



# 2014 MEETING PROGRAM

**SOUTH CAROLINA ACADEMY OF SCIENCE  
EIGHTY-SEVENTH ANNUAL MEETING**

**SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE**



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Please see the Program Cover and Back cover

## **SOUTH CAROLINA ACADEMY OF SCIENCE OFFICERS:**

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### *Councilors to 2016*

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Waltena Simpson, SC State University

### *Emeritus Councilors*

Bill Pirkle, USC Aiken  
Jim Privett, USC Sumter  
David Stroup, Francis Marion Univ.

## Welcome to the South Carolina Academy of Science 2014 Annual Meeting

Dear Students, Teachers, Scientists, and Colleagues,

Good morning and welcome to the South Carolina Academy of Science Annual Meeting. I am Dr. Laurie Fladd, President-Elect of the South Carolina Academy of Sciences (SCAS). I am the Associate Dean of Science and Mathematics here at Trident Technical College and a Microbiology instructor as well. On behalf of the Academy it is my pleasure to welcome you to Trident Technical College and to the beautiful city of Charleston. For those of you who are new to the Academy, SCAS is a state-wide, interdisciplinary science organization established in 1924. Membership is open to anyone with an interest in science and includes students, faculty, administrators, and related professionals. The Academy also sponsors the South Carolina Junior Academy of Science which is composed of high school students and introduces these students to the



excitement of the scientific community by giving them an opportunity to present original research. Our mission is to promote the creation of scientific knowledge; to improve the quality of science education in our state; to foster the interaction of business, industry, government and education in the academic scientific community; to improve public understanding and appreciation of science; and to encourage young people to become involved in science.

The theme of this year's annual meeting "Aerospace" provides students with the opportunity to explore a fascinating field that combines science and engineering at its core. The aerospace industry has become very important to the economy in South Carolina and is expected to be a major contributor to jobs here in this state in the future. The combination of academic endeavors and industrial application will provide wonderful new opportunities to advance a very unique and exciting field. The SCAS is excited about the addition of the aerospace industry to our state and is dedicated to fostering the growth of this industry through the development of a skilled and knowledgeable workforce.

We are thrilled that over 400 students, faculty, teachers, and scientists in biology, chemistry, physics, astronomy, engineering, mathematics, health sciences and more are participating in this year's meeting and sharing their discoveries through oral presentations and poster sessions. We are also excited to present the Governor's Awards for Excellence in Scientific Research with a special introduction from Governor Haley this year. We are thrilled and honored to have as our plenary speaker Mr. Craig Charlton a mechanical engineer from Boeing who has a vast level of aerospace experience working on projects that include the 787 DreamLiner, Space Shuttle, Space Station, Air Borne Laser (ABL), C-130 aircraft, satellites, and military aircraft.

These events do not happen without teamwork. I would like to sincerely thank all of our sponsors and donors for their generous support of this important event. We are so grateful to Trident Technical College and its faculty, especially President Dr. Mary Thornley for her generous hospitality and support for this meeting. Many thanks for the countless hours

from our current President Dr. Pearl Fernandes and our Academy Councilors, especially Dr. Bill Pirkle, Professor Tammy Taylor, Dr. John Kaup, Dr. David Ferris, Dr. Edna Steele, Dr. Justin Wyatt, and Dr. James Privett, along with several others who have worked so hard to make today's meeting a success.

A very special thank you to all of the students, their teachers, mentors, parents, scientists, and volunteers who have worked so hard to bring us their outstanding work today. Your hard work makes the South Carolina Academy of Science a better organization and reminds us of the words from Issac Asimov, "there is a single light of science, and to brighten it anywhere is to brighten it everywhere".

Enjoy your day,

A handwritten signature in black ink that reads "Laurie A. Fladd". The script is cursive and fluid, with the first letters of each word being capitalized and prominent.

Laurie Fladd, PhD  
President –Elect, South Carolina Academy of Sciences

## **SCHEDULE OF EVENTS**

**Saturday, April 5<sup>th</sup>**

<b>7:30AM-1:00PM</b>	<b>SCAS &amp; SCJAS Registration</b>	<b>College Center 920 Building lobby</b>
<b>8:00AM-8:30AM</b>	<b>Welcome</b>  Mr. Scott Poelker, VP of Finance and Administration, Trident Technical College Dr. Pearl Fernandes, USC Columbia, President SCAS Dr. Laurie Fladd, Trident Technical College, President-Elect SCAS	<b>College Center 920 Building Salon F&amp;G</b>
<b>8:30AM-11:30AM</b>	<b>SCAS Oral Presentation Morning Sessions</b> Cell, Field, and Molecular Biology Math and Computer Science Meteorology/Climatology and Physics/Astronomy Physics/Astronomy and Chemistry/Biochemistry Medicine and Pharmacology	<b>Building 970, Room 318 Building 510, Room 133 Building 510, Room 132 Building 510, Room 134 Building 970, Room 215</b>
<b>8:30AM-11:30AM</b>	<b>Poster Presentations, SCAS &amp; SCJAS</b>  <i>Presenters should be at their posters from 8:45 to 11:30AM</i>	<b>College Center 920 Building, Salon E</b>
<b>11:45AM-1:30PM</b>	<b>Lunch</b>	<b>College Center (920 building lobby)</b>
<b>1:30PM-2:00PM</b>	<b>Introduction to Plenary Speaker</b> Dr. Pearl Fernandes, USC Columbia  <b>Plenary Speaker</b> Craig Charlton, The Boeing Company	<b>College Center 920 Building Salon F&amp;G</b>
<b>2:00PM-2:30PM</b>	<b>Awards Presentation</b> Governor's Awards Presentation	<b>College Center 920 Building Salon F&amp;G</b>
<b>2:30PM-3:00PM</b>	<b>Undergraduate Awards Presentation</b>	<b>College Center 920 Building Salon F&amp;G</b>

**Undergraduate Judges Meeting Room:  
920 building (College Center) room 101**

## **Plenary Speaker**

### **Craig Charlton The Boeing Company**

Craig Charlton has been with the Boeing Company for 29 years and works at the Boeing facility in Charleston, South Carolina. His most current position is Project Manager - Automation Strategy for Boeing South Carolina in support of Future Factory. Prior to current position Craig was Senior Project Manager / Supervisor of the Fabrication Support Operations and Machine center in support of commercial aircraft emergent operations with primary focus on the new Boeing 787 aircraft.



In his 29 years with Boeing, he has had the good fortune to work on a variety of programs including Satellite Systems, Air Borne Laser, C-130 modification for weapons electronic upgrades for the purpose of greater global protection; Space Shuttle main engine mechanic advancing to lead on complete Space Shuttle overhaul and major modification team. He worked as an advanced Manufacturing Engineer and Thermal Production Systems Engineer at Kennedy Space Center in Florida on the International Space Station program with concentration on the Thermal Blankets that protect the Station.

The South Carolina Academy of Science gratefully recognizes the contribution of

**MeadWestvaco and the  
South Carolina Research Authority**

for their support of the

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

1985-1988 Drug Science Foundation Award for Excellence in Science

1989-Present Governor's Awards for Excellence in Science

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 2004, MeadWestvaco became a sponsor of the awards and in 2013, the South Carolina Research Authority joined in sponsorship of the Governor's Awards.

Beginning in 1990, two of these awards were given annually to include an award for scientific discovery and/or an award 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 is sponsored by the South Carolina Research Authority. The awards are presented to the recipients 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.



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MEADWESTVACO



**2014 Governor's Award for  
Excellence in Science Awareness**

is awarded to

**Russell R. Pate  
University of South Carolina Columbia**

Russell R. Pate, is a Professor in the Department of Exercise Science in the Arnold School of Public Health at the University of South Carolina. He has held several administrative positions including Chair, Department of Exercise Science; Associate Dean for Research, Arnold School of Public Health; and Vice Provost for Health Sciences. Pate is an exercise physiologist with interests in physical activity and physical fitness in children and the health implications of physical activity. He has published more than 300 scholarly papers and has authored or edited eight books. His research has been supported by the National Institutes of Health, the U.S. Centers for Disease Control and Prevention, the American Heart Association, and several private foundations and corporations. He heads a research team that is currently supported by multiple grants from the National Institutes of Health and from the U.S. Centers for Disease Control and Prevention. He coordinated the effort that led to the development of the recommendation on Physical Activity and Public Health of the U.S. Centers for Disease Control and Prevention and the American College of Sports Medicine (1995). He served on the U.S. Dietary Guidelines Advisory Committee (2003-04), the U.S. Physical Activity Guidelines Advisory Committee (2007-08), and an Institute of Medicine panel that developed guidelines on prevention of childhood obesity. He currently serves as President of the National Physical Activity Plan Alliance. Pate has served in several leadership positions with the American College of Sports Medicine (ACSM), and in 1993-94 served as that organization's president. He is a past-president of the National Coalition on Promoting Physical Activity. In 2012 he received the Honor Award from the American College of Sports Medicine.

***This award is generously sponsored by***



**The 2014 Governor's  
Young Scientist Award for Excellence in Scientific Research  
and the three 2014  
Governor's Awards for Excellence in Scientific Research  
are Sponsored by**



## **2014 Governor's Young Scientist Award for Excellence in Scientific Research**

is awarded to

**Brian A. Powell**  
**Clemson University**

Brian A. Powell earned a B.S. in Chemistry from the University of Montevallo in 1999, and M.S. and Ph.D. degrees in Environmental Engineering and Science from Clemson University (2001 and 2004, respectively). Dr. Powell worked as a postdoctoral fellow at Lawrence Berkeley National Laboratory (2004-2006) and Lawrence Livermore National Laboratory (2006-2007) until returning to Clemson University as an assistant professor in 2008. He is currently an associate professor in the department of Environmental Engineering and Earth Sciences. He holds memberships in the American Chemical Society, the Geological Society of America, the Association of Environmental Engineering and Science Professors, the American Geophysical Union, and Sigma Xi. At Clemson University, Dr. Powell teaches courses in Actinide Environmental Chemistry, Environmental Radiation Protection (Lecture and Laboratory courses), Geochemistry, Health Physics, and Geochemical Reaction Modeling.

Dr. Powell's major research interest is to understand interrelated chemical, biological, and physical processes that control the fate and transport of radionuclides and trace metals in the environment. He has conducted sponsored research in a wide range of projects dealing with topics of nuclear forensics, evaluation of nanoparticle behavior, sorption and environmental transport of plutonium, development of radiation detection and radiation detection laboratory courses, iodine, radium, strontium geochemistry in wetland and subsurface sediments, radionuclide geochemistry of saltstone and solid waste performance assessments at the Savannah River Site, measurement of thermodynamic parameters supporting advanced fuel cycle chemistry, and related topics. He has published over 30 refereed journal publications, 19 research reports, and made over 70 technical presentations on these topical areas. These research projects have received over \$7.7M in funding from the National Science Foundation, the Department of Energy, the Nuclear Regulatory Commission, the Department of Homeland Security, the National Nuclear Security Agency, and Savannah River Nuclear Services (through the South Carolina Universities Education and Research Foundation). Most recently Dr. Powell was awarded a DOE Early Career Research Program grant through the Office of Basic Energy Sciences.

Dr. Powell is committed to student education and currently advises 11 graduate students, 3 undergraduate students, and one postdoc. He serves on a number of national and local professional boards and committees including 1) the United States Environmental Protection Agency (USEPA) Science Advisory Board – Radiation Safety Committee, 2) the National Council on Radiation Protection - Program Area Committee 5 on Environmental Radiation and Radioactive Waste Issues, and 3) the Clemson University Radiation Safety Committee (Vice-chair). Dr. Powell has assisted in the development of webinars for radiochemistry education through the DOE National Analytical Management Training Program and is a frequent lecturer at the ACS Nuclear Chemistry Summer School in San Jose.

**2014 Governor's Award for  
Excellence in Scientific Research (Co-recipient)**

is awarded to

**John Ballato  
Clemson University**

John Ballato is Vice President for Economic Development at Clemson University. Dr. Ballato previously served as Clemson's Vice President for Research (interim), Associate Vice President for Research and Economic Development, and Faculty Representative to the Board of Trustees. Through these appointments, he represented Clemson on many of the Upstate's county-level economic development organizations and directly participated in the recruitment of numerous large and small companies across South Carolina. A professor of materials science and engineering and of electrical and computer engineering, Dr. Ballato co-founded and directed for 14 years the Center for Optical Materials Science and Engineering Technologies (COMSET), a South Carolina Research Center of Economic Excellence. More recently, he has also served as Academic Director for the Clemson University Restoration Institute (CURI).

He earned a B.S. in Ceramic Science and Engineering (1993) and the Ph.D. in Ceramic and Materials Engineering (1997) from Rutgers, The State University of New Jersey. Dr. Ballato has published 300 archival scientific papers, holds over 25 U.S. and foreign patents, has given in excess of 150 keynote / invited lectures, and has co-organized 70 national and international conferences and symposia. In the classroom, Ballato has taught over 1,000 students and served on 100 graduate student thesis/dissertation committees. He has been a Principal Investigator on more than \$46 million worth of sponsored programs and has co-founded 3 SC-based companies.

Among numerous other honors, he is a Fellow of the Optical Society of America (OSA), the International Society of Optical Engineering (SPIE), and the American Ceramic Society (ACerS). He is a Liberty Fellow (Class of 2007), Fellow of the Aspen Global Leadership Network of the Aspen Institute, past recipient of Clemson's Byar's Prize for Excellence in Teaching (2001), and the Medal of Excellence for Alumni Achievement in Academia (Rutgers University, 2009) for "ground-breaking research, dedication to training the next generation of engineers, and for reflecting great honor on your alma mater." More recently, he was the 2014 recipient of the Class of '39 Award for Excellence, which is presented annually to one distinguished member of the Clemson faculty whose outstanding contributions have been judged by his or her peers to represent the highest achievement of service to the University, the Student Body, and the larger community.

**2014 Governor's Award for  
Excellence in Scientific Research (Co-recipient)**

is awarded to

**Russell R. Pate  
University of South Carolina Columbia**

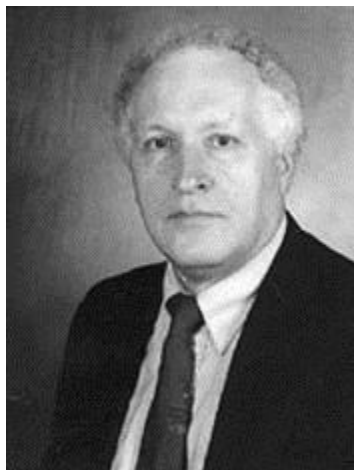
Russell R. Pate, is a Professor in the Department of Exercise Science in the Arnold School of Public Health at the University of South Carolina. He has held several administrative positions including Chair, Department of Exercise Science; Associate Dean for Research, Arnold School of Public Health; and Vice Provost for Health Sciences. Pate is an exercise physiologist with interests in physical activity and physical fitness in children and the health implications of physical activity. He has published more than 300 scholarly papers and has authored or edited eight books. His research has been supported by the National Institutes of Health, the U.S. Centers for Disease Control and Prevention, the American Heart Association, and several private foundations and corporations. He heads a research team that is currently supported by multiple grants from the National Institutes of Health and from the U.S. Centers for Disease Control and Prevention. He coordinated the effort that led to the development of the recommendation on Physical Activity and Public Health of the U.S. Centers for Disease Control and Prevention and the American College of Sports Medicine (1995). He served on the U.S. Dietary Guidelines Advisory Committee (2003-04), the U.S. Physical Activity Guidelines Advisory Committee (2007-08), and an Institute of Medicine panel that developed guidelines on prevention of childhood obesity. He currently serves as President of the National Physical Activity Plan Alliance. Pate has served in several leadership positions with the American College of Sports Medicine (ACSM), and in 1993-94 served as that organization's president. He is a past-president of the National Coalition on Promoting Physical Activity. In 2012 he received the Honor Award from the American College of Sports Medicine.

**2014 Governor's Award for  
Excellence in Scientific Research (Co-recipient)**

is awarded to

**Apparao M. Rao  
Medical University of South Carolina**

After obtaining his Ph.D. in Condensed Matter Physics from the University of Kentucky in 1989, Dr. Rao served as a post-doctoral research associate in the Department of Materials Science and Engineering at Massachusetts Institute of Technology until 1991. Following his stint at MIT, he moved to academia (first to University of Kentucky from 1991 – 2000, and then to Clemson University from 2000 – present) and in the past two decades has demonstrated sustained excellence in nanoscience and nanotechnology research. Specifically, he has pioneered (i) synthesis methods for growth of carbon nanotubes, thermoelectric and oxide nanostructures with controlled morphology on the 1-100 nm length scale, (ii) the use of such structures in the development of energy storage devices, chemical and biological sensors, and nanolithography, and (iii) the use of spectroscopy as a versatile tool for characterizing these nanostructures. Most of the concepts and materials developed within his laboratories are now patented technologies at Clemson. Dr. Rao has served on the editorial advisory board of 4 scholarly journals, and as a consultant for five companies. He has also been instrumental in bringing two international conferences to Clemson University: Carbon 2010 and Nano 2010, and leading a NSF competition for a \$12M Materials Research Science and Engineering Center (MRSEC). His awards and honors include the following: 2012 Alumni Award for Outstanding Achievement in Research, Clemson University; elected as the Fellow of the American Association for Advancement of Science, November 2011; R. A. Bowen Professor of Physics, January 2010; elected as the Fellow of the American Physical Society, January 2008; 2006 Faculty Achievement Award, Clemson University, for exemplary leadership in the sciences; and World Technology Evaluation Center, panel member to evaluate carbon nanotube manufacturing capabilities in Europe and Asia (2006-2007).



### **DWIGHT CAMPER UNDERGRADUATE AWARD IN PLANT MEDICINE OR NATURAL PRODUCTS RESEARCH**

Dwight Camper was an icon at Clemson University, having taught thousands of students and mentoring more than 50 graduate students during his 43 year tenure as professor in the Department of Plant Pathology and Physiology.

In addition to his teaching and mentorship, Dr. Camper was an active member of the South Carolina Academy of Science, serving as president for two terms. He received many awards through his career including the Cutting Edge endowment professorship by the SC Commission of Higher Education, the Godley Snell Award for Excellence in Agricultural Research, and Clemson University Marshall.

The Dwight Camper Research Award is given to an undergraduate student engaged in research in the Plant Sciences with first preference given to students in the field of Plant Medicine or Natural Products Research. Dr. Camper taught a very popular class at Clemson University called Plant Medicine, Magic and Murder. This was the first exposure most students had to Plant Medicine and led many to pursue research in his laboratory. These students benefited from his rigorous guidance while learning to use the scientific method to arrive at meaningful conclusions. Dr. Camper appreciated students who demonstrated a passion for the botanical sciences and approached research with an inquisitive mind, creativity and perseverance. His encouragement and can-do attitude enabled his students to become successful researchers. Dr. Camper felt deeply that research findings should be enthusiastically shared with others and encouraged his students to participate in the South Carolina Academy of Sciences as an avenue to share their discoveries.

This award is presented at the Annual Meeting of the South Carolina Academy of Science to an undergraduate student with an overall GPA of 3.0 or better who engages in research in plant medicine and natural product discovery for at least 1 year, and who has contributed to the generation of a scientific publication(s). This award is sponsored by Jane Camper

April 5, 2014

**IN MEMORIAM  
DR. DANIEL J. ANTION**

On Sunday, March 23, 2014 Dr. Daniel J. Antion passed away at his home in Columbia, South Carolina. Dan's passing was sad news and a tremendous loss for science education in the state of South Carolina. During the past three decades that I have worked with the South Carolina Academy of Science (SCAS), I can think of few individuals who put as much time and energy into supporting this organization's programs and goals than Dan Antion. Dan twice was elected and served as SCAS President, an enormous contribution by itself. In addition, Dan played a vital role in finding funding for the SCAS and the South Carolina Junior Academy of Science (SCJAS) activities for decades throughout his involvement with these organizations.



Even though much of Dan's career was spent working at the highest levels of academia, what perhaps impressed me most when I was just starting out as a young science teacher, was the number of Saturdays that I would bring my high school classes to a SCJAS workshop and see Dan Antion in his lab jacket leading a workshop for the students. He was truly a dedicated and talented science educator and a role model and inspiration for many of us in the field.

The SCJAS will recognize Dan during our awards ceremony at the upcoming annual meeting. At our next SCAS Council Meeting we will also be discussing ways that we might remember Dan's significant contribution to our organization and to science education in South Carolina, so that his legacy can continue.

Respectfully submitted,

*Thomas J. Reeves, PhD*

Executive Director South Carolina Junior Academy of Science



**TOPICAL SESSIONS SCAS**  
**Saturday, April 5th**

**BIOLOGY: CELLULAR**  
**8:30 - 9:15 AM, BLDG. 970 RM. 318**

- 8:30 A NOVEL MECHANISM OF NEURAL RESPONSE MODULATION  
**Davy C. Vanderweyen**, College of Charleston
- 8:45 INVESTIGATING THE FUNCTION OF AIL7 IN ARABIDOPSIS FLOWER DEVELOPMENT  
**Yvonne Wright**, Morris College
- 9:00 FUNCTIONAL CHARACTERIZATION OF TRANSPORTERS INVOLVED IN ARABIDOPSIS MITOCHONDRIAL IRON UPTAKE  
**Shaquille Jackson**, Morris College
- 9:15 ROLE OF CASEIN KINASE 1 ACTIVITY IN THE AUDITORY SENSORY CELL PATTERNING  
**Cory Wright**, Morris College

**BIOLOGY: FIELD**  
**9:30 - 10:15 AM, BLDG. 970 RM. 318**

- 9:30 A PRELIMINARY STUDY OF THE VASCULAR FLORA OF THREE ABANDONED RICE FIELDS, GEORGETOWN, SC  
**Richard Stalter**, St. John's University
- 9:45 COMPARISON OF LIPID PROFILES IN THE ERICAN ALLIGATORS AT KENNEDY SPACE CENTER/MERRITT ISLAND NATIONAL WILDLIFE REFUGE  
**Sheka Carter**, Morris College
- 10:00 BREAK
- 10:15 LONG TERM NATURAL ATTENUATION EFFECTIVENESS IN REMEDIATING A TCE GROUNDWATER PLUME  
**John B Williams**, South Carolina State University

**BIOLOGY: MOLECULAR**  
**10:30 - 11:00 AM, BLDG. 970 RM. 318**

- 10:30 MEASURING THE EFFECT OF ANTI-HIV TAT siRNAs ON HIV REPLICATION  
Emily M. Webb, University of South Carolina Aiken
- 10:45 THE CELLULAR EFFECTS OF HIV-1 TAT-DEPENDENT EXPRESSION OF PRO-APOPTOTIC TBID AND BAX  
Claudia Fulmer, University of South Carolina Aiken
- 11:00 TARGETED INSERTION OF THE TRANSPOSABLE ELEMENT, MPING, BY MANIPULATION OF TRANSPOSASE PROTEINS  
Ashley Strother, University of South Carolina Aiken

**MATH / COMPUTER SCIENCE**  
**8:30 - 9:30 AM, BLDG. 510 RM. 133**

- 8:30 DEVELOPING AN AUTOMATED PROCESSING PIPELINE FOR PROPRIETARY RAIN MEASUREMENT EQUIPMENT  
Joshua Teves, College of Charleston, Department of Physics and Astronomy
- 8:45 COMPUTATIONAL COMPLEXITY OF ENUMERATING LINEAR EXTENSIONS  
Wesley Alexander, Morris College
- 9:00 CAN COMPUTERS PROVE THEOREMS? AUTOMATIC GEOMETRIC THEOREM PROVING  
Fabian Maple, Morris College
- 9:15 GENERALIZED FIBONACCI SERIES AND THE GOLDEN RATIO  
John Watson, The Citadel
- 9:30 BULLS AND COWS GAME  
Anton Khristyuk, University of South Carolina Salkehatchie

**METEOROLOGY / CLIMATOLOGY**  
**8:30 - 8:45 AM, BLDG. 510 RM. 132**

- 8:30 EXPLORATION OF LINKS BETWEEN RADAR AND AUTOMATED  
WEATHER STATION DATA  
Joerael Harris, Department of Physics and Astronomy, College of Charleston
- 8:45 STATISTICAL ANALYSIS OF RAIN ARRIVAL TIMES  
Cassidy Jenks, Department of Physics and Astronomy, College of Charleston

**PHYSICS / ASTRONOMY SESSION I**  
**9:00 - 10:15 AM, BLDG. 510 RM. 132**

- 9:00 COMBINING THE SUPERSYMMETRIC LEPTOPHILIC AND NEUTRINO  
SPECIFIC HIGGS MODELS  
Timothy B. Hayward, College of Charleston
- 9:15 SUPERSYMMETRIZING THE INERT HIGGS DOUBLET MODEL  
Christopher Hipp, College of Charleston
- 9:30 EXPLORATION OF PRACTICAL TOOLS TO CHARACTERIZE  
STATISTICAL SYSTEMS  
Timothy Hayward, College of Charleston
- 9:45 DARK MATTER ANALYSIS OF A SUPERSYMMETRIC INERT HIGGS  
DOUBLET MODEL  
Shikha Chaurasia, College of Charleston
- 10:00 BREAK
- 10:15 GENERAL RELATIVISTIC RADIATION MAGNETOHYDRODYNAMIC  
NUMERICAL SIMULATIONS OF MULTIDIMENSIONAL ACCRETION  
ONTO A BLACK HOLE  
Ally Olejar, College of Charleston

**PHYSICS / ASTRONOMY SESSION II**

**8:30 – 9:30 AM**

**BLDG. 510 RM. 134**

- 8:30 INVESTIGATION OF ALTERNATE LIGHT SOURCES FOR THEATER  
Benjamin Fetterolf, College of Charleston
- 8:45 EXOPLANET AND CIRCUMSTELLAR DISK STUDIES WITH THE  
HUBBLE SPACE TELESCOPE  
Brittany Yeager, College of Charleston
- 9:00 EXPLORING CIRCUMSTELLAR DISKS WITH THE HUBBLE SPACE  
TELESCOPE  
Zachary Griggs, College of Charleston
- 9:15 ACCURACY AND PRECISION OF INTERVAL TIMING WITH STRIATAL  
BEAT FREQUENCY MODEL  
Derek Novo, College of Charleston, Department of Physics and Astronomy
- 9:30 SEARCHING FOR EXTRASOLAR PLANETS WITH THE SUBARU SEEDS  
SURVEY  
Kellen Lawson, College of Charleston, Department of Physics and Astronomy

**CHEMISTRY / BIOCHEMISTRY**

**9:45 - 10:15 AM, BLDG. 510 RM. 134**

- 9:45 MULTIPLE ANIONS 1: PREPARATIONS OF ISOXAZOLES AND  
PYRAZOLES FROM THE 1,4-DIANIONS OF OXIMES AND VARIOUS  
HYDRAZONES  
Charles F. Beam, College of Charleston
- 10:00 BREAK
- 10:15 MULTIPLE ANIONS 2: PREPARATIONS OF HETEROCYCLIC  
COMPOUNDS FROM THE MULTIPLE ANIONS OF OXIMES,  
HYDRAZONES OR HYDRAZIDES  
Charles F. Beam, College of Charleston

**MEDICINE PHARMACOLOGY PHARMACY**

**8:30 – 9:45 AM, BLDG. 970 RM. 215**

- 8:30 EFFICACY OF OXIDATIVE STRESS TREATMENTS ON HUMAN  
SQUAMOUS CELL CARCINOMAS  
Alex Cattran, College of Charleston
- 8:45 INVESTIGATION OF THE EFFECTS OF NEAR INFRARED LIGHT ON  
OXYGEN BINDING TO HEMOGLOBIN  
Allison Sullivan, College of Charleston
- 9:00 NONINVASIVE TECHNIQUE TO DETERMINE LOCALIZED BLOOD  
OXYGEN SATURATION AND RELATIVE BLOOD VOLUME  
Sarah Sharpe, Dept. of Physics and Astronomy, College of Charleston
- 9:15 THE EFFECT OF A HIGH SUCROSE DIET ON COGNITION IN RATS  
Rachel Roberts, University of South Carolina Aiken
- 9:30 THE EFFECTS OF SUGAR CONSUMPTION ON BODY FAT AND  
FASTING GLUCOSE LEVELS IN RATS  
Breanna Marshall, University of South Carolina Aiken
- 9:45 THE EFFECTS OF A HIGH SUGAR DIET ON STRESS IN RATS  
Jessica Lee, University of South Carolina Aiken

## **SCAS Undergraduate Presentation Judges 2014**

Dorothy Bishoff, Morris College

Cassandra Bishop-Robinson, Trident Technical College

Mei Chen, The Citadel

Joe Emily, SC State University

Carlos Estol – Trident Technical College

Gary Heaton, Trident Technical College

Bill Jones, Coastal Carolina University

Don Jordan, USC Columbia

David Magnin, Morris College

Neil Miller, USC Aiken

Carole Oskeritzian, USC School of Medicine

Lucia Pirisi-Creek, USC School of Medicine

Louis Rubbo – Coastal Carolina University

Ron Ruszczyk, USC Aiken

Waltena Simpson, SC State University

Rich Thomason, Savannah River Nuclear Solutions (Ret.)

