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# BULLETIN

# of the

# SOUTH CAROLINA ACADEMY OF SCIENCE

**INCLUDING 2010 MEETING PROGRAM**

**VOLUME LXXII**
**2010**

**THE SOUTH CAROLINA ACADEMY OF SCIENCE**
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# BULLETIN

# of the

# SOUTH CAROLINA ACADEMY OF SCIENCE

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**2010**

*MISSION*

*The South Carolina Academy of Science, together with the South Carolina Junior Academy of Science, is the only statewide interdisciplinary science organization whose membership includes: high school students, teachers, administrators, college students, professors, scientists, related professionals, parents of students, college presidents, business executives, small and large businesses, financial institutions, and institutions of higher education.*

*Its purposes are:*

- *To promote the creation and dissemination of scientific knowledge within the state of South Carolina by stimulating scientific research and publication.*
- *To improve the quality of science education in the state of South Carolina.*
- *To foster the interaction of business, industry, government, education and the academic scientific community.*
- *To improve public understanding and appreciation of science through support of the Junior Academy of Science.*
- *To encourage young people to become involved in science through support of the Junior Academy of Science.*

*The South Carolina of Science (SCAS) was organized in 1924, and in 1927 the Academy affiliated with the American Association for the Advancement of Science. Publication of the Bulletin of the Academy began in 1935, and in 1973 the Newsletter was established as a vehicle for communication among members. Beginning in the 1960's, industry and business joined academic institutions in support of the Academy and have helped to set goals to aid and improve the development of science in South Carolina. Its annual meetings provide a forum for the exchange of scientific information among members. Sponsorship of numerous awards, science programs and student research projects are yearly activities of the Academy.*

**SCAS Web Site:**
**www.scacadsci.org**

The South Carolina Academy of Science web site:http://www.scacadscience.org. has been functioning since October of 1999. Website features include, but are not limited to: online registration for SCAS, SCJAS & MESAS events, Journal access, links to NAAS website, and other documents for download, such as registration documents and information about the SCAS events and Science Fairs. Criteria and nomination forms for Teacher of the Year and the Governor's Award of Excellence in Science also are available for download.

Please visit the website often for updates on the many activities of the SC Academy of Science!

# WELCOME TO 2010 SCAS ANNUAL MEETING!

Dear Fellow Scientists,

It is a privilege to welcome all of you, on behalf of the South Carolina Academy of Science, to the 2010 Annual SCAS and SCJAS meeting. I am so very pleased to see so many students registered to participate, even when the economic times and the increased competitiveness in the science world would seem to discourage young people from engaging in scientific research. It is clear that curiosity and the desire to learn (which are as old as humankind) are alive and well and, therefore, so are we.

I am delighted to detect the enthusiasm that drives you to pursue your questions until you get a satisfactory answer, even though you know all too well that the answer you find may merely open a door to many more questions. I know that sort of enthusiasm; I recognize it as mine, as I still experience it. We scientists are lucky people, and foolish as well, for being oblivious to our good fortune, for not giving thanks every day. We get to do what we love and, in so doing, we can change people's lives for the better. Most scientists don't get rich and work all their lives without achieving significant public recognition. Research is a painstaking process where for every small gain made, there are one hundred failures. However, the joy of those rare moments in which we push the boundaries of our knowledge a step forward makes it all well worth.

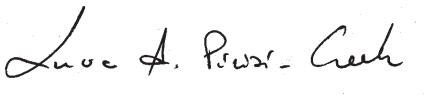
I am very concerned about the strong destructive trends I detect in today's science world, particularly in what goes under the peculiar name of "big science". A scientist's worth is increasingly placed exclusively in his/her ability to win grants. Money, that used to be regarded as a means to support discovery and education (important, yes, but not all-encompassing) becomes the objective, and the only accepted measure of success. Scientists are evaluated, put to the test, judged at every turn, whether they seek to publish a paper, submit a grant proposal, apply for tenure: this is normal, and most of us take it in stride. However, when funds are scarce and values are upside-down, these mechanisms can be used to destroy people. Many scientists live in fierce competition with their colleagues, and regard their own success as more important than giving someone else a fair chance or even, in extreme cases, their own scientific integrity. These are the tendencies we must recognize and reverse, in order to avoid the collapse of academic science and the loss of an entire generation of researchers, as our students (who are certainly not stupid) look at us and say: "I don't want to do what you do". We must work to rebuild a sane world of academic science, one where research and education – seamlessly joined – are again the goal and money the means, and where scientists remember that the best among them know an insignificant fraction of all that there is to be known. In order to reverse these destructive trends and restore sanity to science, we must remember the real motivations that keep us going: the enthusiasm, curiosity and satisfaction, heartfelt and genuine, that we experience today as we share and celebrate the results of so much selfless work, by so many enthusiastic students and dedicated teachers. This meeting is a breath of fresh air and I am sure that my colleagues, those of my generation, know exactly what I mean.

This event – and indeed, most of the SC Academy of Science activities – would not be possible without the dedication and efforts of a large number of people, first and foremost the Head Organizer and the Academy's President Elect, Dr. Justin Wyatt; Past President, Dr. Dave Gangemi; Professors Tom Reeves, Tammy Taylor, Bill Pirkle, Jim Privett, and many others. They have generously donated much time and effort to the organization of this meeting and to the Academy, without any compensation, other than the personal

satisfaction they derive from knowing that they make a difference for so many students, statewide. People like them are a source of inspiration and hope.

During these difficult times, when the Academy (just as many families in our society) faces serious financial challenges, the help of our many sponsors and friends is particularly important and very much appreciated.

I wish all of you a fantastic day, when you will learn much about your own field and even more about things you did not know existed (which is at least twice the fun!) I also hope that you will meet people with similar interests, someone to work with, perhaps a future mentor. I hope that many of the students who present their work today will choose to become scientists. Last, but certainly not least, I hope that all of those in attendance will remember and treasure the enthusiasm, the sense of genuine wonder that today's meeting brings to all of us.



Lucia A. Pirisi-Creek, MD
President, South Carolina Academy of Science

# Contents

**SCHEDULE, EIGHTY_THIRD ANNUAL MEETING**
**SOUTH CAROLINA ACADEMY OF SCIENCE**
**April 17, 2010**
**NEW SCIENCE CENTER BUILDING, COLLEGE OF CHARLESTON**
**CHARLESTON, SOUTH CAROLINA**

| | | |
|---|---|---|
| 7:30-10:00 am | Registration: SCAS and SCBASM | New Science Center Building (NSCB) Lobby |

| | | |
|---|---|---|
| *8:30-10:15 am* | **Plenary Session I** | **NSCB Auditorium (Room 129)** |
| | Welcome | Dr. James Deavor, Dean of SSM (CofC) |
| | Introduction of Speaker | Dr. J. David Gangemi, Past President SCAS (Clemson) |
| | Speaker | Dr. Paul Deason, Sav. River National Lab, Acting Director |
| | Introduction of Speaker | Dr. Robin Brigmon, President SCASM (SRNL) |

*Keynote Presentation*
Dr. Christopher J. Woolverton, Kent State University
Detecting Microorganisms Using Liquid Crystal Sensors"

***10:15-12:15 pm*** **Morning Sessions** **Senior Academy and SCBASM**

**Poster Session:** SCBASM *2nd floor of the NSCB*

| **Oral Sessions:** | **Senior Academy (SCAS)** | | |
|---|---|---|---|
| Chemistry/Biochemistry | Room 105 | NSCB | 10:15 am |
| Chemistry/Biochemistry/ Cancer Research | Room 109 | NSCB | 11:00 am |
| Field Biology/Oceanography | Room 141 | NSCB | 10:15 am |
| Field Biology/Environmental Science | Room 145 | NSCB | 10:30 am |
| Microbiology/Molecular Biology/ Cell Biology | Room 138 | NSCB | 10:30 am |
| Neuroscience/Psychology/ Cell Biology | Room 140 | NSCB | 10:45 am |
| Nanoscience/Math/Computer Science/ Astronomy | Room 115 | NSCB | 10:30 am |

***12:15-1:15 pm*** **Lunch** **Liberty Café on King St**

*CONTINUED*

| | | |
|---|---|---|
| ***1:15-3:00 pm*** | **Plenary Session II** | **NSCB Auditorium (Room 129)** |
| | SCAS Awards Presentation | Dr. Lucia Pirisi-Creek, President SCAS (USC) |
| | SCBASM Awards Presentation | Dr. Susan Morrison, Associate Provost (CofC) |
| | Introduction of Speaker | Dr. Justin Wyatt, President Elect SCAS (CofC) |

*Keynote Speaker*
Dr. Craig Beeson, MUSC
"Discovery of cytoprotective agents for treatment of retinal degenerative diseases"

***3:15-5:00 pm*** **Afternoon Sessions** Senior Academy and SCBASM

**Poster Session:**

| | |
|---|---|
| Senior Academy (SCAS) | *2nd and 3rd floor NSCB* |
| Science Fair Winners (SC Junior Academy) | *2nd and 3rd floor NSCB* |

**Oral Sessions: SCBASM**

| | | | |
|---|---|---|---|
| Medical Microbiology | Room 239 | NSCB | 3:15 pm |
| Marine Microbiology | Room 241 | NSCB | 3:15 pm |

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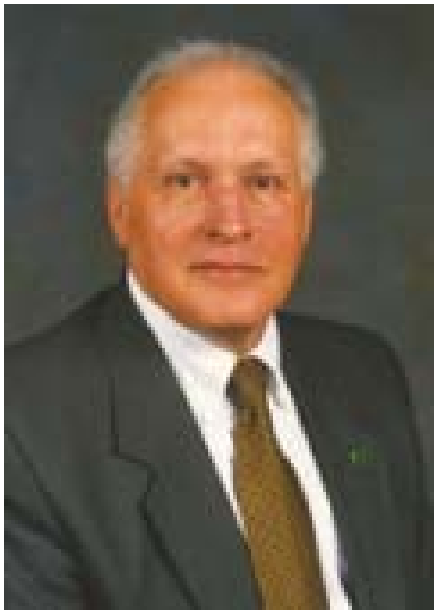
| | | |
|---|---|---|
| SCAS Judges Room | Room 130H | NSCB |
| SCJAS Judges Room | Room 113 | RHSC |
| SCBASM Room for Meeting | Room 100 | NSCB |
| SCAMP Luncheon Room | Room 138/140 | NSCB |



## IN MEMORIAM

# Dr. N. Dwight Camper
# 1939 - 2010

***Thank You,***
***for Decades of Service to the South Carolina Academy of Science***

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.

He was a native of Forest, Virginia and received his B.S. in Chemistry from Louisburg College in Virginia and PhD in Crop Sciences with an emphasis on plant physiology and biochemistry from North Carolina State in Raleigh, NC in 1967. When he came to Clemson in the 1960's, his research focused on herbicide physiology, studying the mode of action of these growth regulators. There was a paradigm change in the scientific interests of our nation as well as the interests of his students at Clemson University during the nineties that included both environmental issues and a revival in plant medicines. During this time, Dr. Camper tailored his research to fit the needs of the students, incorporating into his research studies on the fate of pesticides in the environment as well as the potential medicinal activity of herbs and plants using techniques such as tissue culture, isolation and analysis of active ingredients and bioassays of biological activity. His teaching activities included graduate level classes in plant physiology such as Organic Plant Metabolism, Plant Growth and Development, Mode of Action of Plant Growth Regulators and Plant Cell and Tissue Culture. He also developed and taught a very popular class at Clemson called "Plant Medicine, Magic and Murder".

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, a member of Sigma Xi and the American Chemical Society. 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. He was an active member of the First Baptist Church in Clemson, serving as Deacon and on many committees. Dr. Camper and his lovely wife Jane lived in Clemson and had two daughters and several grandchildren.

**Please join the South Carolina Academy of Sciences in thanking our Meeting and Award sponsors:**



**Roche Carolina Inc.**





## SOUTH CAROLINA ACADEMY OF SCIENCE
## EXCELLENCE IN SECONDARY SCIENCE
## OR MATHEMATICS TEACHING

(TEACHERS OF THE YEAR)

John D. Bernard, 1970 ..... Lower Richard High School
Major C. Rhodes, 1972 ..... Spartanburg High School
Troy Bridges, 1972 ..... Spartanburg High School
Elizabeth Reagan, 1974 ..... J. L. Mann High School
Katherine J. Farnell, 1975 ..... Spring Valley High School
William J. Hilton,Jr,1976 ..... Fort Mill High School
Margaret W. Cain, 1977 ..... Sumter High School
Carline Bowers, 1978 ..... Spring Valley High School
Naomi Seifert, 1979 ..... Spartanburg High School
Maxine Moore, 1980 ..... Spartanburg High School
Elizabeth Lashley, 1981 ..... D.W. Daniels High School
Lucretia Herr, 1982 ..... Spring Valley High School
Michael H.Farmer, 1983 ..... Riverside High School
Glenda George, 1984 ..... Richland Northeast High School
Myra Halpin, 1985 ..... Goose Creek High School
Jessica B. Creech, 1986 ..... Hartsville High School
Jane P. Ellis, 1987 ..... Dixie High School
Linda D. Sinclair, 1988 ..... Lexington High School
Johanna O. Killoy, 1989 ..... Dreher High School
Wyatt Y. McDaniel, 1990 ..... Spartanburg High School
Sonda F. Weiland, 1991 ..... Fort Mill High School
John L.Kinard, 1992 ..... Spartanburg High School
Larry Jones, 1993 ..... R.C. Edward Jr. High School
Dianne H. Earle, 1994 ..... Dorman High School
David Salter, 1995 ..... Aiken High School
Richard Hager, 1996 ..... Ridge View High School
Charlotte Meares, 1997 ..... Academic Magnet High School
Leone Rochelle, 1998 ..... Spring Valley High School
William C. Alexander, 1999 ..... Gov. School for Science and Mathematics
Ginger R. Foley, 2000 ..... Spring Valley High School
Annitra Jean Allman, 2001 ..... Mullins High School
Ruth S. Taylor, 2002 ..... Mayo High School
Patricia Ann Smith, 2003 ..... Greer High School
Randolph M. Brooks, 2004 ..... Dreher High School
Maureen M. Albright, 2005 ..... Lakewood High School
Christopher D. White, 2006 ..... Seneca High School
Michelle Sutton 2007 ..... Spring Valley High School
Lisa Rose 2008 ..... White Knoll High School
Katharine Lee Metzner-Roop 2009 ..... Academic Magnet High School

## South Carolina Academy of Science 2009 Award for Excellence in Secondary Science or Mathematics Teaching is Presented to:

### KATHARINE LEE METZNER-ROOP

Teacher of Honors Marine Science
and Honors Physical Science
Academic Magnet High School
Charleston, SC

Ms. Metzner-Roop received a BS degree in Marine Science from College of Charleston in 1990 and a Masters degree in Marine Science from the University of Charleston in 1993. She also holds Advanced Placement certification. She was selected Teacher of the Year at Academic High School in 2004 and SCJAS Sponsor of the Year in 2005.

Ms. Metzner-Roop's creativity is evidenced throughout her teaching, and her students are engaged in meaningful inquiry-based labs on a regular basis. Activities which stimulate the interest of young people in science include bringing her students to SCJAS workshops and competitions. She practices with the challenge bowl teams and reviews the students' research papers and presentations. Her students compete and win in the Low Country Science Fair and the International Science and Engineering Fair as well as the Junior Science and Humanities Symposium. She and her students are involved in the Noisette Creek Research Project in which they monitor the health of the water and soil around the marsh creek that runs through the school campus. As a result, her students were invited to present their Noisette Creek research in Washington DC and lobby for environmental protection before the President's Cabinet, the Senate, House of Representatives, and world renowned scientists.

Ms. Metzner-Roop believes that teaching is the most important job because we guide the next generation and help determine the future of our world. She says that "I love being a teacher and I cannot imagine doing anything else." Colleagues point out that she is a dedicated teacher who truly loves her school and works tirelessly on providing students with relevant and fun activities.

It is therefore appropriate that this wonderful teacher be recognized by the SCAS for her innovation and effectiveness in the classroom, her dedicated service to school and community, and her ability to impart to her students an understanding of science as a way of knowing about the world. Ms. Katharine Metzner–Roop is hereby named the 2009 Awardee for Excellence in Science Discovery.

**ERRATA: Teacher of the year for 2008:**

## LISA ROSE of White Knoll High School,

**was left out of the 2009 Bulletin.**
**We congratulate Ms. Rose on her well-deserved award and sincerely regret the omission.**

# Governor's Award for Excellence in Science 2010

The award was established in 1985 by the Drug Science Foundation to honor specifically an individual or team within the state whose achievements and contributions to science in South Carolina merit special recognition and to promote wider awareness of the quality and extent of scientific activity in South Carolina. Since 1989 the award, named the "Governor's Award for Excellence in Science", has been under the joint sponsorship of the Governor's office and the South Carolina Academy of Science. In 1993 these groups were joined by the Dewees Development Corporation and Harbor Watch of Charleston. In 2000 **Roche Carolina Inc**. took the lead, in 2004 **MeadWestvaco** joined and in 2005 **Michelin North America** joined in sponsorship of the Governor's Awards.

Beginning in 1990, two of these awards were given annually with one being for scientific discovery and the other for scientific awareness. In 2005 the Academy, in conjunction with the Governor's Office, initiated the sponsorship of a third award directed to a gifted young researcher (***only those individuals who have completed no more than 12 years beyond the Ph.D***.). The award is called the Governor's Young Scientist Award for Excellence in Scientific Research and was sponsored by Michelin North America. The awards consist of an honorarium of $1,000 and a handsomely framed certificate which is presented to the recipient at a special awards ceremony held in the spring in conjunction with the South Carolina Academy of Science's annual meeting.

Candidates should be currently working in South Carolina or have conducted a substantial portion of their work within the state. Contributions may be in any area of science and may be for service to science through non-formal education in the various media, for exemplary exposition at the college or university level, or as an acknowledgement for significant outstanding formal research. The award may be given to an individual or a team. If the award is made to a team, the honorarium will be distributed equally.

Dr. Don M. Jordan
Center for Science Education
College of Arts and Sciences
Sumwalt Room 323
University of South Carolina
Columbia SC 29208
Email: Jordan@gwm.sc.edu

**Roche Carolina Inc.**

**Michelin North America**

MeadWestvaco

The South Carolina Academy of Science gratefully recognizes the contribution of

**Roche Carolina, MeadWestvaco,** and **Michelin North America**

for their support of the

**Governor's Award for Excellence in Science**

**PAST RECIPIENTS**

James R. Durig, 1985 ..... University of South Carolina
Howard F. Harrison, 1986. ..... CR Seeds, Hartsville, South Carolina
F. John Vemberg, 1987. ..... University of South Carolina
Danyl D. DesMarteau, 1988. ..... Clemson University
Harry S. Margollus, 1988. ..... Medical University of South Carolina
Lon B. Knight, Jr., 1989. ..... Furman University
Paul D.Ellis, 1990. ..... University of South Carolina
William J. Padgett, 1990. ..... University of South Carolina
James A. Marshall, 1991. ..... University of South Carolina
Rudolph E. Mancke, 1991. ..... SC Educational Television Network
Makio Ogawa, 1992. ..... Medical University of South Carolina
Larry Joe McCumber, 1992. ..... Francis Marion University
Yakir Aharonov, 1993. ..... University of South Carolina
William F. Junkin, III, 1993. ..... Erskine College
Donald D. Clayton, 1994. ..... Clemson University
R. Bruce Dunlap, 1994. ..... University of South Carolina
Frank Avignone, 1995. ..... University of South Carolina
Daniel Antion, 1995. ..... University of South Carolina
Elizabeth Martin, 1996. ..... College of Charleston
Maria G. Buse, 1996. ..... Medical University of South Carolina
John H. Dawson, 1997. ..... University of South Carolina
Sarah F. Stallings, 1997. ..... Winthrop University
Joseph Manson, 1998. ..... Clemson University
George E. Temple, 1998. ..... Medical University of South Carolina
Michael Farmer, 1999. ..... Greenville Technical College
Roy Edward Wuthier, 1999. ..... University of South Carolina
Thomas Borg, 2000. ..... South Carolina School of Medicine
Louis Terracio, 2000. ..... South Carolina School of Medicine
Elaine L. Craft, 2000 ..... State Center for Excellence
Kenneth Marcus, 2001. ..... University of South Carolina Aiken
Jeffrey M. Priest, 2001 ..... University of South Carolina Aiken
Roger R. Markwald, 2002. ..... Medical University of South Carolina
William T.Pennington, 2002. ..... Clemson University
Richard D. Adams,, 2003 ..... University of South Carolina Columbia
Charles Beam, 2003. ..... College of Charleston
John W. Baynes, 2004. ..... University of South Carolina Columbia
David J. Stroup, 2004. ..... Francis Marion University
Frank Berger, 2005 ..... University of South Carolina Columbia
Thomas Reeves, 2005 ..... Midlands Technical College
Ya-Ping Sun, 2005 ..... Clemson University
Gabriel Virella, 2005 ..... Medical University of South Carolina
Omar Bagasra, 2006, ..... Claflin University
Rebecca Bullard-Dillard, 2006 ..... Claflin University
Karen Burg, 2006 ..... Clemson University
Yusuf Hannun, 2006 ..... Medical University of South Carolina
Stacey Franklin Jones, 2007 ..... Benedict College
Varavut Limpasuvan, 2007 ..... Coastal Carolina University
Daniel Reger 2007 ..... University of South Carolina
Don Jordan 2008 ..... University of South Carolina
Donna Chen 2008 ..... University of South Carolina
Terry Tritt 2008 ..... Clemson University
Barbara Speziale 2009 ..... Clemson University
George W. Wicks 2009 ..... Savannah River National Laboratory
Paul R. Thompson 2009 ..... University of South Carolina

# 2009 Governor's Award for Excellence in Scientific Awareness

is presented to

## Dr. Barbara Speziale, Biological Sciences
## Clemson University

Dr. Speziale received her PhD from Clemson University in 1985 in Zoology. Her academic interests encompass aquatic ecology and limnology, extension outreach, and K-12 science education. She currently directs the SC Life Program, with funding ($3.4 million) from the Howard Hughes Medical Institute Undergraduate Biological Sciences Program. SC Life develops and supports: graduate courses for in-service middle and high school teachers; a standards-based middle school curriculum, SC LIFE: Natural History of South Carolina; research opportunities for undergraduates and for high school students; and enhancing participation of underrepresented groups in biology activities. Previous science education activities include: an interactive water quality videoconference; the high school biology curriculum, Biology: A Community Context; and molecular biology lessons for high schools. Her Cooperative Extension water quality education activities include: $4H_2O$ - Pontoon Classroom, water quality education program for children; and South Carolina Home*A*Syst, a water quality education program for homeowners. Dr. Speziale's primary research interest is the ecology and taxonomy of freshwater algae.

# 2009 Governor's Award for Excellence in Scientific Research

is presented to

## Dr. George W. Wicks, Consulting Scientist Savannah River National Laboratory

Dr. Wicks has worked for more than 30 years at Savannah River National Laboratory (SRNL), and was the 2005 winner of the CNTA Distinguished Scientist Award. He is best known for his research and leadership in developing and understanding processes, systems, and procedures for immobilizing and disposing of potentially hazardous nuclear waste. In 2004, SRNL and the Medical College of Georgia (MCG) signed an historic collaborative agreement that combines the skills of the two premier research institutions, to achieve results that would be out of the reach of either institution on its own. The two institutions' strengths enhance the quality of the team's work, making it more attractive to funding organizations such as the National Institutes of Health. Current and potential areas of collaboration include expansion of research in dental materials science, including studies of radiation effects on dental materials; biotechnology research in areas from biodefense to biological waste treatment and bioremediation; behavior and health effects of environmental contaminants; technologies developed for homeland defense applications and emergency medicine; materials developed for waste management uses that could be adapted for therapeutic treatments; 3-D imaging and rapid fabrication technologies; and adapting sensor systems from environmental monitoring and cleanup for use in surgery and diagnosis.

# 2009 Governor's Young Scientist Award for Excellence in Scientific Research

is presented to

## Dr. Paul R. Thompson
## Department of Chemistry and Biochemistry, University of South Carolina

Professor Paul R. Thompson joined the USC faculty in 2003 after being a post-doc at Johns Hopkins University and earning his PhD at McMaster University. His research program has been highly successful with over 20 peer-reviewed publications since 2005. His research interests are focused on using techniques at the interface of chemistry and biology to elucidate the cell signaling pathways controlling human gene transcription. In 2005, he was named a New Investigator of the American Heart Association. In 2008, he was elected a member of American Chemical Society Division of Biological Chemistry Nominating Committee. In 2009, he received the prestigious Camille Dreyfus Teacher Scholar Award. Dr. Thompson will be moving to join the faculty of the Scripps Research Institute in Jupiter, Florida at the end of this semester.

## SONAR MULTIBEAM ANALYSIS OF BLOCK CANYON TO ASSESS LANDSLIDE PRONE AREAS ON THE CONTINENTAL SLOPE

Emily Allen, Karen Black, Leslie R. Sautter
College of Charleston

In May of 2009, multibeam sonar data were collected by the US Geological Survey (Marine Branch, Woods Hole) aboard the NOAA Ship Ronald Brown along the continental slope from Cape Hatteras to Nova Scotia. The sonar acquisition system used was an ELAC SeaBeam 2112, and data were processed using CARIS HIPS and SIPS 7.0. The purpose of the cruise was to identify submarine landslide prone areas, which are potential tsunami generators. The areas studied included Block Canyon located south of the Connecticut coast (39 degrees 50' N, 71 degrees 60'). Continental slope morphology was examined revealing dramatic submarine canyons with precipices formed by past landslides. These canyons are features that are historically formed by submarine landslides. Sedimentation rates along the base of the slope in this area changed dramatically during the middle to late Pleistocene and Holocene as a result of the network of submarine canyons. In addition to the tsunami hazard study, this site has also been explored for the purpose of evaluating sediment reworking and lobster and tilefish habitat. Fine grain turbidites and hemipelagic sediments accumulate on the slope and parts of the continental rise creating a dynamic environment. This study will be extended to include high resolution mapping of additional regions of the continental margin to further understand the complex submarine canyon morphologies and to identify potential tsunami hazard coastlines.

## DISTRIBUTION AND DIEL VERTICAL MIGRATION OF ZOOPLANKTON IN THE SOUTH ATLANTIC BIGHT

Lieanna Arnold, Gorka Sancho
College of Charleston

The vertical and horizontal distributions of zooplankton over the South Atlantic Bight were analyzed and correlated with temperature, salinity, and chlorophyll distributions. Zooplankton samples were taken with a Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS) in November of 2009 in continental shelf waters off Charleston, SC along two transect lines perpendicular to the coastline. The abundance and diversity of different zooplankton taxa were analyzed from preserved samples using a compound scope in order to describe distributional patterns in relationship to oceanographic variables. To characterize possible diel vertical migration (DVM) behavior patterns within the zooplankton community, MOCNESS tows were taken at discrete depths during day and night times and compared.

## INDUCEMENT OF APOPTOSIS THROUGH TAT-DEPENDANT EXPRESSION OF PRO-APOPTOTIC BAX

Angela A. Arthur, William H. Jackson
University of South Carolina Aiken

The human immunodeficiency virus (HIV) is a retrovirus that infects and destroys CD4+T helper cells. In later stages, the loss of the T helper population leads to Acquired Immune Deficiency Syndrome (AIDS), which is characterized by a weakened immune system and infection by opportunistic pathogens. Therapeutic treatments such as highly active antiretroviral therapy (HAART) have been developed in an effort to decrease HIV-1 replication. While these treatments reduce the viral load, they do not completely eliminate the infected cells. Therefore other methods to inhibit HIV replication continue to be explored. One possible direction for research involves apoptosis, a naturally occurring process in immune cells. During the early course of infection, HIV inhibits apoptosis in infected cells; however, the late stages of HIV infection are associated with induction of apoptosis in these cells. If the early inhibition of apoptosis in HIV infected cells could be overcome so that apoptosis can proceed, viral replication should be significantly inhibited. Research has shown that increased levels of the Bcl-2 associated X protein (Bax) is capable of inducing cell death by apoptosis. Therefore, one means to induce HIV infected cells to undergo apoptosis may be to induce over-expression of Bax. An important consideration in these cells is the presence of the viral tat protein, which acts to increase transcription rates from the HIV promoter 100 fold. Transcriptional regulation of viral genes is controlled by the 5' LTR which consists of the U3, R, and U5 regions. Most important for transcription is the U3 region that contains the viral enhancer/promoter, and the R region that encodes the TAR region within the first 60 nucleotides from the +1 site. Here, we describe the creation of a heterologous expression cassette in which expression of the murine Bax gene is controlled by the HIV-1 U3R promoter. This was done by amplifying the U3R region of the HIV-1 genomic clone NL43 (accession number: M19921) and cloning this fragment into pCMVBax by replacing the CMV promoter to create the plasmid, pU3RBax. This plasmid, pU3RBax, is able to induce apoptosis in 293T (human embryonic kidney) cells when cotransfected with pCMV-Tat. Our current goal is to explore delivery methods of this pro-apoptotic cassette.

## SIMILARITIES IN CRITICAL POINT FLUCTUATIONS IN MICROGRAVITY AND DENSITY MATCHING MIXTURES ON EARTH

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Supercritical fluids (SCF) are widely used as non-pollutant solvents and volatile compounds extractors. A feed material in contact with a SCF allows volatile substances to partition into the supercritical phase. Subsequently, the extract containing the dissolved substances is separated from the SCF by temperature and/or pressure change while the SCF is recycled. This application of soft condensed matter covers industrial applications such as decaffeination of tea and coffee, extraction of essential oils and aroma from spices, extraction of some edible oils, production of cholesterine-free egg powder, etc. Practical applications of SCF must overcome their very high compressibility,

which confines the critical phase in a very narrow layer and limit their industrial applicability. Our research makes use of sulfur hexafluoride (SF6) experimental data recorded in microgravity in order to eliminate the sedimentation and convective flows due to gravity. Alternatively, we used a density matching binary mixture of methanol and partially deuterated cyclohexane (CC*-Me) on Earth in order to minimize compressibility, sedimentation and convection. Our goal was to obtain information regarding the molecular interactions near critical point using light scattering techniques. For this purpose, red laser light was passed through a sample cell unit (SCU) filled with the fluid of interest near critical point. A sensitive coupled charge device (CCD) camera with a microscope objective was used to record the light passing through the SCU. We used bright field, dark field, and phase contrast techniques to record two-dimensional images with 24 frames per second. Light scattering occurs due to interactions between the microscopic regions of fluid and incident electromagnetic radiation. The power spectrum of scattered light contains information about local inhomogeneities encountered by light traveling through the SCU. Although to necked eye the recorded images near critical point may seem like random flicker of light, our statistical analysis revealed long range spatial and temporal correlations between fluctuations. The spatial correlation is revealed by the Fourier transforms of spatial fluctuations and follow a power law both for SF6 in microgravity and binary mixture on Earth. This is an indication of the universality of fluctuation mechanisms near critical point and the fact that all critical systems could be described using the same "universal" power laws regardless their molecular structure. The temporal correlation of fluctuations was determined from the correlation time determined with the dynamic light scattering method.

## COMPARISON OF BENTHIC FORAMINIFERA BETWEEN TWO CROSS-SHELF TRANSECTS OFF CHARLESTON, SC

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In November 2009 NOAA funded a five day research cruise aboard the R/V Savannah as part of the College of Charleston Transect Program. Fourteen sediment samples were collected using a Shipek Grab Sampler along two cross-shelf transects, ranging in depth from 16 to 108 m. The two cross-shelf transects, Primary Transect (off Folly Island) and Capers Transect (off Capers Island), are approximately 35 km apart from each other. A 120 mL homogenized sub-sample was taken from each grab sample for the purpose of studying benthic foraminifera. Benthic foraminifera assemblages are indicators of environmental change, but their distributions are not well known across the continental shelf. Foraminifera and other carbonates were separated from lithogenic sediment using a sodium metatungstate density separation method. Foraminifera specimens were picked from the > 125 um size fraction and identified to the genus level. The most common foraminifera genera were compared between the two transects for the inner, middle, and outer continental shelf regions. Results will be interpreted as assemblage variations related to depth, as well as proximity to the shoreline and Gulf Stream.

## A MOTION-BASED ONE-TRIAL OBJECT RECOGNITION TASK IN ADOLESCENT SPRAGUE-DAWLEY RATS

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Although novelty preference remains the preeminent construct for quantifying object recognition in rodents, definitions of exploratory behavior are confounded by the origination of preferential activity in exploratory or locomotor contexts (Renner, 1990). A composite of complex interaction between intrinsic/extrinsic motivations (Hughes, 2007) and non-exploratory behavior decreases validity of traditional measures of novelty preference. The influence of these factors may be minimized by animating objects encountered in the open field. Prior to evaluating the validity of a motion-based object recognition task, it is necessary to determine whether object motion demonstrates sensitivity to novelty preference. To evaluate the impact of motion on object discrimination, we subjected male and female adolescent Sprague Dawley rats to either a standard or motion-based one-trial object recognition task using measures of raw time exploration and ratios of object discrimination. Following a 1-hour inter-trial interval, all animals spent significantly more time exploring novel rather than familiar objects, with animals in the motion-based task demonstrating a significant increase in exploration when pooled across object role. Furthermore, male rats showed significantly greater raw time exploration of the novel object than females, although a log transformation revealed no significant differences. Ratios of discrimination showed that object recognition did not significantly differ between standard and motion-based presentations, although the absence of a task-specific variation reflected a ceiling on discrimination ratios. These results suggest that a motion-based one-trial object recognition task was sensitive to raw time preference of novel objects in male and female adolescent Sprague Dawley rats. Future studies should seek to determine whether object motion enhances the ratio of discrimination in rodents with concurrent decreases in non-exploratory behaviors.

## ARE CARROTS AND PUMPKIN SEEDS EFFECTIVE HOMEOPATHIC REMEDIES FOR HYMENOLEPIS DIMINUTA INFECTIONS?

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Sixteen male Wistar rats were experimentally infected with Hymenolepis diminuta cysticercoids. After infection was confirmed, they were separated randomly into four equal groups. One group received oral treatments of 2.0 mL carrot juice (16 g/mL). Another group received 2.0 mL pumpkin seed juice (1 g/mL) and the negative control group received 2.0 mL distilled water. The positive control group received a one-time oral treatment of praziquantel (0.5 mg/kg BW) on the first day, and then distilled water only for the remainder of the treatment period. The treatments were administered to each rat daily for a total of 15 days. Tapeworm eggs were collected from rat feces using modified zinc sulfate floatation. Examination of fecal samples revealed presence of numerous eggs throughout the treatment period in feces of all rats in both the experimental (carrot- and pumpkin seed-treated) and negative control groups. The presence of adult tapeworms in these rats was further confirmed upon dissection of intestines of euthanized animals. All rats that received one dose of praziquantel (positive control) were completely free of tapeworms by day 14 post treatment. Results of this study indicate that carrots and pumpkin seeds were ineffective anthelminthics against H. diminuta infections.

## DO SNAKES SMELL?: THE CHARACTERIZATION OF OLFACTORY RECEPTOR GENES IN FOUR SPECIES OF SNAKE

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Though it is well known that snakes detect odor via the vomeronasal system (facilitated by their flickering tongue), the study of their use of olfactory reception (like humans) to detect odor has been severely neglected. The primary purpose of this study was to estimate the reliance on an olfactory receptor system by Water snakes (Nerodia fasciata), King snakes (Lampropeltis getula) Copperhead snakes (Agkistrodon contortrix), and Hognosed snakes (Heterodon platirhinos); and to generalize these results to make an early hypothesis about the snake family as a whole. DNA from the aforementioned species was isolated and specially designed primers were added to amplify olfactory receptor (OR) genes through PCR. An Invitrogen Cloning Kit was used to replicate the OR genes, and these samples were purified using a Pure Link Quick Plasmid Miniprep Kit before sequencing. The resulting sequences were screened through the NCBI Network Blast Server, and genes were monitored for the presence of stop codons (indicating that they were non-functional, or 'pseudogenes'). Clustal X was used to align similar gene sequences, and Mega 4 was used to create a phylogenetic tree (visually representing all results as a related 'family' of genes). After sequencing and screening, a total of 112 unique olfactory receptor genes were isolated: 36 Copperhead Snake, 34 King Snake, 16 Water Snake, and 26 Hognosed Snake. Only one of the 112 genes was identified as being a pseudogene; this being a sample from the Copperhead Snake. As pseudogenes are essentially non-functional copies of genes, the percentage of pseudogenes that code for a given trait should have an inverse relationship with a species' reliance on that system. Therefore; based on the results of this study, it was determined that these four species do indeed use olfactory reception as a method of odor detection. If we were to generalize the results from these four species of snake to all species of snake, we would hypothesize that all snakes have the capacity to use olfactory reception alongside their vomeronasal system.

## AROMATIC AND ALIPHATIC SIDE CHAIN DERIVATIVES OF THE ANTIBIOTIC CYTOSPORONE E

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The antibiotic cytosporone E is being used as a template to synthesize derivatives that are potentially more potent than the parent compound. Specifically, there are three alterations of focus for these derivatives: the selective deletion of oxygen atoms in order to find the pharmacological core of the molecule; substitution of the seven carbon side chain to alter functionality; and the incorporation of nitrogen to provide a new site for side chain addition. These derivatives of the parent antibiotic will be tested on both gram-positive and gram-negative bacteria in order to determine the relationship between cytosporone E's structure and its biological activity. This structure activity relationship study will provide information for developing more effective analogues of the parent antibiotic, which are needed with the ever-increasing number of antibiotic-resistant bacteria.

## INTERANNUAL MARINE PHYTOPLANKTON COMMUNITY DYNAMICS IN CONTINENTAL SHELF WATERS OFF CHARLESTON, SC

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Rarely do offshore phytoplankton surveys return to the same geographic locations at the same time of year to observe interannual changes in community structure and correlate these changes to differences in oceanographic environmental variables. This study offers an interannual comparison of continental shelf phytoplankton species composition and distribution in the fall of 2004 and 2009. Undergraduate students from the College of Charleston Transect Program collected data aboard the R/V Savannah. Oceanographic data were recorded along 2 parallel transect lines stemming from nearshore waters off Charleston, SC to the western edge of the Gulf Stream. Phytoplankton samples were collected using a 20 micron phytoplankton net towed on the surface for 3 minutes. Samples were identified using Scanning Electron Microscopy at the National Oceanic and Atmospheric Administration's Center for Coastal Environmental Health & Biomolecular Research at Charleston (NOAA - CCEHBR). Cell counts were made using light microscopy to calculate relative abundance of different phytoplankton species and ratio of diatoms to dinoflagellates. Interannual differences in the diversity and abundance of phytoplankton communities will be described and interpreted in accordance to recorded surface water environmental parameters. The abundance and distribution of the Domoic acid producing diatom species, Pseudo-nitzschia, will be highlighted because of the potential role of this harmful algae in the mortality of marine mammals.

## SYNTHESIS OF A NOVEL BIS-INDENE WITH POSSIBLE CATALYTIC PROPERTIES

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There are a number of catalytic ligands that help to increase a metal catalyst reactivity. A novel bis-indene is being synthesized that will potentially be used as a more reactive ligand. The modeling of the bis-indene shows that it will bind to a metal such as Rhodium, but will be reactive due to a more strained system. The synthesis of this novel system begins with indene and ends with an interesting cyclization to form the bis-indene product.

## LEARNING AND MEMORY BEHAVIOR MODIFICATION IN RATS DUE TO LATENT TOXOPLASMOSIS

Brian Daniels, Susan Rouse
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Toxoplasma gondii is one of the world's most prolific and successful parasites, commonly predicted to have infected at least one-third of the world's human population. A growing collection of data has well documented the ability of the parasite to alter host behavior, particularly in rodents, where behavioral deficits have been demonstrated to render rodents more susceptible to predation by the parasite's definitive host, Felis catus. Early correlative data of infection in man has also drawn interesting connections between infection and abnormalities in human behavior, including affective disorders such as schizophrenia. This study attempted to further characterize the parasite's ability to alter host behavior, particularly as it relates to learning and memory. To this end, rats were infected with Toxoplasma gondii via intraperitoneal injection of live parasites.

After allowing the established thirty days for infection to become latent in experimental rats, rats were tested via ELISA to confirm infection status. Following this, a battery of learning and memory tests were performed on both experimental (n=10) and control (n=10) subjects. Behavioral tests were performed utilizing the Morris water maze apparatus, a device which requires rats to learn the location of a hidden platform submerged beneath opaque liquid, remember its location, and navigate to it using spatial cues in their environment. In the water maze, rats performed navigation tasks which tested for simple associative learning, spatial reference memory, information-seeking behavior during task training, reversal learning, and working memory. The results support previous findings, which suggest that latent toxoplasmosis has few effects on simple associative learning or spatial reference memory in rats performing Morris water maze tasks. However, the data suggest that the parasite does exert at least some influence on learning and memory behaviors in rats. Highly significant differences were observed in levels of information seeking behavior between experimental and control populations, with non-infected rats exhibiting approximately three times the levels of information seeking over infected counterparts. Infected rats also seemed to exhibit greater ability in the area of reversal learning, while control rats seem to have at least slightly better working memory capacity. These findings suggest that toxoplasmosis does, in fact, affect learning and memory processes in hosts, and gives clues about the broader behavioral impact of infection in both rodent and human populations.

## DIPHENYLACETIC ACID AMIDES: NEW INDICATORS FOR STRONG BASES

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Currently there are numerous methods for the titration of very strong bases including organolithium, organomagnesium and metalamide bases. Some of these methods include: titration using activated halogens and disulfides, titration with colored reversible charge transfer complexes, titration via single deprotonations to give colored anions, titration via double deprotonations to give colored anions, concentration determination via NMR, and titration via cleavage of metal-metal bonds.1 The majority of these methods work very well within restricted ranges generating the dilemma of which method is best for a given specific circumstance. This problem suggests the need for a method that provides excellent accuracy that spans a very wide range of structural- and metallo- diversity. We envisioned that real improvements could be forthcoming by modifying one of the existing titration methods. Previous work with indicators of very strong bases has demonstrated that color and acidity modulation can be achieved by modifying the electronics of the aromatic rings. However these types of modifications have not been systematically incorporated in the "double deprotonation of diphenylacetic acid derivatives". Our strategy was to modify diphenylacetic acid templates to develop an indicator with an enhanced titration profile over existing methods. Our observations with organolithium and organomagnesium reagents suggest that improvements in indicator design can be achieved with amide derivatives of this class of compounds.

