?  
Eric Bingley, Irmo High School

**Session 1: Cell & Molecular Biology / Mentored, Room 138, B & E Building**

- 10:45 AM THE EFFECT OF THE NOTCH SIGNALING PATHWAY ON CELL-TO-CELL ADHESION  
Amy Chang, South Carolina Governor's School for Science and Mathematics
- 11:00 AM THE EFFECT OF THE TRANSCRIPTION FACTOR CREL ON THE PRODUCTION OF THE INFLAMMATORY CYTOKINE, INTERFERON  $\beta$   
Sona Chowdhary, South Carolina Governor's School for Science and Mathematics
- 11:15 AM Intrinsic Change of neural stem cells in the auditory nerve  
Luke Havens, South Carolina Governor's School for Science and Mathematics
- 11:30 AM COLD SURFACE STERILIZATION OF STAPHYLOCOCCUS AUREUS WITH A COLD CARBON DIOXIDE SPRAY  
John Rosemeyer, South Carolina Governor's School for Science and Mathematics
- 11:45 AM PAR1 ACTIVATION BY SFLLRNP ALTERS MOTOR NEURON CYTOSKELETON  
Juhi Srivastava, South Carolina Governor's School for Science and Mathematics

12:00 PM THE EFFECTS OF SUBSTRATE STIFFNESS WITHOUT GROWTH FACTORS ON THE GROWTH AND DEVELOPMENT OF RAT BONE MARROW STEM CELLS  
Tri Vo, South Carolina Governor's School for Science and Mathematics

**Session 2: Cell & Molecular Biology / Non- Mentored, Room 138, B & E Building**

12:15 PM EFFICIENCY OF BREAKING DOWN CELLULOSE INTO BETA-GLUCOSE  
Anurag Khandavalli, Southside High School

**Session 1: Consumer Affairs / Non- Mentored, Room 143, B & E Building**

9:00 AM THE EFFECT OF FABRIC TYPE ON THE TRANSMITTANCE OF UVA RAYS  
Sydney Ellen, Kate Evans, and Margo Mullins, Heathwood Hall Episcopal School

9:15 AM THE EFFECT OF VELOCITY ON BUCKSHOT PENETRATION  
Nicks Quan, Will Till, and Morgan Brooks, Heathwood Hall Episcopal School

9:30 AM THE EFFECT OF DIFFERENT DYE TYPES ON COLOR RETENTION ON COTTON, WOOL, AND POLYESTER  
Grayson Stribling and Olivia Bell, Heathwood Hall Episcopal School

9:45 AM THE EFFECT OF DEBBIE MEYER GREEN BAGS, ZIPLOC BAGS, AND PAPER BAGS ON THE RIPENING OF A CAVENDISH BANANA  
Meg Evans & Paige Bryant, Heathwood Hall Episcopal School

10:00 AM A COMPARISON OF THE RATE OF GROWTH OF ESCHERICHIA COLI AT THREE DIFFERENT TEMPERATURES (FREEZING, REFRIDGERATED, AND ROOM) ON ORGANIC BEEF AS OPPOSED TO NON-ORGANIC BEEF  
Cecelie Kondapaneni, Heathwood Hall Episcopal School

10:15 AM THE EFFECT OF POTENTIALLY DANGEROUS CHEMICALS LEACHING FROM CHEAP PLASTIC, EXPENSIVE PLASTIC, AND GLASS BABY BOTTLES ON THE MORTALITY RATE OF DAPHNIA MAGNA  
Alexis McCullough, Heathwood Hall Episcopal School

10:30 AM Break

10:45 AM THE EFFECT OF THE LENGTH OF A LACROSSE STICK ON THE SPEED OF THE SHOT  
Matthew Zielinski & Logan McGill, Heathwood Hall Episcopal School

11:00 AM THE DURABILITY OF NAIL POLISH WITH RESPECT TO COLOR  
Charlotte Jones, Heathwood Hall Episcopal School

11:15 AM POLYMER PERMEABILITY: WHICH PLASTIC WRAP IS THE MOST EFFECTIVE AT LIMITING THE AMOUNT OF WATER EVAPORATED?  
Charles Williamson, Heathwood Hall Episcopal School

11:30 AM THE EFFECT OF LAUNDERING ON COPPER IONS IN ANTIMICROBIAL FABRICS  
Lydia Zeiler, Spring Valley High School

11:45 AM THE ABILITY OF MOBILE PHONE RADIATION CASE MATERIAL TO BLOCK MICROWAVE RADIATION  
Meisha Draper, Spring Valley High School

12:00 Lunch

1:00 PM THE EFFECT OF THE DISPERSION OF HOUSE HOLD AEROSOL SPRAYS ON THE COMBUSTIBILITY OF COTTON/POLYESTER BLENDS  
Paul Kim, Spring Valley High School

1:15 PM AN EVALUATION OF THE INHIBITORY EFFECT OF PLANT ESSENTIAL OILS AND ETHANOLIC EXTRACTS ON CULTURES OF PHYOPATHOGENIC FUNGI AND FOOD CONTAMINATING BACTERIA  
Subina Saini, Spring Valley High School

- 1:30 PM THE EFFECT OF THE 2007-2009 RECESSION ON AUTOMOBILES REGISTERED FOR PARKING AT A SUBURBAN HIGH SCHOOL  
DJ Lee, Spring Valley High School
- 1:45 PM THE EFFECT OF AIRPLANE MODE ON BATTERY LIFE IN CELLULAR DEVICES  
Aaron Meyer, Spring Valley High School
- 2:00 PM ADHESIVE STRENGTH OF D-LIMONENE ON EXPANDED POLYSTYRENE MIXTURES  
Stefanie Martin, Spring Valley High School
- 2:15 PM SOFT HANDS,  
Jennings Walker, White Knoll Middle School
- 2:30 PM DOES DIRECTIONALITY AND LIGHTING AFFECT RED EYE?  
Ashlee Wilcox, Timberland High School

**Session 1: Engineering/ Mentored, Room 234, B & E Building**

- 8:15 AM THE CONVERSION OF JP-8 FUEL TO LPG USING A HIGH THROUGHPUT METHOD TO TEST AS MANY CATALYSTS AS POSSIBLE TO MEET THE PARAMETERS GIVEN BY DARPA  
Joshua Boland, South Carolina Governor's School for Science and Mathematics
- 8:30 AM DEVELOPING TOOLS TO VISUALIZE DATA FROM OBJECTIVE FUNCTIONS  
Lacie Cochran, South Carolina Governor's School for Science and Mathematics
- 8:45AM THE EFFECTS OF SURFACE CHARGE ON THE BINDING AFFINITY BETWEEN NANOPARTICLES AND PROTEIN FOR DRUG DELIVERY IN CANCER TREATMENT  
Lina Davda, South Carolina Governor's School for Science and Mathematics
- 9:00 AM THE EFFECT OF DYNAMIC LOADING ON SOLUTE TRANSPORT IN AGAROSE HYDROGELS  
JC Elmore, III, South Carolina Governor's School for Science and Mathematics
- 9:15AM SYNTHESIS AND CHARACTERIZATION OF SULFUR-FUNCTIONAL LAYERED SILICATES FOR USE IN NANOCOMPOSITE ELASTOMERS  
Randy Fang, South Carolina Governor's School for Science and Mathematics
- 9:30AM THE ABSORPTION OF CITRATE-COATED NANOPARTICLES BY 3T3 FIBROBLAST CELLS  
Nathan Gilreath, South Carolina Governor's School for Science and Mathematics
- 9:45 AM ELECTROCHEMICAL REDUCTION OF CO<sub>2</sub> ON COPPER AND COPPER OXIDE ELECTRODES FOR SELECTIVE FORMATION OF HYDROCARBONS  
John Isenhower, South Carolina Governor's School for Science and Mathematics
- 10:00 AM FABRICATION AND EVALUATION OF PLATINUM CATALYST PEM FUEL CELL ELECTRODES FOR SPACE FLIGHT APPLICATION  
Joshua Johnston, South Carolina Governor's School for Science and Mathematics
- 10:15 AM INCREASING SOUTH CAROLINA'S ENERGY EFFICIENCY WITH THE ADOPTION OF HECTORITE P-PBI HIGH-TEMPERATURE PEM FUEL CELLS  
Maggie Westbrook, South Carolina Governor's School for Science and Mathematics
- 10:30 AM SPARK PLASMA SINTERING SYNTHESIS OF Ni<sub>3</sub>Al  
Cameron Taylor, South Carolina Governor's School for Science and Mathematics
- 10:45 AM - Break

**Session 2: Engineering/ Non- Mentored, Room 234, B & E Building**

- 11:00 AM THE EFFECT OF ELEVATED TEMPERATURES ON THE RESISTANCE OF IRON DISULFIDE  
Sebastian Fearn, Spring Valley High School

- 11:15 AM HARVESTING MECHANICAL ENERGY FROM A ZNO NANOGENERATOR AND ITS APPLICATION FOR POWERING A LED  
Miheer Bavare, Spring Valley High School
- 11:30 AM THE EFFECT OF ETHANOL IMPURITIES ON THE EFFICIENCY OF A HYDROGEN FUEL CELL  
Clayton Brandenburg, Spring Valley High School
- 11:45 AM THE EFFECT OF DIFFERENT VOLUMES OF WATER USED IN A MISTER, AND THE TEMPERATURES ON THE AMOUNT OF ENERGY AN HVAC UNIT CONSUMED WHILE COOLING A HOUSE.  
Elisabeth Brown, Spring Valley High School
- 12:00 Lunch
- 1:00 PM A COMPARISON OF GRAPHENE, GRAPHITE, AND CARBON SOOT CATHODES IN DYE-SENSITIZED PHOTOVOLTAIC CELLS  
Jordan Byrne, Spring Valley High School
- 1:15 PM LAYER-BY-LAYER SELF-ASSEMBLY TO DEVELOPMENT OF DNA-BASED BIOMATERIALS FOR FUEL CELL APPLICATION  
Kimberly McRae, Spring Valley High School
- 1:30 PM BUILDING AND TESTING A PV-PEM HYDROGEN REFUELING SYSTEM  
Vikram Melchizedec, Spring Valley High School
- 1:45 PM THE EFFECT OF POLYVINYL ALCOHOL ON THE SPLIT TENSILE AND COMPRESSIVE STRENGTH OF CONCRETE  
Philip Richardson, Spring Valley High School
- 2:00 PM ROBOT VERSUS RODENT TIME THROUGH A MAZE  
Jamie Mayson, Heathwood Hall Episcopal School
- 2:15 PM THE EFFECT OF PROPELLER PITCH ON THE TAKEOFF DISTANCE OF A REMOTE CONTROL AIRPLANE  
Donen Davis & Sam Nassab, Heathwood Hall Episcopal School
- 2:30 PM THE EFFECTS OF SURFACE ROUGHNESS ON THE PRODUCTIVITY OF THE DISK SKIMMER  
Tom Krouglicof, Southside High School

**Session 1: Environmental Science/ Mentored, Room 140, B & E Building**

- 8:00 AM CONCENTRATION OF PCBs ACROSS THE TROPHIC LEVELS OF A STREAM ECOSYSTEM  
Jacob Crouse, South Carolina Governor's School for Science and Mathematics
- 8:15 AM THE EFFECTS OF LEGACY AND CURRENT LAND USE ON STREAM VERTEBRATES IN THE PIEDMONT REGION NEAR GREENVILLE, SOUTH CAROLINA  
Alex Jeffers, South Carolina Governor's School for Science and Mathematics
- 8:30 AM USING GEOGRAPHIC INFORMATION SYSTEMS TO CONVEY THE COMPLEXITY OF TRADITIONAL KNOWLEDGE AMONG THE EASTERN BAND OF CHEROKEE INDIANS  
Alyssa Palmer-Keriazakos, South Carolina Governor's School for Science and Mathematics
- 8:45AM APPLICATION OF INDICES OF REFRACTION OF SPONGE SPICULES AS PALEOTHERMOMETERS FOR DETERMINING PEATLAND WILDFIRE TEMPERATURES  
Anna Ridenour, South Carolina Governor's School for Science and Mathematics
- 9:00 AM USE OF ULTRAVIOLENT BAND PASS FILTERING FOR THE PURPOSE OF AUGMENTING REFRACTIVE INDEX PALE-FIRE INTENSITY ESTIMATES  
Abbie Wendelken, South Carolina Governor's School for Science and Mathematics

9:15AM MICROGRAVITY AND PLANT GROWTH  
Sashank Sakamuri, Academic Magnet High School  
9:30AM- Break

**Session 2 : Environmental Science/ Non-Mentored, Room 140, B & E Building**

9:45 AM THE EFFECT OF COMPOSTING METHOD ON RESULTING NUTRIENT VALUE  
(NITROGEN, PHOSPHORUS, OR POTASSIUM)  
Pinkney Beal, Heathwood Hall Episcopal School

10:00 AM THE EFFECT OF SARCOPHAGA BULLATA LARVAE AND DERMETES  
MACULATES ON THE RATE OF THE DECOMPOSITION OF MICE  
Tay Davant & Norrie Beach, Heathwood Hall Episcopal School

10:15 AM THE EFFECT OF POLARITIES OF LIQUIDS ON THE AMOUNT OF BISPHENOL A  
RELEASED FROM PLASTICS  
Karen Lee, Spring Valley High School

10:30 AM THE EFFECT OF ALGAE ON NITRATE LEVELS IN MANURE EFFLUENTS AND  
THE EFFECTIVENESS OF ALGAL BIOMASS AS AN ALTERNATIVE FERTILIZER  
Erin Doll, Spring Valley High School

10:45 AM EFFECT OF USING CHLORELLA ALGAE AS BIODIESEL IN MICROBIAL FUEL  
CELLS  
James Brewer, Spring Valley High School

11:00 AM USING MAIN GROUP ELEMENTS TO DIMINISH OZONE DESTRUCTION  
Johnathon Long, Timberland High School

11:15 AM REMOVAL OF ARSENIC TRIOXIDE BY AN INTERMITTENT OPERATED SLOW  
SAND FILTER USING STERLING SAND MODIFIED WITH ALUMINUM CHLORIDE  
AND IRON OXIDE  
Meghan Franco, Spring Valley High School

11:30 AM THE EFFECT OF NITROUS OXIDE PRODUCED BY THE DENITRIFYING  
BACTERIA BACILLUS COAGULANS ON THE PH OF THE SOIL  
Liqi Zhao, Spring Valley High School

11:45 AM THE EFFECT OF QUANTUM CDS ON BACILLUS STEAROTHERMOPHILUS  
Manushi Patel, Spring Valley High School

12:00 PM DEGRADABILITY OF POLYPROPYLENE WITH STARCH ADDITIVE IN A  
SIMULATED SEABIRD STOMACH  
Anessa Pettis, Spring Valley High School

12:15 Lunch

1:15 PM THE UTILIZATION OF OPHIOPOGON JAPONICUS, CAMELLIA JAPONICA, AND  
ILEX OPACA BY PRIMARY LEVEL CONSUMERS  
Victor Phillips, Spring Valley High School

1:30 PM THE EFFECT OF CALCIUM HYPOCHLORITE CONCENTRATION ON SWIMMING  
POOL ALGAE, WITH SPECIAL REFERENCE TO THE DEVELOPMENT OF  
RESISTANCE TO CALCIUM HYPOCHLORITE  
Virginia Skidmore, Spring Valley High School

1:45 PM THE EFFECT OF PLEUROTUS OSTREATUS, SACCHAROMYCES CEREVISIAE,  
AND COMPOST ON THE DEGRADATION OF FOOD WASTE  
Linda Thomas, Spring Valley High School

2:00 PM A COMPARISON OF LEAD, COBALT, COPPER, AND IRON IONS PRESENT IN  
THREE AQUATIC ENVIRONMENTS OF HEATHWOOD HALL EPISCOPAL SCHOOL  
(POND, RIVER, SWAMP)  
Elise McKelvey, Heathwood Hall Episcopal School

- 2:15 PM THE EFFECT OF FOUR DIFFERENT TYPES OF ANTIFREEZE ON THE AMOUNTS OF PHOSPHOROUS, NITROGEN, AND POTASSIUM ALONG WITH THE PH LEVEL OF SOIL  
Heather Pusey & Katie Beach, Heathwood Hall Episcopal School
- 2:30 PM - Break
- 2:45 PM THE ABILITY OF AEROGEL TO ADSORB PHARMACEUTICALS FROM WATER  
Jed Gist, Spring Valley High School
- 3:00 PM ENVIRONMENTAL EFFECTS OF FERROFLUIDS IN AN OIL SPILL  
Mohit Gandhi, Southside High School
- 3:15 PM THE RUN OFF INTO AQUATIC HABITATS: ACID RAIN & COPPER (II)  
Salvatore Donzella, Southside High School
- 3:30 PM THE EFFECT OF INCREASED SUBSTRATE AND REDUCED RESISTANCE ON OUTPUT VOLTAGE GENERATED IN MICROBIAL FUEL CELLS  
Maddie Norris, Heathwood Hall Episcopal School
- 3:45 PM THE EFFECT OF WORMS ON THE CHANGE OF NUTRIENT VALUE IN SOIL WITH OR WITHOUT EGGSHELLS  
Olivia C. Harden, Heathwood Hall Episcopal School
- 4:00 PM THE EFFECT OF LOCATION ON THE WATER QUALITY FACTOR IN GILLS CREEK AT POINT FOREST LAKE AND POINT LAKE KATHERINE  
Brooke Grice, Heathwood Hall Episcopal School

**Session 1: Math/Computer Science - Non-Mentored, Room 131 B & E Building**

- 1:00 PM THE COMPARISON BETWEEN ARCHIMEDES' METHOD AND HUI LIU'S METHOD OF THE VALUE OF Pi  
Sherry Shu & Maria Wei, Hammond School
- 1:15 PM DETECTING METAMORPHIC MALWARE: A CASE STUDY  
Joseph Marazzo, Spring Valley High School
- 1:30 PM THE EFFECT OF IMPLEMENTING MAZE SOLVING ALGORITHMS ON THE MAZE COMPLETION TIME OF A 3 PI ROBOT  
David Nam, Spring Valley High School
- 1:45 PM THE EFFECT OF HABITAT CHANGE ON THE EVOLUTION OF A POPULATION OF ORGANISMS USING COMPUTATIONAL MODELING  
Gregory Rassolov, Spring Valley High School

**Session 2: Math/Computer Science -Mentored, Room 131 B & E Building**

- 2:00 PM ON THE RECIPROCAL OF THE BINARY GENERATING FUNCTION FOR THE SUM OF DIVISORS  
Sandy Neal, South Carolina Governor's School for Science and Mathematics
- 2:15 PM A VIEWER-MODEL FRAMEWORK FOR VISUALIZING MULTI-SCALE THREE-DIMENSIONAL GENOME WITH ONLINE INTEGRATION  
Paul Park, South Carolina Governor's School for Science and Mathematics
- 2:30 PM LETHALITY OF PROTEIN DOMAINS IN PROKARYOTIC ORGANISMS  
Michael Lu, South Carolina Governor's School for Science and Mathematics

**Session 1: Microbiology/ Non- Mentored, Room 144, B & E Building**

- 11:00 AM THE EFFECT OF THE TYPE OF STORAGE OF CONTACT LENSES ON THE AMOUNT OF BACTERIAL BIOFILM THAT ACCUMULATES ON THE LENSES  
Jordan Motlong, Spring Valley High School

- 11:15 AM THE EFFECT OF ULTRAVIOLET AND VISIBLE SPECTRA-INDUCED PHOTOLYTIC DEGRADATION OF 5-CHLORO-(2,4-DICHLOROPHENOXY) PHENOL'S ANTIBACTERIAL PROPERTIES, OBSERVED USING ESCHERICHIA COLI  
Benjamin Fechter, Spring Valley High School
- 11:30 AM THE EFFECT OF MANNOSE SOLUTION ON ESCHERICHIA COLI'S IMMUNITY TO TETRACYCLINE HYDROCHLORIDE  
Katie Peffen, Spring Valley High School
- 11:45 AM BIOCIDAL EFFICACY OF COPPER AND BRASS AGAINST PATHOGENIC PSEUDOMONAS AERUGINOSA  
Kate Hoffman, Heathwood Hall Episcopal School
- 12:00 Lunch
- 1:00 PM THE ANTIBACTERIAL PROPERTIES OF MELALEUCA ALTERNIFOLIA ESSENTIAL OIL AND ECHINACEA PURPUREA EXTRACT ON STAPHYLOCOCCUS EPIDERMIDIS  
Caroline Swan, Spring Valley High School
- 1:15 PM THE EFFECT OF ENVIRONMENTAL CONDITIONS ON THE ABILITY OF P. POLYCEPHALUM TO FORM PROTOPLASMIC LOGIC GATES  
Chandler Pobis, Spring Valley High School
- 1:30 PM THE EFFECT OF DRYING HANDS WITH A PAPER TOWEL, HAND DRYER, AND EVAPORATION ON THE GROWTH OF MICROCOCCUS LUTEUS  
Trey Edmonds & Jeff Lim, Heathwood Hall Episcopal School
- 1:45 PM A RETROSPECTIVE STUDY OF THE PRESENCE OF THE BETA- LACTAMASE GENE IN AMPICILLIN RESISTANT BACTERIA ISOLATED FROM WITHIN THE CHARLESTON HARBOR AREA, SC  
Chelsea Joseph, Heathwood Hall Episcopal School
- 2:00 PM DO CIGARETTE SMOKE PARTICULATES HARBOR BACTERIA?  
Shauntia White, Timberland high School
- 2:15 PM CAN POWDERED FOUNDATIONS INHIBIT GROWTH OF BACTERIA?  
Denice Elswick, Timberland High School

**Session 1: Microbiology/ Mentored, Room 144, B & E Building**

- 2:30 PM REGUENCY OF PLASMID-MEDIATED RESISTANCE AMONG WILD BACTERIA  
Shawn Patel, Dutch Fork High School

**Session 1: Physics/Non- Mentored, Room 144, B & E Building**

- 8:30 AM THE EFFECT OF ALUMINUM, BRASS, AND COPPER FOILS ON THEIR SHIELDING STRENGTH OF A MAGNETIC FIELD  
Coley Beavers, Heathwood Hall Episcopal School
- 8:45AM UNIDIRECTIONALIZATION OF PARTICULATE DISTRIBUTIONS IN ISOTROPIC  $D+D \rightarrow HE3+N$  REACTIONS UTILIZING DIFFERENTIAL ION VELOCITIES – YEAR 2  
Ben Bartlett, Lexington High School
- 9:00 AM THE EFFECTS OF HUMIDITY ON SPEED OF SOUND PROPAGATION ABILITIES IN DIFFERENT VARIETIES OF EXOTIC WOOD  
Sean English, Spring Valley High School
- 9:15AM STUDYING THE AMOUNT OF RADIATION EMITTED FROM CELL PHONES DURING A CALL  
Ayan Dasgupta, Hammond School
- 9:30AM A COMPARATIVE ANALYSIS OF THE EFFICIENCY OF ULTRA-CAPACITORS VERSUS BATTERIES THROUGH THE USE OF ELECTRO-MAGNETIC FIELDS  
Michael Wang, Karthik Chandrasekar & Sai Bikkani, Southside High School

9:45 AM OIL REMEDIATION UTILIZING FERROFLUIDS  
Harshita Jain, Southside High School

**Session 2: Physics/ Mentored, Room 144, B & E Building**

10:00 AM STUDIES OF CHARM PARTICLES IN THE ATLAS DETECTOR  
Karl Schober, South Carolina Governor's School for Science and Mathematics  
10:15 AM OBSERVING THE MILKY WAY GALACTIC PLUME AT 1420 MHZ  
Virginia Tkacik, South Carolina Governor's School for Science and Mathematics  
10:30 Break

**Session 1: Physiology & Health /Non- Mentored, Room 235, B & E Building**

8:45AM THE EFFECTS OF COMBINING DATAIN-2 AND HEAT SHOCK PROTEIN 70 ON SPINOCEREBELLAR ATAXIA TYPE 3 PATHOLOGY IN DROSOPHILA MELANOGASTER  
Aakash Shingala, Spring Valley High School  
9:00 AM COMPARISON OF VISUAL SHORT TERM MEMORY BETWEEN TEENAGERS AND ADULTS  
Tia Eskridge, Hammond School  
9:15AM THE EFFECT OF BACKPACK MASS ON THE BALANCE OF ADOLESCENTS  
Rana Sobeih, Spring Valley High School  
9:30AM THE EFFECT OF COLOR ON BLOOD PRESSURE  
Ellie Barr, Anna Beavers & Catherine Savoca, Heathwood Hall Episcopal School  
9:45 AM THE EFFECT OF GREEN TEA, BLACK TEA, OOLONG TEA, AND WATER ON THE REGENERATION RATE OF DUGESIA DOROTOCEPHALA  
Alice Verbrick & Laura Hungiville, Heathwood Hall Episcopal School  
10:00 AM DOES CAFFEINE HAVE AN EFFECT ON ONE'S MEMORY?  
Daniel Settana, Heathwood Hall Episcopal School  
10:15 AM Break  
10:30 AM THE EFFECTIVENESS OF AN IONIC SILVER SOLUTION ON INHIBITING THE GROWTH RATE OF STAPHYLOCOCCUS EPIDERMIS CELLS  
Gabriel Brandner, Heathwood Hall Episcopal School  
10:45 AM THE COMPARISON OF VITAMIN K TABLETS AND KALE JUICE ON THE EFFECTIVENESS ON INCREASING FORMATION OF FIBRINS IN BLOOD OVER TIME  
Helen Clay, Heathwood Hall Episcopal School  
11:00 AM THE EFFECT OF GATORADE AND WATER ON HEART RATE AND BLOOD PRESSURE  
Owen Withycombe, Heathwood Hall Episcopal School  
11:15 AM THE EFFECT OF BREATHING EXERCISES ON LUNG CAPACITY  
Ryan McCormick, Spring Valley High School  
11:30 AM THE CORRELATION BETWEEN POVERTY AND DIABETES MELLITUS: INSULIN THERAPY VS. ANTI- DIABETIC ORAL MEDICATIONS  
Ayana Moore, Spring Valley High School  
11:45 AM META-ANALYSIS OF VARIATIONS IN THE GENE SEQUENCES IN BARRIER RECEPTORSIN ATOPIC DERMATITIS POPULATIONS  
Sharika Rao, Spring Valley High School  
12:00 PM THE EFFECTS OF CAFFEINE ON DAPHNIA  
Celina Goins & Summer Kinlaw, Timberland High School  
12:15 PM MOST EFFECTIVE LACTASE DELIVERY FOR LACTOSE INTOLERANCE  
Ashley Ranta, Dutch Fork High School



**Session 1: Physiology & Health / Mentored, Room 237, B & E Building**

- 8:30 AM THE EFFECT OF CHOLESTEROL LOADING ON MACROPHAGE INTERACTIONS WITH CANCER  
David Qu, Spring Valley High School
- 8:45AM THE EFFECT OF VIRAL HPV16 E7 GENE EXPRESSION ON THE INFLAMMATORY RESPONSE IN HUMAN PAPILLOMAVIRUS INFECTED, EXFOLIATED, HUMAN CERVICAL EPITHELIAL CELLS  
Shannon Hall, Spring Valley High School
- 9:00 AM COMBINATION THERAPY ALTERED SPECIFIC MICRORNA LEVELS AND INCREASED DIFFERENTIATION AND APOPTOSIS IN MALIGNANT NEUROBLASTOMA CELLS  
Mehrab Khandkar, Spring Valley High School
- 9:15AM QUANTITATIVE MEASUREMENTS OF HORSE MOTION DURING HIPPOThERAPY FOR FUTURE USE IN THERAPEUTIC TREATMENT  
Tyler Watt, South Carolina Governor's School for Science and Mathematics
- 9:30AM THE EFFECT OF EXERCISE TRAINING ON SKELETAL MUSCLE ANGIOGENESIS DURING CANCER CACHEXIA  
Danielle Schwartz, South Carolina Governor's School for Science and Mathematics
- 9:45 AM SPINAL SENSITIZATION FOLLOWING VASO-OCCLUSION IN A MODEL OF SICKLE CELL DISEASE  
Sarah Beasley, South Carolina Governor's School for Science and Mathematics
- 10:00 AM INVESTIGATION OF OXIDANT-INDUCED ZINC RELEASE  
Tracy Biaco, South Carolina Governor's School for Science and Mathematics
- 10:15 AM- Break
- 10:30 AM THE EFFECTS OF THERAPEUTIC ULTRASOUND TREATMENT IN DELAYED-ONSET MUSCLE SORENESS AND FORCE PRODUCTION RECOVERY AFTER MUSCLE DAMAGE  
Aidan Brougham-Cook, South Carolina Governor's School for Science and Mathematics
- 10:45 AM PROPRANOLOL REPURPOSING FOR DRUG RELAPSE PREVENTION  
Chanté Glass-Walley, South Carolina Governor's School for Science and Mathematics
- 11:00 AM USING HERPES SIMPLEX VIRUS TO TARGET GENE EXPRESSION TO INJURED NEURONS FOR THE TREATMENT OF PAIN  
Catherine Fryland, South Carolina Governor's School for Science and Mathematics
- 11:15 AM THE REGULATION OF OSTEOPROTEGERIN EXPRESSION BY P62P392L MUTANT IN PAGET'S DISEASE OF BONE  
Angela Li, South Carolina Governor's School for Science and Mathematics
- 11:30 AM NATURAL EXTRACTS AS CHEMOIMMUNOTHERAPEUTICS IN MULTIPLE MYELOMA  
Maya Mason, South Carolina Governor's School for Science and Mathematics
- 11:45 AM EFFECTS OF HORSE MOVEMENT DURING HIPPOThERAPY ON THE PATIENT LUMBAR SPINE MOTION  
Martin Shea McLaughlin, South Carolina Governor's School for Science and Mathematics
- 12:00 PM EFFECTS OF TLR4 AND STEATOSIS ON HEPATIC MITOCHONDRIAL HOMEOSTASIS  
Erik Schatzer, South Carolina Governor's School for Science and Mathematics
- 12:15 PM THE EFFECTS OF QUERCETIN ON BREAST CANCER PROGRESSION  
Supriya Juneja, Dutch fork High School

**Session 1: Psychology & Sociology /Non- Mentored, Room 236, B & E Building**

- 8:15 AM THE EFFECTS OF TEXTING ON THE INATTENTIONAL DEAFNESS OF HIGH SCHOOL STUDENTS  
Will Braddock, Spring Valley High School
- 8:30 AM THE CORRELATION BETWEEN DAY OF THE WEEK AND STUDENT DRESS HABITS  
Alsten Jones, Spring Valley High School
- 8:45AM THE EFFECT OF SIBLINGS ON THE FALSE BELIEF UNDERSTANDING OF THREE AND FOUR YEAR OLDS  
Nicole Lazar, Spring Valley High School
- 9:00 AM THE EFFECT OF LIGHTING AND TEMPERATURE ON THE HEART RATE AND PHYSICAL EXPRESSION OF FEAR IN HUMAN BEINGS  
Eric Baxley, Heathwood Hall Episcopal School
- 9:15AM THE EFFECTS OF BRAIN DOMINANCE ON THE ACCURACY AND SPEED OF COMPLETION OF THE STROOP TASK IN TEENAGERS  
Michaela Jenkins & Sunaina Kapur, Heathwood Hall Episcopal School
- 9:30AM HOW GENDER AFFECTS LYING  
Preston Levy, Hammond School
- 9:45 AM PHEROMONES AND VISUAL ATTRACTION IN TEENAGERS  
Emily Wassermann & Catherine McElveen, Hammond School
- 10:00 AM PHONE USE WHILE DRIVING: ARE AGE AND GENDER FACTORS?  
Alexandra Rice, Hammond School
- 10:15 AM REACTION TIME OF CENTRAL VS PERIPHERAL VISION  
Deepti Athavale, Southside High School
- 10:30 AM WHAT AFFECTS STUDENT PARTICIPATION IN CLASS  
Danielle Page, Timberland High School
- 10:45 – Break

**Session 2: Psychology & Sociology / Mentored, Room 236, B & E Building**

- 11:00 AM THE SELF-ADMINISTRATION OF 20% ETHANOL IN FEMALE C57 WILDTYPE, FEMALE BETA-ENDORPHIN HETEROZYGOTE MICE, AND MALE BETA-ENDORPHIN HETEROZYGOTE MICE WHEN EXPOSED TO A PREDATOR URINE STRESSOR  
Sean Sweat, South Carolina Governor's School for Science and Mathematics
- 11:15 AM SEX AND GENOTYPE DEPENDENT LEVELS OF SOCIAL PLAY IN MICE  
Leah VanSyckel, South Carolina Governor's School for Science and Mathematics
- 11:30 AM CONSCIENTIOUSNESS, STRESS, AND COPING: A DAILY DIARY STUDY  
Sara Wilson, South Carolina Governor's School for Science and Mathematics
- 11:45 AM WHETHER NICOTINE CAN BE DISTINGUISHED FROM SALINE AS A SIGNAL FOR THE REWARD, BY USING PAVLOVIAN CONDITIONING  
Andrew Motts, South Carolina Governor's School for Science and Mathematics
- 12:00 PM PHYSIOLOGY OF SELF-CONTROL: DOES BLOOD GLUCOSE LEVEL HAVE EFFECT ON SELF-CONTROL?  
Chad D. Erturk, Spartanburg Day School

**Session 1: Zoology / Non-Mentored, Room 138, B & E Building**

- 8:30 AM THE EFFECT OF WATER TEMPERATURES ON THE REPRODUCTION OF DAPHNIA PULEX  
Kiran Ravindra, Spring Valley High School

- 8:45AM THE INTERACTIONS BETWEEN TRANSIENT RECEPTOR POTENTIAL CHANNEL VANILLOID RECEPTOR MEMBERS ONE AND THREE IN DROSOPHILA  
Meg Teuber, Spring Valley High School
- 9:00 AM THE EFFECT OF HUMIDITY ON THE RATE OF GROWTH AND DEVELOPMENT IN SARCOPHAGA BULLATA  
Jordan Dowell, Spring Valley High School
- 9:15AM MUSIC AND MICE  
Bailey Koller Schmidt, Hammond School

**Session 1: Zoology / Mentored, Room 138, B & E Building**

- 9:30AM PRELIMINARY IN VITRO AND IN VIVO STUDIES TO DETERMINE HOXA3 FUNCTION IN ADULT VASCULATURE  
Terral Patel, South Carolina Governor's School for Science and Mathematics
- 9:45 AM THE EFFECT OF SPECIFIC GENES ON THE FORMATION AND MAINTANCE OF THE FOLLICULAR EPITHELIUM IN DROSOPHILA OOGENESIS  
Krista Wunsche, South Carolina Governor's School for Science and Mathematicss
- 10:00 AM MULTISPECTRAL IMMUNOFLUORESCENT IMAGING OF PROGESTERONE RECEPTOR IN PREPUBERTAL HEIFERS AND ITS CORRELATION WITH FOLLICULAR ACTIVITY  
Elizabeth Gregory, South Carolina Governor's School for Science and Mathematics

**9:45 AM – 11:45 AM**

**Session 1: Poster Session, 2nd floor Gymnasium of B & E Building  
State Regional Science Fair Winners**

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# SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE ABSTRACTS

## TRANSFORMATION APPROACHES TO THE DEVELOPMENT OF DISEASE RESISTANT POPLAR TREES

Jameel M. Abbess IV

South Carolina Governor's School for Science and Mathematics

Hybrid poplars are grown for pulpwood. Other forms of poplar trees are used to manufacture paper, inexpensive hardwood timber, and plywood. In the wild *S. musiva* spreads rapidly via spores in the air, splashing from rainfall and being carried from plant to plant by local wildlife. Many of the wild-type poplar trees are susceptible to this disease. Infection by *S. musiva* results in losses of vast areas of poplar forests. Previous work done by our group found genes that relate to disease resistance in transgenic poplars. The goal of our lab group was to transform poplar tissue with the candidate genes that show resistance to the fungus. Our group used transformed agrobacterium for inserting the candidate genes into the poplar tissue. One line was transformed successfully. Our next goal is to evaluate the disease resistance and study the gene expression profile in the susceptible (wild-type) and resistant (transformed) poplar clones. The benefit of this experiment is to increase survivability of poplar forests allowing for higher biomass production.