Jay Vinson, Trident Technical College

**Judges Meeting Room:  
920 building (College Center) room 101**

**POSTER SESSION**  
**College Center, 920 Building, Salon E**  
**8:30AM-11:30AM**

*Presenters should be at their posters from 8:45 to 11:30AM*

- 1     **THE QUEST FOR A BACTERIOPHAGE LYTIC TO STAPHYLOCOCCUS AUREUS AND ESCHERICHIA COLI**  
      **Derek Pride** and Paul E. Richardson, Coastal Carolina University
- 2     **USING SHADOWGRAPH METHOD TO INVESTIGATE CONCENTRATION-DRIVEN FLUCTUATIONS IN GOLD, SILVER, AND SILICA COLLOIDAL SUSPENSIONS**  
      **Danielle Massé** and Ana Oprisan, College of Charleston
- 3     **TRIBOELECTRIC GENERATORS**  
      **Luther Meyer**, College of Charleston
- 4     **IMPLEMENTING THE NODAL DISCONTINUOUS GALERKIN METHOD IN COSMOS++**  
      **Thomas Briggs** and Chris Fragile, College of Charleston
- 5     **DEVELOPMENT OF Z-R RELATIONSHIP FOR A LOCAL AUTOMATED WEATHER STATION**  
      **Katelyn O'Dell** and Michael L. Larsen, College of Charleston
- 6     **BIOLOGICAL EFFECTS OF EXTRACTS TAKEN FROM PHYTOLACCA AMERICANA**  
      **Gregory Barrett** and Diana Ivankovic, Anderson University
- 7     **FURTHER CHARACTERIZATION OF MAB 2C11 (A EOSINOPHILIC GRANULAR CELL) IN INTESTINAL TISSUE OF FISH FROM SALUDA SHOALS PARK, COLUMBIA, SOUTH CAROLINA**  
      Sarah Brown and Marlee B. Marsh, Columbia College
- 8     **IMMUNOHISTOLOGIC EXAMINATION OF HOST-PARASITE RELATIONSHIPS IN GILL TISSUE OF TELEOSTS FROM SALUDA SHOALS PARK, COLUMBIA, SOUTH**  
      **Martha Molina-Sanchez** and Marlee B Marsh, Columbia College
- 9     **USING MAB M24-2 (A FISH LYSOZYME) TO EXAMINE THE HOST-PARASITE RELATIONSHIPS IN LIVERS OF FISH FROM SALUDA SHOALS PARK, COLUMBIA**  
      **Shannon Theobald** and Marlee B Marsh, Columbia College

- 10 ANTICARCINOGENIC PROPERTIES OF EXTRACTS DERIVED FROM THE TREE CLUSIA ROSEA TESTED ON RAT-DERIVED PHEOCHROMOCYTOMA (PC12), ASPC-1  
**Zachary Perdun and Katey Robinson**, Anderson University
- 11 IMMUNOLOCALIZATION OF ZONULA OCCLUDENS-1 (ZO-1) IN HUMAN BREAST CARCINOMA MCF-7 CELLS FOLLOWING TREATMENT WITH TAMOXIFEN, 17B-ES  
**Esther Orjiand** and Samir Raychoudhury, Benedict College
- 12 OPTIMIZING GERMINAL TRANSPOSITION OF MPING IN ARABIDOPSIS THALIANA  
**Courtney Burckhalter** and Nathan Hancock, USC Aiken
- 13 DETERMINING THE ROLE OF TARGET SITE DUPLICATION SEQUENCES ON THE TRANSPOSITION OF MINIATURE INVERTED REPEAT TRANSPOSABLE ELEMENT  
**David Gilbert**, Catherine Bridges, and C. Nathan Hancock, University of South Carolina Aiken
- 14 IDENTIFYING SEQUENCES RESPONSIBLE FOR THE HIGH TRANSPOSITION RATE OF A TOURIST MITE  
**Daymond Parrilla** and C. Nathan Hancock, University of South Carolina-Aiken
- 15 Move to oral presentation session
- 16 CLONING A RETROVIRAL VECTOR TO EXPRESS ANTI-HIV RNAS  
**Crystal Ryan** and William H. Jackson, University of South Carolina, Aiken
- 17 DEVELOPMENT AND OPTIMIZATION OF A PCR PROTOCOL TO RAPIDLY DETECT BACTERIOPHAGES INFECTING STAPHYLOCOCCUS AUREUS  
**Nicholas Thurn** and Paul Richardson, Coastal Carolina University
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John B. Williams, **Andrew W. McCray**, Walter J. Williams, and Elizabeth Ashley Shull<sup>2</sup>, South Carolina State University, <sup>2</sup>Savannah River Nuclear Solutions



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John B. Williams, **George B. Taylor**, Quinn I. Thomas, Quincy I. Pickett-Stokes and Elizabeth Ashley Shull<sup>2</sup>, South Carolina State University,  
<sup>2</sup>Savannah River Nuclear Solutions
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**Jordan Wesel**, Ina Troutman, and Paul E. Richardson, Coastal Carolina University
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**Valoria Ritter** and Rachel Whitaker, Coastal Carolina University
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**Lauren Sharpe** and Dorota Abramovitch, Anderson University
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**Sean P. Kearns**<sup>1</sup>, Mason S. Deinema<sup>1</sup>, Kay Perry<sup>2</sup>, and Edward L. D'Antonio<sup>1</sup>, <sup>1</sup> University of South Carolina Beaufort, <sup>2</sup>, Cornell University

- 29    **BEYOND DISSECTION: INTERACTIVE COMPUTER-BASED METHODS  
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**Samantha Suiter**, M.A, Trident Technical College/ People for the Ethical  
Treatment of Animals

## SCAS ABSTRACTS

### COMPUTATIONAL COMPLEXITY OF ENUMERATING LINEAR EXTENSIONS

Wesley Alexander and Joshua Cooper  
Morris College

The counting of linear extensions in posets is known to be #P-complete. However, there have been discoveries of classes of dimension 2 posets that are easy to compute for their linear extensions, among other things. The big question is whether or not all dimension 2 posets have a way to count their number of linear extensions in polynomial time. BWISIC (Bounded Width Indecomposable Strong Interval Condition) posets are an extension to series parallel posets, which are already known to be “easy” to compute for their linear extensions. Using part of Gallai’s decomposition method, we arrived at insight into why it seems dimension 2 posets are in the “hard” class, but it helped us create a method for computing those posets in the BWISIC class faster.

### DETERMINATION OF RATE OF REACTION FOR THE HYDROLYSIS OF PHTHALATES WITH VARIOUS BASES

Tyler Aslund and Kevin McWilliams  
Coastal Carolina University

Phthalates mostly come from plasticizers for improving the flexibility of polymeric materials. When these materials degrade, these phthalates have been known to accumulate in the environment; therefore it is useful to know about various side reactions occurring with the pollutants within the environment. Through experimentation I determined the rate law for the hydrolysis of such phthalates by use of three hour reaction times and quantification using a gas chromatography-mass spectrometry (GC/MS) instrument.

### THE GEOMETRIC BREAKDOWN OF THE $\text{Zn}^{2+}$ CHELATING POCKET WITHIN THE ZN-1 DOMAIN OF *E. COLI* LEUCYL-TRNA SYNTHETASE CONTRIBUTES TO ITS CATALYTIC CYCLE

Mallory Banton and Rachel Whitaker  
Coastal Carolina University

The *Escherichia coli* (*E. coli*) leucyl-tRNA synthetase (LeuRS) enzyme is part of a larger family of enzymes known as aminoacyl-tRNA synthetases (aaRS). The aaRS enzymes aminoacylate their respective tRNAs, which then become incorporated by ribosomes during protein translation. For many of these aaRSs, a zinc binding domain(s) plays a central role in the process of aminoacylation. We have provided a novel analysis of the zinc binding domain’s role in the catalytic cycle of *E. coli* LeuRS. Chelation of  $\text{Zn}^{2+}$  within the zinc binding domain (ZN-1) changes the

domain's geometric configuration. This rigid architecture is stabilized by thiol groups from the residues C159, C176 and C179. When LeuRS is in the aminoacylation complex, these cysteine residues form a planar triangular configuration with  $Zn^{2+}$ . The rigid geometric shape of the zinc-binding pocket appears to breakdown as the ZN-1 domain transitions between the aminoacylation and editing conformations. Until now, the ZN-1 domain of LeuRS has not been visualized in both the aminoacylation and editing configurations in the same species. Therefore, we have generated a homology model to visualize the ZN-1 domain of E. coli LeuRS while in the editing conformation, which we then compare to the configuration of the ZN-1 domain while in the aminoacylation conformation. From this homology model, we conclude that the drastic structural changes within the ZN-1 domain play a central role in LeuRS's catalytic cycle.

## BIOLOGICAL EFFECTS OF EXTRACTS TAKEN FROM PHYTOLACCA AMERICANA

Gregory Barrett and Diana Ivankovic  
Anderson University

The objective of this research project was to determine the effects of crude extracts taken from *Phytolacca americana* (Pokeweed) on differing cancer cell lines. Two morphologies of the rat derived pheochromocytoma (PC12) cancer cell line were tested along with the human carcinomas, AGS (pancreatic) and ASPC-1 (stomach) cell lines. Soxhlet extractions were performed on mature pokeweed berries, leaves, and roots using methanol, distilled water, and methylene chloride. The plant sections were extracted in the Soxhlet apparatus for twenty four hours. Afterwards, solvents were dried under rotary evaporation to yield crude extracts. Subcultures were exposed to the crude extracts in varying concentration for forty eight hours, and PC12 cells were subcultured with or without the presence of nerve growth factor (NGF). The MTS viability assay was then performed to determine the cytotoxicity of the pokeweed crude extracts. Western blot analyzes probing for the neurite associated protein,  $\beta$ -III tubulin, were also done on PC12 cells grown in the presence of NGF and pokeweed extracts.

## THE GEOMETRIC BREAKDOWN OF THE $Zn^{2+}$ CHELATING POCKET WITHIN THE ZN-1 DOMAIN OF E. COLI LEUCYL-TRNA SYNTHETASE CONTRIBUTES TO ITS

Layla Baykal and Rachel Whitaker  
Coastal Carolina University

*No Abstract Text available*

## MULTIPLE ANIONS 1: PREPARATION OF ISOXAZOLES AND PYRAZOLES FROM THE 1,4-DIANIONS OF OXIMES AND VARIOUS HYDRAZONES

Charles Beam<sup>1</sup>, Clyde Metz<sup>1</sup>, and Bill Pennington<sup>2</sup>

<sup>1</sup>College of Charleston

<sup>2</sup>Clemson University

Our research program has been involved with the initial and follow-up unequivocal strong base syntheses of isoxazoles and pyrazoles. [1] The isoxazoles resulted from the condensation-cyclization of the 1,4-dianions of C(alpha),O-oximes of ketones, such as substituted acetophenones, with electrophilic reagents, initially with aromatic esters, to C-acylated intermediates that immediately cyclized to isoxazoles, usually unsymmetrical 3,5-disubstituted. [2] This project was followed by condensation-cyclization of the oxime dianion intermediates with carbonyl compounds resulting in dihydroisoxazoles. [3] These syntheses were expanded to include condensation-cyclization of dilithiated C(alpha),N-phenylhydrazones and esters or ketones resulting in N-phenylpyrazoles/N-phenyl dihydropyrazoles; [4] trilithiated C(alpha),N,N-hydrazones underwent condensation-cyclization with esters resulting in NH-pyrazoles; [5] dilithiated C(alpha),N-benzoylhydrazones underwent analogous condensation-cyclization with esters resulting in N-benzoylpyrazoles; [6] dilithiated C(alpha),N-carboalkoxyhydrazones (ethyl, methyl, and tert-butyl) have undergone additional condensation-cyclization with esters resulting in N-carboalkoxypyrazoles; [7] dilithiated C(alpha),N-benzenesulfonylhydrazones undergo additional C-acylation-cyclization with esters resulting in N-benzenesulfonylpyrazoles; [8] and limited polyolithiated C(alpha),N-semicarbazones condensed with esters followed by acid cyclization resulting in N-(1H-pyrazol-3-yl)arylamides and 1H-pyrazol-3-amines. Many of these syntheses are regioselective Claisen-type condensations of the nucleophile of the C(alpha)-carbanion with the electrophilic carboxy carbon of the ester followed by acid cyclization of the C-acylated intermediate to the heteroaromatic substituted isoxazole or substituted pyrazole; or by the regioselective aldol-type condensation of the same type of carbanion nucleophiles with the carbonyl carbon of aldehydes or ketones followed by separate acid cyclization to the targeted non aromatic dihydroisoxazoles or dihydropyrazoles. Many of these substituted azoles are prepared and studied because of their biological potential for use in agriculture and medicine. [249 words]

## MULTIPLE ANIONS 2: PREPARATION OF HETEROCYCLIC COMPOUNDS FROM THE MULTIPLE ANIONS OF OXIMES, HYDRAZONES OR HYDRAZIDES

Charles Beam<sup>1</sup>, Clyde Metz<sup>1</sup>, and Bill Pennington<sup>2</sup>

<sup>1</sup>College of Charleston

<sup>2</sup>Clemson University

Syntheses involving condensations of 1,4-dilithiated oximes or hydrazones of varying types with of electrophilic reagents, such as esters or carbonyl compounds,

give intermediates that can be cyclized to isoxazoles/dihydroisoxazoles or pyrazoles/dihydropyrazoles. The reaction product depends upon the pendant group substitution of the entry compound, and/or the electrophilic reagent, and sometimes the method of cyclization of intermediates resulting after the initial condensation. Some of these unexpected reaction products lead to new procedures for other important compounds. [1] Quinolinones/quinolines resulted from the treatment of dilithiated oximes or dilithiated carboalkoxyhydrazones with anthranilate esters to afford intermediates and can undergo cyclization to quinolinone products; or these dilithiated carboalkoxyhydrazones, can also undergo condensation with 2-aminophenyl ketones followed by cyclization to afford quinolines. [2] Benzothiopyranones resulted from the condensation of dilithiated carboalkoxyhydrazones with lithiated methyl thiosalicylate and a different cyclization path to afford the benzothiopyranone. [3] Pyrazolobenzoxazinones resulted when dilithiated carboalkoxyhydrazones underwent condensation-cyclization with lithiated methyl salicylates. [4] spiro(Benzisothiazole–isoxazole)dioxides or spiro(benzisothiazole–pyrazole)dioxides have been prepared by the condensation followed by the twofold acid cyclization of dilithiated oximes or dilithiated carboalkoxyhydrazones with lithiated methyl 2-(aminosulfonyl)benzoate. [5] Another new spiro system, spiro(benzothiopyran–isoxazoles), has resulted from the condensation-cyclization of dithiooximes with select coumarins.

These results have directly or indirectly led to additional investigations. [1] New 1H-pyrazol-3(2H)-ones from phenylacetic acid hydrazides and esters. [2] Isoquinolin-1(2H)-one from ortho-toluic acid phenylhydrazide and esters. [3] 2-(1H-pyrazol-5-yl)benzenesulfonamides from C( $\alpha$ ) $\square$ , N-carbo-tert-butoxyhydrazones and methyl 2-(aminosulfonyl)benzoate. [4] Benzisothiazole dioxides from beta-ketoesters and methyl 2-(aminosulfonyl)benzoate. [5] N-aryl-4-oxo-4H-1-benzothiopyran-2-acetamides from trilithiated acetoacetanilides and lithiated methyl thiosalicylate. [248 words]

## IMPLEMENTING THE NODAL DISCONTINUOUS GALERKIN METHOD IN COSMOS++

Thomas Briggs and Chris Fragile  
College of Charleston

Cosmos++ is a multi-physics, object oriented software package designed to simulate high energy astrophysical phenomena. The Nodal Discontinuous Galerkin Method (NDG) is a finite element method by which systems of partial differential equations can be solved with a higher degree of accuracy compared to the finite difference and finite volume methods currently used in Cosmos++. The NDG method allows for a greater degree of flexibility when dealing with complex geometry and complicated boundary conditions, all of which arise when developing a high energy astrophysical code.

FURTHER CHARACTERIZATION OF MAB 2C11 (A EOSINOPHILIC  
GRANULAR CELL) IN INTESTINAL TISSUE OF FISH FROM SALUDA SHOALS  
PARK, COLUMBIA, SOUTH CAROLINA

Sarah Brown and Marlee B Marsh  
Columbia College

Host-parasite immune responses of higher vertebrates are often mediated through Th2 cells, resulting in the secretion of IL-5, eosinophilia, and immunoglobulin class-switching to an IgE. Host-parasite interactions in fish are one of the least understood areas of comparative immunology, mostly because immunoglobulin class-switching does not occur in fish, and evidence for Fc receptors on phagocytes is unequivocal at this time. However, the presence of eosinophilic granular cells (EGCs) in some species of fish suggests that there may be a role for these cells in the immune response to parasites. In this study, monoclonal antibody (mAb) 2C11 has been developed against a protein found only in highly granulated cells that may be equivalent to eosinophilic granular cells (EGCs) found in various species of fish. Several species (E.g. *Lepomis* spp., *Ictalurus* spp. and *Micropterus* spp.) of freshwater fish (n=41) were collected from Saluda Shoals Park, Columbia, South Carolina, necropsied and examined for parasites. All abdominal tissues were collected and preserved. mAb 2C11 was used to probe paraffin-embedded intestinal tissues from fish. Differences in EGC profile of parasite infected and non-infected fish are described.

OPTIMIZING GERMINAL TRANSPOSITION OF mPING IN  
*ARABIDOPSIS THALIANA*

Courtney Burckhalter and Nathan Hancock  
USC Aiken

Transposable elements (TE) are repetitive sequences that are able to move throughout the genome. Some types of TEs, including mPing from rice, are mobilized by a cut and paste mechanism catalyzed by transposase proteins. The overall goal of our research is to develop mPing into an efficient mutagen for gene discovery in plants. To be effective, mPing must produce heritable insertions that disrupt gene function. Previous studies have shown that mPing preferentially inserts near genes and can cause mutant phenotypes in plants. However, the transposition of mPing in *A. thaliana* has only rarely produced germinal transposition when the 35S promoter was used for driving expression of the transposase genes. Recently, germinal mPing transposition was detected when the constitutive RPS5A promoter was used to drive the expression of the Pong ORF1 and Pong TPase LA proteins. Also, a chimeric ORF1 (ORF1S C1) made from the Pong and Ping ORF1 and a nuclear import signal was shown to produce drastically increased transposition of mPing in yeast assays.

This project tests novel mPing mutagenesis constructs to determine if they increase the germinal mPing transposition rate in plants. Our hypothesis is that using two different constitutive promoters and the ORF1S C1 protein will increase

transposition rate and germinal transposition in *A. thaliana*. Constructs with the RPS5A promoter driving ORF1S C1 and the GmUbi promoter driving Pong TPase LA were transformed into *Arabidopsis* using the floral dip method. The transposition in the T1 generation was monitored by the use of a GFP reporter gene. A high percentage of these plants were found to have large sectorized areas of GFP, suggesting that they will produce germinal transposition events. The next generation will be analyzed to determine the germinal transposition rate. When complete, this research should provide more information about how to optimize using mPing as a mutagenesis tool.

## COMPARISON OF LIPID PROFILES IN THE AMERICAN ALLIGATORS AT KENNEDY SPACE CENTER/MERRITT ISLAND NATIONAL WILDLIFE REFUGE

Shameka Carter and Louis Guillette, Jr.  
Morris College

At Kennedy Space Center/Merritt Island National Wildlife Refuge there is a certain group of alligators that are heavily emaciated within this specific coastal population. The goal of this study is to elucidate possible mechanisms as to why this specific coastal population is wasting away using lipidomics. A Bligh Dyer extraction was performed to isolate the lipids from the alligators' plasma and the samples were run on the LC/MS/MS 4000 QTRAP. Lipidomics was used to display the lipid profiles. BCA protein assay was another method used as a normalization factor. A few investigatory scans were dicylglycerol (DAG), phosphatidylcholines (PC), and cholesterol esters (CE). The processed scans of DAG and PC did not show any difference between the emaciated and normal alligators; therefore, they were not statistically significant. By doing a ratio of intensities between the normal and emaciated alligators, normal alligators showed a higher signaling than the emaciated group but we need to further quantify to see if there data are significant. This is the first step in figuring out the phenomenon. Lipidomics is used in health studies to assess the progression of disease. This technique was used on this wild population to figure out the possible mechanism as to why this coastal population is wasting away.

## EFFICACY OF OXIDATIVE STRESS TREATMENTS ON HUMAN SQUAMOUS CELL CARCINOMAS

Alexander Cattran, Anna-Liisa Nieminen and Linda Jones  
College of Charleston

I have tested the efficacy of different types of oxidative stress treatments on human head and neck cancer cell (HNSCC) lines both in vitro and in vivo. A large portion of the experiments were run using photodynamic therapy (PDT). PDT is a treatment in which a photosensitizer is used to make tissues and cells susceptible to certain wavelengths of light so that a laser can then be used to target only the



cancerous tissues. The main photosensitizer used was phthalocyanine, or Pc4. One challenge of photosensitizers is that they are not specific to any particular tissue; they will diffuse into their surroundings and be taken up by the entire body. One way to overcome this is to use a targeted drug which utilizes nanoparticles to aid in transport into the cancerous cells. The targeted drug was shown to be much more effective in killing the cells.

Another form of oxidative stress that will be tested is using Doxorubicin and Bafilomycin. Doxorubicin is linked to the iron transporter mitoferrin2. Bafilomycin helps to release iron from the lysosomes which helped to increase killing rate. The rate of killing for both of these is measured in a propidium iodide (PI) assay. As the cells degrade and the cytosol escapes, the PI and cytosol come into contact causing it to fluoresce which is detected using a cytofluorimeter. This is measured typically in a 96 well plate with duplicates and varying concentrations. These different methods were tested on human HNSCC lines, each with slightly varying expressivity of genes that may affect the rate of killing. Western blots were run to compare these cell lines and try to determine when it is best to use each method. They were all tested at different concentrations, incubation times, and with different nanoparticles to determine the ideal conditions.

## DARK MATTER ANALYSIS OF A SUPERSYMMETRIC INERT HIGGS DOUBLET MODEL

Shikha Chaurasia and Gardner Marshall  
College of Charleston

We are looking to explain the confirmed positron excess in earth-bound cosmic rays detected by the Alpha Magnetic Spectrometer by introducing supersymmetry to the Inert Higgs Doublet Model and analyzing possible decays or annihilations of the dark matter particle obtained in our model. We will constrain the dark matter parameter space using the recently released data from AMS in hopes that it provides insight into the unexplained positron excess.

## THE PROBLEM OF FITTING ENERGY-EFFICIENT LIGHTING INTO THE THEATRE: ARE SMART REFLECTORS A POSSIBLE ANSWER?

Benjamin Fetterolf and Linda Jones and Paul Collins  
College of Charleston

The halogen incandescent lamp (HID) has been the industry standard in theatre spotlights since its introduction in the mid twentieth century because of excellent color rendering properties (CRI), throw, and ability to retain a natural-like color when dimmed. However the power- conversion efficiency of these lamps is low because a good deal of their energy is wasted as heat. Consequently, replacement bulbs such as light-emitting diodes (LED) and compact-fluorescent lights (CFL) are being developed for theater lighting. Substantial progress has been made in adapting these efficient light sources in static applications such as household

lighting, street lighting, and outdoor floodlights, but under the dynamic conditions of the theatre, there are still problems to be overcome such as instantaneous on/off, ability to retain natural colors when being dimmed, and true color rendering. In this research, possible enhancement of the CRI of LED lamps by reflectors of different color and materials will be discussed and tested, as well as the possibility of developing tunable “smart” dispersion reflectors that could change the spectral power distribution, and thus the CRI, of the light on command or as part of a feedback loop while dimming.

## THE CELLULAR EFFECTS OF HIV-1 TAT-DEPENDENT EXPRESSION OF PRO-APOPTOTIC tBID AND BAX

Claudia Fulmer and William H. Jackson  
University of South Carolina Aiken

Human immunodeficiency virus (HIV-I), a lentivirus in the family Retroviridae, infects CD4<sup>+</sup> T-lymphocytes and upon activation, destroys this T-cell population, leading to AIDS. Among the virus' essential genes is the transactivator of transcription, Tat, which acts to dramatically increase the rate of viral transcription through its interaction with the viral transactivation response element (TAR), encoded within the U3/R promoter region of the HIV genome. Because Tat is expressed early in HIV-I infected cells, it may be possible to exploit this viral function to induce apoptosis, or programmed cell death. The truncated BH3 interacting-domain death agonist (tBid) and the Bcl-2-associated X protein (Bax) are host proteins that are early participants in the apoptotic pathway and act on mitochondria to cause the release of cytochrome C, which induces caspase activation and ultimately cell death. Our lab has cloned a series of plasmids that couple tBid, Bax, or the enhanced Green Fluorescent Protein (eGFP) with the HIV-1 promoter/enhancer (U3R) to render them Tat-dependent. Initial studies of 293T cells, transiently transfected with pU3ReGFP, indicated that fluorescence increased in a Tat-dependent manner. This project investigated the effect of tBid and Bax expression in 293T and Jurkat cells using cell viability and apoptosis assays. These studies indicated minimal cell death of 293T cells when transiently transfected with pU3RtBid or pU3RBax in the absence of HIV-1 Tat, although pU3RBax-transfected cells showed somewhat lower viability as compared to pU3RtBid-transfected cells. Current studies are underway to assess the effect of HIV-1 Tat on the induction of apoptosis in 293T and Jurkat cells.

## DETERMINING THE ROLE OF TARGET SITE DUPLICATION SEQUENCES ON THE TRANSPOSITION OF MINIATURE INVERTED REPEAT TRANSPOSABLE ELEMENTS

David Gilbert, Catherine Bridges, and C. Nathan Hancock  
University of South Carolina Aiken

DNA transposons are sequences within the genome that are mobilized by transposase proteins, which excise and re-insert the element back into the genome. Some transposons, including miniature inverted transposable elements (MITEs), do not encode transposase proteins, but are mobilized in trans. Some MITEs have been found to reach very high copy number in plants and are thought to play a large role in genome evolution. MITE insertion produces identical target site duplications (TSDs) flanking the element. The focus of our research is to determine how the TSDs influence the transposition of the element and excision site repair. To address this question, we are using the Tourist-like MITE mPing and the Stowaway-like MITE 14T32-T7 from rice. mPing insertion creates a 3bp TSD, which is then repaired precisely upon excision (reverting the site of insertion back to the original). 14T32-T7 creates a 2bp TSD and but leaves behind the TSD and a little bit of the end of the element upon excision. To determine the role of the TSD in transposition, we have mutated single bases in the TSDs of both mPing and 14T32-T7 and performed yeast transposition assays. For both elements, we observed that some mutations in the TSD severely inhibit transposition rates. Interestingly, when the two TSD sequences on either end are not matching, the transposition rate is also reduced. To further determine cause of this reduction, we have created a strain of yeast that is unable to repair double-stranded DNA breaks by non-homologous end joining, but can still perform homologous repair. By performing assays in this strain, we will be able to separate the role of excision and repair and determine which transposition step is responsible for this phenomenon.

## HOLDER'S INEQUALITY AND FIBONACCI SEQUENCES

Rachel Graves  
First Baptist School

I solved an open problem from Fibonacci Quarterly that deals with the finite sum of Fibonacci sequences and inequalities. In this talk, we discuss some background information about Fibonacci sequences and finally we solve the problem.

## EXPLORING CIRCUMSTELLAR DISKS WITH THE HUBBLE SPACE TELESCOPE

Zachary Griggs and Joe Carson  
College of Charleston

We present a status report on our efforts to develop computational tools to improve the effective sensitivity of Hubble Space Telescope (HST) imaging observations of circumstellar disks around nearby stars. Specifically, we are implementing and optimizing an algorithm, the Locally Optimized Combination of Images (LOCI), that enables one to combine tens or hundreds of digital images in a manner that strips away the overwhelming light from the parent star, while leaving intact the faint light from the surrounding disk. The computational tools are being applied to data collected as part of the Hubble DICE Survey (Disk Imaging, Characterization, and Exploration) of 11 nearby stars.

## SYNTHESIS OF OSMIUM-OLEFIN COMPOUNDS

Cameron Hance and Kevin McWilliams  
Coastal Carolina University

Group 8 organometallic compounds involving olefins have been studied extensively due to the activation of the olefin upon binding to the metal core. The reactivity of these compounds is known for the iron species, but less so for ruthenium and osmium. This project is directed toward synthesizing a couple new olefin-containing compounds wherein osmium is the metal core in order to investigate the reactivity of the olefin to simple external nucleophiles, such as phosphines or amines.

## EXPLORATION OF LINKS BETWEEN RADAR AND AUTOMATED WEATHER STATION DATA

Joerael Harris and Michael L. Larsen  
College of Charleston, Department of Physics and Astronomy

We hypothesize that there are physical correlations between radar data and other quantities (e.g. temperature, rainrate and wind speed). To test this hypothesis for one particular location, radar data collected between 2008 and 2013 was acquired from the National Climatic Data Center's public server. Corresponding weather data from an online repository was also acquired. Using data-processing software, the collected data was assembled into a readily available form for analytical processing. The links between large-scale parameters and small-scale data sets were explored. Analysis and results will be discussed.

## COMBINING THE SUPERSYMMETRIC LEPTOPHILIC AND NEUTRINO SPECIFIC HIGGS MODELS

Timothy B. Hayward and Gardner Marshall  
College of Charleston

In this talk, two separate models of particle physics are combined. In the first, an explanation is provided for the observed mass of neutrinos, a particle that was previously thought to be massless. In the second, the notion of the Higgs mechanism is extended to include four separate Higgs bosons which are responsible for giving mass to different particles. It is shown that it is possible to fit a Higgs boson into the model with a mass similar to the one recently observed at the Large Hadron Collider. Finally, it is noted that because of a total decoupling between the different sectors of the combined model it will be difficult to differentiate experimentally between the combined model and the two separate models.