## EXPLORING THE BOOTSTRAP MEAN EXPOSURE TIME IN PROFESSIONAL BULL RIDING

Erica Deahl
Presbyterian College

Resampling is a computationally intensive form of modern data analysis. This paper explores the bootstrap technique of resampling as a way to investigate the distribution of mean exposure to injury time in the extreme sport of professional bull riding.

## IDENTIFYING ACESSORY PROTEINS IN PRION DISEASES

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Prion diseases are fatal neurodegenerative conditions caused by a unique infectious agent that is very different from bacterial and viral pathogens. A prion is an infectious protein that can reproduce in a host in the absence of a nucleic acid genome. Prion diseases include: Kuru and Creutzfeldt-Jakob disease in humans, Bovine Spongiform Encephalopathy(Mad Cow Disease) in cattle and Chronic Wasting disease in deer and elk. These diseases are invariably fatal and can cross from one species to another at a very low frequency. Epidemics of prion diseases in cattle occurred in the late 1980's as a result of the inclusion of prion contaminated material into the protein supplements of cattle. Several hundred cases of human prion disease resulted from the consumption of contaminated meat. The interest in these diseases stems primarily from the unique composition of the pathogenic agent. Similar infectious proteins have recently been identified in the eukaryotic organism Saccharomyces cerevisiae (baker's yeast). In order to understand the replication of prions in yeast, we have disrupted genes that are involved in protein degradation. The controlled destruction of many proteins in the eukaryotic cells is carried out by a complex protein machine called the proteasome. Proteins that are to be digested in this way are first tagged by the covalent attachment of the protein ubiquitin. A large number of genes are known to be involved in the attachment of ubiquitin to target proteins. We have disrupted two genes individually in the yeast to investigate their role in the formation and maintenance of prions. These genes UBC13 and UBC11 are known to be involved in the covalent attachment of ubiquitin to many different protein targets. These mutants have been characterized for their ability to generate the infectious prion form and for the ability to maintain the prion form during successive cell divisions.

## A COMPUTATIONAL MODE O TIMING WITH BIOLOGICALLY REALISTIC MODEL NEURONS

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How does the brain perceive time? How is our brain estimating the time elapsed between events? Timing is not only important in recalling stored data, but also in planning future actions. Timing is also important in a series of neurological diseases. It is believed that in Parkinson's disease there is a deficiency in correlating subjective timing with motor actions. The computational model we developed assumes that the prefrontal cortex is made of a network of neurons that oscillate with different frequencies and they provide the time base for measuring any time interval we need from milliseconds to years. We implemented a new model of neural networks for timing with a biologically realistic model neuron that mimics potassium and calcium currents in giant squid

axons. Our results suggest that with a set of biologically realistic model neurons and a significantly larger neural network than every other research team used so far, we can reproduce behavioral measurements. Our current implementation was designed from the beginning in a modular fashion that will allow us to add more features to the basic model.

## MICROWAVE ASSISTED SYNTHESIS OF ALPHA-DIIMINES

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The goal of our research is to develop a practical and rapid synthetic methodology for the synthesis of alpha-diimines. Such methodology would be extremely useful to synthetic chemists due to the diverse applications of alpha-diimines as versatile ligands that bind to metals. Ni-diimine complexes are proven catalysts in oligomerization reactions, and Pt-diimine and Pd-diimine complexes have strong DNA-binding and cyto-toxic properties and are being studied as candidates for cancer chemotherapy. The synthesis of alpha-diimines is generally performed by reacting two equivalents of primary amines with alpha-dicarbonyl compound in the presence of an acid catalyst. The reaction mixture is stirred overnight to provide alpha-diimines in good yields. Our methodology utilizes the same procedure with one major difference – the use of microwave radiation. We undertook a broad study of microwave-assisted syntheses of diimines using a variety of primary amines and dicarbonyl compounds. Our study began with a screening of solvents for the reaction of cyclohexyl amine and 2,4,6-trimethyl aniline in methanol, tetrahydrofuran (THF), acetonitrile and toluene. A comparison of diimine yields obtained in methanol (polar, protic solvent), THF, acetonitrile (polar, aprotic solvents), and toluene (nonpolar solvent) provided an understanding of the effect of solvent polarity on the reaction outcome. Methanol gave the best results and was the solvent of choice for further reactions. It also allowed the precipitation of relatively non-polar diimines, which are then easily isolated by filtration and do not require further purification. We performed the reactions of variously substituted aliphatic and aromatic primary amines with a variety of dicarbonyl compounds (alpha-dialdehydes, alpha-diketones, alpha-ketoaldehydes). We observed that the yields in these reactions after 30 seconds of microwave irradiation were comparable, or greater than the yields produced after 24-hours of stirring. Both aliphatic and aromatic amines generally gave moderate to good yields of diimine products.

## SEDIMENT ANALYSIS AND MINERAL COMPOSITION ACROSS THE SOUTH CAROLINA CONTINENTAL MARGIN

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Leg 05 of College of Charleston's Transect Program was conducted in November 2009, during which sediment samples were collected across the continental shelf off Charleston, South Carolina. Sediments were collected using a Shipek Grab Sampler at 14 locations along two transect lines, one extending from Folly Island and the other from Capers Island. Using a particle size analyzer, grain size distributions were determined along two cross-shelf transects. The Primary Transect data of Folly Island will be compared to previous Transect Program cruises taken in November 2003, May 2004, November 2004 and May 2005. A Scanning Electron Microscope and binocular microscope were used to determine mineral composition contained in coarse material greater than 0.5 mm. Grain size distributions and mineral composition will be related to distance from shore and proximity to the Gulf Stream.

## MICROWAVE-ASSISTED SYNTHESIS OF BOLAAMPHIPHILIC DIIMINES

Caitlyn B. Driscoll, Patrick N. Jenkins, Pramod R. Chopade
Coker College

We have developed a practical and rapid synthetic methodology for the synthesis of bolaamphiphilic diimines using microwave irradiation. These significant diimines were synthesized by the reactions of diamines and carbonyl compounds in presence of an acid catalyst and microwave irradiation. Optimum reaction conditions such as solvent conditions and time of irradiation were determined. Tetrahydrofuran (THF) was the solvent of choice because it provided the best yields of products. Microwave irradiation for two minutes gave the best yields. It was observed that this reaction methodology is applicable to a variety of diamines including (a) aliphatic, acyclic diamines such as 1,2-ethylenediamine, 1,3-propylendiamine, and 1,6-hexamethylenediamine, (b) aliphatic, cyclic diamines such as 1,2-cyclohexyldiamine and 1,4-cyclohexyldiamine, and (c) aromatic diamines such as ortho- phenylenediamine and para-phenylenediamine. Additionally, various carbonyl compounds including aliphatic and aromatic aldehydes as well as ketones provided good to excellent yields. This reaction is tolerant of various electron-donating and -withdrawing functionalities. In conclusion, we have developed an efficient protocol for the synthesis of diimines in minutes rather than hours. Product identification and determination of product yields was performed using various spectroscopic techniques.

## TOWARDS MODELING OF BLACK HOLE ACCRETION DISKS AND JETS

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The Cosmos++ general relativistic magnetohydrodynamic (GRMHD) code has been further developed to better model the accretion of a magnetically seeded disk onto a Kerr black hole. By altering the tilt of the disk relative to the black hole spin axis, features such as standing shocks and coherent oscillation modes have been observed which are absent in non-tilted simulations. Our motivation in the current work is to study the effects that tilt and spin have upon the formation and orientation of the resulting relativistic plasma jets. The simulation of accretion disks and jets on a spherical-polar type grid has two major impediments: the expected orientation of the jet coincides with the location of the axial singularity and the small zone sizes near the axis require that the area be under-resolved or excised from the grid in order to guarantee a reasonable timestep constraint. To this end, a cubed sphere grid has been developed that is formed from six independent coordinate patches. Such a grid has no singularities outside of the event horizon and provides convergent resolution of the disk and jets while operating at an allowable timestep. The implementation of the cubed sphere was accompanied by changes to the core magnetohydrodynamic scheme in Cosmos++ -- notably the addition of flux-constrained transport -- in order to better model magnetically dominated jets. In this presentation, we explain the importance of modeling tilted accretion disks and recent advances in numerical simulations of such systems. This includes an explanation of the structure and implementation of the cubed sphere grid and its contrasts with a spherical-polar grid. We further present a series of test results using the new version of Cosmos++ that demonstrate its ability to model GRMHD processes. The early results of a series of large-scale tilted disk simulations at varying black hole spins are also given.

## FROM SHOOT TO ROOT: NATURAL VARIATION OF ABOVE AND BELOWGROUND TRAITS IN IBERIAN ARABIDOPSIS

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Genetic and environmental variation directly influence phenotypic expression of ecologically important traits. We conducted a detailed characterization of four naturally occurring Spanish populations of Arabidopsis thaliana within their environments. We then planted field collected seeds in a common garden to identify genetic influence on observed aboveground phenotypic characters. Significant phenotypic variation within and among populations in both the field and greenhouse populations indicate genetic variation for traits including rosette diameter, height and reproductive output. Because much of environmental variation is principally found in soil conditions, we also manipulated soil nutrient and texture conditions. Field seed as well as seed from accessions of Iberian origin from the ARBC (nineteen total lines) were also planted in varying nutrient and soil conditions and root traits were measured. Other studies have identified significant genotype by environmental interactions in accessions across wide geographical areas; our study indicates similar patterns among populations encompassing a much smaller area, even with only 3.24 kilometers between. Furthermore, we provide evidence of phenotypic variation among belowground traits in Arabidopsis thaliana, an arena nearly untouched by researchers in this field. Our data will complement the numerous genetic studies on molecular and hormonal development of ecologically important plant characters.

## PHOTOACOUSTIC SPECTROSCOPY: AN EFFICIENT METHOD TO MEASURE THERMAL PROPERTIES OF POWDER SAMPLES

Matthew Fitzgerald, Narayanan Kuthirummal
College of Charleston

Photoacoustic spectroscopy (PAS) has been used in this work to study the thermal diffusivities of bismuth oxide and bismuth telluride thermoelectric materials. Unlike in the conventional absorption and fluorescence spectroscopic techniques, this form of PAS monitors the pressure changes in the gas medium surrounding the sample, due to the heat generated as a result of nonradiative deexcitation following optical absorption. As a result, PAS can be tailored to measure a host of parameters other forms of spectroscopy cannot, such as the optical absorption spectra of opaque or scattering samples, as well as the thermal properties of a material. In PAS, the incident light is intensity modulated by a mechanical chopper, and as its frequency changes, the length through which the thermal energy penetrates into the sample changes. The length within which the entire heat energy is dissipated is known as the thermal diffusion length. The sample is thermally thin if l<thermal diffusion length; (l - sample thickness) and the sample is thermally thick if l>thermal diffusion length. Upon changing the chopping frequency, there will be a crossover from the thermally thick, to thermally thin case. The frequency at which such a crossover occurs is known as the characteristic frequency, fc. Thermal diffusivity can be calculated using the equation, where D is thermal diffusivity. The characteristic frequencies of Bi2O3 and Bi2T3 were found and, based on these, the calculated values of their thermal diffusivities are 1.06 mm2/s and 0.80mm2/s respectively. These values match relatively well with those available in the literature. We have also analyzed the spectral features of these compounds in the visible and infrared regions. We are currently measuring the thermal diffusivities and spectral properties of their nano counterparts in an attempt to generate a systematic data on these materials.

## MEF2 EXPRESSION IN THE DEVELOPING SEA URCHIN, LYECHINUS VARIEGATUS

Erica Flores, Beth Ahern, Travis O'Dell, and Christine Byrum
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The sea urchin, Lytechinus variegatus, serves as the model organism for our studies on myoregulatory genes and their particular role in muscle specification. Currently, MEF2 (myocyte enhancing factor 2) is under investigation to determine its temporal and spatial expression throughout embryonic development. MEF2 interacts with the transcription factor MyoD to initiate the skeletal muscle program. Homologous gene sequences were found in the Strongylocentrotus purpuratus genome, and served as a reference for primer design to be used in our model organism. Spawning was induced in the sea urchins and embryos were collected every two hours post fertilization (hpf). The mRNA was extracted from each sample and cDNA was synthesized by use of reverse transcriptase. PCR cloning allowed for confirmation of the correct product and also indicated temporal expression patterns at each time point. MEF2 expression was found to be between 16 hpf and 24 hpf, excluding 20 hpf. Currently, probes are being designed for whole mount in situ hybridization (WMISH) to visualize spatial expression of MEF2 as a function of time.

## TILAPIA FISH GROWTH UNDER ACID RAIN

Jared Frazier, Vikram Gautham, Donald Anadu and Ajoy Chakrabarti
South Carolina State University

Tilapia fish, native of Africa and Asia has been introduced around the world in both fresh and seawater. The fish is generally resistant to harsh environment. The current research proposes to explore the growth and respiration rate in low doses (parts per million) of sulfuric, nitric and carbonic acids that are ingredients of acid rain. Body weight and body length were recorded periodicallyas parameters of growth in both of the control and treated environments. Any visible injury such as discoloration, loss of scale or abnormal behavior were also recorded. The fish died in pH 2 treatment within 2 hours with disintegrated body. In pH 3 and 3.5 the fish died in 24 hours. The fish survived a week in pH 4 treatment. The fish lost mobility and balance in lower pH treatment. Body weight and body length in ph 5 and 6 treatments were similar to control. Respiration rates were inhibited in lower ph the rates showed gradual increase in the dimension of time.

## SYSTEMATIC ANALYSIS OF THE MARINE HATCHETFISH POLYIPNUS TRIPHANOS SPECIES COMPLEX (STERNOPTYCHIDAE) USING A CONSTRUCTED WETLAND TO REMEDIATE NON-POINT SOURCE POLLUTION

Justin J. Gavin, Michele Harmon
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Brick Pond Park of North Augusta, SC, includes a constructed wetland that receives and treats stormwater as it flows from nearby streets and into the park's pond system. This three-month project involved a biweekly assessment of water sampled from six locations throughout the wetland treatment system. Basic water quality parameters, including temperature, dissolved oxygen, and pH, were measured in the field. Toxicity was evaluated through the use of standard 7-day static renewal toxicity tests with Ceriodaphnia dubia. Enzyme-linked immunosorbent assay tests were used to detect concentrations of total petroleum hydrocarbons. Nitrate and phosphate concentrations were measured via ion chromatography. This assessment demonstrated the effectiveness

of a wetland treatment system for remediating some of the effects of non-point source pollution.

## BATHYMETRIC ANALYSIS OF LIONFISH HABITATS ALONG THE CONTINENTAL SHELF EDGE OFF ONSLO BAY, NC

Greg Goldberg, Amber Onufer, Dr. Leslie Sautter
College of Charleston

Bathymetric survey data were collected by NOAA Center for Coastal Fisheries and Habitat Research scientists (Beaufort, NC) along the shelf edge of Onslow Bay aboard the NOAA Ship NANCY FOSTER in April 2008 and June 2009. Two sites, "Big Fish" and "OS05" (water depths ranging 50 to 100 m) were examined using a Simrad 1002 multibeam sonar system, and processed using CARIS HIPS 7.0 software. Mapping the bathymetry of this rocky seafloor area will aid in assessing the benthic habitat of the non-indigenous Lionfish, which has been seen to propagate in the waters of the Atlantic as far north as North Carolina since the early 1990's. The venomous Lionfish thrives in warm waters up to depths of 200 meters. This species has no known predators and is a danger to the commercial grouper fishing industry off the southeast U.S. coast. There is little information explaining the population growth of this invasive species, therefore habitat mapping is necessary where Lionfish sightings have occurred, particularly along the shelf edge where rocky seafloor habitats are bathed in warm Gulf Stream waters.

## EVALUATING TREE DEVELOPMENTS IN URBAN AND RURAL AREAS USING DENDROCHRONOLOGY

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Dendrochronology is the study of trees to determine their age. Annual tree rings provide useful information about the tree growth. They reveal the changes in the environment from the past and show what factors might have affected the growth. The process for evaluating tree rings depends on how wood is added to the trunk as the tree grows. A ring is composed of two parts: earlywood and latewood. The earlywood, light in color, marks the early season and consists of thin walls and large cells. The latewood is generated later in the season and it appears darker, with thicker walls and smaller cells. The differences between the light and dark rings make counting possible. By comparing growth patters between trees in different environmental conditions, researchers can test a variety of environmental questions. We used dendrochronology to distinguish growth patterns along an urban to rural gradient in Sumter County, SC. The results will allow us to see if there are any differences in growth patterns between trees grown in an urban setting versus those growing in a more natural, rural environment.

## LANDSCAPE EVOLUTION FRAMEWORK FOR THE COASTAL PLAIN AND CONTINENTAL SHELF OF SOUTH CAROLINA

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The Coastal Plain and Continental Shelf of South Carolina represent a continuum of submerged and emerged portions of a geologically and ecologically dynamic coastal landscape. Focusing on the Middle and Lower Coastal Plain and Continental Shelf regions, this ongoing research program provides a revision to past Coastal Plain maps (Clark, 1943; Colquhoun, 1969) and a summary of past and continuing offshore studies

from the shoreline to the outer Continental Shelf. The maps and detailed landscape analyses include data from new and existing high-resolution LiDAR surveys, multibeam-bathymetric surveys, sidescan sonar mosaics, marine sub-bottom surveys, soils survey maps, satellite imagery, ground penetrating radar surveys, and geological cores within an integrated geographic information server system. On land, well-preserved emergent coastal sequences include barrier island ridges, dune fields and old marsh and continental shelf surfaces modified by a complex array of Carolina Bays, sinkholes, dune fields, colluvium, and erosional landforms. The high, mainland coastal systems of the north coast give way to the lowcountry of the southern coastal embayments. Offshore, the prism of sediment at the modern barrier systems generally thin offshore into exposed rocky hard grounds. Variously distributed rocky platforms with buried cypress forests, entrenched tidal creek systems, and thin sediment accumulations extend to -50m at a nearly-continuous rocky outcrop, with essential fish habitat and ecologically important areas focused around eroded and exposed geological materials extending to depths of greater than 1000m where deep sea corals prevail with demersal fish populations. On land and offshore, these types of maps and extracted data layers will provide basic scientific information for informed terrestrial and marine spatial planning efforts as we move forward in our studies of these two diverse, but closely-linked geological and ecologically important systems.

## HIGH-RESOLUTION SEDIMENT PROFILES OF THE TOPPER ARCHAEOLOGICAL SITE IN ALLENDALE COUNTY, SC

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The Topper archaeological site in Allendale County, SC, contains a well-documented, complex stratigraphic context with associated archaeological materials. Older swamp and flood plain deposits dated at >50 thousand years are overlain by alluvial sands of the ancient Savannah River and a colluvial apron eroded from upland deposits (Waters et al., 2009). This study focuses on providing a sedimentological context for these Quaternary deposits in order to provide a clearer understanding of sediment transport processes active in the region during various occupation episodes. Samples collected at 10-cm intervals from the land-surface down through the paludal deposits were analyzed using a CILAS laser particle size analyzer to determine sediment textures. Microscope analysis provides additional information with respect to grain composition and wearing patterns to provide an empirical history of this section of clearly stratified archaeological materials along the Savannah River. The findings of this study will assist archaeologists in interpretation of the site formation processes and the influence of those processes on the preservation of the archaeological record in this important North American paleoindian site.

## ANALYSIS OF PAWPAW LEAF CHARACTERISTICS: A STATISTICAL INVESTIGATION OF POSSIBLE HYBRIDIZATION

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Presbyterian College (1), Newberry College (2)

Physical characteristic data of pawpaw leaves was collected during Summer 2009 in the midlands of South Carolina. The purpose of this study is to determine whether pawpaw species is related to three physical characteristics of the leaves: leaf length, leaf length to widest, and leaf width. Three statistical approaches are employed: analysis of variance, a nonparametric equivalent, and bootstrapping.

## CHANGES IN CROSS-SHELF GRAIN SIZE DISTRIBUTION OFF THE COAST OF CHARLESTON, SC FROM 2003 TO 2009

Veronica Holton, Leslie R. Sautter
College of Charleston

Temporal changes in cross-shelf grain size distribution have been studied by undergraduate students from the College of Charleston Transect Program using sediment samples collected at eight stations during five research cruises from November 2003 to November 2009. Variations in grain size demonstrate changes in wave energy, currents, and tides affecting how deposition occurs. In November 2009, samples were collected along a cross-shelf transect off Folly Island, South Carolina using a Shipek grab sampler at depths ranging from 18.0 to 104.0 m. Ro-Tap sieve and statistical analyses were conducted, and compared to results from four previous Transect Program cruises on sediment samples collected at the same stations to demonstrate temporal changes in cross-shelf grain size distribution. Sediments along this transect range from coarse-grained sands at the inner-shelf to fine-grained sands and silts on the outer shelf, with coarse relict deposits near the Gulf Stream. Temporal variations in grain size indicate changes in energy levels which have occurred over the course of six years.

## THE EFFECTS OF PH ON GENETIC DIVERSITY OF DAPHNIA

Aubrey Hughes, Pearl Fernandes, Jeff Steinmetz
University of South Carolina

Preventing the decline in biodiversity is a serious ecological challenge scientists face today. This decline can be attributed to many factors which include habitat loss, exploitation, pollution, and global climate change. Though the threats to biodiversity are well known, the relationship between diversity at different levels is not well understood. Understanding the forces that maintain biodiversity at multiple levels preserves healthy, stable communities. We used genetic techniques of microstatellite markers to identify the Daphnia species. Daphnia was collected from several lakes in South Carolina and DNA was extracted and amplified using polymerase chain reaction (PCR). Three microsatellite markers (Fol Forward, Fol Reverse, and CoI) known to cross-amplify with several Daphnia species were used to identify our samples. For our ecological results, the zooplankton we found included rotifers, ostracods, copepods, and several types of cladocerans including the invasive species Daphnia lumholtzi. Our results from the genetic analysis produced PCR fragments of approximately 700 bp in the control, but no products in the samples. This could potentially be a method to distinguish our species of Daphnia from other species. However, our data is preliminary and studies with a larger population using a greater number of markers will be useful not only for studying species identification but also the genetic diversity in these populations. Sequencing of PCR products could also add further information towards the population structure and genetic diversity. The work done through this research will specifically contribute to the understanding of how environmental degradation, such as lake acidification, can affect genetic diversity. It will also form a base for more detailed future studies exploring the connections between genetic and species diversity.

## INVESTIGATING QUATERNARY SEDIMENTS USING GROUND PENETRATING RADAR, CAPE FEAR ARCH, SOUTHEASTERN USA

Kristen Hughes, Scott Harris
College of Charleston

The Coastal Plain of South Carolina retains the remnants of a dynamic environment in which barrier island complexes were constructed due to the transgressions and regressions of global sea levels. This study investigated a single chain of barrier islands from the Cape Fear Arch of North Carolina to Charleston, South Carolina. It is uncertain whether the elevation and overall morphology of these ancient barrier islands has been shaped by cyclic transgressions and regressions alone, or if tectonic forces have played a role in shaping this landscape. Ground penetrating radar and existing LiDAR data were used to estimate elevations of these ancient barriers at high-stands of sea level. Relict shoreline deposits interpreted during the analysis of radar facies, revealed prominent overwash deposits representing sea level maxima. Using this combination of topography and GPR data, lateral trends with elevations along this barrier ridge from the Cape Fear Arch, to Charleston, SC is revealed.

## MULTIBEAM SONAR ANALYSIS OF DRY TORTUGAS NATIONAL PARK, FLORIDA

Kristen Hughs, Leslie Sautter
College of Charleston

Dry Tortugas National Park was established in 1992 in order to maintain its unique and pristine marine habitat. Located ~112 km west of Key West, Florida, Dry Tortugas spans over 64,700 acres, with 99 % of its area under water. Unique coral communities with pinnacles, staghorn, and elkhorn corals are attracted to this tropical shallow water substrate. Multibeam sonar data were collected on the NOAA Ship Nancy Foster in September 2009 by investigators from the NOAA Florida Keys National Marine Sanctuary Coral Disease and Condition project. Bathymetric data were then processed using CARIS HIPS 7.0. The detailed seafloor maps and 3-D images created highlight some of the prominent features in the park, including various reef structures and east-west trending sand bodies. The reef platform is mainly composed of oolitic and coral sand deposits, with some carbonate muds and large sand bodies. The stratigraphy of Dry Tortugas ranges from sand and anthropogenic debris in the upper 1 to 15m of Holocene limestone. The most prominent layer is the Pleistocene Key Largo Limestone, which underlies Holocene deposits and is composed of fossilized patches of reef complexes and oolitic limestone. The living coral reefs are currently under threat of degradation due to vessel groundings and overuse. Multibeam analysis of Dry Tortugas provides a baseline and starting point for future efforts to preserve this National Park.

## MEASUREMENT OF BISPHENOL A LEACHED FROM PLASTIC BOTTLES BY SPME GC-MS

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University of South Carolina Lancaster

Bisphenol A (BPA) is a compound used in the commercial synthesis of various plastics and resins commonly used for food packaging. Its use has become controversial in recent years due to BPA's biological role as an endocrine disruptor potentially leading to a variety of negative health effects. This research project was aimed at developing an analytical test method for determining trace levels of BPA in water stored in BPA-containing plastic bottles. Samples were analyzed using Solid Phase Micro-Extraction

(SPME) sampling and Gas Chromatography-Mass Spectrometric (GC-MS) detection with selected ion monitoring. The method was capable of quantifying BPA down to 10 parts per billion in aqueous samples with a linear calibration range of 10 to 1,000 ppb. Water samples stored under a variety of conditions in polycarbonate plastic and glass control bottles were tested. BPA levels varied between 27 and 310 for the plastic bottles and less than 10 ppb for the glass bottles. This method was designed for use in project-based laboratories for undergraduate analytical chemistry courses.

## MULTIBEAM SONAR ANALYSIS AND CHARACTERIZATION OF THE CHARLESTON BUMP

Kacey L. Johnson, M. Scott Harris, Leslie R. Sautter, and Robert L. Nusbaum
College of Charleston

Multibeam sonar data, video surveys, and surficial rock samples have been collected, analyzed, and interpreted from the Charleston Bump aboard multiple research vessels 200-km off the coast of Charleston, SC. The high-relief survey site is approximately 1400 km², with bathymetric depths ranging from 450 to 1000 m. The Charleston Bump is part of the upper continental slope on the northern part of the Blake Plateau, covered with Neogene phosphorite pavements with ferromanganese nodules and crusts that foster the growth of deepwater corals. The pavement has partly eroded over time to form caves, ledges and overhangs, providing habitat for deep-dwelling, demersal fish. Moreover, the Charleston Bump deflects the Gulf Stream eastward, strengthening bottom currents while causing upwelling that supports the reproduction and nourishment of pelagic marine life. Due to the nature of the geologic conditions and associated biological habitats, the Charleston Bump has been classified as an Essential Fish Habitat. The purpose of this project is to create a high-resolution bathymetric map of the survey area and to characterize the deepwater rocky substrate and fish habitats so that fishery management plans can be initiated.

## IS THE CURE FOR STAPHYLOCOCCUS INFECTION RIGHT BEFORE OUR NOSES?

Erin Kelly, Sherri Tomlinson, and Dr. Paul E. Richardson
Coastal Carolina University

Over the years bacteria and man have waged a constant war against one another. Man develops an antibiotic to fight off infection and the bacteria evolve a means to counter the drug. It is time that we use techniques that can evolve to fight the bacteria. The use of bacteriaphages to fight infections is not a novel idea. Currently there are products in market that use bacteriophages to fight off skin infections in skin grafts (phagederm). Unlike static drugs, bacteriophages can evolve with the bacteria to constantly keep up with the pathogen. This study was undertaken to identify bacteriophages that are found on everyday people to fight Staphylococcus aureus. Dozens of volunteers were screened to see if they naturally contained bacteriophages that could be useful in destroying Staphylococcus aureus. Samples from behind the ear and the nasal cavity were collected and tested to determine if there contained lytic bacteriophages against the bacteria.

## SYSTEMATIC ANALYSIS OF THE MARINE HATCHETFISH POLYIPNUS TRIPHANOS SPECIES COMPLEX (STERNOPTYCHIDAE

Iris M. Kemp, Antony S. Harold
College of Charleston

The hatchetfish genus Polyipnus contains more species than any other genus in the Sternoptychid family and has been subjected to several revisions. The P. triphanos species complex is the subject of the present systematic analysis. Observations on qualitative morphological features with emphasis on the body pigmentation and photophores, serially repeating features such as fin rays and light organs, and internal structure based on radiography and histological analysis were included. We also compiled a set of landmark-based morphometric measurements for use in bivariate and multivariate statistical analyses. Sheared principal components analysis was used to assess and quantify size-free variation in body shape. A reference image library was created to assist in the description of meaningful features. This has particular import in its inclusion of information about the dorsally positioned pigment bar and saddle marking, which provide distinguishing characteristics among some populations. Preliminary results indicate the presence of at least two distinct species within the P. triphanos complex. Further resolution of this hatchetfish group will have an impact on marine species conservation in the Indo-Pacific region, including a more accurate assessment of marine biodiversity and areas in need of protection.

## SCHOOLING FISH DENSITIES AROUND URBAN PIERS

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The Hudson River estuary is highly urbanized and the majority of its habitats have been artificially modified by influences such as shoreline piers. Results from studies that focus on this area have the potential to be generalized to other estuarine habitats. Previous research has shown that under-pier habitats are unsuitable for many juvenile fishes, likely due to the depression of light availability in these locations. However, it has been postulated that the pier-edge habitat can be utilized. Schooling fish may take advantage of structure as a refuge from predation and/or a feeding oasis. In this study, schooling fish density was measured around piers and pilings in order to establish the value of structure as potential fish habitat. Data obtained from dual-frequency identification sonar (DIDSON) scans were used to quantify and qualify schools and school density. The habitats considered were classed as under-pier, pier-edge, open water, and relict pile field (pilings with no covered deck). The DIDSON equipment was attached to the bottom of a kayak and the paddler executed five to seven minute transects. Physical measurements were taken at each transect and in under-pier habitats, incident light levels were also recorded. “School” was defined as an organized grouping of ten or more fish and to quantify large schools, we superimposed a grid on the DIDSON image and sub-sampled abundance. As commercial development continues along the Hudson River estuary, it is important to realize the consequences of building and rehabilitating man-made structures. Behavioral observation around and under piers will increase understanding of the way fishes interact with these potential habitats. As structure becomes more prevalent, its viability as potential habitats and its effects on fish mortality must be researched.

## OPTIMIZED SEIRA SUBSTRATE FABRICATION BY PHYSICAL VAPOR DEPOSITION

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Physical vapor deposition (PVD) is the most common nanofabrication method for producing surface-enhanced infrared absorption spectroscopy (SEIRA) substrates. However, to make sensitive, reproducible SEIRA sensors, practical questions remain, such as: 1) Which IR substrate is best for SEIRA? 2) What rate and angle of deposition and thickness provides the greatest enhancement? 3) More fundamentally, how do these experimental parameters affect the overall morphology (i.e., size, shape, and spacing) of the metallic nanoparticles that provide the SEIRA response? In this systematic study, using a slow, controlled rate of deposition, we deposited Ag and/or Au films (at 0o degrees) simultaneously onto six common IR substrates (CaF2, BaF2, ZnSe, KRS-5, Ge, Amtir) and compared their SEIRA response in transmission as a function of overall thickness deposited. We found that Ag and Au deposited onto CaF2 provided the highest, routine SEIRA enhancement factors (EFs) for cast films of para-nitrobenzoic acid (PNBA), but with different metal thicknesses. As we observed using atomic force microscopy (AFM), the differences in SEIRA response between substrates is attributed to differences in the morphology of each film grown on each substrate. For a given film thickness, it appears that the size, shape, and spacing of the Ag nanoparticles are greatly influenced by the chemical composition and temperature properties of the underlying substrate. Additionally, Ag films were deposited onto IR substrates that were tilted (85o degrees) and rotated during deposition to understand how these manipulations further alter the size and spacing of the Ag nanoparticles and their SEIRA response. Finally, we have determined that a two-step deposition process provides SEIRA EFs that are almost double (EF=165) compared to EFs produced from a single-step deposition (EF=90). The morphology of the two-step film is also very different from the single-step deposition film. Spectral differences between substrates and percolation effects leading to band asymmetry were observed and will also be discussed.

## PYRAN/PYRANONES: STRONG BASE PREPARATION OF A VARIETY OF PYRANONES AND BENZOPYRANONES

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Targeted pyran/pyranones have been prepared from trilithiated beta-ketoacetanilides, dilithiated carboalkoxyhydrazones, dilithated ortho-toluic acids, trilithiated phenylacetic acid phenylhydrazides, and monolithiated ethyl propionanate that have been condensed-cyclized with salicylate esters, methyl thiosalicylate, or in a select instance other aromatic esters. Trilithiated beta-ketoacetanilides were prepared from acetoacetanilide by deprotonation with excess lithium diisopropylamide (LDA) and condensed with lithiated methyl thiosalicylate followed by acid cyclization of expected C-acylated intermediates to afford benzothiopyranones, also named as thiochromone

acetanilides. The same condensation-cyclization of this trilithiated intermediate with a variety of lithiated methyl salicylates gave the targeted benzopyranones, also named as chromone acetanilides. Unexpectedly, trilithiated beta-ketoacetanilides when condensed with other aromatic esters such as methyl benzoate to afford C-acylated intermediates that underwent rearrangements to afford 4-anilinopyran-2-ones. Dilithiated C(alpha),N-carboalkoxyhydrazones prepared in excess LDA underwent C-acylation with lithiated methyl thiosalicylate to give C-acylated intermediates that cyclized to benzothiopyranones instead of originally targeted N-carboalkoxypyrazoles. When trilithiated phenylacetic acid phenylhydrazide prepared in excess LDA was treated with lithiated methyl thiosalicylate followed by cyclization phenylhydrazino-benzothiopyranones resulted instead of a substituted pyrazolone. ortho-Toluic acids can be dilithiated with LDA followed by an aldol-type condensation with select carbonyl compounds to afford intermediates that could be acid cyclized to dihydroisocoumarins. These dilithiated toluic acids were prepared in excess LDA, C-acylated with aromatic esters, then followed by cyclization to isocoumarins. Momolithiated ethyl propionate can be condensed-cyclized with lithiated methyl salicylates or lithiated methyl thiosalicylate to prepare 4-hydroxy-coumarins or a 4-hydroxy-thiocoumarin. Lithium hexamethyldisilazide (LHMDS) deprotonated acetone followed by condensation with aromatic esters resulting in symmetrical triones that can be separately acid cyclized to symmetrical pyranones. Unsymmetrical triones can be prepared in a similar manner from LHMDS, 1-benzoylacetone and a variety of benzoate esters. Upon acid cyclization of these triones, unsymmetrical pyranones are prepared. When 1-benzoylacetone was lithiated with HMDS followed by an aldol-type condensation with 1-hydroxy[-2-naphthaldehyde, cyclization occurred on work up resulting in a naphtha-pyran. Current studies are focused on acid cyclization of symmetrical and unsymmetrical 1,3,5-pentanetriones to the targeted pyranones. The synthesis of pyrones/benzopyranones by others has been extensive because of its applications and potential for applications, especially in biological and chemical sciences.

## DISTRIBUTION OF DECAPOD CRUSTACEANS ALONG THE SOUTH ATLANTIC BIGHT

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In order to characterize the distribution of benthic crustaceans of the order decapoda in the South Atlantic Bight, samples were collected using a 2 m. beam trawl over a soft and sandy bottom. The collection of samples took place as part of the College of Charleston's Transect Program in May 2005 and November 2009, along two parallel transects perpendicular to shoreline and extending to the continental rise, reaching a maximum water depth of 150 m. Benthic crustaceans collected by beam trawls were preserved in formaldehyde and later transferred to alcohol. The abundance and diversity of decapods in inner, middle and outer shelf habitats will be correlated to bottom sediment grain size and composition in order to establish the habitat preferences of specific crustacean species.

## DEVELOPMENT OF A NOVEL ANTICANCER AGENT MODELING COMBRETASTATIN A-4 USING QSAR

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The anticancer drug combretastatin A-4 (CA-4) binds specifically to the colchicine-binding site in the formation of microtubulin. This binding restricts the flexibility of the protein, which prevents cell division at the end of mitosis. Because CA-4 stops cell division, it is most effective against cells that divide rapidly, like cancer cells; however, it does stop normal cells from dividing as well. We are designing and synthesizing CA-4 analogs that are potent against tumors but have a lower level of cytotoxicity. To determine which derivatives were to be synthesized docking experiments of the colchicine-binding site were conducted compared to colchicine. This was not an effective tool. Currently a quantitative structure-activity relationship (QSAR) study is being conducted. This is where other derivatives of CA-4 that have already been synthesized have numerical values for their binding capability and potency. These numbers will be entered into the QSAR equation to find the hot spots necessary for activity. This will afford a 3D-image based on these "hot spots" from other compounds. We will then see if our structures we are currently synthesizing fit into the model based on the QSAR, and also design others based on the results.

## PHYSIOLOGICAL MARKERS OF ACTIVITY BASED ANOREXIA IN RATS

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"Activity-based anorexia (ABA) in animals is a viable model of anorexia nervosa, reproducing many of the core behavioral components of the disorder including restriction of food consumption in the presence of hunger, dramatic weight loss, an increased drive for wheel-running, and the physiological consequences associated with the disorder. Many of the core physiological changes that are seen in anorexia nervosa are also observed in activity-based anorexia. Of interest in this investigation are changes in glucose levels in the blood and urine, and changes in ketones in the urine. Previous research examining the effects of fasting and food deprivation in the rat and human have indicated that glucose and ketone levels rise. Though these changes have been examined in rats under food deprivation, whether a significant difference in these levels occurs for rats under food deprivation with access to an activity wheel has not been examined. The study utilized the paradigm of activity-based anorexia in rats to investigate whether a difference exists in these levels due to an increase in physical activity, in comparison to the sole effect of food deprivation. The study consisted of three treatment groups – 1) Food restriction where access to food is confined to one hour per day, 2) Wheel running during food restriction, and 3) Ad libitum food with no wheel access. The duration of the experimental treatments was 14 days. Blood and urine were collected at the beginning of each trial, halfway through and at the end of the two weeks. It has been observed that rats with access to an exercise wheel under conditions of food deprivation will run immediately after being fed. Preliminary data suggests that there are changes in glucose and ketone levels in the three treatment groups."

## IMPACT OF AN INTERACTIVE HIV-EDUCATION MODULE FOR COLLEGE STUDENTS AND HEALTH WORKER TRAINEES

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Background: Young African Americans are disproportionately affected by HIV. Methods: Using a prospective, pre- vs. post single group study design, this study compares the pre- and post-intervention results of a HIV-education module (3 class sessions, 6 class hours) with an experiential learning approach among biology major freshmen at the University of South Carolina, Sumter campus and among trainee health care workers in Kenya, total 65 students. The anonymous survey had 62 questions. The knowledge domains were: A) HIV-AIDS biology (virology, replication, HIV-AIDS symptoms, transmission and treatment; 20 items; Likert scale, 1 equal to definitely true, 5 equal to definitely false); B) HIV-risk behaviors (8 items, true/false responses); C) HIV-transmission potential of general life activity events (HIV risk from general life activities or events without involving active choice of behavior; 8 items). The attitude/self efficacy constructs were: D) blaming attitude (persons with HIV are to blame and not deserving of respect; 2 items); E) self-efficacy for protective behaviors (comfort level to discuss sexual history and risk behaviors with partners; 3 items); and F) comfortable to discuss HIV/AIDS with family and friends (2 items). Survey participation was voluntary.Results: Paired t-tests showed significant knowledge improvements on HIV biology and on the remaining domains (p less than .0001). Logistic linear regression showed that blaming attitude, self-efficacy for self protection, and intent to engage in risk behaviors were predicted by knowledge scores, cross sectional and over time. Conclusions: Using biology concepts and an experiential learning approach facilitates changes in HIV-related knowledge, attitude and behavioral intent among college students and trainee healthcare workers.

## HABITAT CHARACTERIZATION OF CONTINENTAL SHELF SEAFLOOR OFF CHARLESTON, SC

Stephen Long, Leslie Sautter
College of Charleston

Habitat characterization of seafloor sites on the continental shelf off the coast of Charleston was conducted using video and sediment samples collected as part of the College of Charleston Transects Program. Video images were recorded aboard the R/V Savannah between November 13 - 22, 2009, using a Phantom 300 remotely operated vehicle (ROV). Four video surveys were conducted along portions of the inner to outer continental shelf to document living and nonliving resources at depths ranging 20 to 58 m. Through video image analysis combined with sediment samples collected with a Shipek grab sampler, substrate morphology was quantified and described. The types of seafloor observed range from soft to hard substrate featuring pockmarks, megaripples, and irregular bedforms with low (less than 0.5 m) to high (greater than 1.5 m) relief. Sediment grab sample analysis consisted of grain size and compositional analyses, including relative abundances of biogenic and lithogenic materials. Abundant marine life was observed in the area of highest relief at depths of approximately 57.6 m and megafaunal invertebrate populations were qualitatively described. Comparison to previous video surveys at other nearby sites and sediment samples will be used to characterize the fish and invertebrate communities. These results can help contribute to the current knowledge of sea bed physical features, and supplement additional research being conducted.

## BENTHIC BIOTA DIVERSITY IN THE VICINITY OF HYDRATE RIDGE OFF THE OREGON COAST

Stephen A. Long, Leslie R. Sautter
College of Charleston

The Ocean Observatories Initiative (OOI) INSITE '08 expedition was conducted by the University of Washington's School of Oceanography July 22 to August 5, 2008. The primary purpose of the INSITE'08 research cruise was to create bathymetric seafloor maps of the two areas where nodes will be installed as part of a the National Science Foundation's Regional Scale Nodes of the OOI, a fiber optic cable network on the Juan de Fuca tectonic plate. One of these areas, Node 1, is in the vicinity of Hydrate Ridge off the Oregon/Washington coast at the edge of the continental margin. Photographic images of the seafloor in the vicinity of Node 1 were collected from aboard the University of Washington R/V Thomas G. Thompson, using the Woods Hole Oceanographic Institute's TowCam system. The TowCam was used primarily to ground truth the ship's EM300 multibeam sonar bathymetric data in areas that will be future cable routes for the regional cable observatory. There were 8 TowCam dives in the Hydrate Ridge region during which approximately 8,500 digital color images were taken at intervals varying between 10 and 15 seconds. In addition to terrain, the seafloor images showed a variety of invertebrates and fish. Through examination of each image the extraction and enlargement of approximately 850 organisms was possible, and a web gallery was produced containing the entire record of these organisms. This work establishes a semi-quantitative baseline for the abundance and distribution of benthic biota in the vicinity of Node 1 of the OOI's Regional Scale Nodes observatory.