## UNIDIRECTIONALIZATION OF PARTICULATE DISTRIBUTIONS IN ISOTROPIC $D+D \rightarrow He^3+n$ REACTIONS UTILIZING DIFFERENTIAL ION VELOCITIES – YEAR 2

Benjamin C. Bartlett

Lexington High School

This continuation study was designed to induce unidirectionality in the particle distribution emanating from the output of an IEC (inertial electrostatic confinement) fusion reaction through the utilization of differential initial ion velocities. While the  $D+D \rightarrow He^3+n$  reaction normally outputs particles in a spherical, isotropic pattern when induced in an IEC device, it was hypothesized that the directionality of the output particles ( $n+He^3$ ) could be influenced by accelerating one side of the input deuterons through a greater voltage potential leading to the polar accelerator grid than the other, naturally recurring, side of recirculating ions trapped in the potential well of the accelerator grid. This was accomplished through the use of a directional ion source attached to a LINAC-style chamber setup for an IEC reactor. This ion source consisted of a single-body electrified tube and plate to accelerate ions through an increased voltage. A detailed predictive mathematical analysis, expressing chamber conditions initially as a set of separable differential equations, and later as a virtual set of overlapping spheres, was run to optimize bubble detector placement. Through the use of triple integration, the ratio of the smaller and larger sections of the spheres can be found, indicating the ratio of neutron radiation exiting the front compared to the rear of the reactor. However, the velocity differential applied to the system was found to cause some of the neutron radiation to supersede the range of energy levels the detectors were calibrated to; a set of calculations was performed to accommodate for this, giving a final result of a linear unidirectionalization coefficient (front-biased neutrons/rear-biased neutrons) of 2.095.

## HARVESTING MECHANICAL ENERGY FROM A ZNO NANOGENERATOR AND ITS APPLICATION FOR POWERING A LED

Miheer Bavare

Spring Valley High School

A piezoelectric nanogenerator is composed of interconnected arrays containing millions of nanowires that convert mechanical energy into electric energy. The mechanism of the nanogenerator relies on the piezoelectric potential created in the nanowires by an external strain: a dynamic straining of the nanowires results in a transient flow of the electrons in the external load because of the driving force of the piezopotential. The purpose of this project was to utilize the mechanical energy triggered from induced strains via a piezoelectric ZnO nanogenerator to power a LED. The engineering goal of this project was to fabricate a nanogenerator that could power a LED and produce an output voltage of 2.0V and a current of 35nA. The nanogenerator was fabricated using ZnO nanowires that were spin coated on PMMA, and this composition was essentially placed in between two conductive metal films. After building the nanogenerator, the output voltage and current produced by the nanogenerator were investigated by bending the nanogenerator 1 cm. Experimental results showed that the nanogenerator produced an average output voltage and current of 1.31V and 21nA. A single sample t-test, for output voltage and output current, showed that there was a significant difference (Output Voltage:  $t(24) = -31.15$ ,  $p = 6.39 \times 10^{-21}$  and Output Current:  $t(24) = -9.24$ ,  $p = 2.26 \times 10^{-9}$ ) between the hypothesized value and the mean of the data acquired in this experimentation, since the  $p$  value for both output voltage and current was  $< 0.05$ . The nanogenerator was able to power the LED, thus the engineering goal was partially achieved.

## THE EFFECT OF COLOR ON BLOOD PRESSURE

Ellie Barr, Anna Beavers and Catherine Savoca  
Heathwood Hall Episcopal School

In this experiment, the effect of color on blood pressure was examined. This information is beneficial because it gives one with high or low blood pressure, insight about the factors that can affect it; in this case it is color. The purpose of this experiment was to determine the effect that color has on blood pressure. To conduct this experiment test subjects were asked to wear a pair of lab goggles covered in colored cello sheets. Fifteen pairs chemistry lab safety goggles were covered in red, blue, green, yellow, and clear cello sheets. The subjects had their blood pressure taken first by wearing clear goggles as a control, and secondly with the red, blue, green, and yellow for five minutes(tested in random order). After that, the subjects blood pressure data was recorded and analyzed. The results show that the goggles covered in green and blue cello lowered both the systolic and diastolic pressures. The goggles covered in blue cello made the subjects diastolic pressure higher and lowered the systolic pressure. The goggles covered in red cello raised both the systolic and diastolic pressures. The control in this experiment is the goggles covered in clear cello. The dependent variable in this experiment is the subjects blood pressure. The independent variable in this experiment is the color of the cello sheets wrapped around the goggles. Based on a t-test at an alpha of 0.05, there was a statistically significant difference between color and blood pressure; therefore, the null hypothesis is rejected, and the alternate hypothesis of "Exposure to the color red will have a larger effect on a person's arterial blood pressure than exposure to other colors of light" can be accepted.

## THE EFFECT OF LIGHTING AND TEMPERATURE ON THE HEART RATE AND PHYSICAL EXPRESSION OF FEAR IN HUMAN BEINGS

Eric Baxley  
Heathwood Hall Episcopal School

The purpose of this experiment was to determine the effect of different factors on the intensity of fear in humans. For each phase of this experiment, the subject was asked to sit down in front of a specific computer. Their heart rate was recorded with a Vernier heart rate monitor and the built-in camera was on. For phase 1, the subject watched an eerie video in a well lit, room-temperature lab. For phase 2, the same thing happened as in phase 1, except the lights were turned off. For phase 3, the room was room temperature and well lit. A prop syringe was taken out and wielded like it was going to inject radioactive isotopes into the subject's blood stream in order to track it. When the test was close to an end, a loud noise would be produced at the peak of the tension. For phase 4, the same thing happened as in phase 3, except a fan was turned on to make the space noticeably colder. For phase 5, the room was well lit and room temperature. The subject listened to the *X-files* theme for a little while, then, while they were still listening, the procedure of phase 3 was repeated. For phase 6, the same procedure as phase 5 was repeated, except the lights were off and the fan was on. The data showed that altering these factors decreased the intensity of fear in the subjects; therefore, the data suggested that the null hypothesis was correct.

## THE EFFECT OF COMPOSTING METHOD ON RESULTING NUTRIENT VALUE (NITROGEN, PHOSPHORUS, OR POTASSIUM)

Pinkney V. Beal  
Heathwood Hall Episcopal School

The purpose of this experiment was to compare two processes of composting with respect to the resulting nutrient values (Nitrogen, Phosphorus, or Potassium) in barrel and vermi composting processes. Hypothesis 1 stated that the barrel composting method would produce a higher nutrient value in terms of either Nitrogen, Phosphorus, or Potassium than the vermi composting method. Hypothesis 2 stated that the addition of worms in the vermi composting method would produce a higher nutrient value in terms of either Nitrogen, Phosphorus, or Potassium. The null hypothesis stated that there would be no difference when comparing between barrel and vermi-composting methods. The independent variable was the composting style, and the dependent variables were the nutrient values (N, P, or K). A vermi-composting bin and a composting barrel were placed side by side, and the food that went inside of each was evenly split. Compost from both bins was analyzed weekly within an hour of each other with a RapiTest soil kit. In total, eight trials were conducted, four for each process of composting. After conducting an ANOVA test and a t-test at  $p < .05$ , data showed a significant statistical difference between the Potassium levels in the barrel and vermi composting processes, noting that the average barrel level of Potassium was higher than the average vermi level of Potassium. The null hypothesis, which stated there was no difference between the two methods, was rejected, and hypothesis 1, which stated that the barrel composting process would produce a higher nutrient value than that of the vermi-composting process in terms of either Nitrogen, Phosphorus, or Potassium, was accepted. For a future study, one may look into another style of composting, such as "hot composting".

## SPINAL SENSITIZATION FOLLOWING VASO-OCCLUSION IN A MODEL OF SICKLE CELL DISEASE

Sarah Beasley

South Carolina Governor's School for Science and Mathematics

Sickle Cell Disease (SCD) is characterized by painful vaso-occlusive crises (VOCs) that can affect the whole body. These crises can begin as early as four to six months of age and may sensitize children to later crises. The purpose of this experiment was to determine if the VOCs sensitize organisms to other kinds of painful stimuli. The project examined the number of c-fos positive, or activated, spinal cord neurons following capsaicin administration in VOC naïve or VOC experienced rats. Capsaicin is a non-VOC nociceptive stimulus that is the hot part of chili peppers. A significant increase in neuronal activity was found for both female and male rats that were VOC experienced as compared to VOC naïve rats, which supported the hypothesis that the VOCs globally sensitize organisms to pain. In addition, the capsaicin receptor may be a new drug target for treating pain in children with SCD.

## THE EFFECT OF ALUMINUM, BRASS, AND COPPER FOILS ON THEIR SHIELDING STRENGTH OF A MAGNETIC FIELD

Coley Beavers

Heathwood Hall Episcopal School

The purpose of this experiment is to investigate the strength of the magnetic field in relation to the foils and paper its wrapped in. This experiment relates to EOD robots used by the United States military. This experiment would show if an IED or other explosive device was wrapped or covered in copper foil, brass foil, aluminum foil, or paper, that they would shield or repel the magnetic field being emitted and thus making it harder for the robot to find the explosive. The magnet was wrapped in each of the materials and was taped to a 12' ruler. the ruler was suspended at 11cm above a Vernier™ magnetic field sensor. The magnet was then passed over the sensor for 5 seconds. Each measurement was repeated. The results showed that none of the materials repelled or shielded the magnetic field. The hypothesis was not supported by the data in this experiment.

## THE BIOENCAPSULATION OF ENZYMES THROUGH THE PROCESS OF SOL-GELS

Jalen Benjamin

South Carolina Governor's School for Science and Mathematics

For this project, an attempt was made to bioencapsulate lysozyme inside of sol-gels. A sol-gel is a chemical technique that is used to make ceramics. The complex is made through hydrolysis, condensation, gelation, ageing, drying, and densification reactions. Sol-gels start as solutions made up of a precursor, in this case tetraethyl orthosilicate (TEOS) or sodium silicate, mixed with water and HCl. Contrasts between TEOS and sodium silicate were made through UV-vis and IR tests. Data involved making solutions of TEOS or sodium silicate, with or without the lysozyme, which were then allowed to gel for 36 hours. The solutions that did not have the lysozyme acted as a form of control. Results were complex. For TEOS, the solutions that had a pH of approximately 3.88 did not gel, and for the sodium silicate, all of the solutions froze and after being allowed to come to room temperature, they were all still liquids. This probably means that TEOS is more effective for creating sol-gels, especially since it does not involve the use of a resin in order to create the solution. However, since the experiment could be done only once due to time constraints, more testing needs to be done.

## INVESTIGATION OF OXIDANT-INDUCED ZINC RELEASE

Tracy Biaco

South Carolina Governor's School for Science and Mathematics

Zinc neurotoxicity is an important element of neuronal injury in hypoxic-ischemia, spinal chord injury, and several neurodegenerative diseases such as Alzheimer's disease, and a need to treat these disorders has increased. In previous studies, chelation with compounds that have high binding affinity towards free zinc have been shown to effectively reverse DTDP-induced toxicity in neurons. This research examined oxidant-induced zinc release and the effectiveness of zinc chelation in reversing neurotoxicity. HT22 cells, a cell line taken from mice hippocampal tumors, were treated with oxidizing agents, 2,2'-dithiodipyridine (DTDP) and 2-methyl-4-isothiazolin-3-one (MIT) that cause zinc release from metalloproteins. Flou-Zin 3 (FZ-3) dye detected oxidant-induced zinc release, and FZ-3 fluorescence increased in response to zinc accumulation. Here, we report that oxidants mediate cell death, partly due to intracellular zinc release. Contrary to previous experiments, this study shows that cell-permeant zinc chelator, N,N,N',N'-Tetrakis (2-pyridylmethyl) ethylenediamine (TPEN), was unable to block zinc toxicity. Depletion of intracellular zinc by TPEN caused neuronal cell death in the HT22 cells. Results suggest that during oxidative stress, zinc released from intracellular stores may cause neuronal apoptosis, and a balance between the concentrations of bound and free zinc must be preserved to avoid cell death.

THE CONVERSION OF JP-8 FUEL TO LPG USING A HIGH THROUGHPUT METHOD TO TEST AS MANY CATALYSTS  
AS POSSIBLE TO MEET THE PARAMETERS GIVEN BY DARPA

Joshua Boland

South Carolina Governor's School for Science and Mathematics

Our main goal of the project is to find a catalyst that can convert JP-8 fuel to LPG while meeting DARPA's parameters. Such a technology would enable electricity production while taking advantage of the military's existing JP-8 distribution network thus easing logistics. In order to find such a catalyst, we search with a high throughput method- meaning we test a wide range of substances hoping to find an appropriate catalyst. First, we heat the JP-8 to above 270 degrees Celsius. We allow the vaporized JP-8 to pass over our catalyst samples in separate tubes. Each channel is kept separated and travels through our 16-way valve. Previously we took Infrared scans (Infrared spectroscopy) of the samples as they flowed through the tubes but we are currently using a Gas Chromatography Mass Spectrometer (GCMS) exclusively. We analyze the data provided by the MS and determine the contents of the sample. Our results indicate that nanoparticles known as zeolites work well for converting JP-8 to LPG. With this knowledge, we hope to continue to test other substances but also attempt to optimize the zeolites used by varying structure and chemical composition.

THE EFFECTS OF TEXTING ON THE INATTENTIONAL DEAFNESS OF HIGH SCHOOL STUDENTS

Charles Braddock

Spring Valley High School

The purpose of this experiment was to see how a decrease in time intervals between texts impacted the severity of inattentive deafness exhibited by high school students. The hypothesis was that as the time intervals between text messages decreased, the high school student would exhibit a more pronounced degree of inattentive deafness. The subjects in this experiment were asked to listen to The Bet while receiving text messages. After the story, they took a comprehension test. They then listened to the story again while receiving the same text messages and were asked how many times they heard the word "banker." In the first experiment, a one sample ANOVA test and a Correlation test were run at a confidence value of 0.05. The results showed that there was no difference in the numbers of questions answered correctly between those that received no texts and those that received texts at 1, 2, 3, 4, and 5 minute intervals,  $F(5, 56) = 0.62, p = 0.684$ . The results also showed that there was no correlation between time intervals between text messages and the number of times the subjects heard the word "banker",  $r(62) = 0.54, p = 0.644$ . These results disproved the hypothesis. This is important because this shows that texting has no apparent effect on inattentive deafness.

THE EFFECT OF ETHANOL IMPURITIES ON THE EFFICIENCY OF A HYDROGEN FUEL CELL

Clayton Brandenburg

Spring Valley High School

The purpose of this experiment was to determine if ethanol poisons a fuel cell and how much the impurities affect the fuel cell output. This is important because impurities in fuel cells can dramatically decrease the efficiency of hydrogen fuel cells. It was hypothesized that concentrations of ethanol greater than 1 ppm would lower the voltage created from the PEM fuel cell. This was studied by the electrolysis of water in a fuel cell containing low concentrations (0.5 ppm, 1 ppm, 2 ppm, and 5 ppm) of ethanol. The voltage produced by the PEM fuel cell was a measure of its efficiency. The efficiency was measured using a Vernier Voltage probe to measure how many volts were created from the PEM fuel cell. At 0 ppm ethanol, there was an average of 0.74 V created, at 1 ppm there was an average of 0.75 V, at 2 ppm there was an average of 1.4, and at 5 ppm there was an average of 1.32 ppm. Fifteen trials were run for each group. An ANOVA test was run at  $\alpha = 0.05$ .  $F(3, 56) = 119.07, p < 0.001$ . Since  $p$  was less than 0.05, there was a significant difference between two of the groups. A Tukey post-hoc test was run to see which groups were significantly different. 0 ppm was significantly different from 2 ppm and 5 ppm. 1 ppm was significantly different from 2 ppm and 5 ppm. There was enough evidence to reject the claim that the increase of the concentration of ethanol would decrease the amount of energy produced by the PEM fuel cell.

THE EFFECTIVENESS OF AN IONIC SILVER SOLUTION ON INHIBITING THE GROWTH RATE OF  
*STAPHYLOCOCCUS EPIDERMIS* CELLS

Gabriel Brandner

Heathwood Hall Episcopal School

The effects of colloidal silver on *Staphylococcus epidermis* as a bacteriostatic are under researched. The purpose of the research is to see if colloidal silver is an effective bacteriostatic as compared to the FDA supported medication, Mupirocin. A bacteriostatic is a substance that if in the presence of bacteria will stop its growth; however, once removed, bacteria would resume growth. A spectrophotometer was used to measure growth of *Staphylococcus epidermis* with respect to Beer's Law: absorbance directly correlates to concentration. During the course of the experiment, the bacteria was administered either a colloidal silver or a Mupirocin treatment one time. At 24, 42, 48, and 72 hours, absorbance readings were taken of the treated bacteria. The readings were graphed and growth percentages were calculated. As growth occurred, a visual change was

observed: the solution that the staphylococcus epidermis grew in became more turbid. A t-Test was run between the growth percentages of the silver treated bacteria and the Mupirocin treated bacteria. The t Stat value (.772) fell between the +/- value of the t Critical two-tail (2.306) thus the null hypothesis was accepted. In other words, colloidal silver's effectiveness as a bacteriostatic in treating *Staphylococcus epidermis* showed no difference than Mupirocin's effectiveness as a bacteriostatic in treating *Staphylococcus epidermis*. Further research could explore the effect of periodic application of treatments and how it affects growth.

#### QUANTITATIVE AND QUALITATIVE ANALYSIS OF CANCER PROTEIN BINDING TO NANOPARTICLES

Joshua Breece

South Carolina Governor's School for Science and Mathematics

Current cancer treatment, especially chemotherapy, can be harmful to healthy cells. This is one reason why nanoparticles are used to transport anticancer drugs to tumors. Also, the enhanced permeability and retention (EPR) effect makes drug loaded nanoparticles accumulate in the tumor through the formation of leaky blood vessels and the buildup of lymphatic drainage. Nanoparticles can target different cells by modifying surface functional groups to increase interaction with cancer proteins. Understanding how cancerous proteins interact with nanoparticles can show which types of nanoparticles to use with which types of cancer for improved cancer therapy. Cellular protein binding from NCI-H460 human lung and U87 human brain cells was tested on neutral charged and negatively charged nanoparticles. The study obtained quantitative and qualitative results for nanoparticle-protein interaction with each cell line. BCA assays quantified amount of protein of each cancer cell line bound to a specific type of nanoparticles. Gel electrophoresis showed qualitative results of which types of proteins bound to the nanoparticles. Results showed that in both U87 and NCI-H460 cells, nanoparticles with a methoxy functional group had more proteins bound than nanoparticles with a carboxyl functional group. Although these results were not statistically significant, the results still provide potentially valuable information on nanoparticle-protein interaction. Future work could use different nanoparticles and different types of cancer to add further to this area of research.

#### THE EFFECT OF CACHEXIA AND CANCER ON CARDIAC MUSCLE OXIDATIVE CAPACITY IN MALE APC<sup>Min+/-</sup> MICE

Kyle C. Brennan

South Carolina Governor's School for Science and Mathematics

Cachexia is a side-effect of cancer, but it can also be present independent of cancer, occurring with other diseases. It is also found in as many as 15 % of patients with chronic heart failure and in 80% of patients with an advanced form of cancer. The mortality rate for cancer patients with cachexia is approximately 80%. Cachexia is a disorder that causes muscle deterioration, which leads to a drop in body weight due to the muscle loss as well as fat loss. The purpose of the research was to determine if and how cachexia changes the oxidative capacity in the heart. Hearts from four different types of mice were used as a model for this study. The mice had undergone an electrical stimulus that simulated resistance training before they were sacrificed at 12-20 weeks old. B6 mice (n=5) do not have cancer or cachexia and were used as the healthy controls. The Apc<sup>Min+/-</sup> mice with severe cachexia (n=6) had weight loss greater than 10%. Apc<sup>Min+/-</sup> mice with mild cachexia (n=5) had body weight loss less than 10% but greater than 5%. Apc<sup>Min+/-</sup> mice not exhibiting weight loss (n=4) were also used. These mice had cancer, but did not lose any body weight. To perform the study, the hearts were removed from the mice and then homogenized. Protein extracts were fractionated by the use of western blots to determine differences in amounts of Cox IV and Cytochrome c proteins.

#### EFFECT OF USING *CHLORELLA* ALGAE AS BIODIESEL IN MICROBIAL FUEL CELLS

James Brewer

Spring Valley High School

The purpose of this experiment is to find a way of making microbial fuel cells (MFC) work with a higher efficiency in energy production. To do this, *Chlorella* algae are fed to bacteria so that bacteria can metabolize at a higher rate, thus producing more energy. The alternate hypothesis was that when a greater amount of algae are metabolized by the bacteria, the MFC will produce a higher amount of energy. Algae was cultured in Alga grow solution and added to the anode chamber containing the bacteria. The bacteria metabolize the algae, which produces electrons, hydrogen ions, and carbon dioxide. The carbon dioxide is expelled from the chamber, while the hydrogen ions and electrons are used in the chamber to produce electricity and water. After experimental procedures were completed, it was shown that the fuel cell designed failed, since no voltage change was measured. The MFC did not work because there was a design error in the MFC. Since there was no measurable data, the results have been marked inconclusive.



## THE EFFECTS OF THERAPEUTIC ULTRASOUND TREATMENT IN DELAYED-ONSET MUSCLE SORENESS AND FORCE PRODUCTION RECOVERY AFTER MUSCLE DAMAGE

Aidan Brougham-Cook

South Carolina Governor's School for Science and Mathematics

Previous studies with Therapeutic Ultrasound treatment (TUS) involving cell models (in vitro) and animal models have shown that exposure to therapeutic ultrasound waves has led to increased gene and protein expression, muscle synthesis and repair, and have shown muscle force production recovery from a functional perspective. There is no conclusive evidence showing any positive effects of TUS on Delayed-Onset Muscle Soreness (DOMS) or muscle repair in human models, both functionally or biochemically. The purpose of this study was to determine the effect of TUS treatment on the recovery of muscle force production after muscle damaging and to examine the effect of TUS treatment on DOMS in humans. The study consisted of 30 subjects total, 15 male and 15 female and they were divided into a control group, CON, and an experimental group, EXP. The CON group received a placebo TUS treatment throughout the study, whereas the EXP group received TUS treatment throughout the study. Twenty-four hours post establishment of baseline strength, subjects underwent a muscle damage protocol consisting of 5 sets of 10 eccentric contractions using a Biodex isokinetic dynamometer. Twenty-four hours after damage, subjects began their 16-day period of ultrasound treatment and along with strength and pain measurements. Both groups will receive their respective TUS treatments in their non-dominant biceps brachii muscle belly for 10 consecutive days starting at 24 hours post muscle damage. All subjects completed pain and force production measurements at each appointed time point during their 16 days–10 days of treatment plus 6 days post-treatment.

## THE EFFECT OF DIFFERENT VOLUMES OF WATER USED IN A MISTER, AND THE TEMPERATURES ON THE AMOUNT OF ENERGY AN HVAC UNIT CONSUMED WHILE COOLING A HOUSE.

Elisabeth Brown

Spring Valley High School

All occupied buildings require a supply of outside air to be brought in. In order to heat and cool, a Heating, Ventilation and Air Conditioning (HVAC) unit is used. The purpose of this experiment was to determine whether there was a relationship between the performance of an HVAC unit and the temperature and number of nozzles spraying the unit. It was hypothesized that there would be the greatest change in performance during the highest outside temperature, and when the most nozzles were used to mist the unit. This was tested by assembling an apparatus surrounding the lower half of the HVAC unit. Six misters were placed evenly around the HVAC unit by attaching them to wooden dowels; this was positioned around the HVAC. The outdoor air temperature, the exit air temperature, the coil temperature and the current were measured using a temperature probe and a loop amp meter with the misters off and on. The number of misters was then changed, and the measurements were repeated. The hypotheses were both partially supported; with a constant number of misters, the cooling fan and coil exit temperatures, and the current running through the unit showed the greatest change during the hottest outside temperatures. The changes in all three measurements were statistically significant ( $\alpha = 0.05$ ,  $t_{crit} = 2.365$  (fan and coil),  $t_{crit} = 3.182$  (current),  $p = 0.002$  (fan),  $p = 0.036$  (coil),  $p = 0.002$  (current)). A weak positive correlation was found for the relationship between the outside temperature and the change in cooling fan exit temperature ( $r = 0.729$ ). No correlation was found for the relationship between the outside temperature and the coil exit temperature change ( $r < 0.1$ ). A strong positive correlation was found for the relationship between the outside temperature and the current drop ( $r = 0.917$ ). With varying numbers of misters (from 2 to 8), the cooling fan exit temperature and the current drop showed statistically significant differences ( $\alpha = 0.05$ ,  $t_{crit} = 2.132$ ,  $p = 0.022$  (fan),  $p = 0.002$  (current)), while the coil exit temperature changes were statistically insignificant ( $p = 0.394$ ). Strong positive correlations were found for the relationship between the number of mister nozzles and the change in cooling fan exit temperature as well as the current drop ( $r = 0.947$  and  $r = 0.996$ , respectively). No correlation was found between the change in the coil exit temperature and the number of misters attached to the HVAC ( $r = 0.629$ ).

## A COMPARISON OF GRAPHENE, GRAPHITE, AND CARBON SOOT CATHODES IN DYE-SENSITIZED PHOTOVOLTAIC CELLS

Jordan Byrne

Spring Valley High School

The properties exhibited by graphene have made it a material of great interest among the scientific community of late. The purpose of this experiment was to compare the maximum voltage production and degradation by dye-sensitized photovoltaic cells constructed with graphene, graphite, and carbon soot cathodes. This is important because the efficiency of energy output by a solar cell could be increased and the cost decreased, leading to improved distribution of solar powered energy. It was hypothesized that a pristine graphene monolayer would best conduct the electrons produced by dye-sensitized  $\text{TiO}_2$ , therefore producing higher voltage readings. The solar cells were constructed using methods described by the University of Wisconsin-Madison. A thin layer of Degussa P-25  $\text{TiO}_2$  was deposited on a piece of conductive glass. This was then heated and soaked in photosensitive dye. On a separate piece of conductive glass, one of the three sources of carbon was applied, graphene, graphite, or carbon soot. The two pieces of conductive glass were then sandwiched together with the  $\text{TiO}_2$  and carbon source facing each other. The dye-sensitized photovoltaic cells were exposed to light from an overhead projector and the resulting voltage readings were recorded using a handheld multimeter. The carbon soot cathodes produced the highest average voltage,

320.35 mV, when exposed to the light source. Graphite produced the second highest voltage, 312.68 mV, and graphene, 255.09 mV, the lowest on average. The carbon soot cathode showed the least amount of degradation over a period of one week, only producing a maximum voltage 2.46% less than that of week one. The greatest amount of degradation was seen in the graphite cathodes, which produced a mean maximum voltage of 10.83% less than the voltage produced in week one. The degradation of the graphene cathodes was found to be 10.54%. It was statistically concluded by an ANOVA test, that the null hypothesis should be rejected because the average maximum voltage production of the graphene cathodes was less than that of the carbon soot and graphite cathodes. The ANOVA test was conducted at  $\alpha = 0.05$  with an F-critical value of 2.10, yielding a p-value of  $< 0.001$  and an F-value of 541.

#### THE EFFECT OF FOOD COLORING, HIGHLIGHTER DYE, AND SUBLIMATING DYES ON THE VISIBILITY OF LATENT FINGERPRINTS USING THE CYANOACRYLATE (SUPER GLUE) FUMING METHOD

Allison Callaway  
Heathwood Hall Episcopal School

An increase in the visibility of latent, or chemical, fingerprints in criminal investigations could help many police identify a criminal in-question a lot faster than with a low quality latent fingerprint. This experiment tested to see if adding food coloring, highlighter dye, or sublimation dyes would have an effect on the visibility of latent fingerprints using the Cyanoacrylate Fuming Method. The hypothesis stated that if latent fingerprints are exposed to the Cyanoacrylate Fuming Method with liquid dyes added, the fingerprints will become more visible. The null hypothesis stated that there would be no difference in the visibility between the control group and the groups with dyes added. The latent fingerprint, copied onto a glass slide, was hung in a glass aquarium above the superglue (ethyl-cyanoacrylate monomer) and the dyes that were boiling on the hot plate. They were left for 15 minutes for the chemicals in the fumes to bond with the chemicals in the latent fingerprint making the fingerprint visible. When testing the sublimation dyes, it was discovered that instead of boiling and producing a gas, the dyes hardened to a solid. Because of this, the sublimating dye was eliminated from the experimentation. Some constants during experimentation included the room that the experiment took place in, the super glue used, and the temperature that the hot plate was set to. It was discovered that there were no significant changes in visibility of the latent fingerprint when exposed to the dyes, thus the null hypothesis failed to be rejected.

#### THE EFFECT OF THE NOTCH SIGNALING PATHWAY ON CELL-TO-CELL ADHESION

Amy Chang  
South Carolina Governor's School for Science and Mathematics

Weak endothelial-endothelial cell adhesion in the innermost layer of blood vessels promotes intravasation, the entry of tumor cells into the vascular system. Strong tumor-endothelial cell adhesion promotes extravasation, exit of tumor cells from the vascular system. Liebler et al. (unpubl. data) demonstrated in 2010 that A549 tumor cells have a significantly higher rate of adhesion to Notch1 protein overexpressing cells than to Green Fluorescent Protein (GFP) overexpressing cells. The purpose of the following research was to identify the adhesion factor responsible for this strong adhesion and evaluate the effect of the Notch Signaling Pathway on endothelial-endothelial cell adhesion. Human umbilical vein endothelial cells separately overexpressing GFP, Dll4 (Delta-like Ligand 4), and Notch1 were used in this study. Slices of spherical cell aggregates called spheroids were stained via the Hematoxylin and Eosin, Masson's Trichrome, and Curtis staining methods. In the results of the Curtis staining, the Notch1 samples exhibited the greatest red collagen intensity and the GFP exhibited the least. This suggested that Notch signaling pathway activity enhances collagen expression. The results also demonstrated that there were fewer and smaller gaps between adjacent Dll4 and Notch1 protein overexpressing cells than between GFP-overexpressing cells. This implied that the activity of the Notch signaling pathway increases the strength of endothelial-endothelial cell adhesion. This research suggests that collagen may play an important role in endothelial-endothelial cell adhesion.

#### THE EFFECT OF THE TRANSCRIPTION FACTOR CREL ON THE PRODUCTION OF THE INFLAMMATORY CYTOKINE, INTERFERON $\beta$

Sona Chowdhary  
South Carolina Governor's School for Science and Mathematics

Protein – protein interaction plays a major role in inflammation. One such protein is NF- $\kappa$ B, a transcription factor that exists as homo or heterodimers. It is made of various domains and belongs to a family of proteins known as Rel/NF- $\kappa$ B proteins. The transcription factor cRel belongs to this family and therefore is hypothesized to play a role in inflammation. Previous studies have shown that NF- $\kappa$ B is a key regulator of inflammatory genes. The purpose of this research was to determine the effect of the transcription factor cRel on the production of the inflammatory protein interferon  $\beta$  (IFN $\beta$ ) which is involved in the body's immune response. A total of three trials were conducted in which the bone marrow macrophages of a cRel knockout mouse and a cRel wildtype mouse were isolated. The mice were genotyped to ensure that the genotype was correct. The cells were stimulated with LPS and CPG at zero, one, two, four, and eight hour intervals. RNA was then isolated and converted to cDNA followed by QRT PCR to determine the relative amount of IFN $\beta$  produced. The results indicated that cRel inhibits the production of IFN $\beta$ . Further research and developments it could aid patients with autoimmune diseases. If the production of

IFN $\beta$ , one of the main inflammatory proteins released in the early stages (the innate immune response), could be inhibited, it would be on step closer to solving the issue of hyperactive immune responses.

#### THE COMPARISON OF VITAMIN K TABLETS AND KALE JUICE ON THE EFFECTIVENESS ON INCREASING FORMATION OF FIBRINS IN BLOOD OVER TIME

Helen Clay  
Heathwood Hall Episcopal School

In *The Comparison of Vitamin K Tablets and Kale Juice on the Effectiveness on Increasing Formation of Fibrins in Blood Over Time*, the problem of weak blood clotting was addressed. The purpose was to explore whether the natural form of vitamin K (kale juice) or a vitamin K tablet solution would have the greater effect on increasing blood-clotting factors. The hypothesis stated if the blood was treated with vitamin K tablet solution, it would have greater increase in blood clotting factor than kale juice. In the control group, a capillary tube was filled with distilled water, which was squeezed onto a microscope slide. Blood filled an additional capillary tube and was squeezed onto the distilled water droplet. The slide was observed and fibrins counted through the microscope, with pictures taken at specific time intervals. In following, fresh kale juice was tested with blood. The control group procedures were repeated, with the substitution of kale juice for distilled water. The final test treated the blood with vitamin K solution (1 vitamin K tablet and 200 mL distilled water). The same procedures were repeated, substituting vitamin K tablet solution for fresh kale juice. The results showed a significant increase at a  $p < .05$  of fibrins formed in both the treated groups as compared to the control. Although, the vitamin K tablet solution had the greater effect on increasing blood-clotting time, there was no significant difference in clotting time between the effect of vitamin K in table 1 form as compared to natural form.

#### THE TOXICITY OF CHLOROTHALONIL AND GASOLINE VAPOR TO THE GROWTH AND HEALTH OF *BRASSICA OLERACEA*

Daniel Clements  
Spring Valley High School

The purpose of this research was to determine how detrimental gasoline and chlorothalonil are to the health and growth of *Brassica oleracea*. Depending on the degree of toxicity of these substances, which were selected because of their benzene content or derivation, exposure of cabbages to them could be minimized accordingly. This was to maximize crop yield and to consider human health effects upon the consumption of cabbages that come into contact with these benzene derivatives. It was hypothesized that exposure to benzene containing and benzene derived compounds would have a negative effect on the growth and health of *Brassica oleracea*. Exposure was compared in three scenarios, one with chlorothalonil exposed cabbages, one with gasoline vapor exposed cabbages, and one with neither, the control. A greenhouse was constructed for each experimental scenario. Qualitative observations were made of cabbage health, while quantitative growth (height and width) measurements were taken to determine how growth was affected. The population that was exposed to gasoline vapors had the lowest percent change in growth, in terms of height,  $F(2,87) = 8.84, p < 0.001$ , and width,  $F(2,87) = 82.9, p < 0.001$ , among the three chemicals. The populations of the control and the green house were not found to be statistically different. Therefore, the hypothesis was partially supported in that the benzene containing substance, gasoline, had negative effects on growth, but partially rejected in that the benzene derived substance, chlorothalonil, did not cause statistically significant negative effects on percent change in growth.