## EXPLORATION OF PRACTICAL TOOLS TO CHARACTERIZE STATISTICAL SYSTEMS

Timothy B. Hayward and Michael L. Larsen  
College of Charleston

The statistical approaches used to characterize discrete stochastic physical systems often rely on the properties of statistical stationarity (for a time series) or homogeneity (for a spatial point process). Separate methods are necessary for nonstationary or inhomogeneous data sets. The use of stationary tools with a nonstationary dataset, or vice versa, may lead to unphysical conclusions. Unfortunately, all finite data sets are mathematically non-stationary and the data analyst must, in some way, determine the appropriate statistical tools to use. A review of this problem is presented as well as a discussion of possible computational methods aimed at determining the efficacy of identifying statistical stationary or nonstationary behavior.

## SUPERSYMMETRIZING THE INERT HIGGS DOUBLET MODEL

Christopher Hipp and Gardner Marshall  
College of Charleston

We extend the Standard Model of particle physics by introducing supersymmetry to the Inert Higgs Doublet model. In doing so we hope we create a technically natural model. Upon the completion of this model we will analyze our parameter space and mass spectrum in hopes of achieving a consistent model of particle physics.

## FUNCTIONAL CHARACTERIZATION OF TRANSPORTERS INVOLVED IN ARABIDOPSIS MITOCHONDRIAL IRON UPTAKE

Shaquille Jackson and Erin Connolly  
Morris College

Iron is an essential micronutrient for plants. The sub-cellular mechanisms of mitochondrial iron uptake are not well understood. In this study we characterized the mitochondrial transporters (MIT1 and MIT2) for iron uptake. PCR results identified the knockout genes in WT, 2b2, and 2b3. MIT1 and MIT2 appear to be essential for mitochondrial iron uptake as well as plant growth and survival.

## STATISTICAL ANALYSIS OF RAIN ARRIVAL TIMES

Cassidy Jenks and Michael L. Larsen  
College of Charleston, Department of Physics and Astronomy

The goal of this research was to design a low cost disdrometer that had a useful degree of precision capable of resolving individual drop sizes and arrival times. An audio recording was taken from beneath a metal pan in rainfall. This recording was used to create a time series of raindrop arrival times. Then, a statistical analysis of rain arrival time was completed. Results from rainstorm data taken in early 2014 are presented and interpreted.

## EXPLORATION OF COMPETITIVE MONOSACCHARIDE INHIBITORS OF TRYPANOSOMA CRUZI GLUCOKINASE

Sean P. Kearns<sup>1</sup>, Mason S. Deinema<sup>1</sup>, Kay Perry<sup>2</sup>, and Edward L. D'Antonio<sup>1</sup>

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Chagas' disease (or American Trypanosomiasis) is a neglected tropical disease caused by *Trypanosoma cruzi* protozoa. Worldwide, there are approximately 8 million people infected by *T. cruzi* parasites, which is life threatening in advanced stages. Available medicines for Chagas' disease are problematic because they are intolerable (lead to adverse side effects) and toxic; therefore, drug development is highly mandatory in this area. New insights into trypanosomal drug targets reveal that *T. cruzi* cells are highly susceptible when glycolysis, an essential energy-producing biochemical pathway, is inhibited. The goal of this study is to design and test for potent competitive inhibitors of gateway enzymes in glycolysis, such as glucokinase and hexokinase. Glucokinase phosphorylates its substrate glucose to product glucose 6-phosphate at the carbon-6 (C-6) hydroxyl in the presence of ATP to help trap glucose in the cells. Glucose-analogues that lack this key hydroxyl group at C-6 were used as a starting-point, primarily because C-6 phosphorylation cannot occur. The method used on hypothesizing for potent inhibitors was structure-based drug design using available protein databank coordinates, such as PDB entry 2Q2R. These inhibitors were then tested against *T. cruzi* glucokinase

(TcGlcK), in-vitro. The X-ray crystal structure of TcGlcK complexed with a rare 6-deoxy glucose-analogue compound will be presented along with its corresponding inhibitor kinetics. These results will follow with a discussion about the long-term objective, in which a selective inhibitor of TcGlcK will be developed with respect to the human homologue.

### BULLS AND COWS GAME

Anton Khristyuk and Wei-Kai Lai  
University of South Carolina Salkehatchie

The game Bulls and Cows is said to be a paper-and-pencil version of the game Mastermind. It requires lots of logical reasoning, and yes, a little bit of luck. In this talk we will introduce several variations of this paper-and-pencil game. Using examples, we will also discuss the mathematical techniques that we used to analyze the game. Some winning strategies of simple cases will be mentioned as well.

### SEARCHING FOR EXTRASOLAR PLANETS WITH THE SUBARU SEEDS SURVEY

Kellen Lawson and Joe Carson  
College of Charleston, Department of Physics and Astronomy

Strategic Explorations of Exoplanets and Disks with Subaru (SEEDS) is an international astronomical survey that uses observations with the Subaru Telescope to directly image extrasolar planets and debris disks in order to reach a better understanding of their nature and origin. Our research group comprises a portion of the High-Mass Star group within SEEDS which targets early type stars in the search for exoplanets. We use the Angular Differential Imaging (ADI) technique, which utilizes the symmetrical nature of a star throughout a set of rotated images in order to isolate asymmetries such as planets. In addition to ADI, we make use of the Locally Optimized Combination of Images (LOCI) algorithm, which combines a large number of images in order to strip away bright starlight while leaving the relatively faint planetary light intact. Once a planet is confirmed, additional observations can allow direct imaging techniques to reap information such as planet temperature, composition, and atmospheric chemistry. This information aids in filling a significant gap in the census of exoplanet data, and will help to reach a more complete understanding of the nature of these astronomical bodies.

### THE EFFECTS OF A HIGH SUGAR DIET ON STRESS IN RATS

Jessica Lee and Michelle Vieyra  
University of South Carolina Aiken

There is evidence that an increase in the consumption of sugar in America has led to increases in many health problems including obesity. There is also evidence that

an increase in body fat is related to increases in cortisol levels. Increases in sugar consumption in America is also correlated with a 25% increase in anxiety disorders. This study looked at sugar consumption in rats to see if it is correlated with increased stress avoidance and urinary cortisol levels. Rats were given a 10% sucrose solution for six months and then given two behavioral stress tests, an elevated plus maze and a light- dark exploration task. Both tests allow a rat the choice of spending time in an enclosed environment or exploring a more open environment. Urine was also collected and cortisol was measured using an ELISA test kit. Sugar consumption seemed to affect females more than males. Sugar fed females spent significantly more time avoiding stressful situations in both the elevated plus maze and light- dark exploration task as compared to control females. They also had significantly higher levels of urinary cortisol as compared to control females. Both male groups had higher cortisol levels than both female groups but there was no difference between sugar fed males and control males.

## CAN COMPUTERS PROVE THEOREMS? AUTOMATIC GEOMETRIC THEOREM PROVING

Fabian Maple and Francisco Blanco-Silva  
Morris College

As Bernard Silverman very sharply put it: “Ancient mathematics is at the heart of a very modern game of hide and seek.” Mathematics can be used to tackle crime, manage migration and counter terrorism. For example, Euclidean Geometry has been used to predict the effect of explosions on buildings, or to keep track of offenders and undertake search-and-rescue operations. There is a great need of complex geometric results in Engineering, yet their proofs may be hard to achieve. But with the aid of nowadays computing power, we are able to decide within minutes, whether a given thesis follows from a set of hypotheses in Euclidean Geometry—and thus use the result confidently, even without a proper proof! Our project this summer has been learning the different techniques to achieve this so-called “Automatic Geometric Proving,” as well as applying them to the proof of two extremely challenging theorems (if proved synthetically).

## THE EFFECTS OF SUGAR CONSUMPTION ON BODY FAT AND FASTING GLUCOSE LEVELS IN RATS

Breanna Marshall and Michelle Vieyra  
University of South Carolina Aiken

The obesity rate in America is rising at an alarming rate and the consumption of sugar is often blamed. In order to study the effect of sugar on human health, rats are often used as model organisms. High concentrations of sucrose fed over a short period of time have been shown to produce high body fat content, increased body weight and insulin resistance. Many of these affects have been shown to lead to diseases such as hypertension and Metabolic Syndrome. In this study, rats were



given a 10% sucrose solution immediately after weaning for a period of six months. This concentration of sucrose is comparable to that consumed by humans. It was expected that the rats given sugar would have greater body weight, higher body fat content, and increased fasting blood glucose levels. Twenty-four rats were fed 10% sucrose water from April through September 2013, while eighteen rats were on a control diet. Body weight was monitored weekly and fasting blood glucose levels were measured after the six month period. Fat was dissected from two locations and percent body fat calculated. Fasting blood glucose levels, though not outside of normal, were significantly higher in the experimental rats. There was no difference in body weight between the groups but sucrose-fed rats had body fat percentages that were significantly higher than control rats.

### USING SHADOWGRAPH METHOD TO INVESTIGATE CONCENTRATION-DRIVEN FLUCTUATIONS IN GOLD, SILVER, AND SILICA COLLOIDAL SUSPENSIONS

Danielle Massé and Ana Oprisan  
College of Charleston

The direct visualization and analysis of concentration-driven fluctuations in nanocolloidal suspensions provide invaluable information about cooperative phenomena and the role played by fluctuations in a free diffusion process. Non-equilibrium concentration-driven fluctuations in three different nanocolloidal suspensions (silica, gold and silver) with a wide range of particle sizes were recorded using a shadowgraph technique. We used a dynamic structure factor algorithm for image processing in order to compute the structure factor and the correlation time of the concentration fluctuations. Based on the correlation time analysis we found the diffusion coefficients of each colloid. In addition we compared the characteristic length and lifetime of these fluctuations using spatio-temporal sections of fluctuating images. By comparing spatio-temporal section of fluctuation images we found that the temporal fluctuation last the longest in silver colloid suspension and have the largest characteristic length in gold colloidal suspension. The experimental and data analysis of these fluctuations allows us to gain more knowledge about the solubility, mobility, spatial and temporal evolution, therefore furthering the biomedical applications of these colloids.

### EFFECTIVENESS OF PASSIVE DIFFUSION BAGS VERSUS AMBIENT GROUNDWATER SAMPLES FOR VOC PLUME MONITORING

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Passive diffusion bags (PDB) are an effective way to collect volatile organic compounds (VOC) from surface and subsurface waters especially when subsurface

conditions hinder the collection of adequate water volumes. PDB's are typically deployed for two weeks in a sampling well to accumulate VOC's until reaching equilibrium with ambient waters. Since shallow groundwater flows surrounding the PDB's will vary depending upon conditions such as ambient rainfall, PDB concentrations represent a temporally integrated sample. For this reason, PDB's may give a more accurate representation of average VOC conditions at a location than temporally separated grab samples. Scheduled grab samples may occur after locally high volume antecedent rainfalls or after temporary drought conditions. In either case, a more extreme picture of VOC levels may emerge. The primary objective of our study was to determine whether VOC concentrations collected using PDB's differed significantly from pumped samples from the same hole immediately prior to PDB insertion and pumped samples from the same hole at PDB recovery time. It was hypothesized that the mean VOC of the before and after pumped water samples should approximate VOC levels in the PDB. This methodological study was an integral part of our overall investigation on the suitability of natural attenuation to remediate VOC plumes originating from an EPA Superfund site "operable unit" at Savannah River Site, SC. This waste disposal area, CMP Pits, was closed in 1979 when the pits were closed and backfilled. Subsequent monitoring indicated that perchloroethylene (PCE) and trichloroethylene (TCE) plumes were seeping beneath the vadose zone in groundwater reaching the Pen Branch valley below. As a part of the overall sampling program supporting compliance monitoring for CMP Pits, this study will help to provide the most accurate approaches for documenting natural attenuation of VOC's. The EPA has found natural attenuation to be an acceptable mode of achieving compliance to regulatory standards as long as sampling documents its adequacy.

Our study was replicated from 2011 to 2013 and VOC samples were mainly analyzed using GCMS purge and trap methods. In general, VOC concentrations showed similar trends for both methods (i.e. stations with higher VOC levels were higher than other stations under both methods. However, concentrations in the PDB's usually exceeded VOC levels for initial and final pumped water samples from the same holes (e.g. Station 5B-60 had 100 ppb cis-dichloroethylene (cis-DCE) and 3.0 ppb PCE in PDB's while mean grab sample cis-DCE was 60.5 ppb and 1.5 ppb PCE). However, some holes had more similar results for PDB sample versus hole water sample (e.g. Station 5E had 11 ppb cis-DCE in PDB's while mean grab sample cis-DCE was 15 ppb). For practical purposes, we accepted our hypothesis that both methods yield similar conclusions for VOC variations between locations. However, further studies should address these comparisons over shorter time intervals. Our PDB's were incubated for up to three weeks for some holes.

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## TRIBOELECTRIC GENERATORS

Luther Meyer  
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Triboelectric generators for energy harvesting and production purposes have been optimized within the last two years to the point that relatively small ones are now capable of supplying the power necessary to charge batteries and power small electronics. The generators rely on two triboelectric materials (Teflon and Nylon for this experiment) from opposite sides of the triboelectric series being in frictional contact such as pressing or sliding. The friction induces an electrical gradient and with the presence of electrodes on either side of the materials, the electrons flow through an external circuit. The conductivity of a thin film Teflon matrix can be increased via the method of doping with silver nanoparticles. I intend to use 0, 30, 60, and 90 percent silver doped Teflon, in multiple trials, in a sliding triboelectric generator in order to determine if the added conductivity of the system will lower the resistivity of the generator and thus increase the current output. I intend to measure the current density of silver doped Teflon and compare this value to non-doped Teflon in a triboelectric generator. I will also classify the triboelectric series into subgroups based upon physical and chemical structure in order to make the material selection process less cumbersome for different applications.

## IMMUNOHISTOLOGIC EXAMINATION OF HOST-PARASITE RELATIONSHIPS IN GILL TISSUE OF TELEOSTS FROM SALUDA SHOALS PARK, COLUMBIA, SOUTH CAROLINA

Martha Molina-Sanchez and Marlee B Marsh  
Columbia College

While immunologic responses of mammals to parasites have been well documented in the literature, and generally include eosinophils and the secretion of IL-5 and IgE, there is no good immunoparasitology model that exists in fish. Initial studies of the fish eosinophilic granular cell (EGC) have demonstrated their involvement in parasite responses, making these cells a logical focal point in understanding fish immunoparasitology. Fish (*Ictalurus* spp, *Fundulus* spp, etc.) are commonly used as models in comparative immunology labs, but the underlying problem with advancing the knowledge of immunoparasitology in fish is a lack of suitable reagents to characterize cell types and general immune responses against parasites. We recently developed a monoclonal antibody (mAb) 2C11, which recognizes a protein found only in highly granulated cells that may be equivalent to EGCs found in various species of fish. Since EGCs may function like eosinophils of higher animals, this antibody reagent may be useful in identifying some of the roles of EGCs in fish-parasite interactions. Several species (E.g. *Lepomis* spp., *Ictalurus* spp. and *Micropterus* spp.) of freshwater fish (n=41) were collected from Saluda Shoals Park, Columbia, South Carolina, necropsied and examined for parasites. All gills were collected and preserved. mAb 2C11 was used to probe paraffin-embedded

gill tissues from fish. Differences in EGC profile of parasite infected and non-infected fish are described.

## ACCURACY AND PRECISION OF INTERVAL TIMING WITH STRIATAL BEAT FREQUENCY MODEL

Derek Novo and Sorinel A. Oprisan

College of Charleston, Department of Physics and Astronomy

Time is an essential dimension of the world around us, determining the decisions we make, the actions we choose to take, and the very precision of our slightest movements. Millisecond timing is important for speech recognition, auditory processing, playing music and dancing. Circadian timing controls sleep and wakefulness, and is critical for metabolic and reproductive fitness. Interval timing, or timing in the seconds-to-minutes range, is crucial for rate estimation, decision-making and foraging. Interval timing has been demonstrated in many species, from invertebrates to many vertebrates. In most species, interval time estimation follows a Gaussian-like curve centered on the desired criterion time. Furthermore, the time estimation error increases quasi-linearly with the estimated duration, a characteristic known as scalar property. We used a biophysically realistic striatal beat frequency model, which mimics the activity of cortico-striatal structures responsible for producing a Gaussian-distributed motor response that peaks at the learned criterion timing and obeys scalar property. We investigated the effect of the number of neurons allocated to interval timing task on scalar property.

## DEVELOPMENT OF Z-R RELATIONSHIP FOR A LOCAL AUTOMATED WEATHER STATION

Katelyn O'Dell and Michael L. Larsen

College of Charleston, Department of Physics and Astronomy

Local weather station data and historical radar data from the National Climatic Data Center were acquired for heavy rain events between August 2008 through April 2013. This data was compiled and analyzed in order to formulate a site-specific relationship between the radar reflectivity factor,  $Z$ , and the rain rate,  $R$ . This relationship was then used to infer the rain rate for several precipitation events that occurred at the weather station during the same time period. Our results revealed inconsistencies between the rain rate calculated by this  $Z$ - $R$  relationship and the rain rate reported by the weather station for the selected events. These results, in accordance with a previously calculated  $Z$ - $R$  relationship for a nearby site of particular interest for future research, warrant the need for further study of small-scale temporal and spatial variability within precipitation events.

# GENERAL RELATIVISTIC RADIATION MAGNETOHYDRODYNAMIC NUMERICAL SIMULATIONS OF MULTIDIMENSIONAL ACCRETION ONTO A BLACK HOLE

Alicia Olejar and P. Chris Fragile  
College of Charleston

We use state-of-the-art astrophysics computational code, Cosmos++ to produce general relativistic radiation hydrodynamic and magnetohydrodynamic simulations of low-angular momentum, super-Eddington accretion onto black holes in two and three dimensions. We compare the inhomogeneities and outflows of radiation hydrodynamic driven cases versus magnetohydrodynamic driven cases. The role and importance of the Eddington luminosity is investigated for each case. Throughout all simulations we note how much matter reaches the black hole compared to how much matter is caught in the outflows.

# IMMUNOLOCALIZATION OF ZONULA OCCLUDENS-1 (ZO-1) IN HUMAN BREAST CARCINOMA MCF-7 CELLS FOLLOWING TREATMENT WITH TAMOXIFEN, 17B-ES

Esther Orji and Samir Raychoudhury  
Benedict College

The purpose of this research was to study the expression of ZO-1 protein in human breast cancer MCF-7 cells following treatment with estrogen and anti-estrogen. ZO-1 is a tight junction protein that is located on cytoplasmic membrane surface precisely at sites of cell-cell contact. Tight Junctions are present in the luminal surface of epithelia where it creates an intercellular barrier by limiting ability of solutes, water and immune cells to travel paracellular space. Thus the passage of material is controlled since they can only pass through the cell membrane. Since tamoxifen mimics the action of 17- $\beta$  estradiol and also acts as an anti-estrogen, the current study was undertaken to test the effects of tamoxifen and estradiol on human breast cancer MCF-7 cell line. Using western blot and indirect immunofluorescence microscopy, we investigated expression and cellular localization of ZO-1 in MCF-7 cells following treatment with 500nM TAM, 500nM E2, 500nM benzo[a]pyrene and 500nM PAHs for 24 hours and compared it to 0.01% DMSO and 0.5% acetonitrile containing media as control groups. Proteins were separated by SDS-PAGE electrophoresis and immunodetection of proteins was carried out by western blot analysis. Using indirect immunofluorescence microscopy, we also investigated cellular localization of ZO-1 in MCF-7 cells by culturing cells on square 22 x 22 mm coverglasses and treated as mentioned above. We have observed a strong and intense staining of ZO-1 in control and treated cells. However, with tamoxifen treatment, the ZO-1 localization was reduced. We hypothesize that the anti-estrogenic effect of tamoxifen may be mediated by downregulating ZO-1 protein. Supported by the Grant # DE-FG52-08NA28800

## IDENTIFYING SEQUENCES RESPONSIBLE FOR THE HIGH TRANSPOSITION RATE OF A TOURIST MITE

Daymond Parrilla and Nathan Hancock  
University of South Carolina Aiken

Transposable elements are repetitive sequences, which have the ability to move throughout the genome. These elements are very useful because they can be used as tools to for mutagenesis and gene discovery. The focus of this study is, mPing, a 430-bp deletion derivative of the natural occurring Ping element, from the rice genome. Miniature inverted repeat transposable elements (MITEs) like mPing, potentially exhibit a very high transposition activity and can reach very high copy number in plants. For comparison we constructed, mPong, an artificial deletion derivative of the natural occurring Pong element that shares approximately 80% identity to mPing. The mPong element shows very low transposition activity, compared to mPing. The question we are trying to address is how one naturally occurring MITE is mobilized very well, while the other is not? To answer this, we compared chimeric constructs of mPing with mPong. By performing yeast transposition assays on the different constructs, we were able to identify a region that promotes transposition in mPing. The next step after determining the transposition promoting region is to identify the specific sequences required for high transposition. To do this, I performed mutagenesis of mPing using manganese error-prone PCR. We are screening these mutants to identify lines with altered transposition activity. By comparing the sequences of the mutant mPings with mPing we hope to determine the sequences responsible for high transposition. Identification of these sequences should allow us to further understand the behavior of MITEs and allow us to develop more useful mutagenesis tools.

## ANTICARCINOGENIC PROPERTIES OF EXTRACTS DERIVED FROM THE TREE CLUSIA ROSEA TESTED ON RAT-DERIVED PHEOCHROMOCYTOMA (PC12), ASPC-1

Zachary Perdun, Diana Ivankovic, Andy Norris, and Dorota Abromavitch  
Anderson University

The purpose of this experiment was to assess any potential cytotoxic, antiproliferative or neurodegenerative properties of extracts from the tree *Clusia rosea* on the ASPC-1 pancreatic cancer cell line, AGS gastric adenocarcinoma cell line and two morphologies of rat derived pheochromocytoma (PC12 cells). These cells were all tested in the presence of crude extracts of *Clusia rosea* prepared using the soxhlet apparatus extraction method. The extraction solvents used were methanol and deionized distilled water for duration of 20-24 hours in the apparatus. The extracts used were derived from the leaves and stems (including bark) of mature plants. The extracts were added to cell growth medium at varying concentrations, then applied to all cell lines. The PC12 cell line was differentiated with 100ng/mL neural growth factor (NGF) for 48 hours while being sub-cultured on

rat tailed collagen coated growth vessels. Proteins distinctly associated with neuronal growth in the differentiated morphology of PC12 cells were assessed using a western blot analysis, and an MTS cell viability assay was performed on all cell lines after the extracts were allowed to incubate for 48-96 hours. Rate of proliferation was assessed in the presence of each extract through performing a cell count daily with a hemocytometer during the duration of incubation with each extract.

## CHEMICAL AND BIOLOGICAL PROPERTIES OF CINNAMALDEHYDE DERIVATIVES

Taylor Prater and Dorota Abramovitch  
Anderson University

Cinnamaldehyde is a naturally occurring organic compound that is isolated from cinnamon oil, which is found in the bark of cinnamon trees. It is known for its antimicrobial properties, specifically in halting the growth of cocci and bacillus by inhibiting Z-ring formation in these bacteria. During Z-ring assembly FtsZ protein filaments aggregate to form the future site of the septum of bacterial cell division. In our project we carried out a docking study of cinnamaldehyde and its derivatives to FtsZ protein using VegaZZ and PyRx programs. We are reporting theoretical values of the binding site locations for the target protein and binding affinities between the ligand (cinnamaldehyde) and the FtsZ. In addition, we carried out the preparation of cinnamaldehyde derivatives in the laboratory and examined its effect on the growth of *Staphylococcus aureus*, using the disk diffusion method.

## THE QUEST FOR A BACTERIOPHAGE LYTIC TO STAPHYLOCOCCUS AUREUS AND ESCHERICHIA COLI

Derek Pride and Paul E. Richardson  
Coastal Carolina University

The discovery of antibiotics has drastically altered the prognosis of bacterial infections over the last century. One intriguing example is *Staphylococcus aureus*, which causes skin and wound infections. To prevent this infection doctors regularly prescribe antibiotics, but some strains of *Staphylococcus aureus* have become resistant to antibiotics and are named Methicillin-resistant *Staphylococcus aureus* (MRSA). In 2013, the Centers for Disease Control and Prevention classified MRSA as a serious threat, which “Requires prompt and sustained action to ensure the problem does not grow.”<sup>1</sup>

With antibiotic resistance on the rise, an alternative will become essential. Bacteriophages, which are host-specific viruses that solely infect and lyse bacteria without harming the supraorganism, could be the solution. These microscopic viruses are naturally occurring in the human population and have the capability of genetically evolving with the bacteria, prohibiting bacterial resistance.

The purpose of this study was to collect and isolate naturally occurring bacteriophages that could be used as potential therapeutic agents. To obtain samples, human participants volunteered to be swabbed behind the ear and just inside the nostril. These swabs were then placed in a phosphate buffered solution (PBS), to extract the microbes from the swab. The solution was then filtered to reduce the amount of microbial organisms within the sample. The filtered sample was then introduced to a solution of log phase pathogenic bacteria. This amplified only the bacteriophages that were lytic to the pathogenic bacteria. In order to detect the presence of these phages, a bacterial spread plate was inoculated with a small amount of each amplified sample. Samples that were positive for lytic phages formed a clear zone of inhibition amidst a lawn of pathogenic bacteria. Plates that were positive for these zones of inhibition were separated for additional study.

1. Centers for Disease Control and Prevention. (2013). Antibiotic Resistance Threats in the United States, 2013.

## BIOMATERIAL DEVELOPMENT FOR THE REMOVAL OF METAL CONTAMINANTS IN WATER

Valoria Ritter and Rachel Whitaker  
Coastal Carolina University

Drinkable water is a luxury for most of the world's population. Heavy metal contamination of drinking water is common and is becoming more of a problem as the world-wide pollution continues to rise and more countries become industrialized. The main sources of metal pollutants in the environment originate from industrial waste, fertilizers, battery waste, or electronic waste. Many industrial processing plants and waste management sites are often in close proximity to aquatic ecosystems, which increases the likelihood of metal pollutants contaminating natural water systems. To exacerbate the problem, metal ions are highly soluble in water, therefore they are difficult to detect by human sight. Furthermore, because they are very soluble they can be difficult to completely remove. Exposure to heavy metals can be harmful to human health and in high concentrations can lead to neurodegeneration and eventually death. Carbon-based filtration systems for water are often used in the industrialized world to remove metal contaminants from water, however recent scientific findings indicate that constant exposure to carbon debris from these filters may be harmful. Furthermore, these carbon-based filtration systems are often expensive and therefore are rarely used in the developing world. To address these water-quality concerns, our research focus aims to develop a novel biomaterial that would be biodegradable and allow for the efficient removal of metal ions from water. We believe that the proposed biomaterial is the first of its kind and may be a viable alternative to the current metal-removal methodologies. The biomaterial will be composed of RNA (ribonucleic acid) tethered to biodegradable filter paper.



## THE EFFECT OF A HIGH SUCROSE DIET ON COGNITION IN RATS

Rachel Roberts and Michelle Vieyra  
University of South Carolina Aiken

According to statistics from 2005 to 2010, about 13% of the calories adults consume come from sugar. This is high considering the Dietary Guidelines for Americans suggests that only 5% to 15% of calories come from a combination of fat and sugar. Due to a high saturated fat and refined sugar diet, 36% of Americans were cited as overweight in 2012 and rising obesity rates bring attention to the risks of being obese. Obesity increases an individual's chances of developing insulin resistance, type II diabetes, hypertension, hyperglycemia, heart disease, stroke, but what about cognitive ability? Rats have been used as models to better understand the effect of high sugar diets on the cognition of humans. In the following study, a 10% sucrose solution, the percentage found in sweetened beverages, was fed to a group of rats for twenty-eight weeks. During this time long-term and short-term memory was tested using a Morris Water Maze (MWM) and a Novel Object Recognition (NOR) test. The serum concentrations of brain-derived neurotrophic factor (BDNF), which is linked to learning and memory, were also analyzed using a rat BDNF ELISA kit. The results were analyzed using a two way ANOVA. A 10% sucrose solution fed to Sprague Dawley rats ad libitum significantly increased the short-term memory of female rats fed sucrose compared to control rats in the NOR test but did not significantly affect long-term memory in the MWM or serum concentrations of BDNF.

## CLONING A RETROVIRAL VECTOR TO EXPRESS ANTI-HIV RNAS

Crystal Ryan and William H. Jackson  
University of South Carolina, Aiken

The human immunodeficiency virus (HIV-1) is a lentivirus that targets CD4+ T-lymphocytes, which act to control the adaptive immune response. HIV-1 is the causative agent of the acquired immunodeficiency syndrome (AIDS), which is associated with loss of immune function. We have developed a number of anti-HIV ribozymes and siRNAs that have been shown to down-regulate specific virus functions; however, delivery of these reagents is an important consideration and until recently we have used the pSuper.retro.neo+GFP (pSRNG) plasmid to express these antiviral RNAs from the RNA Polymerase III H1 promoter. Although pSRNG appears to efficiently express these reagents, we have found that it is inefficient at generating recombinant retroviral particles. The retroviral vector, p1744 takes advantage of the picornavirus internal ribosome entry site to express the selective markers  $\beta$ -galactosidase and the neomycin resistance ORF (open reading frame) from a monocistronic mRNA, and has been shown to efficiently produce recombinant retroviral particles; however, it lacks a useful characteristic of pSRNG: the RNA Polymerase III H1 promoter. The goal of this research is to modify the self-inactivating p1744 retroviral vector to express anti-HIV RNAs from the RNA Polymerase III H1 promoter. To do this, the H1 promoter will be amplified from

pSRNG using primers engineered to introduce a BspEI site downstream of the promoter. The resulting PCR product will be cloned into p1744, such that the H1 promoter will be in an upstream and opposite orientation to the  $\beta$ -gal/neoR ORF, creating a retroviral vector capable of efficient siRNA delivery.