## PHOSPHORYLATION OF ERK BY ANGIOTENSIN II IN RAT CULTURED PERITONEAL MESOTHELIAL CELLS

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Background: There are increasing numbers of people in the United States with end stage renal disease, with over 400,000 on dialysis. Many are on peritoneal dialysis, the utility of which is limited by peritoneal membrane thickening and scarring. Several studies suggest that the potent vasoconstriction/ mitogen Angiotensin II (Ang II) contributes to this process. Therefore, we tested the hypothesis that ANG II stimulates Extracellular Signal- Regulated Kinases (ERK), an important Ang II second messenger, in a concentration- dependent manner and through its AT 1 receptor in rat peritoneal mesothelial cells. Methods: Peritoneal mesothelial cells were collected from the peritoneal cavity of a Sprague- Dawley rat incubated for 2 hours with Trypsin- containing medium. The cells were studied in passage 2 through 3 when they retained a cobblestone appearance. Preliminary studies demonstrated that passages greater than 3 show non-cobblestone fibroblasts appearances with greatly reduced Ang II binding and signaling. The cells were stimulated in culture for 5 minutes at 37˚C with vehicle or Ang II ranging from 0.1-100 nM. Afterwards, the cells were lysed, subjected to electrophoresis and immunoblotting for phospho-ERK and total ERK. Results: The phosphorylation of ERK had a dose-dependent curve with an increase of angiotensin II. According to our data the antibodies Vimentin, E-Cadherin, and Smooth Muscle Actin show evidence of cell markers for angiotensin II specific cell types. The antagonist Losartan shows evidence of a specific AT 1 receptor. Conclusion: The rat peritoneal

mesothelial cells seem to show phosphorylation of ERK in a dose-dependent manner and specific AT 1 receptors are present. Further studies need to be done to show how these cells play a role in renal disease.

## GEORGES BANK EAST

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College of Charleston

Mapping the continental slope east of Georges BankDaniel, Alex, and Leslie R. Sautter Dept. of Geology and Environmental GeosciencesGeorges Bank is a shallow submarine shoal created approximately three thousand years ago during the Wisconsin Glaciation. Georges Bank is geographically located near the edge of the continental shelf off the eastern coast of Massachusetts and south of Nova Scotia. In May 2009 scientists from the U.S. Geological Survey (USGS, Woods Hole, MA) collected multibeam sonar data from aboard the NOAA Ship RONALD H. BROWN, surveying the continental slope east of George's Bank where water depths ranged from 200 to 3000 m. A Seabeam 2112 12KHz swath bathymetric sonar system was used to collect the bathymetric data, which was then processed using CARIS HIPS 7.0 software. The bathymetric image created makes it possible to view the seafloor morphology and depth relief of the continental slope area east of Georges Bank East. Numerous submarine canyons cut through the slope, and are conduits for submarine landslides. The USGS scientists will use the images produced to better understand areas of potential slumping off the Georges Bank region, for the purpose of investigating areas prone to tsunami generation.

## QUANTUM CHEMICAL CALCULATIONS ON PERICYCLIC REACTIONS

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The purpose of this experiment was to use computational methods to test the applicability of the Woodward-Hoffman rules to a set of pericyclic reactions. We used Gaussian W03 (an advanced electronic structure software suite) to perform geometry optimizations as well as frequency and energy calculations of the reactants, products, and transition states in a pericyclic reaction involving the rearrangement of cyclohexadienone derivatives. These substrates contain a nucleophilic imide, ester, or thioester functionality that can potentially undergo [3,3] and [3,5] rearrangements via 6- or 8-membered transition states. We performed ab initio (DFT/B3LYP and MP2) calculations on three different (oxygen-, nitrogen-, and sulfur-containing) substrates using the 6-31G(d) and 6-311++G(2d,p) basis sets for optimization and energy calculations, respectively. The Woodward-Hoffman rules predict that for each cyclohexadienone substrate, the [3,3] rearrangement is allowed, while the [3,5] rearrangement is disallowed. Our hypothesis was that due to these rules, the energy of the [3,5] transition state would be much higher than that of the [3,3] transition state. The results and conclusions of this study will be presented.

## SIGNALING FROM LYSOSOMES ENHANCES MITOCHON-TARGETED PDT THERAPY IN A431 EPIDERMOID SKIN CANCER CELL

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Photodynamic therapy, (PDT) is a promising treatment against a wide range of cancers including lung, esophageal, colon, and lymphoma. PDT involves either local or systemic administration of a photosensitizer followed by illumination with light. It is thought that mitochondria-targeted photosensitizers are more effective in killing cancer cells than photosensitizers targeted to other organelles such as lysosomes and endoplasmic reticulum. Our results with Confocal microscopy show that the silicon phthalocyanine photosensitizer Pc 4 co-localizes with a mitochondria-specific probe MitoTracker Green, demonstrating that Pc 4 targets to mitochondria. Our goal in this study was to determine whether lysosome-targeted agents, such as bafilomycin, further enhance Pc 4-mediated cell killing. A431 epidermoid skin cells were used for the study. Cell killing after PDT was monitored with propidium iodide exclusion assay using a fluorescence plate reader. Pc 4-PDT induced 51.3 % cell killing after 8 hours. Bafilomycin, an inhibitor of the acidic vacuolar proton pump that collapses the pH gradient of the lysosomal/endosomal compartment, did not cause toxicity by itself but greatly enhanced Pc 4-PDT-mediated cell killing (76.4 %). Mode of cell death was predominantly apoptosis, as assessed from nuclear morphology using a fluorescence microscope. Pc 4-PDT and Pc 4-PDT plus bafilomycin induced 10% and 60% apoptosis, respectively, after 8 hours of PDT. These results indicate that lysosomal perturbation by bafilomycin effectively enhances mitochondrial-mediated cell killing during PDT. Agents that disturb lysosomal function could potentially be used as an adjuvant treatment with mitochondria-targeted photosensitizers to treat cancer patients.

## THE USE OF MOLECULAR TOOLS IN THE STUDY OF PHILOMETRID NEMATODES

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The southern flounder, Paralichthys lethostigma, is infected by two species of philometrids, Philometra overstreeti and Philometroides paralichthydis, which are composed of four genetic clades corresponding to their respective habitat in the host: “fin muscles”, “buccal bones”, “teeth”, and “gill arches”. Population dynamics data showed that these clades have a different ecology and rarely infect all habitats simultaneously. We hypothesized that individuals belonging to these clades have life cycles that involve different fish paratenic host species reflecting potential sequential infection by the various clades. Polymerase Chain Reaction-Restriction Fragment Length Polymorphism (RFLP-PCR) technique was used to identify species and clades of philometrids. Part of the Cytochrome Oxydase I (COI) gene was amplified with taxon-specific primers. Amplicons were digested with six selected endonucleases, Mse I, Alu I, BsaW I, CviA II, HpyCH4 V and Bda I. Restriction profiles were obtained for each clade of P. overstreeti and P. paralichthydis and for Philometra carolinensis that parasitizes the spotted seatrout, Cynoscion nebulosus, which is sympatric to the southern flounder. Mesenteries of 8 fish species known to be preyed upon by southern flounder and infected with nematode larval stages were analyzed. Out of 228 fish

dissected, 32 were infected by nematodes, of which 14 were found to be infected by philometrids using PCR. RFLP analysis showed several results: the presence of the "gill arch" clade in the mesentery of one mummichog, Fundulus heteroclitus and one freshwater goby, Ctenogobius shufeldti, the presence of P. carolinensis in three freshwater gobies, and the presence of 12 unknown profiles in various other fishes. The other three clades ("teeth", "fin muscle", and "buccal bones") were not encountered in any of the fish studied. Although this study demonstrated the usefulness of PRC-RFLP technique to distinguish between philometrids species, the occurrence of several unknown profiles showed its limitation when in the presence of unknown species as is clearly our case. Direct sequencing of a portion of the COI gene is currently being used to differentiate between individuals that could not be positively identified by RFLP.

## CROSS-SHELF DISTRIBUTION AND DIEL VERTICAL MIGRATION OF ICHTHYOPLANKTON OFF CHARLESTON, SC

Jessica Miller, Gorka Sancho
College of Charleston

Evidence for diel vertical migration (DVM) of larval fishes ascending in the water column during the night has been documented in several studies and is mainly attributed to predator avoidance and pursuit of food sources. In order to describe possible DVM behaviors in the ichthyoplankton community over continental shelf waters, plankton net tows were taken off of the R/V Savannah along two transects across the continental shelf off the coast of SC in November 2009. Surface water tows were made with a Neuston net, and the water column was sampled by a Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS) which collected three stratified plankton samples across the water column. Samples were taken across the inner, middle, and outer zones of the continental shelf and preserved in 95% ethyl alcohol for later identification. By comparing the day and night samples of both the Neuston and MOCNESS samples, the diel vertical movement of ichthyoplankton will be quantified and cross-shelf larval fish communities will be characterized.

## ANALYSIS OF THE P1 PROMOTER FROM LB400

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LB400 is a gram (-) bacterium that was isolated in 1983 from soil contaminated with biphenyl and polychlorinated biphenyls (PCBs). It can oxidize over 20 PCB congeners. Degradation of biphenyl and PCBs requires enzymes encoded by the bph cluster. This cluster contains the 13 genes: orf0, bphA, bphE, orf1, bphF, bphG, bphB, bphC, bphK, bphH, bphJ, bphI, and bphD. Biphenyl dioxygenase catalyzes the rate-limiting reaction in the metabolism of biphenyl. The four subunits of this enzyme are encoded by bphA, E, F, and G. In LB400 these genes are present on a polycistronic transcript that is transcribed from a single promoter called p1.The plasmid pGEM6 contains the region upstream of bphA and is thought to include p1. If this promoter is present, it may be possible to use a reporter gene to demonstrate that it is functional in E. coli. A restriction digest was performed to remove a reporter gene, Green Fluorescent Protein (GFP), from the plasmid pGREEN TIR. The same enzyme was used to linearize GEM6. The GFP insert and pGEM6 plasmid were ligated together using T4 DNA ligase. The restriction enzyme chosen for this experiment should produce a recombinant plasmid with GFP inserted immediately downstream of p1. The ligation reactions were transformed into DH5α cells. A rapid heating procedure was used to isolate plasmids from a number of clones, and the sizes of the inserts were determined. If GFP is expressed in clones

with the correct recombinant plasmid, its presence can be detected using short wave blue light.

## GENERALITY OF DISRUPTION OF PREPULSE INHIBITION BY THE DOPAMINE AGONIST APOMORPHINE

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Sensorimotor gating, the process by which organisms filter extraneous sensory stimuli, is commonly assessed with manipulations of prepulse inhibition (PPI). Alterations in gating are observed in individuals with schizophrenia, HIV-1 dementia and other neuropsychiatric disorders. Dopaminergic pathways play a putative role in sensorimotor gating. It is well-established that apomorphine, a dopamine agonist, disrupts PPI of the auditory startle response at low prepulse intensities (75 dB) at an interstimulus interval (ISI, time between the prepulse and the startle stimulus) of 100msec. In the present study, it was hypothesized that disruption of PPI by apomorphine would also occur with a tactile prepulse stimulus, and further, that a range of ISIs would provide a more precise index of any such disruption. It was also hypothesized that PPI of the auditory startle response would be disrupted by apomorphine with a prepulse of a higher intensity (85 dB), when assessed with a range of ISIs. Accordingly, sensorimotor gating was measured with tactile and auditory prepulse stimuli in the PPI paradigm (ISIs of 0, 8, 40, 80, 120, 4000 msec, 6 trial blocks, Latin square design). A within-subjects design was used for each experiment, with 12 adult male Sprague-Dawley rats that were tested 5 minutes after a subcutaneous injection of saline or one of three apomorphine (APO) doses (0.1, 0.25, and 0.5 mg/kg) in an ascending series with 48 hr between assessments. Tactile PPI was disrupted as a linear function of apomorphine dose at the 40 msec ISI. At the 100 msec ISI, although there was disruption of PPI at all doses, there was no dose-response effect. Auditory PPI with a prepulse intensity of 85 dB was not significantly disrupted by apomorphine at the 100 msec ISI, as found previously. However, there was a leftward shift of the ISI function with dose of APO. These results indicate the generality of PPI disruption by apomorphine across prepulse stimulus modalities and the importance of manipulating the temporal dimension of PPI instead of using a single ISI.

## ANALYSIS OF HAMMERHEAD RIBOZYMES TARGETED TO HIV-1 TAT

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The acquired immune deficiency syndrome (AIDS) results from infection by the human immunodeficiency virus (HIV) and is accompanied by a number of opportunistic infections, such as Pneumocystis carinii pneumonia. In 2009, the CDC estimated that approximately one million people in the United States currently live with HIV or AIDS, and approximately a quarter of them are unaware of their infection. During 2008, the South Carolina Department of Health and Environmental Control (DHEC) estimated ten new HIV/AIDS per 100,000 individuals in Aiken county. Across the state, DHEC reported that the greatest number of new cases occurred in Richland County (142 diagnosed per 100,000). HIV treatments currently target virus entry into host cells (fusion inhibitors), reverse transcription (reverse transcriptase inhibitors), provirus integration (integrase inhibitors), and virus maturation (protease inhibitors). One step in the HIV replication cycle that is not currently targeted is viral transcription. A possible transcription target is the Tat/TAR complex. The HIV-1 transactivator of

transcription (tat) is a regulatory protein that increases the rates of transcriptional initiation and elongation. Short, nascent viral RNAs transcribed from the viral long terminal repeat (LTR) form a stem loop structure called the transactivation response element (TAR). Tat, cyclin dependant kinase 9 (CDK9), and cyclin T form a heterotrimeric complex that associates with the stem loop TAR structure. CDK9 phosphorylates the C-terminal domain of RNA Polymerase II (RNAPII). This results in increased RNAPII processivity and prevents early termination after synthesis of short transcripts. Here we describe targeting of tat mRNA using a hammerhead ribozyme. A suitable cleavage site (5'-GUA-3') was identified at nucleotide 5840 within the tat sequence of the HIV-1 genomic clone NL43 (Accession number M19921) and a hammerhead ribozyme was designed based on the model of Haseloff and Gerlach. For cloning purposes, BglII and HindIII sites were added to the ribozyme 5' and 3' ends respectively. The molecule was synthesized and cloned into the retroviral vector, pSUPER.retro.neo+gfp (pSRNG). The resulting plasmid, pSRNGTat5840, and the previously cloned pSRNGTat 5910, will be used to compare anti-tat activity in tissue culture assays using HeLa-CD4-LTR-beta-galactosidase cells. These cells express beta-galactosidase in a tat-dependent manner and are good indicators of ribozyme activity.

## CALPONIN FAMILY GENES IN THE DEVELOPING SEA URCHIN LYTECHINUS VARIEGATUS

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Calponin is an important actin-binding protein known to be specific to smooth muscle in vertebrates. In addition, this molecule can also bind actin cofactors. Actin is a versatile protein in the cell, forming microfilaments in muscle and the cytoskeleton as well as playing important roles in endocytosis. In this project, we have identified possible members of the Calponin family in echinoids using the genome of the sea urchin Strongylocentrotus purpuratus. In addition, each family member was further characterized using domain analysis.To determine whether two of these Calponin family members, transgelin and calponin, are present in the local sea urchin species Lytechinus variegatus, PCR amplification was used. Several developmental stages were evaluated. Transgelin and calponin were of particular interest to our laboratory because we study myogenesis and these are both late markers of smooth muscle formation in vertebrates. Markers obtained from this study will be used in the future to further characterize muscle types produced in Lytechinus variegatus during embryogenesis.

## AN INTERANNUAL COMPARISON OF BENTHIC FORAMINIFERA DISTRIBUTION OFF THE COAST OF CHARLESTON, SC

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Benthic foraminifera are single celled protists found in all marine environments. Calcium carbonate tests, or shells, that house these chambered sand-sized organisms have proven to be invaluable proxies in reconstructing paleo-climates, paleo-bathymetries and paleo-environments. The College of Charleston Transect Program has conducted five oceanographic research cruises off the coast of Charleston, SC along established cross-shelf transect lines. By using a Shipek Grab Sampler, sediment samples were collected at seven predetermined sites along the transect off Folly Beach, SC. Samples were collected from the continental shelf's inner, middle and outer shelf in water depths ranging from 18 to 108 m. Foraminifera greater than 125 μm were extracted from each

sediment sample using a density separation method after a series of dry-sievings, and identified to the genus level. Distributions of foraminifera as well as the degree of diversity at sample sites were studied. Data will be compared to results from Leg 01 (November 2003) and Leg 03 (November 2004) in order to address interannual changes in cross-shelf foraminifera assemblage distribution.

## LATE STAGE PHASE SEPARATION OF SULFUR HEXAFLOURIDE DROPLETS AT CRITICAL POINT

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Near the liquid-vapor critical point in pure fluids, material and thermal properties vary considerably with temperature. The behavior of the system as it approaches the critical point is characterized by large-scale density fluctuations and increasing instability in the fluid. The fluctuations behave according to well know universal power laws that lead to perfect wetting by the liquid phase near critical temperature. Using the Alice 2 apparatus, a series of experiments were performed in microgravity in order to study phase separation in pure fluids without gravity-driven instabilities. The apparatus contained an optical cell filled with sulfur hexafluoride ($SF_6$) near the critical point. The pure fluid is heated above the critical temperature then quenched slightly below the critical temperature such that gas and liquid domains form. During the early stage, droplet nuclei form from thermal fluctuations and grow in size with time. Sets of full view images and microscopic images were investigated to evaluate the power law governing the late stage phase separation. We analyzed spherical droplets that form during late stage in the microscopic images and recorded the behavior into histograms. The mean diameter of droplets and the variance of the distribution were found to increase with time. We investigate the effect of the coalescence induced-coalescence via diffusion and the droplet evaporation mechanism on phase separation in pure fluids at late stages.

## DEMERSAL JUVENILE FISH DISTRIBUTION AND DIVERSITY IN THE SOUTH ATLANTIC BIGHT

Marisa Ponte, Gorka Sancho
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Many past demersal fish studies in the South Atlantic Bight have focused solely on adult fishes, due to the use of heavy commercial trawl gear to sample fish communities, overlooking the ecologic importance of the juvenile fish population. The use of finer mesh sizes in trawls allows for the capture of juvenile fishes and the study of their populations across the continental shelf. Benthic fishes were sampled using 1 and 2m beam trawls off the coast of South Carolina, as part of the Transect Program at the College of Charleston. Eight stations distributed throughout the inner, mid- and outer shelf areas were sampled in May (2004, 2005) and November (2003, 2004, 2009) to characterize the juvenile fish assemblages in each region. Juvenile fish abundance and diversity at each station will also be compared between years to describe possible temporal changes in juvenile fish communities.

## INHIBITION OF HIV-1 TAT FUNCTION USING A RETROVIRAL VECTOR EXPRESSING ANTI-TAT SIRNA

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Human immunodeficiency virus type I (HIV-I) is a lentivirus belonging to the family Retroviridae and infects cells expressing a CD4 receptor. Due to the role these cells play in the immune system, their infection leads to compromised immune activities. As the infection progresses, the weakened immune system leaves the body vulnerable to secondary infections and other characteristic diseases. Having one or more of these conditions, along with a CD4 T cell count less than 200 microliters defines acquired immune deficiency syndrome (AIDS). There is no effective HIV-1 vaccine, and current treatments are designed to slow the progression to AIDS. Therefore, researchers have been studying new ways to combat the virus. One way to do this is through the use of RNA interference (RNAi). One class of RNAi is small interfering RNA (siRNA), which are gene-specific sequences that activate the DICER/RNA-induced silencing complex (RISC) pathway. Formation of the RISC complex results in cleavage of the targeted mRNA. siRNAs have been used to decrease HIV gene function by binding to and mediating the cleavage of viral transcripts resulting in a decrease of gene function. We have designed a siRNA targeted to tat mRNA at nucleotides 6010 through 6028 of the HIV-1 genomic clone NL43. Tat plays a major role in viral transcription and is required for replication. Tat functions by binding to the transactivation-response region (TAR), which is transcribed in the first 60 nucleotides of all HIV transcripts, and increases transcription through interaction with host factors. The anti-tat siRNA and a control were cloned into the retroviral vector, pSuper.retro.neo+GFP (pSRNGsi6010 and pSRNGsiControl). The ability of the siRNA to decrease tat function will be analyzed using HeLa-CD4-LTR-beta-galactosidase cells, which express beta-galactosidase in a tat-dependent manner. These cells will be cotransfected with pCMV-Tat and pSRNGsi6010 or pSRNGsiControl. Tat functions will be measured indirectly by analyzing the percentage of HeLa cells that appear blue after X-gal staining.

## SCREENING FOR MEDIUM-CHAIN ACYL-COA DEHYDROGENASE DEFICIENCY IN ADULTS IN SOUTH CAROLINA

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Medium-chain acyl-CoA dehydrogenase deficiency, or MCADD, is the most common inherited defect in the beta-oxidation of fatty acids. It is caused by mutations on chromosome 1 that result in an insufficient amount of medium-chain acyl-CoA dehydrogenase, an enzyme necessary for the beta-oxidation of medium-chain fatty acids. The purpose of this research is to determine the percentage of carriers of MCADD in a given population. This population consisted of DNA samples taken from patients in South Carolina aged eighteen years and older provided by the Greenwood Genetic Center. A 209 base pair segment of the gene for medium-chain acyl-CoA dehydrogenase was amplified using polymerase chain reaction (PCR). The PCR product was digested with the restriction enzyme Sty I which cut the amplified DNA at a site created by an A985>G mutation. This mutation is present in 85-90 % of all MCADD cases. The results were run on agarose gels to detect the presence of mutations. So far, 584 patients were tested in this study and four were positive as carriers of the mutation. This is in keeping with the known rates of occurrence for this disorder. For example, according to Gregersen, et al., the carrier frequency is 1/84 in North Carolina, 1/333 in Italy, and

between 1/68 and 1/101 in Denmark and the United Kingdom. The results of this research indicate that the known rates of occurrence for this disorder most likely similar to those that apply specifically to South Carolina.

## IDENTIFICATION OF CONSERVED TBX20 TARGET GENES IN CIONA INTESTINALS

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Tbx20 is a member of the T-box family of transcription factors that is an important regulator of cardiac development during embryogenesis. In vertebrate hearts, Tbx20 regulates the expression of target genes that promote proper heart morphogenesis via the regulation of myocardial maturation and proliferation as well as valve development. As a urochordate, Ciona intestinalis is a primitive chordate ancestor to vertebrates and provides an intriguing animal model system to study the conserved regulatory mechanisms that direct heart development. Morphogenesis of the Ciona heart is very similar to early vertebrate heart development presumably due to conserved genetic programs that regulate morphogenesis of the heart during embryogenesis. Interestingly, the genetic sequence of Tbx20 is highly conserved between vertebrates and Ciona Intestinalis. However, the function and transcriptional target genes of Tbx20 in Ciona have not been identified. Preliminary studies show that orthologs of many of the Tbx20 target genes that are well characterized in vertebrates can be found within the Ciona genome; however, activation and expression of these potential evolutionarily-conserved Tbx20 target genes has not been verified in urochordates. We have designed a series of oligonucleotide primers to specifically examine the expression of orthologus Tbx20 target genes in Ciona hearts throughout development. Furthermore, we have generated antisense RNA probes to examine the expression patterns of these genes. Our goal is to identify Tbx20 target gene expression during morphogenesis of the Ciona heart though RT PCR and in situ hybridization. Collectively, these studies will provide insight into conserved regulatory mechanisms of heart development and elucidate the role of Tbx20 in Ciona.

## REPTILE AND AMPHIBIAN INVENTORY OF RED BLUFF LODGE, ALLENDALE COUNTY, SOUTH CAROLINA

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University of South Carolina Aiken (1), University of South Carolina Salkehatchie (2)

The Red Bluff Lodge Herpetofuana Inventory was initiated in May 2009 in Allendale County, South Carolina. The study objectives were to generate a reptile and amphibian species list, assess the importance of wetland habitats for amphibian breeding, compare diversity across habitats, and detect species with conservation status or limited geographic distribution. Red Bluff Lodge is a private 2,833 hectare tract of land near the Savannah River in the Upper Coastal Plain. Linear drift fence pitfall traps, minnow traps, and hand capture are being used to sample herpetofauna occurring in cypress pond, oxbow lake, bottomland hardwood forest, stream, pine plantation, and man-made impoundment habitat types. Sample sites were randomly selected within each habitat type for a total of 12 sample locations. Sampling has been conducted for no less than two consecutive weeks each month since August 01, 2009. A total of 658 individuals have been captured composing 13 amphibian species and 9 reptile species. Amphibians represented the majority (93.8%) of captures. Commonly captured amphibians include

the southern toad (Bufo terrestris), eastern narrowmouth toad (Gastrophryne carolinensis), and mole salamander (Ambystoma talpoideum). Cypress pond habitats produced the most captures (34.8%) followed by the bottomland hardwood forest (17.6%) and man-made impoundment sites (17.6%). The stream and pine plantation sites produced the fewest captures. The property at Red Bluff Lodge supports a diversity of habitats that are important breeding and staging grounds for a variety of herpetofauna. Sampling is in progress and will continue on this study through 2010.

## THE ORBIT OF AN ARTIFICIAL SATELLITE

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This project consists of the development of a computer program that calculates how the orbit of an artificial satellite revolving around the Earth will change by the action of a force, such as the force of a rocket attached to the satellite. The program originally places the satellite on a circular orbit and uses an applied force that is directed along the line that connects the centers of gravity of the Earth and the satellite. The program user can specify the radius of the initial orbit, the magnitude of the applied force, whether the force is directed towards or away from the Earth and how long the force will act on the satellite. The program calculates the path that the satellite follows during the time the force is acting on it and the new orbit of the satellite after the applied force is turned off. In some cases the new orbit will cross the Earth's surface and the satellite will crash onto the Earth. This may happen even when the applied force is directed away from the Earth. The program is based on Mathematica 7 and the results are presented by an interactive computer animation.

## DIVERSITY & DISTRIBUTION OF PTEROPODS ACROSS THE CONTINENTAL SHELF OF SOUTH CAROLINA

Kayla Spry, Gorka Sancho
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Pteropods, commonly known as "sea butterflies," are a common group of planktonic mollusks (subclass Opisthobranchia). All species of pteropods are holoplanktonic, typically living in surface waters of the ocean for their entire life span, with species widely distributed around the world's oceans. Pteropods were collected across the continental shelf of South Carolina using two different plankton nets: a Neuston net and a Multiple Opening/Closing Net Environmental Sampling System (MOCNESS). The Neuston net had a mesh size of 1000 micrometers and sampled the top 1 meter of the water column, while the MOCNESS had three nets with mesh sizes of 150 micrometers that sampled three distinct portions of the water column, from a depth of 40 meters to the surface. The diversity of pteropod species and their relative abundance across the shelf were explored through comparison of samples taken with both collecting mechanisms. By examining organisms both at the surface and at different depths, vertical stratification, diversity and distribution of pteropods across the continental shelf were analyzed. Through comparison of day and nighttime tows from the same locations, diel vertical migration behaviors of pteropod species were also investigated.

## THE SHAMAN'S MEDICINAL PLANTS OF THE HIGH ECUADORIAN ANDES

Richard Stalter, Jorge Cruz, Kimberly Bukucuyan, Arnold Natarov, Vivian Persaud, Mohammad Hussan
St. John's University

The knowledge of medicinal plants in the Andean highlands may be as old as the original inhabitants, the Mayans, who settled the area around 10,000 BC. Information on useful medicinal plants has been passed from father to son from time immemorial. One is knowledgeable source of plant medicines is the shaman, an Indian doctor, who was responsible for curing ills of his tribe. The shaman's means of curing sick people was multidimensional. To combat the evil spirit that had taken hold of the sick, the shaman ate or drank a product of local hallucinogenic plants, producing a trace-like state that was the essential part of curing the sick. The shaman may have also proscribed medicinal cures made from local plants to heal the afflicted. This treatment was refined after thousands of years of testing various plant products on the diseases of native people. This presentation includes the pictures and descriptions of 15 out of 150 in the Shaman's medicinal vascular plants inventory and currently being used by indigenous Quechuan people in the vicinity of Quito, Ecuador, to cure and treat a multiplicity of illnesses. This presentation is from a booking being prepared by Stalter and Cruz.

## THE VASCULAR FLORA OF CAPE HENLOPEN, DELAWARE

Richard Stalter, Bill McAvoy, Eric Lamont, Arnold Natarov, Joseph Arbelaez
St. John's University

The vascular plants at Cape Henlopen, Sussex County, Delaware consist of 362 species within 223 genera in 87 families. The list was compiled from the Delaware Natural Heritage Programs surveys during the 1997 field season, an earlier Natural Heritage survey from 1987-1996, published lists generated by Fleming (1978) an unpublished list by Moul (1970) as well as herbarium records of the C. E. Philips Herbarium (Delaware State College) and the herbarium of The Philadelphia Academy of Natural Science. Additional collections were made by the authors during the 2007-2009 growing seasons. The flora contains for Global Four ranked taxa and 34 state rare species. An additional rare species, Drosera filiformis, was collected by Rafinesque during a foray on the Delmarva Peninsula in 1773. Three state rare orchids, Plantathera blephariglottis, P. cristata and Pogonia ophioglossoides grow together in a small 150m2 bog near Dog Pond. These orchids may become locally extinct in the future as succession proceeds from a bog to a shrub-tree community.

## ESSENTIALS OF GREEN WEB SCIENCE

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Expanding on the idea of web science as defined by Sir Tim Berners-Lee and others, green web science encourages the study of interrelationships between the web and green energy practices, as well as creating and maintaining energy efficient decentralized information systems. Our research has shown an area central to green web science is web deployment, focusing on the areas of hardware, software and web services. In this paper, we will discuss topics of green web science that include:* Servers: Green web science uses more course-grained energy efficiency metrics such as total energy usage across a given number of web-centric transactions, including site visits. Previous metrics focused on fine-grained measures such as watts/flops or joules/instruction. Such metrics

are often too narrowly applied and are no longer adequate.* Data centers: Efficient rack placement and configuration, as well as reuse of the heat by-products for other sustainable purposes are a foundation of green web science. Previously, the focus was on blades per square feet and absolute cooling needs.* Flexible resource allocation: Virtualization allows resources to be created in software, allocating resources as-needed, instead of the inefficient power-up, use, power-down cycle that is more costly in terms of energy and is not an enabler of power savings. We will also discuss seven virtualization strategies commonly used today: operating system, application server (load balancing), software applications (thin-client), management, network, hardware and storage.* Monitoring and tracking: Green web science employs XML to capture, store, display and analyze information from devices, appliances, homes and offices for power usage. Platforms such as AMEE and the new Google PowerMeter will provide stores of data to be monitored and mined for valuable information.* Bandwidth conservation: Green web science studies and develops strategies to decrease network latency through AJAX and the proper use of query caching with Web 2.0 technologies. These areas of green computing not only signal a significant shift in the web science paradigm, but they also represent the initial factors to consider as we begin to explore the green web science parameter space.

## BATHYMETRIC SURVEY OF LIONFISH HABITAT AT A MID-SHELF ROCKY LEDGE, ONSLOW BAY

Allison Stone, Leslie Sautter
College of Charleston

The problem of growing populations of the venomous lionfish along the Southeastern United States coast has become an increasingly pressing issue for the regional fisheries of Onslow Bay. The lionfish, an invasive species, is native to the Indo-Pacific, and was introduced into the South Atlantic Bight within the last few decades. This non-indigenous fish has few natural predators, allowing populations to reproduce rapidly and threaten indigenous populations. Beginning in 2005 researchers from the NOAA Center for Coastal Fisheries and Habitat Research (Beaufort, NC) began a multibeam sonar study of Onslow Bay, hoping to gain a better understanding of lionfish densities and habitat, in order to address management concerns. Multibeam sonar surveys of two mid-shelf sites, Lobster North and Lobster South were conducted aboard the NOAA Ship NANCY FOSTER. Each year the area of study was expanded to build a larger, more concise bathymetric image of the sea floor. The bathymetric data have been processed using CARIS HIPS 7.0 and will focus on Lobster South using data collected in 2008 and 2009.Comparison to previous Lobster North data will also be made to assess variations in seabed morphology and lionfishpopulation densities.

## IMPROVING THE PHARMACOKINETIC PROFILE OF CART PEPTIDES

Brian Douglas Stogner Jr., Jason Stover, Whitney Cofield, Fernanda M. Burke
University of South Carolina Lancaster

The long-term goal for the project is to develop a novel medicinal agent for the treatment and prevention of obesity and obesity-related diseases. However, in order to achieve such goal, the research must first focus on the structure of CART and how it can be modified to improve its pharmacokinetics. A strong pharmacokinetics profile is indispensable for the development of a medicinal agent. The introduction of unnatural amino acid residues into the structure of CART could potentially slow down or stop the digestion since the enzymes only recognize naturally occurring amino acid residues.

This technique along with peptide bond manipulation and peptide capping are often used to protect peptides from degradation along the digestive tract. The first step for this project was the development of an HPLC based degradation assay using trypsin as the endopeptidase and a test peptide with an arginine-proline bond as the cleavage site. The assay has been developed and optimized, and CART peptides are currently being synthesized with both natural and unnatural amino acid residues. The degradation of the peptides will be measured and compared as a means of determining whether or not the introduction of unnatural amino acid residues can modulate the degradation by trypsin.

## THE HISTORY OF THE SOUTH CAROLINA ACADEMY OF SCIENCE

David J. Stroup
Francis Marion University

The South Carolina Academy of Science (SCAS) was organized in 1924 under the direction of Dr. G.C. Mance, Professor of Geology at Winthrop College. In 1927, the academy affiliated with the American Association for the Advancement of Science. Soon after this affiliation publication of the Bulletin of the Academy began, and in 1973 the SCAS Newsletter was established as a vehicle for communication among members. Beginning in the 1960s, industry and business joined academic institutions in support of the Academy and have helped to set goals to aid and improve the development of science in South Carolina. The South Carolina Junior Academy of Science was founded by Dr. John Michner in 1969 and the Middle School/Elementary School Academy was founded by Dr. Don Jordan in 1991. The first issue of the peer reviewed, electronic, Journal of the South Carolina Academy of Science was published in the Fall of 2003. The Academy is dedicated to raising the level of science education in South Carolina and to promoting research and the transmission of knowledge within the State. The Academy of Science is the only statewide interdisciplinary science organization whose membership includes high school students, teachers and administrators, college students, professors, scientists, related professionals, parents of students, college presidents, business executives, small and large businesses, financial institutions, and institutions of higher education. One reason for this broad spectrum of support for the Academy is that individually and collectively, members share a deep commitment to promote research and to stimulate the creative abilities of senior scientists and the youth of our State.

## RANDOM STIMULATION OF THE MORRIS-LECAR COMPUTATIONAL MODEL

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Biology Department (1), Physics and Astronomy Department (2), College of Charleston

Ubiquitous in all stages of the sensorimotor loop, noise is an external variable that must be physiologically tolerated to maintain the viability of our cells. We investigated how a Morris-Lecar (ML) model neuron responds to an externally injected noise current of different distributions. The magnitude of oscillation, defined by the standard deviation of the external noise, was manipulated to apply ranging intensities of noise to our system. ML model could be easily tuned to represent a type 1 (spiking) or type 2 (bursting) excitable cell. For a type 1 cell we found that the level of noise significantly changes the average firing rate in the model. Type 2 neurons act as resonators and they tonically respond only to certain frequencies present in the background noise. From a biological point of view, type 1 excitable cells seem to be more sensitive to noise level

and are ideal candidates for information processing. Type 2 neurons are relatively resistant to noise, and are presumably responsible for biorhythms and pacemakers.

## ASSESSING MOLECULAR METHODS TO DIAGNOSE AND PREDICT NUTRIENT DEFICIENCY IN CROPS

Kaitlyn Thompson, Doug Van Hoewyk
Coastal Carolina University

A majority of the human population relies heavily upon a plant-based diet to receive needed nutrients, vitamins, carbohydrates, and proteins. According to World Hunger facts from 2009, 1.02 billion people or 15% of the world population is undernourished. Often times, undernourishment can be a direct consequence of consuming crops that lack essential elements. Nitrogen, sulfur, and iron are important elements for both plants and humans. In humans, lack of iron can lead to anemia. Nitrogen is a constituent of amino acids and nucleic acids, and nitrogen deficiency in the human diet could therefore lead to lower protein production and inhibit DNA synthesis. Sulfur is also found in two amino acids and various vitamins essential for human health. Consequences of nitrogen, sulfur, and iron deficiency in crops grown in South Carolina include (1) a decreased crop harvest and associated economic losses and (2) possible malnourishment in the human diet. The goal of this research project is to diagnose nutrient deficiency in plants before symptoms are observed and irreversible damages to crops occur. To meet this challenge, corn and sunflower were grown hydroponically in complete media (control) or media lacking either sulfur, nitrogen, and iron. We used and evaluated several molecular techniques that might predict if crops are experiencing iron, sulfur, or nitrogen deficiency. We conclude that it is possible to diagnose nutrient starvation in plants prior to nutrient-deficient symptoms are visually observed. The significance of the findings is further discussed.

## UV IRRIDIATION ON BACTERIOPHAGE SURVIVAL

Sherri Tomlinson, Erin Kelly, and Dr. Paul E. Richardson
Coastal Carolina University

Bacteriophage is of great interest because of its potential medical benefit. UV exposure has a damaging effect on the virus, which is used in some experiments to study the reproductive system of phage. This study sets out to test the effects of UV radiation, in amounts comparable to local environmental conditions, on bacteriophage T2. The virus is placed in a Petri dish in either a liquid or soil medium and exposed to UV radiation. The irradiated virus is allowed to infect E. coli and plated. The plaques formed are counted to determine the amount of virus present after radiation. This study was undertaken in an effort to better understand the survival of bacteriophages in conditions similar to those found along the grand strand.

## SPECIES LIMITS IN THE GENUS CELASTRINA (LEPIDOPTERA: LYCAENIDAE) IN SOUTH CAROLINA

Aaron Tripp, Brian Scholtens
College of Charleston

Identifying butterfly species based solely on morphological traits can be difficult. Sometimes too much attention can be put on small, highly variable traits, such as color and emergence date. With the recent increase in the study of the genus Celastrina, several new species have been proposed. The most controversial is a new species

described by Wright and Pavulaan (1999), called idella. This new species is supposedly similar to ladon and neglecta with changes in flight period and some scale features. 64 specimens from the genus Celastrina were captured in South Carolina from March to September, to determine if idella extends into South Carolina. Our evidence indicates that there is no idella in South Carolina and that Wright and Pavulaan may have been studying late flying ladon. The phenotypes were examined and compared among the three species and statistical tests were used to determine if there was a significant difference.

## AZOLES: PYRAZOLES, ISOXAZOLES AND RELATED HETEROCYCLIC COMPOUNDS

Spencer W. Todd (1), Shabree L. Knick (1), Sarah K. Gilreath (1), Sarah M. Williams (1), Amanda M. Acevedo-Jake (1), Ellyn A. Smith (1), Thomas M. C. McFadden (1), William T. Pennington (2), Donald G. VanDerveer (2), Clyde R. Metz (1), and Charles F. Beam

College of Charleston (1), Clemson University (2)

Strong base syntheses involving selectively reactive 1,4-dilithiated oximes or a variety of substituted hydrazones have been accomplished using n-butyllithium or lithium diisopropylamide (LDA) for polylithiation. These polylithiated intermediates underwent Claisen-type C-acylations with a variety of esters to afford C-acylated intermediates that could be isolated, but would readily undergo acid cyclization to a single heteroaromatic isoxazole or pyrazole of unequivocal structure and not a mixture of isomeric azoles with very similar physical properties that would require a separate separation procedure. The key step is C-acylation that places the five atoms predetermined to make up the heterocyclic ring in place so that the cyclization process involves the formation of a single bond resulting in a single product that can usually be purified by recrystallization from common solvents. Current projects are the preparation of ferrocenyl-pyrazoles and NH-pyrazoles. The aldol-type condensations-cyclizations result from treating l,4-dilithiated C(alpha)-oximes or 1,4-polylithiated C(alpha)-hydrazones with aldehydes or ketones to afford beta hydroxyoximes or beta-hydroxyhydrazones which are usually isolated and separately acid cyclized to the respective dihydroisoxazole or dihydropyrazole. These non aromatic heterocyclic products are also of unequivocal structure since the cyclization step involves the formation of a single bond. A current investigation involves preliminary studies for the synthesis of ferrocenyl-dihydropyrazoles. A variety of C(alpha)-oxime entry compounds have included those prepared from condensations hydroxylamine and substituted acetophenones, cycloalkylnones, 1- and 2-tetralones and related carbonyl compounds. A larger variety of hydrazones has resulted from the condensation of the same carbonyl compounds with hydrazine, phenyl-hydrazine, and the three readily available alkyl hydrazinecarboxylates (methyl, ethyl, or tert-butyl). The esters employed in the condensation reactions have included hydroxybenzoates,aminosulfonylbenzoates, hydrogen phthalates, oxamates, and other aromatic and aliphatic carboxylic acid esters. Almost all of the heterocyclic compounds prepared and reported are new, because they cannot be prepared by traditional synthetic pathways. Hundreds of recent review articles attest to their usefulness and the desirability to find new synthetic routes for preparing them.