#### DEVELOPING TOOLS TO VISUALIZE DATA FROM OBJECTIVE FUNCTIONS

Lacie Cochran  
South Carolina Governor's School for Science and Mathematics

Model updating is performed to create accurate computer models of buildings, but only one model is found at the end of the traditional process. A procedure called the Model Updating Cognitive System was developed to return multiple updated models to the analyst. This new process has an objective function similar to the traditional process. It was important to be able to visualize the multidimensional functions and check the values found by the objective function. A function called `plotsscatter()` was developed to be able to do this. This code plots the minima or maxima of a multidimensional function that represents the computer model. The values found by the objective function relate the error between data from the computer model and data from experiments. Analysts look for the minimal error to insure that the computer model accurately represents the building. One and two-dimensional functions can be created to ensure the accurateness of the objective function. Three or more dimensional functions can also be created and show the analysts the relative error of their data.

## MAPPING OF ADVENTITIOUS ROOTING IN POTENTIAL PEACH [*PRUNUS PERSICA* (L.) BATSCH] SEMI-HARDWOOD CUTTINGS

Lydia Colvin

South Carolina Governor's School for Science and Mathematics

Adventitious rooting of vegetative cuttings is important in the propagation of many tree species. Within species, there is considerable variation for rooting ability and the cause of this variation is not understood. Variation in adventitious rooting potential was previously observed in an F2 mapping population designed to investigate chilling requirement. Here we have quantified rooting potential of this population with the goal of identifying genetic regulators of the trait. Ten cuttings with a uniform length of 15 cm were collected from each of 378 F2 offspring. Basal ends of cuttings were then dipped into K-IBA (2500ppm) for five seconds and planted into vermiculite filled trays. After four weeks in a mist house, cuttings were categorized for survival, presence of callus, or presence of callus and roots. We will present the results of the rooting phenotyping and the genetic mapping of the trait.

## CONCENTRATION OF PCBs ACROSS THE TROPHIC LEVELS OF A STREAM ECOSYSTEM

Jacob W. Crouse

South Carolina Governor's School for Science and Mathematics

The flux of polychlorinated biphenyls (PCBs) introduced to Twelve Mile Creek by wastewater from the Sangamo Corporation in Pickens, SC, from 1955 to 1975 has contaminated the region. Since their entrance into the creek, PCBs have moved through the different trophic levels of the system's food web. The benthic leaf material of the creek passes the contamination gradient on to the periphyton, a producer in the creek. The periphyton is consumed by the primary consumers in the creek, such as the *Corbicula fluminea* (Asian clam). The consumers are then eaten by secondary consumers like the *Notropis lutipinnis* (yellowfin shiner). All of these samples used in the experiment were collected just below the Easley/Central Dam in 2007. Biomagnification and bioaccumulation led to the highest amount of PCB being found at higher trophic levels.

## STUDYING THE AMOUNT OF RADIATION EMITTED FROM CELL PHONES DURING A CALL

Ayan Dasgupta

Hammond School

This project was undertaken to study the amount of radiation emitted from a cell phone during a call. The study tried to answer the following questions: Do smart phones emit more radiation during a call or do non-smart phones? Do phones in general emit more radiation during a call outside or inside a building? In this project many phones, smart phones and non-smart phones, were studied by measuring the amount of radiation emitted from the cell phones during a call. The purpose was to see what type of phones have the most radiation emitted during call and whether the phones emit more radiation outside or inside. The hypothesis was that smart phones would emit more radiation because smart phones are constantly streaming data, and that the radiation emitted from the phones would be greater inside a building. Fourteen phones were measured, four non-smart phones and nine smart phones. They were compared by looking at the amount of radio / microwaves emitted from the phone both inside and outside a building. The results showed that there was no significant difference between smart phones and non-smart phones in emitting radiation, but there was a significant difference between the amount of radiation the smart phones emitted inside compared to outside and the same was true for non-smart phones.

## THE EFFECT OF *SARCOPHAGA BULLATA* LARVAE AND *DERMETES MACULATES* ON THE RATE OF THE DECOMPOSITION OF MICE

Tay Davant and Norrie Beach

Heathwood Hall Episcopal School

The purpose of this experiment was to determine which species of insect, the *Sarcophaga bullata* larvae (flesh flies) or the *Dermetes maculatus* (dermestid beetles), has a greater effect on the rate of the decomposition of mice. It was hypothesized that if mice are placed in an environment containing *Sarcophaga bullata* larvae or an environment containing *Dermetes maculatus*, then the mice in the environment containing *Dermetes maculatus* will decompose at a faster rate. Ten dead mice were placed in three separate environments: one containing *Sarcophaga bullata* larvae, one containing *Dermetes maculatus*, and one with no insects. At the end of four weeks, the mice in the environment with the *Dermetes maculatus* were in the skeletal stage of decomposition. The mice in the environment with the *Sarcophaga bullata* larvae reach the post-decay stage, but the larvae had pupated after four days, and they only affected the rate of decomposition while they were larvae. Both groups decomposed at faster rates than the control group. The data showed that the *Dermetes maculatus* decomposed the mice at a faster rate and more completely than the *Sarcophaga bullata* larvae, but compared to the control, the *Sarcophaga bullata* did increase the rate of decomposition significantly, as did the *Dermetes maculatus*. Further studies could be done to test other species and their effect on the rate of the decomposition of mice. Other studies could be conducted to see how other elements, such as the environment (dry, moist, or submerged in water) or light, affect the rate of decomposition.

## THE EFFECTS OF SURFACE CHARGE ON THE BINDING AFFINITY BETWEEN NANOPARTICLES AND PROTEIN FOR DRUG DELIVERY IN CANCER TREATMENT

Lina Davda

South Carolina Governor's School for Science and Mathematics

According to the American Cancer Society, 1.5 million people in the US are diagnosed with cancer each year and over one million die from the disease, which is caused by abnormal uncontrolled cell growth. The delivery of cancer-fighting drugs is an increasingly important area of bioengineering research. Current cancer treatments, which include radiotherapy and chemotherapy, are inefficient in targeting cancerous cells, and they often affect healthy, normal cells as well. To find a treatment that better targets cancer cells, research was conducted to study proteins' affinity for poly(lactide)-poly(ethylene glycol) (PLA-PEG) nanoparticles with neutral (-OCH<sub>3</sub>) and negative (-COOH) surface charge, and the interaction with NCI-H460 lung and U87 brain cancer cells. In this research, a BCA assay was performed to measure the quantity of proteins that bound to a known concentration of nanoparticles in PBS. A gel electrophoresis was run to identify the type of proteins which bound to the nanoparticles. This experimentation allowed a better understanding of how to increase drug-carrying nanoparticles' interaction with certain types of cells. Results showed that the average binding affinity of methoxy nanoparticles for lung cancer proteins is slightly higher than that of carboxyl nanoparticles. Additionally, the average affinity of methoxy nanoparticles for brain cancer proteins is slightly higher than that of carboxyl nanoparticles. Both results were statistically insignificant. Future research must be performed to explore the types of protein that bind to each type of nanoparticle.

## THE EFFECT OF PROPELLER PITCH ON THE TAKEOFF DISTANCE OF A REMOTE CONTROL AIRPLANE

Donen F. Davis and Sam J. Nassab

Heathwood Hall Episcopal School

Remote control (rc) surveillance planes are being flown in the skies above some of the most important areas across the world. These planes provide valuable intelligence for our government, which helps them make some very important decisions; the planes also work to keep soldiers out of harm's way. The purpose of this experiment is to determine if propeller pitch has an effect on takeoff distance of an rc airplane. Our hypothesis is that: If the propeller pitch on an rc plane was changed, the takeoff distance would change. At a local flying field, every two feet for fifty feet was marked, the wheels of the plane placed even with the first marker. Five take offs and landings were performed using each of the 4 differently pitched propellers. After each set of five take offs, the battery was removed and re-charged. This was repeated with each of the four propellers. After three trials the testing was complete. An analysis of the data showed that there was a statistically significant difference in the takeoff distance, which was dependent upon the pitch of each propeller. Out of all four propellers, the 11x10 propeller had the shortest takeoff distance, with an average take off distance of 24 feet; this was proved by an ANOVA test, which showed a higher F value, than the F critical value. After analyzing the data, it can be concluded that propeller pitch has a statistically significant effect on takeoff distance.

## THE EFFECT OF ALGAE ON NITRATE LEVELS IN MANURE EFFLUENTS AND THE EFFECTIVENESS OF ALGAL BIOMASS AS AN ALTERNATIVE FERTILIZER

Erin Doll

Spring Valley High School

The purpose of this study was to find an effective method of treating agricultural waste waters and creating a useful byproduct after treatment. The goal of experiment 1 was to grow a crop of algae on the nutrients in manure effluents and use the algae to aid in cleaning the water. The goal of experiment 2 was to use the algal biomass created in the first experiment as an effective organic nitrogen rich fertilizer. It was hypothesized that if the manure effluent was run through an algal turf scrubber, Nitrogen removal rates would be highest at the medium manure concentration and the algal biomass would be as effective in aiding plant growth as a commercially available organic fertilizer. The experiment was accomplished by running two concentrations of manure effluent through an algal turf scrubber for 10 days. Nitrate removal rates were quantified using a nitrate test kit. The algae was harvested and dried. 30 radish plants were grown with no additive, 30 radish plants were grown with algae, and 30 radishes were grown with manure as a soil additive. After the growing period the radishes were harvested, and mass was recorded. The hypotheses were partially supported. The Algal Turf Scrubber was effective in reducing nitrate concentrations in the manure effluents. There was no significant difference in the algae and fertilizer in aiding plant growth. The results of this study suggest that algae can be used to lower nitrate concentrations in manure effluents and can be used as an effective fertilizer.

## THE UNDERWATER BREATHING MASK USING ELECTROLYSIS

Rebeca Dominguez  
Southside High School

The experiment was testing the feasibility of a underwater mask which supplies oxygen through electrolysis, which would essentially solve the issue of limited oxygen supply under water. The set up was a Hoffman Electrolysis apparatus which was created using PVC pipe, rubber stoppers, and wire. Salt was the electrolyte used and the ratio between water and salt, so that it could imitate sea salt, was determined using a law created by Sir Francis Drake. The first setup used a nine volt battery, and when left alone to run for an entire day, only 50 milliliters of oxygen were created, which isn't sufficient for even one normal human breath. Then a ten volt power supply was connected, which had much more successful results. It yielded about 120 milliliters of oxygen in 100 minutes. In the end, it was found that the electrolysis apparatus does not make enough oxygen even accounting for adding in other gasses, mainly nitrogen, to make the same composition of air that one finds in the atmosphere. However, if one could improve the efficiency of the apparatus, mainly by changing some circuitry, adding surface area to the electrodes, and potentially finding a more efficient power source, it may be possible to reach the necessary levels for a human to be able to sustain breathing underwater.

## THE RUN-OFF INTO AQUATIC HABITATS: ACID RAIN & COPPER (II)

Salvatore Donzella  
Southside High School

Unfortunately when industries dump chemicals, or pollute chemicals into the atmosphere some of it inevitably ends up in different aquatic habitats. The main question is, compared to the concentration of the chemicals originally introduced to the environment, how much will get transferred into aquatic habitats? For the experiment multiple units were constructed which tested the runoff of two different solutions into aquatic habitats. A copper (II) chloride solution was introduced to the terrarium of three units and a sulfuric acid solution was introduced to the terrarium of three units. No solution was introduced to the remaining three units to serve as a control. After a couple weeks of consistently adding the different pollutants to the terrarium, the aquatic habitats were checked for runoff through pH analysis and ICP-AES testing. Through the testing it was seen that the water of the aquarium that the sulfuric acid solution was introduced to had a change in pH. It was also discovered that the water that the copper (II) chloride solution was introduced, had only trace amount of copper but a definite increase in copper concentration. Through these experiments it is seen that even though it is trace amounts, chemical pollutants that are introduced into the environment have definite transfer into aquatic habitats.

## THE EFFECT OF HUMIDITY ON THE RATE OF GROWTH AND DEVELOPMENT IN *SARCOPHAGA BULLATA*

Jordan Dowell  
Spring Valley High School

In this experiment, *Sarcophaga bullata*, a common species of blowfly used in forensic entomology, was raised in environments with varying relative humidity percentages. This blowfly species is widely used to determine the time at which an individual died. This time is determined by looking at, amongst other things, the various stages of the blowfly's development. For this reason, this species of fly was examined in environments of varying humidity to see if there was any effect on the rate at which they grew and developed. It was predicted that as relative humidity decreased, rate of development/growth would decrease. It was hypothesized that 95% relative humidity would show the greatest rate of development, and the rate would decrease in 50% and 15% humidity. Flies were collected over a few weeks using common rearing methods, and then the larvae were divided into different containers equally. Different amounts of  $MgCl_2$  were used to obtain desired percentages of humidity and a Vernier LabPro/ Relative Humidity probe was used to check levels of humidity and make any necessary adjustments to keep humidity at required levels. Results were collected over a period of one week, and then were statistically analyzed at  $\alpha=0.05$ . The hypothesis that lower percentages of relative humidity would have lower rates of development was rejected. Decreased humidity caused a higher rate of insect development,  $[F(2,24)=9.14, p=0.001]$ . In conclusion, a low and moderate humidity showed the fastest rate of development.

## THE ABILITY OF MOBILE PHONE RADIATION TO BLOCK MICROWAVE RADIATION

Meisha Draper  
Spring Valley High School

The purpose of this experiment was to see if the cell phone case material affects the amount of microwave radiation emitted from the phone. Due to measurements not being able to be picked up from the phone, a microwave oven was used in place. The hypothesis was that a tire tread case would block and/or absorb the most radiation. This research was carried out by measuring the amount of radiation emitted from a microwave oven through various phone cases (leather, plastic, silicone, and tire tread). For each type of case, the cell phone case was pressed between the microwave oven and the meter, and then the emitted microwave radiation was measured with a 2.45 GHz microwave meter. The amount of radiation was compared to the amount of radiation emitted without the case. The amount of radiation emitted was also measured through a pig skull to

simulate the amount of radiation blocked by the human skull. The pig skull blocked an average of 0.0721 mW/cm<sup>2</sup>, which was the lowest average amount of radiation blocked. Results showed that tire tread blocked the most amount of radiation and silicone was second. An ANOVA test was run and a Tukey post-hoc test showed a significant difference between all of the materials, except for the plastic and silicone case ( $p < 0.01$ ,  $\alpha = 0.05$ ,  $F_{crit} = 2.31$ ,  $F = 128.47$ ).

#### THE EFFECT OF DRYING HANDS WITH A PAPER TOWEL, HAND DRYER, AND EVAPORATION ON THE GROWTH OF *MICROCOCCUS LUTEUS*

Trey Edmonds and Jeff (Sang-Hyun) Lim  
Heathwood Hall Episcopal School

The purpose of this project was to test the effectiveness of bathroom hand dryers. Ten subjects were gathered to place their hands into a bag with 10mL of *Micrococcus luteus*. The subject splashed their hand around in the bag, until their hands were completely wet. The hand was then dried using paper towels, a hand dryer, or shaking them dry. The subjects then had 50mL of phosphate buffered water poured over their hand. A sterilized bacterial spreader was used to spread the bacteria from the buffered water onto a tryptic soy agar plate. The cultured agar plates were placed in an incubator at 25C. After 24 hours the colonies were counted. The first trial of this experiment did not go as planned. The bacteria overgrew all the plates the plane in the 24 hours. There were lawns of bacteria on every tryptic soy agar plate from not diluting the contaminated water. The bacteria colonies were so dense on the surface of the tryptic soy agar plate that it could not be counted accurately or quickly. This led to the agar plates being thrown out and the experiment being restarted. The second trial is currently underway. The procedure of the second trial of this experiment is the same, except for the fact that the bacteria in the phosphate buffered water solution will be diluted in distilled water before it is spread onto the nutrient agar plates with the bacterial spreader. This means that there will be less bacteria on the agar plates, making the colonies more easily counted.

#### THE EFFECT OF FABRIC TYPE ON THE TRANSMITTANCE OF UVA RAYS

Sydney Ellen, Kate Evans and Margo Mullins  
Heathwood Hall Episcopal School

In this experiment, the transmittance of UVA rays through different types of fabrics was tested. This information would be beneficial because it could heighten the awareness that different fabrics may allow the transmittance of different amounts of UVA rays, thus allowing sunburn even through clothing. The experiment involved testing fabric samples from a 100% polyester shirt, a 100% cotton shirt, and a 94% nylon 6% spandex shirt under a Full-Spectrum Metal Halide light source for six minute trials, repositioning and recording the amount of UVA rays that were transmitted through each fabric every two minutes. After testing all the new fabrics, each fabric was washed in a washing machine for thirty minutes. Then the fabrics were hung to allow them to air dry. The steps of collecting data were repeated, using fabrics that were washed once. Then the fabrics were washed a second time in the same washing settings. After all the data was collected, the data was averaged using *Excel* software statistical analysis. Overall findings showed that the maximum amounts of UVA rays were transmitted through nylon spandex fabric. The minimum average amount of UVA rays were transmitted through the polyester fabric with a 4.6% difference compared to the UVA rays transmitted through cotton fabric. Polyester fabric transmitted 170.4 millowatts per square meter, followed by cotton fabric, which transmitted 178.5 mW/m<sup>2</sup>, then nylon spandex fabric, which transmitted 520.3 mW/m<sup>2</sup>.

#### THE EFFECT OF DYNAMIC LOADING ON SOLUTE TRANSPORT IN AGAROSE HYDROGELS

John Elmore  
South Carolina Governor's School for Science and Mathematics

The transport of nutrients plays an important role in maintaining the normal function of cells in tissue engineered scaffolds. Mechanical loading could significantly affect solute transport in tissue engineered scaffolds with porous structures. Dynamic loading has previously been shown to increase overall concentration ratios in porous samples. The goal of this project is to more specifically determine the effect of dynamic loading on solute transport in agarose hydrogels. The hypothesis is that the solute concentrations in the agarose hydrogels could exceed the external solution concentration under dynamic loading for certain combinations of gel concentration and solute molecular weight. 70kDa FITC-Dextran and 7% type VII agarose gel discs were tested. Discs were subjected to either free swelling or unconfined compression with a dynamic compressive strain ( $\pm 5\%$  amplitude) superposed over a static strain offset (15%) at a frequency of 1 Hz for up to 40h. The concentration profiles in the discs were measured by a confocal laser scanning microscope at different time points. The results show dynamic loading to cause an increase in the partition coefficient of the discs compared to free swelling controls. However the level of increase does not show as dramatic results as reported previously. Cross-sections of the discs show the concentrations in the middle layers of discs do not increase dramatically compared to the superior surfaces. These results support the idea that dynamic loading can enhance nutrient transport in porous media, however the effect does not appear to be as dramatic as previously thought.

THE EFFECTS OF HUMIDITY ON SPEED OF SOUND PROPAGATION ABILITIES IN DIFFERENT VARIETIES OF  
EXOTIC WOOD

Sean English  
Spring Valley High School

Pernambuco (*Caesalpinia echinata*) is a tropical tree native to Brazil that is currently used in the manufacture of sting bows. Due to overharvesting, Pernambuco has been placed on the endangered list becoming close to extinction. By finding a suitable wood that can replace Pernambuco for bow manufacture, Pernambuco may be able to again flourish in its own environment. Four woods were used for experimentation; Snakewood, African Kingwood, Cocobolo, and Pernambuco. Woods were chosen based on average density, each wood close to the average density of Pernambuco. The purpose of this experiment was to find if one of these woods could suitably replace Pernambuco in bow manufacture. Because Snakewood is the densest of the specimens, it's hypothesized that it will have the best propagation ability. Each wood was tested for their average humidity before testing, by using the Omega HHMM690 Humidity sensor. Each wood was then placed in either a container of water or incubator to level the humidity at either 9%, 12%, or 15%. Then each wood was tested by using a tuning fork and a Vernier labquest unit, by hitting the tuning fork and observing the decibels coming through the other end of the sample. Pernambuco was found to have the best propagation ability, and the best humidity level for each wood was 12%. Because Pernambuco has a prime humidity level of 12%, this provides support to that observation. Otherwise, the results of this experiment show that there are other factors that affect Pernambuco's ability to propagate sound.

PHYSIOLOGY OF SELF-CONTROL: DOES BLOOD GLUCOSE LEVEL HAVE AN EFFECT  
ON SELF-CONTROL?

Chad D. Erturk  
Spartanburg Day School

A growing body of literature claim that self-control relies on a resource. This research claims that when self-control is exerted this resource, which is reported as glucose, is depleted from the peripheral blood. It is also reported that when this resource is unavailable individual will be able to exert less control. An opposing view claims that self-control is regulated by a motivational mechanism rather than metabolic. In this project, I investigated the effects of glucose on self-control as well as the self-control vs. non-self-control task on the depletion of glucose from blood by using rats as a model system. My results show that self-control tasks do not deplete glucose neither does the injection of glucose improve self-control. I also used Scratch visual programming language to create scenarios to simulate self-control, immediate reward and forced trials. I also created an interactive scenario that allows the observer to suggest a condition and then observe how the rat would respond to this data in real life.

COMPARISON OF VISUAL SHORT TERM MEMORY BETWEEN TEENAGERS AND ADULTS

Tia Eskridge  
Hammond School

Visual short term memory is the number of objects a person can hold in their mind over a span of a few seconds. It studies the ability of an individual to detect changes as more information is given to them. This project was undertaken to study if visual short term memory showed a decrease in adults when compared to high school students due to a mature mind's deterioration over time. The study tried to answer the following question: Does short term memory decrease as we get older? In this study students and faculty were to look at a pair of cards and tell me the color change(s) between the two as either the number of pictures (Part 1) or changes (Part2) grew. The hypothesis was that the students would be able to identify more changes correctly than adults and would therefore have better short term memory.

Thirty-eight subjects (18 adults and 18 students) were tested on the correctness of their responses. They were then tallied up as points on a spreadsheet. Results showed that the students and faculty showed about the same performance. The conclusion is that visual short term memory doesn't have an effect with age.

THE EFFECT OF DEBBIE MEYER GREEN BAGS, ZIPLOC BAGS, AND PAPER BAGS ON THE RIPENING OF A  
CAVENDISH BANANA

Meg S. Evans and Paige B. Bryant  
Heathwood Hall Episcopal School

For this investigation, three different types of storage bags, Debbie Meyer, Ziploc, paper, and the control, which was no bag, were manipulated to see if the ripening process of Cavendish bananas would decrease. For the experiment, the independent variable was the type of bag applied to the Cavendish banana and the dependent variable was ripening of the bananas as indicated by the weight, number of brown spots, and the sugar content, measured in Brix degrees. The hypothesis that was tested was: If a banana is placed in a Debbie Meyer Green bag, Ziploc bag, paper bag, and no bag at all, then the Debbie Meyer Green bag will slow down the ripening process. The null hypothesis that was tested was: If a banana is placed in a Debbie Meyer Green bag, Ziploc bag, paper bag and no bag at all, then there will be no difference in the ripening process among the conditions. An analysis of the data showed that the Debbie Meyer Green bag was the overall best product used for



slowing down the ripening process of a banana. The bananas in the paper bag, however, ripened the fastest, rotting quicker than the other conditions. An ANOVA test ( $\alpha=0.05$ ) was used to compare the four conditions. The hypothesis was accepted, that the Debbie Meyer Green bag slowed down the ripening process of a Cavendish banana when compared to Ziploc, paper, and no bag. The paper bag and no bag showed no statistical difference between each other, but the Debbie Meyer Green bag and the Ziploc bag were statistically different from each other.

#### THE PRODUCTION OF CYTOTOXIC ACETALDEHYDE THROUGH THE OXIDATION OF ETHANOL IN CULTURED MALE RAT HEPATOCYTES

Kemper Fagan

South Carolina Governor's School for Science and Mathematics

The increased demand for ATP in ureagenesis stimulates oxidative phosphorylation increasing cellular respiration. It was hypothesized that the oxidation of ethanol produced cytotoxic acetaldehyde (AcAld). The inhibition of aldehyde dehydrogenase increases the concentration of free AcAld in cultured hepatocytes and the inhibition of alcohol dehydrogenase decreases the concentration of free AcAld. This process would suppress the urea cycle and cellular respiration stimulated by ureagenic substrates. The effect of the oxidation of ethanol at different concentrations ( $\mu\text{M}$ ) at different time intervals was measured using the Shimadzu spectrophotometer and cultured rat hepatocytes. The effect on the cells was also measured in the presence of inhibitors such as phenyl isothiocyanate and 4-methyl pyrazole. The calibration curve was established to determine the amount of ethanol production that should be expected. The data was analyzed using the standardization curve and the concentration of the ethanol was determined mathematically. The experiment resulted in the determination that greater concentrations of ethanol are directly related to the increased amount of cytotoxic AcAld in the rat hepatocytes.

#### SYNTHESIS AND CHARACTERIZATION OF SULFUR-FUNCTIONAL LAYERED SILICATES FOR USE IN NANOCOMPOSITE ELASTOMERS

Randy Fang

South Carolina Governor's School for Science and Mathematics

In this project, we are synthesizing and characterizing new kinds of layered silicates functionalized with sulfur-containing silanes for future use in nanocomposite elastomers and, perhaps later, in automobile or truck tires. Starting with a natural clay mineral, sodium montmorillonite (Na-MMT), we added (1-hexadecyl) trimethylammonium bromide (CTAB) to Na-MMT, thus expanding the interlayer spacing between platelets in MMT from 1.2 nm to 1.8 nm. This was followed by grafting a sulfur-containing silane, bis(triethoxysilylpropyl) tetrasulfide (TESPT) onto the MMT surface, resulting in sulfur-functional MMT (SMMT). The mass and surface densities of sulfur grafts were characterized by thermogravimetric analysis (TGA) and elemental analysis. Finally, we studied the reaction of SMMT with squalene, a small molecule analog of natural rubber, to learn more about how SMMT platelets might affect cross-linking in a nanocomposite elastomer.

#### MEDIATING THE YIELD OF *BRASSICA RAPA* AND PET RATE OF *VIOLA X WITTRICKIANA* THROUGH THE APPLICATION OF ASPARTIC AND GLUTAMIC ACID UNDER SALINITY STRESS

Habiba Fayyaz

Spring Valley High School

In coastal and arid regions worldwide, soil salinization has decreased the amount of available land sufficient for crop production. The purpose of this experiment was to determine if the amino acids aspartic and glutamic acid can be used to enhance the salt tolerance of *Brassica rapa* and *Viola x wittrockiana*. It was expected that both aspartic and glutamic acid would induce significant resistance to the detrimental effects of salt stress by improving fresh weights and PET rates in the plants, but that glutamic acid would be more efficient in doing so. After subjecting both plants to salt treatments of 12 deciSiemens/meter (dS/m) and corresponding amino acid treatments of either aspartic or glutamic acid at either 2.5 or 5.0 mM, the *Brassica rapa* plants were measured for their fresh weights and the *Viola x wittrockiana* plants were isolated of their chloroplasts and measured spectrophotometrically for their photosynthetic electron transport (PET) rate at 600 nm. At  $\alpha=0.05$ , the amino acid treatment did not significantly improve the *Brassica rapa* plants' yield,  $F(4, 76)=2.07$ ,  $p=0.09$ , but the treatment did significantly improve the PET rates of the *Viola x wittrockiana* plants,  $F(4, 52)=12.10$ ,  $p<0.001$ . In comparison to the control with no amino acid application, the 5.0 mM aspartic acid, 2.5 mM glutamic acid, and 5.0 mM glutamic acid groups significantly improved the PET rates of the *Viola x wittrockiana* plants. The PET rates of the 2.5 mM aspartic acid group were also significantly different from the 5.0 mM glutamic acid group.

## THE EFFECT OF ELEVATED TEMPERATURES ON THE RESISTANCE OF IRON DISULFIDE

Sebastian Fearn  
Spring Valley High School

There is an increasing need for semiconductors that can withstand high-temperature environments such as those used in engine transducers or underwater drills. This requires that alternative semiconducting materials (rather than SI-based materials) be identified and tested for their high temperature properties. The purpose of this experiment was to determine how the resistance of iron disulfide changes with increasing temperature. This is important because iron disulfide could replace silicon in higher temperature environments. The hypothesis was that iron disulfide would have a decreasing resistance as the temperature rose. This experiment was accomplished by exposing iron disulfide to temperatures ranging from 973K to 1573K while measuring the resistance passing through the iron disulfide with a multimeter. The specimen was set in a clay triangle for stability. The temperature of the laboratory burner was monitored using a K-type thermocouple (Vernier). A linear regression test was run on the differences of the starting temperature and the elevated temperature. The equation was Resistance =  $-0.0288 + 1.12 \times 10^{-4}$  Temperature with ( $s=0.0452$ ,  $r^2=0.186$ ,  $r=0.4312$ ). Another test was run on the elevated temperature resistances and the equation was Resistance =  $0.098 - 2.310 \times 10^{-5}$  Temperature ( $s=0.0449$ ,  $r^2=0.01$ ,  $r=0.1$ ). This test showed that there was no correlation between the temperature and the resistance in the specimens. Due to the position of the multimeter and the wires, the resistance could not be measured in a proper method. The resistances were too erratic to calculate the resistance of iron disulfide at elevated temperatures. The hypothesis was not supported and should be rejected.

## THE EFFECT OF ULTRAVIOLET AND VISIBLE SPECTRA-INDUCED PHOTOLYTIC DEGRADATION OF 5-CHLORO-(2,4-DICHLOROPHENOXY) PHENOL'S ANTIBACTERIAL PROPERTIES, OBSERVED USING *ESCHERICHIA COLI*

Benjamin Fechter  
Spring Valley High School

In this experiment, a common antimicrobial agent, triclosan, 5-chloro-(2,4-dichlorophenoxy)phenol, was exposed to sunlight for varying time periods in order to observe the effect of photolytic degradation on the agent's antimicrobial properties. It was predicted that increasing levels of sunlight exposure would decrease antimicrobial performance. The experiment was accomplished by exposing groups of 20 5-chloro-(2,4-dichlorophenoxy)phenol (methyl-triclosan) samples to sunlight for 0, 15, 30, 60, and 120 minute periods. *Escherichia coli* were used in this experiment, cultured in nutrient broth, and incubated. The cultured *E. coli* were placed in one hundred 4cm<sup>3</sup> cuvettes and separated into groups of 15. One group of 20 was exposed to non-irradiated triclosan to serve as a control, identical sample groups were exposed to triclosan irradiated at 15, 30, 60, and 120 minute periods. The cuvettes were placed in a spectrophotometer, and % absorbance at 395 nm was measured for each cuvette at 1 hour, 2 hours, and 3 hours. The hypothesis that increased irradiation would cause lower levels of cell death was not supported. At  $\alpha = 0.05$ , increases in irradiation caused lower levels of cell death,  $F(14, 285) = 1.72660539$ ,  $p < 0.001$ . Growth was substantially greater in the samples containing the most irradiated triclosan after three hours when compared to samples irradiated for 0 minutes and measured after 1 hour, and samples irradiated for 15, 30, and 60 minutes measured after 2 hours. In conclusion, the hypothesis was rejected, as increased irradiation indicated lower levels of cell death in samples exposed to the triclosan over time.

## REMOVAL OF ARSENIC TRIOXIDE BY AN INTERMITTENT OPERATED SLOW SAND FILTER USING STERLING SAND MODIFIED WITH ALUMINUM CHLORIDE AND IRON OXIDE

Meghan Franco  
Spring Valley High School

In many countries worldwide, clean drinking water is very scarce. The number of people without access to safe drinking water is 1 billion, and 3.575 million people die each year from water-related diseases. There is a search for an inexpensive, durable household-sized sand filter. Sand serves as an appropriate filter media because it is both durable and widely available. The purpose of this experiment was to determine whether aluminum chloride and iron oxide would increase the ripening process in water filters. This is important because decreasing the time of the ripening process would allow people access to cleaner water at an earlier stage. It was hypothesized that mixing sterling sand with a combination of aluminum chloride and iron oxide would quickly ripen the water filter. This investigation was accomplished by modifying sterling sand, in water filters, with aluminum chloride or iron oxide, or a combination of aluminum chloride and iron oxide. Arsenic was passed through each filter and percentage, before and after, was calculated by using a HACH© Arsenic Test Kit. The results of the experiment showed that the filters that were coated with iron oxide removed all of the detectable arsenic trioxide. An ANOVA and a Tukey post-hoc test indicated that there was no significant difference between the filter coated with a combination of aluminum chloride and iron oxide, and the filter coated with solely iron oxide. However, there was a statistically significant difference between the control and both filters containing sand coated with iron oxide ( $p$  value was  $<0.001$ ).

## PREPARATION & PROPERTIES OF SILVER-MOLTEN CARBONATE DUAL-PHASE MEMBRANE FOR CARBON DIOXIDE SEPARATION

Maxwell Franks

South Carolina Governor's School for Science and Mathematics

CO<sub>2</sub> permeable membranes can be used to prevent the release of CO<sub>2</sub> into the atmosphere through flue gas produced by power plants. In this study, a new mixed electronic and carbonate-ion conductor (MECC), Ag-MC dual-phase membrane, was chosen and prepared as CO<sub>2</sub> permeable membrane. Its permeation properties were also studied. The molten carbonate (MC) phase in this study was a binary eutectic mixture of Li<sub>2</sub>CO<sub>3</sub> and K<sub>2</sub>CO<sub>3</sub> in a molar ratio of 62:38. The MC powders and the Ag powders were finely mixed, pressed into pellets with different thickness, sintered at 600 °C for 2 hours, polished, then sealed in a testing apparatus. At varying temperatures, feed gas (CO<sub>2</sub>, O<sub>2</sub> volume ratio 50:50) was exposed to one side of the sealed pellet. CO<sub>2</sub> and O<sub>2</sub> reacted to form CO<sub>3</sub><sup>2-</sup>, which then diffused through the molten mixed carbonate. On the other side, the reverse reaction occurred and sweep gas (He) flushed the permeated gas out of the apparatus and into a gas chromatograph (GC). The Ag-MC pellet with a thickness of 1.60 mm was prepared and the permeation properties were studied at different temperatures. The permeation fluxes of CO<sub>2</sub> and O<sub>2</sub> increased with temperature and reached maximums of about 0.82 and 0.44 mL cm<sup>-2</sup> min<sup>-1</sup>, respectively at 650 °C. Above 650 °C, the fluxes decreased. The flux of CO<sub>2</sub> was almost two times of that of O<sub>2</sub> at all tested temperatures, as predicted by the driving reactions. The long-term permeation property was also studied at 650 °C, and the fluxes had minimal change for 80 hours, thus making it a promising candidate material for a CO<sub>2</sub> separation membrane.

## USING HERPES SIMPLEX VIRUS TO TARGET GENE EXPRESSION TO INJURED NEURONS FOR THE TREATMENT OF PAIN

Catherine Fryland

South Carolina Governor's School for Science and Mathematics

Chronic pain is a problem many face that does not have an effective treatment yet. Herpes Simplex Virus – 1 (HSV-1) has been shown to be effective in introducing the DNA of opioid peptides and receptors and decreasing pain in multiple preclinical pain models. The overall goal of this project is to develop a viral vector that will produce injury specific regulation of mu opioid receptors (μOR) to treat chronic neuropathic pain. In the current study, HSV-1 viral vectors were designed to express Green Florescent Protein (GFP) with an injury specific galanin promoter (GAL-GFP) or a non-specific cytomegalovirus (CMV) promoter (CMV-GFP) in mice with or without a nerve injury. The results show galanin is up-regulated by a nerve injury, and that GAL-GFP produces more GFP in injured animals than in uninjured animals. The CMV-GFP was shown to produce GFP in both injured and uninjured animals.