## NONINVASIVE TECHNIQUE TO DETERMINE LOCALIZED BLOOD OXYGEN SATURATION AND RELATIVE BLOOD VOLUME

Sarah Sharpe and Linda Jones

Department of Physics and Astronomy, College of Charleston

We have developed a noninvasive method to determine localized blood oxygen saturation (SpO<sub>2</sub>) and relative blood volume,  $r$ , in superficial tissue layers. The reflectance spectrum of blood varies according to the amount of bound oxygen and relative volume of blood. We used SpectraSuite Software and a fiber optic (OceanOptics SD2000) to collect the reflectance spectra (400 to 750nm) of tissue phantoms containing 2% blood. The reflectance spectra were fitted and analyzed according to a previously established method (Amelink, 2005). *In vivo* experiments with a blood pressure cuff and pulse oximeter were used to calibrate the fitted SpO<sub>2</sub> values yielding the linear equation, Pulse oximeter value = (29.4) x (fitted SpO<sub>2</sub>) + 84.2. A further *in vitro* calibration for  $\rho$  yielded the equation, Percent blood volume = 6.7 $\rho$  + 1.6. This non-invasive technique is applicable to a wide variety of medical uses in diagnostics and monitoring. The objective of the current project is to determine three wavelengths that can be used to generate a simple algorithm for oxygenation levels which will be programmed on an SD card of a portable, real-time measuring device (OceanOptics Inc. Jaz Smart Spectrometer).

## THE PRACTICAL SYNTHESIS OF A GINGEROL DERIVATIVE WITH BINDING MODELS AND BIOLOGICAL TESTING

Lauren Sharpe and Dorota Abramovitch  
Anderson University

Gingerol is a bioactive constituent of the roots of *Zingiber officinale*, commonly referred to as ginger. Since ancient times, it has been utilized for its health benefits in natural medicine to treat many ailments. Both, in vitro and in vivo studies have shown gingerol to act against cancerous tumors in ovaries, breast tissue, the pancreas, colorectal cells, and other body tissues. Also, its apoptotic properties have made it very successful in leukemia studies. Since Bcl-2 (B-cell lymphoma 2) is a regulator protein that regulates apoptosis, its damage causes many types of cancer and is a source of resistance to cancer treatments. AGS is a human carcinoma of the stomach and as characteristic of gastric cancers, by the time symptoms occur, the cancer has already often reached an advanced stage and likely metastasized. Using VegaZZ and PyRx programs, we carried out a docking study of gingerol and its derivatives to Bcl-2, investigating binding site locations and binding affinities. Also, we carried out the preparation of the gingerol diester in the laboratory and examined its effect on the growth of an AGS cell line using a colormetric metabolic assay and fluorescent microscopy techniques using apoptotic stains.

## A PRELIMINARY STUDY OF THE VASCULAR FLORA OF THREE ABANDONED RICE FIELDS, GEORGETOWN, SC

John Baden, Richard Stalter<sup>1</sup>, Joseph Khaimov<sup>1</sup>, Alberto Ramirez<sup>1</sup>, and Gillian Richardson<sup>1</sup>

U.S. Army Corps of Engineers (Ret)

<sup>1</sup>Department of Biology, Saint John's University

The objective of this preliminary study was to record changes in the vascular flora in three abandoned rice fields on the Belle Baruch Institute for Marine Biology and Coastal Research, Georgetown, South Carolina over a 45 year period, 1967 to 2013. Collecting trips were made to the three sites during the growing season of 2013 beginning in April, August and October 2013; additional trips will be made through the growing seasons of 2015. Vascular plant species at the three abandoned rice fields were collected by Baden during the growing seasons of 1967-1968 his master's degree thesis project. Baden found species diversity was greatest in the least saline rice field, Alderly and lowest in the most saline site, Thousand Acre Rice Field. Notable changes have occurred during the past 45 years. *Phragmites australis*, an aggressive non-native taxon has invaded all sites and is dominant at Air Port Marsh and Alderly. *Spartina alterniflora*, a salt marsh associate was not observed at Alderly in 1967 but was present in 2013. Rising salinity and sea level at the three abandoned rice fields may reduce vascular plant diversity at all three sites in the future. The present floristic inventory is unique over as the same investigators, Baden and Stalter have collected taxa at each of the abandoned rice field for 45 years.

## TARGETED INSERTION OF THE TRANSPOSABLE ELEMENT, MPING, BY MANIPULATION OF TRANSPOSASE PROTEINS

Ashley Strother and C. Nathan Hancock

University of South Carolina Aiken

Transposable elements, like mPing, are mobile pieces of DNA that move throughout the genome of a cell through a cut-and-paste mechanism. The rice transposon, mPing, is mobilized by two proteins, ORF1 and Transposase, encoded by the autonomous transposons, Ping and Pong. This element preferentially inserts in gene-rich regions and has high transposition activity, making it a great tool for disrupting genes to determine gene function. My goal is to modify the ORF1 and Transposase proteins to produce targeted insertion of mPing. If the transposon's insertion can be targeted to specific sequences in the genome, specialized mutagenesis applications could be performed. To determine if targeted insertion of mPing is possible, I added a GAL4 DNA binding domain to the N-terminus or C-terminus of the ORF1 and Transposase proteins. The transposition rate and quality using the modified proteins was tested using a yeast transposition assay. The results indicated that addition of the GAL 4 binding domain to the proteins reduces transposition frequency to different degrees depending on where it is located. However, these modified proteins show increased frequency of insertion near a GAL target sites compared to control proteins. These results suggest that targeted insertion of the mPing element is possible, providing a potentially new mechanism for plant genome modification.

## BEYOND DISSECTION: INTERACTIVE COMPUTER-BASED METHODS FOR BIOLOGY EDUCATION

Samantha Suiter

Trident Technical College

Alternatives to dissection are increasingly being sought by science educators to reduce teaching expenses, avoid harmful animal use, integrate technology in the classroom and accommodate students opting out of dissection.

The National Science Teachers Association, the National Association of Biology Teachers and the Human Anatomy and Physiology Society all advise teachers to offer students alternatives to dissection. Scores of states, districts, K-12 schools and colleges have policies requiring teachers to provide non-animal learning methods to students wishing to opt out of animal dissection. The NSTA and HAPS also endorse teachers' decisions to completely replace dissection with non-animal methods, which many schools have done.

This constellation of factors makes it important for science educators at all levels to be familiar with the range of nonanimal teaching methods available and their

efficacy, whether they are choosing to fully or partially replace animal dissection or need to have alternatives available to students in their courses to fulfill policy requirements. This poster provides visuals of several popular virtual dissection software programs and discuss benefits of replacing animal use.

## INVESTIGATION OF THE EFFECTS OF NEAR INFRARED LIGHT ON OXYGEN BINDING TO HEMOGLOBIN

Allison Sullivan and Linda Jones  
College of Charleston

Red and near infrared light is used for the relief of pain and inflammation as well as for the stimulation of wound healing. One proposed mechanism is that the light causes oxygen to be released from hemoglobin when focused on the tissues. The purpose of this study was to investigate factors affecting the behavior of oxyhemoglobin including light and temperature. In this project, hemoglobin was isolated by lysing red blood cells with a hypotonic buffer. These samples were then treated with either heating or illumination with 670-nm light. Temperature, dissolved oxygen, and bound oxygen were monitored simultaneously with the use of a temperature probe, a fiber optic dissolved-oxygen probe, and a fiber optic reflectance spectroscopy system. The anticipated outcome of this project is the identification of factors which affect the behavior of oxyhemoglobin. The hypothesis is that photo-induced temperature changes cause the release of oxygen from hemoglobin. The data collected from this study and its results will be presented.

## SENSITIVITY OF TREE CORE SAMPLING IN DETECTING TRICHLOROETHYLENE GROUNDWATER PLUMES

John B. Williams, George B. Taylor, Quinn I. Thomas, Quincy I. Pickett-Stokes and  
Elizabeth Ashley Shull<sup>1</sup>

Department of Biological & Physical Sciences, South Carolina State University

<sup>1</sup>Savannah River Nuclear Solutions

Natural attenuation includes any ecosystem functions that can reduce contaminant loads in the surface and subsurface environment. Programs by the EPA, other government agencies, and industry are carefully documenting the completeness of these natural pollution-reduction pathways through a process called “monitored natural attenuation”. Advantages to end-users from successful natural attenuation include reduced clean-up costs and often more esthetically pleasing work-sites. Our project was conducted near an EPA Superfund site “operable unit” at Savannah River Site, SC. The major impact from this site was trichloroethylene (TCE) groundwater plumes moving downslope to the Pen Brach wetlands valley. The focus of our study was to determine the utility and effectiveness of tree core sampling to detect plume flow and evidence of TCE degradation. Trees play a major role as a form of natural attenuation in a special subcategory, phytoremediation. Phytoremediation primarily involves trees serving as natural “pumps” to move

groundwater from the rhizosphere to the leaves and into the atmosphere as evapotranspiration. Along with this uptake and transport, some tree enzymes have been shown to degrade TCE to breakdown compounds along the TCE→dichloroethylene (DCE)→vinyl chloride (VC) pathway. However, these mechanisms are less completely documented than the bacterial reductive dechlorination pathways in natural attenuation. Collectively these compounds are classified as volatile organic compounds (VOC). Our primary objective was to determine the utility of coring trees in the Pen Branch floodplain to detect TCE plume movements and degradation. If this methodology were shown to be as reliable as shallow well construction, monitoring results might be obtained more quickly with less expense than hole-auguring and pumping. Our methods utilized standard tree coring methods with extracted cores being placed into septa-seal vials and stored on ice for later GCMS analysis. An additional objective was to determine whether tree roots radiating in different directions from the trunk might provide even more detailed information on spatially small scale plume conditions. The TCE parent compound, perchloroethylene (PCE) and DCE were present in significantly higher concentrations in tree tissues than nearby piezometer reference stations. Roots radiating outwards in different compass directions sometimes showed greater than a10X difference in VOC between roots for the same tree (e.g. 1,1 DCE varied from 96 ppb to 4 ppb between roots). Replicate sampling of the same trees on different dates was consistent for tree to tree VOC levels, but was inconsistent with regards to which root direction display highest VOC.

\* Supported under DOE/SRS Cooperative Agreement DE-FC09-88SR418049 and DOE Award # DE-EM0000594

## DEVELOPING AN AUTOMATED PROCESSING PIPELINE FOR PROPRIETARY RAIN MEASUREMENT EQUIPMENT

Joshua Teves and Michael L. Larsen

College of Charleston, Department of Physics and Astronomy

In a newly constructed rain measurement array, 21 instruments with proprietary data formats were used to collect rain drop size distributions. The data was transmitted on a minutely basis, with full reports consisting of approximately one week of transmitted data. In order to effectively use the data, an automated pipeline was developed to both process the reports for the instruments and to organize the data into a system more suitable for analysis, as well as to handle erroneous data transmission. These techniques, their development and implementation, and performance will be discussed.

## USING MAB M24-2 (A FISH LYSOZYME) TO EXAMINE THE HOST-PARASITE RELATIONSHIPS IN LIVERS OF FISH FROM SALUDA SHOALS PARK, COLUMBIA

Shannon Theobald and Marlee B Marsh  
Columbia College

Fish innate immune responses are routinely evaluated as indicators of immune function and status following exposure to pathogens, biological response modifiers, immunotoxicants, and nutritional regimes. Recently, we developed monoclonal antibody (mAb) M24-2 that recognizes lysozyme in several species of fish (E.g. *Fundulus heteroclitus*, *F. grandis*, *Ictalurus punctatus*, *Morone saxatilis*) used in comparative immunological studies. Lysozyme is found in macrophages and neutrophils and is one of several humoral and cellular factors associated with innate immunity in all vertebrates. The purpose of this study was to use mAb M24-2 to examine cellular profiles of immune cells in livers of parasite-infected and uninfected livers of 41 fish from Saluda Shoals Park in Columbia, SC. There is no current model for fish immune responses to parasites. Furthermore, any direct role(s) of neutrophils and macrophages in fish immune responses to parasites has yet to be determined. This is mostly due to a lack of suitable reagents. In this study, we probe paraffin-embedded livers of several species of freshwater fish (E.g. *Lepomis* spp., *Ictalurus* spp. and *Micropterus* spp.) and compare the lysozyme profiles of parasite-infected vs. uninfected individuals.

## DEVELOPMENT AND OPTIMIZATION OF A PCR PROTOCOL TO RAPIDLY DETECT BACTERIOPHAGES INFECTING STAPHYLOCOCCUS AUREUS

Nicholas Thurn and Paul Richardson  
Coastal Carolina University

Bacteriophages are viruses that infect and lyse bacteria. Methicilin-resistant *Staphylococcus aureus* is a pathogenic bacteria that exhibits antibiotic resistance. Unlike drugs, bacteriophages evolve with their host and are able to keep up with mutating pathogens. Currently, a PCR protocol and primers are being tested and optimized to enable rapid detection of bacteriophage that may be lytic against Methicilin-resistant *Staphylococcus aureus*.

## A NOVEL MECHANISM OF NEURAL RESPONSE MODULATION

Davy Vanderweyen and Sorinel A. Oprisan  
College of Charleston

Neurons communicate with each other via large all-or-nothing electrical impulses called Action Potentials (APs). APs are presumably stereotypical electric activities, i.e. each neuron fires identical APs. Neurons encode the characteristics of external stimuli, such as their intensity or duration, and their relative timing (or phase) with respect to the most recent AP as transient changes of their firing frequency. The APs, which are brief voltage spikes in the membrane potential of a neuron, are mostly used as time markers or phase references. We used a single-compartment generic Hodgkin-Huxley model to investigate the AP shape changes due to external stimuli. We found that neurons are sensitive to the phase of the stimulus, but also to its shape. Our results also show that both the rising and the falling phase of APs encode some characteristics of external stimuli, hence, it can be inferred that neurons encode information regarding the external stimuli by modulating AP duration in addition to their rate of firing. The raising phase of an AP uses the nonlinear gating properties of sodium channels, while the falling phase of an AP uses potassium gated channels to encode different characteristics of the external stimulus.

## GENERALIZED FIBONACCI SERIES AND THE GOLDEN RATIO.

John Watson and Antara Mukherjee and Rigoberto Florez  
The Citadel

In this talk I will discuss how I solved a particular case of a generalized Fibonacci series. This will entail the use of the Fibonacci Sequence, Cassini's Formula, and some known Fibonacci identities. Additionally, I will discuss the general form of this series, subsequent work from this generalization, and possible solutions that this offers. The problem solved was an open problem in the Fall 2013 issue of the Fibonacci Quarterly. It was submitted for consideration.

## MEASURING THE EFFECT OF ANTI-HIV TAT SIRNAS ON HIV REPLICATION

Emily Webb and William H. Jackson  
University of South Carolina Aiken

Human Immunodeficiency Virus (HIV) is a retrovirus that infects CD4+ T lymphocytes and progressively destroys the immune system and its functions. Eight to ten years after initial infection, if treatment is not available, HIV infection results in Acquired Immunodeficiency Syndrome (AIDS). Antiretroviral drugs are being used to successfully reduce viral replication and extend the time to AIDS, but no treatments have completely eradicated the virus, and a number of these drugs have already been targeted for viral resistance. Because current treatment options are not curative, it is necessary for further investigations into ways to combat HIV.



One vital target of HIV is the viral transactivator of transcription (tat), which is an essential regulatory protein that acts to upregulate viral transcription. Using siRNAs to inhibit the function of several HIV genes, in particular tat, seems to be a promising route. siRNAs are short-interfering RNA sequences that can be used to target and cleave specific mRNAs through the DICER/RISC complex. The DICER/RISC complex is recruited to the target mRNA through complementary base-pairing with the siRNA and activates a cleavage reaction of the mRNA that results in down-regulation of gene expression. To study the ability of siRNAs to inhibit HIV replication, four anti-HIV tat siRNAs (si5834, si5860, si5892, si6010) and a control siRNA have been designed and cloned into the retroviral vector; pSuper.retro.neo+GFP, under the control of the RNA polymerase III H1 promoter. Indirect testing of these siRNAs, using a tat-dependent luciferase assay, showed various levels of anti-tat activity, with si5892 showing the greatest efficacy. Currently, direct measurements of the effects these siRNAs have on HIV replication through a HIV p24 antigen capture assay are being conducted.

#### D-AMINO ACID INHIBITORY PROPERTIES ON *STAPHYLOCOCCUS AUREUS* AND *ESCHERCHIA COLI* GROWTH

Jordan Wesel, Ina Troutman, and Paul E. Richardson  
Coastal Carolina University

The over prescription and misuse of antibiotics has resulted in antibiotic-resistant strains of bacteria. In order to combat these evolved strains, the scientific community must develop new treatments. A potential new option is using D-amino acids as a bacteriostatic agent. D-amino acids are important components of bacterial cell walls, but are unusable for protein synthesis, where only the “l-“ enantiomers are utilized. If D-amino acids were incorporated into the proteins, it would severely deform the protein and render it useless. The “d-“ conformation has the potential to slow and perhaps halt bacterial cell wall synthesis. Given this, the D-amino acids methionine, leucine, and phenylalanine, will be tested for potential inhibitory effects on the gram-negative bacteria *Escherichia Coli*, and the gram-positive bacteria *Staphylococcus aureus*.

# LONG TERM NATURAL ATTENUATION EFFECTIVENESS IN REMEDIATING A TCE GROUNDWATER PLUME

John B. Williams and Elizabeth Ashley Shull<sup>1</sup>

Department of Biological & Physical Sciences, South Carolina State University

Elizabeth Ashley Shull<sup>1</sup>

<sup>1</sup>Savannah River Nuclear Solutions

In recent decades, field studies have continued to document the efficacy of natural attenuation as a ‘green’, cost-effective technology for remediating contaminated sites. When applicable, the EPA has found natural attenuation to be an acceptable mode of achieving compliance to regulatory standards. While natural attenuation can include any ecosystem function that reduces contaminant loads in the surface and subsurface environment, it is focused on microbial biochemical pathways. Our study was replicated several years near an EPA Superfund site “operable unit” at Savannah River Site, SC. This waste disposal area, CMP Pits, was in operation from 1971 until its closure in 1979 when the pits were closed and backfilled. However, monitoring well data indicated that perchloroethylene (PCE) and trichloroethylene (TCE) had seeped beneath the vadose zone and formed groundwater plumes reaching the Pen Branch valley below. Although ‘hot spots’ of TCE were found within the Pen Branch floodplain, it was unknown just how the flow pattern was entering Pen Branch and to what degree natural attenuation was destroying the contaminant load. To accurately predict rates of natural attenuation for these plumes, it was vital to determine plume flow patterns, suitability of chemical and microbial conditions, and degradation rate seasonality. Intensive sampling of different reaches of Pen Branch from 2005 to 2013 addressed these questions for the critical hyporheic zone beneath Pen Branch and adjacent floodplain. Collectively PCE, TCE, and their degradation products are labeled as volatile organic compounds (VOC) and a favorable trend of contaminant reduction was detected. Total VOC concentrations at some stations have declined by >25% and concentrations of vinyl chloride (VC), a nearly-final stage degradation product increased from 0.0 ppb to >20 ppb. However, flow patterns are complex and plumes do not directly outcrop into Pen Branch surface waters, but emerge into the stream through pathways in the porous hyporheic zone. For this reason continued sampling must identify critical depths and downstream locations where plume flows may be more intense. During drought periods with no surface flow in Pen Branch, subsurface plume flows may be flowing downslope in the hyporheic zone. \* Supported under DOE/SRS Cooperative Agreement DE-FC09-88SR418049 and DOE Award # DE-EM0000594

## INVESTIGATING THE FUNCTION OF AIL7 IN ARABIDOPSIS FLOWER DEVELOPMENT

Yvonne Wright and Beth Krizek  
Morris College

AINTEGUMENTA-LIKE 7 (AIL7/ PLT7) is a member of the AINTEGUMENTA-LIKE/PLETHORA (AIL/PLT) transcription factor family; these proteins act as important regulators of flower development in *Arabidopsis thaliana*. The AIL/PLT family is made up of eight genes, four of which are expressed in flowers. These four AIL genes: AINTEGUMENTA (ANT), AIL5, AIL6 and AIL7 act in a partially redundant fashion in floral organogenesis. Loss of AIL7 function alone has no phenotype. However, loss of both ANT and AIL7 together results in a more severe phenotype than loss of ANT alone, ant ail7 double mutants have some fused sepals, reduced numbers of petals, and partly unfused carpels. The sepal and petal defects are similar to those seen in petal loss (ptl) and these could be rescued by a transgene conferring increase synthesis of the plant hormone auxin in the intersepal zone. Auxin is an important signal for lateral organ initiation in plants. The purpose of this research is to investigate the role of AIL7 in transcriptional regulation of *Arabidopsis* flower development and to determine whether increased auxin production in the intersepal zones can rescue the outer whorl defects observed in ant ail7 double mutants

## ROLE OF CASEIN KINASE 1 ACTIVITY IN THE AUDITORY SENSORY CELL PATTERNING

Cory Wright and Chandralaka Puligilla  
Morris College

The inner ear is comprised of two sections: ventral portion (vestibular system) is responsible for spatial orientation and equilibrium, and the dorsal portion (auditory system cochlea) is responsible for hearing. The organ of Corti within the cochlea converts sound into electrical signals that are perceived by the brain. Within this remarkable structure two types of sensory hair cells (inner hair cells and outer hair cells) and at least four different types of nonsensory supporting cells are arranged in precise rows and in a highly invariant pattern that extend along the length of the cochlear duct. The proper development of these cell types and their organized arrangement is essential for normal hearing function. However, the molecular mechanisms responsible for the correct cellular pattern formation remain elusive. Casein kinase 1 (CK 1) is a serine-threonine kinase that has been shown to regulate various signal transduction pathways in most eukaryotic cell types. Several cellular processes including cell division and DNA transcription all involve CK1. Our preliminary data indicate that inhibition of CK1 activity in the developing mouse cochlea results in significant disruption in the patterning of sensory cells. In addition, CK1 inhibition leads to the downregulation of junctional molecule, E-cadherin. Experiments are currently underway to determine the molecular mechanism utilized by CK1 to regulate cellular pattern formation in the

developing mouse cochlea. We expect our results can improve our understanding of the cellular pattern of the cochlea that can help with deafness and other balance disorders.

## EXOPLANET AND CIRCUMSTELLAR DISK STUDIES WITH THE HUBBLE SPACE TELESCOPE

Brittany Yeager and Joe Carson  
College of Charleston

We present a status report on our work carried out as part of the Hubble DICE survey to explore nearby young stars for circumstellar disks and extrasolar planets. Specifically, DICE (Disk Imaging, Characterization, and Exploration) is a Hubble Space Telescope survey of 11 nearby stars that uses visible-wavelength, coronagraphic imaging with the STIS camera to better understand exoplanetary systems in the context of our own solar system, and advance the characterization of the small-body dust grain populations in these environments. As part of this effort, we are developing new data processing software to improve the survey's effective sensitivity to circumstellar disks and extrasolar planets at very narrow separations from the parent star.

**END**

SC Academy of Science Abstracts  
(Sr. Academy)

**SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE**  
**SCHEDULE OF EVENTS**  
**APRIL 5<sup>TH</sup>, 2014**

**Saturday, April 13<sup>th</sup>**

<b>7:30- 9:00 AM</b>	<b>SCJAS Registration</b>	920 Building Lobby
<b>8:00-8:30 AM.</b>	<b>Welcome</b>	920 Building Salon F & G
<b>8:30-12:00 AM</b>	<b>SCJAS Morning Sessions:</b>	Assigned Classrooms, see session schedules
<b>8:45-11:30am</b>	<b>Showcase of Regional Science Fair Winners</b>	920 Building Salon F&G
<b>11:45 AM-1:30 PM</b>	<b>Lunch</b>	
<b>1:30-2:00 PM</b>	<b>Plenary Session Speaker</b>	920 Building Salon F & G
<b>2:15-3:30 PM</b>	<b>SCJAS Afternoon Sessions:</b>	Assigned Classrooms, see session schedules
<b>2:30-3:00 PM</b>	Teachers Meeting with Dr. John Kaup	Building 970 Room 327
<b>3:00-4:00 PM</b>	'Journey to the Center of the Atom' presentation	Building 920 Room 791
<b>4:30–5:00 PM</b>	<b>Pizza Dinner</b>	Building 920 Room 791
<b>5:00–6:00 PM</b>	<b>SCJAS Award Ceremony</b>	Building 920 Room 791

## **2014 SCJAS AWARD CEREMONY SCHEDULE**

### **Welcome:**

Dr. Tom Reeves, Midlands Technical College

SCJAS Executive Director

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

Award: \$100 for student winner and teacher sponsor

Presenter: Dr. Mikhail M. Agrest, Adjunct Professor,  
Trident Technical College

### **Daniel Antion Chemistry Award**

Award: \$200 first place in Oral Presentation for category  
of Non-mentored Chemistry

Presenter: Dr. Jim Privett, USC Sumter

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

Award: one year subscription to ChemMatters  
to all presenters in categories of Chemistry and Biochemistry

Presenter: Dr. Jim Privett, USC Sumter

### **2014 SCJAS Written Presentations**

Presenter: Dr. Jim Privett, USC Sumter

### **2014 SCJAS Oral Presentations**

Presenter: Dr. Edna Steele, Converse College

### **Nominations for 2015 AJAS meeting**

February 12th-16th San Jose, CA

Presenter: Dr. John Kaup, Furman University

### **Closing remarks**

Dr. John Kaup, Furman University

## 2014 SCJAS JUDGES

\* indicates Lead Judge

### **Biochemistry(M, NM)**

\*Mr. Robert Smith, Science Instructor, York Technical College

Dr. Doug Florian, Charleston

### **Botany (M, NM)**

\*Dr. Henry Slone, Associate Professor of Biology, Francis Marion University

Dr. Charlotte Song, Assistant Professor, Charleston Southern University

### **Cell &Molecular Biology (M)**

\* Dr. Virginia B. Baker, Assistant Professor, Charleston Southern University

Dr. Joshua Kerns, Assistant Professor, Charleston Southern University

### **Chemistry (M, NM)**

\*Dr. Lisa Brodhacker, Associate Professor of Chemistry, Lander University

Dr. Aiye Liang, Assistant Professor of Chemistry, Charleston Southern University

### **Consumer Affairs (M, NM)**

\*Daniel Kiernan, Instructor of Biology, USC Sumter

Leah Kiernan, Teacher, St. Anne's Catholic School, Sumter

### **Engineering (M)**

\*Dr. Simon Ghanat, Assistant Professor, The Citadel

### **Engineering (NM)**

\*Dr. Tim Jur, Engineer, Engineering Design & Testing Corp.

Len Dillinger, Senior Program Manager, Michael Baker Jr., Inc.