## MYOCARDIAL REGENERATION IN CIONA INTESTINALIS

James Tucker
Winthrop University

Ciona intestinalis is an invertebrate animal model system that provides many advantages in the study of heart development due to the relatively simple heart design, reduced genetic redundancy, and the possession of numerous genes homologous to those found in vertebrates. Cardiac myocytes in Ciona are reported to have the ability to regenerate new cells in order to replace old or damaged cells throughout the lifespan of the adult Ciona, an ability which does not occur in postnatal mammals. However, regeneration of cardiac myocytes in Ciona has not been verified using modern techniques. Whole-mount and section immunohistochemistry using proliferation marker phosphohistone H3 (PHH3) and sarcomeric muscle marker MF20 was performed to identify regions of cardiac myocyte proliferation and to determine the baseline rate of proliferation in the Ciona. Preliminary data show distinct regions of proliferation in the differentiated cardiac myocytes of the myocardium. Proliferating cardiac myocytes were found between the outer layer of pericardial connective tissue and inner layer of myocardium. This data suggests that a maturation gradient exists among cardiac myocytes within the Ciona myocardium, which is likely to contribute to regeneration. Myocardial regeneration will be stimulated by subjecting Ciona hearts to injury as well as hypoxic conditions and cardiac myocyte proliferation will be assayed. Furthermore, 3D reconstructions of triple-labeled confocal images of regenerating Ciona myocardium and TEM ultrastructure analyses are currently underway. These studies will provide the foundation for further studies into the molecular differences between regenerative cardiac myocytes in Ciona and non-regenerative cardiac myocytes in mammals.

## RELATIONSHIP OF COARSE-GRAINED SEDIMENT DISTRIBUTION AND COMPOSITION WITH ECHINODERM SPECIES' HABIT

Delynn Woodman, Leslie R. Sautter
College of Charleston

Characterizing the habitat of benthic echinoderm species requires a close examination of sediments on the ocean floor. Using sediment grab sampling devices, sediments were collected by the College of Charleston's Transect Program from eight stations across the continental shelf off Folly Island, SC in November 2004, May 2005 and November 2009. Collection stations ranged in depth from 18 to 108 m. Grain size distributions were determined using dry sieving analysis, and the larger grain size fractions of gravel (>2.00 mm) and very coarse sand (1.00 to 2.00 mm) were examined for composition focusing on the biogenic component. Using a beam trawl, echinoderm specimens were collected at the same sediment sample locations in November 2009 and compared with spatial distribution and abundance of echinoderms previously studied for the November 2004 and May 2005 cruises. Results will correlate sediment characteristics with the distribution and abundance variations of echinoderm species across the continental shelf.

**END**
**Senior Academy Abstracts**

**SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE**
**ABSTRACTS**

## THE EFFECT OF WASHING COTTON FABRIC TREATED WITH A BORAX BASED FLAME RETARDANT ON THE COMBUSTION TIME

Stephanie Ackerson
Spring Valley High School

The combustion of furniture and clothing in households is a leading cause of residential death in America. Flame retardants are used to decrease residential death; however, many contain chemicals that can be damaging to the body. In the previous year's experiment it was shown that a 0.12 g/mL concentration of borax and water is an effective retardant. The purpose of this experiment was to test if washing cotton fabric would cause the combustion of the fabric to be statistically higher than that of the unwashed, treated fabric. It was hypothesized that if cotton fabric treated with a borax-based flame retardant is washed, then the fabric would statistically lose retardancy. 56.7 g of borax was mixed with 273 mL of boiling water and 60 cotton squares were soaked in the solution for a minute. The squares dried for 24 hours and 30 of them were washed with water and left to dry for another 24 hours. All cotton was tested by combusting them and keeping time with a stopwatch. Combustion time is found by timing the amount of time it takes for a piece of fabric to burn completely after ignition. The control was the cotton that was not washed. After all the data were collected a two sample T-test was conducted with alpha at 0.05. The p-value was found to be 6.765 at alpha = 0.05 and the $T_{(45)}$=7.11. Due to the fact that the p-value was greater than the alpha value the null hypothesis was not rejected. It can then be concluded that while a 0.12g/mL concentration of a borax flame retardant is effective in protecting cotton clothing, the flame retardant needs to be re-applied after washing.

## CAN THE CONCEPT OF STEREO VISION BE APPLIED IN ROBOTICS?

Arjun Aggarwal
Lexington High School

The intent of this study was to determine if by using the concept of stereo vision a robot could calculate the coordinates of a target object placed in front of it. This research was conducted over a period of eight months. A total of fifteen versions of the robot were constructed. Strength and weakness of each version was analyzed and the subsequent version was made to improve on the precious version. For the purpose of the initial experiment, a simple robotic head was constructed with two laser pointers, serving as the eyes of the robot. As the research progressed web cameras were used for autonomous tracking of the target object. For each working version of the robot observations were made for computing the distance of the target object, against a set standard matrix. The computed distance was calculated using a formula derived during the course of the research. 40 such readings were taken to compare the derived coordinates as against the measured coordinates for each version of the robot. Across all the models, the percentage range of difference in the derived verses the measured values was 8% and -8%. This experiment along with further research on stereo vision & current technologies of autonomous robotic navigation confirm that concept of stereo vision can and is being effectively applied for autonomous robotic navigation.

## SOCIAL BEHAVIOR AND DEVELOPMENT OF THE OLFACTORY SYSTEM IN NrCAM MICE

Rowan Armstrong
South Carolina Governor's School for Science and Mathematics

NrCAM deficiencies have been noted in autistic human patients. This study aims to link the role of NrCAM in the vomeronasal organ during the early postnatal development of mice, with behavioral attributes. Social testing was performed on female NrCAM mice to test for social abnormalities or other unusual behaviors. With these subjects, immunostaining was used to trace the pathway from the vomeronasal organ to the accessory olfactory bulb. The disruption of the usual pathway for pheromones in the NrCAM deficient mice could serve as an explanation for the mouse's inability to perform the correct social interactions.

## CYTOKINE REGULATION OF HEMATOPOIETIC STEM CELL-DERIVED FIBROBLAST DIFFERENTIATION

Christopher Avins
South Carolina Governor's School for Science and Mathematics

Fibroblasts play a substantial role in forming the structural framework for most animal tissues, including stroma of solid tumors. Fibroblasts that help form the tumor stroma are known as carcinoma-associated fibroblasts. Carcinoma-associated fibroblasts differ from normal fibroblasts because of their ability to stimulate growth and proliferation of epithelial cells and elevated expression of matrix metalloproteinases, a key molecule in tumor metastasis. Recent research from Dr. LaRue's laboratory has shown that fibroblasts, specifically CAFs, have a hematopoietic stem cell (HSC) origin. It was hypothesize that tumor cells produce cytokines that affect the differentiation of these HSCs into fibroblasts. The objective was to test the differentiation capacity of five known cytokines that are commonly produced by tumors. These were TGF beta 1, PDGF-BB, M-CSF, G-CSF, and VEGF--A. This was achieved by extracting bone marrow from healthy mice, isolating the non-adherent cell fraction and culturing the cells in fibronectin plates with exogenous cytokines, tumor conditioned media (LLC-CM) or control media. The results showed that M-CSF had the greatest effect on fibroblast differentiation, followed by VEGF-A and PDGF-BB. The HSC-rich bone marrow fraction that was cultured in the LLC-CM also reached a high percentage of fibroblast differentiation. These results suggest that tumor cells produce cytokines, specifically M-CSF, PDGF-BB and VEGF, that may affect fibroblast differentiation. Further, M-CSF, a cytokine known to play a significant role in myeloid lineage development, had the greatest effect on differentiation, supporting the concept that the fibroblast is closely related to the monocyte lineage.

## COMPREHENSION AND PRODUCTION IN ADULT WORD LEARNERS

Spencer Babb
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An extensive body of previous research suggests that when children are first learning a language, they comprehend more words than they produce. In fact, when children are first learning to speak, they may understand 50 words, and only say 10 words. There is widespread speculation that the comprehension-production gap is specific to the early word learner, though little data exists to support this assumption. The current study investigates the relationship between comprehension and production in adult word learners at two sessions. Twenty participants were taught novel names (e.g., booma,

dax) for a set of twelve unfamiliar objects. Immediately following training, word learning was assessed using measures of both comprehension and production. Comprehension was tested by having participants point to pictures of the objects as the experimenter named them. Production was tested by asking participants to name objects as they were presented individually. Seven days later, training and testing were repeated at the second session. Analyses indicate that adults, like children, exhibit a comprehension-production gap when they are first learning new words. In fact, due to increased initial comprehension, the comprehension-production gap appears to be larger in adults relative to children. With an additional session of training, comprehension and production aligned, suggesting that the asymmetry between receptive and productive knowledge in adults is short-lived.

## THE EFFECT OF HYDROGEN PEROXIDE CONCENTRATION OF 2, 6, AND 10% IN COMBINATION WITH EXPOSURE TO NONCOHERENT BLUE LIGHT ON THE INHIBITION OF *STREPTOCOCCUS MUTANS* BIOFILMS ON IN VITRO ADULT TEETH

Jessika Banks
Spring Valley High School

The most prevalent bacteria known to grow in the human mouth is the *Streptococcus mutans* species in the form of biofilms. These communities of microcolonies adhere to the tooth surface with an increased resistance to antibacterial agents and destroy tooth enamel. The purpose of this experiment was to identify which concentrations of $H_2O_2$ in combination with blue light would yield the most inhibition of *S. mutans* biofilms. It was hypothesized that the biofilms subjected to 10% hydrogen peroxide and 60s of blue light at 400nm would result in the highest inhibition of bacteria. A group of 80 teeth were placed into agar-filled Petri dishes and inoculated with *Streptococcus mutans*. Inhibition disks containing $H_2O_2$ treatments were placed on teeth and select teeth were treated for 60s with blue light. The zone of inhibition of bacteria was measured using Motic Imaging Plus 2.0 © software. The one-way ANOVA indicated that there was a difference between the treatments of blue or no blue light and the various concentrations of hydrogen peroxide, $F(7,72) = 3.77$, $p<0.05$. The null hypothesis was rejected. A Tukey test indicated that the differences occurred between blue light and 10% $H_2O_2$ and the control, no blue light and no $H_2O_2$, as well as no blue light and 6% $H_2O_2$. It was concluded that a combination of 10% hydrogen peroxide and exposure to blue light yields the most successful antibacterial effects of *Streptococcus mutans* biofilms on in vitro adult teeth.

## ANALYSIS OF THE EFFECTS ON NET FUSION EFFICIENCY OF INTEGRATING CENTRAL HYDROGEN IONIZERS IN A THERMONUCLEAR FUSION REACTOR

Benjamin C. Bartlett
Lexington High School

This study was designed to find the operation conditions of greatest efficiency in a thermonuclear IEC fusion reactor using a multivariate analysis of the critical variables of power distribution and reaction vacuity. Inertial electrostatic confinement (IEC) fusion uses a hollow cathode accelerator charged to a highly negative potential to ionize fuel particles and pull them at extremely high velocities towards the epicenter of the accelerator, colliding them at very high energy levels to produce fusion – essentially functioning as a radial particle accelerator. The reactor constructed for this experiment, T.E.R.A. (Thermonuclear Electrostatic Reactor Apparatus) is an IEC reactor with a

central ionizer (charged to the same conditions as the cathode) placed in the reactor's fuel input system to ionize fuel particles before they enter the main reactor chamber. These ionizations were accomplished by electrifying the internal gas feedthrough to conditions similar to the primary cathode, promoting maximum collision rates. Adding ionizers has been shown by IEC fusion studies to generally increase the efficiency of an IEC reactor. However, no quantitative study had ever been performed to analyze 1) the magnitude of the increase in efficiency, and/or 2) what the optimal conditions (namely power distribution and reaction vacuity) were for this increase in efficiency. Given a ratio of power distribution between the primary cathode and the ionizer, both distribution extremes (a 1:0 or 0:1 ratio) produce nominal amounts of fusion, while the operational vertex of efficiency is located between the two extremes: efficiency as a function of power distribution forms a paraboloid when graphed on a Cartesian plane. Chamber vacuity has also been shown to affect the output of the reaction: efficiency also forms a paraboloid as a function of vacuity. To analyze the hypothetical point of greatest efficiency in the intersection of the two aforementioned functions, a 20-by-20-by-$z$ xyz model was constructed – with $x$ as the power distribution, $y$ as the chamber vacuity, and $z$ as the amount of energy released per second. After preliminary analysis of the results of this model, the procedure was repeated with more finely adjusted parameters to fit the area of greatest efficiency. Final analysis revealed that the optimum point of operation was at the point (0.91, 5) – 91% of the power directed to the cathode accelerator, and the chamber vacuity at 5 milliTorr. The integration of ionizers in the reactor produced a 227% increase in efficiency at this operation point, compared to a standard design.

## THE CORRELATION BETWEEN POSITIVE THOUGHTS AND FASTER FINISHING TIMES IN HIGH SCHOOL LEVEL CROSS-COUNTRY RUNNERS

Brittany R. Beasley
Spring Valley High School

Cross-country running is a major sport in many high schools nationwide. The sport consists of a team of runners completing a 5K race (about 3.1 miles) and takes much discipline, patience, and hard work to succeed in. The purpose of this project was to determine if there was a correlation between faster finishing times of these athletes and positive thoughts. It was hypothesized that there would be a negative correlation between positive thoughts and faster finishing times in high school level cross-country runners. In other words, faster finishing times will be correlated with positive thoughts. To determine this, pre-race and post-race surveys were distributed to two high school cross country teams at a Region 4-AAAA meet. The pre-race survey asked the runners to rate their confidence and excitement about running in the meet. The post-race survey asked them to answer how they were feeling and how positive they were thinking during the race. A linear regression was performed for each survey group (pre-race boys, pre-race girls, post-race boys, and post-race girls) at an alpha level of 0.05. The pre-race value for boys was r= 0.1; for girls, r= -.7. The post-race value for boys was r= 0.4; for girls post-race, r= 0. Therefore, the data indicates that among girls, the more confident they are or less nervous they are about the race, the faster their times are. The regression equation for the girls pre-race results is: finishing time= 1.53- 0.0346 x scores. However, for the boys pre-race, and boys post-race, the p values were greater than the .05 alpha level. Therefore, the data was insignificant. However, this study does show that higher confidence and less nervousness in girls before racing relates to faster finishing times.

## MYELIN-ASSOCIATED GLYCOPROTEIN PRODUCTION IS DECREASED IN THE DEVELOPING SPINAL CORD FOLLOWING ACTIVATION OF PROTEASE-ACTIVATED RECEPTOR-1

John Benjamin Beasley
South Carolina Governor's School for Science and Mathematics

Previous histological studies have demonstrated that activation of the protease-activated receptor-1 (PAR-1) results in decreased myelin in the developing spinal cord. While it is known that oligodendrocytes, the myelinating cells of the CNS (Central Nervous System) express PAR-1, the reason for the decreased myelin is not known. This decrease could be the result of the oligodendrocytes' inability to synthesize myelin or the result of oligodendrocyte cell death after PAR-1 activation. Oligodendrocytes process and retain several myelin proteins in their cytoplasm until they are expressed on their plasma membranes and wrapped around axons, forming the myelin sheath. Therefore, regardless of whether the myelin sheath is formed around axons, these proteins are expressed if the oligodendrocytes are properly functioning. It was predicted that the PAR-1 activation would lead to decreased formation of myelin proteins. Beginning on embryonic day 5 (E5), chick embryos were treated daily with either 200 μL of 1x PBS (control) or 100 μM SFLLRNP (experimental), the amino acid sequence needed to activate PAR-1. On embryonic days 8 and 10, the spinal cord proteins were isolated. Equal concentrations of proteins were separated through a 4-20% Tris-glycine gel, transferred to nitrocellulose and then immunoblotted with goat anti-myelin-associated glycoprotein (MAG). In all cases, the band identified as MAG was decreased in net intensity following activation of PAR-1. However, these results suggest that PAR-1 activation does decrease the formation of MAG, an essential protein needed for proper myelination in the spinal cord.

## THE EFFECT OF HOLISTIC TREATMENTS IN COMPARISON TO MEDICATION AS DETERMINED BY SURVEY AND META DATA ANALYSIS

Ryan C. Beasley
Spring Valley High School

The purpose of this project was to see how effective each holistic and traditional treatment was in reducing tic severity. A survey was created and sent out to 72 individuals on a TS support website with Tourette syndrome, and data collected from this survey were analyzed. Four of the six survey participants used stress counseling, and one used medication. Meta data from 8 studies were analyzed to determine if alpha 2 adrenergic receptor agonists would be the most effective. It was hypothesized that the alpha-2 adrenergic receptor agonists would provide the best tic reduction. Linear regression t-tests calculated from one of the studies indicated strong positive correlations relationships between the YGTSS and STAI, $t(15)= 2.58$, $p< .05$ , and the YGTSS and YBOCS baseline scores, $t(15)= 3.10$, $p< .05$ in DBS (deep brain stimulation) patients before treatment. Based on the results from this analysis, DBS was found to support the hypothesis, providing the best tic reduction with the least amount of side effects. From the survey data, relaxation techniques were shown to have little effect in reducing tics. All participants who had used neuroleptics in the past had discontinued them due to side-effects. The background information indicated that the alpha-2 adrenergic receptor agonists were the best medicinal treatment, followed by neuroleptics, and then deep brain stimulation as the best surgical treatment. Neuroleptics provide the greatest reduction in tic severity, but also produce the greatest number of side-effects, limiting its long term use.

## THE EFFECT OF ANDANTE AND ALLEGRO ON JOGGING PACE

Sarah Beasley
Spring Valley High School

Music has been thought of as a motivator in exercise since the age of the compact disc player. People run with an iPod or some other form of mp3 player to distract themselves from their tiredness. The purpose of this experiment was to see if slow music (andante tempo) or fast music (allegro tempo) had an effect on a jogger's pace as compared to no music. It was hypothesized that allegro would increase the jogging pace of a jogger and andante would decrease it. Runners were selected from a physical education class, a softball team, and a Research I class from Spring Valley High School to run a half-mile, or two laps around the track, with or without an iPod playing an andante or allegro song. The runners also had a Garmin Forerunner 305 watch to run with that timed their pace. Armbands were used to hold the iPods while the participants ran, and the experiment took approximately one month to complete. A one-way ANOVA test was conducted to see if there was a significant difference in the average running paces of people who ran with andante, allegro, or no music. It was concluded that there was no difference in the jogging pace of runners listening to andante, allegro, or no music, $F(2, 56) = 0.86$, $p>.05$.

## EXPRESSION OF THE NUCLEAR HORMONE RECEPTOR 97 FAMILY MEMBERS IN *DAPHNIA MAGNA*

Alexis Bertram
South Carolina Governor's School for Science and Mathematics

*Daphnia pulex* is the first crustacean to have its genome fully sequenced and *Daphnia magna* is currently being sequenced. Twenty-five nuclear receptors were identified in *D. pulex*. Three of these receptors have never been observed before. Therefore, they were placed into their own group, the NR1L group, and given common names of HR97a, HR97b, and HR97g due to similarities with the HR96 group. Nuclear receptors play an important role in helping organisms reproduce and adapt to their environment. The objective of our research is to understand the expression of these new receptors. *Daphnia magna* were aged and organisms of 1, 2, 4, 7, and 14 days old were collected for RNA extraction. RNA was reverse transcribed to cDNA, amplified by PCR, and analyzed by gel electrophoresis to semi-quantitatively measure gene expression in the different age groups. In general, Daphnia *magna* showed higher expression of HR97's at 1-2 days old, and weak expression in 2-week old daphnids. Once expression was verified, immunohistochemistry was done to determine where HR97g is expressed, as we currently only have an antibody to this HR97 member. Slides of 1-2 week old *D. magna* were made and stained with antibodies. Our data indicates that in 1-week old *Daphnia*, expression is weak but primarily in the head, ovary and maybe gut, consistent with a hormone receptor involved in reproduction. Overall, HR97g was mainly expressed in young *Daphnia* with primary expression in head and ovary in adults. More immunohistochemistry data are needed to confirm organ expression and investigate juveniles.

## CORRELATION BETWEEN URBANIZATION AND GRAIN SIZE DISTRIBUTION IN URBAN AND RURAL STREAMS OF THE ENOREE AND SALUDA RIVER BASINS IN SOUTH CAROLINA

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South Carolina Governor's School for Science and Mathematics

The size distribution of sediment found in a streambed is a reflection of the overall characteristics of the drainage area, including the stability of the adjacent banks, the land use, and the energy regime of stream flow. An understanding of how the changes in land cover affects channel geomorphology and in turn the grain size distribution is important for several reasons. This is in relation to the size and type of bed load sediment controls the quality of in-stream habitat development for aquatic organisms such as benthic macroinvertebrates and fish. We studied 15 different stream reaches spread over a large area within Enoree, Saluda and Reedy River Basins in the Upstate of South Carolina that have different levels of urban development within their drainage area. We collected sediment samples and carried out complete geomorphic survey at each site. Data collected in the field includes channel conditions, bank and adjacent slope conditions, nature of vegetation in the riparian corridor, bankfull cross-section and flood-prone width and depth measurements. We have calculated the drainage area for each site studied, percentages of different land cover within the drainage area and percentage of impervious cover for each site. Results indicate that urban streams did have larger mean grain size compared to the rural sites, but neither channel incision nor grain size correlated with percentage urban land cover. Historic land uses may have played a more significant role in determining the condition of streams today.

## THE EFFECTS OF THE ESTROUS CYCLE ON INDUCED NOCICEPTION

Kayla Bingham
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It has been shown in research that female rats respond differently than male rats when injected with endothelin-1. These differences were originally thought to be caused by changes in hormone status, especially due to the estrous cycle. Through our research, we worked to prove this original hypothesis. We used adult female Sprague Dawley rats in three different stages of the estrous cycle (diestrous, proestrous and estrous) and injected them with endothelin-1 to determine if hormonal changes modulated pain-like behaviors. In addition, we examined neuronal activation in the spinal cord via c-fos immunoreactivity. Rats in different stages of the estrous cycle did not show differences in the number of paw flinches, maximum behavior or behavior at resolution after administration of endothelin-1. However, rats in diestrous stage had earlier time to maximum behavior in comparison with estrous and proestrous rats. These results suggest that contrary to our hypothesis the estrous cycle does not modulate pain-like behavior, but interestingly it does modulate the temporal activation of pain.

## THE EFFECTS OF INTERLEUKINS ON ADULT AND NEONATAL FIBROBLASTS

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Physiological hypertrophy occurs during exercise and pregnancy. It is reversible: after the baby is delivered and after you have finished exercising, your heart returns to its normal size. However, pathological hypertrophy does not reverse itself and eventually leads to cardiac arrest. Many studies have aimed at discovering the functions of different components of the heart in order to discover what makes physiological hypertrophy reverse. Also of interest is a method to reverse pathological hypertrophy. Cytokines are proteins, glycoproteins and peptides that help in the communication between the cells of the heart. This study focused on a particular group of cytokines known as interleukins to observe their effects on both adult and neonatal fibroblasts. Fibroblasts collected from the hearts of adult and neonatal rats (Rattus Norvegicus) were examined. Four different types of interleukin were used: Interleukin 4 (IL-4), Interleukin 10 (IL-10), Interleukin 13 (IL-13), and Interleukin 18 (IL-18). Because these fibroblasts produce collagen through the extra cellular matrix, collagen gels were treated with different amounts of Interleukin to see how this affected the contraction rate. It was found that Interleukin 18 stimulates collagen contraction in both Heart Fibroblasts. Plated cells were treated with different amounts of the Interleukin. They were stained with BrdU and Propidum Idodine in order to evaluate them under a light microscope, observing how the cells divided with the different amounts of interleukin. It was found that Interleukins appear to stimulate proliferation of cardiac fibroblasts. However, when Interleukin 18 was increased, proliferation decreased.

## CLASSIFICATION AND PHOTOPHYSICAL CHARACTERIZATION OF *trans*-$[Cr(N_4)(CN)_2]^+$ COMPOUNDS FOR USE IN ENERGY TRANSFER EXPERIMENTS

Nicholas Ryan Bishop
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The photophysical characteristics of 1,5,9,13-tetraazacyclohexadecane ([16]ane$N_4$) and 1,4,7,11-tetraazacyclotetradecane (isocyclam) are investigated. Included are the absorption spectra, emission spectra, and the lifetime. The molecules are similar in their structure except for the macrocyclic ligand around the chromium atom. This slight variance accounts for the differences in the characteristics of these compounds. Before energy transfer experiments could be completed, these characteristics had to be investigated. The process of deuteration is described to lengthen the lifetime, as is the indicated in the resulting data for two of the isomers of the [16]ane$N_4$ complex.

## THE EFFECT OF FOOT TYPE ON WEIGHT DISTRIBUTION WHILE "EN POINTE"

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The pointe shoe, a satin slipper reinforced with stiff canvas, leather, and wood, is an essential tool for accomplished female ballet dancers as it allows them to balance on the tips of their toes creating an illusion of weightlessness. However pointe shoes cause discomfort and even injuries, some of which are provoked by the dancer's foot type. There are three main types of feet- Egyptian, Greek, and Square- based on the length of toes in comparison to one another. Differences in toe length affect how weight is distributed over the box of a pointe shoe- when different toes bear more weight, problems

can occur in the foot. The purpose of this experiment was to test how different foot types distribute weight while en pointe. Pressurex film was used to determine the pressure on different areas of the Egyptian, Greek and Square foot types in traditional shoes. It was found that while the toe with the greatest length did bear a little extra weight in comparison to the toes with less length, most weight was distributed on the outside edges of the box. This partially supported the hypothesis that longer toes would bear the most weight in pointe shoes. The toes of greatest length did bear more weight than the other toes, but this did not support our hypothesis in that the outer rim of the shoe supported more weight than any of the toes, regardless of length.

## FUNCTIONAL MRI STUDY OF BRAIN ACTIVATION DURING THE READING OF MUSIC

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Functional MRI shows which regions of the brain are activated using blood-oxygen levels. This experiment was designed to determine the area of the brain activated by reading sheet music. It was hypothesized that subjects who were musicians would show brain activity in the motor or pre-motor cortexes when reading sheet music because the music stands for the actions of playing the instrument. Eight subjects were tested: four musicians and four non-musicians (as the control). During the scans, they were asked to tap their fingers to locate their motor cortexes, to read sheet music, and finally to read a series of notes without a staff, in order to locate the regions of the brain activated by eye movement that need to be subtracted. The results supported the hypothesis, and the musicians showed pre-motor and motor cortex brain activity when reading music, as opposed to the non-musicians who showed no pre-motor or motor cortex activity. This experiment helps further the understanding of the regions of the brain and the associated functions, and has potential medical relevance because reading music could be a potential method for helping paralyzed patients, such as those who have suffered a stroke or those who have a previous musical background to rebuild the motor connections in the brain.

## THE EFFECT OF ULTRA VIOLET LIGHT ON BACTERIA ON MONEY

Shy-da Bradley
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The purpose of this experiment was to see if Ultra Violet light would kill bacteria on both paper and coin money. The independent variable in this project was the UV light, and the dependent variable was the amount of bacteria killed after one, one and a half, and four minute time intervals. The hypothesis for this experiment was that the bacteria would die quicker when shone with UV light for four minutes. There were yellow, red, white and brown bacterial colonies on the agar. After exposure of UV light for one minute, the bacteria died in a minimum of three to four days. Exposure for one and a half minute caused the bacteria to grow more. While the exposure for four minutes caused the bacteria to die in a minimum of two to three days. Some of the findings in this experiment were that the money carried a lot of bacteria. Swabbing bacteria from money onto the Petri dishes showed what different colonies grew and looked like. For further research the UV lights should be placed in cash registers and drink machines. Recommendations would be to test specific certain wavelengths of UV light instead of a combination of short and long, or perhaps use infrared light to kill bacteria. The

original hypothesis that the exposure of UV light for four minutes would kill the bacteria quicker was supported.

## THE EFFECT OF WOOD TYPE BAT ON THE EXIT VELOCITY AND SPEED ON THE BASEBALL

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There are a lot of choices when it comes to choosing the right baseball bat. There is maple and ash, the two main and most popular wood types of choice, but there a new wood making an appearance in the major leagues, bamboo. 2008 NL Batting Champion, Chipper Jones, has given bamboo a good reputation. This experiment compared ash, maple, and bamboo bats in two categories: exit velocity of the ball off the bat and distance the ball traveled. Hypothesis 1: the use of an ash bat will result in the greatest speed and distance as compared to the maple and bamboo bats. Hypothesis 2: the use of a bamboo bat will result in the greatest speed and distance as compared to the ash and maple bats. Hypothesis 3: the use of a maple bat will result in the greatest speed and distance as compared to the ash and maple bats. The results supported hypothesis 2. The independent variables in this experiment were the ash, maple, and bamboo bats. The dependent variable was the exit velocity and distance of the ball. Former MLB player, Coach Ashley Farr, performed the test. He was chosen because of his ability to duplicate his swing, making the results as consistent as possible. The bamboo bat performed greatest in the distance category. The ash bat performed best in the exit velocity category, but bamboo was closely behind. Overall, the bamboo bat performed the greatest.

## USING *STEINERNEMA* AND *EISENIA FETIDA* TO REDUCE THE HEAVY METALS IN INDUSTRIAL SLUDGE

Brenden Britton
Timberland High School

Using *Steinernema* and *Eisenia fetida* to reduce the heavy metals in industrial sludge is what was trying to be accomplished. The hypothesis of this project was that the nematodes would reduce the amounts of heavy metals found in the industrial sludge more than the other worms and the control. Samples of the sludge were collected for analyzation of base line data. The nematodes were soaked in water for 30 minutes. The nematodes and were in 1600 milliliters total sludge mixtures; the dirt mixture was composed of two different types of dirt, ground dirt and potting soil (800milliliters beakers full). The sludge part of the mixture was 1600 milliliters by itself. The hypothesis was that nematodes will reduce the amounts of heavy metals found in the industrial sludge more than the other worms and the control. The null hypothesis was that there will be no decrease in the amounts of heavy metals found with the addition of any organisms. The hypothesis was supported based on a chi square test. The nematodes had a higher decrease rate percentage. Out of the 17 toxins tested, there was only one increase out of 17 for the nematodes. The toxins in the sludge were broken down by every type of worm tested. Some of the worms died in the process (the live bait and the red worms) of the experiment.

## IMMUNOCOMPETENCE AS A PREDICTOR OF DOMINANCE IN THE MADAGASCAR HISSING COCKROACH

Kayla Broeker
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To establish dominance, males often compete in intra-sexual antagonistic encounters. The healthiest of the competing individuals are predicted to win these encounters; a dominant male would require high immunocompetence to cope with the stress and energy expenditure required to gain and hold his social status. Male Madagascar Hissing Cockroaches (*Gromphadorhina portentosa*) frequently engage in intra-sexual combat. This study investigated the relationship between behavioral factors and total hemocyte counts to determine if immunocompetence is a reliable predictor of dominance in antagonistic encounters. Six males were individually isolated from a common colony. Pairs were pitted against each other in a round-robin style tournament. We observed and recorded the behaviors of the competing males and used these data to calculate a group hierarchy based on the percentage of time allotted to dominant, submissive, or neutral behaviors per male. Males were assigned ranks from most dominant to most submissive. Using the hemocyte count of each male, we examined the association between immunocompetence and social ranking. No significant results were found due to small sample size, but the full-scale experiment involves fifty males. Future research will incorporate mate choice to see if dominance benefits not only the male with increased immunocompetence, but also provides a fitness advantage to the female. Females will be allowed to choose between either a dominant or submissive male. The resulting offspring will be analyzed to determine whether immunocompetence, and subsequently social status, is heritable.

## PARTICULATES, GASES, AND HEAVY METALS FOUND IN VARIOUS TREATED WOODS AND "GREEN" FIRELOGS

William H. Broome
Timberland High School

Scientists and the United States Government have been trying to solve the global warming crisis by eliminating the harmful greenhouse gases from polluting the environment any further. The following research investigation was focused on finding a possibly cleaner alternative than burning creosote logs. The samples of wood tested were pressure treated 2 by 4, green lumber such as pine sawdust and pine shavings, creosote railroad tie, creosote utility pole, Duraflame brand firelogs, Pine Mountain brand firelogs, and plastic wood boards used for decking. All results have not been concluded, but it seems that Pine Mountain and Duraflame is the cleanest so far in the burns with GC measurements of 32.06 parts per million of Carbon Dioxide, 0 parts per million of Methane, 0 parts per million of Ethylene, and 29.95 parts per million Carbon Monoxide, and 51.74 parts per million of Carbon Dioxide, 0 parts per million of Ethylene, 0.79 parts per million of Methane, and 0 parts per million of Carbon Monoxide respectively. In the heavy metals test Pine Mountain firelogs look to have the least heavy metals. In Arsenic, Cadmium, Lead, and Selenium the total of milligrams per liter is zero. In the pH tests the woods with the most neutral pH are the light pole, pine 2 by 4, and pine shavings. All tests were performed at Santee Cooper's Operation Center in Moncks Corner, South Carolina. The people there also helped with the Gas Chromatograph and heavy metals portion of the testing. During experimentation, two of the glass dishes exploded because of the intense heat and then the rapid cooling. Particulates and gases were collected on all burns. The set-up that collected the

particulates and gases goes as follows: out of the top of the furnace to a .45 micron rated filter where the particulates were collected. All the gases were pulled through a vacuum to a cooling system to cool the gases to be collected in an airtight bag.

## THE EFFECT OF PH CHANGES ON THE HEALTH OF *AIPTASIA PALLIDA*

Megan M. Brovan
Spring Valley High School

The purpose of this experiment was to determine the relationship between a decrease in pH and the health of *Aiptasia pallida*. Previous studies have shown that the increase of CO2 in the oceans is causing ocean waters to become more acidic. Because of this ocean acidification, many marine organisms are expected to be affected. This experiment was designed to assess the effects of ocean acidification on *Aiptasia pallida*. It was hypothesized that as the pH of the water decreased, the health of *Aiptasia pallida* would change. 27 *Aiptasia pallida* were put into groups and placed in three tanks, with tank three as the control, set at normal ocean pH, about 8. Tank two's pH was lowered over time using hydrochloric acid (HCl), and the pH of tank one was lowered to about 7, replicating the expected drop of the oceanic pH. Health was determined by observing the trends in *Aiptasia pallida* including eating habits and response to stimuli. Following data collection, three two-sample t-tests were conducted to determine if there was a significant difference between the *Aiptasia pallida* in tanks one, two, and three. The t-tests were each conducted with a critical value of 1.96. The p-value for the tests between Tanks 1 and 2 (0.001) and Tanks 1 and 3 (0.023) was less than ˜= 0.05, meaning that my results indicated that lowering pH does have a significant difference on the health of *Aiptasia pallida.*

## THE MOTIVATION OF SPECIAL EDUCATION STUDENTS TO EXERCISE WITH AND WITHOUT THE NINTENDO WII

Reilly J. Brown
Spring Valley High School

The purpose of this experiment was to test the motivation of special education students to exercise on the Nintendo Wii as opposed to exercise without the Nintendo Wii. A group of 8 special education students were exercised according to a set number of movements with and without the Nintendo Wii. Wii Sports was used as the program to exercise on the Nintendo Wii and also served as a basis for the exercise program. When the Nintendo Wii was used, adaptive equipment that attached the Nintendo Wii remote was used to keep the movements the same. Each student exercised for about 5 minutes for 3 days for each exercise program. After each of the 3 day testing periods, the students took a survey using questions from the Exercise Motivations Inventory asking the students questions pertaining to intrinsic motivation to do the exercises again. A dependent samples t-test was conducted at the ˜=0.10 confidence level. There was one survey question that showed a significant difference in motivation levels. However, most students were confused about the meaning of the survey and therefore, the results are inconclusive.

## VITAMIN D AS A SUPPRESSOR OF MICROGLIAL ACTIVATION

Victor Roosevelt Brown
South Carolina Governor's School for Science and Mathematics

Vitamin D is known to have beneficial effects on Multiple Sclerosis but the mechanism of its effects is unclear. Since microglial activation is known to play a role in demyelination, we wanted to test if Vitamin D has a direct effect on microglial activation. Using BV2 microglial cell line as an in vitro model, we tested the hypothesis that vitamin D directly suppresses microglial activation. The cells were treated with a combination of lippopolysacchoride and interferon y in the presence and absence of different concentrations of calcitriol. The medium was analyzed for nitric oxide production and the cells for iNOS expression. There was a calcitriol dose dependent inhibition of NO production. The mechanism of calcitriol inhibition of microglial activation involved inhibition of NFKB pathway. The results suggest that Vitamin D could be used as a therapeutic agent for a number of neurodegenerative diseases where microglia activation plays a role.

## THE IMPACT OF JITTER ON LIVE STREAMING VIDEO

Matthew Burrows
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Intelligent Transportation Systems, ITS, uses video and other types of data collection sensors to correct the flow of traffic. Jitter is the amount of delay between each packet of data sent across a network and can affect the quality of streaming videos. The objective of my experiment is to compare the jitter of the packets sent over a network to the video recorded for one minute. There are other factors affecting the quality of the video such as packet rate and packet loss rate; however, the main topic of my project centered on jitter and its effects. From the observations of the jitter and its effects on video quality, a formula was constructed for calculating the length of skips on the corresponding videos.

## FEAR CONDITIONING OF NEURONAL CELL ADHESION MOLECULE DEFICIENT MICE

Anna Capps
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Neuronal cell adhesion molecule (NrCAM) is one of the many homologous molecules of the L1 family responsible for axonal guidance and cell-cell interaction during brain development. It has been found that in humans the NrCAM gene is a candidate for Autism susceptibility. Autistic patients typically exhibit abnormal social behaviors, obsessive compulsive behaviors and increased anxiety/ fear. Studies done have found that NrCAM deficient mice show these autistic characteristics, making them a good scientific model to study the autistic emotional response to fear. In a lab, testing an animal's response to fear is done by using fear conditioning. Twenty eight mice were used during this experiment; thirteen mice had the NrCAM gene(WT), and fifteen lacked it (KO). They were placed in conditioning boxes for a five minute period during conditioning where they received two presentations of an auditory cue paired with a scrambled foot shock. The remaining days were testing days, extinction days, and days when the mice where left in their home cages before testing renewal. It was found by analyzing the testing days that the KO mice were significantly more afraid of the

SAME context than the WT mice during conditioning, became more afraid of the ALTERNATE context after extinction, and again showed more fear of the SAME context than the WT mice when testing a period of renewal. These results can be correlated with immunostaining images to deduce the probable causes for the behaviors and whether the KO mice are modeling autistic reactions to induced fear.

## SOIL MOISTURE AND NUTRIENT CONTENT ANALYSIS ON THE EDGES AND INTERIORS OF MAINLAND SITES AND ISLANDS AT LAKE RICHARD B. RUSSELL

Alexis Rankin Carr
South Carolina Governor's School for Science and Mathematics

Lake Richard B. Russell was created in 1984 when the Savannah River was dammed and the surrounding hilly area flooded for hydroelectric power. All hilltops that had elevations high enough to keep them above the water became islands in the lake, with forest fragments remaining on top of them. Previous studies on forest fragments have shown dramatic changes in soil moisture and nutrient levels on the edges and interiors, presumably due to increases in solar radiation and wind velocity and decreases in litter mass following fragmentation. Here we tested whether soil moisture and nutrient levels differ between edge sites as compared to interior sites and on island sites as compared to mainland sites. Soil samples were taken from transects spanning from the edges to interiors of islands and mainland sites on Lake Russell. At each mainland site soil was taken at 4 and 50 m from the edge. At each island site soil was taken at two separate points, each located 4 m from the edge, and at two more points, each located at the approximate center of the island. Soil moisture content was then determined gravimetrically for each sample, and samples were sent to the Clemson Agricultural Service Laboratory for nutrient (N, P, K, Ca, and Mg) analysis. Although soil moisture did not differ significantly between edges and interiors, soil moisture levels were considerably higher on mainland sites than on islands and soil nutrients were, on average, higher on islands.

## THE EFFECT OF ACTION VIDEO GAMES ON A PERSON'S SPATIAL ABILITY, REACTION TIME, AND MEMORY

Margaret C. Carter
Spring Valley High School

The intent of this study was to determine the effects that action-based video games have on a person's memory, reaction time, and spatial ability. Thirty participants were used for the control group, and the same thirty were used for the experimental group on a separate testing day. Each participant took three separate tests which measured memory, reflexes, and spatial ability. They were then exposed to the non-action video game for one hour. After exposure, similar tests were taken by the participants which measured their memory, reflexes, and spatial ability. The following day the same procedure was performed, except that the participants were exposed to an action video game (experimental) instead of a non-action. The results showed that the exposure to a non-action video game had no effect on the participant's reflexes or spatial ability, but decreased their memory test scores. The results also showed that the exposure to the action-based video games affected all three of the tests taken. The action based video game decreased the participant's memory, but increased their spatial ability and reflexes.

## THE LITTLEST LOSER (THE EFFECTS OF DILUTED APPLE CIDER VINEGAR ON WEIGHT MAINTENANCE IN FEEDER MICE)

Clara Chalk
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The purpose of this experiment was to analyze the effects of adding diluted apple cider vinegar to the diet of feeder mice. If the mice exposed to the solution lost weight, possible reasons would have been investigated to further understand the results of the dilution on the mice and, ultimately, its supposed effect on humans. It was predicted that both cages two and three would gain weight due to the increase of food quantity. After a week of drinking the apple cider vinegar dilution along with water, cage three was predicted to lose some of the weight gained because due to previous research, vinegar is predicted to have an effect of satiety.

Three cages were assembled with three mice in each. Cage one received 3 pellets and ample water every day. Cage two was given 5 pellets every day but remained with only water. Starting in the third week, cage three also had 5 pellets and water, as well as an 8 oz dilution of apple cider vinegar. Cage one, the control mice provided with proper diet and exercise, lost an average of about 5.2 grams. The mice of cage two that were provided with an elevated food amount also lost weight but only at an average of 1.1 grams. All mice in cage three had gained weight, mostly due to developmental growth. Apple cider vinegar cannot be proven as any sort of weight loss remedy. Therefore, the hypothesis was rejected. However, to improve this experiment, the mice would be separated to closely control and monitor the food, water, and dilution intake by each mouse.