## ENVIRONMENTAL EFFECTS OF FERROFLUIDS IN AN OIL SPILL

Mohit Gandhi

Southside High School

Here we report the environmental effects of ferrofluids to aide in the remediation of oil spills. Green algae were selected as the environmental medium. By the end of the experiment, the ferrofluid had negative repercussions on a long-term scale. The control group had consistent growth while the vegetable had a slight decrease in its population and then leveled off. Overall, it was concluded that if the ferrofluids were used short term and quickly removed it would be an effective method, but left prolonged it would have harsh consequences on the environment.

## THE ABSORPTION OF CITRATE-COATED NANOPARTICLES BY 3T3 FIBROBLAST CELLS

Nathan Gilreath

South Carolina Governor's School for Science and Mathematics

To be categorized as a nanoparticle, a particle must have a diameter of less than 100 nanometers. Currently, there is a huge demand for nanoparticles to be used in new technology, medicine, and other engineering purposes. Despite the popular demand, not much is known about the effects of these small particles. In the study, 3T3 fibroblast cells and 5-nm citrate-coated gold nanoparticles were used. These cells were plated in a gold nanoparticle concentration of 50 μg/ml, 25 μg/ml, and a nanoparticle free citrate control solution. Using transmission electron microscopy (TEM), the effects of the nanoparticles inside the cell were observed. In addition, confocal imaging was used to observe the pinocytosis at a 50 μg/ml gold nanoparticle concentration. After 24 hours of exposure to gold nanoparticles, gold nanoparticles visibly entered the 3T3 cells through as seen in the TEM. In the images received through confocal microscopy, few particles seem to be fully absorbed by the cells after only 270 minutes. Despite this, the cell did change morphology during this period due to the gold nanoparticles. This project was funded by South Carolina Governor's School for Science and Mathematics, Clemson University, SC LIFE, NIH K25 HL 092228.

## THE ABILITY OF AEROGEL TO ADSORB PHARMACEUTICALS FROM WATER

Jed Gist  
Spring Valley High School

The purpose of this experiment was to determine if silica-based aerogel is a viable and effective option for the filtration of household pharmaceuticals from water. This is important because a harmful amount of these drugs can be found in common water sources, and currently there is no efficient and cost-effective way to remove these drugs. It was hypothesized that silica-based aerogel would reduce the concentration of pharmaceuticals by at least 10% of their original concentration. Testing consisted of dissolving acetylsalicylic acid, acetaminophen, and ibuprofen separately into water, running each of the solutions through a burette "filter" containing silica-based aerogel granules, and then performing a titration on the filtrate to determine how much of the pharmaceutical remained. Each pharmaceutical was tested 30 times against a control of distilled water. A maximum of 91.71% of ibuprofen and a maximum of 10.69% of acetylsalicylic acid was removed from water. Acetaminophen results were inconclusive. The hypothesis (10% removal) was supported for ibuprofen, but not supported for acetylsalicylic acid. The theoretical maximum amount of pharmaceutical that could be removed by the aerogel was determined by plotting the quantity of pharmaceutical removed versus the total mL of pharmaceutical solution passed through the aerogel. In conclusion, silica-based aerogel was found to be a viable option for the filtration of ibuprofen from water.

## PROPRANOLOL REPURPOSING FOR DRUG RELAPSE PREVENTION

Chanté Glass-Walley  
South Carolina Governor's School for Science and Mathematics

Medical studies have shown that there are over 24 million U.S. residents over the age of 12 suffering from addiction. The majority of addicted individuals do not seek rehabilitation because the process appears intimidating and for individuals who do seek help, between 80 to 90 percent of rehabilitation attempts fail overall. Recent research in the Aston Jones lab of MUSC has tested and proven that the drug propranolol can be used to decrease the desire to seek a drug during a period where the drug is denied. Other research results show that propranolol could be used as treatment for stimulant, anesthetic and depressant drug rehabilitation. By repurposing propranolol, a new drug rehabilitation treatment can be created to aid addicts who are afraid of other procedures. In creating and providing this new treatment, a business can be formed.

## MULTISPECTRAL IMMUNOFLUORESCENT IMAGING OF PROGESTERONE RECEPTOR IN PREPUBERTAL HEIFERS AND ITS CORRELATION WITH FOLLICULAR ACTIVITY

Elizabeth Gregory  
South Carolina Governor's School for Science and Mathematics

The capacity for bovine milk production is established during prepubertal development. Mammary parenchyma greatly increases in size in the time from birth to puberty, and epithelial cells proliferate. Progesterone Receptor (PR) expression is controlled by estrogen and the bovine protein is located primarily in epithelial cells. Ovarian follicles emit estrogen, which then causes PR to be produced. PR signaling can cause alveolar growth and stem cell expansion. In ovariectomized heifers, PR is not detectable in the epithelia, but other information for prepubertal bovine PR expression is limited. If ovarian follicle activity is limited from birth through day 40, PR expression should also be low. To test our hypothesis, tissue samples were taken from heifers at seven day intervals starting at birth through day 42 and were embedded in paraffin. Samples were then sectioned and stained by immunofluorescence for PR detection. There was a significant effect of age on PR staining ( $P < 0.001$ ). Animals sampled at birth and later time points had detectable PR expression, but staining was minimal between day 7 and day 28. PR was more concentrated in areas of stratified epithelia, and heifers showing no PR had less stratified epithelia than heifers with PR. Animals with no detectable PR also had limited ovarian follicles, with the exception of a day zero calf that had no visible follicles but showed PR expression, likely because of maternal hormones. Changes in PR expression may therefore relate to important neonatal mammary development processes.

## THE EFFECT OF LOCATION ON THE WATER QUALITY FACTOR IN GILLS CREEK AT POINT FOREST LAKE AND POINT LAKE KATHERINE

Brooke Grice  
Heathwood Hall Episcopal School

Water quality is a term used to describe the chemical, physical, and biological characteristics of water. Water quality standards are used for the protection of water for designated uses such as drinking, recreation, agricultural irrigation, or maintenance of aquatic life. A major cause of water pollution is non-point source pollution, which is formed when rainwater carries everything in its path, such as dirt, grease, fertilizers, pet waste, and trash, and is deposited into nearby bodies of water. The purpose of this experiment was to compare the water quality factor at two contiguous points, at Forest Lake and at Lake Katherine along Gills Creek, in Columbia, South Carolina. It was hypothesized that the water quality factor would be greater at point Forest Lake than at point Lake Katherine. Nine different tests, temperature, pH, turbidity, total solids, dissolved oxygen, biochemical oxygen demand (BOD), phosphates, nitrate, and fecal coliform, were performed at the two

different locations along Gills Creek three times. The water quality factor was calculated from the combination of these tests, as measured using Vernier probes and bacterial strips. All chemical tests were performed in a controlled setting except for the temperature test, which was tested on-site. At a confidence level of 0.05, an ANOVA statistical analysis failed to reject the null hypothesis. Thus, these data supported the hypothesis that the water quality factor at point Forest Lake is greater than at point Lake Katherine. Further studies of the Forest Lake area would indicate environmental conditions with a more positive effect on water quality.

#### THE EFFECT OF VIRAL HPV16 E7 GENE EXPRESSION ON THE INFLAMMATORY RESPONSE IN HUMAN PAPILLOMAVIRUS INFECTED, EXFOLIATED, HUMAN CERVICAL EPITHELIAL CELLS

Shannon Hall  
Spring Valley High School

The effect of viral HPV16 E7 gene expression on the inflammatory response in human cervical tissue was studied through the expression of viral mRNA E7 protein in fifty-nine HPV16-positive cervical cDNA samples. It was hypothesized that lower levels of E7 gene expression would correlate with lower levels of interferon-gamma (IFN $\gamma$ ) expression since HPV16 evades the immune system. Each HPV16-positive cDNA sample was prepared for real-time PCR analysis. PCR well plates were prepared for each of the 59 HPV16 cDNA samples, each being run in duplicate to determine actin, IFN $\gamma$ , and E7 expression. Ct values and primer efficiencies were calculated for samples exhibiting primer expression; efficiency values were calculated using the Pfaffl method while Ct values were recorded from the RT-PCR machine. HPV16 E7 expression was 4.11 times higher and IFN $\gamma$  expression was 1.44 times higher in subjects with non-negative Pap smears when compared to those with negative Pap smears. Subjects with persistent HPV16 infections had 0.33 times higher E7 expression and 0.14 times higher IFN $\gamma$  expression compared to those who cleared the infection. Subjects that cleared the HPV16 infection had 3.01 times higher E7 expression and 7.18 times higher IFN $\gamma$  expression when compared to those with persistent infections. Correlations between E7 and IFN $\gamma$  expression existed in the following groups at  $\alpha=0.05$ : all samples,  $t(36)=4.31$ ,  $p<0.01$ , persisters,  $t(33)=4.06$ ,  $p<0.01$ , abnormal Pap results,  $t(12)=1.81$ ,  $p=0.048$ , and normal Pap results,  $t(22)=4.21$ ,  $p<0.01$ . Low levels of E7 and IFN $\gamma$  expression implied that HPV16 was not active and therefore did not initiate an immune response.

#### THE EFFECT OF WORMS ON THE CHANGE OF NUTRIENT VALUE IN SOIL WITH OR WITHOUT EGGSHELLS

Olivia C. Harden  
Heathwood Hall Episcopal School

The purpose of this experiment was to determine the effect of worms on the change of nutrient value in soil with or without eggshells. The hypothesis states that the nutrient values as measured by pH, organic matter, and concentrations of nitrate, phosphorus, potassium, calcium and magnesium of the soil with eggshells and combined with worms will increase more over a 36-day period than the nutrient value in soil with just eggshells. A LaMotte Soil test kit was used to measure nutrient values, for each soil over the 36-day period. There were four different soil treatments used in the experiment: soil, soil treated with eggshells, soil treated with worms, and soil treated with eggshells and worms. There were 3 jars of soil with its specific treatment for each soil and there were 4 trials run over a 36-day period. There was a statistically significant difference between the treatment groups for potassium, and phosphorus nutrient values as suggested by a p-test. The pH of the soil samples with treatments in them did become more neutral over the course of the experiment and therefore better for crop growth. The nitrate level in the soil with red worms and eggshell was the only treatment group to increase. The results show that a combination of eggshells and worm treatments can cause changes in soil nutrient values and therefore it could be beneficial to add nutrient rich organic matter in combination with red worms to soil used for agriculture to possibly enrich infertile soil.

#### INTRINSIC CHANGE OF NEURAL STEM CELLS IN THE AUDITORY NERVE

Luke Havens  
South Carolina Governor's School for Science and Mathematics

Hearing loss affects 36 million Americans and our only current treatments are the cochlear implant and hearing aid. Despite the discovery of stem/progenitor cells in the mammalian inner ear, no regeneration of either damaged hair cells or auditory neurons has been observed in mammals. Self-renewal and differentiation capabilities of cells derived from the auditory nerve of adult mice has been shown recently *in vitro* using a neurosphere assay. It was still unclear why these endogenous stem cells did not play a role in replacing damaged cells *in vivo*. We hypothesized that neural stem cells within the auditory nerve experience intrinsic changes with age in their ability to proliferate and differentiate. To test this hypothesis, *in vitro* neurosphere assay, *in vivo* and *in vitro* BrdU incorporation, and quantitative immunohistochemical analyses were used. The number of BrdU<sup>+</sup> cells within the neurosphere culture was compared to the results of BrdU analysis *in vivo*. Our data showed that self-renewal ability of the cells in the mouse auditory nerve decreased with age *in vivo* and *in vitro* equally. In addition, the changes of the cellular heterogeneity of the neurospheres derived from different postnatal ages were also analyzed using a set of markers for glial cells, neurons, and fibroblasts. Our data suggest that decreased regenerative ability constituted an intrinsic change in neural stem cell ability with age rather than an environmental one, explaining the inability of stem cells derived from the auditory nerve to repair damaged nerve fibers *in vivo* without outside intervention.

## COMPARISON OF PHOTOCATALYSTS, TiO<sub>2</sub>, SrTiO<sub>3</sub>, AND ZnS IN PHOTOCATALYTIC WATER SPLITTING UNDER ULTRAVIOLET IRRADIATION

David Hodge  
Spring Valley High School

The purpose of this study was to investigate the efficiency of semiconductors, titanium dioxide, strontium titanate, and zinc sulfide, in photocatalytic water splitting. Photocatalysis is a method that utilizes solar energy and light-absorbing catalysts to evolve hydrogen from water for its use in the hydrogen fuel cell. It was hypothesized that zinc sulfide, with a reported band gap of 3.68eV should yield the greatest output of H<sub>2</sub>, because the greater the band gap energy, the greater the volume of gaseous H<sub>2</sub> can be separated relative to another photocatalyst. Each photocatalyst was mixed with deionized water and injected by syringe into the hydrogen measurement apparatus. Each sample was exposed to ultraviolet irradiation by an Eliminator 400 watt black light (Amazon.com) in a controlled environment for four hours. The amount of H<sub>2</sub> produced was measured by the change in volume of solution due to the conversion of liquid solution into H<sub>2</sub> and O<sub>2</sub> gas. Results of the experiment showed that the average hydrogen production of strontium titanate and titanium dioxide, 0.352mL and 0.345mL respectively, was greater than the control group, 0.064mL, and zinc sulfide, 0.102mL. However, a one-way analysis of variance test,  $p = 0.237$  when  $\alpha = 0.05$ , indicated no significant difference between the means and therefore, the null hypothesis was not rejected. Although SrTiO<sub>3</sub> and TiO<sub>2</sub> showed greater hydrogen gas production than zinc sulfide and the control group, it was concluded that TiO<sub>2</sub>, SrTiO<sub>3</sub> and ZnS did not show a significant difference in photocatalytic water splitting under UV irradiation.

## BIOCIDAL EFFICACY OF COPPER AND BRASS AGAINST PATHOGENIC *PSEUDOMONAS AERUGINOSA*

Katharine T. Hoffman  
Heathwood Hall Episcopal School

There is increasing concern over the growing number of antibiotic resistant bacteria. *Pseudomonas aeruginosa* can be difficult to eradicate, is transmissible, and becoming resistant to more antibiotics. Copper and copper alloys have been investigated as potential antimicrobial surfaces and this study compares the biocidal potential of pure copper and copper alloys containing 85% and 70% copper. Clinical isolates of *P. aeruginosa* were inoculated onto copper, copper alloys, and glass surfaces and left in contact with the metal for 0, 30, 60, and 120 minutes. The samples were collected from the coupons and assessed for the presence of viable and non-viable cells. Detection of the ratio of living and dead cells was evaluated with *BacLight Live/Dead* stain technique. Copper was found to have the most biocidal efficacy with few viable cells being detected following exposure to the metal for 60 minutes. Statistical analysis for the results on the efficacy of the copper alloys showed no statistically significant data. Future research could study the mechanisms of copper induced bacteria death. Analyzing different bacterial strains and their resistance to copper could also be studied.

## ELECTROCHEMICAL REDUCTION OF CO<sub>2</sub> ON COPPER AND COPPER OXIDE ELECTRODES FOR SELECTIVE FORMATION OF HYDROCARBONS

John Isenhower  
South Carolina Governor's School for Science and Mathematics

The purpose of this research is to investigate the effect of surface morphology and size of copper-based nanoparticles on the electrochemical reduction of CO<sub>2</sub>, specifically involving increasing the surface area of the nanoparticles by decreasing the size while simultaneously obtaining a cubic surface morphology. These nanoparticles will act as catalysts for the electrochemical reduction of CO<sub>2</sub>, and their catalytic ability will be positively impacted by the increased surface area. Samples were synthesized using a solution of organic solvents and copper acetate to which heat was applied. Electron microscopy, electrochemical tests, U.V. visible microscopy, and x-ray diffraction were used to determine the size, shape, and effectiveness of the particles. The temperature at which synthesis occurred seems to affect the size of the particles, while the chemicals used as surfactants and the atmosphere created around the reaction seem to affect the purity of the copper and its morphology. These nanoparticles will have applications in many technologies, such as fuel cells. They will also be able to assist in the cleaning up of the greenhouse gas CO<sub>2</sub>.

## COLORIMETRIC QUANTIFICATION OF FERMENTABLE SUGARS IN *PUERARIA LOBATA* FOLLOWING TREATMENT WITH DIFFERING LIGNOCELLULOSIC PRETREATMENT TECHNIQUES

Bushra Islam  
Spring Valley High School

As non-renewable resources are quickly depleting, sources of energy derived from non-edible plants, such as Kudzu, are emerging as viable sources for the production of cellulosic ethanol. The purpose of this experiment was to determine the most effective method of lignocellulosic pretreatment on Kudzu leaves to yield the highest percentage of fermentable sugars. It was hypothesized that treating Kudzu samples with a white-rot fungi mixture would result in the highest yield of fermentable sugars in the samples after 48 hours. Kudzu leaves were pretreated using differing techniques in order to break the lignocellulosic material in the samples. Kudzu leaves were acquired, shredded to 0.02 kg piles, and placed into 25 separate

bottles. Each pretreatment method was tested on 5 samples for 24 or 48 hours. The pretreatment methods were sulfuric acid ( $H_2SO_4$ ), sodium hydroxide (NaOH), steam, water, and white-rot fungi (*Phanerochaete chrysosporium*). The Somogyi Nelson Colorimetric Quantification Method of Carbohydrates was then used to examine the concentration of fermentable sugar present in the samples. The average absorbance values (500 nm) were highest for the white-rot fungi pretreated samples, indicating higher sugar concentration at an average of 0.973 g/L. The average absorbance values for sulfuric acid and sodium hydroxide pretreated samples were nearly equal, with sugar concentrations of 0.915 g/L, while the data for the steam-catalyzed samples was in between that of the white-rot fungi and both chemically treated samples. At  $\alpha=0.05$ , there was a significant difference between the white-rot fungi group and all other groups, besides steam catalyzed,  $F(4, 20)=18.76$ ,  $p<0.001$ .

#### THE EFFECTS OF LEGACY AND CURRENT LAND USE ON STREAM VERTEBRATES IN THE PIEDMONT REGION NEAR GREENVILLE, SOUTH CAROLINA

Alexandria S. Jeffers  
South Carolina Governor's School for Science and Mathematics

Little research has examined the influence of current and legacy agricultural land uses on stream ecosystems. Previous studies in rural areas of the SC Piedmont have discovered lower diversity and an overall homogenization of fish populations in the streams, possibly caused by current and historical land use. The goal of this project was to determine the effects of both legacy agriculture (cotton farming from 1880 to 1950) and current agricultural use (especially row crop and pasture) on the biodiversity of fish in streams in the Piedmont region near Greenville, South Carolina. To collect data for fish diversity studies, 11 streams were sampled using an electrofishing technique for six minutes. Streams selected were of approximately equal watershed area, but varied with respect to the amount of current agricultural land cover. All fish collected were anesthetized, preserved, and sorted using a dichotomous key. Copper and arsenic were used in pesticides during the Cotton Era and could continue to have negative effects on stream biota, thus, water and soil samples were collected to test for copper and arsenic levels as well as many organic compounds and heavy metals. From this research, it can be concluded that there are strong correlations between water chemistry in rural or forested sites and the land that surrounds them to the overall health of the fish populating those streams. In the future, this project will continue to analyze the specific effects of agriculture on stream biota diversity within these watersheds for reference and comparison.

#### THE EFFECTS OF BRAIN DOMINANCE ON THE ACCURACY AND SPEED OF COMPLETION OF THE STROOP TASK IN TEENAGERS

Michaela D. Jenkins and Sunaina Kapur  
Heathwood Hall Episcopal School

Discovered by John Ridley Stroop in the 1930's, the Stroop Task has been analyzed for years. A color word is given, printed in the same or different color than the word is written in. The participant is to say the color that the word is written in. Color words are arranged and recorded in a table. Different parts of the brain, categorized by right or left brain, struggle against each other in the Stroop Task. Individuals have differently strengthened parts of the brain, and some are more dominant on one side of the brain than another. It was hypothesized that right brain dominant individuals would have a higher accuracy and faster speed of completion at the Stroop Task than those who are left brain dominant. Nine participants were analyzed for brain dominance and were categorized by left, right, and middle brain dominance. They were then given a Baseline Stroop Test and a Stroop Task. Results were recorded for time and accuracy in a table. Statistical analysis showed one statistically significant difference, the difference between right brain dominant individuals versus middle brain dominant individuals over percent change in time from the Baseline Test to the Stroop Task, while the rest showed no statistically significant difference. Participants with middle brain dominance had the greatest accuracy on the Stroop Task. Participants with left brain dominance took the least amount of time on the Stroop Task. Future studies could give an arbitrary amount of time for each word.

#### FABRICATION AND EVALUATION OF PLATINUM CATALYST PEM FUEL CELL ELECTRODES FOR SPACE FLIGHT APPLICATION

Joshua Lee Johnston  
South Carolina Governor's School for Science and Mathematics

Space flight application requires that stringent durability requirements be met. These requirements necessitate that an unsupported platinum catalyst be used in order to provide the performance needed in space flight. The target performance set by NASA was a current density of 200 mA/cm<sup>2</sup> at about 0.9 volts. In this study, membrane electrode assemblies (MEA's) were fabricated for use in Polymer Electrolyte Membrane fuel cells (PEMFC's), using a low-temperature decal transfer method, a catalyst-coated membrane (CCM) or a gas diffusion layer (GDL). Several substrates were tested in order to find a material that transferred the electrode most effectively using the decal transfer method. A gas diffusion electrode (GDE) was fabricated by coating a carbon paper composite membrane. An ultra-sonic sprayer was used to disperse the electrode uniformly onto the substrate. Two GDE's were hot pressed to a Nafion® membrane to form the anode and cathode of a multilayer MEA. The CCM was then hot-pressed in order to ensure integration of the layers, which lowered interfacial

contact. Each MEA was placed inside of a fuel cell tester and connected to a fuel cell test station which ran standard performance characterization analysis. A potentiostat was used for additional electrochemical tests including a cyclic voltammetry test. Each method was compared and the most effective method was found to be the GDE method.

#### THE CORRELATION BETWEEN DAY OF THE WEEK AND STUDENT DRESS HABITS

Alsten Jones  
Spring Valley High School

Businesses, companies, and even schools, nationwide are experiencing a Dress-up in the workplace phenomenon (Rafaelli, 2003). Many businesses believe that this could add incentive to their employees and also increase work ethic in the work place due to the better attitude about them. The purpose of this experiment was to statistically analyze the correlation between the day of the week and dress patterns to determine if this "Dress-up Friday" phenomenon is true. It was hypothesized that 60% of the students chosen for the dress analysis would rate at least a 9, qualifying them as dressy. The researcher placed himself at a vantage point watching and systematically (every 5th person) rating arriving students. After each subject was scaled on attire, the researcher recorded each total sum. Once all the data were collected for all five days of the week it was statistically analyzed using a one-way ANOVA with alpha at 0.05. The results showed that the p-value was greater than alpha at  $0.41(4,145)=p>0.001$ ,  $p=0.926$ , causing the null hypothesis to not be rejected; disproving the hypothesis. It was concluded that although dress may affect work ability or demeanor in the work place it does not correlate with the day of the week, at least in this setting.

#### THE DURABILITY OF NAIL POLISH WITH RESPECT TO COLOR

Charlotte Jones  
Heathwood Hall Episcopal School

Nail polish, in a wide array of colors, is a cosmetic product utilized around the world; however, darker nail polish colors have long been suspected to chip and fade more easily. This experiment tested the relationship between color and durability. In this experiment, durability is defined as the ability to withstand pressure from a piece of fine sandpaper without chipping or fading. The purpose of this experiment is to determine whether nail polish color is a variable for durability. It was hypothesized that the durability of nail polish with respect to color as determined by the differences of masses, will decrease as the brightness of the color increases: white to dark red. The null hypothesis was no difference of mass exists between the colors. In order to test the durability of nail polish, two coats of nail polish were painted on pieces of acetate, soaked in water for two hours, and weighed for their original weight. Each color swatch was stroked 60 times then the mass after was recorded, with two trials and five repetitions. Analysis of differences among the colors of nail polish at a confidence level of 0.05, failed to reject the null hypothesis. Since nail polish and nail treatments are a modern luxury, this experiment may help nail salons and consumers dispel the rumors that darker nail polishes are less durable and thus have more choices in durable nail polishes.

#### THE EFFECT OF MILD LEAD NITRATE STRESS ON *RAPHANUS SATIVUS*

Chantaezia Joseph  
Spring Valley High School

Heavy metals are defined as any metallic chemical element that have high densities and that is toxic to the environment. These metals are among the chief environmental contaminants that still stand as severe threats to plant, animal, and human health due to how long they remain in environments. Many plants, such as *Raphanus sativus* (or known as radish seeds), have high retention periods of heavy metals, thus leading to massive contamination among an ecosystem. The purpose of this study was to observe the effects of different concentrations of lead nitrate on *Raphanus sativus*. It was hypothesized that the higher concentrations of the heavy metals, the more detrimental the effects would be on the plants. There were two groups of 23 plants, with one group receiving 20 ml of 0.5 molar of lead nitrate-contaminated water and one serving as a control. After a period of two weeks, the plants' growth was recorded and compared to the control group. As a result, the raw data showed a significant difference between the mass of the control and the experimental groups, favoring the control group, which had higher masses. This significant numerical difference between the masses of the two groups of plants was supported by a two sample t-test, which showed a calculated p value of 0.0171, which was less than  $\alpha$  at 0.05, and thus supported the hypothesis.

#### A RETROSPECTIVE STUDY OF THE PRESENCE OF THE BETA- LACTAMASE GENE IN AMPICILLIN RESISTANT BACTERIA ISOLATED FROM WITHIN THE CHARLESTON HARBOR AREA, SC

Chelsea Joseph  
Heathwood Hall Episcopal School

The purpose of this experiment was to investigate the presence of the Beta- lactamase gene in Ampicillin resistant bacteria isolated from the anal swabs of bottle-nose dolphins in the Charleston Harbor Area, SC. This was done by obtaining the bacterial isolates from the Charleston Harbor Area and then proceeding to streak plates containing LB Broth in order to allow



the bacteria to grow. Additionally, 2 *E. coli* cultures were grown to serve as positive controls for the Beta- lactamase gene and 1 to serve as a negative control. The isolates were then placed in an incubator and left to grow overnight. One bacterial colony was picked from each previously streaked plate and placed into a separate test tube via sterile toothpick. Two PCR's were performed on these colonies, one using the 16S Ribosomal RNA primers and one using Beta- lactamase primers to amplify the 16S Ribosomal RNA gene and the Beta- lactamase genes, respectively. The samples were then run through on a 1% agarose gel in TAE Buffer, using gel electrophoresis. The gel was run at 100 V for 30 minutes. It was stained with Ethidium Bromide and examined under UV light to determine whether the Beta- lactamase gene was present. The results indicated that the protocol did not work since the 16S Ribosomal RNA gene was not amplified in samples. Therefore, no conclusions can be made about the presence or absence of the Beta- lactamase gene.

#### THE EFFECTS OF QUERCETIN ON BREAST CANCER PROGRESSION

Supriya Juneja  
Dutch Fork High School

It is believed that non-genetic factors like diet play a role in the progression of cancer and that dietary flavonoids have beneficial properties. Supplements like quercetin are being tested as angiogenesis inhibitors, which diminishes the nutrients being produced for the support of tumor growth, as well as antioxidant, and anti-inflammatory properties. In this study, the objective is to determine how varying amounts of quercetin in daily diet affect tumor progression in breast cancer using five groups of female C3(1)SV40Tag mice. Two groups are controlled and the last three have varying amounts of quercetin. Each week, food consumption will be measured and correlated with body mass and tumor sizes. Upon sacrifice, tumors will be collected for further measurements and statistical analysis. The hypothesis indicates that tumor progression will decrease consistent with the amount of quercetin present. Currently, the experiment shows a higher volume of tumors in the control mice and the 2% group with a large deviation from the .02% and .2% groups. If this trend continues for the duration of the research, a positive relationship can be established with the smaller dosages.

#### ELECTROPHORETIC INVESTIGATIONS OF THE INTERACTION OF POTENTIAL CHROMIUM (III) ANTI-CANCER DRUGS WITH DNA

Caitlin Keen  
South Carolina Governor's School for Science and Mathematics

During their lives, approximately one-third of American women and one-half of American men are affected by cancer. Cancer involves the abnormal growth of cells, which spread to healthy tissues within the body. Current cancer drugs, such as cisplatin, inhibit the expansion of cancerous tumors by forming intrastrand crosslinks with DNA. Although cisplatin effectively kills cancerous cells, it has many side effects. The research conducted was done to study the interaction between different photoactive chromium (III) complexes and DNA, with the ultimate goal of developing a better cancer treatment. The use of photoactive transition metal compounds in cancer therapy could make the targeted treatment of cancerous tumors possible. Targeting diseased cells would lessen the side effects suffered by cancer patients undergoing therapy. Studies with gel electrophoresis, liquid chromatography, and the polymerase chain reaction have shown that Cr(III) complexes with the dipyrrophenazine intercalating ligand react with DNA following photoactivation at 350 nm. During the study, two main factors impacting the interactions between chromium (III) compounds and DNA were examined using agarose gel electrophoresis: the number of intercalating ligands in the metal complexes and the ratio of chromium to DNA in the prepared solutions. Direct relationships with the rate of DNA degradation were determined for both of the variables studied. Future work may involve studying the interaction between DNA and other photoactive metal compounds or performing different tests to examine the reaction.

#### EFFICIENCY OF BREAKING DOWN CELLULOSE INTO BETA-GLUCOSE

Anurag Khandavalli  
Southside High School

This goal of this experiment was to determine whether beta-glucose could be successfully extracted from the cellulose in kudzu. This was determined by measuring the amount of ethanol that was created by distilling the beta-glucose containing biomass. The procedure consisted of decomposing harvested kudzu into beta - glucose by means of abiotic and biotic decomposition. This decomposition process included the pressure cooking the kudzu in order to liberate the cellulose and the addition of enzymes to create an acidic environment. The enzyme Cellulase was then added to the kudzu in order to facilitate the breakdown of the cellulose into beta glucose. The resulting biomass was then tested for the content of beta-glucose by distilling the biomass. The amount of ethanol that was obtained from the distillation of the kudzu biomass was minimal and insignificant suggesting that this method to extract beta-glucose from the cellulose in kudzu was inefficient and unsuccessful.

## COMBINATION THERAPY ALTERED SPECIFIC MICRORNA LEVELS AND INCREASED DIFFERENTIATION AND APOPTOSIS IN MALIGNANT NEUROBLASTOMA CELLS

Mehrab Khandkar  
Spring Valley High School

Malignant neuroblastoma is a childhood tumor that originates from immature neuroblasts, typically, from adrenal glands. Currently available therapeutic strategies are inadequate to cure malignant neuroblastoma, leading to death of affected children at a pre-school age. In this investigation, a combination of two therapeutic agents, 4-(N-Hydroxyphenyl)-retinamide (4-HPR) and epigallocatechin-3-gallate (EGCG), was used for treatment of human malignant neuroblastoma SK-N-BE2 and IMR-32 cells. MTT assays were performed to get an optimum inhibitory concentration for the combination therapy of the two drugs. Methylene Blue staining and Wright Staining were performed to observe effects of the drugs on the morphological features of differentiation and apoptosis, respectively. The alteration of expression levels of different microRNA after drug treatment were observed and it was shown that combination therapy of 0.5  $\mu\text{M}$  4-HPR and 50  $\mu\text{M}$  EGCG was most effective against both neuroblastoma cells. Treatment with 0.5  $\mu\text{M}$  4-HPR for 72 hours induced neuronal differentiation in both SK-N-BE2 and IMR-32 cell lines. *In situ* Wright staining showed the morphological changes in apoptotic cells after combination therapy. It was also observed that treatment with 0.5  $\mu\text{M}$  4-HPR and 50  $\mu\text{M}$  EGCG alone or in combination resulted significant changes of expression of oncogenic as well as suppressor microRNAs in both cell lines, as well as differences in the expressions of proteins. The suppressor type microRNAs were shown to inhibit growth of neuroblastoma cells and promote the induction of apoptosis in treated cells. Therefore, ectopic expression of different miRNA along with 4-HPR or EGCG could be used as a potential therapeutic regimen for effectively controlling the growth of human malignant neuroblastoma.

## THE EFFECT OF THE DISPERSION OF HOUSE HOLD AEROSOL SPRAYS ON THE COMBUSTIBILITY OF COTTON/POLYESTER BLENDS

Paul Kim  
Spring Valley High School

The purpose of the research was to investigate the flammability of fabrics when common household aerosol sprays were applied and allowed to dry. Benefits gained by conducting this experiment are that consumers would be better informed on the use industrial and personal care products with caution. It was hypothesized that when the aerosol residue was present, the flammability of the fabrics would increase. The commonly used household spray, the hairspray and the disinfectant, was dispersed on to fabric samples by aerosol spray propellants and left to dry for 10 minutes. To conduct the tests, methods included placing a sample of fabric above an alcohol burner and measuring the time it took for the fabric to break apart. Four trials were carried out for each cotton/polyester blend, including 100% cotton, 100% polyester, and 50/50 polyester/cotton when dispersed with a disinfectant spray and then a hair spray. Two sample t-tests were run on the burn times for treated and non-treated fabrics of both variable groups ( $\alpha=0.05$ ). The burn times of the 100% cotton,  $t(6)=2.0393$ ,  $p=0.0875$ , and the 50/50 blend group,  $t(6)=1.6134$ ,  $p=0.1578$ , significantly decreased when treated with the household aerosol sprays; the hypothesis was supported. When the 100% polyester samples were tested, the sprays seemed to have a less than significant effect on the burn times,  $t(6)=24.02410$ ,  $p<0.001$ .

## A COMPARISON OF THE RATE OF GROWTH OF ESCHERICHIA COLI AT THREE DIFFERENT TEMPERATURES (FREEZING, REFRIDGERATED, AND ROOM) ON ORGANIC BEEF AS OPPOSED TO NON-ORGANIC BEEF

Cecelie Kondapaneni  
Heathwood Hall Episcopal School

People are sickened each year by *E. coli* contamination in their beef. The purpose of this study was to determine if there was a difference of bacteria growth on organic beef vs. non-organic beef at three different temperatures (freezing, refrigerated, and room). The hypothesis of this experiment is if organic and non-organic beef is placed in three different temperatures, then the growth rates would be the highest for the room temperature of non-organic beef. The null hypothesis of this experiment is if organic and non-organic beef is placed in three different temperatures, then the growth rates would be the same for all three climates on organic beef as opposed to non-organic beef. Due to limited data no inferential statistical tests could be performed. However, after analyzing the limited data, it could be concluded that the non-organic beef had a higher contamination of *E. coli* bacteria than the organic beef. The results of this study support the hypothesis and reject the null hypothesis.

## THE EFFECTS OF SURFACE ROUGHNESS ON THE PRODUCTIVITY OF THE DISK SKIMMER

Tom Krouglicof  
Southside High School

A disk skimmer uses a rotating disk that separates an oil slick from the ocean. The oil adheres to the disk and is then wiped from the surface and collected in a separate container. Although disk skimmers are very efficient and pick up no water, they clean up the oil slowly compared to other methods such as chemical dispersants. The goal of this project is to determine the effects of surface roughness on the output of the disk skimmer. To create the disk skimmer, plastic CDs were used as the disk and various grits of sand paper were rubbed on each of the disks to give them a surface roughness. Each CD was connected to a rotating motor and the bottom half of the CD was placed into a container that contains both water and oil. The oil that adheres to the disk was wiped off using a rubber strip and sent into a trough that leads to a collection container. For the experiment, the time for the disk skimmer to collect 250 mL of oil into the collection container was recorded with each of the CDs and multiple trials were run. The results for the CDs with None, Fine, Medium, and Coarse surface roughness were 0.579 L/Min, 0.649 L/Min, 0.676 L/Min, and 0.742 L/Min, respectively. Overall, by applying surface roughness to the CD, the increased surface area gave the oil more area to adhere to. For future experiments, by doing it on a larger scale rather than on a small prototype, it would make it easier to both measure the oil accurately and see the effects of the disk skimmer in an ocean-like environment.