### **Environmental Science (M)**

\*Dr. Michael G. Schmidt, Professor of Microbiology and Immunology,

Medical University of South Carolina

Dr. Ajoy Chakrabati, Professor of Biology, South Carolina State University

### **Environmental Science (NM)**

\* Mrs. Sukla Chakrabati, Orangeburg, SC

Dr. Kevin B. Jones, Instructor of Biology, Charleston Southern University

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

\*Odysseas Kakaras, Instructor of Mathematics, University of South Carolina  
Sumter

Dr. Ze Zhang, Associate Professor of Computer Science, Coker College

### **Microbiology (M,NM)**

\*Dr. Stefanie Baker, Associate Professor, Wofford College (Papers only)

Ms. Dawn Heldreth, Lab Instructor and Lab Manager, Trident Technical College  
Dr. Kaustubha R. Qanungo, Instructor, Trident Technical College (Orals only)

**Physics (NM)**

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

**Physiology and Health (M)**

\*Dr. Amy Nolan, Professor of Biology, Charleston Southern University  
Ms. Margaret Gibson, Instructor of Biology, Trident Technical College

**Physiology and Health (NM)**

\*Dr. Roger Schmidt, Associate Professor of Biology, Columbia College  
Dr. Derrick James, Adjunct Biology Professor, South Carolina State University

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

\*Dr. Nancy Simpson, Psychologist, Trident Technical College  
Jonathon Fish, Departmental Coordinator, Trident Technical College

**Zoology (M,NM)**

\*Dr. Todd Heldreth, Professor of Biology, Charleston Southern University  
Ms. Andrea LeSchack, Instructor of Biology, Trident Technical College



## **SCJAS PRESENTATION SCHEDULE**

### **BIOCHEMISTRY- MENTORED BLDG 920 ROOM 769**

- 8:30 AM EFFECT OF FREE TUBULIN ON VOLTAGE-DEPENDENT ANION CHANNEL DURING RESPIRATION IN CANCER CELLS  
Gina Song, Governor's School for Science and Mathematics
- 8:45 AM PDA/PLGA NANOPARTICLE-BASED DRUG DELIVERY SYSTEM FOR THE TREATMENT OF CANCER  
Emily Hattaway, Governor's School for Science and Mathematics
- 9:00 AM SPECIFIC INTERACTIONS BETWEEN 10-FORMYLTETRAHYDROFOLATE DEHYDROGENASE AND APOPTOTIC PROTEINS JNK 1/ JNK 2 IN FOLATE METABOLISM IN VITRO  
Christopher Loe, Governor's School for Science and Mathematics
- 9:15 AM DETERMINING THE SUBSTRATE SPECIFICITY OF THE GLYCOSIDASE ACTIVITY OF NEISSERIA GONORRHOEAE BY AMIDASE C  
Jamal Merritt, Governor's School for Science and Mathematics
- 9:30 AM UNDERSTANDING THE EFFECTS OF OIL AND HYPERBRANCH POLYMERS AS DISPERSANTS ON SYNECHOCYSTIS  
Ronald Goins, Governor's School for Science and Mathematics
- 9:45 AM THE EFFECT OF MEMBRANE CURVATURE ON THE ANCHORING OF THE N-RAS PROTEIN  
Daniel Ott, The Center for Advanced Technical Studies

### **BIOCHEMISTRY - NON-MENTORED BLDG 920 ROOM 769**

- 10:15 AM UTILIZATION OF NON-WOODY BIOMASS AS A LOCAL FUEL SOURCE  
Abraham Oh, The Center for Advanced Technical Studies
- 10:30 AM HOW DO DIFFERENT BIODIESEL BLENDS EFFECT FUEL EFFICIENCY AND ENGINE CORROSION?  
Manning Lumpkin, The Center for Advanced Technical Studies

- 10:45 AM THE EFFECT OF VARIOUS TYPES OF STATINS ON THE DEPLETION OF THE SUPPLEMENTAL COENZYME Q10  
Alexandra Bergren, Spring Valley High School
- 11:00 AM THE EFFECT OF UNSATURATED, OMEGA FAMILY FATTY ACIDS ON THE ZONE OF INHIBITION OF ESCHERICHIA COLI IN SPINACIA OLERACEA CULTURES  
Azalfa Lateef, Spring Valley High School
- 11:15 AM DEVELOPMENT OF NOVEL FLUORSECENT SENSORS FOR HYDROGEN SULFIDE  
Francis Lee, Dutch Fork High School
- 11:30 AM HOW HOMEMADE REPELLENTS AFFECT BLATELLA GERMANICA ACTIVITY  
Caleb Thomas, Dutch Fork High School

**Lunch**

**BOTANY – MENTORED  
BLDG 920 ROOM 773**

- 9:00 AM RT-QPCR ANALYSIS OF MIRNAS AND PUTATIVE TARGET GENES IN LATERAL ROOTS UNDER DROUGHT STRESS IN UPLAND COTTON (GOSSYPIMUM HIRSUTUM)  
Caroline Gilmer, Governor's School for Science and Mathematics
- 9:15 AM AMPLIFICATION AND TRANSFORMATION OF ATRSPK  
Paul Hughes, Governor's School for Science and Mathematics
- 9:30 AM MARKER ASSISTED SELECTION FOR RED COLORATION IN PEACH [PRUNUS PERSICA]  
Rachel Quick, Governor's School for Science and Mathematics

**BOTANY - NON-MENTORED  
BLDG 920 ROOM 773**

- 10:00 AM THE EFFECT OF SCARIFICATION WITH 3% HYDROGEN PEROXIDE SOLUTION, 3% HYDROCHLORIC ACID SOLUTION, OR 3% ISOPROPYL ALCOHOL SOLUTION ON THE SEEDS GERMINATION RATE OF WISCONSIN FAST PLANTS (*BRASSICA RAPA*)  
Isabelle Robinson and Carter Smith, Heathwood Hall Episcopal School
- 10:15 AM THE EFFECT OF DIFFERENT INTENSITIES OF UVB LIGHT VS DIFFERENT INTENSITIES OF FULL SPECTRUM GROW LIGHTS ON THE GROWTH RATE OF *RAPHANUS SATIVUS*  
Will Pertile, Heathwood Hall Episcopal School
- 10:30 AM THE COMPARISON OF THE MINIMUM INHIBITORY CONCENTRATIONS OF *ALLIUM SATIVUM*, *TRACHYSPERMUM AMMI*, AND *HYDRASTIS CANADENSIS* ON *ENTEROBACTER AEROGENES*.  
Teebro Rahman, Spring Valley High School
- 10:45 AM THE EFFECT OF RELATIVE HUMIDITY ON THE DRY MASS OF *BRASSICA RAPA*  
Linnea Bacon, Spring Valley High School
- 11:00 AM THE ALLELOPATHIC EFFECTS OF *EUCALYPTUS CINEREA* LEAF AND ROOT EXTRACTS ON THE SEED GERMINATION AND SEEDLING GROWTH OF *IPOMOEA ALBA* SEEDS  
Asheya Hinkle, Spring Valley High School
- 11:15 AM THE EFFECT OF WHITE FLUORESCENT, INCANDESCENT, AND LIGHT-EMITTING DIODE (LED) LIGHT SOURCE ON THE HEALTH (HEIGHT, NUMBER OF LEAVES, NUMBER OF FLOWER BUDS, NUMBER OF FLOWER BUDS BLOOMED, NUMBER OF DEATHS) OF THE *BRASSICA RAPA* COMPARED TO THE HEALTH UNDER THE AGROSUN FLUORESCENT FULL SPECTRUM GROW LIGHT  
Erica Fowler, Heathwood Hall Episcopal School

**Lunch**

**CELL & MOLECULAR BIOLOGY-MENTORED  
BLDG 920 ROOM 502**

- 8:30 AM SUPPRESSION OF HPV16 EXPRESSION IN HUMAN KERATINOCYTES BY ANTI-E7 SIRNA, AND THE USE OF HRAS-V12 AND SIX1 TO EXPLORE THE DEPENDENCY OF HPV16 ON E7  
Aspasia Amiridis, Heathwood Hall Episcopal School
- 8:45 AM EXAMINING THE EFFECTS OF DIFFERENT FORMS OF MUSIC EXPOSURE ON THE DEVELOPING BRAIN  
Rachael Dawson, Academic Magnet High School
- 9:00 AM THE DEVELOPMENT OF HEPARINASE ON TISSUE DIGESTIONS FOR USE IN MALDI – MSI DEVICES  
Sheldon Carpenter, Governor’s School for Science and Mathematics
- 9:15 AM NOTCH SIGNALING IN ENDOTHELIAL CELLS AS A REGULATOR OF GLUCOSE METABOLISM  
Gabe Carrillo, Governor’s School for Science and Mathematics
- 9:30 AM THE EFFECTS OF ARF 1 AND ARF 2 ON CANDIDA ALBICANS  
Mairin Cotter, Governor’s School for Science and Mathematics
- 9:45 AM RANKL INDUCES TRAIL EXPRESSION AND OSTEOCLAST FORMATION IN ORAL CANCER CELLS  
Angel Glover, Governor’s School for Science and Mathematics
- Break**
- 10:15 AM CHARACTERIZATION OF THE TOXIN-ANTITOXIN SYSTEM GNSA-YMCE  
Reilly Kilpatrick, Governor’s School for Science and Mathematics
- 10:30 AM BIOCHEMICAL CHARACTERIZATION OF ALPHA-SYNUCLEIN CONTAINING PROTEIN AGGREGATES IN A YEAST MODEL FOR PARKINSON’S DISEASE  
Madison Massengale-Roberts, Governor’s School for Science and Mathematics
- 10:45 AM THE EXPRESSION OF THE CREEPING BENTGRASS’ HEAT SHOCK PROTEIN GENE, HSP 26.8, IN ARABIDOPSIS PLANTS  
Justice Mullen, Governor’s School for Science and Mathematics

- 11:00 AM     ELECTROPORATION OF FLUORESCENT PLASMIDS IN CIONA  
INTESTINALIS  
Bailey Nicolas, Governor's School for Science and Mathematics
- 11:15 AM     KRUPPEL-LIKE FACTOR KLF4 DEFICIENCY DECREASES  
FIBROBLAST CONTRACTION  
Parmida Parsa, Governor's School for Science and Mathematics
- 11:30 AM     ANALYZING THE ROLE OF NEUROPILIN 2 AND ITS ISOFORMS  
IN THE EPITHELIAL MESENCHYMAL TRANSITION PROCESS BY  
SHORT-HAIRPIN RNA TECHNIQUE  
Kendell Peterson, Governor's School for Science and Mathematics
- 11:45 AM     UNDERSTANDING THE IN VIVO ROLE OF FZLC IN BACTERIAL  
CELL DIVISION THROUGH A LONG TERM GROWTH  
COMPETITION  
Maddie Sansbury, Governor's School for Science and Mathematics
- Lunch**
- 1:00 PM     ROLE OF NRF2 TARGET GENES IN RESPONSE TO  
THYMIDYLATE SYNTHASE INHIBITORS IN HUMAN COLON  
CANCER  
Paul Shim , Governor's School for Science and Mathematics
- 1:15 PM     FUNCTIONAL CHARACTERIZATION OF OSMIR408: A RICE  
MICRORNA POTENTIALLY INVOLVED IN PLANT RESPONSE TO  
ENVIRONMENTAL STRESS  
Jensen Tomberlin, Governor's School for Science and Mathematics
- 1:30 PM     THE EFFECT OF GP130 RECEPTOR PROTEIN LOSS ON HEART  
MASS IN MICE WITH CANCER CACHEXIA  
Jacqueline Budidharma , Governor's School for Science and  
Mathematics
- 1:45 PM     DETECTING ALLERGENIC PROTEINS THAT TRIGGER ASTHMA  
IN INDOOR ENVIRONMENTS  
Summer York , Governor's School for Science and Mathematics
- 2:00 PM     THE EFFECT OF DISKS LARGE HOMOLOG 1 (DLG1) AND DISKS  
LARGE HOMOLOG 5 (DLG5) GENES ON ADIPOGENESIS IN  
MESENCHYMAL STEM CELLS  
Lydia Zeiler , Governor's School for Science and Mathematics

- 2:15 PM THE EFFECT OF DIFFERENT CONCENTRATIONS OF MERCURY (II) CHLORIDE, LEAD (II) CHLORIDE, AND CADMIUM CHLORIDE ON THE PRESENCE OF  $\text{TNF}\alpha$  AND  $\text{IFN}\gamma$  IN HUMAN PBMC SAMPLES  
Nabihah Kumte, Spring Valley High School
- 2:30 PM THE ROLE OF HEAT SHOCK PROTEIN 90 BETA ONE (GP96) AS A CHAPERONE FOR LOW-DENSITY RECEPTOR-RELATED PROTEIN 6 (LRP6) IN PLASMA CELLS  
Mira Bajaj, Governor's School for Science and Mathematics
- 2:45 PM THE EFFECT OF NETRO 1 AND NETRO 2 ON THE FORMATION OF HETEROMERIC KAINATE RECEPTORS  
Jason Erno, Spring Valley High School

**CHEMISTRY – MENTORED  
BUILDING 920 ROOM 771**

- 8:30 AM DETERMINATION OF THE OPTIMAL SUPPORTED RUTHENIUM NANOPARTICLE CATALYST SIZE FOR AMMONIA DECOMPOSITION  
Justin Abbasi, Governor's School for Science and Mathematics
- 8:45 AM SYNTHESIS OF 3-AMINO-3-(HYDROXYIMINO)-N[2-HYDROXYL]PHENYL]PROPANAMIDE  
Pat Balmediano, Governor's School for Science and Mathematics
- 9:00 AM SYNTHESIS OF NON-ATP COMPETITIVE CYCLIN BINDING GROOVE INHIBITORS  
Andrea Detter, Governor's School for Science and Mathematics
- 9:15 AM PRODUCING MARKERS TO DETERMINE POSITIONING FOR IN SITU RAMAN SPECTROSCOPY OF A FUEL CELL  
Joshua Halbritter, Governor's School for Science and Mathematics
- 9:30 AM SYNTHESIS OF NANOPARTICLES FOR THE DEVELOPMENT OF THE ELECTRODE FOR SOLID OXIDE FUEL CELLS BY USING THE GLYCINE-NITRATE COMBUSTION PROCESS  
Jimmy Hurst, Governor's School for Science and Mathematics
- 9:45 AM SYNTHESIS, STRUCTURE DETERMINATION, AND OPTICAL PROPERTIES OF RARE-EARTH (RE) SILICATES (RE= EU, Y, LA, SM, IN)  
Alexis Myers, Governor's School for Science and Mathematics

- 10:00 AM SYNTHESIS OF AG-AU-AG CORE-SHELL-SHELL  
NANOPARTICLES  
Olivia Sequerth, Governor's School for Science and Mathematics
- Break**
- 10:30 AM ROLE OF QUANTUM EFFECTS IN THE INTRAMOLECULAR  
PROTON TRANSFER IN 10-HYDROXYBENZO[H]QUINOLINE  
Michael Slattery, Governor's School for Science and Mathematics
- 10:45 AM CO-CRYSTALLIZING PYRIDYL BIS-UREA MACROCYCLES WITH  
ALCOHOL GUEST MOLECULES  
Graham Tindall, Governor's School for Science and Mathematics
- 11:00 AM GENERATION OF POROUS HYDROGELS BY CARBONATION  
Ayan Dasgupta, Hammond School
- 11:15 AM EFFECT OF VARIOUS ELECTROLYTES ON THE ELECTROLYSIS  
OF WATER  
Jacob E. Rabinovitch, Greenville Technical Charter High School
- 11:30 AM PORTABLE THERMAL ENERGY STORAGE IN ZEOLITE  
ADSORBENT BEDS  
Aaron Vincent, The Center for Advanced Technical Studies
- 11:45 AM EFFECT OF INTERIOR PAINT TYPE ON VOLATILE ORGANIC  
COMPOUND EMISSIONS  
Krista Knowles, Dutch Fork High School
- 12:00 PM THE EFFECT OF L-HISTIDINE TREATED STEEL PELLETS  
SUBJECTED TO 18 M SULFURIC ACID  
Revanth Kanumuri, Spring Valley High School

**Lunch**

**CONSUMER AFFAIRS –MENTORED  
BLDG 920 ROOM 751**

- 8:30 AM      AN EYETRACKING STUDY ON TOTAL FIXATION DURATION  
TIMES OF A CONSUMER WHEN FOCUSING ON UNFAMILIAR  
BRAND PRODUCTS  
Lauren Ambuhl, Governor's School for Science and Mathematics
- 8:45 AM      BRANDING BLUFFTON: A CASE STUDY  
Joe Marazzo, Governor's School for Science and Mathematics
- 9:00 AM      SURVEY DESIGN TO EFFECTIVELY MEASURE TECHNOLOGY  
INTEGRATION IN SOUTH CAROLINA SECONDARY SCHOOLS  
Franklin Piedade, Governor's School for Science and Mathematics
- 9:15 AM      STATEWIDE OCCUPATIONAL TRENDS IN SOUTH CAROLINA  
INFORMATION TECHNOLOGY  
Kayla Sommers, Governor's School for Science and Mathematics
- 9:30 AM      THE EFFECT OF USING SODIUM HYPOCHLORITE VS. SODIUM  
PERCARBONATE BLEACH TO INTERFERE WITH THE  
DETECTION OF BLOOD RESIDUE BY A BLUESTAR MAGNUM  
LUMINOL TEST  
Jordan Withycombe, Heathwood Hall Episcopal School
- 9:45 AM      THE EFFECT OF TEMPERATURE ON THE LEGALITY OF THE  
REBOUND HEIGHT OF A TENNIS BALL  
Elizabeth W. Barr, Heathwood Hall Episcopal School
- 10:00 AM      THE EFFECT OF ENVIRONMENTAL AND TRADITIONAL CARPET  
CLEANERS ON RED WINE CARPET STAINS  
Samantha Marie Piper, Heathwood Hall Episcopal School

**Break**



- 10:30 AM THE EFFECTIVENESS OF NATURAL AND CHEMICAL SOAPS AND SANITIZERS IN THE KILLING OF E. COLI  
Isabella Antonetti and Leila Barwick, Heathwood Hall Episcopal School
- 10:45 AM A COOL LOOK AT EFFICIENT ROOFING  
Samuel Rennick, Center for Advanced Technical Studies
- 11:00 AM THE EFFECT OF WHITENING PRODUCTS ON THE COLORATION OF TEETH  
Sharmila Sabine Samuel, Greenville Technical Charter High School
- 11:15 AM THE EFFECT OF COLOR ON THE PERCEPTION OF FLAVOR IN VANILLA ICE CREAM  
Savannah Hillmeyer and Olivia Price, Heathwood Hall Episcopal School
- 11:30 AM THE EFFECT OF DIFFERENT STYLES OF ANKLE TAPING ON ANKLE STABILITY AND PERFORMANCE ON THE SEBT  
Casey Glick, Heathwood Hall Episcopal School
- 11:45 AM THE EFFECT OF LAUNDRY DETERGENT TYPE AND TEMPERATURE ON PROTEIN DIGESTION  
Emma Barr, Heathwood Hall Episcopal School
- 12:00 PM THE ABSORBENCY OF SIX BRANDS OF PAPER TOWELS  
Jordan Obinna Nwanagu, Heathwood Hall Episcopal School
- Lunch**
- 1:15 PM THE EFFECT OF TAP WATER RINSE AND FIT® PRODUCE WASH RINSE ON THE RESIDUAL AMOUNT OF MALATHION METHYL REMAINING ON GRANNY SMITH APPLES  
Anna Farr, Heathwood Hall Episcopal School
- 1:30 PM THE EFFECT OF ORGANIC FERTILIZER (MOLASSES) COMPARED TO COMMERCIAL FERTILIZER (MILORGANITE) ON THE GROWTH OF LETTUCE PLANTS  
Margaret Mullins, Heathwood Hall Episcopal School
- 1:45 PM THE EFFECT ON BOUNCE HEIGHT OF DIFFERENT TYPES OF BASKETBALLS ON A HARDWOOD BASKETBALL COURT  
Julian Hennig IV, Heathwood Hall Episcopal School

2:00 PM EFFECTS OF AIR FRESHENER CHEMICALS ON THE HEALTH OF MICE  
Maraya Bidjerano, Greenville Technical Charter High School

2:15 PM THE EFFECTS OF NATURAL VS. CHEMICAL CLEANING AGENTS ON HOUSEHOLD BACTERIA  
Brandon Hill, Heathwood Hall Episcopal School

**ENGINEERING-MENTORED  
BLDG 920 ROOM 749**

9:00 AM DESIGNING A LONG RANGE TASER TO REPLACE RUBBER BULLETS  
Edward Leber, Academic Magnet High School

9:15 AM CREATING ENGINEERED LUMBER PRODUCTS FROM KENAF (HIBISCUS CANNIBINUS L.) STALKS  
Sarah Dellinger , Governor's School for Science and Mathematics

9:30 AM MOLECULAR SIMULATIONS OF PEPTIDES INTERACTING WITH CARBON NANOTUBES AND GRAPHENE SHEETS  
Cassidy Baldwin, Governor's School for Science and Mathematics

9:45 AM PREPARING AN ELECTRIC SCOOTER FOR THE INSERTION OF A SOLID OXIDE FUEL CELL  
Jalen Fuller, Governor's School for Science and Mathematics

10:00 AM INVESTIGATION OF SYNTHESIS AND ELECTRICAL PROPERTIES OF INDIUM NITRIDE NANOWIRES  
Elizabeth Graves, Governor's School for Science and Mathematics

10:15 AM MODELING PEPTIDE CHAINS AND THEIR INTERACTIONS WITH CARBON NANOTUBES (CNTS) AND GRAPHENE SHEETS  
Gisela Griesheimer, Governor's School for Science and Mathematics

**Break**

10:45 AM WIRELESS ENERGY HARNESSING  
Ali Hamilton, Governor's School for Science and Mathematics

11:00 AM DETERMINING THE THERMAL CONDUCTIVITIES OF PITCH-DERIVED CARBON FOAMS  
Will Hardy, Governor's School for Science and Mathematics

- 11:15 AM HUMAN FALL DETECTION: EFFECTS OF DIFFERENT TYPES OF FLOORING ON ACCELEROMETERS  
Wesley Harvey, Governor's School for Science and Mathematics
- 11:30 AM DESIGN OF A LAPAROSCOPIC SURGERY SIMULATOR  
Madeline McHugh, Governor's School for Science and Mathematics
- 11:45 AM X-RAY RADIATION DOSE RESPONSE OF ARTICULAR CARTILAGE  
Kelli Nugent, Governor's School for Science and Mathematics
- 12:00 PM A STUDY ON THE EFFECTS OF ER:YAG LASER BEAM-SHAPING ON BIOLOGICAL TISSUE  
Governor's School for Science and Mathematics
- Lunch**
- 1:15 PM STRUCTURAL HEALTH MONITORING IN PLATE-LIKE STRUCTURES USING PIEZOELECTRIC WAFER ACTIVE SENSORS  
Bailey Oedewaldt , Governor's School for Science and Mathematics
- 1:30 PM WIRELESS ENERGY SENSING USING INDUCTIVE COILS  
Neal Vaughn, Governor's School for Science and Mathematics
- 1:45 PM HEART MODEL FOR IMAGE-GUIDED ASD REPAIRS  
Savanah Whitten, Governor's School for Science and Mathematics
- 2:00 PM MOLTEN CARBONATE RETENTION EFFECT STUDY OF MIXED ELECTRIC AND CARBONATE ION CONDUCTOR FOR CO<sub>2</sub> SEPARATION  
Jacob Yaggie, Governor's School for Science and Mathematics
- 2:15 PM FALLING OBJECTS, FALLING PEOPLE – AN ANALYSIS OF THE DYNAMICS OF FALLING  
Jennifer Yu, Governor's School for Science and Mathematics
- 2:30 PM AN ACOUSTIC METAMATERIAL FOR HIGH PRECISION MANUFACTURING  
Hollin He and Carol Yu, Hammond School

**ENGINEERING-NON-MENTORED  
BLDG 920 ROOM 747**

8:30 AM      BIOMASS PYROLYSIS AND THE EFFECT OF STOVE SCALING ON  
                 BIOCHAR CONVERSION  
                 Aidan Barney, The Center for Advanced Technical Studies

8:45 AM      THE EFFECTIVENESS OF MICRO-HYDRO GENERATORS IN  
                 POWERING A COMMON LED BULB  
                 Eric Baxley, Heathwood Hall Episcopal School

9:00 AM      THE EFFECT OF AMBIENT TEMPERATURE ON THE  
                 EFFICIENCY OF A FUEL CELL  
                 John Weiss, Heathwood Hall Episcopal School

9:15 AM      THE EFFECT OF CRUSHED CONTAINER GLASS AGGREGATE  
                 ON THE FLEXURAL STRENGTH OF CONCRETE  
                 Campbell Paine, Heathwood Hall Episcopal School

9:30 AM      SONAR FOR THE VISUALLY IMPAIRED  
                 Matthew Quan, Heathwood Hall Episcopal School

9:45 AM      THE EFFECT OF AN ALCOHOL-WATER MIXTURE ON CAR GAS  
                 MILEAGE  
                 Logan Corn, Spring Valley High School

**Break**

10:15 AM     RELATION OF TURBINE SPEED TO DIFFERENT VARIABLES  
                 Yanni Koutsoukis, Greenville Technical Charter High School

10:30 AM     THE EFFECT OF DIFFERENT SOIL TYPES ON THE SOUND  
                 PRESSURE OF A SOUND WAVE  
                 Prithvi Tippabhatla, Spring Valley High School

10:45 AM     THE EFFECT OF THE RATIO OF THE HORIZONTAL AND  
                 DIAGONAL MEMBERS IN A WARREN TRUSS ON THE ABILITY  
                 OF THE TRUSS TO WITHSTAND LOADS  
                 Matthew White, Spring Valley High School

- 11:00 AM THE EFFECT OF POLYPROPYLENE, POLYETHYLENE, AND A POLYPROPYLENE-ETHYLENE COPOLYMER ON THE ELECTROCHEMICAL POTENTIAL OF SYNTHESIZED SULFUR AND LITHIUM CHLORIDE AS LITHIUM-SULFUR BATTERY ELECTRODES  
Muhammad Fayyaz, Spring Valley High School
- 11:15 AM THE EFFECTS OF ZEOLITE PARTICLE SIZE ON THE REMOVAL OF BACTERIA FROM LAKE WATER USING A ZEOLITE BIOSAND FILTER  
Ronit Kulkarni, Spring Valley High School
- 11:30 AM THE DESIGN AND CONSTRUCTION OF AN ORNITHOPTER  
Mitchell England, Spring Valley High School
- 11:45 AM AN IMPROVED HAND RECOGNITION SYSTEM BASED ON OPTIMAL SELECTION OF HAND DIMENSIONS  
Richard Chen, Spring Valley High School

### **Lunch**

### **ENVIRONMENTAL SCIENCE-MENTORED ROOM 920BLDG 745**

- 9:00 AM EFFECTS OF AZADIRACTIN ON THE BEHAVIOR AND MORTALITY OF THE SWEET POTATO WHITEFLY, BIOTYPE B  
Dana Krzyzaniak, Academic Magnet High School
- 9:15 AM A STUDY OF HYPERBRANCHED POLYMERS AS A LESS TOXIC ALTERNATIVE TO COREXIT IN THE ALGAL SPECIES DUNALIELLA  
Reagan Ulmer, Governor's School for Science and Mathematics
- 9:30 AM THE EFFECTS OF SUPEROXIDES ON THE AFLATOXIN PRODUCTION IN ASPERGILLUS PARASITICUS  
Isabelle Mikell, Hammond School
- 9:45 AM EFFECTS OF PENICILLIN ON CYNANOBACTERIA  
Natalie Alvarez, Governor's School for Science and Mathematics

10:00 AM     COMPARING THE EFFECTS OF LAND USE ON STREAM  
GEOMORPHOLOGY AND FISH DIVERSITY AND ABUNDANCE IN  
THE SALUDA AND SAVANNAH RIVER BASINS OF SOUTH  
CAROLINA

Devon Frazier, Governor's School for Science and Mathematics

**Break**

10:45 AM     THE EFFECTS OF POLLUTANTS ON PYROCYSTIS FUSIFORMIS  
Melissa McClure, Dutch Fork High School

11:00 AM     THE EFFECT OF TRIHALOMETHANES (THMS) ON THE LIFE-  
CYCLES AND COLOR OF ARTEMIA  
Yi Yang, Dutch Fork High School

11:15: AM     EFFECT OF CLIMATE CHANGE ON THE LOSS OF PHENOLIC  
COMPOUNDS DURING DECOMPOSITION OF GRASS LITTER  
Kyle Blomberg, Governor's School for Science and Mathematics

**Lunch**

**ENVIRONMENTAL SCIENCE-NON-MENTORED  
BLDG 920 ROOM 735**

8:00 AM     EFFECT OF PH ON ARAGONITE DISSOLUTION  
Ashley Davis, Dutch Fork High School

8:15 AM     REMOVING NUTRIENT-BASED WATER CONTAMINANTS WITH  
NON-WETLAND PLANTS USING TREATMENT WETLAND Systems  
Wilson Edenfield, Dutch Fork High School

8:30 AM     A COMPARISON OF FOUR DIFFERENT ROOFING MATERIALS'  
ABILITY TO CREATE THE COOLEST SURFACE TEMPERATURE  
Katherine Cureton Evans, Heathwood Hall Episcopal School

8:45 AM     THE EFFECT OF URINE ON THE RATE OF VERMICOMPOSTING  
Witt Bauknight, Heathwood Hall Episcopal School

9:00 AM     THE EFFECTS OF SIGNIFICANT WAVE-HEIGHT ON THE  
EFFICIENCY OF A LINEAR GENERATOR BUOY  
Zachary Wallick, Spring Valley High School

- 9:15 AM THE EFFECT OF DISCHARGE ON SPECIFIC CONDUCTANCE FROM THREE DIFFERENT SITES WITHIN THE SANTEE RIVER BASIN  
Madison Pobis, Spring Valley High School
- 9:30 AM WASTEWATER SANITIZATION AND NUTRIENT REINTEGRATION VIA SUPERPOROUS FILTRATION  
Benjamin Fechter and Jedidiah Gist, Spring Valley High School
- 9:45 AM THE EFFECT OF ROSMARINUS OFFICINALIS EXTRACT AND THYMUS VULGARIS EXTRACT ON THE GROWTH OF CYANOBACTERIA  
Arya Soman, Spring Valley High School
- 10:00 AM THE ALLELOPATHIC POTENTIAL OF IPOMOEA BATATAS ON THE GROWTH OF DIGITARIA SANGUINALIS  
Sara Wallam, Spring Valley High School
- Break**
- 10:30 AM THE EFFECT OF COPPER(II) SULFATE ( $\text{CuSO}_4$ ) MOLARITY INCREASE ON PARAMECIUM CAUDATUM CONCENTRATIONS  
Ali El-Ali, Spring Valley High School
- 10:45 AM THE EFFECTS OF VARYING FRESHWATER LEVELS ON THE POPULATION OF CLADOPHORA AEGAGROPILA  
Paige Mewborn, Dutch Fork High School
- 11:00 AM THE EFFECT OF EBB-AND-FLOW AND TOWER HYDROPONIC SYSTEMS ON THE DRY WEIGHT SHOOT/ROOT RATIO OF PHASEOLUS VULGARIS  
Matthew Frierson, Spring Valley High School
- 11:15 AM EVALUATING EGGSHELLS AS A SOURCE OF CALCIUM OXIDE AND CALCIUM CARBONATE FOR WATER REMEDIATION  
Mohammad Arammash, Spring Valley High School
- 11:30 AM THE EFFECT OF POLYETHYLENE, POLYVINYL CHLORIDE, POLYPROPYLENE, AND POLYSTYRENE FOAM ON THE PH LEVEL OF SALTWATER  
Austin Wiesehahn, Spring Valley High School

11:45 AM THE EFFECT OF MIRACLE-GRO ALL PURPOSE PLANT FOOD WITH EISENIA FOETIDA, MIRACLE-GRO ORGANIC CHOICE BLOOD MEAL FERTILIZER WITH EISENIA FOETIDA, AND EISENIA FOETIDA ON THE PLANT HEIGHT, NUMBER OF FLOWERS, AND CO<sub>2</sub> EMISSIONS OF *BRASSICA RAPA*  
Priscilla Li, Spring Valley High School

12:00 PM SNOWPURE'S ANION-EXCHANGE MEMBRANE EFFECTIVENESS AT CARBON SEQUESTRATION IN DIFFERENT SHAPES  
Paul Beasley, Dutch Fork High School

### **Lunch**

1:15 PM LAND USE AND MANAGERMENTS EFFECT ON SOIL AND WATER QUALITY ON WATERSHEDS IN IRMO, SC  
Jennifer Klett, Dutch Fork High School