## MICROTUBULE MODIFICATIONS IN FILAMENTOUS FUNGUS, *ASPERGILLUS NIDULANS*

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

Of the seventeen existing families of kinesin motor proteins, the kinesin-3 family is mainly responsible for transporting endosomal vesicles along the microtubules of the filamentous fungi, *Aspergillus nidulans*. Specifically, the UncA kinesin-3 motor protein transports vesicles through hyphae and is important for hyphal growth in the fungi. Recent findings show that UncA is localized with a single, particular microtubule (Zekert and Fischer, 2009). In this study, UncA was found to play an important role to transport a cytoplamic linker protein, ClipA. Further examinations of the modified microtubule showed that ClipA has a tendency to localize to the plus-end of the microtubule. Additionally at the minus-end of the microtubule, Alp4, the homologue of a protein that localizes to the microtubule organizing center (MTOC) of *S.cerevisiae*, was found to be present everywhere in the nucleus of the *Aspergillus*, while Alp6, another MTOC homologue protein of *S.cerevisiae*, localized specifically to the MTOC. No antibody staining was detected for the presence of detyrosination modifications, acetylation and polyglutamylation of side-chains along this particular microtubule. These findings provide future understandings of this subpopulation of microtubules.

## THE STUDY OF LIGHT MANIPULATION AND THE AFFECT ON AUXIN CONCENTRATION IN TWO PLANT SPECIES

Ivory Chen
Dutch Fork High School

The intent of this study is to determine whether the given amount of light manipulated within the twenty-four hour period in two plant species, the Avena sativa and Wisconsin fast plant, will affect the concentration of auxin located at the meristem of the plant. Actual auxin concentrations will not be measured with such advanced technology but will instead be measured by a protractor for the degree of the plant's curvature. Previous studies were majorly influenced by Darwin and Darwin's discovery of phototropism and later research was done by Frits Went and Winslow Briggs on the coinage of the plant hormone auxin. This experiment will be conducted by growing the plants under constant conditions and then exposed to light for a certain interval of hours. In conclusion, the anticipated results will be that the plants exposed to the most light will have a greater curvature from auxin concentration accumulation of the underside of the plants.

## THE ROLE OF SEX HORMONES ON ENDOTHELIN-1-INDUCED NOCICEPTION IN EARLY DEVELOPMENT

Stephanie Choe
South Carolina Governor's School for Science and Mathematics

Endothelin-1, a peptide released following tissue injury, has been shown to be involved in pain signaling via endothelin-A and –B receptors. Exposure to endothelin-1 on postnatal day 7, developmentally equivalent to a human infant, has been found to alter the expression of the endothelin-B receptor and nociception on postnatal day 11 in a sex-dependent manner. This study investigated the effect of sex hormones on endothelin-1-induced alteration in subsequent nociception. It was hypothesized that administration of flutamide, an anti-androgen drug, before endothelin-1 would prevent endothelin-1-induced sensitization in males. It was also hypothesized that administration of fulvestrant, an estrogen receptor antagonist, before endothelin-1 on postnatal day 7, would prevent endothelin-1-induced desensitization in females. On postnatal day 7, rats were injected with vehicle and saline, flutamide/fulvestrant and saline, vehicle and endothelin-1, or flutamide/fulvestrant and endothelin-1. On postnatal day 11, they were injected with endothelin-1. They were recorded on video, and the videos were watched by an observer who counted spontaneous paw-flinching for 75 minutes in 5-minute intervals. Males exposed to vehicle and endothelin-1 experienced the most paw-flinching. Pre-treatment with flutamide on postnatal day 7, before endothelin-1, resulted in a decrease in endothelin-1-induced paw-flinching in males. No differences were observed in endothelin-1-induced behavior between females who were given fulvestrant and those not given fulvestrant. The investigation showed that sex hormones influence endothelin-1-induced alteration in subsequent nociception in early development in males, but not in females.

## THE EFFECTS OF HAND SOAP VERSES HAND SANITIZERS ON KILLING *ESCHERICHIA COLI-K12*

Megan Citrano
Timberland High School

The purpose of this project was to see the different effects between hand soaps and hand sanitizers on *Escherichia coli-12(E. coli-12)*.Eight different products were tested: Distilled Water, Dial complete® foam soap, Equate® soap, Bodycology® soap, Germ X® Aloe, Germ X® Advanced, Purell® hand sanitizer, Soft Soap®. In this experiment these produce were tested to see how much *E. coli K-12*. With the results that have been collected the foam soaps have had better results in killing the *E. coli K-12*.

## DOES PRICE HAVE ANY EFFECT ON THE WEARABILITY OF LIPSTICKS?

Evie Cooke and Elizabeth Fonger
Heathwood Hall Episcopal School

The purpose of this experiment was to compare three differently priced lipsticks (inexpensive, moderate, expensive) to determine which lipstick had greater wearability. Is cost of a lipstick related to the how well is wears? Each lipstick was tested 8 times, 4 trials for 2 different experiments. Measurements of how much lipstick rubbed off after experimental treatment of both side-to-side motion and pressure on lipstick blots. These tests were designed to simulate rubbing lips back and forth, and blotting the lipstick. A wooden device was built to test these factors as an indication of wearability. The independent variable of the project was friction and pressure, while the dependent variable was the grams of lipstick rubbed off. From data collected, it was determined that the least expensive lipstick had the least amount of mass rubbed off after the tests and implied the greatest wearability. These results do not support the hypothesis, which was that if three brands of lipsticks were tested; the most expensive lipstick would have the greatest wearability. The data analysis failed to reject the null hypothesis, that there is no difference in wearability among different brands of lipstick, and that cost played no role in wearability.

## SYSTEMIC AMYLOIDOSIS IN THE *PHOENICOPTERUS RUBER RUBER*

China Grayson Cox
South Carolina Governor's School for Science and Mathematics

When the Caribbean flamingos, *Phoenicopterus ruber ruber*, at SeaWorld San Diego fell ill and inevitably died, the veterinarians there collected tissues and sent them to Dr. Mark Kindy, a neurodegenerative disease researcher, to analyze. The veterinarians at SeaWorld diagnosed the flamingos with systemic amyloidosis. Amyloids are aggregated protein tangles and can either be neurological or systemic. Although Dr. Kindy specializes in the neurological amyloids, systemic amyloids are rarer and function similarly to the way neurological amyloids do. They are also simpler in function and composition compared to the neurological amyloids. If the mechanisms of systemic amyloid growth and function are worked out then we could use systemic amyloidosis as a model for neurological amyloidosis. Further research that could help cure or prevent systemic amyloidosis would be a basis for finding the cure for neurological amyloidosis, which leads to diseases such as Alzheimer's disease and Parkinson's disease. Congo Red stain was used to prove that amyloids were present, while serum amyloid A and serum amyloid P stains were used to determine what specific types of amyloids were present.

Western blots were run on the frozen tissue samples as well as blood samples, also to determine if serum amyloid A and serum amyloid P were present. This paper details the protocols followed, the results obtained, and the conclusions that can be drawn from our analysis.

## DEGRADING TCE BY ENHANCING AEROBIC CO-METABOLISM IN OLIGOTROPHIC GROUNDWATER SYSTEMS USING HUMIC SUBSTANCES

Emmie Daly
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Past and ongoing experimentation has developed a method for treating trichloroethene-contaminated groundwater systems in aerobic and oligotrophic environments, mainly through inducing the production of oxygenases by introducing the soil microorganisms to soluble humates. This process, called cometabolism, is currently being monitored through soil column testing and treated groundwater DNA sample analysis. Soil columns contain compacted soil from contaminated areas and are used with the dissolved humates to test retention and dispersion of the humates to simulate diffusion in soil and groundwater. The humates being used are derived from coal tar and mainly consist of humic and fulvic acid, which have a key difference – solubility. In this experiment, the humates were separated into humic and fulvic acid for further column testing, dissolved organic carbon (DOC) analysis, and possibly enzyme kinetic studies. In the DNA analysis, treated groundwater samples were tested for the presence of functional oxygenase genes and monitored for changes in the microorganismal population over time using the 16S gene as a marker. This is done using the amplification and quantification of genes in quantitative polymerase chain reaction (qPCR) with the addition of a universal 16S primer. Several universal primers were tested for any variations in amplifying capability in various environmental DNA samples. Both of these experiments were considered intermediate or efficiency-testing trials for the induction of organic matter and the amplifying primer. Column testing is being completed on the successfully separated humic and fulvic acids. A negligible amount of variation occurred between the qPCR results of the universal 16S primers aside from the effects of bacterial specificity.

## THE EFFECTS OF MUSIC ON THE BREEDING HABITS OF *MUS MUSCULUS*

Jennifer L. Dangerfield
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Mice breeders have noticed problems with the reproduction of mice during the winter months of the year. Mice are usually known to suffer from stress that occurs because of their environments. They also suffer from emotional stress and anxiety. In this experiment, Mice were placed in four different environments and the rate of pregnancy is recorded in each. There was one controlled environment with no music playing. The other three environments each consisted of a different type of music: Rhythm and Blues, Country, and gospel. It was hypothesized that mice in the gospel group would produce the most offspring. The mice were isolated into the environments and nothing changes throughout the months of experimentation. It was concluded that mice are in more stress if music plays because of the behavior that occurred during the experiment.

## THE EFFECTS OF CONVENTIONAL PESTICIDES, BIOPESTICIDES, AND BIOLOGICAL CONTROL ON *DROSOPHILA MELANOGASTER*

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This study investigated the effects of conventional pesticides, biopesticides, and biological control on the mortality rate of *Drosophila melanogaster*. This study may enlighten people about using safer alternatives to harmful pesticides. Twelve *Drosophila* climbing ladders were placed in individual jars with ten *Drosophila* for each jar. Three climbing ladders were sprayed for three seconds on both sides with Raid® Flying Insect Killer: Formula 5 and three were sprayed with EcoPCO® ACU Contact Insecticide. A long-tailed lizard was put in each of the three jars for biological control. For the control, ten *Drosophila* were put into three jars, each with a climbing ladder. Mortality rate was recorded for the first three hours and at the twenty-four hour mark. Mean data and standard deviation were determined, and an ANOVA test showed no statistically significant difference between the conventional pesticide and biopesticide. There was no statistically significant difference between the conventional pesticide and the biological control, showing that the biological control works just as well as the conventional pesticide. Also, there was a statistically significant difference between the conventional pesticide and the control, and there was a statistically significant between the biopesticide and the control.

## THE EFFECT OF MILD ANNEALING ON GRAPHENE-OXIDE SHEET STRENGTH

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Carbon is a very common and cheap element, but it still has many useful qualities. It is often used as a lubricant, a strengthening additive, and is also used in electronics because of its conductive characteristics. Graphene is an atom-thick sheet of carbon, and it is the strongest as well as the least resistant material known to man. In order to obtain and arrange graphene flakes that are atoms thick and often only a few micrometers wide, the Hummer's method of chemical modification of graphite is employed. This results in a polar-soluble suspension of graphene oxide that can be filtered in order to make strong films. Those films are then exposed to annealing in order to reduce the sheets, making reduced graphene (r-GO). However, sheets are quickly exposed to temperatures up to 800° C lack most of the strength capabilities of graphene, as well as loose uniformity in thickness. I hypothesized that GO sheets exposed to relatively low temperatures for longer periods of time (150° C for 30 minutes) would exhibit similar characteristics to sheets exposed to high temperatures. An ANOVA and Tukey test were used to find differences in the strengths of sheets exposed to various conditions. All tests were performed at the 0.05 significance level.

## THE GROWTH RATE AND DEVELOPMENT OF APETALA1 *ARABIDOPSIS THALIANA* VERSUS WILD-TYPE *ARABIDOPSIS THALIANA* PLANTS

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*Arabidopsis thaliana* is a plant that consists of 5 chromosomes and is commonly used for testing. APETALA1 *Arabidopsis thaliana* plants are produced when one or more genes are disabled by genetic modification and wild-type *Arabidopsis thaliana* plants are normal plants. The purpose of this experiment was to compare the genetic effect of *Arabidopsis thaliana* plants on its factors of growth and development such as physical differences. It was hypothesized that the wild-type plant would show a significant difference in growth and also have a better development in terms of structure and germination rate. The results were conclusive that the APETALA1 plants had a higher germination rate of 37 percent and also had a taller height of 32 centimeters in comparison to 27 centimeters.

## THE EFFECT OF *PSEUDOMONAS PUTIDA* ON ACETYLSALICYLIC ACID IN AQUEOUS SOLUTIONS

Feifei Deng
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In this experiment, the ability of *Pseudomonas putida* to degrade acetylsalicylic acid was studied. This was studied because of water pollution due to pharmaceuticals in the environment that are dangerous to aquatic life. It was hypothesized that acetylsalicylic acid would be consumed or degraded by *Pseudomonas putida.* The bacteria *Pseudomonas putida* was cultured and then added in equal amounts to bottles filled with equal amounts of acetylsalicylic acid. There was one control that had only the pharmaceutical and no bacteria. At four, nineteen, and twenty-four hour intervals, the amount of base took to titrate the samples were measured and recorded. This was done for a period of three days and the whole experiment was done once including the culturing of *P. putida.* An acid/base titration was used to determine the concentrations of acetylsalicylic acid. On the first day at 0 hours, the average amount of base required to neutralize the samples of acid was 0.49mL. At four hours, the average amount of base required to neutralize acidity was 0.52mL. Nineteen hours afterward, an average of 0.53mL of base was required to neutralize the acid. Twenty-four hours later, the bacteria produced 0.13mL more acid resulting in an average of 0.66mL of base required to neutralize the samples. The results were inconclusive due to acid production by the bacteria.

## THE EFFECT OF BLUE-LIGHT ON THE EARLY RELEASE OF MELATONIN ON THE SLEEP HABITS OF PEOPLE WITHOUT SLEEP DEPRIVATION AND PEOPLE WITH INSOMNIA

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Artificial light, while seeming to help people maximize the hours in a day for work and personal output, appears to have a negative effect on a person's sleep cycle; and therefore, many sleep deprivations have made their entrance into the world, causing disruption of the average sleep patterns. The purpose of this project was to analyze a prospective treatment for insomnia. Blue light was used to try to activate the early release of melatonin to produce a more restful sleep to those with insomnia. Blue light is a

wavelength of 475 nanometers, and in other research has been verified as being able to disrupt the body's circadian rhythm. Human subjects were recruited and randomly assigned to two groups. The treatment group was required to turn off all other light thirty minutes before going to sleep, and turn on the blue light. Data were measured using the Stanford Sleepiness Scale and were analyzed with a two-sample t-test. The two-sample t-test indicated that there was no difference between the treatment and the control group, $t(23) = -1.19$, $p = 0.244$. The data included in the study concludes that blue light does not produce a more restful sleep as a potential treatment for insomnia.

## ENGINEERING A HYDROELECTRIC TURBINE TO HARNESS THE ENERGY OF TIDAL CHANGE

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A hydroelectric turbine converts the energy of tides into electricity and other useful types of power. Although this renewable energy is not widely used, tidal power has the potential to create a reliable form of electrical generation. The purpose of this experiment was to design a hydroelectric turbine demonstrating the Venturi effect and to determine the amount of electrical energy that can be captured by the turbine as the tides fluctuate. A prediction of an average of 106.1 watts was formulated by comprising an equation using the following elements: $P = (1/2)NqA(V^3)$:P= Power in Watts, N= Efficiency, q= Density of the site's salt water, A= Area of the mouth of turbine, V= Average velocity of salt water in location. The first step was to design and build the turbine. In order to increase the energy harnessed, the turbine would have to demonstrate the Venturi effect in order to increase the velocity of the flowing water. Thus two cone-like devices were attached to either side of a shaft with an impeller inside. A series of aluminum braces are attached to the turbine to ensure a sturdy connection to a dock. As the impeller spins, a generator atop the turbine would also spin, therefore generating electrical energy to be read by a multimeter. The average power captured by the turbine was determined to be 15.92 watts. While this value is lower than predicted, the output is still significant because approximately 15.00% of the power can be captured by a first year prototype. With further experimentation and adaptation, a more efficient device can be used and possibly implemented into personal use.

## THE SYNTHESIS OF INDIUM NITRIDE NANOWIRES USING A CHEMICAL VAPOR DEPOSITION SYSTEM

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Though most nanowires today are made from silicon, used for transistors because of its near ideal electrical properties, indium nitride could be useful for different applications. It has been recently found that indium nitride has unique properties. It has similar properties to silicon, and though it should not replace silicon, it could be used widely in a different application, such as for cantilevers or gas sensing. The aims of this project were to test indium nitride nanowires. However, a way to consistently create them was needed. This is just the beginning of a much larger project on indium nitride nanowires. The goals of this small part of the project were to find a procedure to consistently create nanowires suitable for experimentation. There was a basic procedure that had to be modified and tested. To discover the best procedure, parameters for the chemical vapor deposition (CVD) were varied separately to test which one would produce the best

nanowires. The flow of the gas into the system, which is the basis of the CVD reaction, was varied to try and find the standard cubic centimeter (sccm) flow which was most ideal for the reaction to occur. It was found that the experiments where the nitrogen and ammonia gas flow were equal yielded the best results.

## THE EXPRESSION AND PURIFICATION OF N- TERMINAL FRAGMENTS OF ARABIDOPSIS THALIANA RECQ4A AND RECQ4B FOR ANTIBODY PRODUCTION

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Responsible for the maintenance, assistance in recombination, and repair of the genome, RecQ helicases occur in every kingdom of life. *Arabidopsis thaliana* RecQ4A and RecQ4B, homologues of the BLM RecQ helicase in humans, allow for study of RecQ dysfunction diseases, such as the cancer-causing Bloom's Disease. Yet to specifically study these varieties of RecQ helicases, a polyclonal antibody needed to be created by expressing and purifying a large amount of N-terminal fragments of the protein via plasmid (containing RecQ4A or RecQ4B and either a Step-His or N-His1 histidine tag) transformation of and expression in *E.coli*. The aim of this research is threefold: 1) to express and purify approximately 1 mg respectively of the N- terminal fragments of *Arabidopsis thaliana* RecQ4A and RecQ4B protein for antibody production, 2) to determine the most effective plasmid construct for expression of *At*RecQ4A and *At*RecQ4B and 3) determine most efficient methods of purification, as well as 4) to determine if histidine tag cleavage is necessary for more specific antibody production. Nickel and Copper Immobilized Metal Ion Affinity Chromatography (IMAC), gel electrophoresis and western blot analysis, as well as quantification processes showed more than 1.4 grams of RecQ4B as well as about 0.6 grams of RecQ4A were purified, enough to inject into a guinea pig, and rabbit respectively.

## SIMULATION OF ULTRASOUND IMAGING USING C# AND THE XNA FRAMEWORK

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Ultrasound imaging is a very useful method of diagnosing conditions occurring in the human figure, such as the state of a fetus in the womb. The procedure is not very costly to perform, making it a favorable alternative to other varied types of diagnosis. Training future medical employees is necessary; however, purchasing such instruments and ultrasound machines may not be an economically viable option. In order to considerably lower the cost of ultrasound training, this project aims to build the base for an ultrasound simulation program, where the organs and problems to be diagnosed and viewed digitally. The program is written in the C# language and utilizes the XNA Framework for the basis of this simulation. Data is read in order to construct an organ in virtual space and render it to the computer screen with appropriate effects. Ultrasound machines use transducers that, when applied to the body, send out sound waves which interact with tissues within the body. Simple ray tracing is implemented to simulate sound waves traveling through the body. The Nintendo Wii Remote, along with the Wii MotionPlus accessory, was intended for use in order to have refined control and simulation of the transducer in the ultrasound process, but the control system was not integrated with the graphical portion of the program.

## THE EFFECT OF PT, PTIR, AND PTRU CATALYSTS WITH NB-DOPED $TIO_2$ AND $TIO_2$ SUPPORTS ON THE ELECTROLYSIS OF WATER

Jake Farell
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The purpose of this project was to determine which of three catalysts combined with one of the high surface area supports has a high stability and the highest efficiency for generating Hydrogen. Three catalysts (Pt, PtIr, and PtRu) were combined with five catalyst supports to determine which combination would have the highest efficiency for generating Hydrogen. It was hypothesized that the PtIr catalyst on the Nb-doped $TiO_2$ support would provide the greatest efficiency. Proven metal catalysts were combined and imbedded into high surface area supports, tested in an Electrode Rotator machine, and analyzed using CoreWare software. The resulting current densities were determined for each voltage applied. It was determined that by using a combination of two metals, a higher efficiency was achieved. However, doping the supports with Nb did not aid and possibly hindered the efficiency of the supports. This experiment was novel because it showed the combination of two metals as a catalyst on the high surface area supports and introduced the Nb-doping into the support. This study provides useful information to help build cost effective hydrogen fuel cells to be coupled with solar panels for, what could be, a versatile source of renewable fuel. An ANOVA test $F(8, 6831) = 56.65$, $p < .05$. The p-value was less than .001 which was less than the alpha value determining that the data were statistically different. The Tukey tests were run and the results indicated that the PtIr/$TiO_2$ (anatase) combination yielded the most current density.

## THE EFFECTS OF WILDFIRE ON PEAT FROM THE MINNIE'S LAKE IN THE OKEFENOKEE SWAMP-MARSH COMPLEX

Shane Farmer
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Peat is generally brown or black sediment derived from partially decomposed plant matter. It is normally found in marshes, swamps, or other wet areas. Several core samples were taken from the Okefenokee Swamp-Marsh Complex after a wildfire burned almost all of the 1416 $km^2$ of the swamp. Never before has a study been done on wildfires and peat because this was the only time a swamp had been almost completely burned. The samples came from the location known as Minnie's Lake (MLF1) towards the center of the swamp-marsh complex. The purpose of this research was to see the effects that fire had on peat and the changes that occur as a result. The sample was analyzed with a microscope, examining its area percentage of brown matrix, brown framework, gray matrix with quartz, gray matrix with spicules, spicules, and charcoal less than 150μm and greater than 150μm. The petrographic components varied at increasing depths showing the effects of climatic change in the region, such as the 2007 wildfires in the Okefenokee Swamp-Marsh Complex. The fires during 2007 caused an increase in the gray matrix, ash, due to the intense burnings and a decrease in brown framework and brown matrix, plant matter that had not been decomposed.

## A COMPARISON BETWEEN THE 32-BIT AND 64-BIT VERSIONS OF WINDOWS 7 FOR PROCESSING SPEED

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Computers are essential to modern life. Most people have issues with their computer running slowly or not functioning as well as expected. A major change in the architecture of the central processing unit (CPU) from the 32-bit x86 to the 64-bit x64 is supposed to dramatically increase the performance of computers. The purpose of this experiment was to see how the 32-bit and 64-bit versions of Windows 7 handle the same program with respect to time. In order to determine if the results on Windows 7 were valid, Ubuntu Linux was used similarly. On the same computer, separate partitions were created and each one had a different operating system: Windows 7 32-bit, Windows7 64-bit, Linux 32-bit, and Linux 64-bit. A two sample t-test was performed on the times for each operating system. For Ubuntu Linux the t value was -3.13 and $p=0.006$; for Windows 7 the t value was 12.05 and $p<0.001$. Both results show that one version performed faster. In Linux the 32-bit version performed slightly better by approximately 1 second because it is based on the C language and was designed for text output, which was what the program did for most of the time. Windows 7 showed a significant improvement from 64-bit to 32-bit of approximately 409 seconds. This is because the 64-bit multiplication used would require fewer CPU calculations in a 64-bit environment vs. a 32-bit environment. Therefore, though Linux did not behave as expected, Windows 7 64-bit is significantly faster than Windows 7 32-bit.

## A STUDY OF THE INVERTEBTES LIVING ON LEMON BACOPA, ZOSTERA MARINA, AND CABOMBA CAROLINIANA IN LAKE MOULTRIE

Daniel Flagler
Timberland High School

The Department of Natural Resources has been trying to discover a way to expand the fish population in Lake Moultrie by transplanting aquatic plants such as *Lemon bacopa, Zostera marina, and Cabomba caroliniana*, in parts of the lake where they no longer exist, due to past drought conditions peaking in the late summer of 2007 and continuing to the summer of 2009. The purpose of the experiment was to identify the invertebrates living on these aquatic plants, then to find a way to put them back into bare areas of the lake because they serve as a major food source for the fish. The major findings in this experiment were that most of the aquatic plants had the same types of invertebrates living on them. The common invertebrates that were identified were rotifers, amphipods, flat worms, snails, water mite, May fly, nematodes, and ceratoponidea. The research hypothesis was not supported by the data because there were the same invertebrates on different plants. The findings agreed with other findings with that, the types of invertebrates found on the *Lemon bocopa* and *Combom*a matching the same kind that was researched. Because the aquatic plants were all gathered from the same lake that would likely explain the similarities between the invertebrates found on them. Additional experiments could be held on the behavior of the fish and why they are so attracted to these invertebrates on these aquatic plants. Also, could there be another food source for the fish in the lake, if so, perhaps it could be use to benefit the fish in the lake.

## THE EFFECT OF CAFFEINE ON ACADEMIC PERFOMANCE OF MALES AND FEMALES

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The long term effects of caffeine are still unknown and research is currently being conducted to find out this question. One study has shown that males and females can react differently to caffeine. Another study shows caffeine affects performance in daily activities. The purpose of this project was to determine if caffeine affects test scores of males and females differently. The hypothesis was that caffeine would have a more significant effect on males than females and increase their accuracy on a math test. The control of the experiment was using water which has no sugar or caffeine. The constants in this experiment were using the same type of caffeinated soda (Diet Mountain Dew), the same energy drink (diet AMP), and the same brand of water. The independent variable was caffeine and the dependent variable is the accuracy of the test scores. The dependent variable was measured by giving out a simple math test and then adding up the number of correct answers. The results of this experiment showed that there was not a significant difference in test scores between the male and female subjects, indicating that caffeine had no significant effect. An extension to this experiment would be to have the participants wait longer to ensure that the caffeine would be in the participants' bloodstream.

## A COMPOSITE SWEAT BAND INSIDE A FOOTBALL HELMET TO PREVENT SWEATING IN THE EYES

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The purpose of the project is to absorb forehead sweat inside a football helmet when playing football. Sweat gets in your eyes resulting in your eyes burning and blurred vision. You have to wipe your eyes and risk missing a play, missed catches, or not being able to see. A survey conducted at Dutch Fork on 9/24/09 98% of the sample wiped there eyes due to sweat. Also 100 percent of the sample believes that sweat is a problem. There was four material tested (cotton, Felt, Foam Sheet, Nylon Patch) that could be place inside a football helmet. They where tested to see which material would absorbs the most water. Then grab one of the materials and place this material in the middle of the board. Fill the measuring cup with water until the measuring cup reads 1 cup. Pour the water down the board slowly. Observe the materials for 5 minutes. Then measure how much water is in the bucket each time and take that measurement and subtract that from one cup. Repeat the process until all the material has been tested. Record the results in the data table. I will be able tell with of the four material is the most absorbent which should absorb 75 percent of the water.

## INVESTIGATING THE CHEMICAL LEGACY OF HISTORICAL COTTON FARMING ON AQUATIC HEALTH IN UPSTATE SOUTH CAROLINA WATERSHEDS

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South Carolina Governor's School for Science and Mathematics

The Upstate region of South Carolina was home to textile mills and extensive cotton farming from the 19$^{th}$ century through the 1950's. Cotton was such a profitable crop that various kinds of herbicides, pesticides and fungicides were used to maximize the

production and profit. Most of the chemicals used during this time period contained metals such as arsenic and copper. In this study, sediment and water samples were analyzed using Inductively Coupled Plasma Atomic Emission Spectroscopy, to determine if the tributary creeks of the Saluda and Reedy Rivers contained elevated levels of these metals. It was hypothesized that the presence of these metals in high concentrations was the cause for the lack of biodiversity. The collection of data is still in process but there were sites, such as the second Big Creek site (BG02), which warrant further research.

## AN ANALYSIS OF THE HORIZONTAL VELOCITY AND VERTICAL ACCELERATION AT THE BOTTOM OF THE FIRST HILL OF THE AFTERBURN ROLLER COASTER USING MATHEMATICAL MODELING AND VIDEO ANALSIS METHODS

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In this experiment, the horizontal velocity and vertical acceleration of the Afterburn coaster were investigated. The horizontal velocity was measured with a physics mathematical equation and video analysis. The vertical acceleration was also measured with a video analysis and direct measurements using a spring accelerometer. The hypothesis was that a mathematical prediction would accurately predict the horizontal velocity of the actual coaster, "Afterburn." The other part of the hypothesis was that the vertical acceleration found by the spring accelerometer would correspond with the vertical acceleration found by the video analysis. The null hypotheses were that the mathematical prediction would not accurately predict the horizontal velocity of the actual coaster, "Afterburn", and the vertical acceleration found by spring accelerometer will not correspond with the vertical acceleration found by the video analysis. An ANOVA test was run to compare the mean accelerations obtained graphically to the mean acceleration measured with the spring accelerometer. The results of the ANOVA indicated the "Fstat" (101.29) is outside the range of the "Fcrit" (+/- 4.19). Therefore, there is a statistically significant difference between the mean acceleration obtained graphically and the mean of acceleration measured with the spring accelerometer. This can be said with a 95% confidence. The average velocity found using video analysis was 37.967 m/s. The velocity found using the mathematical formula was 46.430 m/s. The two velocities found showed that there is about a 19.94% difference. Those results support both of the null hypotheses and reject the both of the hypotheses.

## THE EFFECT OF QUICK FREEZE-THAW CYCLES ON THE GROWTH OF *ESCHERICHIA COLI* ON READY-TO-EAT TURKEY BOLOGNA

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Contamination of ready-to-eat (RTE) products most often occurs in between the cooking and the packaging steps. Therefore, strategies for reducing the numbers of pathogens in packaged products are needed. In this study, consecutive quick freeze-thaw cycles were applied to the surface of ready-to-eat turkey bologna inoculated with *E. coli* JM 109. In a first set of experiments, the products were surface-frozen in liquid nitrogen and surface-thawed in a water bath at 50-55 °C. They were frozen and thawed for 11 and 3 seconds, respectively, in order to reach -18 and 5 °C only on the surface of the product. Significant reductions in the number of bacteria on the surface were observed after 1, 3 or 5 freeze-

thaw cycles. In a second experiment, the original freezing and thawing times were increased five times to evaluate the effect of extreme temperatures on the survival of *E. coli*. After 1, 3 or 5 freeze-thaw cycles of 55 and 15 seconds, respectively, statistical differences were seen among the control and the treatments. None of the final reductions was greater than 1 log; therefore, the freeze/thaw treatments do not show practical significance. We conclude that fast freeze-thaw cycles are ineffective in reducing the numbers of common pathogenic bacteria, such as *E. coli* on the surface of RTE turkey bologna.

## THE EFFECT OF MATHEMATICAL LOCATION ON THE OPTIMAL TILT ANGLE AND ORIENTATION OF A SOLAR PANEL

Abhinav Gianey
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As fossil fuels decline, solar energy is becoming a more efficient source of energy (Chang, 2009). The purpose of this experiment was to see whether the mathematical location (latitude and longitude) correlated with the optimal tilt angle and optimal direction of a solar panel. This was done so that an equation could be developed relating the variables together. It was hypothesized that the tilt angle of the solar panel would increase with increasing latitude, and that the longitude would have no effect on the tilt angle. To achieve the optimal tilt angle, the solar panel's direction was hypothesized to face south in the northern hemisphere and to face north in the southern hemisphere. The optimal angle (the angle at which most voltage was generated) and the optimal direction were calculated for several locations. For each location, the angle and direction at which the highest voltage was generated were recorded. Correlation and regression tests showed that the latitude correlated with the optimal angle. The test showed that the optimal tilt angle increases when the latitude was increased, $r(8) = 0.775$, $p<0.05$. The test gave the formula: $A = 16.2 + 1.02L$, in which $A$ represented angle, and $L$ represented latitude. Longitude, however, did note correlate with the angle. The optimal direction was proven to be southern in the northern hemisphere. The results showed that the time of year also had an effect on the angle. These results can be used so that solar panels are used more efficiently.

## SHAKABLE CELL PHONE CHARGERS

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Current cell phone chargers are portable, reliable and environmentally friendly. I hypothesize that a shakable cell phone charger will allow people to make a 2 minute phone call after shaking the device for no longer than 60 seconds. A shakable cell phone charger produces renewable energy from a simple shaking motion. The shakable charger works by using a strong earth magnet that slides through a copper wire coil when shaken vertically. The copper coils create a magnetic field. The energy from the magnetic field is carried through the copper coils. The energy from the wires is directed into a circuit board, consisting of five bridge rectifiers, a capacitor, and a positive and negative output. The charger was shaken for different time periods (20-60 seconds); after each phone retained the call was recorded (seconds). The time shaken that produced the most amount of energy was 60 seconds, in this time the phone worked for 54 seconds of charge. The hypothesis was rejected because shaking the charger for 60 seconds did not yield 2 minutes of charge.

## THE ROLE OF TOXINS, SPECIFICALLY THAT OF LEAD AND MERCURY, IN THE INDUCEMENT OF ALZHEIMER'S DISEASE

Millie Howard Griffin
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Alzheimer's Disease is a neurodegenerative disease characterized by the presence of senile plaques that are composed mostly of aggregations of the ˜-amyloid peptide. The extent of the effect that toxins have on brain development remains unknown. In representation of those toxins found in the modern day environment, lead acetate and methyl mercury were tested. A Chinese hamster cell line (CHO 2B7) and a murine hippocampal cell line (HT-22) were subjected to these compounds and the progression of cell death was monitored daily. Western blot analysis and color reactions were performed with antibodies to detect the ˜-amyloid precursor protein (˜APP) and sAPP (secreted derivative of APP), which become severed to create the ˜C-terminal fragments (˜CTF) that form the ˜-amyloid peptide. Other antibodies were used to detect ˜CTF. It was discovered that lead acetate and methyl mercury do appear to break down APP, thereby increasing the amount of ˜CTF. These results correspond to an increased level of amyloid peptide and thus to symphonic manifestations of Alzheimer's disease.

## THE EFFECT OF DIFFERENT AMOUNTS OF RHIZOBIA LEGUMINOSARUM ON THE GROWTH RATE OF VIGNA UNGUICULATA

Amanda J. Grimes
Spring Valley High School

The purpose of this research was to find the amount of nitrogen fixing bacteria to have in the soil or growing medium to achieve optimal growth. If the amount of bacteria that helps the plant the most is known, then farmers can know exactly how many legumes to plant near their crops or know how frequently they need to rotate their crops so they can get as much as they can from their crops each season. The hypothesis is if more nitrogen fixing bacteria is inoculated into the plants, then the plants will have a higher growth rate, until a certain point where the bacteria will then become overpowering and will cause the plant to not be as healthy or grow as well. The plants were grown in non nutrient agar with 0-10-10 fertilizer and the corresponding amount of bacteria for 3 weeks and were measured. A one-way ANOVA test was used to determine if the difference in plant growth were statistically significant at the  = 0.05 level. A Tukey test was used to determine which group was statistically different. The p value was greater than ˜, so the null hypothesis was rejected. The Tukey results showed group 4 results were significantly lower than the other groups. A one-way ANOVA was run to see if there was a significant difference between the numbers of dead plants in each group after 3 weeks. There was not enough evidence to support the claim that more bacteria lead to more deaths.

## THE EFFECT OF VOLTAGE ON THE FORMATION ON THE EFFECT OF AMORPHOUS CARBON FILMS DEPOSITED BY ELECTROLYSIS OF METHANOL

Jonathan Grimes
Spring Valley High School

Carbon films have a multitude of applications in electronics, abrasive and durable coatings, plastics, and biomedical applications. Carbon films can be made using a variety of methods such as chemical vapor deposition, sputter deposition, and

electrolysis. The purpose of this experiment was to create carbon films electrolysis at different voltages and analyze the films using Raman spectroscopy. It was hypothesized that films created under higher voltages would exhibit a higher $sp^3$–$sp^2$bond ratio than films created using lower voltages. A 304 stainless steel electrode acted as the cathode while a $SiO_2$ glass plate acted as the anode. They were connected to a DC power source and placed into a methanol solution. Kosher salt was added and the entire electrolytic cell was placed on a magnetic stirring plate. The DC power source was turned on and the cell was left to deposit for 25 seconds. The films were wrapped in parafilm and sent to the University of South Carolina for analysis.

## THE EFFECT OF THE FACE PERCEIVED FROM THE FRONT END OF AN AUTOMOBILE ON THE APPEAL OF AN AUTOMOBILE TO A POTENTIAL BUYER

Joseph S. Guy Jr.
Spring Valley High School

The purpose of this study was to relate faces and emotions perceived in the front end of a car to the appeal of a car to a potential buyer. The hypothesis was that people would find cars with an angry or aggressive disposition more appealing. The methodology was to expose human subjects to randomized photographs of the front end of a car. The subjects were asked to rate the photos on the expressions and faces that they perceive. Next, they gauged the appeal of the car. A computer survey was used to gather data from 100 subjects. Photographic images of forty different makes and models of automobiles will serve as the independent variable in this experiment. Each photograph was a "head-on" shot of the front end of cars, both domestic and imported, from the last seven years. Each car was gray with a gray background. All photographs were edited using PhotoShop CS4 in order to remove differences in color and surroundings. License plates were erased, but brand logos were retained. Due to time constraints 10 participants that answered to having seen faces in at least ten cars were selected for analysis. Each of the ten participants answered four traits and of those traits showed a correlation with the appeal of the car ( = .05).

## THE EFFECT OF LOW-DOSE ACETYLSALICYLIC ACID ($C_9H_8O_4$) ON THE HEART RATE AND MORTALITY RATE IN *DAPHNIA MAGNA*

Hunter Hale
Spring Valley High School

Aspirin has recently begun to be prescribed by doctors for the purpose of lowering blood pressure. The purpose of this experiment was to test the overall effect of aspirin on heart rate and mortality rate, using as test subjects. It was hypothesized that the use of aspirin would overall lower the heart rate, while resulting in no change in mortality rate of the daphnia. *Daphnia magna* were obtained and randomly placed in one of the following test groups; control, one aspirin, and ¼ aspirin. They were monitored for death and heart rate over the course of two weeks. The heart rate data were analyzed using a one way ANOVA at the alpha equals .05 level. The p-value was found to be .001, and since p<alpha, the null hypothesis was rejected, indicating that a significant difference in the heart rate means among the test groups existed. F(d.f.N- 2 d.f.D.- 57)= 10.04, p= .001. These results supported the hypothesis, suggesting that the use of aspirin significantly lowers heart rate. For the mortality rate data, only the control and the ¼ aspirin group were used for statistical significance testing. A two-sample t-test was conducted at the alpha equals .05 level. t(59)=2.73, p=0.013. Since the p-value was less

than that of alpha, the null hypothesis (claim) was rejected. This failed to support the hypothesis, and suggested that the use of aspirin lowered mortality rate.

## DEVELOPING AN ANTIMICROBIAL PEPTIDE FOR CATHETER APPLICATION USING *CUPRIAVIDUS SRNL*

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*Cupriavidus SRNL* is a strain of bacteria found near the Savannah River National Lab. Both the Savannah River National Lab and Dr. Tzeng's microbiology lab at Clemson University have been working with this species. The goal of the work with the *Cupriavidus* is to develop an antimicrobial peptide for catheter application, primarily for use against biofilms, which are large complex colonies of bacteria that are highly resistant to most treatments. In hospitals, the biofilms have the potential to cause dangerous infections if allowed to grow on catheters. The research conducted focused on effective production of *Cupriavidus SRNL* as well as basic tests of its antimicrobial properties. The results of this experiment will allow for further work to be done on this topic.

## GILT REGULATES CYTOKINE GENE EXPRESSION IN PROSTATE CANCER CELLS

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Human prostate cancer cells lack an important enzyme, Gamma-Interferon-inducible Lysosomal Thiol-reductase (GILT), altering the profile of peptides displayed to lymphocytes, thereby preventing functional mobilization of CD4+ T cells which orchestrate the immune response. The absence of GILT facilitates escape mechanisms of the tumor cells from the immune system. The immune system is regulated by intercellular signaling molecules called cytokines. Interleukin-8 (IL-8) and Prostaglandin E-Synthase (PGE-S) are cytokines that promote angiogenesis, or the proliferation of blood vessel networks into cancerous growths, supplying nutrients and oxygen while removing waste, inducing tumors to grow and metastasize. Indoleamine-2,3 dioxygenase (IDO) is a T-cell inhibitor that degrades amino acid tryptophan, starving T cells and causing tumor tolerance. Here, we show that the induction of GILT expression in prostate cancer cells enhances immune recognition of prostate cancer cells by downregulating angiogenic factors, IL-8 and PGE-S, and immune inhibitory molecules, IDO. The data suggest that the induction of GILT expression in prostate cancer cells may attenuate their immune escape mechanisms and allow them to be destroyed by T cells.

## THE EFFECT OF COLOR PREFERENCE ON INDIVIDUAL PRODUCTIVITY

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It is an inevitable part of every person's life to engage in some form of work. As the economy becomes more unstable, the priority of keeping one's job becomes more important. The purpose of this study was to determine whether color preference affects the productivity of an individual (time to complete a task). It was hypothesized that if the task provided is the subject's most preferred color choice, then the time that it takes the subject to complete the task will decrease (showing an increase in productivity). The subjects completed three mazes printed on different colored sheets of paper, according

to the results of their completed survey. The first maze was the control trial printed on non-colored paper. The time that it took the subject to complete this task was recorded. The subject then completed mazes printed on their most preferred and least preferred colored paper. These trials times were then recorded. A one way ANOVA test was used to compare the trial times of the subjects. The test showed that there was a significant difference between the subject completion times. The results concluded that the subject improved their productivity when performing a task with their most preferred color than when they performed the task with their least preferred color.

## THE EFFECT OF HUMIDITY ON THE FREQUENCY OF BEHAVIORAL INFRACTIONS IN HIGH SCHOOL STUDENTS

Paul Han
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Weather impacts every organism in many complex ways. Biometeorology is the study of how different weather conditions affect the behavior of living organisms on Earth. The purpose of this study was to determine if humidity affects the frequency of behavioral infractions by high school students. This project is a study to explore the effects of weather sensitivity on humans, and for this project, humidity is the manipulated weather condition. It was hypothesized that as humidity decreases, the frequency of student infractions would increase. A list containing all of the discipline notices written for the 2006-2007 and 2007-2008 school years were obtained from a public high school. The number of behavioral infractions for each day of the month was tallied and correlated with the average relative humidity on that particular day. A linear regression t-test was conducted for each month with ˜=0.05. The results indicate that only the month of May 2007 had a correlation between the two variables. An overall analysis indicates there is no significant correlation between humidity and the frequency of behavioral infractions in high school students.