## REGIOSELECTIVE PHOTOOXIDATION OF ALKENES WITHIN THE CONFINED ENVIRONMENT OF A MACROCYCLE

Tori Laird  
South Carolina Governor's School for Science and Mathematics

A macrocycle is an organic molecule arranged in a ring structure with at least twelve carbon molecules. It was hypothesized that if a photooxidation reaction occurred within a confined environment, such as a macrocycle, that the reaction would be more selective for the desired products. A selective reaction costs less and takes less time to perform. The solid macrocycle crystals were soaked in 2-methyl-2-pentene, in its liquid state. The 2-methyl-2-pentene was loaded into the macrocycle and irradiated with UV light. The 2-methyl-2-pentene loaded in a ratio of 4:1 macrocycle molecules to 2-methyl-2-pentene molecules as determined by NMR and TGA. Due to conflicting results, no conclusion could be made on if the reaction occurred. These conflicting results could be due to humidity in the air. Future work for this research project includes further testing with 2-methyl-2-pentene and with other alkenes.

## MICROWAVING PANSY PLANTS: ENVIRONMENTAL EFFECTS OF MICROWAVE RADIATION

Abisshek Lakshman  
Southside High School

We set out to determine if microwave radiation coming from cell phones could be a potential danger to humans. Since there is controversy about radiating humans with microwave radiation, we decided to use pansy plants. These plants grow well during the winter and have certain living requirements. For the experiment we radiated the plants with microwave radiation from a microwave for eight seconds every day. We measured changes in the height of each plant, moisture level of the soil, and the physical changes in the plants' leaves for nine days. At the end of the experiment, there were drastic differences in the moisture level between the control and experimental plants. The soil in the control plants was moister than the soil in the experimental plant. Moreover, pictures of the plants show that the control plants were healthy, while the experimental plants were slowly dying during the nine day period. Looking at the height of the plants, it can be seen that the control plants were able to maintain a constant height while the experimental plants' height was slowly falling. Our results show that microwaves have effect on the biological and environmental aspects of the plants, but there is not enough evidence to conclude that the level of microwave radiation from cell phones is detrimental to human life.

## THE INTERACTION OF BIOLOGICAL TRANSITION METALS WITH THE CALCIUM DYE FLUO-5N

Daniel Lamm  
South Carolina Governor's School for Science and Mathematics

In order to measure ion concentrations on the cellular level, many biologists use fluorescent dyes. These dyes are designed to bind to a specific metal ion in solution and then fluoresce. Though these dyes are intended to bind to one metal, there are sometimes multiple metals attracted to the dye. This study focused on the fluorescent dye Fluo-5N which is designed to bind to higher levels of  $\text{Ca}^{2+}$  in solution. The purpose of this study was to test for metals that may produce unintentional binding with Fluo-5N. With a spectrofluorometer, the metals  $\text{Ca}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Pb}^{2+}$ , and  $\text{Zn}^{2+}$  were tested with Fluo-5N.  $\text{Cd}^{2+}$ ,  $\text{Ca}^{2+}$ , and  $\text{Pb}^{2+}$  were found to display fluorescence with Fluo-5N while  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ , and  $\text{Zn}^{2+}$  were found to have no attraction. Dissociation constants that described the attraction for each metal were also calculated.  $\text{Ca}^{2+}$  was found to have properties and an attraction for Fluo-5N that correlated with previous findings.  $\text{Cd}^{2+}$  was found to be the most responsive Fluo-5N while  $\text{Pb}^{2+}$  was found to be the least responsive.

## THE EFFECT OF SIBLINGS ON THE FALSE BELIEF UNDERSTANDING OF THREE AND FOUR YEAR OLDS

Nicole Lazar  
Spring Valley High School

One of the world's greatest enigmas is the human mind, yet it is one of the most studied topics. The mental development of children is also just as fascinating because children mostly learn from the people in their environment, such as their parents and siblings. False belief is where someone acts on false information, lies, or on deception. Scientists have discovered that children develop an understanding of false belief from the ages of three to four. The purpose of this project was to observe the effects of siblings on the false belief understanding of three and four year olds. It was hypothesized that children with siblings would have a better understanding of false belief. Three and four year olds from a daycare with siblings or no siblings were shown different models and were asked different questions depending on the scenario. Children understood false belief if they answered one of the questions targeting false belief correctly. There was no significant difference between the children with siblings and the children without siblings,  $t(6)=0.64$ ,  $p=0.64$ , possibly because the sample size was too small. The hypothesis was not supported, but there was a significant difference,  $t(5)=-2.61$ , ( $p=0.038$ ), between the three and four year olds, as supported by studies.

## THE EFFECT OF THE 2007-2009 RECESSION ON AUTOMOBILES REGISTERED FOR PARKING AT A SUBURBAN HIGH SCHOOL

DJ Lee  
Spring Valley High School

A recession, which is not to be mistaken with a depression, is a decrease in economic activity and results in a high number of job losses and less spending from consumers. According to the National Bureau of Economic Research (NBER), the U.S. economy entered a recession in December 2007 through June 2009. The purpose of this study was to determine if there was a correlation between the age of a driver and the recent recession on the frequency of different car models registered for parking at a high school. The biodiversity and evenness of sedans and trucks/SUVs registered for parking by staff and students were also observed. It was hypothesized that the recession would have had an effect on the frequency of automobiles registered to park at a suburban high school for faculty and students. The diversity and evenness of the vehicles were calculated using the Shannon index. Diversity and evenness were compared using bar graphs. Two sample t-tests were conducted to observe the relationship between frequency of the vehicles and the recession. For trucks/SUVs owned by staff, at  $\alpha=0.05$ ,  $t(175) = -0.36$ ,  $p = 0.716$ . For sedans owned by staff, at  $\alpha=0.05$ ,  $t(168) = 3.16$ ,  $p = 0.002$ . For trucks/SUVs owned by students,  $t(176) = 0.55$ ,  $p = 0.581$  at  $\alpha=0.05$ . The test for sedans owned by students was  $t(241) = 0.75$ ,  $p = 0.453$  at  $\alpha=0.05$ . The hypothesis was partially supported because the recession only had an effect on sedans owned by staff.

## THE EFFECT OF POLARITIES OF LIQUIDS ON THE AMOUNT OF BISPHENOL A RELEASED FROM PLASTICS

Karen Lee  
Spring Valley High School

The purpose of this study was to give an accurate understanding of the risk of using plastic containers that consist of Bisphenol A. Bisphenol A is used in the manufacture of polycarbonate plastics. Many fear exposure to the chemical because it is an endocrine disrupting compound. This experiment presents the solubility of Bisphenol A respective to the polarity of the solution. Bisphenol A is a non-polar substance. Therefore it was hypothesized that as the polarity of the solution increased, the amount of Bisphenol A leached from plastic containers would decrease. To carry out the experiment, solutions with various polarity levels were poured into water bottles containing Bisphenol A for a set period of time under controlled environments. Solutions of different polarity levels were prepared by adding different amounts of sodium chloride to the distilled water. Concentrations of 10 ppm, 30 ppm, 50 ppm, 70 ppm were prepared. Pure distilled water was used as a control. 8 trials were held for each of the 5 polarity levels. To find the Bisphenol A concentrations in each testing solution, Iron (III) chloride was used as an indicator. The results were tabulated according to the indicator color change. A correlation coefficient test was conducted, along with significance testing using the PPMC at  $\alpha=0.05$ . The results revealed positive and significant correlations between the salt concentrations of the solutions and the amount of Bisphenol A released. The correlation coefficient for the solutions placed under shade, sunlight, microwaved shade, and microwaved sunlight showed a significant positive correlation  $r(4)=0.988$ ,  $p=0.0016$ ;  $r(4)=1.000$ ,  $p=0$ ;  $r(4)=0.993$ ,  $p=0.00069$ ;  $r(4)=0.958$ ,  $p=0.01446$  respectively. Hence the hypothesis was supported.

## THE REGULATION OF OSTEOPROTEGERIN EXPRESSION BY P62<sup>P392L</sup> MUTANT IN PAGET'S DISEASE OF BONE

Angela Li  
South Carolina Governor's School for Science and Mathematics

Paget's disease of bone (PDB) is a major bone disease that causes bone pain and bone deformity in a localized area. Several mutations have been identified in p62 gene, and p62<sup>P392L</sup> is the most common form seen in PDB patients. Bone forming osteoblasts and bone resorbing osteoclasts maintain a healthy cycle of bone remodeling. The interaction of NF- $\kappa$ B (RANK)

expressed on osteoclast cells and NF- $\kappa$ B ligand (RANKL) expressed on osteoblast precursor cells induce osteoclast differentiation and bone resorption. PDB is characterized by an increased amount of osteoclasts, an increased number of osteoclast nuclei, and more bone resorption activity resulting in high bone turnover. Osteoprotegerin, OPG, is a decoy receptor that acts like the RANK and suppresses osteoclast formation. It was hypothesized that mutant p62<sup>P392L</sup> suppresses OPG expression and thereby, stimulates osteoclast formation. To test this hypothesis, p62<sup>P392L</sup>, p62 wild type, and empty vector were transfected into SAKA-T bone marrow stromal cells. Western blot analysis indicated a significant decrease in OPG expression compared to wild type and empty vector transfected cells. Furthermore, real-time PCR analysis of isolated RNAs showed a significant decrease in OPG mRNA expression in these cells. These results suggest that p62<sup>P392L</sup> mutation associated with PDB inhibits OPG expression and that OPG could be a possible therapeutic agent to prevent high bone turnover in patients with PDB.

#### USING MAIN GROUP ELEMENTS TO DIMINISH OZONE DESTRUCTION

Johnathon Long  
Timberland High School

The effects of ozone in the upper atmosphere are essential to the survival of life on Earth. In the upper atmosphere (specifically, the stratosphere), ozone filters harmful ultraviolet radiation from sunlight. Ozone is the most intensely studied compound in the atmosphere because of its ability to filter biologically harmful wavelengths of radiation (Elliott & Rowland, 1987). This ultraviolet radiation is highly energetic and would damage both plants and animals exposed to it. Ultraviolet radiation with wavelengths between 240 and 290 nm is not absorbed by oxygen molecules. This radiation is instead absorbed by ozone.

If chlorine is the cause of ozone depletion in the upper atmosphere than what could be used to remove the chlorine from the upper atmosphere? Using an ozone generator model ZO-30N and an ozone detector model 106-M, compounds representing elements in the alkaline earth metals of the periodic table were tested as to their effectiveness at reacting with the chlorine in the stratosphere. The chlorine was generated and injected into the ozone chamber. Compounds were then added to the chamber and the ppm of the ozone and chlorine were monitored for 2 hours each. Barium Hydroxide was the only compound tested that actually caused the ozone levels to rise above the initial amounts.

#### LETHALITY OF PROTEIN DOMAINS IN PROKARYOTIC ORGANISMS

Michael Lu  
South Carolina Governor's School for Science and Mathematics

Understanding the functionalities of proteins is an important task in the post genome era. Most proteins consist of multiple domains. In this study, the probability of lethality for domains in eleven different prokaryotic organisms was calculated. This project demonstrated that the different protein domains have different probabilities of lethality. Multiple programs were constructed to obtain the probabilities. The domain of each individual organism was processed to calculate the probability of lethality and then cross referenced with domains of other organisms to determine the weighted factor of each domain. Three domains with a lethal probability above fifty percent were found to exist throughout all eleven of the organisms, and twenty-four lethal domains were found in ten of the eleven organisms. The Gene Ontology (GO) of those common lethal domains was explored and the function of the lethal domains was recorded. Implication of this research may lead to further understanding of lethal protein function and the effects of interactions between essential domains.

#### DETECTING METAMORPHIC MALWARE: A CASE STUDY

Joseph Marazzo  
Spring Valley High School

This paper analyzes the ability of antivirus programs widely used in 2011 to detect metamorphic malware created by Next Generation Virus Creation Kit (NGVCK). NGVCK is a freely available metamorphic engine that applies code obfuscation techniques in order to "camouflage" malicious source code. It was hypothesized that all twenty of the tested antivirus programs would detect 0% of the NGVCK malware. The creation, execution, and scanning of the NGVCK malware was conducted within a Windows 7 virtual machine, using the Oracle VirtualBox program. Each of the twenty antivirus programs scanned the same set of 100 NGVCK malware files. Of the twenty antivirus programs, thirteen detected none of the NGVCK malware. This paper confirms that NGVCK malware, a threat that has been known for ten years, has not been addressed by the majority of antivirus products. This paper also confirms that there is no significant difference in the rate of detection of NGVCK malware between antivirus products that are purchased compared to free antivirus programs. Although scientifically proven methods of detecting 100% of NGVCK malware have been developed, such as the Hidden Markov Model (Venkatesan and Stamp, 2008), nineteen of the twenty antivirus products did not detect all 100 of the NGVCK malware in this experiment. The mean detection rate for antivirus was 16.2%. This paper illustrates that antivirus developments lag behind the developments of malware creators and supports previous researchers' conclusions that Windows users are vulnerable to old and new malware threats.

## ATURAL EXTRACTS AS CHEMOIMMUNOTHERAPEUTICS IN MULTIPLE MYELOMA

Maya Mason  
South Carolina Governor's School for Science and Mathematics

Current treatments for multiple myeloma are chemotherapy and radiation, which have high toxicities resulting in many dangerous side effects. This has led to research into the use of natural products, which may exhibit lower toxicities, as drug treatments. In this study, gandoeric acid DM (GA-DM), an immune-strengthening compound found in *Ganoderma lucidum* mushrooms, was evaluated as a chemoimmunotherapeutic along with resveratrol (RES), a compound found in the skin of grapes that has been shown to induce apoptosis in several cancer cell lines. It was found that both GA-DM and RES induce significant levels of dose-dependent cell death in two multiple myeloma cell lines (ARH 77 and RPMI-8226 DOX 40) through an MTS cytotoxicity assay. All analyses of proteins involved in apoptotic or autophagic cell death were done by Western blotting. Results indicated that Caspase 3 expression was upregulated in both cell lines treated with RES. Expression of the pro-apoptotic protein, BAX, was also found to be increased in GA-DM and RES treated RPMI-8226 DOX 40. It was further determined that cell death may be partially attributed to increased autophagy, through upregulation of the LC3B protein in both cell lines. GA-DM treatment of RPMI-8226 DOX 40 cells increased expression of HLA class I, which suggested enhanced antigen presentation. Based on these results, it was determined that both drugs may induce autophagy and apoptosis in multiple myeloma cells and that GA-DM may enhance antigen presentation in RPMI-8226 DOX 40, warranting further investigation into their modes of action and feasibility for future therapeutic use.

## ADHESIVE STRENGTH OF D-LIMONENE ON EXPANDED POLYSTYRENE MIXTURES

Stefanie Martin  
Spring Valley High School

The purpose of this experiment was to find a convenient solution to the overflow to expanded polystyrene by turning it into an adhesive through solubilization with d-limonene. The hypothesis was that using 2mL of d-limonene per gram of expanded polystyrene would yield the most efficient adhesive. The mixtures were made and then the glue was applied to small pieces of sheet metal. Another piece of metal was set on the first and they were left to dry for eleven days, after which they were tested using a shear test. They were tested with a Vernier Lab Pro and a dual range force probe. The hypothesis was disproven because there was no statistical difference between the group with 3mL of d-limonene per gram of EPS and the group with 2mL of d-limonene per gram of EPS. There was a difference between the 2mL and 4mL, and the 2mL and 5mL groups, but since there wasn't a statistical difference between 2mL group and 3mL group, the hypothesis was disproven.  $F(3,116)=9.85$ ,  $p<0.001$ ,  $\alpha=0.05$ .

## ROBOT VERSUS RODENT TIME THROUGH A MAZE

Jamie Mayson  
Heathwood Hall Episcopal School

This experiment was designed to test the speed of a robot through a maze compared with the speed of a mouse. The robot was designed to use sensors to decide which direction to go. It used a touch sensor and an ultrasonic sensor. The hypothesis was that the mice would finish with a shorter time than the robot. In the end the robot ended up finishing the maze quicker than the mice. The program worked perfectly. Since the robot finished first, the results of this study did not support the hypothesis. The ANOVA test showed that the results were significantly different.

## THE EFFECT OF BREATHING EXERCISES ON LUNG CAPACITY

Ryan McCormick  
Spring Valley High School

In this study, trials were conducted to determine the effects that breathing exercises have on lung capacity. The study determined if breathing exercises could help with lung function to as a possible way to rehabilitate patients with lung illnesses, or to just increase lung function. It was hypothesized that if the participants completed routine breathing exercises, then lung capacity would increase. To test the hypothesis, participants were tested for their lung capacity measures using spirometry. The participants then completed breathing exercises every day for four weeks using a series of exercises. After four weeks of exercise, the participants' lung capacities were measured again and were compared to the initial lung capacity measurements. A t-test was used to analyze the data which showed a t-value of 0.554 and P-value of 0.586. Since the P-value was 0.586, the null hypothesis could not be rejected so the hypothesis that breathing exercises increase lung capacity could not be supported. Therefore, the results showed no significant increase in lung capacity of the subjects.

## EFFECTS OF HORSE MOVEMENT DURING HIPPO THERAPY ON THE PATIENT LUMBAR SPINE MOTION

Martin Seamus McLaughlin

South Carolina Governor's School for Science and Mathematics

Hippotherapy is the use of a horse to provide physical or psychological therapy to an individual. It has proven to be useful in rehabilitation therapy for many different conditions, including cerebral palsy, amputation and spinal injuries. Recently, hippotherapy was used on a group of people suffering from spasticity as a result of spinal injury, and after the treatment, the extreme muscle tension associated with spasticity was significantly decreased. In this initial project, one horse and six different riders were observed to assess the reproducibility of rider motion during hippotherapy. The riders were healthy females between ages 18-25 who did not have any previous horseback riding experience. The riders were outfitted with biomechanical measuring devices to monitor their motions during the riding session. The horse had ten white reflective markers placed on joints and other specific locations on the left and right sides of its body. The horse and rider were then filmed with a high speed camera as the horse was led back and forth four times. These videos were then put into a Matlab program, which was used to track and digitize the markers. Using the information received from the Matlab program, the angles between the markers on the horse will be analyzed in Microsoft Excel, and these angles will be used to determine what effect the horse's motion had on the different riders, and whether the horse affected each rider the same or differently.

## LAYER-BY-LAYER SELF-ASSEMBLY TO DEVELOPMENT OF DNA-BASED BIOMATERIALS FOR FUEL CELL APPLICATION

Kimberly McRae

Spring Valley High School

Direct methanol fuel cells are the best contenders of alternative energy. Low efficiency occurs when methanol leaks through the membrane to the cathode. The cornerstone of this research is the ability to create a DNA based biomaterial that would be able to modify the Nafion™ membrane. Poly (amine hynamline), Poly (acrylic acid), and DNA were sequentially assembled onto a substrate at conditions with pH levels of 4 and 7, and NaCl concentrations of 0M, 0.1M, and 0.5M. The frequency shift was measured after every assembled layer using a Quartz Crystal Microbalance. The absorbance of the material assembled, using the best conditions, was measured using a UV-vis spectrometer. The surface morphology was examined using an Atomic Force Microscope. It was hypothesized that a pH of 7 and NaCl concentration of 0.5 M, DNA would be the optimum conditions to use. In the research, the following parameters were used to come to the conclusion of the optimum conditions; the greatest frequency shift, intensity change, and surface roughness. The study showed that a pH of 7 and a NaCl concentration 0.5M allowed the most DNA to deposit;  $t(22) = -9.19$ ,  $p < 0.000$  and  $t(14) = -15.11$ ,  $p < 0.000$ . To determine if a Nafion™ membrane could be modified with this material using these conditions SEM images were taken. It was hypothesized that this material would be able to modify the Nafion™ membrane in a way that would allow it to be used for future fuel cell purposes. This hypothesis was also supported, by evidence received from the SEM.

## THE EFFECT OF POTENTIALLY DANGEROUS CHEMICALS LEACHING FROM CHEAP PLASTIC, EXPENSIVE PLASTIC, AND GLASS BABY BOTTLES ON THE MORTALITY RATE OF *DAPHNIA MAGNA*

Alexis McCullough

Heathwood Hall Episcopal School

Bisphenol A (BPA) is an organic compound that has been used for decades in the manufacturing of polycarbonate polymers, epoxy resins and linings, and other materials that are used to make plastics. It has been found that this chemical can be a developmental toxin at low doses and that it may pose a risk to human development due to the endocrinic activity it has shown. While many manufacturers have removed BPA from their products, they have begun replacing it with other chemicals that may potentially be equally or more dangerous such as BPS, PES, BPAF, and PBDE. The purpose of this experiment was to observe the relationship between the mortality rate of the *daphnia magna* in plastic baby bottles (cheap and expensive) and the mortality rate of *daphnia magna* within a controlled environment (glass baby bottles) and determine whether there any be potentially dangerous chemicals leaching from the plastic bottles. It was hypothesized that if a certain number of *daphnia magna* were placed in distilled water inside of cheap, expensive, and glass baby bottles, then the BPA-free would have a *daphnia magna* mortality rate greater than or equal to that of the *daphnia magna* mortality rate in the glass bottles. Nine baby bottles (three from the leading brand (plastic), three from a cheaper brand (cheaper), and three made of glass) were filled with 200mL of the distilled water (20°C) and *daphnia magna* (nine during trial 1 and eleven during trial 2). After analyzing the results, it was determined that there was no correlation between the data of any of the three bottles during either of the two trials. In conclusion, my hypothesis was rejected and my null hypothesis was accepted.

## A COMPARISON OF LEAD, COBALT, COPPER, AND IRON IONS PRESENT IN THREE AQUATIC ENVIRONMENTS OF HEATHWOOD HALL EPISCOPAL SCHOOL (POND, RIVER, SWAMP)

Elise McKelvey  
Heathwood Hall Episcopal School

Clean water is a necessity for all living things, but contaminants are omnipresent, ranging from minor bacteria to heavy and harmful metals. This experiment tested three different aquatic environments that are home to many forms of life for dangerous metal ions; a pond, river, and swamp were tested for the presence of lead, cobalt, copper, and iron. These three aquatic environments were tested over time and compared to a filtered system, acting as a constant, by running a qualitative analysis of cations. After 48 tests over three weeks, the hypothesis that the presence of lead, cobalt, copper, and iron will vary for the aquatic environments (pond, river, swamp) over time in comparison to the constant, filtered water was accepted. It was found that copper remained present in the pond and swamp for three weeks while the cobalt varied, as it was present in the swamp consistently for three weeks, but was also present in the pond during week three.

## BUILDING AND TESTING A PV-PEM HYDROGEN REFUELING SYSTEM

Vikram Melchizedec  
Spring Valley High School

The purpose of this engineering project was to see if it was possible to power a PEM electrolyzer using solar energy. A PV-PEM hydrogen fueling system was made and tested to see if it was practical to be used in a home setting. A five and fifteen watt amorphous solar cells were used to convert solar energy into electrical energy. The solar cells were connected to a step down voltage regulator which brought down the voltage. A step down voltage regulator changed output voltage from 20 volts to 3.5 volts which was appropriate for use in PEM electrolyzer. The PEM electrolyzer used the energy provided by the solar cell to split water into hydrogen and oxygen. Production of the gases fluctuated accordingly to the amount of sunlight. Hydrogen and Oxygen gas left the PEM electrolyzer through rubber gas tubes and into a gas collecting apparatus. The PV-PEM system was timed until it produced 100 ml of hydrogen and 50 ml of oxygen. The PEM electrolyzer produced 100 ml of hydrogen in 24:27 min using batteries. The system was able to produce 100 ml of hydrogen in 3 of the six trials and couldn't produce 100 ml in the other 3 trials due to lack of sunlight. The PV-PEM system at its best produced 100ml of hydrogen in 16:57 min.

## THE EFFECT OF AIRPLANE MODE ON BATTERY LIFE IN CELLULAR DEVICES

Aaron Meyer  
Spring Valley High School

As the growth of cellular devices has increased many people have had a growing interest in using their cellular devices on airplanes and other modes of inter-country transportation. Due to the safety hazards of sending and receiving cellular signals on aircraft specifically, a new mode on the cellular phone has been invented called airplane mode. Airplane mode is a setting on cellphones which disables their wireless communication abilities, making them approved for use on aircraft. While in airplane mode a phone cannot send or receive any transmissions. The idea behind airplane mode is to allow people to continue using their cell phones on planes to do things like listen to music and check appointments without using the options that could cause interference. Airplane mode allows cell phone users to circumvent the ban while ensuring that their phones are safe to use on aircraft while the plane is in flight. The purpose of this experiment was to determine whether or not placing a cellular device in airplane mode while not in use would increase, decrease, or not affect the battery life of the cellular device. The hypothesis of this experiment was that if airplane mode was turned on throughout the duration of the battery life it would increase the amount of time the battery survives. After experimentation a two-sample t-test was performed at an  $\alpha=0.05$  level. This shows that airplane mode was not statistically different from non-airplane mode on the life of the battery,  $t(22) = 0.05$ ,  $p = 0.959$ .

## ADSORBANCE OF CR(VI) USING *PUERARIA LOBATA* LEAVES, SHREDDED *PUERARIA LOBATA*, AND *PUERARIA LOBATA* ASH

Tina Monzavi  
Spring Valley High School

The purpose of this experiment was to see if shredded *Pueraria lobata*, unaltered *Pueraria lobata* leaves, or *Pueraria lobata* ash would be able to adsorb the most Cr(VI) ions from water. It was hypothesized that kudzu ash would adsorb the most Cr(VI) due to the porous structure that developed after being burned. This is important because Cr(VI) is a toxic water pollutant in some parts of the world and causes millions of people to not have access to clean drinking water. Testing consisted of suspending shredded kudzu, unaltered kudzu leaves, and kudzu ash into solutions of Cr(VI). After being soaked, the kudzu in each trial was filtered out, and then the absorbance was taken using a spectrophotometer. The results were analyzed using a calibration curve, which was created using four standards. Kudzu ash was able to adsorb the greatest amount of Cr(VI). Unaltered kudzu adsorbed the least amount of Cr(VI). Shredded kudzu adsorbed a greater amount of Cr(VI) than unaltered kudzu and a smaller amount of Cr(VI) than kudzu ash. The hypothesis was supported. Kudzu was determined



to be an effective adsorbent for the removal of Cr(VI) ions from aqueous solutions. Kudzu could prove useful in applications like the treatment of urban or agricultural runoff. In conclusion, kudzu is a low-cost, inexpensive, and economically friendly adsorbent for the removal of metal ions, particularly Cr(VI), and should be more widely used for water filtration.

#### ROLE OF SRT1720 IN PREVENTION OF ACETAMINOPHEN-INDUCED HEPATIC INJURY IN THE MOUSE

Allison Moore

South Carolina Governor's School for Science and Mathematics

Acetaminophen (AAP) overdose is the most common cause of acute liver failure in the United States. Previous studies showed that toxic metabolites of AAP damage mitochondria, leading to hepatocyte death. In this pilot study it was investigated whether SRT1720, a stimulator of mitochondrial biogenesis, protected against AAP-induced liver injury. Male C57BL/6 mice were fasted overnight and then injected with AAP (300 mg/kg, i.p.). Mice were given 2 mg/kg of SRT1720 (i.p.) at 0h, 2h, and 6h after AAP administration with a group size of two mice. Mice liver and blood samples were harvested 48 hours after AAP treatment. Necrotic areas were evaluated in the H+E stained liver sections. Mitochondrial oxidative phosphorylation proteins were detected by immunoblotting. Serum total bilirubin was detected colorimetrically. AAP caused overt centrilobular necrosis. SRT1720 injection at 0h and 2h after AAP reduced necrosis by 81.5% and 72.3%, respectively. SRT1720 injected at 6h after AAP decreased necrosis by about 52.2%. AAP increased total bilirubin levels, indicating poor liver function. SRT1720 treatment at 0, 2, and 6h blunted hyperbilirubinemia by 90.6%, 87.8% and 68.2% respectively. Oxidative phosphorylation proteins (ATP synthase- $\beta$  and NADH dehydrogenase-3) were decreased substantially by AAP, which was largely reversed by SRT1720 treatment given at 0h and 2h and partially reversed by SRT1720 treatment at 6h. This pilot study suggest that SRT1720 decreases AAP hepatotoxicity, possibly by stimulating mitochondrial biogenesis and protecting against mitochondrial dysfunction. Further studies with larger sample sizes are needed to confirm these findings and explore the exact mechanism(s) of protection.

#### THE CORRELATION BETWEEN POVERTY AND *DIABETES MELLITUS*: INSULIN THERAPY VS. ANTI- DIABETIC ORAL MEDICATIONS

Ayana Moore

Spring Valley High School

*Diabetes Mellitus* is a group of diseases marked by high levels of blood glucose resulting from defects in insulin production, insulin action, or both. Diabetes is the leading cause of kidney failure, non-traumatic lower- limb amputations, and new cases of blindness among adults in the United States. The purpose of the study was to evaluate the relationship between socioeconomic status (SES) and managing diabetes by comparing the HbA1c level differences of the participants of the bottom fifth, lower middle, middle, upper middle, and top fifth SES groups. This study was conducted in order to see the relationship between poverty and managing Diabetes so that methods could be developed to help poverty stricken people have resources to properly fight the disease. It was hypothesized that participants of a higher socioeconomic status will have an HbA1c level closest to the recommended level, therefore having better control and management of their diabetes. Subjects completed a survey that obtained information about their socioeconomic status and the personal Diabetes information. These data were collected and the subjects' socioeconomic status was determined based on the information of the survey. The HbA1c level differences of the subjects of the different groups were analyzed to see which groups had the mean HbA1C level closet to the recommended level. A two sample t-test was conducted to see whether or not there was a significant difference between the middle and top fifth socioeconomic status groups.  $t(9) = 2.29$ ,  $p = 0.047$  indicated that there is a statistical difference between the groups. The null hypothesis was rejected; therefore the study indicates that socioeconomic status has an effect on managing *Diabetes Mellitus*.

#### BRAIN IRON ACCUMULATIONS WITH A MUTATED *Fa2h* GENE IN A MOUSE MODEL

Emily J. Moore

South Carolina Governor's School for Science and Mathematics

Leukodystrophies linked with the FA2H gene are often accompanied with an increase of iron in the brains of human patients. By observing and quantifying iron accumulation in brain sections from both wildtype and mutant mice, it can be determined whether or not increased brain iron accumulation is also present with a mutated *Fa2h* gene in a mouse model. From previous work, it was expected that there would be an increase in brain iron accumulation with a mutated *Fa2h* gene because there was an increase in brain iron accumulations with a mutated FA2H gene in humans. Brain iron accumulations were quantified by observation under a microscope after using various staining methods which. It was concluded that the results were inconclusive and could not be statistically considered. Future work must be conducted in order to determine a protocol in which brain iron accumulations can be observed within the mouse model.

## THE EFFECT OF THE TYPE OF STORAGE OF CONTACT LENSES ON THE AMOUNT OF BACTERIAL BIOFILM THAT ACCUMULATES ON THE LENSES

Jordan Motlong  
Spring Valley High School

The purpose of this experiment was to determine which method of storage of contact lenses best minimized the formation of common contact lens-infecting bacterial biofilms. This is important because there are many ocular infections that occur due to improper contact lens hygiene. It was believed that the contact lens case that had built-in antimicrobial agents would have the least amount of bacterial biofilm growing on the lenses that it stored. The experiment was done by growing *Serratia marcescens* on contact lenses that were placed inside screw top contact lens cases, flip top cases, antimicrobial cases. The cases were then incubated at room temperature. The lenses were rinsed with sterile water and placed inside test tubes filled with sterile water. The test tubes were then sonicated to remove the biofilm from the lenses. The suspended biofilm was incubated on agar plates at room temperature for 48 hours. The colony forming units (CFUs) on each plate were then counted. An ANOVA test was used to determine whether there was a significant difference between the numbers of CFUs.

## WHETHER NICOTINE CAN BE DISTINGUISHED FROM SALINE AS A SIGNAL FOR THE REWARD, BY USING PAVLOVIAN CONDITIONING

Andrew Motts  
South Carolina Governor's School for Science and Mathematics

Nicotine is the primary compound in tobacco products. Modern research shows that nicotine acts on the brain to produce a number of effects. Research examining its addictive nature has been found to show that nicotine activates the Mesolimbic pathway, which is the pathway within the brain that regulates feelings of pleasure. My experiment was aimed at an operant conditioning approach. Operant conditioning typically consists of a relatively neutral stimulus closely combined with a more biologically relevant stimulus. Conditioning is apparent when there is a response to the conditioned stimulus relative to a controlled value. In this experiment the conditioned stimulus, sucrose, was paired with the unconditioned stimulus of the effects of nicotine. If successful, rats should be conditioned to become able to associate nicotine with sucrose. The rats were tested in experimental boxes attached to a computer that recorded their movement near the entrance for sucrose. Before the training of the rats started, I had to develop a computer program that would allow me to record activity in the box in which the rat was placed. The final program recorded the rat's activity in the box, the rat's entry rate where the sucrose was given, and it controlled the random variable time between each sucrose reward that was given. Each reward gave 0.1 ml of sucrose to the rat for 4 seconds, and there were a total of approximately 36 rewards. After 8 sessions, there was a significant difference in the dipper entry rate before the first dipper with Saline compared to Nicotine. 7 out of 8 rats could distinguish between Saline and Nicotine.

## THE EFFECTS OF BIOCHAR AND GREEN WASTE ON SOIL PH, SOIL NITROGEN LEVELS, AND BIOMASS OF *RAPHANUS SATIVUS*

Lance Murphy  
Spring Valley High School

The purpose of this study was to measure the effects of biochar and green waste on soil pH, soil Nitrogen concentration, and biomass of *Raphanus sativus*. It was hypothesized that the biochar would have the greatest effect on the soil pH, soil fertility, and biomass of the radishes. Biochar and green waste were added to fourteen pots each then the seeds were added. When the plants were fully grown, the pots with living plants were measured for soil pH and soil Nitrogen concentration while the plants were dried and massed. The biochar-applied pots had the greatest mean for soil Nitrogen levels, biomass of the radishes, and soil pH. The second highest mean for soil pH belonged to the control group, while the green waste actually lowered the soil pH. Nitrogen levels were decreasing from the biochar to the green waste to the control group. The same pattern occurred in the biomass of the radishes. For soil pH, there was a significant difference in the biochar at  $\alpha=0.05$   $F(2,5)=5.87$ ,  $p=0.048$ . After Scheffé testing, this difference could not be found. The biochar also raised the soil Nitrogen levels significantly  $F(2,5)=10.68$ ,  $p=0.015$ . After scheffé tests, a significant difference existed between the green waste and biochar, and the biochar and control. There was no significant difference for the biomass of the radishes  $F(2,10)=0.317$ ,  $p=0.88$ . The biochar supported the fact that it was the best fertilizer for improvement of soil pH and soil Nitrogen levels, but there was no significant difference for the biomass of the radishes. The statistical data showed a significant difference between the green waste and biochar, and the biochar and control.