1:30 PM THE EFFECT OF CELL DENSITY ON HYDROGEN GAS PRODUCTION OF CHLAMYDOMONAS REINHARDTII VIA SULFUR DEPRIVATION  
Hannah McCall, Spring Valley High School

1:45 PM THE EFFECT OF MOTOR OIL CONCENTRATION ON THE COLONY COUNTS OF PSEUDOMONAS FLUORESCENS AND PSEUDOMONAS PUTIDA  
Rakib Siddique, Spring Valley High School

2:00 PM THE EFFECT OF SAND, WATER, OR CONCRETE ON THE THERMAL CAPACITY OF A SOLAR HEAT CAPTURING DEVICE  
Payton Phillips, Heathwood Hall Episcopal School

2:15 PM THE EFFECT OF MONOLAYERS FORMED BY HEXADECANOL AND OCTADECANOL ON THE RATE OF EVAPORATION OF WATER  
David A. Long, Spring Valley High School

### **Break**

2:45 PM ANALYSIS OF SYNERGISTIC BEHAVIOR OF BIOCIDES AGAINST BIOFILMS IN DRINKING WATER SYSTEMS  
Himabindu Vinnakota, Spring Valley High School

3:00 PM THE EFFECT OF RADIOFREQUENCY EMFs EMITTED BY APPLE IPAD MINI© ON THE POPULATION GROWTH OF LEMNA MINOR  
David Williams, Heathwood Hall Episcopal School



- 3:15 PM EFFECTS OF SODIUM NITRATE, POTASSIUM PHOSPHATE, AND MAGNESIUM SULFATE ON THE PHYTOREMEDIATION OF COPPER  
Grace Breazeale, Dutch Fork High School
- 3:30 PM THE EFFECT OF THE HERBICIDE, ATRAZINE, ON THE BIOLUMINESCENCE OF VIBRIO FISCHERI  
Sarah Buchanan and McKenna Savoca, Heathwood Hall Episcopal School
- 3:45 PM THE EFFICACY OF LANDFILL LINER SYSTEMS IN COMBINATION WITH CITRUS RETICULATE AND MUSA SAPIENTUM PEELS IN REDUCING THE LEACHING OF CU (II)  
Alexandra Andreen, Spring Valley High School
- 4:00 PM EFFECT OF SALINITY ON THALASSIA TESTUDINUM GROWTH  
Ryann Shealy, Dutch Fork High School
- 4:15 PM THE EFFECT OF POPULUS TREMULA ON A HETEROGENOUS FEEDSTOCK GLUCOSE EXTRACTION THROUGH DILUTE ACID HYDROLYSIS  
August Cole, Spring Valley High School

**MATH & COMPUTER SCIENCE- MENTORED  
BLDG 920 ROOM 507**

- 8:30 AM INTERACTIVE CORAL REEF ECOLOGICAL SIMULATOR  
Robert Bailey, Governor's School for Science and Mathematics
- 8:45 AM A VISUAL APPROACH TO TEACHING INTRODUCTORY COMPUTER SCIENCE  
Marcus Bolton, Governor's School for Science and Mathematics
- 9:00 AM SESAME: A NEW BIOINFORMATICS SEMANTIC WORKFLOW DESIGN  
Alexander Duvall, Governor's School for Science and Mathematics
- 9:15 AM SIMULATIONS OF EVOLUTIONARY GAME THEORY: COMPARING GENERAL AND GENETIC ALGORITHMS  
Patrick Gorospe and Mary DuBard, Governor's School for Science and Mathematics

9:30 AM      SESAME: A NEW BIOINFORMATICS SEMANTIC WORKFLOW  
DESIGN SYSTEM  
Jonathan Lowe, Governor's School for Science and Mathematics

9:45 AM      VISION-BASED CONTROL OF A QUADROTOR  
Foster McLane , Governor's School for Science and Mathematics

10:00 AM     DOCTOR-PATIENT CONNECTION FROM A MOBILE  
APPLICATION TO A WEB SERVICE: CONNECTIONMD  
Adaya Sturkey, Governor's School for Science and Mathematics

**Break**

10:30 AM     EDUCATIONAL CORAL REEF GAME  
Kevin Wang, Governor's School for Science and Mathematics

10:45 AM     MOBILE MEDICATION ADHERENCE APPLICATIONS  
Christian White , Governor's School for Science and Mathematics

11:00 AM     ANALYZING THE PROFITS OF BITCOIN MINING IN RESPECT TO  
POOL CONTRIBUTION  
Derek Rodriguez, Dutch Fork High School

11:15 AM     PAINT: A COMPREHENSIVE PROGRAM FOR NUCLEOTIDE  
ANALYSIS  
Jacob Baltzegar, The Center for Advanced Technical Studies

11:30 AM     EMERGENT PATTERNS IN JOHN CONWAY'S GAME OF LIFE  
William Grismore, Dutch Fork High School

11:45 AM     TECHNIQUES FOR DIGITAL IMAGE STEGANALYSIS  
William Edwards, Spring Valley High School

12:00 PM     A MORE CREDIBLE ARTIFICIAL INTELLIGENCE PROGRAM  
Edwin Rachwal, Dutch Fork High School

**Lunch**

**MICROBIOLOGY-MENTORED  
BLDG 970 ROOM 336**

- 8:30 AM THE ANTIBACTERIAL AGENT TRICLOSAN AS A GROWTH INHIBITOR OF STAPHYLOCOCCUS AUREUS AND STAPHYLOCOCCUS EPIDERMIDIS  
Irene Cheng, Academic Magnet High School
- 8:45 AM DETERMINING THE MOST EFFICIENT METHOD TO DIFFERENTIATE STEM CELLS INTO PHOTORECEPTORS  
Austin Hensley, Governor's School for Science and Mathematics
- 9:00 AM ECOLOGY AND SYSTEMATICS OF MARINE MEIOFAUNA: USING PCR TO IDENTIFY FOOD COMSUMPTION  
Hanna Maghsoud, Governor's School for Science and Mathematics
- 9:15 AM SCREENING OF GENES THAT MIGHT BE ESSENTIAL FOR CRANBERRY EXTRACT MEDIATED PROTECTION AGAINST ALZHEIMER'S DISEASE IN CAENORHABDITIS ELEGANS  
Atiana McBride-Tobiere, Governor's School for Science and Mathematics
- 9:30 AM THE PURIFICATION AND CHARACTERIZATION OF MAZF, A BIOLOGICAL SCISSOR IN ESCHERICHIA COLI  
Ashley Peterson, Governor's School for Science and Mathematics
- 9:45 AM IN VITRO STUDIES TO EVALUATE THE SPECIFICITY OF ADHESIN SPECIFIC BIO-FUNCTIONALIZED IRON-OXIDE  
Ronak Pipaliya, Governor's School for Science and Mathematics
- 10:00 AM THE GENE HSF-1 IS REQUIRED FOR CBE MEDIATED PROTECTION AGAINST ALZHEIMER'S DISEASE IN CAENORHABDITIS ELEGANS  
Logan Richardson, Governor's School for Science and Mathematics
- Break**
- 10:30 BIOASSAY METHODS FOR CHARACTERIZING BACTERIAL MULTIDRUG-RESISTANT EFFLUX-PUMP INHIBITORS PRESENT IN GOLDENSEAL (HYDRASTIS CANADENSIS) EXTRACTS  
Louie Alexander, Governor's School for Science and Mathematics
- 10:45 AM THE EFFECTS OF CRANBERRY ON SILENCING SKN-1 AND PMK-1 PATHWAYS IN THE AGING OF C. ELEGAN WORMS  
Ronak Sitapara, Governor's School for Science and Mathematics

**MICROBIOLOGY-NON-MENTORED**  
**BLDG 970 ROOM 336**  
*(continued)*

- 11:00 AM    A STUDY OF THE AMOUNT OF BACTERIA THAT LINGERS ON  
DIFFERENT CUTTING BOARD MATERIALS  
Sonali Parmar, Heathwood Hall Episcopal School
- 11:15 AM    THE EFFECT OF ALLIUM SATIVUM EXTRACT AND  
AZADIRACHTA INDICA EXTRACT AS A NATURAL BACTERIAL  
AGENT ON THE ZONE OF INHIBITION ON ESCHERICHIA COLI  
K-12  
Pranathi Meda, Spring Valley High School
- 11:30 AM    THE EFFECT OF POMACEA DIFFUSA SNAIL MUCUS ON THE  
INHIBITION OF ESCHERICHIA COLI  
Adiv Sivakumar, Spring Valley High School
- 11:45 AM    THE EFFECT OF E. COLI AND SPIRILLUM VOLUTANS ON THE  
INTENSITY FROM VIBRIO FISCHERI IN DRINKING WATER  
Anthony Frederick, Spring Valley High School
- Lunch**
- 1:15 PM    THE EFFECT OF THE ANTIBACTERIAL PROPERTIES OF  
CERUMEN ON THE REPRODUCTION OF EVOLVING PATHOGEN  
AND NOSOCOMIAL INFECTION, STAPHYLOCOCCUS  
EPIDERMIDIS.  
Alyssia Mitchell, Spring Valley High School
- 1:30 PM    THE EFFECT OF ASPARTAME ON C. ELEGANS IN SOLID AGAR  
MEDIA  
Anjali Gottipaty, Spring Valley
- 1:45 PM    THE INHIBITORY EFFECT OF COLLOIDAL SILVER  
NANOPARTICLES ON CANDIDA ALBICANS, ENTEROBACTER  
AEROGENES, ESCHERICHIA COLI, AND SACCHAROMYCES  
CEREVISIAE  
Noah Fechter, Spring Valley High School

**PHYSICS- MENTORED  
BLDG 920 ROOM 506**

- 9:00 AM GRAVITATIONAL MICROLENSING OF THE QUASAR RXJ 1131-1231  
Zachary Hilliard, Academic Magnet High School
- 9:15 AM THERMAL CONDUCTIVITY OF SPARK PLASMAS SINTERED ZNSE NANOPOWDER  
Eric McLean, Governor's School for Science and Mathematics
- 9:30 AM DETERMINING THE EXISTENCE OF SUPERSYMMETRY THROUGH MONTE CARLO EVENTS OF PROTON COLLISIONS  
Neil Monga, Governor's School for Science and Mathematics
- 9:45 AM THE DESIGN AND EX-SITU TESTING OF A PROTOTYPE CHOPPED LASER REFLECTIVITY TOOL FOR USE IN ULTRA-HIGH VACUUM  
Alyssa Ralph, Governor's School for Science and Mathematics
- 10:00 AM DEVELOPMENT OF A SYSTEM TO ANALYZE CHANGING THIN FILM SUBSTANCES ON A REFLECTING SURFACE  
Andrew Shore, Governor's School for Science and Mathematics
- Break**
- 10:30 AM COMPARING MØLLER SCATTERING, MOTT SCATTERING, AND ELASTIC ELECTRON-PROTON SCATTERING  
Michael Tuten, Governor's School for Science and Mathematics
- 10:45 AM BISB THERMOELECTRIC MATERIAL: SYNTHESIS, CRYSTAL STRUCTURE, MICROSTRUCTURES, AND TRANSPORT PROPERTIES  
MeKhayla Williams, Governor's School for Science and Mathematics
- 11:00 AM SURFACE-MEDIATED ELECTROMAGNETIC PROPERTIES OF THIN FILMS  
Killian Glenn, Governor's School for Science and Mathematics
- 11:15 AM A STUDY OF THE PROPERTIES OF DISCHARGING RECHARGEABLE BATTERIES UNDER VARIED CONDITIONS  
Cormac Kelly, Governor's School for Science and Mathematics

11:30 AM USING FLUORESCENCE CORRELATION SPECTROSCOPY (FCS)  
TO DETERMINE DIFFUSION COEFFICIENTS OF SSDNA AND  
DSDNA  
Max Kirkpatrick, Governor's School for Science and Mathematics

**Lunch**

12:45PM THE EFFECT OF PHONE FUNCTION AND ORIENTATION OF AN  
IPHONE ON THE POWER DENSITY EMITTED AS MEASURED BY  
A 3-AXIS RF METER  
John Patrick Davis, Heathwood Hall Episcopal School

1:00 PM THE EFFECT OF A N-TYPE TIO<sub>2</sub> PHOTOCATHODE WITH A WIDE  
BAND GAP ON A SHEWANELLA ONEIDENSIS MR-1 MICROBIAL  
FUEL CELL  
Krishna Teja Gorrepati, Spring Valley High School

1:15PM THE EFFECT OF THE ANGLE OF ATTACK OF THE GOLF SWING  
ON THE TOTAL DISTANCE THE BALL TRAVELS  
William Sullivan, Spring Valley High School

1:30 PM EFFECT OF THE TUNING OF THE PITCH WITH REGARDS TO  
THE HUMAN EAR  
Kristen Klein, Dutch Fork High School

1:45 PM OPTIMIZATION OF WIND TURBINE BLADE DESIGN USING  
LEADING EDGE TUBERCLE TECHNOLOGY  
Garrett Buchmann, The Center for Advanced Technical Studies

**PHYSIOLOGY & HEALTH – MENTORED  
BLDG 970 ROOM 328**

9:00 AM CLOT OR NOT? COMPLICATIONS OF WARFARIN AND  
ANTIBIOTICS  
Anna Elise Scott, The Center for Advanced Technical Studies

9:15 AM THE DISCREPANCIES IN BALLERINAS' ACTUAL AND  
PERCEIVED KNEE HYPERMOBILITY  
Kathryn Phipps, Dutch Fork High School

- 9:30 AM DOES AGING AFFECT OUR ABILITY TO RAPIDLY SELECT APPROPRIATE ACTIONS?  
Gabriella Herter, Dutch Fork High School
- 9:45 AM DETERMINING THE CORTICAL EXCITABILITY OF MEDITATORS USING TRANSCRANIAL MAGNETIC STIMULATION (TMS)  
Jessa Norton, Governor's School for Science and Mathematics
- 10:00 AM STROKE AND FORELIMB REHABILITATION EFFECTS ON LOCOMOTION  
Tia Curry, Governor's School for Science and Mathematics
- 10:15 AM PHOSPHORYLATION OF DYNAMIN RELATED PROTEIN-1 BY CYCLIN DEPENDENT KINASE-1 RESULTING FROM T-CELL RECEPTOR ACTIVATION  
Rusty Hawes, Governor's School for Science and Mathematics
- 11:30 AM EFFECTS OF HOMOCYSTEINE, AN ALZHEIMER'S DISEASE RISK FACTOR, ON B-AMYLOID METABOLISM  
Trent Large, Governor's School for Science and Mathematics
- 10:45 AM THE EFFECT OF LEPTIN RECEPTOR ANTAGONIST ADMINISTRATION ON RAT SKELETAL MUSCLE METABOLIC GENE REGULATION  
Mathias Schreiner, Governor's School for Science and Mathematics
- 11:00 PM IMPORTANCE OF GLUTATHIONE S-TRANSFERASE P1-1 (GSTP) IN BONE MARROW REGULATION  
Jenna Marie Baker, Governor's School for Science and Mathematics
- Break**
- 11:30 AM MEASURING THE EFFECTIVENESS OF CHIROPRACTIC TREATMENT ON HEADACHES CAUSED BY POST-TRAUMA VERSUS Long-Term Neck Pain  
Hannah Hopfensperger, The Center for Advanced Technical Studies
- 11:45 AM IDENTIFYING RISK FACTORS FOR CLOSTRIDIUM DIFFICILE INFECTION  
Jordan Dimock, The Center for Advanced Technical Studies
- 12:00 AM MATRIX METALLOPROTEINASES AS A BIOMARKER FOR PLAQUE VULNERABILITY  
Cayla Amodio, The Center for Advanced Technical Studies

12:15 AM SHORT-TERM EFFECTS OF HEAD IMPACTS IN STUDENT  
PLAYERS  
Joshua Bristow and Tyler Nguyen, Dutch Fork High School

**Lunch**

**PHYSIOLOGY AND HEALTH- NON- MENTORED  
BLDG 970 ROOM 334**

9:00 AM THE EFFECT OF COLORED CONTACTS ON THE MOISTURE OF A  
HUMAN EYE AS MEASURED BY THE SCHIRMER AND TEAR  
BREAK UP TIME TESTS  
Sophia Holt, Heathwood Hall Episcopal School

9:15 AM THE EFFECT OF NUTRITIONAL LABELING ON CALORIE  
INTAKE  
Sydney Ellen, Heathwood Hall Episcopal School

9:30 AM USING SIMON AS AN EFFECTIVE SCREENING TOOL FOR  
COGNITIVE IMPAIRMENT  
Rose Steptoe, Dutch Fork High School

9:45 AM EFFECT OF DIFFERENT CONCENTRATIONS OF LEMON JUICE  
AS FACIAL ASTRINGENT AGAINST PROPIONIBACTERIUM  
ACNES  
Tulsi Patel, Dutch Fork High School

10:00 AM EFFECT OF ALLERGY DRUGS ON THE LIFE CYCLE OF  
DERMESTES MACULATUS  
Victoria Davis, Dutch Fork high School

10:15 AM PMTHE EFFECT OF VANITY AND HEALTH MOTIVATION ON  
WEIGHT LOSS  
Rachel Shroyer, Spring Valley High School

**Break**

10:45 AM THE EFFECT OF FRESHLY EXTRACTED ALOE VERA VERSUS  
BOTTLED ALOE VERA ON CANDIDA ALBICANS  
Taylor Motlong, Spring Valley High School

11:00 AM THE EFFECT OF FOOT STRIKE PATTERNS ON THE AMOUNT OF  
PRESSURE EXERTED ON THE LOWER LEG  
Lanesa Mahon, Spring Valley High School



11:15 AM THE EFFECT OF SWIMMING DISTANCE ON RESPIRATORY  
FATIGUE  
Carl Lobitz, Spring Valley High School

11:30AM THE EFFECT OF THE ADDITION OF ZINC SULFATE  
HEPTAHYDRATE ON INHIBITING THE REPLICATION OF  
COLIPHAGE T4(T4R+)  
Nigam Sheth, Spring Valley High School

**Lunch**

12: 45 PM THE EFFECT OF HYDROGEN PEROXIDE, SODIUM  
PERCARBONATE, AND VINEGAR SATURATED COFFEE FILTER  
ON THE GROWTH OF BACILLUS CEREUS  
Andres Pineda, Spring Valley High School

1:00 PM THE EFFECT OF BALLET SHOE TYPE ON GROUND FORCE  
REACTION  
Abbie Zvejnieks, Spring Valley High School

1:15 PM THE EFFECTS OF POLYURETHANE, PORON® PERFORMANCE  
URETHANE, AND FORCEBLOC® POLYETHYLENE ON THE  
REDUCTION OF FORCE FROM HEAD-TO-HEAD AND HEAD-TO-  
GROUND CONTACT IN SOCCER PLAYERS  
Andrew Levitt, Spring Valley High School

1:30 PM EFFECT OF ACONTIUM NAPELLUS, SULPHUR, AND  
PHOSPHORUS AS HOMEOPATHIC REMEDIES ON  
STREPTOCOCCUS  
Alexandra Johnson and Morgan Sox, Dutch Fork High School

**PSYCHOLOGY & SOCIOLOGY- MENTORED  
BLDG 970 ROOM 316**

8:30 AM WAYS TO INCREASE RESPONSE EXPECTANCIES AND  
HEIGHTEN THE POWER OF THE PLACEBO EFFECT: A META-  
ANALYSIS  
Kelsey Crawford, Governor's School for Science and Mathematics

8:45 AM CHARACTERIZATION OF THE HIPPOCAMPAL ACETYLCHOLINE  
SYSTEM IN A RODENT MODEL OF FETAL ALCOHOL SYNDROME  
Madison Guyton, Governor's School for Science and Mathematics

- 9:00 AM ANTERIOR CINGULATE CORTEX ACTIVITY IN POST-ERROR AND PREDICTION FUTURE PERFORMANCE TASKS IN OLDER ADULTS  
Storm Harvey, Governor's School for Science and Mathematics
- 9:15 AM USING COCAINE TO CREATE A CONDITIONED PLACE PREFERENCE IN MICE  
Madeline Young, Governor's School for Science and Mathematics
- 9:30 AM GENDER DISPARITIES IN KIDNEY TRANSPLANTS  
Taylor Pannal, The Center for Advanced Technical Studies
- 9:45 AM BREAST CANCER TREATMENT CONTINUATION IN AFRICAN AMERICAN WOMEN  
Jayme Catherine Brown, The Center for Advanced Technical Studies

**PSYCHOLOGY & SOCIOLOGY- NON-MENTORED  
BLDG 970 ROOM 316**

- 10:15 AM THE EFFECTS OF MONOLINGUALISM AND BILINGUALISM IN TEENAGERS ON THE ACCURACY AND SPEED OF COMPLETION OF MULTITASKING (EXECUTIVE FUNCTIONING) ON THE TRAIL TEST AND STROOP TASK  
Sunaina Kapur, Heathwood Hall Episcopal School
- 10:30 AM DOES INDIVIDUAL AND ENVIRONMENTAL SIMILARITY AFFECT PROBLEM SOLVING SKILLS?  
Hunter Street, Greenville Technical Charter High School
- 10:45 AM THE EFFECT OF AUDITORY AND VISUAL DISTRACTIONS ON TEST GRADES  
Annie Heath, Heathwood Hall Episcopal School
- 11:00 AM THE EFFECT OF STAGE LIGHTING COLORS ON STRESS WITH RESPECT TO HEART RATE  
Lucas Clark, Heathwood Hall Episcopal School
- 11:15 AM THE EFFECT OF AGE AND GENDER ON TIME PERCEPTION  
Matt Watford, Heathwood Hall Episcopal School
- 11:30 AM THE EFFECT OF ORIGINAL AND BLACK AND WHITE PAINTINGS AND PAINTING STYLES ON EYE MOVEMENTS AND FIXATIONS OF THE SUBJECTS PERCEIVING THEM.  
Mary Royall Wilgis, Heathwood Hall Episcopal School

11:45 AM THE EFFECTS OF MEDITATION MUSIC ON SLEEP  
Carolina Boccanfuso, Dutch Fork High School

12:00 PM EMOTIONAL ANALYSIS THROUGH ART: SADNESS  
Kylie Walker, Dutch Fork High School

### **Lunch**

1:15 PM THE CORRELATION BETWEEN LEVEL OF  
SPIRITUAL/RELIGIOUS STRENGTH AND LEVEL OF PERCEIVED  
SOCIAL SUPPORT IN VETERANS DIAGNOSED WITH POST-  
TRAUMATIC STRESS DISORDER  
Dorothy Grace Smith, Spring Valley High School

1:30 PM THE COMPARISON OF HIGH SCHOOL STUDENTS JUNG  
TYPOLOGY TEST WITH THEIR MATHEMATICS CAPABILITIES  
Caroline McManus, Spring Valley High School

1:45 PM THE EFFECT OF DIFFERENT CONDITIONS ON A GOLF COURSE  
ON THE SIZE PERCEPTION OF A GOLF GREEN  
Jackson Hall, Spring Valley High School

2:00 PM THE EFFECT OF AUDITORY TRAINING ON COMPREHENSION  
OF LITERATURE FOR DYSLLEXIC STUDENTS  
Victoria Agostini, Spring Valley High School

2:15 PM THE CORRELATION BETWEEN ATTACHMENT STYLE AND  
FACIAL EMOTION RECOGNITION IN 9TH GRADE MAGNET  
STUDENTS  
Lindsey Miller, Spring Valley High School

### **Break**

2:45 PM THE EFFECT OF TEXTING ON REACTION TIME VS THE EFFECT  
OF TALKING ON REACTION TIME FOR BEGINNING DRIVERS IN  
THE 14 TO 15 YEAR OLD RANGE  
Grayson Byrd, Heathwood Hall Episcopal School

2:30 PM QUANTIFYING STUDENT PREFERENCES FOR WHOLE,  
HALVED, AND EIGHTHED APPLES  
Aryn Cooper, Spring Valley High School

**ZOOLOGY- NON- MENTORED  
BLDG 970 ROOM 327**

- 9:00 AM THE EFFECT OF A FERMENTING YEAST MOSQUITO TRAP ON  
THE CAPTURING OF MOSQUITOES IN COLUMBIA, SOUTH  
CAROLINA  
Nicolas Quan, Heathwood Hall Episcopal School
- 9:15AM THE EFFECT OF PH LEVELS OF 5, 7, 9, AND 10 ON THE RATE OF  
METAMORPHOSIS OF AEDES ALBOPICTUS MOSQUITOS  
Caroline Nassab, Heathwood Hall Episcopal School
- 9:30AM THE RELATIVE EFFECTIVENESS OF GERANIUM, CITRONELLA,  
LEMON GRASS, AND LEMON EUCALYPTUS OILS AT  
REPELLING MOSQUITOES  
James H. Mayson, Heathwood Hall Episcopal School
- 9:45 AM THE EFFECT OF LATHERIN ON THE GROWTH AND  
DEVELOPMENT OF CANDIDA ALBICANS FUNGUS AND  
ESCHERICHIA COLI BACTERIA  
Veronica McLean, Spring Valley High School
- 10:00 AM THE EFFECT OF 17 $\beta$ -ESTRADIOL ON THE FECUNDITY AND SEX  
RATIO OF DROSOPHILA MELANOGASTER  
Crystal Lee, Spring Valley High School
- Break**
- 10:30 AM HOW THE AMERICAN SHAD (ALOSA SAPIDISSIMA) REACTS TO  
BEING INTRODUCED INTO THE BROAD RIVER  
Tal Wanish, Dutch Fork High School
- 10:45 AM VARIOUS WAVELENGTHS INHIBITING THE NOCTURNAL  
PATTERNS OF THE ACHETA DOMESTICUS CRICKET  
Savannah Dale, Dutch Fork High School
- 11:00 AM THE EFFECT OF INDIGO, AZO DYES, AND BLONDE HAIR DYE  
ON FUTURE GENERATIONS OF DROSOPHILA  
Almeera Lateef, Spring Valley High School

**ZOOLOGY- MENTORED**  
**BLDG 970 ROOM 327**  
*(continued)*

- 11:15 AM    Age, Growth, and Reproduction of Invasive Lionfish in British Virgin Islands, Caribbean  
Callie Hartsell, Academic Magnet High School
- 11:30 AM    INVOLVEMENT OF HEMOCYTES IN THE FLIGHT MUSCLE  
HISTOLYSIS OF THE HOUSE CRICKET, ACHETA DOMESTICUS  
Nikhila Cheepurupalli, Spring Valley High School
- 11:45 AM    OPTIMAL FORAGING THEORY WITH WRITING SPIDERS  
(AURANTIA ARGIOPE)  
John A. Price, Greenville Technical Charter High School

## SCJAS ABSTRACTS 2014

### DETERMINATION OF THE OPTIMAL SUPPORTED RUTHENIUM NANOPARTICLE CATALYST SIZE FOR AMMONIA DECOMPOSITION

Justin Abbasi

Governor's School for Science and Mathematics

Mentor: Jochen Lauterbach, SAGE, Department of Chemical Engineering,  
University of South Carolina

Advisor: Scott Page

Hydrogen fuel cells have recently received much attention to provide sustainable power for the future. A viable carrier of hydrogen, such as ammonia ( $\text{NH}_3$ ), must be implemented in order to realistically operate such units. It has been shown that catalysts can be used to increase the rate of ammonia decomposition. Previous studies indicate that ruthenium is the most active transition metal catalyst for the decomposition of ammonia. The goal of this research was to make gamma-alumina supported ruthenium nanoparticles and test their effectiveness in the decomposition of ammonia. In order to make ruthenium nanoparticles, the reverse micelles process and polyvinylpyrrolidone method were implemented with the addition of gamma-alumina support. Each method utilized ruthenium (III) chloride and a reducing agent to produce the solid ruthenium nanoparticle catalysts. The nanoparticles were analyzed by using a transmission electron microscope (TEM) and X-ray diffraction (XRD). After testing multiple samples under the TEM, it was determined that nanoparticles produced with the polyvinylpyrrolidone method tend to be more monodispersed than those produced with the reverse micelles method. Because the particles were more monodispersed, it is expected that the supported ruthenium nanoparticles produced from the polyvinylpyrrolidone method will have the most impact on increasing the rate of ammonia decomposition. However, further testing of these nanoparticles is needed. XRD analysis verified the contents of the nanoparticles as solid ruthenium (Rus) and gamma-alumina. The optimal size for such catalysts is expected to be between 4-7 nm in diameter. Through the polyvinylpyrrolidone method, ruthenium nanoparticles were produced at 1.3 nm.

## THE EFFECT OF AUDITORY TRAINING ON COMPREHENSION OF LITERATURE FOR DYSLLEXIC STUDENTS

Victoria Agostini  
Spring Valley High School

Learning disorders are a growing issue in today's society, especially developmental dyslexia, the leading disorder that causes reading deficiencies. Developmental dyslexia currently affects an estimated 5 to 17.5% of children in English speaking countries. Phonological processing and awareness are impaired when a child has dyslexia. The purpose of this experiment was to determine if dyslexic students can best comprehend and analyze a passage in either an auditory or self-read format. It was hypothesized that dyslexic students who receive an auditory form of a passage would have greater performance on a comprehension assessment than students who receive a written text because of better phonological awareness. Twelve dyslexic students, grades 3 through 5, were recruited through Sandhills School. Each participant took part in one randomly assigned auditory and written training session, with different passages of a similar lexile range. An assessment was given after each learning session and was scored using a premeditated rubric. A one sample t-test was conducted on the differences of scores on the assessments. There was no significant difference between the auditory and written training scores ( $M=0.00$ ,  $SD=1.758$ ),  $t(11)=0.00$ ,  $p=0.50$ . The hypothesis was not supported because neither auditory nor written stimuli yielded greater assessment scores, as supported by multi-sensory studies.