## THE EFFECTS OF CALCIUM CHLORIDE CONCENTRATION ON THE TRANSFORMATION OF E. COLI BACTERIA COLONIES

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When researching experiment subjects, it was found that scientists believe that to transform E. coli bacteria and successfully insert the gene for Green Fluorescent Protein (GFP) into it, genome exposure to calcium chloride is critical. The hypothesis was that to higher concentrations of exposure to calcium chloride during transformation would increase the number of E. coli bacteria that successfully received the pGLO gene. This experiment determined how the concentration of calcium chloride could affect the amount of *E. coli* bacteria that accepted the pGLO gene. Basically, in this experiment, ager, ampicillin, and arabinose were mixed, poured into 40 Petri dishes and then left to cool. After the solutions cooled, $CaCl_2$ of different concentrations (12.5%, 25%, 50%, 75%, 100%) and the *E. coli* were spread in each Petri dish. When the dishes were done incubating, a black light was used to see if the colonies had accepted the pGLO gene. The independent variable in this experiment was the concentration of the $CaCl_2$ $CaCl_2$ and the dependent variable is the amount of fluorescent colonies in the Petri dishes of each concentration. The results showed that as the concentration increased, the amount of glowing colonies increased also.

## POLLEN FOOD SYNDROME: COMPARISON OF ANTIBODY REACTION TO PROTEIN PROFILIN IN POLLEN AND SPECIFIC FOODS.

Seema Harpalani
Dutch Fork High School

Pollen Food Syndrome: The intent of this study is to examine the cross reactivity of antibodies to profilin from multiple plants. This will be used to determine whether pollen allergies can cause a higher risk of developing specific food allergies resulting into pollen food syndrome. Pollen food syndrome is an association between inhalant airborne allergies, such as pollen and oral symptoms when ingestion of particular fruits, vegetables, and spices takes place. Previous results of research has concluded that pollen food syndrome affects up to 70% of the patients who are allergic to birch pollen and that this prevalence will increase as the prevalence of airborne allergies increases. Pollen food syndrome is caused by homologous proteins, such as profilin, found in fruits, vegetables, and pollens. This is an observation taken to reassure that there is leading increased allergenicity to these foods. By exposing the antibodies to specific plant profilin and the homologous protein in foods, it will be determined whether such a reaction will occur and how it transpires.

## MEASURING CP-VIOLATION IN THE DECAY OF THE D MESON

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Charge-Parity symmetry is an integral part of the Standard Model of particle physics. In the case of charm mesons, violation of this phenomenon has never yet been observed and is not compatible with the current version of the Standard Model. In order to conduct a study on CP-symmetry in charm particles, the D meson is used as the prime candidate to conduct research, because it is the lightest and most stable charmed meson. The experimental data was collected at the Stanford Linear Accelerator (SLAC). The data was then analyzed using the program library ROOT. Using this program, the data was put through several cuts to extract the signal events and discard the background events, such as requiring the Q-value of a selected event to be within the accepted Q-value of 6 keV. Using this method, no CP-violation was observed, which further supports the current Standard Model.

## EVALUATION OF ANTIBODIES FOR STAINING OF MOTOR NEURONS IN ZEBRAFISH EMBRYO

Emily Harruff
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The development of motor neurons in zebrafish embryo involves two types of motor neurons – primary motor neurons, which pioneer nerve pathways in the muscles; and secondary motor neurons, which follow these pathways. The ability to distinguish between primary and secondary motor neurons and between different primary motor neurons aids in research to find the factors which cause motor neurons to develop along certain pathways. Monoclonal antibodies which bind to cell-specific antigens in the zebrafish nervous system are used to view the motor neurons. The purpose of this research was to evaluate which motor neuronal structures were labeled by the four different monoclonal antibodies (Zn-1, Zn-5, Zn-12, and Znp-1) in comparison to the database provided by the Zebrafish Model Organism Database. Zn-1 was found to clearly stain CaP motor neurons and Rohon Beard neurons as stated by the database;

however, dorsal root ganglions were not stained although they were indicated in the database. The stainings by Zn-5 failed in this research, which is perhaps attributable to a contaminated stock antibody solution; this antibody was meant to show secondary motor neurons. The Zn-12 antibody staining was found to label the enteric nervous system and musculature system, in accordance with the database, but it did not label the Rohon Beard neurons, as per the database. Finally, the Znp-1 antibody stained exactly what the database said it would – the primary motor neurons.

## AN ANALYSIS OF COLLAGEN PRODUCTION IN SKIN IN REGARDS TO THE MATRICELLULAR PROTEIN SPARC AND THE PRO˜1 N-PROPEPTIDE

Nicole Henderson
South Carolina Governor's School for Science and Mathematics

The purpose of this research was to analyze the collagen produced by mice that lack SPARC (Secreted Protein Acidic and Rich in Cysteine) and have a mutated form of collagen I. SPARC, alone had been previously found to limit production of collagen in mice. The collagen I mutation was developed by deleting the Exon 2, which in turn causes the mice to produce collagen I in the absence of the proa1 N-propeptide. The mice with this mutation showed no change in collagen production in comparison to the wild-type mice. The aim of this project is to prove that the overall production of collagen is significantly less in those mice lacking both SPARC and the proa1 N-propeptide. The results provide evidence that the mice who lack both assets generate both less and weaker forms of collagen. Understanding the impact these proteins have on collagen I production is the first step towards deciphering why these specific proteins are involved in collagen production. In the future, this knowledge could be used to generate solutions to diseases which involve the overproduction of collagen.

## THE EFFECT OF TIRE AGE ON THE CONCENTRATIONS OF ZINC AND ARSENIC IN WATER LEACATE

Michael Hobensack
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The disposal of old tires is becoming a major issue in the waste management industry. In landfills they present specific hazards, including fires and the release of chemicals such as benzene. The hollow shape of tires also creates a hazard of insect breeding since the tires tend to fill up with water over time. These concerns among others have turned the attention to recycling the old tires into recreational surfaces rather than disposing of them. The tires do however, contain chemicals that could possible be harmful to people of the surrounding environment. This experiment was designed to determine if the concentrations of arsenic and zinc present in the tires are high enough to harm the environment, and if the age of the tire affects the concentrations. It was hypothesized that if the tire's age was older, then the concentrations of zinc and arsenic would be higher in the water leachate from the tire. Pieces of tire we cut and placed in beakers of distilled water and left to sit for one week. After this time period the tire pieces were removed and the water was tested for zinc and arsenic using the Hach Company's arsenic test kit and ZincoVer reagent. The arsenic tests yielded results indicating that no arsenic was present in the leachate. The zinc tests were analyzed using a one-way ANOVA that yielded a P-value of $<0.001$, indicating a significant difference in the concentrations of zinc that leached out of the tire and into the water. Post-Hoc Tukey tests showed that the difference in the concentrations was between the samples from 1997 and the samples from the other two years. Therefore, the null

hypothesis was rejected and it was concluded that the age of the tire does have an effect on the amount of zinc that leaches out into the water.

## THE EFFECT OF CLEAR-POLYMER MAGNIFYING BARS ON THE EFFICIENCY OF A SOLAR PANEL

Connor Hoffman
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The need for an alternative energy source is greater than ever before. The use of solar cells provides one solution provided they can be made to function at their full potential. The purpose of this experiment was to increase the efficiency of a solar panel by altering its mechanical construction. The change that was made to the solar panel was the addition of clear-polymer magnifying bars placed on the sides of the soar cell perpendicular to the movement of the sun. The hypothesis being tested was if clear-polymer magnifying bars are placed bordering the sides of a solar cell perpendicular to the movement of the sun, then that solar cell will have an increased energy output. First, the wattage output of the cell was measured with and without the magnifying bars while the cell was facing $0^{o}$, $30^{o}$, $60^{o}$, and $90^{o}$ away from direct sunlight. The experiment was conducted 4 times and means and standard deviations were obtained for each group. There was an increase in efficiency when the bars were added of up to 4% when the panel was facing 60 degrees away from direct sunlight. The data were then analyzed using a single-factor ANOVA test. The data for the 0, 30, and 90 degree trials was not consistent enough to be statistically significant. This data still supported the hypothesis, however, since the cell did have an increase in efficiency with the addition of the magnifying bars when the panel was angled at 60 degrees.

## EFFECTS OF ASPECTS OF MUSIC ON COGNITIVE ACTIVITY

Robert Hofmann
Dutch Fork High School

It is scientific fact that music affects the mind. Tests have shown that mice change behaviors differently when one is listening to a genre of music while sleeping. So how does music affect the ability of one to perform a cognitive activity (such as a maze.) A person will be randomly placed in a group, placebo or one of the experimental groups. The person will be asked to listen to a song (varying tempos based on the group) while trying to figure their way from beginning to end of the maze. The time will be recorded. Then two more trials will be completed in the same way and the times recorded.

## HOW LEARNING STYLE AFFECTS THE EFFICACY OF VARIOUS STRESS RELIEF METHODS

Nicolette L. Hook
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In this experiment, the relationship between the learning style and stress relief using the five senses was studied. This was studied because today's adolescents are increasingly stressed due to the additional pressures that society places on them, which could affect their future health. It was hypothesized that the stress relief method that had to do with the same sense as the learning style would be the most effective (ex. Visual learners relieve stress most effectively through the sense of sight). The method used was to first separate all of the subjects into three groups (touch, sight, and control),

with approximately half having the visual learning style and half having the tactile learning style for each group. Each student's blood pressure and pulse rate were taken and they were asked to rate their stress. They were exposed to a stressor (a difficult algebra problem while a recording of crying baby was playing), had their blood pressure and pulse rate taken and rating of stress recorded again, and then they were exposed to the stress relief method corresponding to the senses of touch and sight, depending on their assigned group. The data were analyzed at the ˜=0.05 level using an equal variance independent samples T-test to determine if the differences were statistically different. The results showed no constant significant differences between the two different learning style types through the different.

## SODIUM BOROHYDRIDE HYDROLYSIS: KINETIC STUDIES IN CONCENTRATED SOLUTIONS

Lauryn Jamison
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Sodium borohydride ($NaBH_4$), one of a class of compounds called chemical hydrides, is a candidate for the storage of hydrogen to be used in hydrogen powered fuel cells. This project investigated the kinetics of the aqueous hydrolysis reaction of $NaBH_4$. The reaction usually proceeds as follows: $NaBH_4 + (2+x)H_2O \ddagger NaBO_2 \cdot xH_2O + 4H_2$

Reactions were conducted at three temperatures (25°C, 60°C, 80°C) with initial concentrations of 10 wt%, 15wt%, and 20wt% $NaBH_4$. $B^{11}$ sensitive nuclear magnetic resonance (NMR) was used to monitor the concentration of $BH_4^-$ and $BO_2^-$ over time relative to a standard (boric acid). The solution pH was measured for each reaction condition. At a given concentration, the rate of reaction increased with temperature. At a given temperature, the rate decreased with increasing $NaBH_4$ concentration. There is a relationship between the increase in pH of the solution and the formation of the product (sodium metaborate) or the presence of an intermediate ($BH_3OH^-$). These results will help in the understanding of the kinetics to increase the efficiency of the storage and production of hydrogen.

## MUTATION SCREENING ANALYSIS OF THE TUSC5 GENE BY AUTOMATED SEQUENCING

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Tumor suppressor candidate five (TUSC5), located on chromosome seventeen at c17 p13.3, was thought to have a possible role in mental retardation. This interest came from a similar gene, tumor suppressor candidate three (TUSC3), located at c8 p.22-p.23.1, which was found to cause MR when its primary function (facilitating an oligosaccharyltransferase complex) was disrupted by mutations. In addition, a Norwegian family was found with a c.17 p.13.3 translocation that broke the TUSC5 gene, and further research showed TUSC5 activity in fetal brain development. All of this information culminated in the creation of this project. A mutation screening of the TUSC5 gene for 106 patients' DNA was completed. It was completed through polymerase chain reaction (PCR) , purification of the PCR product for sequencing, and automated sequencing. The results were examined using DNAstar software. The mutations found included three reported single nucleotide polymorphisms (F20S, S57G, and L145L) and two new mutations (P15S, K38E), all of which were point missense mutations. F20S was located at b.59 (T>C) on exon 1, S57G at b.169 (A>G) on exon 1, L145L at

b.435 (A>G) on exon 2, P15S at b.43 (C>T) on exon 1, and K38E at b.115 (A>G) on exon 1. The mutations were assessed using bioinformatics. K38E, F20S, and L145L were predicted to be benign. S57G was predicted to be possibly damaging. P15S was predicted to be probably damaging. This result for P15S, combined with its unreported status, makes it of most interest.

## EXAMINING THE DIELECTRIC CONSTANT OF AlxNy

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Silicon carbide (SiC) can be used as a high bandwidth semiconductor. Due to its natural properties, SiC can work without breaking down at either high temperatures or high frequencies. If properly developed, SiC can eliminate the need for cooling systems in both the automobile and aeronautics industries. Without cooling systems, manufacture of vehicles would be much cheaper, as would the cost of sending shuttles into space. Problems continue to arise, however, in the manufacture of these devices that must be addressed. One such problem arises when an electric field is run through a Schottky contact on the semiconductor. The electric field clumps up on the sides of the metal contact, causing a breakdown in the device allowing current to flow freely. Different attempts have been made to solve this problem, one of which is field plating. The field plate is applied around the contact to extend the sides. The electric field then follows the field plate and does not clump up. To make a working field plate, a good quality dielectric must be used. Silicon oxide, straight aluminum nitride (AlN), and AlN formed on the surface of the semiconductor were all tested. When forming AlN on the sample, more aluminum is sputtered with higher power, yielding a higher aluminum concentration, while higher nitrogen flow yields higher nitrogen concentrations. Varying powers and airflow were also tested. Data was gathered but more is needed to determine the ideal substrate.

## A CORRELATION STUDY OF WORD ASSOCIATION AND PERSONALITY TYPE

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Personality is difficult to correctly define for each individual, seeing as how every person is unique. However, there are behavioral patterns that indicate what kind of qualities a person has. The connections the brain forges between separate matters is one way to show personality, more specifically word association. The purpose of this experiment was to determine if there was a relationship between word association and personality type. Word association is a method of psychoanalysis that represents how an individual thinks. It was hypothesized that there would be a positive correlation between word association and personality type. A total of 36 participants were given computer generated personality tests. After taking this test, each person was given an oral word association test with one person showing them a word and the participant saying the first word that came to mind. The mean scores for both tests were recorded and plotted. A linear regression t- test was used to determine the correlation at an alpha = 0.05 level. The p value was 0.031. The t value was 2.256 and the critical value was 2.032. Since the t value is greater than the critical value, the p value is less than alpha, and the r value is 0.361, it was determined that there was a weak positive linear correlation between word association and personality type.

## THE EFFECT OF 3-5MM SILICA AEROGEL ON THE AMOUNT OF EXXON UNLEADED GASOLINE, 20W-50 MOTOR OIL, 5W-30 MOTOR OIL ABSORBED

Patrick Johnson
Spring Valley High School

The purpose of this experiment was to identify an inexpensive new method of oil spill cleanup using a material with almost no detrimental environmental effects. It was hypothesized that the addition of silica aerogel to an oil spill would absorb a significant amount oil, thus preserving the afflicted ecosystem. This was done by placing petrol products, with varying viscosities, into wells with saltwater to simulate an oceanic oil spill. Aerogel was then added to the wells to see the effect on the simulated environment. A one-way ANOVA test and a Scheffe test were conducted after experimentation; these tests indicated that silica aerogel absorbed significant amounts of the petrol products while maintaining its hydrophobicity toward the saltwater. The p-value was found to be at > 0.001. Since the p-value was less than that of alpha, the null hypothesis was rejected and there is significant difference between the testing groups.

## THE EFFECT OF D-LIMONENE ON THE MORPHOLOGICAL STRUCTURE OF AND PRODUCTION OF OXYGEN BY *SCENEDESMUS* DURING PHOTOSYNTHESIS

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This experiment was designed to test if both the morphological structure and the amount of oxygen produced by *Scenedesmus* were significantly affected by d-Limonene. This experiment is significant because it measures changes in dissolved oxygen levels which are very important for maintaining aquatic life and a healthy ecosystem. It was hypothesized that the highest concentration of d-Limonene, at 50 ppm, would result in the greatest decline of dissolved oxygen levels and also that there would be significant changes in the structure of the algal cells and spines. For the experiment, algal blooms were grown with the use of fertilizer. The number of spines per 150 cell colonies was randomly counted via an electron microscope. *Scenedesmus* was grown in test tubes containing differing concentrations of d-Limonene. Twenty mL of *Scenedesmus* were distributed amongst 120 test tubes each; 30 test tubes containing no d-Limonene, 30 with 20 ppm d-Limonene, 30 with 30 ppm d-Limonene, and 30 with 50 ppm d-Limonene. Dissolved oxygen levels were measured using a dissolved oxygen probe. After 4 weeks of UV exposure, the dissolved oxygen levels were again measured. The data were analyzed using a one- way ANOVA test to determine if the differences in dissolved oxygen levels and growth were statistically significant. At a = 0.05, the p value was <0.001 ($F_{crit}$ = 2.68, $F_{test}$ = 25.55). Individual algal cells and their respective spines were counted after d-Limonene exposure in order to determine if the presence of d-Limonene brought about any morphological changes in the algae.

## DOES THE HEIGHT OF THE TEE AFFECT THE DISTANCE AND ANGLE OF THE GOLF BALL AS IT FLIES

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Most golfers realize that changing your tee height will affect the flight of the golf ball. In this study, the relationship between the tee height and the angle and distance of the golf ball in flight was studied. There were two hypotheses: a) that the shorter the tee, the longer the distance will be b) the higher the tee, the greater the angle will be. The null hypothesis was that tee height would have no affect on either distance or angle. To test this, we used three different tee heights. Test one was 1 inch, test 2 was 1.5 inches, and test 3 was 2 inches. The results of this study support one of our hypotheses, and do not support the other one. Our data shows that the higher the tee height, the greater the angle and the distance. The ANOVA test showed that there was a great difference between the angles of the first tee height and the third tee height. The ANOVA test also showed that there was a great difference between the distances of the first tee height and the third tee height.

## PARTICLE SIZE AND PHASE COMPOSITION ANALYSIS OF A TITANIA-BASED VANADIA CATALYST

Ryan Jones
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Titania ($TiO_2$)-based vanadia ($V_2O_5$) catalysts are important for the synthesis of various industrial chemical reactions, such as the partial oxidation and ammoxidation of alkylaromatic compounds and selective catalytic reduction of $NO_x$. Large surface areas or small average particles are generally desired for facilitating effective catalytic reactions. This project investigated the effects of heat treatment temperature and doping level on the particle size of the catalysts. $TiO_2$ (anatase)-$V_2O_5$ samples were prepared by an impregnation technique and treated at various temperatures from 450°C to 600°C. The samples were then characterized for the phases present and particle size using X-Ray Diffractometry (XRD). The average particle size of anatase-based vanadia catalysts was found to increase with the increasing heat treatment temperature. A sudden increase in particle size was observed between 550°C and 600°C. A small amount of anatase transformed into rutile phase after heating at 600°C. Understanding the particle coarsening and phase transformation are important for increasing the efficiency and cost effectiveness of the industrial catalysts.

## THE EFFECT OF CANCER CACHEXIA ON THE SKELETAL MUSCLE IGF-1/mTOR SIGNALING PATHWAY

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Cachexia is a condition involving the loss of overall body mass due to increased rates of skeletal muscle and adipose tissue catabolism (Durham et al 2009). This combination leads to the frail appearance and weakened physical state of most cancer patients, causing 22% of all cancer patient deaths (Tisdale et al 2009). In healthy individuals, muscle mass is maintained by constant regulation of protein synthesis and degradation. In cachectic patients, the balance between muscle protein synthesis and degradation is disrupted resulting in muscle atrophy. Mechanisms of protein degradation during

cachexia are well documented; however, muscle protein synthesis is relatively unknown. The IGF-1/mTOR pathway is a key component in the regulation of protein synthesis in skeletal muscle. Experiments using different models of cachexia have shown the IGF-1/mTOR pathway inactive in muscle. The $Apc^{Min/+}$ mouse, used in Dr. Carson's lab, is an established model for studying cancer cachexia. The purpose of this experiment is to examine the activation of the IGF-1/mTOR pathway in $Apc^{Min/+}$ mouse with different levels of cachexia. We hypothesize that mice undergoing cachexia will have a reduction in the IGF-1/mTOR pathway. Non-cachectic mice will be represented by 12 week old $Apc^{Min/+}$ mice that have no cachexia or are in the earliest stages. The cachectic mice will be represented by 20 week old $Apc^{Min/+}$ mice that have all shown cachectic symptoms. Using the western blot technique, we plan to measure the activation of different proteins involved in the IGF-1/mTOR pathway in the gastrocnemius muscle including mTOR, 4EBP-1, and p70.

## CAR ALLOWANCE REBATE SYSTEM: THE EFFECT OF ALUMINUM AND MAGNESIUM ON THE FORMATION OF A SODIUM SILICATE LAYER

Sanchit Kapur and Connor N. Kirol
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The purpose of this study was to determine whether metal, aluminum or magnesium, was the most effective in rendering the engine unusable of a car in the Car Allowance Rebate System. It is hypothesized that the mass of the layer of sodium silicate produced from a reaction with forty percent sodium silicate solution will be greater on aluminum than magnesium in a ten second reaction, a twenty second reaction, and a thirty second reaction. Samples of aluminum and magnesium were placed into approximately 30mL of 38-42% Sodium Silicate solution that was heated to 75.5 C. After time intervals of 10, 20, and 30 seconds, the metal was removed from the solution and weighed on an analytical balance. The data analysis showed that the experimental design was effective in determining the difference of the reaction results between aluminum and magnesium at different times because the majority of the data yielded significant results. The data trends, including the mass after the reaction and the percent change between the two masses, show that aluminum was more effective in rendering the engine unusable in the Car Allowance Rebate System than magnesium. The results supported the hypothesis that the mass of the layer of sodium silicate produced from a reaction with forty percent sodium silicate solution was greater on aluminum than magnesium in a ten second reaction, a twenty second reaction, and a thirty second reaction. This project could be improved by testing a car used in the Car Allowance Rebate System.

## DEVELOPING A CONTROL SYSTEM WITH THE WII REMOTE AND MOTIONPLUS FOR USE IN A MEDICAL SIMULATION

Euan Kemp
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This research was undertaken to create a medical ultrasound simulation to produce an accurate imitation of both a real ultrasound device's controls and display. To create a simulation of the controls, a Wii Remote and Wii MotionPlus were used. A programming library was modified to work with the Wii Remote and Wii MotionPlus, and the data was then manipulated to find the position of the Wii Remote, just as an actual ultrasound controller gives its position. Unfortunately, the data retrieved from the Wii Remote and Wii MotionPlus did not result in a position of sufficient precision to be an accurate

simulation of a real ultrasound device's controls. Other methods were examined for viability, and it was concluded that using a Wii Remote in conjunction with infrared lights might offer sufficient precision at the cost of convenience and ease of use.

## ANTIOXIDANT CONTENT IN MUSCADINE SEED AND SKIN EXTRACT

Alexander J. Kerr
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Studies have shown that muscadine grapes have a large content of antioxidants and secondary metabolites. There have been recent research endeavors to find the human nutritional value of antioxidants. The objective of this experiment was to determine bioactivity potential in muscadine grapes in terms of phenolic, flavonoid, and anthocyanin content. By testing standard solutions in a spectrophotometer and comparing their absorbance to muscadine extract, we can observe how these compounds affect human health when consumed. The chemicals are known to protect the body against free radicals and have potential anticancer effects and other health benefits.

## THE EFFECT OF BIOMASS TYPE ON HYDROTHERMALLY CARBONIZED BIOCHAR AS A SOIL SUPPLEMENT AND ENERGY SOURCE

Afia Khan
Spring Valley High School

The annual release of carbon into the atmosphere has been attributed to global warming and other environmental problems. To combat this, the carbon negative implementation of biochar is proposed. This research is aimed at the characterization of biochar produced through hydrothermal carbonization of banana peel, cornstalk, and *Gardenia jasminoides* leaves as agents for carbon sequestration, fertilization, and energy content. Each biomass was shredded, placed with water into airtight reactors, and heated at 250ˆC for 21 h. The mixture was then allowed to cool, and the solid product was filtered out and dried at 80 C for 24 h. Energy yields were measured before the process and after using a calorimeter, and it was shown that while energy yields increased most dramatically (40 times the original biomass) for biochar produced from banana peel, all biochar had energy yields comparable to that of commercial charcoal. Water retention capabilities were also measured as a unit of time. Cornstalk biochar proved to retain water for longer periods of time than raw soil. In addition, for each type of biochar, *Eleusine coracana Gaertn* and *Brassica juncea* were grown indoors in 30 plots of soil with 1.5% additions of char, using a 12 hour on and off light cycle. Due to a cold spell, however, growth was stunted, and plant growth will be allowed to continue so that more conclusive results can be determined. Plant growth will then be massed and statistically analyzed with an ANOVA at the alpha=0.5 level.

## THE ENHANCEMENT OF APOPTOSIS IN HUMAN MALIGNANT NEUROBLASTOMA IMR-32 CELLS AFTER TREATMENT WITH 4-(N-HYDROXYPHENYL) RETINAMIDE AND EPIGALLOCATECHIN-3GALLATE.

Mehrab Khandkar
Spring Valley High School

Malignant nauroblastoma is a childhood tumor that originates from immature neuroblasts, in most cases, 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 IMR-32 cells in culture. Preliminary studies indicated that the combination of 4- HPR and EGCG was more effective than either treatment alone in increasing apoptotic death in IMR-32 cells. Further studies are needed to explore the signaling mechanisms that are triggered for enhancement of apoptosis in IMR-32 cells after treatment with the combination of 4-HPR and EGCG. In the estimation of cell death, a one-way ANOVA indicated that there was a significant difference between control cells and treatment cells in number of live cells, $F(3,8)=12.76$, $p=0.002$ and $p<0.05$. The null hypothesis was rejected. A Tukey test was run and found that the significant differences were between the control, no 4-HPR or EGCG treatment, and EGCG and between 4-HPR and the Combination, 4-HPR and EGCG combination, groups. There were also significant differences found between the 4-HPR and EGCG and between 4-HPR and the Combination.

## THE EFFECT OF DRIED AND CRUSHED; LEMON AND GRAPE FRUIT PEELS ON FILTERATION OF SYNTHETIC DYE

Stella Kim
Spring Valley High School

Dyes can be hazardous to people and living organisms. This project will benefit the environment in third world countries where dye regulation is not strict. The purpose of this project was to test two different citrus fruits lemon and grapefruit and their ability to remove dye. Out of the multiple ways to clean up dye within the environment, absorption is a highly effective method. While absorption is the least expensive method, it is difficult to carry out on a large scale. The hypothesis was that there will be no significant difference between the peelings, since they are both within the citrus family. The method for the test was using filtration and a contact time of an hour. The crushed and dried peels were individually placed in a cup. 20mL of dye solution will be added to each cup for 1hr then left for a day. It was centrifuged, then measured using a spectrophotometer to see the absorbance value. A calibration curve was used to determine the amount of dye that was left in the water. It was made by placing 0.1 mL of dye and 7.9 and the number increased for the dye as it decreased for the water. There was a significant difference in the mean absorption of the lemon versus grape fruit. The mean absorptions of lemon were 0.446 and grape fruit had a 0.586, showing that the lemon peeling had higher adsorption of dye. The two sample t-test showed that the $t(50)=0.038$, $p < 0.05$.

## PHOTOCATALYTICALLY ACTIVATED TITANIUM DIOXIDE NANOPARTICLES USED TO REDUCE THE GROWTH OF *ESCHERICHIA COLI* B

Ayush Kumar
South Carolina Governor's School for Science and Mathematics

The emergence of resistant pathogens has significantly increased with the overuse of broad spectrum antibiotics and bacterial adaptation. As technology rapidly advances in the surgical arena with growing numbers of intensive care units in hospitals, the nosocomial transmittance of pathogenic bacteria is expected to rise. Multi-drug resistant pathogens are found on abiotic surfaces, hands and clothing, along with the patients' sheets and interventional devices. Titanium dioxide nanoparticles for bacterial eradication on these surfaces to benefit the hospital environment were analyzed. Poly-electrolytes present in the anionic and cationic phase were coated onto glass slides and examined for adherence to titanium dioxide. The titanium dioxide coated slides were photocatalytically activated via a 365 nm wavelength lamp with an intensity of 363-4 $\mu W/cm^2$ and exposed to *Escherichia coli* B cultures at a concentration of $1x10^7$ CFU/mL for 2 hours. Results yielded a significant drop in CFU/mL when compared to uncoated glass slides. A free-suspension bioassay using the same parameters evaluated the different types of titanium dioxide. Brookite and nitrogen doped brookite were compared to the commercially available P-25 titania from DeGussa (Germany). No significant difference in the destructive ability between the different types of titanium dioxide was found. All titanium dioxide types yielded a 99% reduction in viable cells compared to *E. coli* exposed to the ultraviolet light without titanium dioxide. Titanium dioxide coating on hospital surfaces can aid in eradicating resistant pathogenic bacteria.

## THE EFFECT OF DIFFERING APPLICATION TIMES OF MUSCLE RELIEF CREAM, MASSAGE THERAPY, OR ICE THERAPY TO PREVENT DELAYED ONSET MUSCLE SORENESS

Alice Le
Spring Valley High School

This study was done to show the effects of differing application times of muscle relief cream, massage therapy, or ice therapy to prevent delayed onset muscle soreness. A survey was formed to ask athletes at Spring Valley whether they used any of the three applicators or none and the times they used comparative to the workout: a day before, an hour before, right before, right after, an hour after, or a day after. After a week, the surveys were turned back in from the boys' cross country team, the girls' volleyball team, and the football team. It was concluded that high school athletes do not highly use muscle relief cream or massage therapy. Applicants who did use ice therapy or none of the treatments didn't show any significant relationship or difference in soreness level over the six day period after the workout. In a one-way ANOVA test [$F(5,348) = 0.63$, $p < 0.05$], there were no difference seen in the treatments over each day. The two-sample t-test showed no significance between the treatments.

## THE EFFECT OF TIME OF RELEASE OF A PERMETHRIN FOGGER ON THE DEATH RATE OF *DROSOPHILA HYDEI*

Akida A. Lebby and Roberts L. Smith
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By using complete release foggers to eradicate household pests, unintentional harm can come to other animals. Is it worth the risk, using these pesticides to kill pest, when pets might be killed in the process? Such was the main purpose of this experiment. It was hypothesized that if *Drosophila hydei* were exposed to food with permethrin within three hours of the fogger's release, then the specimens would have died within 24 hours. Carpet squares that were exposed to these foggers were used to transfer permethrin to water and then to the food of *Drosophila hydei*. Ten *Drosophila hydei* were placed into each container, and death rates of the *Drosophila hydei* were measured according to the time in which the *Drosophila hydei* died after every fifteen minutes starting at 45 minutes after the release of the fogger. The control group used the same procedures but without using a bug bomb, and for one control trial set, without using carpet. The results showed that the time that the permethrin was exposed to the air had no statistically significant effect on the death rate of the *Drosophila hydei*. The presence of the permethrin, however, brought about a 100% death rate in every trial set. The two control sets without permethrin had no deaths after 24 hours, and after around a week they even showed reproduction. These results further validate this experiment.

## THE ASSEMBLY OF BIS-UREA MACROCYCLE INTO COLUMNS

June-Soo Lee
South Carolina Governor's School for Science and Mathematics

The interactions between macrocycles were studied. These macrocycles are synthesized from smaller molecules. There are two different ways that a macrocycle can be assembled. First of all, two or more molecules join through intermolecular forces to create a macrocycle. Secondly, through intramolecular reaction, one molecule reacts with itself to create the macrocycles. We used 5,5'-dimethyl-2,2'-bipyridine molecule to assemble the molecules into building blocks that can be used to create the bipyridyl bis-urea macrocycle. Then, a metal was attached to the macrocycle to create a metallocycle. Thin-Layer Chromatography was used to determine solvent condition and the product was purified by column chromatography. Proton NMR was used to verify the structure of the product.

## THE EFFECTS OF DIFFERENT PHOTOCATALYTICALLY ACTIVATED TITANIUM DIOXIDE NANOPARTICLES ON ESCHERICHIA COLI B

Matthew Lee
South Carolina Governor's School for Science and Mathematics

Rapid bacterial development through transfer of antibiotic resistant genes has significantly increased the morbidity and mortality rates of infections in military personnel, ICU patients, and immunocompromised people. These multi-drug resistant bacteria thrive in hospitals and are transferred by healthcare personnel touching the contaminated abiotic surfaces. A self-sterilizing surface would significantly decrease the transfer rate of these multi-drug resistant bacteria. The aim of this project was to evaluate photocatalytically activated titanium dioxide nanoparticles for their ability to create superoxide anions and hydroxyl radicals. These free radicals kill the bacteria when exposed to long-range ultra violet light (365 nm). The goal was to develop a doped titanium dioxide that was photocatalytically active under visible light (400 to 700nm).

*Escherichia coli* B was exposed for 2 hours to different formulations of doped or non-doped titanium dioxide (P-25, DeGussa, Germany; Brookite 200 and NMP doped Brookite, Clemson Univeristy). Combining the results of four experiments yielded significant results between all samples (average p=0.013). *E. coli* with P-25 exposed to UV (2h) was significantly different from *E. coli* with P-25 in the dark (2h) (p=0.00083). Comparing the 2h UV exposed P-25 to Brookite 200 or NMP Brookite yielded no significant difference between those samples. Comparing the 2h dark exposed P-25 to Brookiite 200 or NMP Brookite yielded no significant difference between those samples. All UV samples were significantly different from all dark exposed samples (average p=0.011).

## FABRICATION OF BIOLOGICAL MICROSPHERE USING SINGLE NOZZLE JETTING

Somin Lee
South Carolina Governor's School for Science and Mathematics

With increasing demand for replacement tissues and organs, the use of inkjet printers as a method of printing cells has emerged as a viable candidate for advanced tissue engineering. The inkjet produces tiny droplets called microspheres which contain cells or other biological material, thus coining the term "bioprinting." Because most applications of microspheres heavily rely on the size of the microspheres, parameter studies regarding microsphere uniformity and size are of particular interest. Specifically, this study focused on the effects of viscosity and backpressure on microsphere size. Glycerol was added to water in varying amounts for the viscosity studies. Printing software called MicroFab™ was used to control the voltage and frequency. A vacuum and pneumatic console was used for the backpressure study. In addition to these parameter studies, yeast cells were encapsulated in hydrogel microspheres using sodium alginate and calcium chloride to be used in future cell viability studies. The study showed that higher viscosities and higher backpressure both result in smaller microspheres although further tests and data are required for more conclusive results. The backpressure study also showed that microspheres become difficult to create when the pressure reaches 9.0 psi or higher. The study also concluded that uniform, yeast cell embedded hydrogel microspheres can be successfully formed using sodium alginate and calcium chloride via the inkjet method.

## THE EFFICACY OF CHLORINE, BROMINE, AND HYDROGEN PEROXIDE TREATED WATER AT PREVENTING THE GROWTH OF *CHLORELLA PYRENOIDOSA*

Ji-Hyun J. Lim and Samuel R. Feldman
Heathwood Hall Episcopal School

The purpose of this experiment was to test the ability of chlorine, bromine or hydrogen peroxide pool chemicals at reducing the growth of *Chlorella pyrenoidosa*. To simulate a pool atmosphere, normal chemical level amounts for each chemical were added in proportion to tap water. For each of the pool chemicals and for untreated water, seven cuvettes were set up to simulate pool environments. Each cuvette was inoculated with a constant quantity of *C. pyrenoidosa*. To measure the growth of the *C. pyrenoidosa*, a Vernier© colorimeter (525 nm) was used to measure the light transmittance through each cuvette. On twelve consecutive dates, the transmittance for each cuvette was measured. Based on the chemical effect of $H_2O_2$ on cellular membranes, it was

hypothesized that the percent growth of *C. pyrenoidosa* would be less with hydrogen peroxide treatment of water as compared to bromine and chlorine treatment. It was found that the *C. pyrenoidosa* had positive growth with each chemical over the twelve-day period. It was found that the *C. pyrenoidosa* had the greatest growth in cuvettes with the hydrogen peroxide treated water, while bromine and chlorine treated water had a lesser percentage growth as compared to water. The analyses of the data showed there were no statistical differences in the percent growth of the *C. pyrenoidosa* in the hydrogen peroxide treated cuvettes, chlorine treated cuvettes, and bromine treated cuvettes as compared to the untreated cuvettes.

## THE EFFECT OF FAT BURNING SUPPLEMENTS ON FAT

Mary Caroline Lowe
Timberland High School

This experiment explores the effect of dietary supplements on fat. During this experiment pig fat was submerged into dietary solutions, which was left for two weeks. After the two weeks were up the fat was taken out and was observed and weighed on a triple beam balance. The hypothesis of this experiment was taking a natural dietary supplement daily would have more positive and cost effective results than taking synthetic supplements which could have adverse effects. The hypothesis of this experiment was neither proven nor rejected. Some of the fats lost mass and some gained mass. With the exception of Hyaluronic Acid and Vitamin B12, the fat lost at least two grams of mass on average.

## THE ROLE OF HUMAN ALKALINE CERAMIDASE 2 IN FENRETINIDE CHEMOTHERAPY

Zhehao Mao
Academic Magnet High School

(4-Hydroxyphenyl)retinamide, also known as fenretinide or 4-HPR, is an anti-cancer chemotherapeutic agent that has been shown to induce the growth arrest and apoptosis (programmed cell death) of tumor cells. The growth inhibitory and apoptotic effects of 4-HPR have been linked by previous studies to changes in the cellular levels of various sphingolipids, such as dihydroceramide and dihydrosphingosine, both of which have been implicated in the growth arrest and apoptosis of tumor cells. It has been shown that treatment with 4-HPR increases the levels of dihydroceramide by inhibiting the activity of an enzyme called dihydroceramide desaturase 1 (DES1), which catalyzes the conversion of dihydroceramide to ceramide. However, the mechanism by which 4-HPR increases the levels of dihydrosphingosine remains unknown. We hypothesized that human alkaline ceramidase 2 (haCER2), an enzyme that catalyzes the hydrolysis of dihydroceramide into dihydrosphingosine, may play a role in mediating 4-HPR-induced generation of dihydrosphingosine and 4-HPR-induced growth arrest and apoptosis in tumor cells. To test this hypothesis, a series of experiments were performed. Quantitative PCR (qPCR) demonstrated that treatment with 4-HPR increased the expression of haCER2 in Hela T-Rex tumor cells. Mass spectrometry showed that haCER2 overexpression increased the levels of dihydrosphingosine in tumor cells and augmented the effect of 4-HPR on dihydrosphingosine levels. Knockdown of haCER2 expression by RNA interference (RNAi) inhibited the 4-HPR-induced increase in the levels of dihydrosphingosine in tumor cells. These results suggest that 4-HPR increases the levels of dihydrosphingosine in tumor cells by increasing the expression of haCER2. It

was found that increasing haCER2 expression made tumor cells more sensitive to 4-HPR-induced apoptosis. On the other hand, blocking the expression of haCER2 through RNAi made tumor cells more resistant to 4-HPR-induced apoptosis. These results suggest that haCER2 expression mediates 4-HPR-induced apoptosis in tumor cells through the generation of dihydrosphingosine. In line with this concept, it was found that treatment with D-erythro(e)-dihydroceramide, which can be converted to dihydrosphingosine, induced apoptosis in tumor cells, whereas treatment with L-t-dihydroceramide, which cannot be converted into dihydrosphingosine, did not. Moreover, L-t-dihydrosphingosine, which cannot be converted into dihydroceramide in tumor cells, induced apoptosis more potently than D-e-dihydrosphingosine, which can be converted into dihydroceramide. Based on these results, we conclude that 4-HPR increases the levels of dihydrosphingosine in tumor cells by increasing haCER2 expression and that the increase in dihydrosphingosine but not dihydroceramide mediates the 4-HPR-induced apoptosis of tumor cells.

## AFFECT OF DIFFERENT MOLARITIES ON DIFFERENT SOILS

Meghan Matlack
Dutch Fork High School

This study's objective was to determine how different molarities of acid rain would affect different soils. Water scientist Greg Lawrence studied the link between acid rain and types of soils determining that although most soils can offset the acidity in acid rain because of elements like calcium and limestone that neutralize the acid it depends on the level of bases in each soil. These results will contribute to the study and be used to determine which molarities have the greatest affect on the soils and which molarities have the least affect on the soils. Based on this research the results that are to be expected from this experiment would be that soils that are more basic will not be as affected as soils that are less basic due to the basic soils being able to neutralize the more concentrated (greater molarity) acid rain better than the less basic soils.

## THE EFFECT OF VARIOUS TYPES OF DISACCHARIDES AND THE HERBICIDE ATRAZINE ON THE HEIGHT OF *BRASSICA RAPA*

Kirstin McCutchan
Spring Valley High School

All plants need the basic elements of water, soil, and sunlight to grow to their highest potential. Some plants have to go through even more though when being grown in a natural environment. There are usually pollutants in natural soil that can stop plants from growing to their highest potential. The purpose of this experiment was to determine what height *Brassica rapa* (Wisconson Fast Plants) would grow to when being polluted with the herbicide atrazine and, at the same time, treated with three different disaccharide solutions. It was hypothesized that the lactose solution would result in the greatest height. The *Brassica rapa* was grown in four trays with the same soil. The trays were split into 18 different plots in which to grow individual seeds in. Each plot of soil was then polluted with the same amount of the herbicide atrazine. There were four different trays of these and they were each watered with different water solutions of different disaccharides. There were 18 plants per tray. The first tray was watered twice a day with tap water, which was the control, by spray bottle. The second tray was watered with tap water plus sucrose, the third with tap water plus maltose, and the fourth with tap water plus lactose via the same method. The amounts of the disaccharides

in the water were held constant. The *Brassica rapa* continued to grow for four weeks and the height of each plant was recorded. An analysis of variance, ANOVA, test was conducted and it was discovered that with an F-value = 2.45, there was no significant difference between the disaccharides and control and thus, the hypothesis was not supported.