THE DIFFUSIVE ESCAPE RATE OF ALBUMIN: LACTATED RINGER'S SOLUTIONS THROUGH SEMI-PERMEABLE MEMBRANES

Rimel Mwamba  
Spring Valley High School

Albumin is a popular intravenous fluid used to replace both the protein and volumetric loss of fluid. It is very expensive but proves to be effective in reducing circulatory dysfunction in patients undergoing abdominal paracentesis due to ascites. The purpose of this experiment was to find out whether a difference existed in various concentrations of Albumin- Lactated Ringer's mixtures and their diffusive escape rate, ionic strengths, and protein content through semi-permeable membranes. The hypothesis was that an increase in the concentration of Albumin with Lactated Ringer's Solution would cause the slowest diffusive escape rate, highest ionic strength, and highest protein content within the membrane. This was accomplished by placing 0%, 1%, 2.5%, 5%, 6.5%, 8%, and 10% Albumin-Lactated Ringer's mixtures into dialysis tubing bags which were submerged into 0.9% NaCl electrolyte solutions. Final and initial volumes were taken for diffusive escape rates, a vernier conductivity probe for ionic strength, and urine analysis protein strips for protein content. The results of an ANOVA test at  $\alpha=0.05$  showed that a significant difference existed in the diffusive escape rate. There was a significant difference in the ionic strengths of the solutions but no significant difference in the protein content. A post-hoc Tukey test showed that there were no differences in the diffusive escape rates. A second post-hoc Tukey test for ionic strengths showed a significant difference between all of the concentrations. The hypothesis was rejected in that there was a significant difference among all of the concentrations with no particular increasing order.

THE EFFECT OF SODIUM NITROPRUSSIDE AND NITRIC OXIDE ON THE GERMINATION RATE OF *BRASSICA RAPA*

Keertana Nair  
Spring Valley High School

The germination rate of crop seeds is used to predict the general crop yield of certain plants. Many pre-treatments and chemicals are known to stimulate germination in various plants. Nitric oxide and sodium nitroprusside, a NO donor, both affect the germination. The purpose of this experiment was to determine whether sodium nitroprusside or nitric oxide increases the germination rate of *Brassica rapa*. This is important because if an ideal quantity of sodium nitroprusside or nitric oxide is discovered on *Brassica rapa*, it can be applied to other crops as a method to increase overall crop yield. It was hypothesized that the seeds applied with sodium nitroprusside would have a greater germination rate than the seeds applied with nitric oxide and the controlled seeds. This was accomplished by allowing three separate groups of 50 seeds each to germinate over a period of 3 days. The first group of seeds was applied with sodium nitroprusside, the second group was applied with nitric oxide, and the third group was the control. The shoot length was recorded each day and the germination rate and average growth rate were calculated. The results showed that the control and the seeds with sodium nitroprusside had higher germination rates than the seeds with nitric oxide. An ANOVA test and Tukey post-hoc test showed that the control and seeds with sodium nitroprusside were significantly different from the seeds with nitric oxide ( $F(2,147) = 19.4874$ ,  $p < 0.001$ ,  $\alpha = 0.05$ ).

THE EFFECT OF IMPLEMENTING MAZE SOLVING ALGORITHMS ON THE MAZE COMPLETION TIME OF A 3 PI ROBOT

David Nam  
Spring Valley High School

There are many cases in which a maze cannot be solved by a robot alone due to various reasons—the terrain might be too dangerous to navigate through for a human, for example. In these situations, robots are usually implemented in order to find the correct pathway. Many innovations have been made in order to improve a robot's performance. The purpose of this experiment was to determine the correlation of implementing maze solving algorithms in a 3pi robot to its maze completion time. The maze solving algorithm was modeled after several examples such as Tremaux's algorithm and Lumelsky's algorithm. The programming language used was C, with a few additional additions to the language in order to make the 3pi robot programming simpler (AVR Studio 4). A maze was designed and constructed on a large, white board. The robot was tested to see if it can solve the maze and then tested again on the same maze in order to see the time difference between the time it took to complete the maze initially and the time it took to complete the maze after solving it. Several mazes were tested on this robot, though only one maze, the most complex one, was used to generate data.

ON THE RECIPROCAL OF THE BINARY GENERATING FUNCTION FOR THE SUM OF DIVISORS

Alexander Neal  
South Carolina Governor's School for Science and Mathematics

If  $A$  is a set of natural numbers containing 0, then there is a unique nonempty "reciprocal" set  $\bar{A}$  of natural numbers (containing 0) such that every positive integer can be written in the form  $a+\bar{a}$ , where  $a$  is in  $A$  and  $\bar{a}$  is in  $\bar{A}$ , in an even number of ways. More important, the indicator functions for  $A$  and  $\bar{A}$  over  $F_2[[q]]$  are reciprocals in  $F_2[[q]]$ . We compute the density of

$\bar{A}$  for the set  $A$  containing 0 and all integers such that  $\sigma(n)$  is odd, where  $\sigma(n)$  is the sum of all the positive divisors of  $n$ , including  $n$  itself. This problem is motivated by Euler's "Pentagonal Number Theorem", a corollary of which is that the set of natural numbers  $n$  so that the number  $p(n)$  of partitions of an integer  $n$  is odd is the reciprocal of the set of pentagonal numbers (integers of the form  $k(3k-1)/2$ , where  $k$  is an integer). An old (1967) conjecture of Parkin and Shanks is that the density of integers  $n$  so that  $p(n)$  is odd (equivalently, even) is  $1/2$ . Euler also showed that  $p(n)$  satisfies an almost identical recurrence as that given by the Pentagonal Number Theorem for  $p(n)$ , so we shed light on the Parkin-Shanks conjecture by finding the density of the reciprocal set of the set of natural numbers so that  $\sigma(n)$  is odd. (We take  $\sigma(0) = 1$  by convention.) We conjecture this particular density is  $1/32$  and provide rigorous results to that end.

#### A COMPARISON ON THE SWELLING AND MECHANICAL PROPERTIES OF A SUPERPOROUS HYDROGEL WITH VARYING POST-CROSSLINKER ION CONCENTRATIONS

Courtney Noh  
Spring Valley High School

Orally delivering drugs has become an increasingly significant field in pharmaceutical research, and gastric drug delivery systems must overcome two obstacles: short gastric retention time and unpredictable short gastric emptying time. The purpose of this study was to measure the change in swollen and mechanical properties of a superporous hydrogel hybrid made from poly acrylamide and alginate and post-crosslinked with  $\text{CaCl}_2$  ions for use as a gastric drug delivery system by using various amounts of post-crosslinker  $\text{CaCl}_2$  ion concentration. The hypothesis was that increasing the amount of post-crosslinker metal ion concentration would increase both mechanical properties and swelling properties. The superporous hydrogel hybrids were prepared, the swelling properties were measured using Motic software and by massing the hydrogel after an hour submerged in deionized water, and the mechanical properties were measured using a classic compression test. Conclusions were drawn from the appropriate one way analysis of variance (ANOVA) tests, where  $F(8, 18) = 21.31, p < 0.001$  and  $F(8, 18) = 9.73, p < 0.001$  and post hoc Tukey tests, which showed a significant difference in both mechanical and swelling properties from increasing the  $\text{CaCl}_2$  ion concentration.

#### THE EFFECT OF INCREASED SUBSTRATE AND REDUCED RESISTANCE ON OUTPUT VOLTAGE GENERATED IN MICROBIAL FUEL CELLS

Maddie Norris  
Heathwood Hall Episcopal School

In a society with insatiable energy needs, the environmental effects of energy sources often go overlooked; however, with diminishing oil supplies, new ways of generating energy are needed. One solution may be microbial fuel cells, which can use sustainable resources as fuel. A microbial fuel cell can be particularly useful when dealing with wastewater as it would serve as the substrate, and microbial fuel cells produce  $\text{H}_2\text{O}$  as waste, the end goal of treatment plants. The purpose of this experiment was to determine the effect of increased substrate and reduced resistance on voltage generated in microbial fuel cells. It was hypothesized that if additional substrate is present and internal resistance is decreased, then more voltage will be generated than if just adding substrate or just reducing resistance. In the study, four microbial fuel cells were assembled. One cell contained increased substrate (increased volume of sugar added). A different cell contained an increased salt concentration, which reduced the internal resistance. A third cell contained both an increased amount of sugar and of salt. This cell served to show the effect of increased substrate when used in conjunction with reduced resistance on the voltage generation in microbial fuel cells. Another cell served as the control. Voltage was measured three times a day for two weeks. Statistical analyses showed no statistical significance. These findings could reflect different microbe groups working in separate microbial fuel cells. Future studies could study the effect of increased substrate and decreased resistance on specific microbes found in wastewater.

#### USING GEOGRAPHIC INFORMATION SYSTEMS TO CONVEY THE COMPLEXITY OF TRADITIONAL KNOWLEDGE AMONG THE EASTERN BAND OF CHEROKEE INDIANS

Alyssa Palmer-Keriazakos  
South Carolina Governor's School for Science and Mathematics

Geographic Information System (GIS) technology was used for the production of a map of the Cherokee Worldview Garden in the South Carolina Botanical gardens and a map of the Center for Cherokee Plants in Cherokee, North Carolina. Geographic Positioning System coordinates were collected through the use of GIS software (ArcGIS) and a handheld device (Juno™ Trimble®). Different layers were also used to depict distinct elements, such as plant points, pathways, signs, or boundaries. The goal of the Cherokee Worldview Garden map was to convey the different perceptions and uses the Cherokee have of plants and features found in their landscape. This goal was accomplished by layering digital stories told by Cherokee elders on the map using a reference point. The Center for Cherokee Plants map was developed for the Eastern Band of Cherokee Indians in North Carolina. This map could later be used to pass down information from elders to younger generations about their culture and culturally significant plants.

## A VIEWER-MODEL FRAMEWORK FOR VISUALIZING MULTI-SCALE THREE-DIMENSIONAL GENOME WITH ONLINE INTEGRATION

Paul Park

South Carolina Governor's School for Science and Mathematics

This research was a six-week effort to develop a 3D web browser for human genomic data. The goal was to create a working 3D browser in Unity Game Engine with streaming capability. A working 3D browser was programmed successfully in C# programming language that is native to Unity Game Engine. Unity Game Engine was chosen as the development setting because of its established web support. The engine allowed for easy publication and running of the program on the web. It also allowed real-time playbacks of the program, permitting convenient and quick tests.

The 3D Browser was able to display genomic materials on three levels. These three levels were stored into separate folders that had the following names from the lowest to highest resolution: gloop, fiber, and nucleo. Each data was stored as either .bin or .xml format. The 3D Browser was programmed to read and load data stored in .xml format. The .bin files were encrypted, so reading them was very difficult. Additionally, the .bin files were simply compressed versions of their .xml variants, and the Unity Game Engine had basic parsers for .xml files. The decision was that developing a parser for the .bin files was unnecessary, and a fully functional parser for .xml files was developed. This project established foundations for the program. Control systems, basic parsers for loading XML data, and basic client-to-server communication systems were developed for the web browser. Although not yet a fully featured program, it has all the basics necessary as a platform for further development.

## A COMPARISON OF *RHIZOBIUM LEGUMINOSARUM*, *AZOTOBACTER CHROOCOCUM*, AND CALCIUM CARBONATE ( $\text{CaCO}_3$ ) ON NITROGEN FIXATION BY *PHASEOLUS LUNATUS* GROWN IN CLAY SOIL

Amber Parnell

Spring Valley High School

The purpose of this study was to determine the soil additive that would increase the nitrogen content in a leguminous plant the most. *Rhizobium leguminosarum* and *Azotobacter chroococum* were used as the bacterial groups because of their nitrogen fixing properties. They were compared to calcium carbonate, as another experimental group, and plain clay as the control. It was predicted that rhizobium would contribute most to the nitrogen content of the plant. To test this, a sodium nitroprusside colorimetric assay was used to determine the nitrogen in digested plant samples. The calcium carbonate group grew the best in the clay soil and the rhizobium and azotobacter failed to survive in the acidic soil; therefore the hypothesis was not supported. An ANOVA and Tukey test were conducted and a significant difference was found in the dry weights between the  $\text{CaCO}_3$  and Rhizobium treated groups, Rhizobium and the control group, the Azotobacter and control group and  $\text{CaCO}_3$  and Azotobacter treated groups with  $p=0.005$ . Another ANOVA and Tukey test were performed for nitrogen content a significant difference was found between the control group and all of the experimental groups with  $p<0.001$  and  $p< \alpha 0.05$ . The performance of calcium carbonate in this experiment was consistent with previous research, whereas the findings for rhizobium and azotobacter did not agree with previous work.

## THE EFFECT OF QUANTUM CDS ON *BACILLUS STEAROTHERMOPHILUS*

Manushi Patel

Spring Valley High School

Nanotechnology has a widespread use in industrial and local lifestyle. Nanotechnology refers to ultra-fine unites manipulated at a sub-100 nanometer scale. Because of the widespread use of CdS nanocrystals and their nano-size, there is a high possibility that microorganisms such as bacteria are affected by cadmium sulfide nanocrystals (Q-CdS). The purpose of this experiment was to determine if nano-meter sized cadmium sulfide was toxic to *Bacillus stearothermophilus*. This is important because the instability of Q-CdS at high temperatures is not well studied, and any changes in temperature may alter the toxicity of Q-CdS to microorganisms. It was hypothesized that Q-CdS would be toxic to *Bacillus stearothermophilus*. This was studied by keeping *Bacillus stearothermophilus* incubated for 8-10 hours in aerated tryptic soy broth, then exposing the bacteria to 0.00%, 0.01%, 0.02%, 0.03%, 0.04%, and 0.05% Q-CdS at 60°C. The impact of Q-CdS on *Bacillus stearothermophilus* was measured by using a spectrophotometer (600nm) and measuring the turbidity after 24 hours of Q-CdS exposure. *Bacillus stearothermophilus* was also grown on agar plates in the presence of 0.00%, 0.01%, 0.02%, 0.03%, 0.04%, and 0.05% Q-CdS solutions. The number of colonies grown on each plate was counted after 24 hours. The hypothesis was supported. An ANOVA test comparing the growth rate of the bacteria with the different concentrations of Q-CdS yielded,  $F(3, 23) = 3.10$ ,  $p<0.001$  ( $F_{\text{test}}=23.53$ ). There was a significant difference between the groups. There was a strong negative correlation between the growth of bacteria on agar plates and the concentration of Q-CdS on the growth medium ( $r$  value= -0.95).

## STAPHYLOCOCCUS AUREUS IMMOBILIZATION ON ALLYLAMINE PLASMA GRAFTED POLYCAPROLACTONE NANOFIBER MESH

Sahil Patel

South Carolina Governor's School for Science and Mathematics

Between 11-32% of healthy adults carry staphylococcus aureus. When these bacteria are found within the deep layers of the skin, the infection is known as cellulitis. Antibiotics have a difficult time traveling to the deeper layers of skin due to a miniscule amount of blood vessels. Even if the drugs reach the bacteria at the site of infection might be resistant. Currently the only other treatments for cellulitis are amputation and the use of a hyperbaric oxygen chamber. Each costs the patient a tremendous amount. The aim of this project was to determine the effect of positively charged mesh on the growth of *S. aureus*. First, unaligned nanofiber meshes were made by electrospinning a polycaprolactone (PCL) solution. Different weight (wt.) percent of PCL solution were created. The meshes were plasma grafted on high and medium power with allylamine to add a large cationic charge to the surface of the mesh. After, *S. aureus* was grown on the meshes. The bacteria were stained and the adhesion and viability on the PCL nanofibers were determined using confocal microscopy. After these methods were completed, the results were surprising. The high power plasma grafted meshes showed a significantly greater amount of bacterial adhesion, but the majority of bacteria that adhered to the mesh were still alive. A general trend of greater bacterial adhesion was seen when the wt. percent of PCL solution was used. Further research has to be done to use the nanofiber mesh in the real world market.

## FREQUENCY OF PLASMID-MEDIATED RESISTANCE AMONG WILD BACTERIA

Shawn N. Patel

Dutch Fork High School

The objective of this experiment is to determine the frequency of antibacterial resistance that is spread by R-factor (resistance carrying) plasmids in everyday human contact. The bacterial strains that are of particular interest are the strains that cause many of the infections commonly found today such as those that are fought with beta-lactam and tetracycline antibiotics. Modern bacteria are becoming much more resistant and less antibiotics remain that will effectively treat serious infections such as MRSA. Therefore it is increasingly important for the public to reduce the chance of infection by knowing where resistant bacteria are most frequently located in their daily surroundings.

In this experiment, bacterial samples are to be taken from various public locations and tested against five antibacterial agents from the Beta-Lactam, Macrolide, Quinolone, Fluoroquinolone, and Tetracycline classes. Cells from the bacterial samples are being tested next for plasmid DNA if resistance is observed. The plasmid isolation results are next to be analyzed by gel electrophoresis under ultraviolet radiation for the presence of DNA. The DNA will then be transformed into the test bacteria if DNA is observed in the gel electrophoresis procedure. Currently 10 samples have been collected from a District 5 High School, and all samples have been tested with carbenicillin (Beta-Lactam) and have yielded four resistant colonies. Each of the colonies were tested for plasmid, but yielded no results.

## PRELIMINARY *IN VITRO* AND *IN VIVO* STUDIES TO DETERMINE *HOXA3* FUNCTION IN ADULT VASCULATURE

Terral A. Patel

South Carolina Governor's School for Science and Mathematics

Little is known about the expression patterns and functions of *Hox* genes in adult vasculature. Initially, these genes were known for specifying the position and development of different structures along the anteroposterior axis of bilaterians during embryonic patterning. This involves the regulation of apoptosis, cell proliferation, and cell differentiation. Recent studies suggest that *Hox* genes are also very important for the proper functionality of vasculature. To address the role of *Hoxa3* in adult vasculature, an *in vitro* model, such as mouse vascular smooth muscle cells (MOVAS) were used to determine the expression of HOXA3 protein by immunohistochemistry (IHC). For the *in vivo* model, tetracycline-inducible transgenic mice were generated that expressed *Hoxa3* under the control of the vascular smooth muscle-specific *Transgelin (Tagln)* promoter. IHC was also performed on vessel sections that came from three independent transgenic founder mice. The MOVAS cells showed prominent staining in the nucleus, which suggests that the *Hoxa3* gene product, HOXA3, is predominantly accumulating in the nucleus as would be expected from a transcription factor. A scratch assay and serum starvation assay of MOVAS cells suggest higher levels of expression in proliferating than resting cells. Results could not confirm the extent to which the tet-induced transgenic mice do express transgene-specific *Hoxa3*. However, vessel wall abnormalities detected by histopathological analysis of the aorta (where *Hoxa3* is naturally expressed) and the femoral artery (where *Hoxa3* is normally not expressed) derived from these mice were likely to result from *Hoxa3* over- and ectopic expression, respectively.

## THE EFFECT OF MANNOSE SOLUTION ON *ESHERICHIA COLI*S IMMUNITY TO TETRACYCLINE HYDROCHLORIDE

Katie Peffen

Spring Valley High School

Biofilms are an ever increasing problem in the industrial and medical industry because of their high resistance to antibiotics. Polysaccharides or sugars play a major role in biofilm development as a part of the extracellular matrix that forms the

biofilm's architecture. Since *Escherichia coli* uses mannose as a binding mechanism, the effect mannose sugar has on *Escherichia coli*'s immunity to tetracycline hydrochloride was investigated. It was hypothesized that culturing *Escherichia coli* in mannose solution would increase its immunity to tetracycline hydrochloride. *E. coli* was cultured in mannose solution, subcultured, and then given tetracycline hydrochloride. A serial dilution was used to count the number of bacterial colonies after tetracycline was given. The same method was used without culturing *E. coli* in nutrient broth with no sugar as a control group. A two tailed t-test was conducted at  $\alpha = 0.05$  to determine the difference between the two means of mannose with tetracycline trials and no sugar with tetracycline trials at  $10^{-5}$ ,  $10^{-6}$ ,  $10^{-7}$ , and  $10^{-8}$  dilutions. The results were insignificant at  $10^{-7}$ , and  $10^{-8}$  dilutions, and the hypothesis that *E. coli* cultured in mannose has a greater immunity than *E. coli* not cultured in sugar was rejected.

#### DEGRADABILITY OF POLYPROPYLENE WITH STARCH ADDITIVE IN A SIMULATED SEABIRD STOMACH

Anessa Pettis  
Spring Valley High School

Many seabirds are dying from the ingestion of bottle caps. The purpose of this study was to see if bottle caps could degrade in a seabird's stomach if the bottle cap was composed of a mixture of starch and polypropylene. The independent variable was the percentage of starch in the mixture. The dependent variable was the decrease in mass of the polypropylene films after sitting in a simulated seabird stomach after five days. The hypothesis was that starch mixed with polypropylene would degrade in a simulated seabird stomach. There were several different concentrations of starch and polypropylene mixes, which were 0%, 5%, 10%, 15%, and 20% starch concentrations. Each sample, relating the mass of a bottle cap, of the several different concentrations of starch was placed in a beaker of a simulated seabird stomach solution. Two different types of simulated seabird stomach acid were used in this experiment, hydrochloric acid and a hydrochloric acid, potassium chloride, sodium chloride, and  $\text{Na}_2\text{CO}_3 \times \text{H}_2\text{O}$  solution. The pieces of plastic soaked in each acid for five days. The degradation of the polypropylene films was determined by the difference in mass from the beginning of the experiment to the end of the experiment. The samples did not degrade in the hydrochloric acid, sodium chloride, potassium chloride, and  $\text{Na}_2\text{CO}_3 \times \text{H}_2\text{O}$  solution, but there was a significant difference in the 20% starch concentrated samples that soaked in the 1M HCl solution, according to a one-way ANOVA test because  $F(4, 145)=17.72$ ,  $p=0.00$ .

#### THE UTILIZATION OF *OPHIPOGON JAPONICUS*, *CAMELLIA JAPONICA*, AND *ILEX OPACA* BY PRIMARY LEVEL CONSUMERS

Victor Phillips  
Spring Valley High School

The green world hypothesis suggests that since the world is mainly primary producers, there should be a considerably large amount of plant biomass. It has been found that only 10% of the energy in one trophic level gets transferred to another. Although much evidence has supported this notion, few looked into how human activity could affect the energy transfer, which was the purpose of this experiment. It was hypothesized that there would be minimum disturbance to the 10% rule due to human activity. This is because natural predation would ultimately determine how much energy would be transferred. *Ophiopogon japonicus*, *Camellia japonica*, and *Ilex opaca* were the selected plants from which thirty leaves were collected, picking three leaves from ten plants of each of the select plant. Moreover, all of the plants were collected within a local neighborhood. The leaves were traced on graph paper and the percentage eaten was calculated. Results revealed that *Ophiopogon japonicus*, *Camellia japonica*, and *Ilex opaca* had percentage eaten means of 3.702%, 7.32%, and 19.51% respectively. A One-way ANOVA revealed significant difference among the means with  $F=(2,3) = 16.27$ ,  $p < 0.0001$ . A Tukey post-hoc at 95% confidence interval found *Ilex opaca* was significantly different from both *Ophiopogon japonicus* and *Camellia japonica* with *Ilex opaca* having the highest energy transfer efficiency. Thus, this study suggested that human activity does play some role in energy transfer from primary producers to primary consumers since *Ilex opaca* is a native species while the others are not.

#### THE EFFECT OF ENVIRONMENTAL CONDITIONS ON THE ABILITY OF *P. POLYCEPHALUM* TO FORM PROTOPLASMIC LOGIC GATES

Chandler Pobis  
Spring Valley High School

*Physarum polycephalum* is a unicellular, multinucleate protist that exhibits tremendous decision-making abilities. It has been shown that *P. polycephalum* can be used as a robust organic computing substrate. The goal of this project was to determine the ideal environmental conditions under which *Physarum polycephalum* could form protoplasmic logic gates and solve various types of Boolean logic gates. The hypothesis was that a temperature of 28°C, a single available nutrient source that was comprised of a 2:1 sugar to fiber nutrient ratio, two illuminated shapes, and one physical barrier would create the most growth in the slime mold. It was determined that *P. polycephalum*'s growth was best cultured under the conditions of 28°C, two available nutrient sources with a 1:1 sugar to fiber nutrient ratio, two illuminated shapes, and two physical barriers. This differed from the hypothesis, which was not supported.

## CRYSTAL GROWTH AND PHOTOLUMINESCENCE OF $Gd_{1-x}La_xKNbO_5$

Ryan J. Pubentz

South Carolina Governor's School for Science and Mathematics

Molten hydroxides are known to be an extremely useful media for growing high quality single crystals of complex oxides. The purpose of this investigation was to develop an understanding of reactivity of lanthanides and early transition metals in high temperature reactive hydroxide melts utilizing a unique silver tube method. Single crystals of  $Gd_xLa_{1-x}KNbO_5$  were grown out of a high temperature hydroxide melt ( $X = 0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0$ ). We were able to successfully synthesize all compounds and each compound exhibited room temperature photoluminescence when excited with short wave (254 nm) radiation. Concentration quenching was observed upon increased concentrations of lanthanum. Concentration quenching occurs when a molecule quenches the luminescence of a compound as the concentration of the molecule increases. The photoluminescent properties of these compounds were studied using fluorescence spectroscopy. Understanding why concentration quenching occurs can give us a better understanding of the reactivity of lanthanides and early transition metals.

## THE EFFECT OF FOUR DIFFERENT TYPES OF ANTIFREEZE ON THE AMOUNTS OF PHOSPHOROUS, NITROGEN, AND POTASSIUM ALONG WITH THE PH LEVEL OF SOIL

Heather Pusey and Katherine Beach  
Heathwood Hall Episcopal School

The purpose of this project was to examine the effects of different types of antifreeze on the amount of phosphorous, potassium, and nitrogen as well as the pH of potting soil. This study is beneficial for those who want to know what type of antifreeze is best for the environment, lest it leaks out of their car. Five eight-gallon containers were filled with soil and then saturated with the different types of antifreeze. The brands of antifreeze were PEAK, Zerex DEX-COOL, Zerex G-05, and Recycled Antifreeze. The fifth container stood as the control; therefore, no fluid was poured into it. After seven days, small amounts of soil were sampled from each of the soil mixtures and were tested with a LaMotte® Soil Testing kit. These tests supported our hypothesis that if one of four different types of antifreeze (PEAK, Zerex DEX-COOL, Zerex G-05, and Recycled Antifreeze) were to be dumped into soil, then there will be a change in the amounts of nitrogen, phosphorous, and potassium along with the pH level of the soil. The data suggested that the chemical effects of the PEAK antifreeze and the Recycled Antifreeze had an almost insignificant effect on the soil.

## THE EFFECT OF CHOLESTEROL LOADING ON MACROPHAGE INTERACTIONS WITH CANCER

David Qu  
Spring Valley High School

This study aimed to analyze the possible consequences of a high lipid diet on the microenvironments where cancer develops. Because of the cheap cost and addictive appeal of foods high in lipids such as cholesterol, many people eat high lipid diets. This trend is especially prominent in the United States with the popularity and convenience of fast-food restaurants. The effect of lipids on macrophages was tested to investigate a connection between such diets and risks of cancer caused by tumor associated macrophages (TAM). It was hypothesized that cholesterol loaded macrophages would induce expression of cancer promoting genes in cancer cells. LLC1-RFP lung cancer cells and Raw 264.7 mouse macrophage cells were used. Conditioned medium was collected after 24 hours of treatment by the cholesterol loaded macrophages. LLC1-RFP cells were treated with the conditioned medium for 16 hours. Relative gene expression was determined by quantitative real time PCR (qRT-PCR). ANOVA tests show that there were statistically significant differences between the groups for expression of CXCL5,  $F(3,8) = 5.549$ ,  $p = 0.0235$  and PIGF,  $F(3,8) = 4.199$ ,  $p = 0.0464$ . Bonferroni's Multiple Comparison post-hoc tests showed that the only significant difference was between HDL loading and the control for CXCL5 gene expression. This indicates that HDL cholesterol loading of macrophages inhibited a cancer gene associated with cancer proliferation and migration. The potential of cholesterol loading of macrophages to promote and inhibit cancer growth was investigated in vitro, but studies in vivo are necessary to determine the cumulative effect of cholesterol high diets.

## THE EFFECT OF VELOCITY ON BUCKSHOT PENETRATION

Nicolas Quan, Will Till and Morgan Brooks  
Heathwood Hall Episcopal School

The purpose of this project was to test two different loads of bullets to find which one is more fit for self-defense, police and military use, and hunting. All of these professions can benefit from using the correct load. People can better defend themselves, police can choose to have more or less lethality, and the military can use the less lethal bullet to have more wounded enemies. Finally, hunters can kill their prey faster and more easily if they use the correct load. The first step is to choose the amount of materials. Then, to create the targets out of ballistics gel and plywood boards. Next, the materials are set up at a gun range. Then the blocks and boards are shot, and the data are collected. The results showed that the higher velocity load had more penetration. This is useful to know so the correct amount of lethal force and penetration can be applied for different purposes. From this experiment one can learn that it is important to take great care when selecting their ammo and learning how to use it because it can make the difference between life and death. The choices one makes are serious, and what could be more important than making the choice which would save your life. The hypothesis for this experiment is that



as the velocity of buckshot is increased, so it its penetration into the target. The results support the hypothesis because the higher velocity loads consistently exhibited more penetration than their lower velocity counterparts. Considering that the velocity was increased by only sixty feet per second, and yet it averaged ten inches more penetration in the ballistics gelatin and an extra two boards.

#### MOST EFFECTIVE LACTASE DELIVERY FOR LACTOSE INTOLERANCE

Ashley Ranta  
Dutch Fork High School

The objective of this study is to find the most effective form of lactase, either hydrolyzed in the milk, or taken with milk containing lactose, as to help better alleviate the symptoms of Lactose Intolerance. If an individual with Lactose Intolerance drinks the lactase hydrolyzed milk, then the symptoms of such condition will decrease in intensity, due to the decrease in pressure inside the small intestine. This study is intended to help those who suffer from Lactose Intolerance, and to offer more research on a growing health problem. Simulated stomachs have been made, either chemically or mechanically, as to manipulate the reactions of the stomach and digestive system, which is a basis to this experiment. This project includes making an artificial stomach, chemically, and allowing digestion to occur at lower levels than in the human stomach. The artificial stomach is used to observe the relationship between orally taken lactase supplement in tablet form while in the stomach. Once the enzyme and dairy product go through the "stomach", the amount of lactose still present will be tested through lactose fermentation with *Escherichia coli*, producing CO<sub>2</sub> and H<sup>+</sup> gases. The pressure of this reaction will be measured, and the results are expected to be that the Lactase-hydrolyzed milk will cause symptoms to decrease in severity. Such findings could allow individuals with Lactose Intolerance to find alternatives to products containing Lactose, such as milk, cheese, yogurt, and even processed foods.

#### META-ANALYSIS OF VARIATIONS IN THE GENE SEQUENCES IN BARRIER RECEPTORS IN ATOPIC DERMATITIS POPULATIONS

Sharika Rao  
Spring Valley High School

The purpose of this study was to find the percentage of the variation between the genetic code for barrier receptors in the atopic dermatitis population and the same barrier receptors in non-atopic dermatitis population. Targeting the phenotypic responses of the abnormal barrier receptors, due to genetic mutations, allows atopic dermatitis to be treated by repairing the barrier abnormalities- driving factors of Atopic dermatitis. The hypothesis was that there would be approximately 1% to 2% genetic variation in the population with atopic dermatitis for the histamine receptors H1 and H2. There was approximately 4% to 5% genetic variation for the protease-activated receptors PAR1, PAR3, and PAR4. The five barrier receptors were the H1, H2, PAR1, PAR3, and PAR4 receptors. DrugBank, ENA, Protein Databank in Europe Database, and The Human Genome Project were utilized to gather the comparison DNA sequences. These DNA sequences of the non-Atopic population were compared to the DNA sequences of the barrier receptors of the Atopic dermatitis population using ClustalW. The H1 receptor had a percent variation of approximately 1%. The H2 receptor had a percent variation of approximately 2%. Both the PAR1 receptor and the PAR3 receptor had a variation of approximately 4%. The PAR4 receptor had a variation of approximately 6%. Skin care companies can work along with researchers to develop specialized creams, lotions, and ointments that cater to the specific needs of damaged or deprived skin of someone suffering from Atopic dermatitis based on the phenotypic response of certain varied genes.

#### THE EFFECT OF HABITAT CHANGE ON THE EVOLUTION OF A POPULATION OF ORGANISMS USING COMPUTATIONAL MODELING

Gregory Rassolov  
Spring Valley High School

The purpose of this experiment was to create a fully controlled, simulated environment with a population of organisms and to manipulate the environment and observe how the population of organisms reacted. Four variables were tested: the probability of two organisms producing offspring, the probability of mutation over generations, the probability of an organism becoming diseased, and the quantitative level of difference of the environment from the optimal habitat for the original population. A program was written in FORTRAN, and this program was composed of a reproduction, mutation, and disease cycle. This program was iterated until stability of the population was reached. It was hypothesized that an increase in the probability of disease and of the environmental difference would restrict population size, while an increase in the probabilities of reproduction and mutation would increase the population's rate of growth and the ability to adapt. Changes were generally evident within 10 iterations, and it was evident within 200 iterations whether or not a population would survive. The general trend of population size was visible over 5000 iterations. The hypotheses were confirmed; graphical displays showed that a more different environment restricted initial population growth, higher disease rates lowered the population size ceiling, higher reproduction rates accelerated initial growth, and higher mutation rates allowed the population to survive in more hostile environments. This was shown by correlation tests, which had a range of values from 0.979505 to 0.698049, showing the correlation between each variable and population size was at least moderately strong.

## THE EFFECT OF WATER TEMPERATURES ON THE REPRODUCTION OF *DAPHNIA PULEX*

Kiran Ravindra  
Spring Valley High School

It is estimated that the temperature of the earth has increased as much as one degree in the past 100 years, which is one-ninth of the temperature change between today and the last ice age. The purpose of this experiment was to determine how rising water temperatures affect the breeding cycle and reproduction of daphnia. As global temperatures rise, at a potential rate of 0.2°C per decade, many temperature-sensitive organisms may suffer and potentially could decline in number or become extinct. It was hypothesized that the number of offspring would be inversely proportional to the change in the temperature of the water. Extremely low temperatures, however, were not expected to yield large quantities of offspring. To create a ensure that age of adult daphnia specimens remained constant during experimentation, one mature female daphnia was placed in a 150 mL beaker, and left for three days at 20°C. All offspring were then collected and divided into the four temperature groups: 4°C, 10°C, 20°C, and 22°C. Offspring of the adult daphnia were taken note of and counted twice weekly. Specimens were given fresh water twice weekly. Experimentation continued until all specimens were dead. The hypothesis was supported. Daphnia kept at 10°C gave birth to the most offspring over the course of the experiment with daphnia kept at 20°C having given birth to the second-highest number of offspring and daphnia at 22°C having given birth to the least; 4°C, however, gave birth to no offspring at all. ANOVA test results ( $\alpha=0.05$ ) comparing the number of original adult daphnia specimens alive at any given point during experimentation showed no significant difference between temperature groups ( $F_{\text{crit}}=2.84$ ,  $F_{\text{test}}=1.43$  where  $p=0.24$ ). ANOVA test results ( $\alpha=0.05$ ), in combination with a Sheffé post-hoc test, showed a statistically significant difference between the number of daphnia born per week in each temperature group ( $F_{\text{crit}}=2.76$ ,  $F_{\text{calc}}=3.85$ ,  $p=0.01$ ).