## BIOASSAY METHODS FOR CHARACTERIZING BACTERIAL MULTIDRUG- RESISTANT EFFLUX-PUMP INHIBITORS PRESENT IN GOLDENSEAL (HYDRASTIS CANADENSIS) EXTRACTS

Louie Alexander  
Governor's School for Science and Mathematics  
Mentor: Tzuen-Rong Tzeng, Department of Biological Sciences, Clemson University  
Advisor: Lance Riddle

Multi-drug resistance in pathogens has been recognized as an increasing threat to human health. Bacteria such as *Staphylococcus aureus* have become increasingly resistant to antibiotics, such as methicillin. One of the methods bacteria use to gain multi-drug resistance (MDR) is through overexpression of an efflux pump, a mechanism that transports materials from within a bacteria's membrane(s) to the outer medium. Over expression allows bacteria to pump out concentrations of antibiotics that would kill or inhibit the cell if not removed. Efflux Pump Inhibitors

(EPI) have been sought as a way to decrease MDR in bacteria by making them more susceptible to antibiotics. Goldenseal is being researched as a possible EPI and has been shown to decrease a strain of *Staphylococcus aureus*'s resistance to Ciprofloxacin. Our research aims to bioassay the components of Goldenseal extract and identify which compounds produce synergetic effects with antibiotics reducing MDR in bacteria. Our bioassay technique involves using thin-layer chromatography to separate the components of Goldenseal extract. The growth of *Escherichia coli* expressing MDR for Ciprofloxacin is measured on a TLC plate with both the separated components of Goldenseal extract and the antibiotic Ciprofloxacin. Areas showing little to no growth exhibit inhibition of bacterial growth due to the synergetic effects of the EPI components and the antibiotic, allowing us to identify those components.

## EFFECTS OF PENICILLIN ON CYNANOBACTERIA

Natalie Alvarez

Governor's School for Science and Mathematics

Mentor: Armah de la Cruz, Microbial Exposure Research Branch, Microbiological & Chemical Exposure Assessment Research Division of EPA's Office of Research & Development, United States Environmental Protection Agency of Cincinnati, Ohio

Advisor: Rebecca Heiss

The effects of penicillin on cyanobacteria microcystis with toxin, 2388 and a strain without toxin, 2386 was investigated in a 13 day period. 100, 250 and 500 units of penicillin per milliliter as well as a control were tested. Three different methods were used to measure cyanobacteria growth: plating, optical density and manual cell count. Growth on a tryptic soy agar plate was used to measure the number of total bacterial colonies the cyanobacteria can grow with penicillin treatments. A spectrophotometer was used to extract wavelengths for the optical density. The manual cell count used a hemocytometer to count cyanobacteria cells. The toxin assay showed that cyanobacteria 2388 still had toxin even after the penicillin treatments. These results show that penicillin alone cannot be used to isolate cyanobacteria from other heterotrophs but it is important to demonstrate the effects penicillin would have on cyanobacteria in an aquatic environment.



## AN EYETRACKING STUDY ON TOTAL FIXATION DURATION TIMES OF A CONSUMER WHEN FOCUSING ON UNFAMILIAR BRAND PRODUCTS

Lauren Ambuhl

Governor's School for Science and Mathematics

Mentor: Rupert Andrew Hurley, The Sonoco Institute of Packaging Design &  
Graphics, Clemson University

Advisors: Robert Fletcher and Jeff Wisdom

Consumer packaging companies desire to better understand the graphic designs that lead to purchases. Researchers hypothesized that a consumer, when choosing a package amongst several options, spends a longer time viewing the one they ultimately purchase. This study seeks to confirm this hypothesis by utilizing a proprietary eye-tracking device. For testing, consumers entered a simulated grocery store (the CU Shop™) with a pre-made shopping list while wearing the Tobii eye-tracking glasses and carrying a handheld data acquisition unit (the Tobii recording assistant). For this experiment, three different consumer products were tested: peanut butter flavored granola bars, canned chili with beans, and bottled canola oil. Consumers were instructed to choose one package of each product and record the purchase number underneath the package selected. While consumers are in the store, the Tobii glasses record the their time spent viewing each package (the “total fixation duration”) and their unique visual scanning pattern. Heat maps given by the Tobii studio provide visual evidence supporting a positive association between total fixation duration and ultimate purchase decision. Further studies need to be conducted to quantify the statistical significance of these results and to determine which specific graphic elements lead to increased fixation duration.

## SUPPRESSION OF HPV16 EXPRESSION IN HUMAN KERATINOCYTES BY ANTI-E7 SIRNA, AND THE USE OF HRAS-V12 AND SIX1 TO EXPLORE THE DEPENDENCY OF HPV16 ON E7

Aspasia Amiridis

Heathwood Hall

Recent progress in microbiology has allowed for many discoveries relating to the understanding of viruses; one virus frequently studied in microbiology is human papillomavirus (HPV) which is the major cause of cervical cancer and can transform normal human skin cells in culture. Another recent advancement has been the discovery of short interfering RNA (siRNA). It was hypothesized that by using siRNA to inhibit the expression of oncoproteins E7 and E6 in HPV16, one can attempt to stop cancerous growth. Cancer, however, has many facets; research has

also identified mutated HRas-V12, a protein responsible for cell cycle progression and growth, among other things, to be tumorigenic as well. Furthermore, overexpressed SIX1 genes, a group of genes called “Master Genes” responsible for regulating the production of muscle and eye cells during development, have been found to be tumorigenic. This project explored the dependency of HPV16-transformed cells on E7 by overexpressing the SIX1 gene and introducing HRas-V12 to Human Keratinocytes transformed with HPV16; since both were seen to be tumorigenic, it was hypothesized that their overexpression would cause HPV16-transformed cells to become independent of E7. In HPV16-transformed Human Keratinocytes transfected with vectors expressing either SIX1, HRas-V12, or anti E7 siRNA, decreases in E7 of up to 50% were found between the control group and groups with anti-E7 siRNA, groups with SIX1 gene overexpression, and groups with mutated HRas-V12, suggesting that HPV16 can be suppressed by using siRNA, and that with the right combination of SIX1 and HRas-V12 mutations, HPV-transformed cells may become independent of E6/E7.

## MATRIX METALLOPROTEINASES AS A BIOMARKER FOR PLAQUE VULNERABILITY

Cayla Amodio

The Center for Advanced Technical Studies

Atherosclerosis is an inflammatory disease characterized by plaque accumulation on the sides of the arteries. A vulnerable plaque is characterized by a thin fibrous cap and large lipid core, contrary to a stable plaque, and is likely to rupture. When the fibrous cap of a plaque is disrupted, clotting factors are activated, leading to the formation of a thrombus. The subsequent thrombus blocks blood flow to tissues causing a heart attack or stroke.

A carotid endarterectomy is a surgical procedure to remove plaque from an artery. The criteria to receive an endarterectomy is a 50-70% stenosis and previous stroke or TIA; however, plaque rupture typically occurs in plaques with <50% stenosis. This presents a paradox and leads to inadequate diagnosis for patients at risk. Also, other diagnostic tools, such as, a Coronary Angiogram, image for the percent blockage of the artery without revealing information on the level of plaque vulnerability. Ultimately, the ability to diagnosis plaque vulnerability is lacking.

The goal of this research project is to identify a biomarker for plaque vulnerability. This would be a protein that would, in the future, be measurable in the blood and give an indication of plaque vulnerability, enabling treatment of vulnerable plaque. I will be investigating Matrix Metalloproteinases (MMPs), proteases that degrade the extracellular matrix, a large component of the fibrous cap. I will be quantifying

the RNA expression of MMPs in plaque, using qPCR, to determine if they are a potential biomarker. My hypothesis is that if a plaque is vulnerable, the mRNA expression of MMPs will be significantly higher.

## THE EFFICACY OF LANDFILL LINER SYSTEMS IN COMBINATION WITH CITRUS RETICULATE AND MUSA SAPIENTUM PEELS IN REDUCING THE LEACHING OF CU (II)

Alexandra Andreen  
Spring Valley High School

Electronic waste is becoming more prominent with the abundant use of technology. This waste often contains toxic materials that could leach into the groundwater supply. When electronic devices are placed into landfills, toxic metals are able to leach into the groundwater, through decomposition and run-off. Copper is one metal commonly found in electronic devices and poses a threat to the environment. Liners have been placed into most landfills to prevent the leaching of toxic materials into the environment but are, in some cases, still unable to contain toxic materials. The goal of this research was to determine the most effective liner system, and it was hypothesized that the use of a double liner system in combination with mandarin/banana peels would be most effective in reducing copper leaching. For experimentation, small scale models were created of the liner systems and a copper nitrate solution was allowed to permeate the filter. The filtrate was then collected and the absorbance and conductivity values were collected. The analysis of variance (ANOVA) was used to determine and significant differences between both the conductivity and absorbance values. The null hypothesis was rejected for the conductivity values with  $F(11, 94) = 26.87$ ,  $p < 0.05$ , although the results did not give a clear idea of which filter system was most effective. The null hypothesis was supported for the absorbance with  $F(11, 94) = 0.94$ ,  $p > 0.05$ . These results determined there was no statistical difference between any of the groups for the absorbance values.

## THE EFFECTIVENESS OF NATURAL AND CHEMICAL SOAPS AND SANITIZERS IN THE KILLING OF E. COLI

Isabella Antonetti

Heathwood Hall

Because of the large scale use of hand sanitizer (natural or chemical) as a replacement for washing hands with soap and water, the effectiveness in the killing of bacteria with these products must be questioned. This study compared the effectiveness of three different hand sanitizer products with different active ingredients (triclosan, ethyl alcohol, and thymus vulgaris oil) by measuring the diameter of the zone of inhibition of growth created by each solution on culture plates. To do this, paper disks were saturated with each of the three sanitizing products and distilled water. These disks were then placed on a Petri dish inoculated with E. coli K-12. After 24 hours and again after 48 hours, the diameter of the zone of inhibition of growth of each disk was measured to determine the effectiveness of each solution. The null hypothesis of this study was that there would be no difference in the diameter of the zone of inhibition between the three solutions and control. The hypothesis was that one product would produce a diameter of zone of inhibition greater than the others. Because of the data collected, the hypothesis that one category of antimicrobial solutions will, on average, be more effective in the killing of E. coli than the other categories, can be accepted. One type of sanitizer, the triclosan based solution, proved more effective in the killing of E. coli.

## EVALUATING EGGSHELLS AS A SOURCE OF CALCIUM OXIDE AND CALCIUM CARBONATE FOR WATER REMEDIATION

Mohammad Arammash

Spring Valley High School

The precipitation of chromium, lead, and cadmium were tested using CaO and CaCO<sub>3</sub> derived from eggshells in comparison to their industrial grade counterparts. Precipitation tests were performed over the course of 60 minutes and samples were collected every 5 minutes, centrifuged, and run in the atomic absorption spectrophotometer. The pH change over time, optimum length of time for treatment, and effect of dosage on the percentage of the contaminant removed were observed. A one-way analysis of variance (ANOVA) showed that there was a significant difference  $F(5,138)=6.62$ ,  $p<.001$  in the removal of cadmium between the eggshell and industrial grade CaCO<sub>3</sub> but no difference between the eggshell and industrial grade CaO  $F(5,138)=2.04$ ,  $p=.077$ . However, there was a significant

difference  $F(5,138)=28.39$ ,  $p<.001$ , in the remediation of chromium between the eggshell derived and industrial grade  $\text{CaCO}_3$  and between the eggshell and industrial grade  $\text{CaO}$   $F(5,138)=14.46$ ,  $p<.001$ . A one-way ANOVA showed that there was a significant difference  $F(5,138)=16.26$ ,  $p<.001$  in the remediation of lead between the eggshell derived and industrial grade  $\text{CaCO}_3$  and between the eggshell and industrial grade  $\text{CaO}$   $F(5,138)=51.14$ ,  $p<.001$ . The eggshell derived  $\text{CaO}$  and  $\text{CaCO}_3$  were able to compete with their industrial grade counterparts in most of the cases and even surpassed them at times as at least one of the dosages of the eggshell precipitant was not significantly different except with the carbonates against chromium, supporting the hypothesis that eggshells can be used as efficient, cost-effective, and environmentally friendly sources of  $\text{CaO}$  and  $\text{CaCO}_3$  for the remediation of cadmium, chromium, and lead.

## THE EFFECT OF RELATIVE HUMIDITY ON THE DRY MASS OF BRASSICA RAPA

Linnea Bacon

Spring Valley High School

Growers have searched for ways to maximize plant size by manipulating environmental conditions. The purpose of this research was to determine whether relative humidity had an affect on the dry mass of *Brassica rapa*. It was hypothesized that if *Brassica rapa* were put in an environment with 90% relative humidity, then they would have a greater dry mass than if put in an environment with a lower relative humidity. Two different greenhouses with relative humidities at approximately 90% and 50% were used, as well as, a control group of plants. Each group had a total of 30 plants and were grown for approximately 30 days. Once grown, the plants were dry massed using an analytical balance to the fourth decimal place. The results showed that there was a significant difference in the plant masses  $F(2,87)=5.69$ ,  $p=.005$ . A Tukey test determined that there was a significant difference between low versus high relative humidity and control versus high relative humidity. It was concluded that the *Brassica rapa* grown in the 90% relative humidity greenhouse had a larger dry mass than the low and control relative humidity groups.

## INTERACTIVE CORAL REEF ECOLOGICAL SIMULATOR

Robert Bailey

Governor's School for Science and Mathematics

Mentor: Jijun Tang, Department of Computer Science and Engineering, University of South Carolina

Advisor: Elizabeth L. Bunn

The goal of this project is to further educate the general populace on the ecology of coral reefs and how to best protect the reefs from a variety of environmental problems. The interactive coral reef project was built based on input from the University of South Carolina Biology Department. The game consists of designing a Farmville type game in the Unity game engine. Creatures are placed on a grid by the player, where they interact through different symbiotic relationships (parasitic, mutualistic, and commensalism) that influence the overall reef health. The different creatures can contract diseases, which also affects the reef. Various natural disasters can occur and, like diseases, increase or decrease frequency based on real-time seasons. In addition, man-made disasters can affect the reef, and it is up to the player to repair the reef after either natural or unnatural problems.

## THE ROLE OF HEAT SHOCK PROTEIN 90 BETA ONE (GP96) AS A CHAPERONE FOR LOW-DENSITY RECEPTOR-RELATED PROTEIN 6 (LRP6) IN PLASMA CELLS

Mira Bajaj

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Advisor: Bhuvana Parameswaran

Heat shock protein beta one (gp96) is an essential protein that chaperones many transmembrane proteins to the plasma membrane of the cell. Gp96 also controls many toll-like receptors involved in the detection of antigens in the immune system. The Wingless(Wnt)/Beta-catenin signaling pathway controls cell proliferation, differentiation, and apoptosis and can lead to multiple myeloma when altered. An important coreceptor on this pathway is low-density receptor-related protein 6 (LRP6). The objective of this research, then, was to determine whether or not gp96 is a chaperone for LRP6 to reach the plasma membrane. This goal was to be accomplished through the creation of a LRP6 lentivirus to transfect into a gp96 knockout cell line. Initially, the pIRESpuro3 plasmid contained the LRP6 gene with an HA tag attached to it. The HA-LRP6 gene was isolated from the plasmid through restriction enzyme digestions with EcoRI and NotI. The HA-LRP6 gene was then

ligated into a pLenti lentiviral vector with the intention of transfecting the new plasmid into a gp96 knockout cell line, which would then be tested for the presence of LRP6 at the plasma membrane. The results, however, showed that the band sizes of the genes isolated from the agarose gels were not the correct size. It was later revealed that there was an EcoRI restriction site in the middle of the LRP6 insert that was previously unknown. Future research must be conducted using a different approach to determine the dependence of LRP6 on gp96.

## IMPORTANCE OF GLUTATHIONE S-TRANSFERASE P1-1 (GSTP) IN BONE MARROW REGULATION

JennaMarie Baker

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Advisor: Bhuvana Parameswaran

Previous studies have shown that Glutathione S-transferase P1-1 (GSTP) has been highly expressed in cancer cells. Knock Out (GSTP  $-/-$ ) mice have shown higher levels of white blood cell counts than Wild Type (GSTP  $+/+$ ) mice. This might indicate a difference in their myeloproliferative capacities. The aim of this research was to determine whether this difference results from altered migration, proliferation, or differentiation of bone marrow cells between WT (GSTP  $+/+$ ) and KO (GSTP  $-/-$ ) animals. A Chemotaxis Assay was performed to determine migration in the two animal models after the addition of CXCL12 (a chemokine) for 16 hours, a BrdU Assay on the two animal models to determine the proliferation of the bone marrow cells and a Western blot analysis on liver, lung, kidney, and pancreatic tissue samples to determine the differentiation and the overall expression of ER $\alpha$  in each tissue sample. Results suggest that KO (GSTP  $-/-$ ) bone marrow cells proliferate more than WT (GSTP  $+/+$ ) bone marrow cells. Their bone marrow cells have higher expressions of ER $\alpha$ , which would contribute to the proliferation differences. In different tissues, there were differences in the ER $\alpha$  expression between the genders of the mice that will be further investigated with more experiments. CXCL12 increases the rate of migration in WT (GSTP  $+/+$ ) mice, but the migration assay will be further investigated to compare the differences in migration and white blood cell counts between WT (GSTP  $+/+$ ) and KO (GSTP  $-/-$ ) mice.

## MOLECULAR SIMULATIONS OF PEPTIDES INTERACTING WITH CARBON NANOTUBES AND GRAPHENE SHEETS

Cassidy Baldwin

Governor's School for Science and Mathematics

Mentor: Sapna Sarupria, Department of Chemical & Biomolecular Engineering,  
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Advisor: K. Sris

Guisseppi-Elie et al. previously decided to use five peptides' sequences with relatively high affinities for carbon nanotubes (CNTs). CNTs consist of graphene, a one-atom thick layer of carbon atoms in a hexagonal pattern folded as a tube one nanometer in diameter. In order to better understand the affinities of the selected peptides to CNTs, we used molecular dynamics (MD) simulations to investigate the nature of the peptide-CNT interactions. GROMACS was used to run the MD simulations of each peptide-CNT system solvated in water. Virtual Molecular Dynamics (VMD) was used to visualize and analyze the output from the simulations. Each simulation ran using eight processors on the Palmetto Supercomputer. As carbon nanotubes are nonpolar, hydrophobic materials, they should attract amino acids with similar properties. Our simulations indicated that the hydrophobic residues of the peptides contacted the CNTs, while the hydrophilic residues remained exposed to water. The placement of these groups on the peptide sequence along with the shape of the CNT governed the resulting peptide structure. To study this further, a simulation of one selected peptide with a flat graphene sheet was performed to be compared to the previous simulations. Insights gained from these simulations will contribute towards designing more efficient biosensors.

## SYNTHESIS OF 3-AMINO-3-(HYDROXYIMINO)-N[2-HYDROXYL)PHENYL]PROPANAMIDE

Pat Balmediano

Governor's School for Science and Mathematics

Mentor: Patrick Woster, College of Pharmacy, Medical University of South Carolina  
Advisor: Scott Page

The enzyme lysine-specific demethylase 1 (LSD1) causes the demethylation of histone 3 methyllysine 4 (H3K4me1) and histone 3 dimethyllysine 4 (H3K4me2), in which a transcription-activating chromatin mark is found. The oxidative demethylation of H3K4me1 and H3K4me2 leads to the silencing of tumor suppressor genes. If allowed rampant, LSD1 can cause cancer in humans. As a result, the synthesis of inhibitors for LSD1 and other demethylases and their



biological effects on cells high in LSD1 levels have become a prime subject of research. The idea is to find a more effective inhibitor of LSD1 that could be easily administered to patients. The goal of this research was to make 3-Amino-3-(Hydroxyimino)-N[2-(hydroxyl)phenyl]propanamide, or Compound 22, and to test the compound's effectiveness as an inhibitor for LSD1. Compound 22 was synthesized in two steps. The first step was the reflux of 2-aminophenol with cyanoacetic acid, to produce the intermediate 2-cyano-N-(2-hydroxylphenyl)acetamide. In the second step, the intermediate was refluxed with hydroxylamine hydrochloride to produce the final product, Compound 22. A Combiflash Purification System was used to purify the intermediate and product. Nuclear Magnetic Spectroscopy was used to verify the purity and structure of the product as Compound 22. Molecular models made of Compound 22 and LSD1 show that Compound 22 could be a prime inhibitor for LSD1. However, biological testing still needs to be performed to test the compound's effectiveness.

## PAINT: A COMPREHENSIVE PROGRAM FOR NUCLEOTIDE ANALYSIS

Jacob Baltzegar

Center for Advanced Technical Studies

Errors are often made in natural and unnatural replication of genetic material. While errors made during this process, commonly referred to as Single Nucleotide Polymorphisms (SNPs), could be meaningless and result in no difference, they may result in significant changes in the resultant amino acid sequence, inducing significant problems in cell behavior. The manual process of aligning two sequences, determining the location of these errors, and evaluating their significance in terms of translation to amino acids, and, therefore, proteins, is a relatively time-consuming task. Computerization of this process not only eliminates human error, but greatly increases efficiency. PAINT (Pairwise Analysis in Nucleotide Translation) utilizes computational traversal of the sequence data to pinpoint the location of SNPs, and, by calling on translation data and accounting for the wobble effect, determines if the mutations between nucleotide sequences relate to a significant change in the resultant amino acid sequence.

## BIOMASS PYROLYSIS AND THE EFFECT OF STOVE SCALING ON BIOCHAR CONVERSION

Aidan Barney

The Center for Advanced Technical Studies

The purpose of this project is to evaluate the effect of scaling a pyrolysis stove on the conversion of biomass into biochar. By scaling multiple stove sizes, it is possible to find the change in percentage of biochar produced of the different scales. By keeping other factors that have been shown to change biochar production constant, such as particle size, feed stock, and moisture content, scaling the stoves will provide data on how scaling affects biochar production. The first scale will have a volume of one gallon; the next stove two gallons, and so on until a five gallon stove is produced. The design will be consistent to prevent skewing the results. Results have shown the one gallon stove converts an average of 22.167% of the original biomass into biochar. The two gallon stove converts about 15.764% of the biomass into biochar. It is expected that as the stoves are scaled larger the efficiency will decrease due to increased temperatures compared to smaller stoves. This is supported by the first two tests, but more tests need to be conducted. Because the biomass will also be scaled to remain consistent, synthesis gases will be released in greater quantities, fueling the reaction in the combustion chamber at a faster rate, thus increasing the temperature faster than smaller stoves. Increased temperature through pyrolysis has been shown to produce more ash than lower temperatures, and the ash has a smaller mass than the biochar produced at lower temperatures.

## THE EFFECT OF LAUNDRY DETERGENT TYPE AND TEMPERATURE ON PROTEIN DIGESTION

Emma Barr

Heathwood Hall Episcopal School

Today, to save money, many households are using cold-water laundry cycles to perform the mundane task of washing clothes. But, is cold water going to do the job more effectively than warm water? The purpose of this investigation was to determine the effect of temperature and laundry detergent type on protein digestion. The following steps were taken to determine the effect of temperature and laundry detergent type on protein digestion. First, 5 mL of prepared orange Jell-O with an adjusted pH of 8 was added to 24 test tubes. Then, the tubes were placed in the refrigerator to solidify. Next, the height of the Jell-O in each tube was measured (cm). Then, 1 ml of each detergent (Tide Original Laundry Detergent,

Tide Coldwater Laundry Detergent, Method Laundry Detergent, Seventh Generation Laundry Detergent) was added to 8 Jell-O test tubes. Half of the tubes (4 of each detergent) were then placed in the refrigerator and served as the low temperature group, and half of the tubes (4 of each detergent) were placed at room temperature and served as the high temperature group. The height of the solidified Jell-O was marked and measured every 12 hours for 48 hours. From this investigation it can be concluded that Tide Cold Water Detergent high temperature had the largest amount of protein degradation and Seventh Generation Detergent low temperature had the smallest amount of protein degradation. All brands performed best in high temperature rather than low temperature. Tide Cold Water Detergent performed the overall best in high temperature, and Tide Original Detergent performed the overall best in low temperature. Therefore, cold water does not work as effectively as warm water will when washing clothes.

## THE EFFECT OF TEMPERATURE ON THE LEGALITY OF THE REBOUND HEIGHT OF A TENNIS BALL

Elizabeth Barr

Heathwood Hall Episcopal School

The purpose of this experiment is to determine the effect of temperature on the legality of the rebound height of a tennis ball. This information is beneficial because it gives insight as to whether or not heating or cooling a tennis ball has any effect on the legality of the rebound height. To conduct this experiment tennis balls were heated (100°C), cooled (0°C), and left at room temperature (25°C). Tennis balls were rebounded from a height of 254 cm. and rebound heights were measured. Tennis ball's that had a rebound between 135 and 147 cm. had legal rebound heights (ITF 2013). The results show that heated tennis balls had an average rebound height of 169.27 cm., which is illegal. Cooled tennis balls had an average rebound height of 68.23 cm., which is illegal. Tennis balls left at room temperature had an average rebound height of 145.97 cm., which is legal. The control variable is the tennis balls kept at room temperature. The dependent variable is the rebound height of the tennis balls. The independent variables are tennis balls heated to 100°C and tennis balls cooled to 0°C. Based on a Single Factor ANOVA test, the results of this experiment are considered statistically significant. The null hypothesis was rejected. The hypothesis of: if the temperature of a tennis ball is increased, then the tennis ball will have a rebound that is higher than a legal height of 147cm. and if the temperature is decreased, then the tennis ball will have rebound that is lower than a legal height of 135cm., and if a tennis ball is left at room temperature, then the rebound height will be within the legal 135-147cm. range can be accepted.

## THE EFFECT OF URINE ON THE RATE OF VERMICOMPOSTING

Witt Bauknight

Heathwood Hall Episcopal School

The purpose of this research is to determine if urine has a positive effect on the rate of vermicomposting. As landfills are continuing to grow because of the ever-increasing amount of waste humans produce, it is becoming a burden to our society's economy and environment. A proportion of that waste is compostable organic waste. Vermicomposting could be useful because it provides a healthy and clean way to deal with yard trimmings and food waste and other compostable waste. The hypothesis, which is if the concentration of urine that is present while preparing the bedding of a worm bin is increased then the rate at which the watermelons halves decomposes will also increase, which will be displayed by the change in mass of the watermelons, was tested by creating small vermicomposting bins, and a third of the bins received a different level of the variable, concentration of urine. Each bin had two watermelons halves in it, and the change of mass for each watermelon half was recorded. The conclusion of this experiment is that the concentration of urine does not affect the rate at which the watermelon halves decompose.

## THE EFFECTIVENESS OF MICRO-HYDRO GENERATORS IN POWERING A COMMON LED BULB

Eric Baxley

Heathwood Hall Episcopal School

The purpose of this project is to determine the effectiveness of 3.6v micro-hydro generators for powering 300 lumen light emitting diodes (LED). Three generators are connected to each other while one end is connected to a spigot, and these generators are connected to each other and to an LED light bulb in series circuit. Water is run through the generators at the lowest flow rate that generates an electrical current strong enough to light up the LED bulb. This minimum flow rate, the voltage at the LED's terminals and the lux produced by the bulb are all measured and recorded. These steps are repeated with 2 generators and then 1 generator. When 2 or 3 generators are connected, the LED bulb produces 770 lux, and when 1 generator is set up, the LED bulb produces 0 lux. The data supports the hypothesis that if 3 micro hydro generators are used, the light bulb will produce 300 or more lux.

## SNOWPURE'S ANION-EXCHANGE MEMBRANE EFFECTIVENESS AT CARBON SEQUESTRATION IN DIFFERENT SHAPES

Paul Beasley  
Dutch Fork High School

The purpose of the experiment is to test the efficiency of these designs at utilizing SnowPure's anion-exchange Membrane at collecting carbon dioxide from ambient air. The anion-exchange membrane is a tool developed by SnowPure and it has the ability to sequester carbon dioxide from ambient air by reacting carbon dioxide with sodium hydroxide (NaOH). The rate that carbon dioxide is emitted in a chamber will be measured using a carbon dioxide probe. Each device will be tested by how well they decrease the rate CO<sub>2</sub>. One device is based off of a honeycomb design and the other is based off of the artificial tree. The first device is the common artificial tree proposed by many organizations. The second design is the cylinder proposed by a professor at Columbia University. The last device is the honeycomb design. The results of this research experiment can be used in developing a new instrument for harnessing the sodium hydroxide sorbent and successfully conducting carbon sequestration. The anticipated outcome is that the honeycomb will collect carbon dioxide at a faster rate because it has a higher surface area in comparison to the other devices.

## THE EFFECT OF VARIOUS TYPES OF STATINS ON THE DEPLETION OF THE SUPPLEMENTAL COENZYME Q10

Alexandra Bergren  
Spring Valley High School

HMG-CoA (3-hydroxy-3-methylglutaryl coenzyme A) reductase is an enzyme which increases the rate of the conversion of HMG-CoA into mevalonate acid during production of cholesterol in the mevalonate pathway. Coenzyme Q10 is an oxidant and is also biosynthesized in the mevalonate pathway with cholesterol. It is necessary for energy production in cells and is essential for the body to survive. Statins are a class of drugs that work by releasing oxidants and replacing the HMG-CoA in the enzyme to decrease the rate of its conversion to mevalonate acid. By inhibiting mevalonate production in the pathway, statins not only decrease cholesterol production, but also CoQ10 production. It was hypothesized that, if Atorvastatin, Lovastatin, Pravastatin, and Simvastatin, were used against CoQ10, Simvastatin would inhibit the Coenzyme Q10 the most. To test the difference in the effects of statins on the CoQ10, four statins (Atorvastatin, Pravastatin, Lovastatin, and Simvastatin) were added to test tubes containing CoQ10. These were placed in

a water bath for 30 minutes to heat the solutions and simulate a metabolic reaction in the human body. Their absorbances were recorded at a wavelength of 524.5 nm to find the level of oxidants each statin released to deplete the CoQ10. The results proved that Pravastatin depleted the CoQ10 the most, shown by its lowest absorbance of the statins, followed closely by Lovastatin and Simvastatin. Atorvastatin had the least effect on the CoQ10, and its average absorbance was closer to that of the control than any of the other statins. The means of the data for each statin showed significant differences between each other, proved using an ANOVA test. The ANOVA test resulted in a p value of .001 when there was 95% confidence. The null hypothesis stating there was no difference in the means was rejected and the claim was accepted. This experiment provided evidence that Atorvastatin is the least harmful statin to CoQ10 out of these four statins.