## THE EFFECTIVENESS OF A POWERED EXOSKELETON ARM IN REDUCING THE HEART RATE INCREASE OF LIFTING

Michael McDonald
Spring Valley High School

The purpose of this experiment was to design and build a pneumatically powered, one degree of freedom powered exoskeleton arm and then test its effectiveness in reducing the heart rate increase that subjects experienced when performing a lifting activity. It was hypothesized that the powered arm would be successful in lowering the heart rate increase a statistically significant amount. To perform the test, a powered exoskeleton was constructed out of PVC pipe, an air cylinder, metal brackets, wood, and tubing. The air cylinder was used to apply a lifting force to the moving part of the arm and help lift a 2.3 kg weight. The subjects lifted the weight for two minutes at a steady rate without using the powered arm. The subjects then lifted the weight for two minutes at the same rate while using the arm. During each of these tests the subject's heart rate was monitored and recorded. The data was collected and analyzed, with heart rate increase being calculated by subtracting the initial rate from the heart rate of the subject after they completed the lifting activity. The increases were visibly less when the subjects used the powered arm, with significantly less heart rate changes. A dependent samples T-test was performed at the a=0.05 level, where it was shown that there was a significant difference in the two samples, meaning the null hypothesis was rejected and the hypothesis that the powered arm would lower the heart rate increase was supported.

## DOES LIGHT OR HEAT ATTRACT NIGHT INSECTS?

Marquell McFadden
Timberland High School

Attraction to light or heat by insects has been investigated from time to time. To put these questions to work, an experiment for a project has been conducted to find out the true answers to these general questions. It was hypothesized that the factor of light would have the most night insects attracted throughout the entire project. Attraction to light or heat by insects has been tested and the results show that majority are attracted to light, which was the object of the fluorescent light bulb (energy efficient bulb). But not to give light all the credit, it has been proven that insects are attracted to heat as well, which would be the incandescent bulb. Factors of light vs. heat were tested on every two days. Factors that may have affected the results of the experiment could have been the weather condition or location of experiment (location was swampy and wet during experiment). To keep this in mind, the time of night each light bulb was tested may have affected the results of the project. Over the four weeks test period, more insects were attracted to the light of the energy efficient light bulb than that of the incandescent light bulb. Therefore the alternate hypothesis was supported.

## SEED DEVELOPMENT USING A PROMOTER REPORTER GENE CONSTRUCT

James McManus
South Carolina Governor's School for Science and Mathematics

*Low Seed Setting 2* (*LSS2*) is a gene in rice that encodes a tetratrico peptide repeats (TPR)-like protein. It was identified through a genome search query for genes homologous to the *Low Seed Setting 1* (LSS1) gene. The *LSS1* gene is involved in pollen viability and seed production in rice plants, and when suppressed, caused a significant reduction in seed yield. It is hypothesized that LSS2 may have a complementary function to LSS1 and contribute to pollen and seed development. To functionally characterize *LSS2* gene, a *LSS2* promoter-GUS reporter gene construct was generated to understand *LSS2* gene expression in plant cells and tissues. The *LSS2* promoter region was amplified using polymerase chain reaction (PCR), and the amplified fragment was cloned into the pGEM-T-easy cloning vector to produce pGEM-T-Os01g_P plasmid. Recombinant clones were selected using colony PCR, and the cloned PCR product was verified by restrictive digestion and gel electrophoresis of the plasmid DNA as well as DNA sequencing. The cloned LSS2 promoter was then restriction digested from the pGEM-T-Os01g plasmid and ligated into the pSBbarB #5-GUS-nos binary vector to produce the final construct: pSBbarB-LSS2-GUS-nos. The successfully transformed colonies will be isolated and the constructed binary vector will be introduced into *Agrobacterium*, which will be used for rice transformation. Transgenic analysis of reporter gene expression will elucidate how *LSS2* gene expressed in plants, shedding light on the functions of *LSS2* in plant development.

## THE EFFECT OF FLOUROPYRIMIDINES, FDURD AND 5-FU ON THE CELL SENSITIVITY OF CELL LINE CHLTS-(PJZ205) THYMIDYLATE SYNTHESIS INHIBITION USING CHEMICAL REAGENTS BSO AND MNTBAP

Jai McQuilla
Spring Valley High School

Colon cancer burdens America by killing a vast majority of the cancer population. It is a highly publicized cancer and more Americans are getting screened. It has also been found to be an "inherited" cancer. As more people become more knowledgeable about the disease it is still coherent that a cure is found. This experiment was preformed to test the best treatments for inhibiting colon cancer cell growth. The test used two fluoropyrimidines, 5-fluorouracil and 5-Fluoro-2'-deoxyuridine, and two antibiotics, BSO and MnTBAP. The hypothesis for the experiment was the solution MnTBAP + BSO would inhibit cell growth. The cells were put into different concentrations, 0nM, 10nM, 50nM, 100nM, 500nM, and 1000nM, of the fluoropyrimidines for each trial. Each trial got a sub-trial of each antibiotic. The living cells were counted and data were put into a table. A one way ANOVA test was conducted to analyze at alpha = .05. All tests rejected the null hypothesis. The p-value for the 5-FU concentration alone was .034 and the alpha value was .05. All other test had the p value < 0.00 and the alpha value of .05. Therefore the hypothesis was supported; BSO + FdUrD had the best effect. The data also indicated that only the FdUrD trials decreased in the number of cells alive and visible. Therefore the study indicates that FdUrd+ BSO has the better effect on killing and inhibiting colon cancer cells.

## CORRELATION BETWEEN HEAT SHOCK STRESS AND AGING IN *CAENORABDITIS ELEGANS*

Mitchell Meadors
South Carolina Governor's School for Science and Mathematics

*Caenorhabditis elegans* is a model organism well suited for use in research involving genetic manipulations. *C. elegans* genome has been completely mapped and it has a relatively short lifespan of two to three weeks, making it an excellent model for experiments concerning lifespan. The nematodes are easily maintained on agar plates seeded with *Escherichia coli* OP50. The life of *C. elegans* consists of five stages: L1, L2, L3, L4, and adult, each easily distinguished from the others. For lifespan assays, L4 worms are usually utilized. Environmental and genetic factors both play a role in the aging process. The purpose of this project was to determine how individual genes play a role in aging. RNA interference (RNAi) was used to silence individual genes. An RNAi feeding library of *E. coli* was used to treat the worms, silencing the desired genes. The worms were then maintained for two generations to ensure health. Next, a heat shock treatment was applied and a lifespan assay performed. Results were analyzed in a statistical model. A group of genes was identified that could possibly extend lifespan in stressful conditions. Further studies need to be performed to confirm these results and to test the genes under various kinds of stress. Eventually, it is hoped that this research will lead to a better understanding of aging in higher-level organisms.

## CORRELATION BETWEEN LOWEST BAROMETRIC READING AND TIME OF RECOVERY TO NORMAL BAROMETRIC READING

David Metz
Dutch Fork High School

The purpose of this project is to find the correlation between the lowest barometric reading of a frontal system and the amount of time that it takes for the barometric reading to return to normal barometric reading before the system passed over a given area. These results will be obtained by finding a radar indicated frontal system and placing the GLX with barometer probe in an open window at Dutch Fork High School 6 hours before the system will be over head to get an accurate barometric reading. Then once that is achieved the barometric pressure will be taken until the lowest reading appears and when the radar indicates the core or center of the storm has passed over the school the GLX will continue taking the readings and the amount of time it takes for the barometric pressure to return to normal level will be collected. From these readings I will then put the graphs on top of each other and find a line of best fit for the graphs (for now 5 storms were used for the line because of time constraints.)

## THE EFFECT OF TEXT COLOR ON THE ABILITY TO RECALL

Christopher Metzger and Jannie Adams
Heathwood Hall Episcopal School

As a person is driving, only two to three seconds are available to look up and read a sign. The purpose is to test whether two colors' relative positions (complementary or adjacent) on a standard color wheel would affect a person's ability to recall the text after reading for two seconds. The test subjects were given five random words, each of five letters or fewer, on a computer screen. They were asked to read these words and then recount all of the words they remembered. There were four slides presented of each of these four

color combinations: black and white (control), red and green (complementary), red and orange (adjacent), and red and indigo (adjacent). The number of words each subject got correct and the number in the correct order were recorded out of five, and then averaged for each of the color combinations. It was hypothesized that color combinations that are complementary would be easier to read than those which are adjacent on the color wheel, and the results supported this hypothesis. The control had the highest accuracy, and the orange text with the red background had the lowest accuracy. Each of the color combinations was then compared to the control group using an ANOVA test; the results showed that all the color combination had a statistically significant difference when compared to the control except the results from the red and indigo slides which was proven to be too similar to the results of the control slides to be significant.

## HISTAMINERGIC RECEPTOR REGULATION OF SEROTONIN TRANSPORTERS

Breelyn Miles
South Carolina Governor's School for Science and Mathematics

Serotonin or 5-Hydroxytrypamine is a neurotransmitter present in the brain which controls various physiological processes such as mood and memory. Deregulation of serotonin concentration in the synaptic cleft has been implicated in many psychiatric disorders such as depression, anxiety disorders, and schizophrenia. SERT, a serotonin specific transport protein, regulates serotonin reuptake in neurons; thereby influencing the amount of extracellular serotonin as well as the amount of time which serotonin is present outside of neurons. Understanding SERT is vital in the development of new treatments for such psychiatric disorders as it is the target for many antidepressant medications. Histamine is another common neurotransmitter which plays a role in sleep regulation, cognitive ability, and pain reception. My laboratory hypothesized a possible relationship between serotonin uptake and active histamine receptors, specifically active H3R receptors. In this study, the effects of histamine receptor activation on the levels of serotonin reuptake by SERT were examined. Levels of SERT protein present in the plasma membrane and intracellular pools of cells following activation of histamine receptors were also examined. Determination of H3R receptor-regulated serotonin reuptake and the effects of antidepressant treatment on such regulation may aid in the study of depression and in the development of effective pharmacological agents for the treatment of depression and other disease states resulting from aberrant serotonin transmission.

## PREDICTING TRAVEL TIMES FOR THE OPTIMIZATION OF PLUG-IN HYBRID VEHICLES USING VEHICLE-GENERATED MICROSCOPIC TRAFFIC DATA

Jassiem Moore
South Carolina Governor's School for Science and Mathematics

Plug-in Hybrid Electric Vehicles (PHEVs) can increase fuel efficiency and reduce greenhouse gas emissions. This research looks for a way to make PHEVs even more efficient by determining the travel time to and from different locations. If the travel time was accurately predicted, the PHEV's modes of operation could be optimized for the most efficiency. The travel times were predicted with a program called Neural Solutions, after traffic data from Paramics was fed into it. A network was built that simulated two intersections within the Clemson Campus. Paramics returned data based on the structure of the network and the cars traveling along it. In this experiment, historical travel times, rate of flow, and vehicle density were taken from Paramics and

used in Neural Solutions. Within Neural Solutions, two programs called Data Manager and Neural Builder were used to train the network. The data from Paramics was placed in an Excel spreadsheet, where the flow of each link, historical travel times, and the vehicle density were marked as input. The different inputs were used together, and separately, to determine which produced the best results. Within Data Manager the data was split into a training and testing set. Tests showed that at an epoch value of 1000, rate of flow and historical travel times performed the best. This test was done with data collected on a single day, but past research show that data collected over several days can lead to a more accurate prediction model.

## THE EFFECTS OF HISTORICAL LAND USE ON BACTERIAL AND FISH COMMUNITIES IN RURAL PIEDMONT STREAMS OF SOUTH CAROLINA

James Evan Musselwhite
South Carolina Governor's School for Science and Mathematics

The aim of this project was to study the impact of historical agrarian land use, specifically cotton farming, on rural Piedmont watersheds in Upstate South Carolina. Extensive historic cotton farming and textile manufacturing was carried out in this area which may have resulted in metal contamination of sediment in this region, as several metals, notably arsenic and copper, were components of historically used pesticides. We hypothesized that historical soil degradation and metal contamination may still be causing negative effects on the biota in these rural areas. As such, the main focus of this research was to monitor bacteria levels and fish populations at varying distances from historical textile mill sites. Total coliform, *E. coli*, and *Enterococcus* bacteria levels were measured at 24 sites using IDEXX. Fish were collected at 15 sites with a backpack electrofisher and seine, with fish later identified to species in the laboratory. Results showed increasing trends for *E. coli*, and *Enterococcus* levels as sites got closer to historic mills with species richness, Simpson's diversity index, and number of intolerant and moderately intolerant species increasing as sample sites increased in distance from mill sites. These trends support our hypothesis, but not all results corroborated these findings. Future research may help us better elucidate the answers to this and other related questions. So we hypothesize that historical agrarian land use, specifically the cotton legacy, has caused negative effects on the bacterial and fish communities in rural Piedmont streams of South Carolina.

## IMMEDIATE AND SUBCONSCIOUS RESPONSE: A STUDY OF SOCIAL AND RACIAL STEREOTYPING

Kaity Nisbet
Dutch Fork High School

The purpose of this project is to determine stereotypes are commonly used in youth and discover what makes certain youth more prone to stereotyping. Racial and cultural diversity in today's society have made prejudices occur at an increasing rate. Over 500 students are planned to be tested by asking them to immediately respond to a certain image after it appears on the screen. After recording the student's responses, follow up questions to determine the student's race, gender, age, family life and religious beliefs will be written down for the students to record answers to. These answers along with the responses to the pictures will be analysis and the data will be recorded to determine which racial groups hold certain stereotypes and how common the stereotypes are in today's youth.

## THE EFFECT OF SODIUM BENZOATE AND SODIUM SILICATE ON MITIGATIONG ZINC CORRSION IN POTASSIUM HYDROXIDE

Sean Noh
Spring Valley High School

Since the industrial revolution, batteries have been increasingly more common and significant. There are many different types of batteries that use different types of electrodes, anodes and electrolytes. One specific type of battery is the silver-zinc battery. Silver is used as the electrode, zinc as the anode, and potassium hydroxide as the electrolyte. The purpose of this experiment is to mitigate the corrosion of one of the metals in the battery to increase lifetime of the battery. It was hypothesized that when the sodium silicate was applied, the corrosion rate of the zinc would decrease. Zinc strips were randomly placed in three groups, and thirty strips were treated with sodium benzoate, thirty strips were treated with sodium silicate, and thirty strips were untreated. They were placed in 3.0M potassium hydroxide. Each zinc strip was massed before treatment, after treatment and after being placed in potassium hydroxide. A one-way ANOVA was conducted on the difference in mass of before and after potassium hydroxide corrosion to determine if there was a significant difference of the mitigation of zinc corrosion from each treatment. The one-way ANOVA tests indicated that there was a significant difference between the means of the before and after masses differences. The Tukey test also indicated that there was a significant difference between sodium silicate and the other two groups. This suggests that sodium silicate had an effect on the mitigation of zinc corrosion in potassium hydroxide.

## THE EFFECTS OF 0 MILLIGRAMS, 20 MILLIGRAMS, AND 80 MILLIGRAMS OF CAFFEINE ON REACTION TIME

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This study compared the effects of 0 milligrams, 20 milligrams, and 80 milligrams of caffeine on the reaction time of teenage girls. The hypothesis was that the 80 milligrams of ingested caffeine would statistically decrease the reaction time more than the 20 milligrams of caffeine. The independent variable was the caffeine amount and the caffeine source, while the dependent variable was the mean reaction time. Ten girls of the ages fourteen through fifteen took the reaction test (Biobytes) on a computer with no caffeine in their system. Afterwards, they digested 2 oz of Red Bull, which contained 80 mg of caffeine, waited 20 minutes for it to be fully absorbed into their system, and then took the reaction test again. This process was then repeated a week later using 2 oz of Folgers Coffee, which contained 20 mg of caffeine. The data showed that when using a one-tail t-test, the reaction times significantly quickened between 0 mg of caffeine and 80 mg of caffeine. The results thus supported the alternate hypothesis, that the reaction time significantly decreases between when 0 mg of caffeine are consumed and 80 mg of caffeine are consumed. Therefore, digesting 80 mg of caffeine significantly decreases your reaction time, thereby effectively improving response time.

## THE EFFECT OF PRE-ASSESSMENT SOCIALIZATION ON ASSESSMENT PREFORMANCE

Naomi E. Nudelman
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Cognitive memory is the ability to retain and recall information. In reference to a test, cognitive memory is useful in remembering facts and being able to apply them properly. The purpose of this project was to discover if pre-assessment socialization improved memory leading to higher assessment scores. Students in four different classes were divided into two separate groups, one was given permission to socialize prior to the memory test they were given. The other group had to remain completely silent for the same amount of time. Next, the students were given an assessment that was meant to test their memories. It was hypothesized that socialization would improve the memory of the students. After data collection, a two-sample t-test was conducted to show whether or not socialization had, in fact, increased memory performance. The results showed that $t_{0.01}= 0.44$, indicating that socialization did not increase memory performance among the sixty-three students in this experiment.

## THE EFFECTIVENESS OF ADDING A PHOTOSENSITIZER TO THE PHOTODYNAMIC TREATMENT OF INFECTED TOOTH ROOTS AND DENTAL IMPLANTS UNDER ANAEROBIC CONDITIONS

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Photosensitizers absorb and concentrate light energy of specific wavelengths. If a photosensitizing dye were to be retained by pathogenic bacteria, then the application of a laser light to these bacteria may enhance the observed lethal photosensitization. The purpose of this experiment is to determine the effects of the addition of a photosensitizer to photodynamic therapy on the roots of teeth and the surface of dental implants.Under anaerobic conditions, human subgingival bacteria were cultivated and applied to twelve tooth roots and twelve implants. Of these, 6 of each group were treated with a photosensitizer (toluidine blue) before undergoing laser disinfection, and six were treated without the photosensitizer.Still under anaerobic conditions, the samples grown in a bacterial media. After 4 days, the turbidity of each sample was measured. On average, the tooth roots with the photosensitizer had 28.3 percent lower turbidity than those treated without the photosensitizer, and the implants treated with the photosensitizer had 40.96 percent lower turbidity than those treated without the photosensitizer.These results indicate that the addition of a photosensitizer greatly increases the bacterial reduction on both the tooth roots and implants, however the improvement is much more prevalent for the dental implants than it is for the tooth roots. In a statistical analysis, these results were shown to be significant ($p< .5$).These results show the effectiveness of adding a photosensitizer, and show that in procedures in which bacterial reduction is the main purpose, a photosensitizer should be utilized.

## IDENTIFYING THERMAL DEGRADATION IN APACHE AH-64 GEARBOX GREASE

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South Carolina Governor's School for Science and Mathematics

The South Carolina National Guard and the University of South Carolina have formed a partnership in developing Condition Based Maintenance Systems for the AH-64 Apache helicopter. Condition Based Maintenance Systems are being developed in order to minimize waste, save money, and improve efficiency in helicopter maintenance. This is accomplished by monitoring the condition of individual helicopter parts through the use of Condition Indicators to properly identify when maintenance is required and parts need to be switched out. In contrast, the current system in use relies on a schedule based system that changes parts out on a regular basis regardless of condition. The University of South Carolina operates a test stand to simulate the main rotor swash plate and tail rotor of the AH-64 Apache helicopter. A special type of NS-4405-FG grease is used inside the tail rotor gearbox and intermediate gearbox. When subjected to high temperatures, the grease is theoretically supposed to break down and produce heat. Its highest operating temperature is 250 degrees. An experiment was conducted to find out what the grease did when subjected to temperatures above its standard operating temperature. An electric oven, three beakers, and three thermocouples were used. Temperatures were taken every five minutes with the thermocouples. The grease was heated to over 400 degrees, at which theoretically it should have broken down and produced heat. However, repeated experiments showed the temperature climb of the grease to be very linear with no exponential climb around 400 degrees as theorized. Therefore we can conclude that there is an unknown factor in addition to heat that causes the grease to break down in the tail rotor and intermediate gearboxes.

## THE EFFECTS OF AN ORGANIC FLAME RETARDANT: INSPECTA-SHEILD® PLUS ON MUTATION RATES IN *DROSOPHILA MELANOGASTER*

Braden D. Payne
Spring Valley High School

The purpose of this research was to determine the mutative affect of INSPECTA-SHEILD® PLUS on mutation rates in *Drosophila melanogsater* (fruit fly). It was hypothesized that the culture with the highest INSPECTA-SHEILD® PLUS concentration would yield the highest mutation rates. In order to test this hypothesis, standard *D. melanogaster* techniques were used to raise the flies, and INSPECTA-SHEILD® PLUS was utilized to supplement the liquid used to prepare the *D. melanogaster* cultures, yielding cultures of varying levels of flame retardant exposure. The flies were left to mature for around 2 weeks, and were then removed and the flies were counted, scored, and 5 females and 5 males from each culture were transplanted in a new "clean" cultures, and left to mature, and were then removed, and scored. After testing, a Chi square test was performed on the F1 and F2 generation data, and it was found that there is no significant correlation between INSPECTA-SHEILD® PLUS application concentration and mutation rates in *D. melanogaster*, and the hypothesis was not supported.

## THE DEVELOPMENT OF A NOVEL POLYMER FOR CONTINUOUS GLUCOSE SENSING

Rebecca E Peltzman
South Carolina Governor's School for Science and Mathematics

Diabetes is a disease that affects around 7.8% of the United States population, or around 23.6 million people in the US alone. A MEMS (microelectromechanical system) device in which glucose can be continuously monitored by changes in viscosity of a polymer as glucose binds within the polymer solution had been developed. In this investigation, we will discuss the engineering of polymers to determine the mechanism the polymer uses to bind to the glucose. The main mechanism expected to be responsible involves the side chain containing boronic acid. A novel polymer, PHEAA-ran-PAAPBA was developed.

## THE EFFECT OF PELLET WEIGHT AND BARREL LENGTH ON ACCURACY OF AN AIRSOFT GUN

Jaron L. Pettis
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Airsoft guns are toy guns that are made to look like real guns. Airsoft teams use these guns to shoot the other team. The guns shoot plastic pellets which are made to let you know you have been hit but not to cause severe damage. A huge conflict is how to increase accuracy of these guns. Two ways that are thought to increase accuracy are barrel length and pellet weight. If a longer barrel is used and heavier pellets are used then the accuracy is believed to increase. To test if barrel length and pellet weight effect accuracy a gun mount was made and used to aim an airsoft gun at a grid paper target. The pellet weights used were .3 grams, .2 grams, and .12 grams. The barrel lengths used were long (29.21cm) and short (19.05cm). The first trial was with the long barrel and the .3 gram pellets. The airsoft gun was loaded with 20 pellets and fired at the target until all pellets were fired. The locations where the pellets hit the target were marked and measured to find the mean and standard deviation. This was then used to find the accuracy and the closer it was to zero the more accurate the trail was. The same thing was repeated until all pellet weights were used and barrel lengths. The result was that the .3 gram pellets and the long barrel was the most accurate with the .12 gram pellets and short barrel being the least accurate supporting my hypothesis.

## THE EFFECT OF LOCATION ON THE ABILITY OF BACTERIA TO GROW IN THE CONGAREE RIVER

Tyler Pixley
Spring Valley High School

It has been found that trace amounts of antibiotics and other harmful substances exist in bodies of water (Giger et al, 2003). This experiment was designed to determine if the Congaree River was safe for bacterial growth. It was hypothesized that the terminus of the Congaree River would provide water samples that would facilitate bacterial growth more than the origin. Samples were taken from the river at the two locations and transported to the lab, where 5mL of each sample was placed in a test tube. These test tubes were incubated. Following incubation, a small sample of each was spread on a petri dish and incubated further. The petri dishes were removed and the number of bacterial colonies on each dish was counted. No bacteria grew on any of the plates. This

lack of variation disallowed the conduction of the appropriate two-tailed T-test. Given the lack of variance, the null hypothesis that the μs would be the same failed to be rejected. This shows that the methods were extremely flawed.

## THE EFFECT OF FORMALDEHYDE GAS EXPOSURE ON *DROSOPHILA MELANOGASTER*

Cate Pollock
Spring Valley High School

The purpose of this study was to determine the effect formaldehyde gas had on *Drosophila melanogaster*. Ten *Drosophila* each were placed in 8 glass jars, 2 of which were a control group. The other 6 jars were exposed to formaldehyde gas using a bubbler system. The concentrations of the formaldehyde liquid solution used to create the gas for exposure were 9.25%, 18.50%, and 37.00% (2 jars of *Drosophila* were exposed to each concentration). Exposure to formaldehyde was constant for the entire lifespan of the *Drosophila*. The lifespan of *Drosophila* that were exposed to formaldehyde was much shorter (approximately 6 days) than the lifespan of the control groups (2 weeks). The control groups reproduced in large numbers, while the groups exposed to formaldehyde were unable to produce normal offspring. Many of the *Drosophila melanogaster* that died during formaldehyde exposure showed a physical change; in many cases, the head and upper abdomen of the *Drosophila* turned bright red and expanded, while the eyes became darker. The physical change was not related to concentration and appeared to have no pattern. An attempt was made to measure the gaseous concentrations of formaldehyde using its color-change reaction with pararosaniline and a sodium sulfite reagent.

## THE EFFECT OF FASTBALLS, CHANGE-UPS, DROPBALLS, SCREWBALLS, CURVEBALLS, AND RISEBALLS ON BATTED BALL DISTANCE

Malyn V. Pope
Spring Valley High School

The dream of hitting a pitch over the fence is pervasive in the softball world. Because of this goal, many players would benefit from the knowledge of what pitch can be hit for the farthest batted ball distance. The purpose of this experiment was to determine which pitch fastball, change-up, dropball, screwball, curveball, or riseball generates the farthest batted ball distance. It was hypothesized that the change-up would generate the farthest batted ball distance because of the pitch's lack of spin and lack of speed. All of the different pitches were thrown. The batted ball distance was measured relative to the tip of home plate. After all the measurements were collected, an ANOVA test at alpha= .05 was run on the data, the ANOVA test produced a p-value of .012; p<alpha, which allowed the null hypothesis to be rejected. Since the null hypothesis was rejected, a tukey test (a statistical significance test) was run on the data set; this shows that there was only a significant difference was between change-ups and screwballs.

## THE INTERACTIONS BETWEEN HURRICANE INDUCED STORM SURGES ON SOCIAL VULNERABILITY ALONG SOUTH CAROLINA'S COASTAL COMMUNITIES

Kailey Porter
Dutch Fork High School

This project compares monetary damages, median flood level, and social vulnerability from using projected storm surge data and the Social Vulnerability Index to determine whether or not there are significant interactions between the three. For this study social vulnerability is defined a community's ability to anticipate, prepare for, cope with, resist, and recover from the impacts of a natural hazard. Utilizing regressions and correlation statistics, this projects attempts to uncover and explain the relationships between modeled damages from projected storm surge in conjunction with a community's social vulnerability. The projected storm surge data obtained from the Federal Emergency Management Agency, shows both the flood levels and the monetary losses from a "worst case" hypothetical hurricane for each community. The Social Vulnerability Index, created by The University of South Carolina's Hazard and Vulnerability Research Institute, identifies the factors that combine to create an indication of a community's vulnerability or their propensity to incur loss/harm from any given disaster event. drive each community to either have an elevated or limited social vulnerability can be shown. Spatial and statistical analysis of social vulnerability, projected hurricane storm surge flood depth, and modeled damages from these flood depths will provide insight into the relationships between these three components. Results will aid in further identifying mitigation measures aimed at reducing losses from these major disaster events in places where people are most vulnerable.

## THE EFFECTIVENESS AT PREVENTING THE GROWTH OF *STAPHYLOCOCCUS EPIDERMIDIS* BY TOPICAL TREATMENTS AS COMPARED TO COPPER

Frederic S. Powers
Heathwood Hall Episcopal School

The purpose of this experiment was to compare the zones of inhibition created by bleach, isopropyl alcohol, and gluteraldehyde to the zone of inhibition created by copper. The hypothesis stated that copper would have the largest zone of inhibition. To add the *Staphylococcus epidermidis* to pre-poured agar plates, two inoculating loops of bacteria were added to a tube of nutrient broth, and 200 microliters of nutrient broth were added to each dish. Four dishes had a disc of copper placed in the middle; four had a normal disc of filter paper in the middle, and the other twelve had a disc of filter paper soaked in bleach, isopropyl alcohol, or gluteraldehyde placed in the middle. All dishes were incubated at $35^0$C. Analysis of measurements showed that isopropyl alcohol, bleach, and gluteraldehyde each created larger zones of inhibition than that of copper. Gluteraldehyde had the largest average zone of inhibition, then bleach, then isopropyl alcohol. The data were averaged and the zones of inhibition from bleach, isopropyl alcohol, and gluteraldehyde were compared to the zones of inhibition made by copper using a t-test. The results were analyzed by a one-way ANOVA test (alpha=0.05). The results showed that the differences were significant and failed to reject the null hypothesis. The hypothesis that copper creates a greater zone of inhibition was not supported.

## HOW CLASSOOM BEHAVIOR IS EFFECTED BY DIFFERENT GENRES OF MUSIC

Levy Price
Dutch Fork High School

The objective of this experiment is to determine whether or not different genres, tempos, and volume of music will either distract or benefit studying proficiency as evidenced by a studying the scores of reading comprehension test. Five groups of twenty high school students will be presented with a novel. Each will be in a study hall type setting and be asked to read the selected passage out of the navel while listening to music. At the end of each session, a short written test of reading comprehension will be administered. Each group of 20 students will read five selections total while listening to five different genres of music. The scores from each reading comprehension test will be compared to each other genre of music. Then ultimately compared to the controlled group of 2 students who will read the same passages and take the same test without any music.

## THE EFFECT OF CHEMICALS LEACHED FROM POLYCARBONATE WATER BOTTLES WHEN EXPOSED TO ALTERED TEMPERATURE OF WATER ON THE MORTALITY OF *DAPHNIA MAGNA*

Fripp Prioleau and Renae Gray
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Bisphenol A (BPA), a high-production-volume chemical, is used in the manufacturing of polycarbonate plastic. Low-level concentrations of BPA in animals suggests that BPA causes endocrine disruption and possibly death. The correlation between the leaching of the potentially dangerous chemical from polycarbonate containers and toxicity was examined in this experiment through toxicology tests using *Daphnia magna*. It was hypothesized that, if the contents of polycarbonate containers were boiled (100 °C) or frozen (0 °C), then they would be more toxic as compared to the control group, and the boiling group would be most toxic. Water was exposed to varying temperatures and contained in 9 polycarbonate water bottles until returned to room temperature. Three bottles contained boiling water, three were frozen, and three were left at room temperature. Water from each bottle was removed and added to 3 individual Petri dishes. 10 *Daphnia magna* were added to each plate and the number alive after each hour was recorded. The boiling and freezing groups showed higher mortality among *Daphnia* than the control groups, and the boiling groups had the highest mortality rate. Using one-way ANOVA, the boiling and freezing groups yielded statistically significant results ($p<0.05$) when compared to the control group, with p-values of 0.00020 and 0.00002 respectively. However, the boiling and freezing groups were not statistically significant ($p>0.05$), with a p-value of 0.66483. These results indicate that the previous studies were correct in stating that Bisphenol A leaches at varied temperatures and contains toxic qualities; therefore, the proposed hypothesis was accepted.

## RELATIONSHIP BETWEEN EL NINO AND LA NINA CLASSIFICATION AND THEIR STORM DEVELOPMENT IN THE ATLANTIC BASIN

Trevor Prioleau
Timberland High School

During every hurricane season, the United States will suffer severe side effects from the storms that develop in the Atlantic Basin. The storms that develop in the Atlantic Basin are the cause of either the ocean waters warming (El Nino classification), ocean waters cooling (La Nina classification), or neither of the two (None). This project was designed to analyze the relationships between El Nino and La Nina classification in addition to their storm development in the Atlantic Basin. NOAA, National Oceanic and Atmospheric Administration, a storm development database, and Microsoft Excel were used to gather and analyze storms (hurricanes, tropical storms, and subtropical storms) that developed in the last six decades (1950-2009). The results of this experiment concluded that there are no statistically significant relationship(s) between El Nino and La Nino classification and the development of storms in the Atlantic Basin.

## AN ANALYSIS OF THE MOBILITY OF ALLELOCHEMICALS EXUDED BY INVASIVE *CENTAUREA MACULOSA* AND CENTAUREA *DIFFUSA*

Dylan Pruitt
South Carolina Governor's School for Science and Mathematics

Invasive, non-native plants cause billions of dollars of environmental damage every year, and they threaten to alter many native plant habitats. One of the proposed mechanisms for the spread of invasive plants is allelopathic plant-to-plant interaction through secondary metabolites. The secondary metabolites may contain dual purposes: supplementing the plant's own nutrient acquisition and exhibiting negative phytotoxic plant-to-plant interactions. The putative phytotoxic allelochemical, 8-hydroxyquinoline (8HQ), is exuded by *Centaurea diffusa* (diffuse knapweed). Several characteristics of 8HQ raise questions about its allelopathic capabilities: the hydrophobicity of 8HQ may diminish its mobility capabilities in a soil matrix, and the ligand portion of 8HQ enable chelation with free metals in the soil system and hence limit toxicity. We hypothesize that the removal of metal ions from the soil will increase the mobility of 8HQ. To test our hypothesis we took samples of washed and unwashed soil and applied different volumes of 8HQ to the soil surface. The soil was allowed to set for an hour and was then separated into three layers. Each layer was analyzed using the UV detector on the High Pressure Liquid Chromatograph (HPLC). There was slight variation between the treatments; however, 8HQ remained concentrated mainly in the top layer of soil; hence the mobility of 8HQ in soil was not shown to increase with the absence of metal ions.

## DIET AND ATHLETIC PERFORMANCE IN ADOLESCENTS

Kristen Rivers
Dutch Fork High School

Is there a correlation between diet and athletic performance in high school students? The purpose of this experiment is to determine if there is a connection between a high school student's diet and their level of fitness. My hypothesis is that the students with a more balanced diet will perform in the healthy ranges of the FitnessGram. To test this, two types of data were collected: 1) a survey of students' diets in the lunch room,

and 2) a measure of students' athletic performance through the FitnessGram test. Data from each student's lunch is analyzed by being entered into their personal food pyramid (mypyramid.gov) based on their age, weight, and height. Data on athletic performance is from a FitnessGram completed as part of physical education classes and includes: age, weight, height, BMI, body fat/electrical impedance, PACER, curl-ups, push-ups, and sit and reach. The results for each student are then compared to The Healthy Fitness Zone standards which were developed by The FitnessGram Scientific Advisory Board to measure aerobic capacity, body composition, strength, endurance, and flexibility. Between one hundred and one hundred and fifty students of each gender will be needed to complete the experiment. To date, data has been compiled from two classes of mostly 9th grade, female students. Each category was averaged and compared against the Healthy Zone standards to look at the general fitness of each age group. In all categories tested, the average for each age group met the standards to be in the Healthy Fitness Zone (HLTHY ZONE in chart) or exceeded them in some categories. This means that the average female of age 14 to 15 at Dutch Fork High School is in the Healthy Zone of Fitness. I expect that the preliminary results for males would follow the same pattern as the girls. As data collection proceeds, I predict that the diets of the students will reflect their level of fitness: those who are more physically fit will have a more balanced and healthy diet and vice versa.

## THE IDENTIFICATION OF A LIPSTICK BRAND: A COMPARISON OF THE RED PIGMENT $R_F$ VALUE USING THIN LAYER CHROMATOGRAPHY

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Forensic evidence can be left behind at a crime scene in many different ways. Lipstick, when analyzed correctly, can be a valuable addition to any selection of forensic evidence. Essentially, all lipsticks are composed of wax, oil, alcohol, and pigments. Thin layer chromatography (TLC) is one method that can be used to identify a lipstick by displaying the band pattern of its dyes. In TLC, the dyes and pigments in the samples of lipstick will travel with the solvent up the chromatography paper and separate according to their solubility within the solvent. It was hypothesized that three lipsticks could be identified by their red pigments alone- that they would have a pigment with an $R_f$ value unique to their brand. A solvent was prepared from acetone, ammonium hydroxide, distilled water, and isoamyl alcohol. Four chromatograms were completed and $R_f$ values for each lipstick's banding patterns were calculated. The data was analyzed using an Analysis of Variance (ANOVA) single factor test, and the differences between each lipstick's $R_f$ values for the red pigment were found to be statistically insignificant. Thus, the hypotheses were rejected, and the null hypotheses were accepted. It was further noted that a qualitative identification of the lipsticks was possible through the presence of bands that were unique to their chromatogram.

## CELLULAR LOCALIZATION OF THE LSS2 PROTEIN POTENTIALLY INVOLVED IN RICE SEED DEVELOPMENT

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*LSS2* is a rice gene encoding a tetratrico peptide repeats (TPR)-like protein, which is homologous to the *LSS1* (*Low Seed Setting 1*) gene. The LSS1 gene is involved in rice pollen and seed development. The pollen viability and seed setting were dramatically impacted in an *lss1* mutant where *LSS1* expression was down-regulated. Over-expression of *LSS1* in the mutant restored the mutated phenotypes similar to those of the wild-type. It is hypothesized that LSS2 has a complementary function to LSS1 and contributes to pollen and seed development. To functionally characterize the *LSS2* gene, it is important to understand where the gene product is localized within plant cells. A chimeric gene construct containing a CaMV 35S promoter-driving reporter gene along with a *gfp* (green florescent protein) fused to the *LSS2* coding sequence. The *LSS2* coding sequence was amplified by PCR from rice genomic DNA and cloned. The accuracy of the cloned DNA was verified by restrictive digestion and gel electrophoresis as well as DNA sequencing. The cloned *LSS2* gene was then released by restrictive digestion and ligated into the p35S-gfp vector to produce the *gfp-LSS2* fusion gene construct, p35S-gfp-LSS2. This construct was used to transform onion epidermal cells by biolistic bombardment. Unfortunately, none of the onion epidermal cells took in the plasmid and no results were returned from the bombardment. Successful fluorescent visualization of the fusion protein within cells will allow insight into where exactly the LSS2 protein is localized in the cell, providing information about what role the LSS2 gene may play in plant development. This will likely be done by repeating the experiment in conditions more favorable for the onion cell.

## EFFECTS OF BIOMECHANICS, PLYOMETRICS, AND STRENGTH TRAINING ON KNEE INJURY RISK PREVENTION IN FEMALE ATHLETES

Lauren M. Roth
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The purpose of this research was to test the effects of biomechanics, plyometrics, and strength training on knee injury risk in female athletes. It was hypothesized that a three week training program that included biomechanics, plyometrics, and strength training would have a positive effect on knee injury risk reduction. Female basketball and soccer players were recruited to participate in a five week study. In the first week they completed hop and leap tests then watched an assigned video on proper biomechanics. The following three weeks the athletes completed a training program consisting of plyometrics and strength training activities twice a week for fifteen minutes each session. After finishing the program the athletes complete the hop and leap test again. The results of the second hop and leap test were compared to the first hop and leap test for each individual to show the effect of the three week training program on knee injury risk reduction. The hop and leap tests produce six measures of knee injury risk. Correlation analyses show that few of the measures are significantly correlated ( = 0.05), thus capturing different dimensions of knee injury risk. The data were analyzed using dependent sample t-tests. The t-test results indicated that the symmetry of hop and leaps in each leg increased significantly (critical p-value at $< 0.05$), while hop and leap distances normalized to height did not. The hypothesis was therefore partially supported. Explanations for the supporting and non-supporting results are presented along with suggestions for future research.

## TESTING OF BOTTLED WATER ON YEAST FOR ESTROGEN

Jasmine Ruiz-Yi
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Recently, the possibility of hormones being present in bottled water has been discovered. Through yeast estrogen screening it seen was that there are three sources for the estrogenic contamination of mineral water. This is due to the possibility that the water from the spring may contain substances with hormonal potency; the hormones may have come from cleaning substances used on the bottles; or migration of xenoestrogens, man-made estrogens, from leaching of the plastic packaging material occurred. In this experiment it was determined if the hormone estrogen was being leeched from plastic into water by growing yeast in the water from plastic water bottles and then measuring the growth. The yeast was grown in three different brands of water and compared to the control which was yeast grown in distilled water. The purpose of this experiment was to determine whether or not bottled water possesses potentially harmful substances such as chemicals or hormones due to sources such as the leaching of substances from plastic bottles. By conducting this research it was hoped that it may help in publicizing the potential threat in water bottles to individuals who may take an interest in that knowledge. It was hypothesized that if there is estrogen present within bottled water, than it will stimulate the growth of yeast. From ANOVA at alpha level .05 it was shown that there was not a difference between the four different water brands; distilled water, Springtime water, Dasani water, and Zephyrhills water. This statistical analysis indicates that the hypothesis was not supported. It was determined that by this test that there is no evidence that the hormone estrogen was being leeched from plastic into water based off growing yeast in the water from plastic water bottles.

## THE EFFECT OF WOOD SPECIES ON THE MASS LOSS AND TIME TO BURNOUT OF WOODEN WALL STUDS

Brady Russo
Spring Valley High School

Wall studs are necessary components of walls and freestanding structures in that they help to hold the structure up. Wall studs can also present a high fire risk however because they are usually made of wood and due to the construction of wall interiors, the wall studs can facilitate hidden fires that can spread to all floors of a structure using balloon framing, which is a type of architectural framing commonly used in Canada and the United States. The purpose of this experiment was to determine if walls are safer from structural collapse due to fire when made from whitewood or laminated veneer lumber. It was hypothesized that whitewood would burnout the quickest and lose the least amount of mass, while southern yellow pine will take longer to burnout and lose more mass. The two wood types were ignited and burned inside of an outdoor grill and measured for time to burnout and mass loss. The means had large difference between them, but there was no statistically significant difference in the time to burnout or mass loss of the whitewood and southern yellow pine samples. For the time to burnout, $t = 0.700$ with a critical value of 2.101 and a p-value of 0.494. For mass loss, $t = 1.93$ with a critical value of 2.101 and a p-value of 0.069, so the null hypothesis was not rejected for both variables.