## PHONE USE WHILE DRIVING: ARE AGE AND GENDER FACTORS?

Alexandra Rice  
Hammond School

This project was undertaken to examine whether a driver's sex and age (teenagers vs. adults 18+) have an effect on his or her driving habits and opinions regarding cell phone use behind the wheel. Teenagers (drivers at or below age 18) and adults (above age 18) of both sexes participated in a blind survey, wherein they were asked to provide information about how frequently and in which ways they use their phones while driving, make observations about their typical daily phone use while driving, and indicate whether they agreed or disagreed with certain statements about phone use while driving. These questions were posed in order to gather data about these age groups and genders based on their responses. The hypothesis that teenagers overall would be more likely than adults to use their phones behind the wheel was refuted, while the hypothesis that males overall would be more likely to use their phones behind the wheel was supported by the survey's findings.

## THE EFFECT OF POLYVINYL ALCOHOL ON THE SPLIT TENSILE AND COMPRESSIVE STRENGTH OF CONCRETE

Philip Richardson  
Spring Valley High School

Scientists and engineers have found that they may increase concrete's strength and durability by adding polymers. The purpose of this experiment was to find what percent of the polymer polyvinyl alcohol, PVA, added to concrete gives it the greatest split tensile and compressive strength. Concrete samples with 0, 2.699, and 5.396 percent PVA by mass were used. It was hypothesized that concrete with 2.699 percent PVA would have the greatest strength. A total of eighteen specimens were made, six containing 0 percent PVA, six containing 2.699 percent PVA, and six containing 5.396 percent PVA. Each group of six specimens was divided into two groups: three used in a split tensile strength test and three used in a compressive strength test. The results partially supported the hypothesis. Two ANOVA tests were performed at alpha value 0.05. The compressive strength of the concretes had no significant difference,  $F(2,5) = 4.000$ ,  $p=0.092$ . The split tensile strength of the concretes did however have a significant difference,  $F(2,6) = 14.38$ ,  $p=0.005$ . Next, a post-hoc Tukey test at alpha value 0.05 was conducted on the split tensile strength. The critical value for the Tukey test was 4.34. Two groups with a significant difference were the specimens in the split tensile strength test with 2.699 and 5.396 percent PVA. The group had a test value of 7.446. Two other groups, the concrete specimens with 0 and 2.699 percent PVA, were different having a test value of -4.973.

## APPLICATION OF INDICES OF REFRACTION OF SPONGE SPICULES AS PALEOTHERMOMETERS FOR DETERMINING PEATLAND WILDFIRE TEMPERATURES

Anna Ridenour  
South Carolina Governor's School for Science and Mathematics

This project seeks to create a method for determining the paleotemperature of wildfires based on the refractive index (RI) of the freshwater sponge spicules in peatlands. Sponge spicules are common constituents in freshwater wetlands in many parts

of the world, giving this study widespread significance. Samples of both *Taxodium* (cypress) and *Nymphaea* (water lily) peat were heated to temperatures ranging from room temperature to 1100 degrees Celsius using a muffle furnace. Ashes of each sample were mounted on slides with an oil of a known RI, and the Becke line movement showed whether the oil or the spicules had a higher RI. The RI of each sample was constrained using this method. These values were then plotted on separate curves for *Taxodium* and *Nymphaea* to determine whether there were any differences between types of peat. The data below 500 degrees Celsius was found to be too varied to show any relationship between the temperature and the RI. However, from 500 to 1100 degrees, there was a linear relationship between temperature and RI, with an  $R^2$  value of 0.8992 for *Taxodium* peat and 0.9185 for *Nymphaea*. Though the slopes for the *Taxodium* and *Nymphaea* were found to be similar, the y-intercepts for the plotted data differed, indicating that peat type must be known in order to use this paleothermometer. These curves were then used to find the temperature of recent wildfires in the Okefenokee Swamp in Georgia by finding the RI's of spicules in ash samples from recent burn sites.

#### COLD SURFACE STERILIZATION OF *STAPHYLOCOCCUS AUREUS* WITH A COLD CARBON DIOXIDE SPRAY

John Rosemeyer

South Carolina Governor's School for Science and Mathematics

The purpose of this project was to test the viability of using a carbon dioxide spray to disinfect surfaces with *Staphylococcus aureus*. This new method of sterilization, if viable, could be used to reduce the rate of community-acquired and nosocomial *S. aureus* infections. The testing of this hypothesis was done by spraying glass inoculated with *S. aureus* with a liquid CO<sub>2</sub> / propellant mixture, contacting the glass with sterile Tryptic Soy Broth, and measuring the turbidity of the broth after a 24 hour 37°C incubation time. It was found that the carbon dioxide spray did not show any significant drop in the absorbance values compared to the control groups. This shows that neither the CO<sub>2</sub> spray nor the cold produced by the spray killed *S. aureus* nor slowed its growth.

#### THE ROLE AND INTERACTION OF ARMADILLO REPEAT VELO-CARDIO-FACIAL (ARVCF) SYNDROME PROTEIN IN THE NUCLEUS OF HUMAN KIDNEY CELLS

Kiersten Rule

South Carolina Governor's School for Science and Mathematics

The Velo-Cardio-Facial Syndrome is characterized by a cleft palate caused by several gene products including the Armadillo Repeat gene deleted in the Velo-Cardio-Facial syndrome (ARVCF). It is a gene that transcribes a protein that functions in both the cellular junctions and in the nucleus. The protein has known functions of stabilizing cell to cell adhesion in adheren junctions, decreasing cell mobility, and protecting the cell from endocytosis (Anastasiadis and Reynolds, 2000). It is also found to be overexpressed in renal tumors, but little is known about its function within the nucleus. Preliminary research to better understand ARVCF's function in the nucleus was conducted using yeast two hybrid screen, immunofluorescence, and immunoprecipitation techniques. The results indicated that ARVCF might interact in a complex with DDX5, an RNA helicase that alters RNA in protein synthesis, and SF2, which is a proto-oncogene that can alter the splicing patterns of cell cycle regulatory genes and suppressor genes (DEAD box, 2011). To test this hypothesis, sucrose gradient centrifugation and western blots were used to characterize the particle sizes in renal cells, both cancerous and noncancerous. They indicated that all three proteins could form a complex because they were all found around fraction 12 in the western blot. From the results, DDX5 is speculated to form a bridge between ARVCF and SF2 because ARVCF and DDX5 interact together, independent of the complex containing DDX5 and SF2.

#### AN EVALUATION OF THE INHIBITORY EFFECT OF PLANT ESSENTIAL OILS AND ETHANOLIC EXTRACTS ON CULTURES OF PHYTOPATHOGENIC FUNGI AND FOOD CONTAMINATING BACTERIA

Subina Saini

Spring Valley High School

Plant essential oils, which are obtained from aromatic plants and contain purified secondary metabolites with antimicrobial qualities, have been reported to exhibit inhibitory activity against microorganisms. Since food/agricultural industries experience economic losses due to food spoilage bacteria and phytopathogenic fungi, the environmentally-friendly and low toxic nature of essential oils suggests their potential as bactericides/fungicides. The purpose of this study was to investigate the inhibitory effects of essential oils and ethanolic extracts of *Syzygium aromaticum* (clove), *M. balsamea* Willd (peppermint), and *Thymus vulgaris* (thyme) on fungal and bacterial cultures in order to observe how the method of extraction affects the plant oils' preservation of antimicrobial properties. It was hypothesized that *Bacillus cereus*, *Pseudomonas fluorescens*, *Aspergillus niger*, and *Penicillium digitatum* would be the most susceptible to the ethanolic clove extract because the clove plant produces the highest percentage of volatile oil out of the plants in this study. The inhibitory effects of essential oils and ethanolic plant extracts against bacterial and fungal cultures were determined by the disc diffusion method and a measurement of zones of inhibition on cultured agar plates. The data were analyzed at  $\alpha=0.05$  with a one-way ANOVA (for each combination of microorganism and plant extract). ANOVA distributions for *Bacillus cereus* ( $F(7,110) = 512.81, p < 0.001$ ), *Pseudomonas fluorescens* ( $F(7,106) = 316.02, p < 0.001$ ), *Aspergillus niger* ( $F(7,107) = 292.57, p < 0.001$ ), and *Penicillium digitatum* ( $F(7,75) = 186.51, p < 0.001$ ) showed that for all cultures, essential oils showcased larger inhibitory

zones than their respective alcoholic counterparts. This suggests the potential of essential oils as bactericides/fungicides as opposed to alcoholic extracts.

#### MICROGRAVITY AND PLANT GROWTH

Sashank Sakamuri

Academic Magnet High School

On earth, gravity is an important factor on life. But in space, the lack of gravity makes life difficult. This study tests the hypothesis that microgravity affects plant growth. I used a NASA developed Rotating-Wall Vessel (RWV) to simulate microgravity conditions to grow mung bean seedlings. Mung bean seeds soaked in water overnight were subjected to microgravity in the RWV for a period of 24 to 96 hours and placed on a filter paper in a petri dish. Seeds that were not subjected to the RWV were grown in a petri-dish as the control group. The petri-dishes were watered for a one week period of time and the growth of the mung bean seedlings was measured. The results identified a significant decrease in total length of seedlings as well as stem and root growth. Further, cross-sections of the seedlings subjected to microgravity and the control group were taken and observed under a microscope. Some of the major differences between the control group cross-sections and the cross-sections subjected to microgravity were that the cilia (hair-like projections) on the epidermis of the seedlings subjected to microgravity have disappeared. Also, the epidermis was beginning to break down in the seedlings subjected to microgravity compared to control. In conclusion, this study demonstrates that microgravity inhibits plant growth.

#### EFFECTS OF TLR4 AND STEATOSIS ON HEPATIC MITOCHONDRIAL HOMEOSTASIS

Erik Schatzer

South Carolina Governor's School for Science and Mathematics

Steatotic livers increase the risk of primary non-function, which is the shutdown of the liver for unknown reasons. This can lead to mortalities or retransplantation, taking away another liver in an already small donation pool. The goal was to why steatotic livers are unhealthy and why they have a tendency to not function properly after transplantation. Another objective was to find what role Toll-like Receptor 4 (TLR4) played in steatotic livers. It was hypothesized that the genes involved in mitochondrial homeostasis had preexisting alterations. mRNA transcript was measured using Quantitative Reverse Transcriptase Polymerase Chain Reaction (qRT-PCR) for 10 different mitochondrial genes involved in cell and mitochondrial homeostasis and two housekeeping genes in four different genotypes of mice. The genotypes were Lean, meaning they were Wild Type, Ob, meaning they were homozygous recessive for the leptin gene and were genetically obese, TLR4KO Lean, meaning they had all the genes of a Wild Type genome excluding TLR4, and TLR4KO Ob, meaning that they were Ob mice that did not have the TLR4 gene in their genome. The mice were male C57/BL6J mice in order to give comparisons of the expression of the genes between lean healthy livers and steatotic livers. Out of the 12 genes tested, it was shown that only Transcription Factor A, Mitochondrial (TFAM) has a significant result. The levels of mRNA transcript of TFAM were significantly higher in TLR4KO Ob mice than in Ob mice. It can be concluded that TLR4 does have a role in deregulating TFAM in mice with steatotic livers.

#### MUSIC AND MICE

Bailey Koller Schmidt

Hammond School

Studies show that music can make notable improvements in a student's academic success and grades. 50 million of brain cells are affected by music which lowers the levels of serotonin giving a positive influence on the brain. That is why this experiment was chosen. Two forms of music were used in this experiment: Classical/Mozart music and Dubstep music. Both forms are completely different, the Classical is slow calming music where as the Dubstep music is fast, hard, and choppy. The mice were put into three groups (control, Classical, and Dubstep). This experiment showed that the control mice were the fastest (average run time of 41.8secs), followed by the Dubstep mice (had an average of 71.8 secs), and Classical mice were the slowest (had an average of 92.8secs), which proved the first part of hypothesis wrong. Also the Dubstep were not at all aggressive after listening to music.

#### STUDIES OF CHARM PARTICLES IN THE ATLAS DETECTOR

Karl Schober

South Carolina Governor's School for Science and Mathematics

Many experiments taking place in the Large Hadron Collider at CERN are vital to the expansion of particle physics knowledge. These experiments, such as the search for the Higgs boson, rely on all of the detectors functioning properly and returning valid data. Using collected data from the production of D0 mesons, the resolution of the detectors can be calculated. In the experiment presented here, code was developed to verify that these detectors are functioning properly so that data from

new experiments can be considered reliable. Approximately 30000 Monte Carlo events were used for evaluation of this code. The resolving time was measured to be 0.250 ps, the lifetime was measured to be 0.480 ps, and the transverse distance resolution was calculated to be 233 pm. These do not contradict theory and so the code can be implemented for detector validation at CERN.

#### THE EFFECT OF EXERCISE TRAINING ON SKELETAL MUSCLE ANGIOGENESIS DURING CANCER CACHEXIA

Danielle J. Schwartz

South Carolina Governor's School for Science and Mathematics

Colon cancer is the third most commonly diagnosed cancer for both sexes. It also has the third highest death rate of all cancer types. Cachexia is a condition related to the loss of body weight, including muscle mass, which occurs with an underlying disease; it is also highly associated with colon cancer. The  $Apc^{Min/+}$  mouse is a model of colon cancer that develops cachexia. Angiogenesis involves the formation of blood vessels in tissue, and it is necessary for providing skeletal muscle with proper amounts of nutrients and oxygen. Vascular endothelial growth factor, or VEGF, is a growth factor that regulates angiogenesis. The quantity of VEGF is related to the amount of angiogenesis occurring in the tissue. The purpose of our study was to determine whether cachexia decreases angiogenesis in the skeletal muscle of the  $Apc^{Min/+}$  mice, and if exercise could reverse the negative effects of cachexia. Two types of mice were examined: the cachectic  $Apc^{Min/+}$  type mouse, and the BL6 wild type mouse, which served as a control. The mice were run on a treadmill at moderate intensity starting at 6 weeks of age (18 m/min, 1h, 6days/wk., 5% grade), and the gastrocnemius muscle was harvested at the time of sacrifice at 14 weeks of age. The skeletal muscle was then homogenized and analyzed by a western blot procedure for the abundance of VEGF protein. It was hypothesized that exercise has a positive effect on angiogenesis in the skeletal muscle of cachectic mice of the  $Apc^{Min/+}$  variety.

#### DOES CAFFEINE HAVE AN EFFECT ON ONE'S MEMORY?

Daniel Settana

Heathwood Hall Episcopal School

In today's society caffeine is consumed regularly by most of the world's population. Caffeine is regularly consumed in sodas, sports drinks, energy drinks, coffee, and tea around the world. This substance is said to cause alertness and to increase performance, which might be the reason the International Olympic Committee banned it in 2004. The purpose of this experiment was to see if caffeine has an effect on one's memory. The hypothesis was that if caffeine were given to a subject, then the caffeine would have an effect on one's memory. The null hypothesis was that if caffeine were given to a subject, then the caffeine would show no effect on one's memory. In the greenhouse at Heathwood Hall Episcopal School a maze was built out of cardboard for the subjects, feeder mice bought at a local pet store, to go through. First the mice were tested individually to see how long it took to get through the maze and they were tested five times each. Then 1mg/mL of a caffeine solution was added to the 16mL water bottle, and after each mouse had some of the solution and a noticeable behavioral change had happen, each mouse was put through the maze five times. So overall each mouse had been through the maze five times with caffeine and five times without caffeine. The results showed a statistically significant difference between the times with caffeine and the times without caffeine. An ANOVA test was taken and showed that the caffeine had an effect on the time taken to run the maze. The results of the ANOVA tests showed a p-value of 1.90587E-07 and an f- critical value of After analyzing the data, it can be said that caffeine has an effect on one's memory.

#### THE EFFECTS OF COMBINING DATAxin-2 AND HEAT SHOCK PROTEIN 70 ON SPINOCEREBELLAR ATAXIA TYPE 3 PATHOLOGY IN *DROSOPHILA MELANOGASTER*

Aakash Shingala

Spring Valley High School

The purpose of this experiment was to find a model for a better treatment method for spinocerebellar ataxia type 3. The hypothesis was that if HSP70 and dAtaxin-2 were used in conjunction, SCA3 would be better suppressed than when both were used separately in a *Drosophila* model. After multiple crosses done with pure strains of SCA378Q, dAtaxin-2, and HSP70, *Drosophila* with 78 CAG repeats of ataxin-3 and dAtaxin-2, HSP70, or both dAtaxin-2 and HSP70 were produced. There were two types of these, one that had the GAL4 driver, producing a phenotype in the eye, and another with the GAL4 driver present in motor neurons, leading to neurodegeneration in the flies. The flies with HSP70 were placed in an incubator at 43 degrees Celsius for 15 minutes each day. The flies with GAL4 present in the motor neurons were given a climbing assay, where about 30 flies were placed into an empty vial and were given 18 seconds to reach a point 5 centimeters high in the vial. The flies with GAL4 in the eye were observed post mortem. It was shown that the flies with dAtaxin-2 and HSP70 had the best motor performance over time when compared to other strains with SCA3-78Q. These flies also had the least visible damage to their eyes.

## THE COMPARISON BETWEEN ARCHIMEDES' METHOD AND HUI LIU'S METHOD OF THE VALUE OF PI

Sherry Shu and Maria Wei  
Hammond School

This project is undertaken to study two ancient methods of finding the value of pi. One method was derived by Archimedes, and other by Hui Liu. The study tried to answer the following questions: What is the difference between Archimedes' method and Hui Liu's method? How did each of them solve the it? Is there any more effective way to find the value of pi today? In this project, both Archimedes' method and Hui Liu's method are displayed. First, Archimedes and Hui Liu used the different ways to find the equation of the area of the circle. Archimedes used the proof by contradiction, whereas Hui Liu used the method of exhaustion. Then, Archimedes started with the regular hexagon circumscribed around the circle and inscribed hexagon to get the range of pi. In comparison, Hui Liu starts with the cyclic hexagon to get the length of one side of regular n-. Then he used the area of the circle to get the area of the circle. Hypothesis: Hui Liu's method is better than Archimedes'. Reason: Hui Liu was born later than Archimedes, so probably in Hui Liu's time, math had already developed a lot compared to the math during Archimedes' time. In addition, the mathematician who got the nearly exact value of pi, called Chongzhi Zu, used a method similar to Hui Liu. Therefore, we think that Hui Liu's method is better than Archimedes' method. The result shows that Hui Liu got a better value than Archimedes.

## THE EFFECT OF CALCIUM HYPOCHLORITE CONCENTRATION ON SWIMMING POOL ALGAE, WITH SPECIAL REFERENCE TO THE DEVELOPMENT OF RESISTANCE TO CALCIUM HYPOCHLORITE

Virginia Skidmore  
Spring Valley High School

Many methods have been looked at concerning the killing off algae blooms, which prohibit certain life forms, but in the case of this project, the methods focused on are those used to kill algae blooms found in swimming pools. The method of using calcium hypochlorite on algae blooms is one of the many techniques used out of a selection of both physical and chemical means. It was hypothesized that if the concentration of the calcium hypochlorite increases above the recommended level, then all existing algae will not be killed, and algae resistance to calcium hypochlorite will form. Five different calcium hypochlorite concentrations were tested, along with a control. Each of the concentrations was used in two different culture bottles. A sample from each bottle was then taken and the absorption of light at different wavelengths was found, with the use of a spectrophotometer, before addition of calcium hypochlorite, and after. From the recorded absorption; concentrations of chlorophyll a, chlorophyll b, and fucoxanthin were found. The final concentrations were subtracted from the initial and a linear regression was performed using the data. Data were statistically analyzed with a linear regression t-test at an alpha equal to 0.05. It was found that a significant linear relationship between variables existed in the chlorophyll a,  $t(10) 2.53$ ,  $p=0.030$ , as well as in the fucoxanthin,  $t(10) 3.06$ ,  $p=0.012$ ; however no significant difference appeared in the chlorophyll b,  $t(10) 1.66$ ,  $p=0.127$ . When it was found that algae survived all five concentrations, the two bottles containing the highest concentrations continued to have four more calcium hypochlorite concentrations added to them. From this set of data the concentrations of the algae were found and compared graphically. The hypothesis was potentially supported because it was found that algae was able to continually grow after multiple calcium hypochlorite concentrations.

## THE EFFECT OF pH ON THE CHEMICAL IDENTITY OF SOIL AS DEFINED BY NITRATE NITROGEN, PHOSPHORUS, POTASSIUM, HUMUS, CALCIUM, AND MAGNESIUM LEVELS

Grace Smith  
Heathwood Hall Episcopal School

In criminal cases, forensic geology can be used as evidence, so the purpose of this experiment was to determine whether the chemical identity could be manipulated by a change in pH, thus determining if a suspect could change the soil's identity, which could get them acquitted. The chemical levels were tested after 0.5 L of acid or base solutions were added to 1.5 L of Scott's Premium Topsoil. The soil was tested, using a LaMotte STH-7 testing kit, according to the instruction manual in the kit. Hypothesis 1 of this experiment was that the acidic solution will cause lower levels of nitrate nitrogen, phosphorus, potassium, humus, calcium, and magnesium in the soil samples. Hypothesis 2 was the basic solution will cause higher levels of nitrate nitrogen, phosphorus, potassium, humus, calcium, and magnesium in the soil samples. Results from this experiment showed that chemical identity of soil could be altered by the addition of strong acids or bases. Although another potential way for criminal suspects to evade conviction, these results indicate it would be a difficult outlet to exploit.

## THE EFFECT OF BACKPACK MASS ON THE BALANCE OF ADOLESCENTS

Rana Sobeih  
Spring Valley High School

The purpose of this study was to assess the impact of differing backpack masses on the balance of adolescents. Backpacks are a significant factor in the life of adolescent students, yet little research has been done to determine how much should be carried. Hypothesis #1 was that subjects with backpacks 10% of their mass would have higher scores on the Agility test than every other weight except for no backpack. Hypothesis #2 was the same, but for the Stillness test. Hypothesis #3 was that

subjects with backpacks 10% of their mass would have lower scores on the Center of Balance test than every other weight except for no backpack. The experiment was accomplished using the Wii™ and the Wii™ Fit CD and Board to implement the Center of Balance, Agility, and Stillness test on thirty subjects, with one trial for each category of no backpack, backpack with 10% of body mass, backpack with 20% of body mass, and backpack with 30% of body mass. The effect of backpack mass was significant  $F(3, 114) = 7.96$ ,  $p < 0.0001$  for the Stillness test. The Tukey-Kramer was run for the Stillness test. The difference between no backpack and 30% of body mass ( $p = 0.0006$ ), the difference between 10% of body mass and 30% of body mass ( $p = 0.0001$ ), and the difference between 30% of body mass and 20% of body mass ( $p = 0.0160$ ) was significant. The Stillness test trends and statistical results supported the hypothesis.

#### PAR1 ACTIVATION BY SFLLRNP ALTERS MOTOR NEURON CYTOSKELETON

Juhi Srivastava

South Carolina Governor's School for Science and Mathematics

Previous experiments have shown that Protease Activated Receptor-1 (PAR-1) activation on motor neurons by SFLLRNP results in apoptosis and decreased neurite growth. Typically, SFLLRNP is applied two hours following motor neuron plating, giving them time to adhere to the plate. Within 24 hours of treatment, neurons begin to retract their neurites, round up, and undergo apoptosis. Given these alterations in the cytoskeleton, the hypothesis of this experiment was that *immediate* treatment with SFLLRNP at the time of plating would alter the neurons' abilities to attach to the plate. To test this hypothesis neurons were treated with SFLLRNP or 1X PBS (control) at the time of plating. After 24 hours, immunocytochemistry to assess focal point adhesions and total fluorescence was performed. Using a fluorescence microscope, images were captured and analyzed with ImageJ (NIH). The SFLLRNP-treated group had significantly more focal adhesion points ( $p < 0.0001$ ) and greater fluorescence ( $p < 0.0001$ ) than the control group. Results suggest that SFLLRNP-treatment may increase neuron attachment in culture, which is surprising given the effects of SFLLRNP on neurites and apoptosis when treatment is given *after* neuron attachment. However, other experiments have shown PAR-1 activation to be beneficial to cells that are experiencing an insult. Perhaps treating cells prior to their attachment is equivalent to an insult, whereby PAR-1 activation aids in attachment and survival. To examine this possibility further, the experiment, will be repeated altering the time of PAR-1 activation which will determine whether immediate treatment of neurons, prior to their attachment, models a stressful situation for the cells.

#### THE EFFECT OF DIFFERENT DYE TYPES IN COLOR RETENTION ON COTTON, WOOL, AND POLYESTER

Grayson Winter Stribling and Olivia June Bell

Heathwood Hall Episcopal School

In this experiment, acid, industrial, jacquard, and Kool-Aid dyes were tested for color retention levels on cotton, wool, and polyester fabrics. The study was important because it examined exactly how much dye is put into our everyday clothing to make their final color come out, and also what dyes are considered best for certain types of clothing. It was hypothesized that if three types of fabric are tested with an acid, industrial, jacquard, and Kool-Aid dye, then the Kool-Aid will have the least fade resistance. Two trials of twelve 12.7cm by 12.7cm swatches of cotton, wool, and polyester fabrics were pre-soaked in a cleaning solution before being dyed. After drying, sitting in the colorant for an elapsed time period, and washing once more, small samples of the leftover colored solution were placed in a Colorimeter to calibrate its transmittance. Analyses of the data showed that industrial and jacquard dyes held the most in the polyester and cotton. A possible explanation for these finding would be that those established dyes were composed solely for the fabrics tested. Further research might show that while assessed on other fabrics, results may differ.

#### THE ANTIBACTERIAL PROPERTIES OF MELALEUCA ALTERNIFOLIA ESSENTIAL OIL AND ECHINACEA PURPUREA EXTRACT ON STAPHYLOCOCCUS EPIDERMIDIS

Caroline Swan

Spring Valley High School

*Staphylococcus epidermidis* is a leading cause of bacterial skin infections and is becoming increasingly common as a nosocomial infectious agent. The purpose of this experiment was to determine the minimum inhibitory concentration, or MIC, of Echinacea and tea tree oil on *Staphylococcus epidermidis*. This is important because many individuals are affected by common bacteria that share characteristics with *Staphylococcus epidermidis*, and research on these two natural medicines may lead to their incorporation in topical skin products to treat such infections. Echinacea and tea tree oil were tested in separate suspensions. It was expected that as the concentration of Echinacea and tea tree oil increased, the number of colony forming units per milliliter, or CFU/mL, of *Staphylococcus epidermidis* would also decrease. This experiment was performed using several trials of a zone of inhibition test as a preliminary experiment. Following the results of these tests, a spectrophotometer was utilized to determine the optical density of *Staphylococcus epidermidis* solutions mixed with Echinacea and tea tree oil. The results concluded that tea tree oil in concentrations of even as low as 5% inhibited growth of *Staphylococcus epidermidis*, but Echinacea only inhibits the growth of *S. epidermidis* by about 20% at 25% concentration.

THE SELF-ADMINISTRATION OF 20% ETHANOL IN FEMALE C57 WILDTYPE, FEMALE BETA-ENDORPHIN HETEROZYGOTE MICE, AND MALE BETA-ENDORPHIN HETEROZYGOTE MICE WHEN EXPOSED TO A PREDATOR URINE STRESSOR

Sean Sweat

South Carolina Governor's School for Science and Mathematics

Previous studies have shown that beta-endorphin, when released in the brain, is able to relieve stress. Beta-endorphin is an endogenous opioid peptide neurotransmitter that is synthesized and released upon the stimulation of the Hypothalamus-Pituitary-Adrenal axis. By introducing feline urine, an aversive stimulus, to mice, they are likely to become stressed. The mice used for this experiment were genetically engineered to release 100% beta-endorphin (wild-type) and 50% beta-endorphin (heterozygote). A total of 25 mice were used for this experiment, eight female C57 wild-type, nine male beta-endorphin heterozygote, and eight female beta-endorphin heterozygote mice. Following a baseline of a two bottle choice paradigm, in which the mice chose between 20% EtOH and water, the mice were exposed to either fresh cat litter or cat litter containing a urine odor for three hours every day. An hour after the appropriate cat litter was added, the mice were given access to 20% EtOH and continued to have access to water. It was expected that the female beta-endorphin heterozygote mice would consume the most EtOH, followed by the male beta-endorphin heterozygote mice, and finally the female C57 wild-type mice. Because heterozygote mice produced 50% beta-endorphin, EtOH intake may stimulate the release of more beta-endorphin, and females appear to be more susceptible to stress. The wild-type mice produce 100% beta-endorphin and therefore their intake of EtOH may have been moderate. The aim of this experiment is to fortify our understanding of stress in relation to beta-endorphin and alcohol abuse.

EFFICIENCY OF GASOLINE AND BIO-FUELS

Mahmood Syed

Southside High School

This experiment was designed to measure the specific energies of and the amount of CO produced by different bio-fuels in order to determine which fuel would be more efficient. The different fuels used in the experiment were ethanol, Methanol, Vegetable Oil Biodiesel, and Gasoline (as a control group). The experiment consisted of burning the different fuels in a glass bulb with a wick. This glass bulb was then placed under a beaker holding 100 ml of water, which was supported by a ring stand. A thermometer was placed in the glass beaker to record the temperature of the water over the course of 5 minutes. Times were taken before the water was heated, after 3 minutes and finally after 5 minutes. This gives the change in temperature, which can then be used to calculate specific energy ( $Q = mc\Delta T$ ). The amount of CO produced can also be calculated from the experiment. By setting up a partial combustion reaction equation and using Stoichiometry, the amount of CO emitted in grams can be found. After the specific energies and amount of CO produced were calculated, it was found that Methanol would make the best fuel, as it released the most energy and the least pollutants.

SPARK PLASMA SINTERING SYNTHESIS OF Ni<sub>3</sub>Al

Cameron Taylor

South Carolina Governor's School for Science and Mathematics

Ni<sub>3</sub>Al is a very hard intermetallic alloy that has multiple practical applications such as being used as a material for jet engines, heat-treating furnace components, and high temperature cutting tools and dies. Of special interest is that this alloy's yield strength increases as its temperature increases, as well as its high wear and oxidation resistant properties. The synthesis of homogeneous Ni<sub>3</sub>Al has long been hindered by the complex phase diagram, especially the peritectic and eutectic points near the melting point of the Ni<sub>3</sub>Al phase. The results of this research show a one-step process to synthesize and densify Ni<sub>3</sub>Al. This method involved producing Ni<sub>3</sub>Al pellets from the single elemental powders of nickel and aluminum by processing the mixed powder through a spark plasma sintering system (SPSS) at temperatures ranging from 500°C to 1280°C. The results of X-ray powder diffraction measurements showed that the Ni<sub>3</sub>Al phase started to form at 600°C and the amount of Ni<sub>3</sub>Al increased as the SPSS temperature increased. The X-ray data was consistent with the densities of the samples measured by an Archimedes' method. Homogeneous Ni<sub>3</sub>Al samples were fabricated at SPSS temperatures above 1000°C. The process described herein will increase the efficiency of Ni<sub>3</sub>Al synthesis, which will have a drastic impact on the use of the alloy.

THE INTERACTIONS BETWEEN TRANSIENT RECEPTOR POTENTIAL CHANNEL VANILLOID RECEPTOR MEMBERS ONE AND THREE IN *DROSOPHILA*

Meg Teuber

Spring Valley High School

The purpose of this study was to determine if the different members of the vanilloid ion channel interact. Since TRP is an initial pain receptor, learning more about the different subfamilies and members of TRP could lead to a useful anesthetic with few side effects. The hypothesis was if *Drosophila* were conditioned to eat food that activates either TRPV1 or TRPV3, then one of the other members of the transient receptor potential ion channel would not be affected. This was done by exposing



fruit flies to foods that contain different chemicals that activate TRPV1 and TRPV3. The foods were mixed with food coloring so that each food was identifiable in the body of each fly. The flies were then given a choice between different media (capsaicin, allyl isothiocyanate, thymol, oregano, and plain media) after being conditioned for a specific medium. After the flies consumed the food of their choice, the flies' abdomens were examined and the numbers of flies that ate each food were recorded. Data were statistically analyzed at alpha equal to 0.05 with an ANOVA test. A statistical difference was shown with  $F(2, 115) = 56.32, p < 0.001$ . A Scheffe post-hoc test was run which determined that there was a significant difference between the flies raised on control medium, the flies raised on TRPV1 activating media, and flies raised on TRPV3 activating media.

#### THE EFFECT OF *PLEUROTUS OSTREATUS*, *SACCHAROMYCES CEREVISIAE*, AND COMPOST ON THE DEGRADATION OF FOOD WASTE

Linda Thomas  
Spring Valley High School

Microorganisms can be found in compost, and they help to decompose the materials in the compost. The purpose of this experiment was to test mixtures of white-rot fungi, mesophilic organisms, and components of compost on the degradation of food waste. This was important because composting is a method of making food waste beneficial while also degrading it, and the use of white-rot fungi and mesophilic organisms may speed up the process. It was believed that the food waste in the compost with the combination of *Pleurotus ostreatus* and *Saccharomyces cerevisiae* added would experience the greatest percentage of mass loss. This was accomplished by putting compost, food waste, and a combination of white-rot fungi and mesophilic organisms in compost columns made of soda bottles. The effectiveness of the white-rot fungi, mesophilic organisms, and components of compost on the degradation of the banana peels was measured by measuring the mass lost by the banana peels in a given amount of time. The combinations of white-rot fungi and mesophilic organisms that were used in this study included *Pleurotus ostreatus* (a white-rot fungus), *Saccharomyces cerevisiae* (brewer's yeast), a combination of *Pleurotus ostreatus* and *Saccharomyces cerevisiae*, and a fourth group with no added fungi. An ANOVA test was run on the percent decrease of the mass of the banana peels after the 30-day growing period in each test group  $F(2, 27) = 0.03, p = 0.97$ . There was enough evidence to reject the claim that there was at least one difference between the percent decrease in the banana peels for different independent variable groups.

#### EFFECTS OF TiO<sub>2</sub> ANATASE PARTICLE SIZE ON THE ELECTRO-CHEMICAL PERFORMANCE OF Li-ION BATTERIES

Michael Tibbs  
South Carolina Governor's School for Science and Mathematics

Lithium-ion batteries have the potential to outdate modern rechargeable batteries. Often providing cell voltages exceeding three volts, they eliminate the need for multi-cell batteries. Additionally, they have an extremely high energy density, allowing construction of lightweight batteries with high capacities. In the development stage, however, researchers continually seek ways to improve cyclic stability and low rate capability. Often, as these lithium-ion batteries are charged and discharged, they lose some of their original capacity. Hence, it becomes necessary to find a way to make the battery design more efficient and reliable. In order to improve battery capacity and cyclic stability, some researchers are testing different anode materials. In that respect, anatase, a spherical nanoparticle of TiO<sub>2</sub>, was used as an anode material to construct lithium-ion batteries. These anodes were constructed with anatase of varying particle sizes to test battery voltage, capacity and rate capability. Preliminary results indicate a possible trend that the electrochemical performance of TiO<sub>2</sub> anodes is dependent on particle size. Results from testing show that the anodes constructed with 10 nm anatase possessed higher capacities than those constructed from 100 nm anatase. Testing also showed that the 10 nm anatase anodes possessed better rate capability than the latter.

#### OBSERVING THE MILKY WAY GALACTIC PLUME AT 1420 MHZ

Virginia Tkacik  
South Carolina Governor's School for Science and Mathematics

A jet-like structure had been noted by Yusef-Zadeh *et al.* (1985) to the north and south of the galactic center. Observations were made of the intensities and velocities of the structure coming from the galactic center at 1420 MHz in an area from a declination of  $-20^\circ$  to  $+40^\circ$  and a right ascension from 13 to 18 hours in increments of  $10^\circ$  declination and one hour right ascension with a resolution of  $2.5^\circ$  using the 4.6-m radio telescope at the Pisgah Astronomical Research Institute (PARI). Due to the latitude of the telescope, these observations were only made of the northern jet. In the same region are 25,000 light year diameter gamma emission Fermi bubbles, which may or may not have come from the same origin as the jet (but are not seen in the radio spectrum), as well as bipolar hypershells. The velocities of the scans were determined, as the source of the 1420 MHz signal is well known. The velocity of the local standard of rest was accounted for, and the scans' velocities appear to mirror each other diagonally but are opposite in direction. The mirror is along the galactic plane, but approximately perpendicular to the jet, which implies that the structure is arcing and was formed with the bubble or that the motion of the particles from the jet move with the spin at which they were expelled.

## SEX AND GENOTYPE DEPENDENT LEVELS OF SOCIAL PLAY IN MICE

Leah VanSyckel

South Carolina Governor's School for Science and Mathematics

Social play is an essential behavior for normal development in animals, and those deprived of it have social and cognitive impairments (Pellis and Pellis 2007). Studies have connected social play's physiological mediation to the endogenous opioid beta-Endorphin. Social play stimulates the production of beta-Endorphin, presumably reinforcing the behavior by producing pleasurable feelings (Trezza et al 2011). In the same manner, adolescent male mice with pharmaceutically blocked  $\mu$ -receptors, inhibiting beta-Endorphin action, exhibit decreased levels of social play (Trezza et al 2011). Previous research focused on social play in male mice, and to our knowledge, this behavior has not been examined in female mice. We hypothesize that adolescent female mice will exhibit social play at similar levels to males. Our second hypothesis is that male and female beta-Endorphin knockout mice will not play as much as mice with beta-Endorphin because they lack this critical component. At 35 days of age, adolescent mice were isolated for two hours and habituated to the test cages for 15 minutes for two consecutive days. On the third, fourth, and fifth days, the mice were isolated and then paired with a previously unfamiliar mouse to play with for 15 minutes. Preliminary data collected for this experiment have been inconclusive and statistical analyses will be run once the experiment has been completed. A greater understanding of the neurological basis of social play could contribute to knowledge of certain disorders associated with impaired social play, such as autism and early onset schizophrenia.

## THE EFFECT OF GREEN TEA, BLACK TEA, OOLONG TEA, AND WATER ON THE REGENERATION RATE OF *DUGESIA DOROTOCEPHALA*

Alice Judy Verbrick and Laura Clare Hungiville  
Heathwood Hall Episcopal School

Cell regeneration is important in the medical world due to the fact that improving cell regeneration leads to improving re-growth in damaged tissue in the body. Flavanioids found in teas are believed to improve skin cell regeneration and health, and tea is consumed throughout the world for its benefits. All animals have the ability to regenerate, but in differing levels. Humans regenerate skin cells constantly, and regenerate cells when healing wounds. Some animals, such as the planarian *Dugesia dorotocephala*, have the ability to re-grow any lost structures in a relatively short amount of time. This study was conducted to test the effect of green, black, and oolong tea on the regeneration of *Dugesia dorotocephala* compared to a control group in water. In this study, incised planarians were placed in green tea, black tea, oolong tea, and water for four days. Their lengths were measured in 24 hour increments, and the measurements, as well as the percent changes, were analyzed in single factor ANOVA ( $\alpha < 0.05$ ) tests and descriptive statistics tests. The data showed a slight positive growth for the group expose to black tea; however, there was no statistically significant data when the groups were compared to the control group ( $p > 0.05$ ). The standard deviations also displayed no trend. Further and more in-depth research would be needed on this study to produce statistically significant results. The hypothesis which stated if *Dugesia dorotocephala* was exposed to green tea, black tea, oolong tea and water, then the groups exposed to green tea, black tea, oolong tea and water would have a descending regeneration rate respectively was rejected. The null hypothesis that stated if *Dugesia dorotocephala* was exposed to green tea, black tea, oolong tea and water, then the groups exposed to green tea, black tea, oolong tea and water, will have no change in the regeneration rate, failed to be rejected.

## THE EFFECTS OF BOTH *SARGASSUM* AND *ASPERGILLUS NIGER* ON THE BIOSORPTION OF LEAD FROM WATER

Himabindu Vinnakota  
Spring Valley High School

Biosorption, a process in which heavy metal ions are linked to binding sites in the cell walls of dead biomass, is one of several strategies that microorganisms have developed after periods of exposure to heavy metals. Lead, one of the major contaminants in industrial effluents, pollutes sources of food and water for people nearby. Since both of the organisms *Sargassum* and *Aspergillus niger* show uptake of lead, then lead biosorption rates using both will be higher than samples containing only a single species. To conduct this experiment, biomasses of the two organisms were transferred into lead solutions. One control setup and three experimental setups were present: one with no biomass, one with only *Sargassum*, one with only *A. niger*, and one with the biomass of both organisms. To quantify the reaction rates of each treatment, the differential rate laws were applied to determine zero-, first-, or second-order kinetics for each treatment. An ANOVA test was performed on the 24 hr values at  $\alpha = 0.05$ ,  $F(3, 16) = 16155.19$ ,  $p = 0.000$ , showing a significant difference between the treatments. The following post-hoc Tukey test revealed that the difference lay between every group, meaning that the treatment using both organisms did have a different effect on the lead concentration than the single organism treatments. Using both in the same treatment group led to a second-order reaction with a rate constant  $1.56 \times 10^{-3}$ , the highest of the three rates. Therefore, the treatment using both organisms was the most effective.

## THE EFFECTS OF SUBSTRATE STIFFNESS WITHOUT GROWTH FACTORS ON THE GROWTH AND DEVELOPMENT OF RAT BONE MARROW STEM CELLS

Huu Vo

South Carolina Governor's School for Science and Mathematics

Cell morphology and function are affected by the cell's surrounding microenvironment. Stem cells are known to be sensitive to their microenvironment, which is comprised of neighboring cells and extracellular matrix. Small biochemical and biophysical changes can greatly alter stem cell growth and differentiation. *In vivo*, the cellular microenvironment can vary in stiffness by several orders of magnitude (0.1-100 kPa) depending on tissue type and location. The goal of this study is to determine how substrate stiffness influences mesenchymal stem cells. Bone marrow stem cells were cultured on polyacrylamide gels with different stiffnesses to simulate the effects of different microenvironments. The cells were cultured on 3kPa and 10kPa polyacrylamide gels and standard glass coverslips. Bicinchoninic acid (BCA) and alkaline phosphatase (ALP) assays were performed to evaluate the production of enzymes. Cells were fixed on the seventh day and stained for alizarin red and osteopontin. Assay results showed that the cells had a greater enzyme activity on glass coverslips than the gels on days 1, 3, and 5. By day 7, the 10 kPa gel had the greatest enzyme activity. Alkaline phosphatase activity is representative of differentiation. The cells cultured on glass coverslips may have shown more growth than on the other substrates because cells are anchorage—dependent. Alizarin red staining was negative indicating no mineral deposits were found. This indicates that the cells did not yet fully differentiate into bone cells, which was consistent with other literature findings. Overall, it appears that substrate stiffness does have an effect on mesenchymal stem cell growth.

## TESTING THE EFFECTIVENESS OF DIFFERENT OILS IN SOAPS TO CLEAN DIRT AND OIL

Maria Vu

Southside High School

To test how different oils affect soaps' cleaning ability, six different soaps were created, each consisting of one main oil component. In looking at the chemical structure of the oils, it was found that each had a unique length of hydrocarbon chain. With a link between chain length and the soaps' different characteristics (i.e. surfactant characteristics and solubility), it was believed that there would also be a direct correlation to its overall ability to remove dirt and oil. To analyze the cleaning abilities of each, the soaps were then run across a dirty shirt twenty times, with the same amount of pressure applied to each. Afterwards, the soaps were ranked from best to worst and compared, with respect to their hydrocarbon chain lengths. The hypothesis that the shorter chains would perform best failed; the shortest chain demonstrated a less effective cleaning ability than two other soaps, both with longer chains. The soap consisting of two different oils (80% olive oil, 20% coconut oil) performed best, cleaning almost as well as the store bought soap we used as a control. This soap contained an 18-count chain, while the soap that was ranked second had a 24-count chain. Rank 3 of the soaps altered the increasing chain pattern because of its 12-count chain (the shortest chain). Because of this, there was no strong correlation yielded from this experiment, making our original hypothesis incorrect.

## ANALYSIS OF AZO COMPOUNDS WITH ULTRAVIOLET-VISIBLE SPECTROSCOPY

Charles Wang

South Carolina Governor's School for Science and Mathematics

Azo compounds, a class of nitrogen-containing organic compound, have many industrial uses. However, certain limitations prevent them from being widely used. The need for new ways of synthesizing azo dyes arose from the desire for a "greener synthesis," avoiding the use of noxious solvents. The goal of this project was to use ultraviolet-visible spectroscopy to examine the spectroscopic properties of azo dyes. Ultraviolet-visible spectroscopy – commonly abbreviated as UV/vis – is an analytical technique wherein the optical transparency/opacity of a compound is measured as a function of the wavelength of incident light. Once the absorption spectra of the dyes were retrieved, appropriate absorption peaks were selected and Beer's Law plots made. In order to determine the extinction coefficients of the dyes.

## THE EFFECT OF COOKING ON CAROTENOIDS

Stella Wang

Hammond School

Among all the nutrients in vegetables, carotenoids are one of the most commonly found nutrient in vegetables. They are presents in large amounts in red, orange and yellow vegetables such as carrots, tomatoes, pumpkins, red and yellow bell peppers. It is a common belief that most of the nutrients are lost in cooking. This project was undertaken to study the effect of cooking on carotenoids. The study tried to answer the following questions: Does the process of boiling the carrots destroy the carotenoids in them? Through the process of boiling the carrots, do all the carotenoids leach into the water in which they are boiled? Does the amount of time for which carrots are boiled affect their presence in the food? Thus carotenoids were extracted from the carrots which were either raw or boiled for different amounts of time. The water in which the carrots are boiled was also fixed to be tested. The samples with extracted carotenoids are tested by a spectrophotometer at different wavelengths. According to the results, carotenoids are not destroyed during the process of boiling because the sum of the percent

absorbencies after cooking is approximately the same as those before cooking. However, some carotenoids do leach into the water in which the carrots are boiled according to the results. Therefore, for the nutritional value of carrots, it is better to drink the water in which the carrots are boiled after cooking the carrots.

#### SYNTHESIS OF A MORE COST-EFFICIENT, COMPOSTABLE, GREEN POLYMER INCORPORATING RECYCLED VEGETABLE OIL

Zachry Z. Wang  
Dutch Fork High School

The purpose of this research project is to find a cost-efficient method to utilize waste cooking oil to synthesize biodegradable polymers from naturally occurring materials. Project objectives include: (1) Developing a method to provide an environmentally friendly approach to recycle waste vegetable oil. (2) The method would produce biodegradable polymers, which can be broken down by microorganisms in a natural environment in a short time scale (over 60% degradation in 180 days) compared to conventional polymers (50+ years). (3) The primary reactants in this approach are all naturally occurring materials. Additional objectives include higher molecular weight and increased cost efficiency compared to the industry standards. Rosin from pine trees (abietic acid) and vegetable oil (10-undecen-1-ol) are used as the primary components to synthesize the monomer using a Diels-Alder reaction followed by an esterification. Next, these monomers are polymerized to make polymers using a particular mode of olefin metathesis known as Acyclic Diene Metathesis. NMR, biodegradability tests, and other tests are then used to determine if a polymer can be synthesized. So far, the monomer has successfully been synthesized and polymerization has been achieved using the Acyclic Diene Metathesis process. Further study will be conducted to increase molecular weight, cost-efficiency, and biodegradability.

#### PHEROMONES AND VISUAL ATTRACTION IN TEENAGERS

Emily M. Wassermann and Catherine S. McElveen  
Hammond High School

This experiment aims to determine the relationship between visual teenage males attraction to the opposite sex and his subconscious preference for a certain pheromone released by a member of the opposite sex. Pheromones are hormones emitted from the skin of male and female humans. They can be detected in the nose by the vomeronasal organ, which sends a message to the hypothalamus causing the release of follicle-stimulating hormone and luteinizing hormone. Pheromones are thought to be important components of attraction. We hypothesized that, teenage males preferences of scent and appearance would correspond to the same female. Heterosexual male singles were tested for their preferences, using high school juniors and seniors (age 16-18) as subjects. Five identical white shirts were purchased and 4 of them were worn during exercise by female subjects in the same age range. The fifth shirt was unworn as a control. The shirts were placed in plastic bags labeled A-E. Headshots of the female subjects were taken and labeled 1-4. Twenty teenaged male participants were asked to rank the scents of the shirts and the pictures of the females from most to least attractive without knowing which female had worn which shirt. Forty five percent of the males sampled chose first choices for scent and appearance the corresponded to the same female compared to an expected 20% if there were no correlation. A one proportion Z test using alpha level 0.05 showed that the data is significant. This conclusion supports our hypothesis.

#### QUANTITATIVE MEASUREMENTS OF HORSE MOTION DURING HIPPO THERAPY FOR FUTURE USE IN THERAPEUTIC TREATMENT

Tyler Watt  
South Carolina Governor's School for Science and Mathematics

Hippotherapy is the use of a horse to give therapeutic treatment to a patient. Currently, horses are assigned based almost completely on how the horse feels to the patient. This method of choosing is subjective and often leads to patients riding a horse that does not help him or her efficiently. Dr. Desjardins and his lab believe that it is possible to not only choose a horse based on its biomechanics but also to scientifically measure these traits (such as gait-width, angular motion in between joints, etc) in order to prescribe a horse based on a patient's condition. This study was designed to observe and analyze the correlations in movement between one horse and six riders. Six subjects were filmed and monitored while riding a horse. The movement of the horse was recorded by a Matlab program that put twenty chosen points into X and Y coordinates. Using Excel, the lab made these coordinates into angles that were graphed to see similarities and differences. The study shows a regular walking pattern for the horse and an observable pattern with the six subjects' motion.

## USE OF ULTRAVIOLET BAND PASS FILTERING FOR THE PURPOSE OF AUGMENTING REFRACTIVE INDEX PALE-FIRE INTENSITY ESTIMATES

Abbie Wendelken

South Carolina Governor's School for Science and Mathematics

The purpose of this research is to establish a paleo-thermometer for past wildfire intensities based on the ultraviolet properties of freshwater sponge spicules in *Nymphaea* (water lily) and *Taxodium* (cypress) peat samples from the Okefenokee Swamp. Experiments were conducted under visible and ultraviolet light using samples that had been burned in a muffle furnace at varying temperatures to establish a proxy for past fires. First, experiments were undertaken to prove that the mounting medium, Elvacite, was not the cause of the fluorescence. Then, photomicrographs of sponge spicules were taken using bandpass filters coupled to a UV excitation filter. These filters included a FITC filter (which represents a greener emission spectral region), a CY3 filter (which reveals emission in a greenish-yellow spectral region), and a 620 nm filter (which shows a more yellow emission spectral region). Differences in the variable degrees of fluorescence intensity and color were encountered from samples heated in the range from 0 to 1100 degrees Celsius. Initial results suggest that as the temperature increases, the color moves closer to the yellow color range and the intensity of the emitted light decreases. This new method might be utilized for establishing temperatures of past wildfires by looking at charcoal-rich fire zones at depth within peat cores from freshwater peatlands worldwide.

## INCREASING SOUTH CAROLINA'S ENERGY EFFICIENCY WITH THE ADOPTION OF HECTORITE *P*-PBI HIGH-TEMPERATURE PEM FUEL CELLS

Maggie Westbrook

South Carolina Governor's School for Science and Mathematics

Proton-exchange membrane fuel cells (PEMFC) are a promising technology for efficient power generation in the 21st century. High-temperature PEMFC's offer several advantages over the traditional low-temperature PEMFC such as the elimination of water management, the increased tolerance of fuel impurities, a wider variety of fuel choices, lower fuel reforming costs, improved electrode kinetics, and higher conductivities. In order for the *para*-PBI PEM to be more widely developed and commercialized, the membrane needs to have improved reliability, a lower cost, and consumer approval. A possible solution is the addition of a specific clay-nanocomposite, Hectorite to the membrane. It does not dissolve in *p*-PBI/PPA solutions at temperatures up to 220°C, and the resulting membranes are stable. Initial testing indicated an increase in conductivity and mechanical properties of the membranes with the addition of Hectorite. Further investigation is required to determine the limits of Hectorite addition while maintaining stable membrane formation. However, the continued research would certainly be worthwhile. The commercialization of fuel cell membrane applications, such as back-up power generators, automobile engines, residential units, and portable applications, is not only a promising prospect, it is a profitable utilization of the pre-existing research programs currently taking place in South Carolina's public universities. South Carolina has taken the beginning steps towards creating and supporting the genesis of a fuel cell industry that would create high-paying jobs in the state and thus stimulate South Carolina's economy.

## COMPARING THE EFFICIENCY OF SUNSCREENS AND CLOTHING FOR PROTECTION AGAINST UV-A AND UV-B EXPOSURE

JJ Wheeler

Southside High School

The purpose of this study was to investigate the effectiveness of several sunscreen and sunblock products with different Sun Protection Factor (SPF) ratings for protecting against UV-A and UV-B exposure. Since different brands of sunscreen contain different chemicals to achieve their SPF rating, and since the SPF rating only refers to protection in the UV-B region, it is important to consider more than one source. The effectiveness of clothing was also considered by using a black t-shirt and a UV protective shirt specially designed for wearing in the sun. All experiments were conducted using a Cary UV-Visible spectrophotometer at Furman University by obtaining a measure of the light transmitted through either the sunscreen/sunblock or the material in the wavelength range between 200 and 600 nm. Sunscreen and sunblock were applied as a thin film to one side a quartz cuvette, which was weighed after each addition to insure equal coverage. Data were collected and stored on the instrument's computer and plotted on scales for the UV-A (320 – 400 nm) and UV-B (290 – 320 nm) regions. For the cloth fabric, a single layer of the material was exposed to the UV light source in the instrument and the spectrum was stored. The results from these experiments showed clear differences in the protection provided by the products tested. The *Neutrogena SPF 70* sunscreen, which is the most expensive brand and contains the chemical avobenzene as an active ingredient, was the best overall product, allowing < 10% of the UV-B light to pass (< 17% of the UV-A light). While this product also had the highest SPF rating, the presence of the avobenzene chemical provided broad-spectrum protection. The *Banana Boat SPF 15* was the worst sunscreen, allowing 80% or more of the light to pass through in both the UV-A and UV-B regions. *Coppertone SPF 30*, which protected well in the UV-B region allowing < 22% of light through, performed much worse in the UV-A region, allowing over 50% of the light to pass. Zinc oxide sunblock was also found to be very effective even when used in small amounts, and protected all across the UV-A spectrum. Clothing was found to be a better shield than all of the sunscreens/sunblock, allowing < 5% of the light to pass (< 0.5% for the UV protective shirt). These experiments demonstrate

that while clothing offers the best protection, sunscreens and sunblock can also be effective, but sun worshippers should be careful to purchase products with high SPF ratings that contain broad-spectrum ingredients such as avobenzone.

#### POLYMER PERMEABILITY: WHICH PLASTIC WRAP IS THE MOST EFFECTIVE AT LIMITING THE AMOUNT OF WATER EVAPORATED?

Charles Williamson  
Heathwood Hall Episcopal School

The purpose of this experiment was to identify which plastic wrap was most effective at limiting the amount of water evaporated as measured by mass change. The ten clean vials were filled with approximately 10 grams of distilled water, mass measured to the  $\pm 0.001$  grams, and then covered with the particular plastic and left out over a three day period. The independent variable in this experiment was the type of plastic wrap: Saran wrap (Polyvinylidene Chloride), Glad wrap (Polyethylene), or Reynold's wrap (Polyvinyl Chloride). It was hypothesized that Saran wrap (Polyvinylidene Chloride) will be more effective plastic wrap than Glad wrap (Polyethylene) or Reynold's wrap (Polyvinyl Chloride) at limiting the amount of water evaporated as measured by mass loss of water over the three day period. The null hypothesis stated that Saran wrap will not differ in the amount of water mass lost compared to Glad wrap (Polyethylene) and Reynold's wrap (Polyvinyl Chloride). Data analyzed using an ANOVA test at a confidence level of 0.05 supported acceptance of the hypothesis that Saran Wrap (Polyvinylidene Chloride) was most effective at preventing evaporation.

#### CONSCIENTIOUSNESS, STRESS, AND COPING: A DAILY DIARY STUDY

Sara Wilson  
South Carolina Governor's School for Science and Mathematics

Conscientiousness is one of the so-called Big Five personality traits characterized by the tendency to follow norms and rules. Highly conscientious people are described as responsible, hard-working, traditional, and high in will power. Previous studies have shown that there is a positive correlation between level of conscientiousness and lifespan. This research project was conducted to look at one possible explanation for this association, stress. The hypothesis examined is to find out if people higher in conscientiousness may have better health outcomes because they experience less stress and/or cope with stress better than those low in conscientiousness. In our study, participants filled out an online daily diary that asked about stressful events and coping strategies every day for two weeks. Conscientiousness level was determined by a self-report questionnaire. Participants reported via open-ended responses about their most stressful event of the day and how they coped with that event. These results were coded based on whether the strategy was problem or emotion focused. These data were analyzed and compared against the subject's level of conscientiousness to determine if better coping strategies are directly related to higher levels of conscientiousness.

#### THE EFFECT OF GATORADE AND WATER ON HEART RATE AND BLOOD PRESSURE

Owen Withycombe  
Heathwood Hall Episcopal School

The decision of whether to bring a sports drink or water to an exercise is a common question asked by many athletes across the country. The project conducted will somewhat discover the answer to this question. Therefore, the purpose of this experiment is to compare the effect of consuming sports drinks and water before exercise on the heart rate and blood pressure recovery after exercise. The independent variable in this project was the type of drink consumed by the participant, affecting the dependent variable, blood pressure and heart rate recovery to baseline. 9 participants agreed to run for 10 minutes for the same distance and the same pace. They then would have their blood pressures and heart rates taken for every 2-3 minutes until it returned to their previously measured baseline. Finally, the results were compared and contrasted to reach a conclusion. This conclusion was very random and scattered, so no clear conclusion could be made accurately.

#### THE EFFECT OF SPECIFIC GENES ON THE FORMATION AND MAINTANCE OF THE FOLLICULAR EPITHELIUM IN DROSOPHILA OOGENESIS

Krista Wunsche  
South Carolina Governor's School for Science and Mathematics

In *Drosophila* oogenesis, developing eggs, or egg chambers, are composed of a cyst of nurse cells and an oocyte encapsulated in a layer of epithelial cells called the follicular epithelium (FE). During oogenesis, the FE undergoes dramatic morphological changes. An earlier screening of *Drosophila* genes was conducted to identify genes that affected the growth and morphogenesis of the FE. Fifteen of the genes were analyzed to further determine their function in the FE. Each gene was knocked down using RNA interference. The knockdown FE was stained using immunohistochemistry techniques and observed using both light and confocal microscopy. The observed phenotypes were then classified according to strength/penetrance, stage of development observed, and type of phenotype. Genes CG13420, CG31509, and CG3722 were found to have no significant phenotype, meaning defects were only observed in 0-25% of egg chambers. Genes CG11760, CG14367, CG12720,

CG7669, CG17836, and CG7325 were found to have weak phenotypes (0-50% occurrence). CG12007, CG6443, and CG5364 were found to have medium phenotypes (50-75% occurrence). CG1131, CG13773, and CG15929 were found to have strong phenotypes (75-100% occurrence). Eight of the knockdowns caused encapsulation defects (the FE incorrectly surrounds the cyst). Three caused compound egg chambers (the FE surrounds more than one cyst); one caused boundary defects (the nurse cells invade the space of the oocyte); two caused ruptured epithelium (gaps in the FE); five caused dissolving epithelium (dying FE), and one caused multilayer epithelium (more than one layer of cells in the FE).

#### THE EFFECT OF LAUNDERING ON COPPER IONS IN ANTIMICROBIAL FABRICS

Isabella Zeiler  
Spring Valley High School

Copper fabrics claim to have a permanent antimicrobial effect. The purpose of this experiment was to determine whether or not laundering would reduce the amount of copper ions released by antimicrobial fabrics, making them less effective at repelling microbes. This is important because the copper ions give the fabrics their unique antimicrobial properties. The more copper ions that remain in the fabric, the more effective the fabric is at discouraging bacterial growth. It was hypothesized that different laundering methods would significantly decrease the amount of copper ions in the antimicrobial fabrics, significantly reducing their antimicrobial effect. This was accomplished by exposing copper oxide impregnated antimicrobial fabrics to a bleach solution, a stain remover, a fabric softener, a laundry detergent and then measuring any decrease in the amount of copper ions. The impact of laundering on the copper ion amount was measured by first washing and drying the fabrics in the different solutions a set number of times, then testing the fabric from each category against the bacteria *Serratia marcescens* by measuring bacterial turbidity. A spectrophotometric method was used to determine bacterial concentrations. There were a total of ten trials for each group. Absorbance values were recorded for each trial. The average absorbance value for the control group was 0.11153. The average absorbance value for the bleach, laundry detergent, fabric softener and stain remover groups were 0.30335, 0.18863, 0.16501 and 0.17691 respectively. An ANOVA test was run at  $\alpha=0.05$ .  $F(4,45)=71.04$ ,  $p<0.001$  to determine if there was a significant difference between any of the groups. Since  $p$  was less than 0.001, a Tukey post-hoc test was run to determine which groups were significantly different. Laundered fabrics showed an increase in bacterial cell populations, indicating that laundered fabrics had a lower antibacterial effect than the control fabric. The results supported the hypothesis which stated that laundering methods decrease the antimicrobial effect, which suggests a decrease in copper ions present in the fabric.

#### THE EFFECT OF NITROUS OXIDE PRODUCED BY THE DENITRIFYING BACTERIA *BACILLUS COAGULANS* ON THE PH OF THE SOIL

Liqi Zhao  
Spring Valley High School

The aim of this research was to analyze the effect of diffusing varying amounts of denitrifying bacteria on the pH of the soil. Due to the significant role that pH plays today's agriculture, the possible factors that can change the pH value are studied. The purpose of this project was to investigate the connection between the activity of the nitrogen cycle and the pH of the soil. It was hypothesized that increasing levels of the *Bacillus coagulans* concentration would decrease the level of the soil pH. *Bacillus coagulans* was used in this research as the of denitrifying bacteria. The bacteria samples were incubated for 24 hours by sub-culturing in nutrient broth, distributed into the soil samples based on the different concentration level. The soil pH levels were measured every 24 hours. The ANOVA tests showed a significant difference between the level of bacteria concentration and the pH level. At different time intervals, all three ANOVA test showed the significance.  $F(3,56) = 87.194$ ,  $p<0.001$ ,  $F(3,56) = 42.180$ ,  $p<0.001$ , and  $F(3,56) = 160.112$ ,  $p<0.001$ . The data indicates that the increasing concentration of the bacterial solution in the soil is associated with the pH level of the soil sample.

#### THE EFFECT OF THE LENGTH OF A LACROSSE STICK ON THE SPEED OF THE SHOT

Matthew Zielinski and Logan McGill  
Heathwood Hall Episcopal School

The purpose of this experiment was to study the effect the size of a lacrosse stick has on the speed of the shot. Knowing how stick lengths affect the speed of a lacrosse shot can benefit players by allowing them to choose the stick length that best maximizes their shot speed. The hypothesis was that the shortest stick would have the fastest average speed, compared to the other lengths of sticks. This was hypothesized because the laws of physics suggest that a shorter stick would be easier to handle and have a faster movement, and therefore, a faster shot. The hypothesis was not supported. Three different stick lengths were tested; a 42 inch stick, commonly used by attackers, a 48 inch stick, used by goalies, and a 72 inch stick, used by defense-men. Ten male high school students ages 15 and 16 each made 20 shots with each length stick. The speed of the shot was measured using a Bushnell Velocity Radar gun. The test subjects stood ten feet from the net, which was used as the target, and a radar gun was positioned behind the net to record the speed of the shot. The results indicated that as the stick increased with size, so did the speed. In conclusion, there was an effect of the length of the stick on the speed of the shot. According to our statistical analysis, the difference was not great enough for an attacker that uses a shorter stick with easier

handling to switch to a longer stick that is much more difficult to handle. In further testing, the accuracy of the shot with each stick could be examined to determine whether a certain length stick has an advantage over another.

END

2012 SCJAS ABSTRACTS



## **DWIGHT CAMPER UNDERGRADUATE AWARD IN PLANT MEDICINE OR NATURAL PRODUCTS RESEARCH**



Dwight Camper was an icon at Clemson University, having taught thousands of students and mentoring more than 50 graduate students during his 43 year tenure as professor in the Department of Plant Pathology and Physiology.

In addition to his teaching and mentorship, Dr. Camper was an active member of the South Carolina Academy of Science, serving as president for two terms. He received many awards through his career including the Cutting Edge endowment professorship by the SC Commission of Higher Education, the Godley Snell Award for Excellence in Agricultural Research, and Clemson University Marshall.

The Dwight Camper Research Award is given to an undergraduate student engaged in research in the Plant Sciences with first preference given to students in the field of Plant Medicine or Natural Products Research. Dr. Camper taught a very popular class at Clemson University called Plant Medicine, Magic and Murder. This was the first exposure most students had to Plant Medicine and led many to pursue research in his laboratory. These students benefited from his rigorous guidance while learning to use the scientific method to arrive at meaningful conclusions. Dr. Camper appreciated students who demonstrated a passion for the botanical sciences and approached research with an inquisitive mind, creativity and perseverance. His encouragement and can-do attitude enabled his students to become successful researchers. Dr. Camper felt deeply that research findings should be enthusiastically shared with others and encouraged his students to participate in the South Carolina Academy of Sciences as an avenue to share their discoveries.

This award will be presented to an undergraduate student with an overall GPA of 3.0 or better who engages in research in plant medicine and natural product discovery for at least 1 year, and who has contributed to the generation of a scientific publication(s).

This award is presented at the Annual Meeting of the South Carolina Academy of Science.



UNIVERSITY OF  
**SOUTH CAROLINA**  
AIKEN

## Building Guide

### Robert E. Penland

#### Administration Building

- Admissions
- Business Services
- Career Services
- Economic Development Partnership
- Financial Aid
- Graduate Office
- Human Resources
- Institutional Effectiveness
- Records

### Roberto Hernandez

#### Baseball Stadium Business & Education (B&E)

- Computer Services Help Desk
- Conference Center
- Continuing Education
- Counseling Center
- Disability Services
- Math Lab
- School of Business Administration
- School of Education
- Small Business Development Center (SBDC)
- Wellness Center\* (entrance to side of B&E building)

### Children's Center

#### Pacer Commons

#### Pacer Crossings

#### Pacer Downs

#### The Market

#### University Police\*\*

#### Convocation Center

#### Athletics

#### Global Spectrum

### Etherredge Center

- Main Theater
- O'Connell Theatre

### Humanities & Social Sciences (H&SS)

- Academic Success Center
- College of Humanities & Social Sciences

### Language Learning Lab

### The Station

### Writing Room

### Gregg-Graniteville Library

### Natorium\*\*

(Entrance at rear of SAC building, facing lot A)

### Alan Miller Nursing Building

### Pickens-Salley House

### Advancement

### Alumni Relations

### Chancellor's Office

### Marketing

### Ruth Patrick Science Education Center (RPSEC)

### Center for Teaching Excellence

### DuPont Planetarium

### SeniNet Lab

### Softball Field

### Student Activities Center (SAC)

### Bookstore

### SAC Cafe

### Student Health Center

### Student Life & Services

### Sciences

### Academic Affairs

### College of Sciences

### Supply and Maintenance

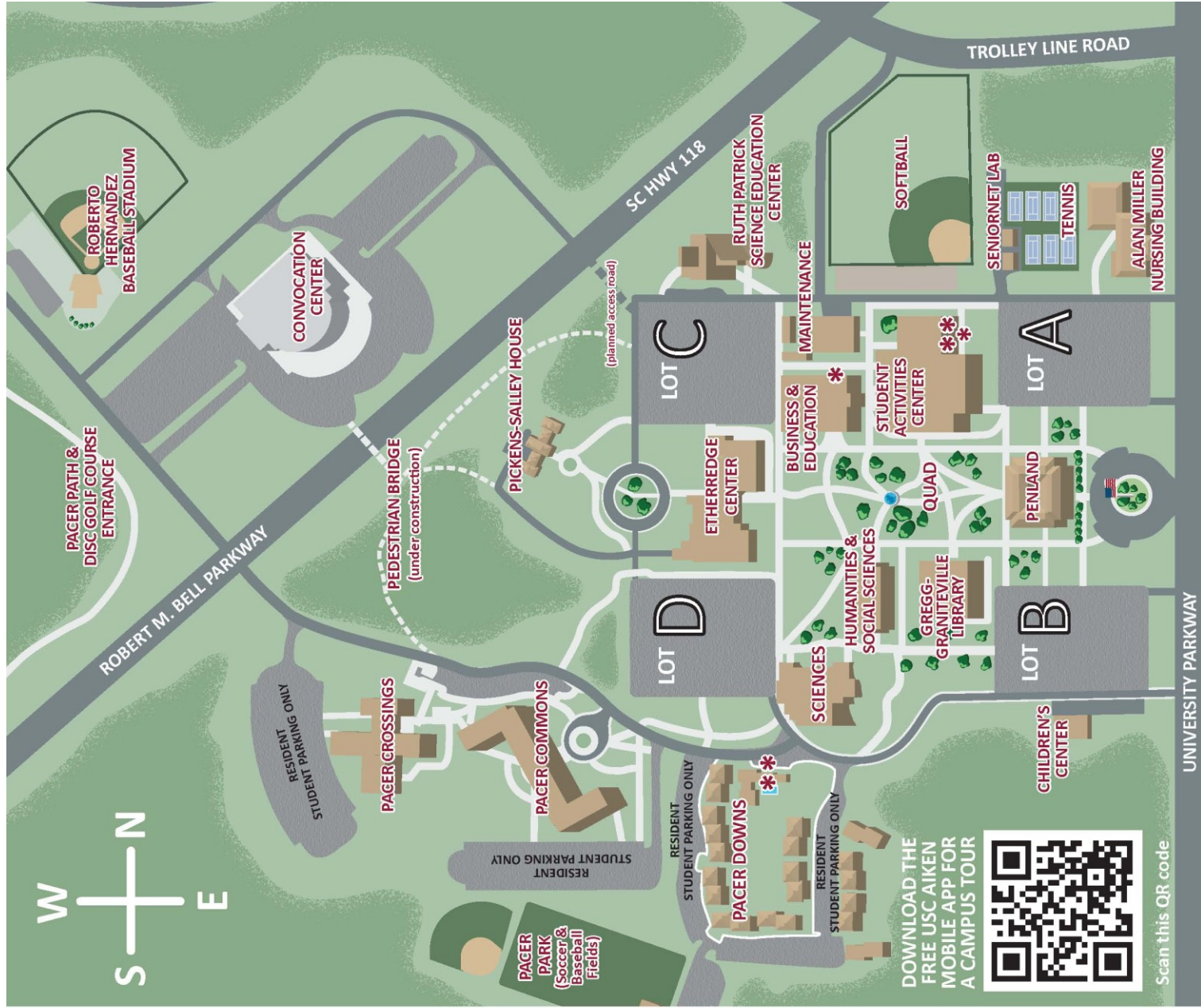
### Copy Center

### Environmental Services

### Mailroom

### Operations

### Purchasing



471 University Parkway  
Aiken, South Carolina, 29801  
803.648.6851

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