## THE EFFECT OF NATURAL ORGANIC SUBSTANCES ON THE ABSORBANCE OF GLYPHOSATE BASED HERBICIDE

Hitomi Saito
Spring Valley High School

Contamination of the environment by pesticides due to volatilization, leaching, adsorption and chemical and biological decomposition has been a concern because large amounts of pesticides are used throughout the world for agricultural and public health issues (El Bakouri et al, 2008, p. 175). Less than 0.1 percent of the applied pesticide reaches the target pest, leaving 99.9 percent of the pesticide to pollute the environment. The purpose of this research was to study the effect of seven types of natural organic substances- bamboo cane, sugar cane, date stones, olive stones, avocado stones, peanut shells and straw- and how well they adsorb a commonly used glyphosate based herbicide, Roundup. This study was conducted to determine whether natural waste products could provide an efficient barrier preventing the pesticide from running off into ground water. It was hypothesized that if the absorbance of pesticide was tested, then the efficiency in decreasing order would be the following: peanut shells, avocado stones, sunflower seeds, pumpkin seeds, plum seeds, and sesame seeds. To test this hypothesis, 0.5g of each of the seven natural organic substances were centrifuged in 5ml of Roundup. The amount of pesticide absorbed by each of the treatments was determined and the results were statistically analyzed at an alpha equal to .05 with a one-way ANOVA. The ANOVA indicated that there was a significant difference, $F(6, 14) = 4.49$, $p < 0.05$, between the treatments. The Tukey test identified that there was a significant difference between each of the treatments.

## THE EFFECT OF CAR AND BIKE TIRE DEBRIS ON THE HEART RATE AND MORTALITY OF *DAPHNIA MAGNA*

Kaori Saito
Spring Valley High School

Pollution from tire debris causes numerous problems to the environment and to humans. By affecting the environment, they also affect humans by causing diseases and defects in the food we eat. Animal consummation of this polluted water directly or indirectly causes harm to us. The purpose of this research was to determine the toxicity that tires cause to the environment. This may help in formulating new ideas, such as making tires out of different materials instead of the many hazardous chemicals used today. It was hypothesized that both types of debris would cause lower heart rate, lower reproductive success, and higher death rates in the *Daphnia magna* than the control. Distilled water was heated and filtered through the tire debris three times for each type of debris. This was cooled and poured into the pond water containing the *Daphnia*. They were observed for fifteen days to evaluate the effect of the different treatments. All of the data were statistically analyzed with a one-way ANOVA at the 0.05 alpha value. The results for the heart rate indicated there was not a significant difference between any of the tests, $F(2, 402) = 2.12$, $p>0.05$. The reproductive success rate, $F(2, 42) = 5.41$, $p<0.05$, and the death rate, $F(2, 42) = 6.06$, $p<0.05$, had a significant difference. The heart rate did not change between the variables, but when using the Tukey test, it was concluded that the reproductive success and death rates differed between the control and both debris.

## CREATING A HEMOCOMPATIBLE SMALL-DIAMETER VASCULAR GRAFT

Ali Serpe
South Carolina Governor's School for Science and Mathematics

The purpose of this experiment was to improve the hemocompatibilty of polymers for a small diameter vascular graft by incorporating heparin into the surface of the polymers. The project aims to help create an improved method for small diameter vascular grafting of cardiovascular patients, which minimizes neointinal thickening and infection. The incorporation of heparin and its effect on the scaffolds was measured by water contact angle tests, toluidine blue assay, plasma recalcification time test, and partial thromboplastin time test. The results indicated that future work should be done, as it was impossible to conclude whether heparin had been successfully incorporated into the surface of the polymers.

## ENERGY HARVESTING USING WIND TO DRIVE A PIEZOELECTRIC GENERATOR

Eric Shine
Spring Valley High School

There is an ever increasing desire for developing devices for harvesting alternate sources of electricity. Harvesting energy from the environment, when conventional power is unavailable has generated interest for research. One source of typically lost energy is the ambient vibrations present around machines and in the environment i.e. wind energy. Automobiles are a source of both "ambient vibrations" and wind energy from "pressure wakes." This source of energy is ideal for the use of piezoelectric materials, which have the ability to convert mechanical strain energy into electrical energy and vice versa. Piezoelectric materials provide a convenient method of capturing the ambient vibration energy and are able to convert it into usable electrical energy. The oscillation of a piezoelectric bending element can be induced by using the elastic restoring force of the piezoelectric bending element to respond to deforming forces applied by a fluid flow causing the piezoelectric element to flutter or oscillate. The energy from these oscillations is converted to electricity. It is believed that a wind driven piezoelectric energy harvester generator could provide an improved, simple and virtually wear free electric power generator for converting wind, or any fluid flow into electric power. It is further believed that this type of generator could be relatively inexpensive and would require a minimum of moving parts. In addition, this type of unit would be a small device that could virtually operate at any wind or fluid flow without any particular adjustment. Furthermore, this type of device could convert any type of fluid flow liquid or gas to electrical power. The engineering goal of this research project was to develop a prototype device that would harvest wind energy using a piezoelectric device. The prototype device generated 16 micro watts of power. However, at this stage the energy generated by these materials is far too small for directly powering most electronic systems.

## THE EFFECT OF OFF!® AND CUTTER'S INSECT REPELLENT™ ON THE FLAMMABILITY OF COTTON AND NOMEX™ FABRIC.

Saeed Siddiqi
Spring Valley High School

The purpose of this experiment was to identify the risk associated with exposure to fire as in the case of wildfires, firefighters, and the military. It was hypothesized that the addition of cutters insect repellent will increase the flammability of all fabrics including the least flammable Nomex™. The 45 Degree test and the Vertical Test were utilized to test the hypothesis. The Vertical Flame Test required the fabric being suspended vertically in a holder exposing the fabric to flame for the time it took to catch fire and burn out, and than seeing how long it takes for it to burn out or completely char. The 45 Degree Test was done by placing the fabric at a 45 degree angle and exposing the fabric to flame for the time it took to catch fire and burn out, or completely char. Multiple one-way ANOVAs were conducted after experimentation and it indicated that Nomex™ treated with insect repellent burned faster than it without insect repellent. Cotton on the other hand increased the time it took to burn when treated with insect repellent.

## THE EFFECTS OF *PHILODENDRON SCANDENS VAR. OXYCARDIUM* ON THE LEVELS OF NITROGEN (PHOSPHONOMETHYL) GLYCINE IN WATER

Rachel C. Smith
Spring Valley High School

Herbicides are being used more frequently now than in the past. Glyphosate based herbicides cause damage to organisms and pollute surface waters. The purpose of this experiment was to remove glyphosate from Roundup® polluted water using a *Philodendron scandens var. oxycardium*. It was hypothesized that Roundup® with philodendron would have a lower absorbency than the non-philodendron water. Three treatment groups were set up and observed. A philodendron clipping was placed in thirty cups containing Roundup® and thirty cups containing Roundup® were left as a control. A philodendron was placed in thirty cups with distilled water for another control. The absorbencies of the water were found before exposure to the plant, seven days after exposure, and fourteen days after exposure. The samples were analyzed with a photo spectrometer at a wavelength of 340. The data were analyzed with a Two-way ANOVA test. The p-value was greater than  = 0.05, the null hypothesis was rejected, and there was an interaction in the absorbency measurements for the solutions. Individual ANOVAs were run and it was determined that there was a significant difference for all of the absorbencies except for the fourteenth day Roundup® with philodendron and distilled water with philodendron. The absorbency for the Roundup® with philodendron was higher than that of the Roundup®; the philodendron actually increased the absorbency. The philodendron may have excreted an enzyme that increased the absorbency. The measurement technique was unable to determine whether glyphosate was actually removed from the water.

## THE EFFECT OF WII™ TENNIS VS. REAL TENNIS ON HEART RATE AND BREATHING RATE

Sarah Jackson Smith and Danielle Zurcher
Heathwood Hall Episcopal School

In this experiment, the effect of heart rate and breathing rate on Wii™ tennis and normal tennis was examined. It was hypothesized that playing real tennis will create a larger increase in heart rate and breathing rate than playing Wii™ tennis. Findings of this study could be beneficial by showing that even though active video games may be better for your health then sedentary video games, they are no substitute for playing traditional sports. This experiment was performed by first testing the resting heart rate and breathing rate of ten participants. The students were then asked to play Wii™ tennis for fifteen minutes and their heart rate and breathing rate were recorded again. Then the same methods were repeated for real tennis using a ball machine set at a speed of 40 MPH with an average spin and balls shot at an interval of three seconds. The change in heart rate and breathing rate for each participant were determined. The mean and standard deviation were determined for the change in heart rate and breathing rate for all participants. There was a statistically significant change in heart rate but not in breathing rate, as shown by the ANOVA analysis. The collected data at the end of this experiment ssuggestd that real tennis raised the heart rate of participants significantly more than Wii™ tennis. Most of the participants reached the target exercising heart rate for their age group, while none of the participants reached their target heart rate by playing Wii™ tennis. These results allowed for the hypothesis to be accepted and suggested that playing Wii™ tennis is not a good substitute for playing traditional tennis.

## HORN SIZE AS A PREDICTOR OF DOMINANCE IN THE MADAGASCAR HISSING COCKROACH (*GROMPHADORHINA PORTENTOSA)*

Will Smith
South Carolina Governor's School for Science and Mathematics

Studies involving various animal populations have shown that secondary sexual traits, such as plumage or antlers, can signal individual fitness in intersexual (mate choice) and intrasexual (male-male contests) interactions. Previous studies on the Madagascar Hissing Cockroach (*Gromphadorhina portentosa*) indicated complex behaviors during antagonistic interactions in which males competed for territory. In addition, males are highly dimorphic compared to females, displaying horns on the pronotum. This research examined the relationship between contest outcome and horn size to determine if this characteristic is a signal for dominance. Six males, all isolated from one another in order to assure social naivety, were pitted against each other in a round robin style tournament and their behaviors recorded. A social hierarchy of the group was established based on the dominant and submissive behaviors exhibited by a male towards the others in the group. This social hierarchy was then correlated to horn size and volume. Future research on this species should include a study of female choice in relation to the dominance status of a male. This female choice experiment will be continued by looking at the biological fitness of the offspring, as determined by the mate choice of the female.

## THE EFFECT OF THE NUMBER OF HOURS OF SLEEP ON THE REFLEXES OF ADOLESCENTS FROM MORNING TO AFTERNOON

Virginia H. Skipper
Spring Valley High School

In this experiment, the reflexes of adolescent test subjects were tested to see the effects of hours of sleep on their reflexes from morning to the afternoon. This was studied to see if there was a correlation between the amount of sleep an individual received and a particular period in the day where adolescents were most awake, i.e. able to learn and concentrate in school. It was hypothesized that the test subjects who had received the most sleep would display the best reaction times throughout the day. A group of students was given a survey questioning the amount of sleep received the previous night. They were given three different tests of reflexes before school started, at lunch, and after school. The three tests were: a ruler was dropped and measured to see how quickly it could be caught, a stop watch was used and had to be stopped as close to ten seconds as possible, and a text online using a computer mouse. Student reflex times were correlated with the number of hours of sleep received. An ANOVA test was done to determine which group of students had the best reaction times. At ¯=0.05, $p > 0.05$, indicating no difference between the groups of students. The amount of sleep did not affect the reflexes of adolescents.

## THE CORRELATION BETWEEN AN ATHLETE'S MAXIMAL SQUAT AND VERTICAL JUMP HEIGHT

Lunden T. Smith
Spring Valley High School

The squat workout is very commonly practiced, as is the vertical jump test. Most athletes are exposed to one of these if not both in their athletic career. Both vertical jump and squat are evaluated by sporting scouts and coaches all over the United States. This is so because scouts consider an athlete's overall performance in the weight room as well as in the game, as do coaches. Scouts want to ensure that they have a quality prospect and coaches want to give that starting position to the player who deserves it. Since squats and vertical jumps are both important pieces of information, this study analyzes both values and looks for a correlation between the two. Squat workouts mainly target the quadriceps muscle group which is the main muscle group involved in jumping. Therefore, if athletes have the desire to increase their vertical jump, it may be beneficial to focus on increasing their maximal squat effort. The purpose of this study was to determine if there is a correlation between an athletes squat and vertical jump. It was hypothesized that there would be a strong correlation between maximal squatting power and vertical jump. Thirty athletes were recruited to have their vertical jumps recorded. Each athlete previously had his squat and weight recorded. Correlation tests were conducted on squat and vertical jump as well as on squat - weight and vertical jump. For squat vs. vertical jump: P value < 0.001. This indicates there is correlation between squat and vertical jump. For squat - weight vs. vertical jump: P value < 0.001. This means there was no correlation between squat - weight. Both tests confirm that there is no correlation between squat and vertical jump or squat - weight and vertical jump. The hypothesis is supported by the provided data.

## THE EFFECT OF *BIFIDOBACTERIUM LONGUM* ON THE ABSORPTION OF LACTOSE IN WHOLE MILK, BUTTERMILK, 2% MILK, AND SKIM MILK

Leslie Snider
Spring Valley High School

The effect of *Bifidobacterium longum* on the absorption of lactose in 2% milk, whole milk, skim milk, and buttermilk were examined. This information could benefit the lactose intolerant population by comparing the effects of the *Bifidobacterium longum* on the amounts of lactose absorbed in the various types of milk, which can be applied to a lactose intolerant individual struggling with dairy consumption or suffering from a variety of lactose intolerant symptoms. It was hypothesized that the *Bifidobacterium longum*, when mixed with the unfermented milks, would absorb significant amounts of lactose, therefore decreasing the amount of lactose intolerance symptoms an individual would experience when consuming unfermented milk. This was accomplished by first retrieving the *Bifidobacterium longum* from the Carolina Biological Supply Company. The lactose absorption in the milks was measured using Glucose Test Strips, which were also acquired from the Carolina Biological Supply Company. 20 milligrams of the bacteria were submerged into each milk, and were mixed until completely dissolved in the milks. Once the bacteria dissolved, a glucose test strip was placed into each solution every minute for seven minutes. Once all of the measurements were recorded, the data were recorded into a data table, recording the amounts of lactose absorbed every minute according to the glucose test strips. The data were analyzed using a one-way ANOVA test ( =0.5). The null hypothesis was rejected meaning there was a significant difference between the glucose concentrations.

## ANALYSIS OF FILM AND COMPUTED RADIOGRAPHY DATA REPRODUCIBILITY WHEN PLOTTING A CHARACTERISTIC CURVE.

Ellis M. Sojourner
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Radiographs, 2D pictures to view the inside of objects, are produced from the capture of X-rays absorbed by a detector, either film or digital. The purpose of this experiment was to compare reproducibility results of computed radiography to film radiography. Radiographs were processed at 80 kilovolts peak (kVp) and milliamp per second (mAs) values 10, 20, 40, 90, 120, 150, 180, 240, 300, and 450, using film radiography. This process was repeated twice on two different days, with the same type film from the same box, the same subject, the same area of the radiograph tested, and same type of radiation. The optical density of the same point on each radiograph was measured using a densitometer. This process was repeated using computed radiography equipment, technology, and procedure. This sample size included mAs values 125, 160, 200, 250, 320, 500, 640, and 960 and identical radiograph positions using AGFA software to measure the Scan Average Level. The calculated t-stat value was 3.127, not falling in the reject region of the t-Critical two-tail value ±2.080 (a= 0.05). It was concluded from this experiment that the data resulting from film radiography had a much larger average slope deviation (9.18%) than computed radiography (0.60%). Because the average slope deviation for film radiography was significantly larger, the null hypothesis, that no difference would exist in data reproducibility when illustrating a characteristic curve, was rejected. The experimental hypothesis was accepted that data results from the computed radiography method are more reproducible than results from film radiography.

## THE EFFECTS OF ELEVATION CHANGES ON CARBON DIOXIDE LEVELS IN A MOUNTAIN ENVIRONMENT AND THEIR COMPARISON TO GLOBAL CARBON DIOXIDE LEVELS

Thaddeus Stephan, Willhoit Moore and Ian Howell Buckley
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The purpose of this research was to measure carbon dioxide ($CO_2$) concentrations on Roan Mountain at incremental elevations and to compare these data to the average global atmospheric concentration of $CO_2$ in 2009 of 387.35 parts per million (ppm). It was hypothesized that as elevation increased at 152.4 m (500 ft) intervals, concentrations of $CO_2$ would decrease, and when compared to the global average, the mountain environment would have a lower level of $CO_2$. Because mountain environments are home to unique species, such as Roan Mountain's rhododendron garden—the largest in the world, that exist in harsh conditions, organisms residing on mountains are highly susceptible to minute changes in their environments. In the last two centuries an increase in the levels of atmospheric $CO_2$ was observed, increasing from 275 ppm throughout most of human history to 2009's average concentration of 387.35 ppm. This change, occurring over a short time frame, has made observing, measuring and reporting concentrations of $CO_2$, especially in sensitive settings, all the more important and significant. As elevation increased, concentrations of $CO_2$ decreased significantly. The data collected were also compared to the 2009 average global concentration of $CO_2$. Data collected at higher elevations (1468, 1620 and 1772 m) showed $CO_2$ concentrations significantly lower than global averages. Data at lower elevations (1315 and 1162 m) showed differences that were statistically insignificant when compared to global data. These results suggest that the air on Roan Mountain, compared to global averages, is within an acceptable range of $CO_2$ concentration.

## THE EFFECTS OF FIRE ON THE OKEFENOKEE SWAMP-MARSH COMPLEX AND ITS RELATIONSHIP TO GLOBAL WARMING AND CARBON SINKS

Lydia Lenora Stiffler
South Carolina's Governor School for Science and Mathematics

Peat is a naturally occurring, phytogenic organic material that tends to be brown or black in color and forms predominately in shallow water environments, such as wetlands. These areas, known as peatlands, contain a wide range of wetland plants that fall into the shallow water as they die and are consequently protected by the anaerobic conditions from decomposition. Human activities and the changing global climate have greatly affected the carbon balance between photosynthesis and decomposition. Surface and near-surface peat samples were collected from the Okefenokee Swamp-Marsh Complex, located in southern Georgia and northern Florida, after the 2007 and 2008 wildfires. The Billie's Lake Fire (BLF1) site is a cypress gum-swamp located approximately 10 km into the Okefenokee Swamp-Marsh. The purpose of this research was to attempt to establish a relationship between global warming and carbon sinks in relation to the catastrophic Okefenokee Swamp-Marsh fires of 2007 and to identify any post-fire changes in peat composition, thickness, and geochemistry. Through the analysis of petrology of the Okefenokee swamp-marsh complex after the fires, a prediction can be drawn as to the effects of added carbon dioxide in the environment from other terrestrial carbon sinks that ignite from the rising global temperatures due to global warming.

## EVALUATION OF NESTING ACTIVITY OF THE DIAMONDBACK TERRAPIN *(MALACLEMYS TERRAPIN)* POPULATION AT NORTH INLET, WINYAH BAY, SOUTH CAROLINA

Alice Sudlow
South Carolina Governor's School for Science and Mathematics

The diamondback terrapin, *Malaclemys terrapin,* lives in estuaries and marshes along the eastern coast of the United States. *Malaclemys terrapin centrata,* one of seven subspecies, ranges from Cape Hatteras, North Carolina to northern Florida. A population of this subspecies resides in North Inlet, Winyah Bay, an estuary near Georgetown on the coast of South Carolina. The population status of the diamondback terrapin is classified as "unknown" in South Carolina. The purpose of this research was to evaluate terrapin nesting in North Inlet as part of a long-term mark-recapture study of the population. Terrapins in North Inlet were collected and marked, and potential nesting areas were examined for signs of terrapin nesting. The annual amount of terrapin nesting was compared to the average winter air and water temperatures. Three years of data were compared to determine any relationship between winter temperatures and the amount of terrapin nesting in the subsequent nesting season. There was a low negative correlation between winter air temperatures and terrapin nesting, indicating that terrapin nesting activity decreases with cooler winter air temperatures. There was a low positive correlation between winter water temperatures and terrapin nesting, indicating that terrapin nesting activity increases with cooler winter water temperatures. However, these comparisons were determined to be inconclusive due to the small amount of data available. Other factors, such as human interference or low predation, may also have affected the amount of nesting evidence recorded. More conclusive results can only be reached through several additional years of study.

## IDENTIFICATION OF NATURAL FREQUENCIES AND MODE SHAPES OF A STEEL BEAM

Winston Hughes Sumerel
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This research focused on a 23 foot long simply-supported steel I-beam. The goal of the project was to determine its first three natural frequencies and the associated mode shapes by typical engineering methods. The natural frequency was determined by measuring the amplitude of vibration when the beam was excited via a rubber mallet. The amplitude was obtained by three accelerometers which sent digitized electrical signals to a computer. A MATLAB™ algorithm was used to process the data and calculate the natural frequencies. Once the natural frequencies were calculated, the mode shapes were found using the same algorithm but a different testing procedure. A shaker, tuned to the calculated natural frequencies, was placed on top of the beam to drive it into resonance. A reference sensor was kept at 11.5 feet, while the other two traversed the entire length of the beam, collecting measurements every six inches. The experimental values for the first two natural frequencies were 9.5 Hz and 35.3 Hz.

## THE EFFECT OF FAT LEVELS IN YOGURT ON THE INHIBITION GROWTH OF *E.COLI* AS MEASURED BY ZONE OF INHIBITION

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Many Americans suffer from a variety of digestive ailments. Probiotics, a culture often found in yogurt, have been found, through a variety of studies, to be an effective treatment for a variety of ailments which range from digestive tract health to atopic ezcema in infants. Based on the supposition that probiotics are beneficial to health, the purpose of this experiment was to determine if a raised fat content of a yogurt could augment the size of zone of inhibition when in a plate of *E. Coli*. The hypothesis was that if a yogurt has a raised fat content, then it will create a greater zone of inhibition when compared to the zones of inhibition created by solutions made from lowered-fat yogurts. The null hypothesis was if yogurt has a raised fat content, then it will not cause a zone of inhibition different than lowered-fat yogurt solutions. An experiment was conducted by inoculating plates with *E. coli*, placing discs soaked in respective types of yogurt (2.5g, 1.5g, and 0g) into the plates, and measuring the zones of inhibition at 24, 48, and 72 hours. The null hypothesis was rejected and the hypothesis accepted, as the yogurt with 2.5 grams of fat was found to be the most effective at inhibiting the growth of *E. coli* by ANOVA statistical analysis. This research could be extended into the study of the effect of fat levels of yogurt in inhibiting bacterial growth when compared to common antibiotic agents.

## FABRICATION OF AIR BRIDGE STRUCTURES ON SILICON CARBIDE (SiC)

David Sung
South Carolina Governor's School for Science and Mathematics

Silicon carbide is one of the more appealing semiconductor materials for high power and high temperature electronics, thanks to its impressive array of properties in comparison to silicon. A high breakdown electric field, wide band gap energy, high thermal conductivity, and high carrier saturation velocity are its more noticeable traits. These allow SiC to perform at far higher temperatures and power densities than Si. However, to make this material viable, steps must be taken to increase its performance and efficiency. One effect which impedes the progress is parasitic capacitance, which increases the amount of current needed to sustain an electrical device. Capacitance is directly proportional to the dielectric constant of a material, and therefore SiC's value of 9.7 is a major factor in the amount of parasitic capacitance. In order to reduce this detriment, the material between the SiC and the conductive metal can be changed. Air, with a dielectric constant of 1, is the ideal material with which to separate the SiC substrate and its conductive metal. In order to do so, a space of air can be created between the two layers; this is known as an air-bridge contact. Experiments using photolithography were performed in order to find the best process to fabricate the contact onto a SiC device. Multiple layers of photoresists were applied with distinct patterns, so that when the metals are deposited on the substrate, they form air-bridges.

## MEASUREMENT OF THE NEUTRAL RHO MESON IN COHERENT PROCESSES

Andrew Svenson
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In the Neutrino Oscillation Magnetic Detector (NOMAD) experiment at the European Council for Nuclear Research (CERN), neutrinos are produced in an accelerator and are directed towards a carbon target within the detector. In the Coherent Rho Experiment, an algorithm was written that could interpret interactions between the neutrinos and the carbon nuclei that were likely to produce a rho meson coherently from the energy transferred in the event. The purpose of this experiment was to more accurately measure the physical properties of the particle, which currently exhibit a high margin of error. The first incarnation of the algorithm was able to reduce the original body of events, which totaled over seven million, to a much more manageable number – only a few thousand. The events that passed through the first series of cuts are all good candidates for rho meson production and will be further analyzed in order to more correctly measure the properties of the particle.

## HUMAN REACTION TO MEDIA BROADCASTS OF APPROACHING HURRICANES

Jessica Thompson
Timberland High School

Despite multiple media outlets and warning systems used today, many people still have problems with hurricane preparedness. Whenever they hear that a hurricane is about to hit somewhere near them, they think that maybe it would not come to where they are. Because of this, they often find themselves in emergency situations that could have been avoided by early preparedness. The purpose of this project was to see what form of media people would use the most to get their hurricane information. It was hypothesized that the local news would have the greatest affect on the public. To do this, a survey was sent out for people to answer. It was shown that 63.4 percent of people would rather use television-related media to inform them of a hurricane. Sixteen percent of people prefer the use of the internet. About 13.4 percent of people prefer the use of paper sources to get their hurricane information. Eight percent of people prefer the use of their local radio station to get hurricane information. It was also shown that 31 percent of people would rather get prepared 3 days before the hurricane is forecasted to hit. Forty-six percent of people would either prepare when they first here it or prepare when a tropical storm warning is issued. Eighteen percent of people would prepare before hurricane season. Five percent of people would prepare when a hurricane warning is issued. A relationship was found in this research project. Since 824 surveys were submitted and there were seven different media preferences, the Chi Square results showed that it was expected for all choices to have 117 each. If the results showed that, then the data would not matter. The "P" value was $<0.0001$ and the data was statistically significant ($alpha<0.05$).

## THE EFFECT OF CAPSAICIN ON THE PREVENTION AND DEGRADATION OF 1-40 AMYLOID FIBRILS

Mason Thornley
Spring Valley High School

The purpose of this experiment was to determine the effect of capsaicin on 1-40 Amyloid Beta fibrils. It was hypothesized that when capsaicin was applied in controlled quantities to the Amyloid Beta fibrils, the plaques would show signs of degradation or a hindrance in growth. Previously prepared 1-40 Amyloid Beta fibrils were used to prepare the experimental and control solutions along with the 40 mM Tris buffer and a diluted capsaicin solution. The experimental solution held both the 1-40 Amyloid Beta fibrils and capsaicin, while the control only held the fibrils. Over a period of four days, the experimental and control group measurements were taken using thioflavinT to make the fibril polymers fluoresce during the luminescence spectrometer measurements. FL WinLab software was used to give a numerical value to each fibril measurement. Throughout two trials, the readings from the Experimental group stayed below the readings of the control group, showing signs that the capsaicin was exhibiting some level of preventative abilities possibly by lowering or keeping the fibril count from rising. Although visual differences were observed in the readings, a paired t-test was conducted. It was found that at the 95% confidence level, the p-value (.105) was greater than alpha value (.05), meaning that there was not enough evidence to show that the experimental capsaicin group's readings were significantly lower than those of the control. The capsaicin did show evidence of inhibiting growth of inhibiting the growth of the 1-40 Amyloid Beta fibrils and should be further investigated as a measure of controlling fibril growth.

## THE EFFECT OF TYPES OF PEDAGOGY AND SOCIAL DESIRABILITY OF STUDENTS ON CHEATING

John Tison
Spring Valley High School

In this experiment, both pedagogy and the type of social desirability were changed in order to test their effects on cheating. This was studied because more needs to be done to help teachers predict cheating behaviors of students. It was hypothesized that when teacher pedagogy is bad and social desirability is low, that more cheating will occur. The method of this experiment was that a questionnaire was handed out to 16 students to fill out. The questions asked included how they view cheating, past cheating, social influences (friends), and their social desirability (future job, amount of money they want to make). During a two-week period afterwards, their GPAs were obtained by a teacher supervising the experiment from the school computer system. The students then took an average standard math test where they were with a confederate; or actor with certain test answers designed to be cheated from. The number of students that cheated during each test was correlated with the level of teacher pedagogy and/or the level of students' social desirability. A Correlation analysis test was performed to see if there was a relationship between social desirability ranks and the number of matching answers (˜=0.05). The resulting linear regression gave an r value of 0.22 with p=0.430. An Independent samples t-test was performed to compare the amount of matching answers in Group 1 with the number in Group 2 (˜=0.05). The resulting t value was -1.99 with p=0.076.

## COMPARATIVE UPTAKE OF PHOSPHOROUS AND NITROGEN BY THREE AQUATIC PLANTS.

Charles Urconis
Dutch Fork High School

This experiment will determine which aquatic plant (Juncus, Hornwort, or Hydrilla) will take up more nitrogen and phosphorous thus improving the water quality. This experiment will be done by placing the Hydrilla and Hornwort in 1.5 gallon tanks and the Juncus in a 20 gallon tank of deionized water. I will then periodically measure the phosphorous and nitrogen levels using a GLX water quality testing kit. The Juncus will prove to be the most effective at taking up and decreasing the phosphorous and nitrogen levels in the water. If the Hydrilla takes up more then the other two aquatic plants then that will prove that society should use an invasive species instead of getting rid of it. The next step is to manipulate the phosphorous and nitrogen levels to mimic that of sewage runoff.

## ASSESSMENT OF OLIGODENDROCYTE SURVIVAL AND MATURATION IN THE DEVELOPING SPINAL CORD FOLLOWING ACTIVATION OF THE PROTEASE-ACTIVATED RECEPTOR- 1

Katelyn Vereen
South Carolina Governor's School for Science and Mathematics

Both motor neurons and oligodendrocytes in the Central Nervous System (CNS) express the protease-activated receptor-1 (PAR-1), which has been linked to neuron cell death and decreased myelination. Whether the decreased myelination is the result of oligodendrocyte cell death, a decrease in their maturation rate, or a decrease in the ability to synthesize myelin remains to be seen. Our goal was to examine the number of surviving oligodendrocytes and their stages of maturation following PAR-1 activation. Beginning on embryonic day 5 (E5) embryos were treated with 200 mL of 1X PBS (control) or 100 mM of the PAR-1 activating peptide SFLLRNP (experimental). Oligodendrocytes from embryos were identified in serial 75 mm cross-sections with anti-mouse MAB345 O4 1°-antibody and goat anti-mouse IgM Alexa Four546 2°-antibody. To categorize the maturation stages, the number of processes per oligodendrocytes WAS counted, as well as the lengths of those processes. There was no significant difference found in the total number of oligodendrocytes in the two groups (Wilcoxon; $n=3$; $p=0.5127$). While the control embryos had no Type I oligodendrocytes, there was no significant difference (Wilcoxon; $n=3$; $p=0.1213$) between the control (0% Type I) and experimental groups (1.87% Type I). Furthermore, there were no significant differences in the percentage of any of the different maturation types between the two groups (Wilcoxon; $n=3$; $p>0.20$). This suggests that PAR-1 activation up until E8 does not affect the number of oligodendrocytes or their maturation and that the decrease in myelin observed following PAR-1 activation is due to decreased myelin formation.

## CHANGE IN VISCOSITY OF GEARBOX GREASE OVER TIME

Aliceann Elizabeth Wachter
South Carolina Governor's School for Science and Mathematics

New NS-4405-FG gearbox grease is spit out of gearboxes being run, but over time remains inside the gearbox. This project tested the viscosity of this grease as it was aged, to see if viscosity change was the factor that controlled this phenomenon. The viscosity was found using a ball drop procedure and a derived fluid equation. As the grease was heated, its viscosity decreased at an average of 79.9%. As it was aged in the oven, the viscosity decreased 77.6% at 66°C, 78.7% at 93°C and 30.0% at 121°C. The viscosity of grease does change with its age, changing how it stays in the gearboxes over time.

## CALCULATING CELLULAR DENSITY OF THE TEMPOROMANDIBULAR JOINT DISC: IMPLICATIONS FOR UNDERSTANDING TISSUE NUTRITION AND TISSUE REGENERATION

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Tissue engineering may offer a better course of action in the treatment of temporomandibular joint (TMJ) disorders. Due to its non-vascular nature, the cartilage tissue of the TMJ is a prime candidate for engineering. However, the understanding of the role of nutrition in tissue degeneration is limited. The objective of this research was to calculate the cellular density of the TMJ cartilage disk to define the parameters for the nutritional model by counting cells using a confocal laser microscope and DNA assay. Discs were divided into five regions composed of three layers each. After being lyophilized and stained overnight in a fluorescent DraQ 5 solution, the cells were imaged using a confocal laser microscope. The 3D reconstruction software, 3D-Bon and Axiovision, were used to compress the 3D image and count the visible stained cells. To check the accuracy of the count, cells were digested in an enzyme and the DNA was counted using a fluorescent microscope. Within the tissue sample general trends of cell densities arose. The results of both procedures support that cellular density is dependent upon region and layer. Each region is composed of approximately $4.00 \times 10^7$ cells/ $mm^3$ of tissue on average. However, more data needs to be obtained before any major conclusions are drawn.

## THE EFFECT OF PREDATORY AND NON-PREDATORY STIMULUS ON THE SIZE OF *LYTECHINUS VARIEGATUS* LARVAE

Harmony White
Spring Valley High School

The purpose of this study was to observe how sea urchin larvae react when exposed to a predator threat. Previous research indicated that morphological changes do in fact take place in the presence of both predatory and, to some extent, non-predatory stimulus. This study was designed for two purposes: to repeat and reaffirm the results of previous experimentation, and to quantify the morphological changes. Two-day-old *Lytechinus variegatus* larvae were exposed to skin extract from either flatfish (predatory) or catfish (non-predatory). It was hypothesized that the predatory stimulus would cause the *L. variegatus* larvae to exhibit cloning, indicated by reduced size. Six days after exposure,

the size of the larvae in each treatment was measured and recorded. These numbers were analyzed using an ANOVA test at alpha equals .05.

## THE EFFECTS OF GOLD NANOPARTICLES ON 3T3 FIBROBLAST CELLS

Kathleen E. Windsor
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Gold nanoparticles are used in a wide array of applications from stained glass to treatments for arthritis. However, the effect of these nanoparticles on cell behavior and function is not well understood. In addition, many factors can alter how these particles interact with cells including surface coating. In this study, 3T3 fibroblast cells were cultured in media and exposed to differing types of gold nanoparticles. Bare sodium citrate and pluronic capped gold particles were tested. In addition, matched capping solutions without nanoparticles were used to determine their effect on the cells. Cells were seeded at a subconfluent 5000 cells per well and allowed to grow for 24hrs. A 100 mL of particle or control solution was then added to the culture. After three days, cells were stained and imaged. Bare sodium citrate gold nanoparticles did not kill the cells. Interestingly, while the control solution of pluronic did not kill the cells, the pluronic capped nanoparticles killed the cells within a day. This could be due to a change in the pluronic when it is immobilized on the nanoparticle surface. Since sodium citrate capped nanoparticles have been shown to embed themselves into the cellular membrane, future work will test the mechanical properties of the cells. In addition, current work is focusing on whether nanoparticles can influence differentiation in bone marrow and dental pulp stem cells. If differentiation can be stimulated, these cells could be used to naturally repair damage to teeth and bones as opposed to the synthetic replacements currently in use.

## A BIOINFORMATIC ANALYSIS OF THE CONSERVED DOMAINS OF AQUAPORIN PROTEINS IN *HOMO SAPIENS* AND *ARABIDOPSIS THALIANA*

Ming Y. Wong
Spring Valley High School

Since the twentieth first century, bioinformatics tools have been used to study the relationships of proteins. Most of the proteins found in the human genome do not have known functions. There have been intense studies on aquaporins, important water-channel proteins that regulate the flow of water in and out of a cell. The purpose of this project was to locate the important parts of aquaporins and to compare them among the different kingdom to better understand its function, which could aid other researchers in the future. It was hypothesized that the parts with the greatest similarity are most likely the domain of the protein that is important to the function, and the aquaporin proteins of the animal kingdom will be more likely to conserve their domains than those found in the plant aquaporin proteins. The aquaporins in *Homo Sapiens* and in *Arabidopsis thaliana* were placed in the Blast program to find similar proteins sequences. Then 167 protein sequences were inputted in the T-coffee program and Smart database to locate its domain. The domains were inputted to the ClustalW program for obtaining the alignment scores, which refers to the conservation percentages. A two sample t-test of the plant and animal aquaporin indicated $t(85)= 1.96$ and $p < 0.05$, meaning that the plant aquaporins domain conservation percentages are significantly lower than those of animals.

## THE EFFECT OF TEXTING AND DUI SIMULATION ON CRASH BEHAVIOR

Andrew O. Wood and William S. Norris
Heathwood Hall Episcopal School

The purpose of this experiment was to compare texting while driving and simulated drunk driving to test which causes a driver to exhibit more crash behavior. The hypothesis is that when novice drivers are compared texting while driving and driving while wearing beer goggles in a simulator, the practice of texting while driving will cause the greatest amount of crash behavior when compared to driving without impairments. The 12 participants each completed three ten-minute periods in a driving simulator: one under normal driving conditions, one while texting, and one while wearing beer goggles that simulated having a blood alcohol concentration (BAC) of .10 to .17. These results were gathered and a total of 400 errors were made. Eighty-four of these errors were made within the control group, 191 errors were made while texting, and 125 errors were made while wearing Beer goggles. These errors ranged from a rolling stop at a stop sign to a 45 mile per hour wreck. The mean number of errors made while in the control group was 7 per driver. The mean number of errors while texting was 15.9, while the mean number of errors for beer goggles was 10.4. Based on a one-way ANOVA, there was a significant statistical difference between texting while driving versus beer goggles and versus the control. However, there was not a statistical difference between the drunk simulation and the control. From these results, the hypothesis that texting while driving would show the most crash behavior was supported.

## A DEEPER LOOK INTO THE MINERAL COMPOSITION OF SOUTH CAROLINA SPRING WATER: A STUDY OF THE RELATIONSHIP BETWEEN THE RATIO OF Ca:Mg IONS IN SOUTH CAROLINA SPRING WATER AND ITS UNDERLAIN LITHOLOGY

Leigh Yarborough
Heathwood Hall Episcopal School

In this experiment, the mineral composition of South Carolina spring water was examined. This could be beneficial knowledge of whether the mineral content of spring water is directly related to rocks underlain beneath them or is independent of the rocks and due to interactions of other aspects. It was hypothesized that spring water throughout the state would have an equal ratio of calcium and magnesium ions as the ratio of these ions in sterile water exposed to the rock embedded beneath the spring. Water from 6 springs throughout the state of South Carolina was tested for calcium and magnesium levels using direct titration. A spatial data mapping program was used to identify the type of rock(s) beneath sites. Sterile water was exposed to a sample of the rock from each spring at high temperatures for long periods of time. This water was also tested for calcium and magnesium levels in the same manner. Findings suggested that spring water of igneous and metamorphic regions had close ratio relations to water exposed to rock samples, thus suggesting a linear relationship of mineral composition between rock and water. Spring water of sedimentary regions had differing ratio relations to water exposed to rock samples, suggesting a non-linear relationship of mineral composition between rock and water. The results were analyzed using a one-way ANOVA statistical analysis test (a=0.05). Analyzed results revealed that ratios of spring water and igneous and metamorphic rock were significantly equal and ratios of spring water and sedimentary rock were significantly different.

## FUNCTIONAL CHARACTERIZATION OF B1 B CELLS

David T. Zhang
Academic Magnet High School

B cells are a part of lymphocytes which have an important role in the humoral immune response. B1 B cells are classified as a sub-class of B cells that express CD5 (T cell marker) and CD11c (macrophage marker). B1 B cells predominantly reside in the pleural and peritoneal cavities and are present in very low numbers in the spleen and lymph node. In this study, B1 cells were isolated from the peritoneal cavity and stimulated with the Toll-like receptor (TLR) 4 ligand Lipopolysaccharide (LPS) and TLR 2 ligand CpG oligodeoxynucleotides (CpG ODN). The conventional B cells and macrophages were isolated from the same mice and used as controls. This study is the first to demonstrate that B1 B cells produce huge amounts of IL-6 and TNF- at 1 hour after stimulation with LPS or CpG DNA as compared to no detectable amounts of IL-6 and TNF- in conventional B cells from the same mice. B1 B cells produced 17.18 molecules of IL-6/cell/second in the first hour after LPS stimulation. The production of IL-6 and TNF- decreased at 6 hours in B1 B cells after stimulation, whereas the production of IL-6 and TNF- peaked in macrophages at 6 hours after stimulation. Taken together, B1 B cells are not only distinct conventional B cells, but also are unique immune cells that have characteristics of B cells and macrophages.

## THE EFFECT OF FLI-1 TRANSCRIPTION FACTOR ON LUPUS NEPHRITIS

William Zhang
Academic Magnet High School

Systemic lupus erythematosus (SLE or lupus) is an autoimmune disease, and lupus nephritis is a major cause of death in both patients and lupus animal models. The cause of SLE is still unknown. The effect of reduced expression of Fli-1 transcription factor in lupus nephritis was studied. NZM2410 mice, an animal model of lupus disease, were used. Fli-1 knockout heterozygous (Fli-$1^{+/-}$) NZM2410 mice were generated. Fli-$1^{+/-}$ NZM2410 mice were mated with wild-type NZM2410 mice to generate two groups of mice, wild-type and Fli-$1^{+/-}$mice. Compared to wild-type mice, expression of Fli-1 protein in Fli$1^{+/-}$NZM2410 mice was reduced by half. Compared with wild-type NZM2410 mice, Fli$1^{+/-}$NZM2410 mice had significantly decreased levels of anti-dsDNA and anti-glomerular basement membrane (GBM) autoantibodies at the age of 34 weeks. There were significantly lower urinary albumin excretions in Fli$1^{+/-}$NZM2410 mice compared to Fli$1^{+/+}$ (wild-type) NZM2410 mice at the age of 34 weeks. Fli-$1^{+/-}$ NZM2410 mice had statistically significant reduced renal disease compared to wild-type NZM2410 controls. These data indicate expression of Fli-1 has an important role in the lupus nephritis disease development.

# END

# Junior Academy Abstracts

# South Carolina Academy of Science Annual Reports

Annual Reports are no longer included in the Bulletin to reduce the environmental impact and printing costs of the SCAS Bulletin. Information typically contained in the annual reports may be obtained through the SCAS office or the SCAS website.

**This section historically contained the following reports:**

Report of the President
Report of the Secretary
Report of the Treasurer
Report of the SCJAS Treasurer
SCAS Legislative Funds
Undergraduate Research Awards Committee
SCAS Two Year College Committee
AAAS Student Research Grants
NAAS/AJAS Delegate Report
MESAS
MESAS Financial Reports
Science & Engineering Fairs
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