## EFFECTS OF AIR FRESHENER CHEMICALS ON THE HEALTH OF MICE

Maraya Bidjerano

Greenville Technical Charter High School

For almost a decade now, families have been using air freshener products in their homes to mask or eliminate common household odors. These products include sprays, solids and liquids that fill the air with perfumes and other chemicals. The brands of these types of air fresheners claim that their products are safe, but research has shown that no real experiment has been conducted to determine if that is true. For this year's SCJAS, I will be examining what harmful effects, if any, household air fresheners have on organisms. Three different groups will be exposed to a solid air freshener, a liquid freshener, a spray, or none at all. Although it may seem that this experiment will be disastrous to the mice's overall health, they will only be exposed to the proportionate amount of chemicals as humans. DNA and blood samples of each mouse will be taken before and after the trial time. Observational data on behavior and diet will also be recorded using cameras. In the end, there should be a significant difference in each group's data, hopefully showing how harmful exposure to certain chemicals from the air fresheners are on living things.

# EFFECT OF CLIMATE CHANGE ON THE LOSS OF PHENOLIC COMPOUNDS DURING DECOMPOSITION OF GRASS LITTER

Kyle Blomberg

Governor's School for Science and Mathematics

Mentor: Nishanth Tharayil, School of Agricultural, Forest & Environmental  
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Advisor: Kurt C. Wagner

The decomposition of plant litter by microorganisms in the soil plays an important role in nutrient and carbon cycling through the global ecosystem. The rate of plant litter decomposition reflects the rate at which microorganisms release carbon dioxide into the atmosphere, which plays a major role in influencing climate change. Phenolic compounds in plant tissue are important because they delay the overall decomposition of plant litter and can serve as a way to quantify decomposition. In this study base hydrolysis and gas chromatography were used to measure the concentrations of different phenolic acids in plant litter decomposed using different climatic treatments. This project looked at the concentrations of two key phenolic acids in the litter of the grass *Poa trivialis*: ferulic acid and coumaric acid. Litter samples used were placed in the Boston Area Climate Experiment at Waltham, MA, in 2008 and were retrieved in 2009 and 2010. These samples were exposed to different levels of warming and precipitation while they decomposed. Samples were either treated with no heating or were heated  $\sim 4^{\circ}\text{C}$  above the ambient temperature along with rainfall levels: ambient, drought (50% of ambient), and wet (150% of ambient). Three samples of plant litter, collected at the same time as the decomposed samples, which were not subjected to decomposition in order to obtain the initial concentration of the phenolic acids. The study found that wet precipitation treatment accelerated the loss of ferulic and p-coumaric acids from the grass litter collected during the first year of decomposition; however, this effect was absent in the second year. Neither of the two years showed any significant effect because of temperature.

## THE EFFECTS OF MEDITATION MUSIC ON SLEEP

Carolina Boccanfuso

Dutch Fork High School

Disorders such as insomnia and sleep apnea cause lethargy, fatigue, and problems functioning through the day for modern-day teens. Sleep is important to any animal's health and well-being because it is required for growth, regaining strength,

and thinking clearly. Music has been shown to relieve anxiety and lower cortisol levels more effectively than anti-anxiety drugs. The purpose of this study is to test this effect of music on teens' sleep. 30 students will be tested in this study. For the first two weeks, participants will record their sleep with the Sleep Time app with no music or sound intervention during the night. Participants will have a set playlist that will play throughout the entire night for the next four weeks. The amount of sleep and sleep quality will be measured using the Azumio Sleep Time app on an Apple device. An increase in the amount of time spent in deep sleep as well as an increase in quality of sleep are the anticipated results of this study. With longer time spent in deep sleep because of music therapy, teens should experience a better work ethic, more energy during the day, and an overall increase in performance.

## A VISUAL APPROACH TO TEACHING INTRODUCTORY COMPUTER SCIENCE

Marcus Bolton

Governor's School for Science and Mathematics

Mentor: Brian Malloy, School of Computing, Clemson University

Advisor: David Nickles

The goal of this project is to develop a visual approach to teaching basic programming techniques to introductory programmers. A video game intended to teach new students the fundamentals of programming is currently under development. The video game is titled Level Up and is designed to be web accessible from any browser. The advantages of hosting the game online is that it will allow more people to access and exploit our visualization of the code to enhance computer science instruction. The game is supported with art and animations that are used to enhance the appearance of the game and animate the code for users, providing a learning guide to the player. Most of the animations act as clues or directions to show what is happening in the game and inside a computer during the execution of code. The game is divided into eight parts, or levels, which the player must complete. Each level is intended to increase in difficulty from the previous one, and introduce new concepts and techniques for the player. The player will be thoroughly tested in each level to ensure that they grasp the concept at the current level before proceeding to the next level. As the player progresses through each level they will become more knowledgeable about the introductory concepts of computer science. After completing the game the player should have a fairly strong grasp of the introductory techniques that were presented, and be able to apply them or learn more advanced techniques.



## EFFECTS OF SODIUM NITRATE, POTASSIUM PHOSPHATE, AND MAGNESIUM SULFATE ON THE PHYTOREMEDIATION OF COPPER

Grace Breazeale  
Dutch Fork High School

The purpose of this experiment was to test different additives and find which one best enhanced the phytoremediation of copper while allowing the plant to survive. Copper and other substances such as lead pose a threat to the environment in which they are present in high concentrations, and to all exposed to this environment, and phytoremediation is a method of removing these substances. Wisconsin Fast Plants were grown hydroponically in Hoagland Nutrient Solution (HNS). Supplementary amounts of one of the three additives (sodium nitrate, potassium phosphate, or magnesium sulfate) were added to the solution as well. Copper in the form of copper sulfate were added to each of the containers that the plants were grown in. The chlorophyll a content in the plant at the conclusion of the experiment was measured using a spectrophotometer, which showed which plant performed the most photosynthesis, and, thereby, grew the most. A colorimeter was used to analyze the solution the plant was grown in before and after it is grown to show which removed the most copper. It was hypothesized that sodium nitrate would best enhance phytoremediation. The dependent variables of this study were the amount of photosynthesis that the plant performed, and the amount of copper the plant removed from the solution. The independent variable was the type of additive that the plant was exposed to, and the controlled variables were a plant that was grown in an ideal environment with no copper and no additive, and a plant that was grown in the nutrient solution with added copper, but no extra additive. The results of this experiment are significant in areas where copper contaminants are present in soil, which run a risk of contaminating ground water, posing a threat to animals and humans in the area. The additive that is found to be most effective at enhancing the plant's ability to take up copper could be used for remediation in these areas.

## SHORT-TERM EFFECTS OF HEAD IMPACTS IN STUDENT PLAYERS

Joshua Bristow  
Dutch Fork High School

In recent years, increasing awareness of head injuries is occurring in contact sports, especially in football and lacrosse where contact is most prominent. Many young players are generally not taught the correct way to tackle, or taught the incorrect way, causing a myriad of head injuries in most cases. The purpose of this study is to be able to quantify a concussion by counting the number of hits a player receives,

and directly correlate that to the amount of concussive symptoms. The qualification of a hit or impact is given an operational definition to standardize contact made by the players. A positive correlation is predicted that as the number of impacts a player executes/receives increase, the severity of concussive symptoms will increase. The methodology involved the Dutch Fork High School Varsity Lacrosse team. Ten players from the team were monitored during practices as well as games, and the number of times the players received/made hits were counted. Once the practice or game was over, a section of the SCAT2, or Sports Concussion Assessment Test 2, called the General Symptoms Checklist, was conducted on each player. This a list of symptoms rating them on severity on a scale of 1 to 6. The numbers and scores from the assessment were analyzed and used to determine which symptoms were common right after contact, practices and games. It is anticipated that through this study, correlating the number of hits student players receive to the level of concussive severity will aid in eventually preventing and treating athletes with concussions and other head injuries. Through this experiment it is hoped to shed light on the short-term effects of head impacts on student athletes of contact sports.

## BREAST CANCER TREATMENT CONTINUATION IN AFRICAN AMERICANS

Jayme Catherine Brown

The Center for Advanced Technical Studies

Mentor: Dr. Sue Heiney

African American women who have already battled breast cancer and are currently cancer-free have volunteered to be a part of a telephone interview. Their session consists of open ended questions as to allow them to speak freely about their experience with breast cancer. They are recorded as written transcripts and mp3 files for further analysis. The interviews are being coded to discover the lifestyle of a woman with breast cancer and address why it is difficult to finish through treatments. It is suspected that because the treatments have horrible side effects it causes these women to choose to suffer through the cancer rather than endure the treatments to rid the disease from their bodies. The lack of treatment leads to an increase in deaths as the un-treated cancer cells continue to spread throughout the body. Many psychological factors are associated with this decision about treatment and through extensive analysis.

## THE EFFECT OF THE HERBICIDE, ATRAZINE, ON THE BIOLUMINESCENCE OF VIBRIO FISCHERI

Sarah Buchanan and McKenna Savoca  
Heathwood Hall

In this experiment, the purpose is to use bioluminescence as a detector of Atrazine levels in the solutions. It was hypothesized that if *Vibrio fischeri* is exposed to the herbicide, Atrazine, then the bioluminescence of the *Vibrio fischeri* will be effected. LBS media was made using Tryptone, yeast extract, Sodium, Glycerol, and Tris-HCL Buffer (pH of 7.5). The cultures were grown over two nights and put into the solutions for testing. An optical density reading was used to determine a high and low optical density. The high optical density level was 2.23 and the low optical density level was 0.55. Atrazine stocks that were produced were 0ppb, 1ppb, 30ppb, and 37.5ppb. A plate that contained 96 wells was used with 20 $\mu$ L of stocks went into wells for the final atrazine concentrations. Data was collected over 72 consecutive hours. The results of the data are still being analyzed.

## OPTIMIZATION OF WIND TURBINE BLADE DESIGNS USING LEADING- EDGE TUBERCLE TECHNOLOGY

Garrett Buchmann  
The Center for Advanced Technical Studies

The research involved in this study is to determine the effect of leading-edge tubercles on the efficiencies of different existing horizontal axis wind turbine (HAWT) blade designs. Each blade design is tested using a control design without leading-edge tubercles and an identical design with tubercles. The blades are compared in terms of voltage output and tip-speed ratio, which measures the efficiency with which a wind turbine blade uses the wind that hits it. Three blades were created from pre-made balsa wood airfoils and fitted onto a KidWind wind turbine kit. The turbine was placed at a fixed distance from a standard box fan in order to create a consistent stream of air. A digital multimeter was used to measure the voltage output of each blade at a set wind speed, while a digital oscilloscope was used to measure the motor period, which was used to calculate the tip-speed ratio. The Trial 1 tests with a traditional blade design results showed the control blades had a higher voltage output. The second test with the traditional blade design did not have a significant difference between the tubercle and control blades. The scimitar blade test concluded that the leading-edge tubercle blades significantly increase the efficiency of scimitar blades. Currently, additional blade designs are being investigated in order to enable more conclusive results.

# THE EFFECT OF GP130 RECEPTOR PROTEIN LOSS ON HEART MASS IN MICE WITH CANCER CACHEXIA

Jacqueline Budidharma

Governor's School for Science and Mathematics

Mentor: James Carson, Department of Exercise Science, University of South  
Carolina

Advisor: David Whitbeck

Cachexia, the unintentional loss of skeletal muscle mass, occurs in cancer. Cachexia can cause heart failure. The cytokine IL-6 has been linked to the development of cachexia, aided by glycoprotein 130 (gp130) which helps form the cytokine receptor complex for IL-6. The gp130receptor is expressed in all tissues including the heart. The purpose of this project is to determine the effect of gp130 receptor protein loss on heart mass in mice with cancer cachexia. It is hypothesized that gp130 receptor protein loss causes increased mass of the myocardium. It is also hypothesized that anabolic signaling related to cardiac growth will be induced by gp130 receptor loss. Female wild-type mice (B6), mice with colon cancer (Min), and mice with colon cancer and a muscle-specific knockout of the gp130 receptor (gp130KOMin), were compared. All were sacrificed at 18 weeks of age. The gp130KOMin had significantly larger hearts than the B6 and Min when sacrificed. Protein concentration and total protein and RNA were quantified in the B6, Min, and gp130KOMin hearts to determine if total protein and total RNA were changed in the hypertrophied female gp130KOMinhearts. No significant difference was found in the protein concentration and RNA concentration between the genotypes in the hearts. Western Blots ran for STAT 3 shows what the inhibition of gp130 protein increases the total STAT. This research will help us understand how inflammatory signaling through the gp130 receptor regulates heart mass during cancer cachexia and lead to the development of treatments to prevent it.

# THE EFFECT OF TEXTING ON REACTION TIME VS THE EFFECT OF TALKING ON REACTION TIME FOR BEGINNING DRIVERS IN THE 14 TO 15 YEAR OLD RANGE

Grayson Byrd

Heathwood Hall Episcopal School

The purpose of this experiment is to determine the effect of texting on reaction time VS. the effect of talking on reaction time. The independent variables are the different types of cell phone distractions while the dependent variable will be the test subjects reaction time. To start this experiment consent forms were made and given out to test subjects. Once they got them signed a time was scheduled at which they would come for testing. They would then play a game that would record their baseline reaction time with no distractions, and then compare that to their reaction time while answering questions via texting. The game presented the results in "time slower texting". They then did the same test but this time they answered questions verbally. The game presented the results in "time slower talking" After completing the tests the results were recorded into excel and and graphs were made expressing my results. The results of the tests showed that the means and medians of both tests were very different. The statistical analysis shows the means of the two different tests telling us how different these two tests are. The t-Test, shows the medians and the tails comparing the two data columns. The medians tell us that these two tests produce very different results. At the  $\alpha=.05$  my t-statistic was 8.624 and the t-criticals were 1.659 and 1.981. Because my t-statistic fell outside the range of the t-critical, and the statistical analysis show extremely different means, I can reject the null hypothesis, stating the effect of texting on reaction time is the same as the effect of talking on reaction time, and support the hypothesis, stating the effect of texting on reaction time is different than the effect of talking on reaction time, was highly probable.

# THE DEVELOPMENT OF HEPARINASE ON TISSUE DIGESTIONS FOR USE IN MALDI – MSI DEVICES

Sheldon Carpenter

Governor's School for Science and Mathematics

Mentor: Richard R. Drake, Director of Proteomics Center, Medical University of  
South Carolina

Advisor: Jennifer Taylor

The highly sulfated glycosaminoglycan (GAG) carbohydrate polymer heparin, or heparin sulfate, is the highest negatively charged GAG currently known and is the main protein my research focused on. This negative charge results in powerful attracting forces towards positively charged molecules. The production of this glycosaminoglycan increases drastically in cancerous tissues. Its presence in cancerous tissues provides numerous binding sites for positively charged protein ligands due to its negative charge. With its location being along the extra cellular membrane (ECM) these protein ligands allow cancer cells to attach to one another and as a result support the growth of cancer masses such as tumors. The enzyme Heparinase is an enzyme that naturally digests heparin and heparin sulfate found in the body. This enzyme has been modified to target a wider amount of genetic sequences found in heparin for research purposes and these modified enzymes have been given the name of Heparinase I, II, and III. Our goal is to discover which strain of Heparinase removes the greatest number of heparin sulfate molecules attached to the ECM. To decrease the number of heparin sulfate glycosaminoglycans for cancer cells to attach to the enzyme Heparinase II will be applied on cell surfaces. The data will be reflected by an increased number of digested glycoprotein particles after enzyme application. Different concentrations of heparinase enzyme were applied to sections of kidney tissue and assessed by MALDI-IMS. We observed a difference in glycosaminoglycan cleavage for Heparinase II enzyme compared to human heparinase enzyme. The results of heparinase II containing more genetic sequences for heparin sulfate as compared to human heparinase indicates that the cancer cells could have more heparin sulfate GAGs removed from their ECM and could limit the growth of cancerous tissue. This limited growth could affect treatment rates for tumors and decrease mortality in terms of easier to treat cancer tumors.

## NOTCH SIGNALING IN ENDOTHELIAL CELLS AS A REGULATOR OF GLUCOSE METABOLISM

Gabe Carrillo

Governor's School for Science and Mathematics

Mentor: Markus Jabs, Vascular Signaling & Cancer, German Cancer Research  
Center (DKFZ)

Advisor: Bhuvana Parameswaran

Notch signaling in endothelial cells begins when the Delta ligand on the surface of one cell binds to the Notch receptor on a neighboring cell. This response causes the intracellular domain of the Notch receptor to be cleaved and travel to the nucleus where it attaches to transcription factor Recombination Signal-Binding Protein 1 for J-Kappa (RBPJk) which attracts a protein complex resulting in the transcription of Hes and Hey genes. Prior research has shown that this signaling cascade is responsible for several functions of the endothelium. However, the role of Notch signaling in glucose metabolism has not been determined. Therefore, cultures of Human Umbilical Venous Endothelial Cells (HUVEC) were exposed to high or low concentrations of glucose followed by a series of RNA isolations, Polymerase Chain Reactions (PCR), and Quantitative Polymerase Chain Reactions (qPCR). An in vitro study found that the transcription of Hey1, Hey2, and Hes5 genes fluctuated with changes in glucose concentration indicating that Notch signaling might regulate glucose metabolism. An in vivo study with RBPJk (+/+) and (-/-) mice was conducted by injecting them with tamoxifen, a drug that inhibits the Notch signaling cascade by blocking the expression of transcription factor RBPJk. These mice were fed either a normal or high lipid diet, and the weight and blood glucose was measured every week. The results showed that RBPJk (+/+) had a higher weight and blood glucose level than RBPJk (-/-) mice. Future research will focus on the pattern by which Notch signaling is regulated by glucose concentration.

## INVOLVEMENT OF HEMOCYTES IN THE FLIGHT MUSCLE HISTOLYSIS OF THE HOUSE CRICKET, ACHETA DOMESTICUS

Nikhila Cheepurupalli

Spring Valley High School

Autophagy is a nonapoptotic programmed cell death which is caused by the action of certain enzymes and signaling pathways. Flight muscle histolysis is a well known autophagic process that occurs to crickets and causes the degenerations of flight muscles. The purpose of this experiment was to see how autophagy plays a role in the flight muscle histolysis of Acheta domesticus. It was hypothesized that the

beads coated with Day 1 flight muscles would have more cells containing beads than beads coated with cricket ringer, Day 2 muscles, and Day 3 muscles. Microscopic beads were injected into healthy female crickets before the crickets were placed into boiling water. The hemocytes from the crickets were drawn and placed onto a slide before being stained with the Giema Stain. 2-3 pictures were taken of the slide that was placed underneath a microscope. In the picture, the number of cells and the number of cells containing beads were counted in order to see if there was a significant difference in the autophagy of beads between the various stages of flight muscle histolysis. Using a One-Way ANOVA with an alpha value of 0.05, the null hypothesis that there the various treatments had no significant difference between the ratio of cells and cells with bead was rejected,  $F(3,20)=70.29$ ,  $p<0.001$ . The Tukey post-hoc test indicated that the number of beads within the cells in the Day 1 treatment was significantly different compared to the number of beads within the cells for the cricket ringer, Day 2 muscle, and Day 3 muscle treatments. Therefore, the hypothesis that the beads coated with Day 1 flight muscles would have more cells containing beads than the beads coated with cricket ringer, Day 2 muscles, and Day 3 muscles. Scientists can use these results to understand more about autophagy and what specific day of flight muscle histolysis would produce the most signals for autophagy to occur.

## AN IMPROVED HAND RECOGNITION SYSTEM BASED ON OPTIMAL SELECTION OF HAND DIMENSIONS

Richard Chen  
Spring Valley High School

Biometrics is a form of identification based on recognition of a person's physiological features, and it is a relatively new, albeit fast-growing, field. The purpose of this research was to improve a contactless biometric hand recognition system based on geometric ratios in both structure and method. This study used an imaging box fitted with a normal webcam to capture 576 images of right hands (6 from each of 96 subjects). The hands were allowed to "float" freely in the box without contact due to the system of ratios used. MATLAB was then used to develop several programs which performed image acquisition, automatic location of data points and dimensions, and hand recognition simulation. The entire system utilized the ratios of a total of eight distinct finger lengths and up to 88 distinct finger widths, as well as palm width. Thirteen different combinations of finger lengths and the palm width were used, and at each of those levels, the number of widths per finger was tested from 1 to 22, meaning 82,944 trials were tested for each level. It was hypothesized that the lowest EER (equal error rate) would occur when palm width



was suppressed, and when the number of widths was 10. Also, it was hypothesized that an EER of 5% or lower, which is indicative of an extremely accurate system, could be achieved, and that the threshold would be negatively correlated with FAR and positively correlated with FRR. It was found that suppressing both index finger lengths as well as palm width yielded the lowest EER at 5.46%, which occurred when 13 widths were used. Correlation regression on the data showed that, across all levels of hand dimensions used, the threshold used was indeed negatively correlated with FAR and positively correlated with FRR. Therefore, this research demonstrated that this system is relatively accurate and suitable for further experimentation or potentially commercial use.

## THE ANTIBACTERIAL AGENT TRICLOSAN AS A GROWTH INHIBITOR OF STAPHYLOCOCCUS AUREUS AND STAPHYLOCOCCUS EPIDERMIDIS

Irene Gayi Cheng  
Academic Magnet High School

Triclosan is an antibacterial and antifungal agent used in commercial goods since 1972 and is now found in a wide variety of household items and personal care products (PCPs). Factors including concentration of soap and chemical exposure time were tested on cultures of *Staphylococcus aureus* and *Staphylococcus epidermidis* to determine bactericidal efficacy and effective concentrations of liquid hand soap available. Cultures were incubated and rated after 24 and 48 hours, and were rated semi-quantitatively on a growth scale of 0-4. No inhibition of bacterial growth occurred when cultures were exposed to triclosan-free soap (NON). Using an ANOVA (Analysis of Variance) statistical test with repeated measures on both factors using a p-critical value of .05, the concentration of triclosan containing soap (TCS) was found to be statistically significant while the time of exposure was not. Concentration and time were also found to be uncorrelated. Triclosan containing soap was fairly effective at higher concentrations. After 48 hours, 58% of *S. epidermidis* cultures and 94% of *S. aureus* bacteria showed growth after an initial rating of 0, showing that triclosan can act as a bacteriostatic agent in concentrations of less than 0.46% TCS.

## THE EFFECT OF STAGE LIGHTING COLORS ON STRESS WITH RESPECT TO HEART RATE

Lucas Clark

Heathwood Hall Episcopal School

Stage lighting can affect a performers mood, but can it effect their stress levels and heart rate? The purpose of this research was to determine the effect of stage-lighting colors on stress with respect to heart rate. The independent variable was the stage-light color used. The dependent variable was the change in heart rate (beats per minute) from each individual's baseline heart rate. The hypothesis was that there would be a change in heart rate when exposed to different colors of stage lighting. The null hypothesis is that there will be no change in heart rate when test subjects are exposed to different colors of stage lighting. Ten test subjects, all regular stage performers, were asked to sit in a chair, center-stage, in the dark for two minutes. After these two minutes, their heart rate was recorded for two minutes at thirty second intervals, while they remained in the dark. An unfiltered spotlight was then focused on them, while their heart rate was recorded for two minutes in thirty second intervals. These steps were repeated for red, blue, and green lighting. The only statistically significant findings were between unfiltered and red lighting, where it was found that being exposed to red stage-lighting increased the heart rate of the participants as compared to their baseline heart rate, rejecting the null hypothesis. The results of this study were similar to a study conducted by Valdez, which used the Pleasure-Arousal-Dominance emotion model and determined that red was described as representing excitement.

## THE EFFECT OF POPULUS TREMULA ON A HETEROGENOUS FEEDSTOCK GLUCOSE EXTRACTION THROUGH DILUTE ACID HYDROLYSIS

August Cole

Spring Valley High School

Fossil fuels are becoming more expensive as our nonrenewable supply is being rapidly used. One solution to this is to find an alternative fuel source. Ethanol is one of the most promising fuel sources of the future. Ethanol is usually produced from a corn feedstock; however this causes negative effects, such as increasing the prices of food. However there is another category of feedstock available, lignocellulosic feedstocks. The goal of this research was to maximize glucose extraction from lignocellulosic feedstocks. Populus tremula and Miscanthus sinensis were used as the two feedstocks, each mixture having varying amounts of Populus tremula. The feedstocks were harvested and cut into 20 centimeter lengths and

dried at 100 degrees celsius for five hours. The feedstocks were then ground to a size of 50 mm and stored in a dry space. The feedstocks were then mixed into 100% Populus tremula; 80% Populus tremula; 60% Populus tremula; 40% Populus tremula; 20% Populus tremula; 0% Populus tremula. The rest of the feedstock was made up of Miscanthus sinensis. Each mixture had 40 mL of .1 M sulfuric acid added to it and was heated to 100 degrees Celsius for three hours. After these three hours 10 mL were extracted from each mixture and tested for the concentration of glucose with potassium permanganate. The amount of glucose extracted from each feedstock mixture showed that there was a statistical difference between these feedstock mixtures, ( $F(5, 24) = 2.8$ ,  $p = .039$ ) with the 100% Miscanthus sinensis being the best for ethanol production.

## QUANTIFYING STUDENT PREFERENCES FOR WHOLE, HALVED, AND EIGHTHED APPLES

Aryn Cooper  
Spring Valley High School

In today's time, children are not eating the number of fruits and vegetables that they should. Many schools have made free fruit available, and even sometimes mandatory, in their schools in order to help with this problem. Another problem spouting from this, though, is that students are just throwing these healthy, free fruits away. This study was conducted in order to see if there is a way to decrease the amount of students throwing away these perfectly good fruit. The purpose of this particular study was to determine what size of apple (whole, halved, or eighthed) students preferred so that the hypothesis that the students prefer smaller sizes of fruit could be supported. Whole, halved, and eighthed apples were presented to students in plastic bags of the same color and type. Each student was asked to come up separately to choose which ever type of apple they wanted. It was found that the largest number of students chose the eighthed apples. A Chi Square test was done in order to find significant differences, and it was found that all of the categories were significantly different from each other;  $\chi^2(1, N=19) = 16.724$   $p < 0.05$ . The hypothesis was not completely supported since the number of students did not get larger with fruit size getting smaller, but the fact that most of the students chose the eighthed apples shows that schools that have not already should consider serving their fruit in smaller sizes.

## THE EFFECT OF AN ALCOHOL-WATER MIXTURE ON CAR GAS MILEAGE

Logan Corn

Spring Valley High School

Isopropyl alcohol, more commonly rubbing alcohol, is a common household item. Rubbing alcohol has been used to increase gas mileage along with water if it has been bubbled and pulled into the engine through the vacuum port. Rubbing alcohol is used mostly because of the price and availability. In this experiment, different concentrations of water and alcohol were used to find the optimal concentration for increasing gas mileage. The solution was placed in a plastic container and vacuum tubing with a valve was connected to the car's vacuum port. It was hypothesized that the higher the concentration of alcohol to water the greater the increase in gas mileage. After running an ANOVA test at  $\alpha=0.05$ , the null hypothesis was rejected,  $F(3,16)= 3.26$ ,  $p=0.049$ . The Tukey test showed that there was no significant difference between values. To determine where the difference was between the independent variables, the differential statistics were used. It was determined that the difference was between the control and the other levels of independent variable because of the standard deviation and the mean of the values. With this difference it is found that rubbing alcohol should be used.

## THE EFFECTS OF ARF 1 AND ARF 2 ON CANDIDA ALBICANS

Mairin Cotter

Governor's School for Science and Mathematics

Mentor: Robert Arkowitz, Institut de Biologie Valrose-University of Nice

Advisor: Jenny Salazar

This research focused on polarized growth in the yeast *Candida albicans* and the proteins involved in its membrane traffic, Arf 1 and Arf 2. *C. albicans* are pathogenic and its diseases can be fatal. Although Arf 1 and Arf 2 are 90% identical, Arf 2 is essential for *C. albicans* viability, cell wall integrity, and invasive filamentous growth, while Arf 1 is not. Chimeras were generated through four constructs in the ORF region between these two proteins to find exactly where these differences occur. This was done with site directed mutagenesis using polymerase chain reaction to introduce enzyme restriction sites into Arf 1 plasmids. Four different regions were cut out of each plasmid and replaced with four relatively different regions of Arf 2 plasmids using transformations and ligations. These new plasmids were then sent to sequencing and examined using Serial Cloner. It was found that the plasmids were generated correctly. After the experiment was concluded, further research was performed to test the effects of the new plasmids. It

was found that the Arf 2 mutant cells do not show the characteristics of Arf 2. Thus, it can now be concluded that the ORF regions are not important in viability. Further research can now be done on the promoter or terminator regions. If the exact region where Arf 1 and Arf 2 differentiate is found then scientists can learn more about *C. albicans* pathogenicity and develop more cures and treatments for yeast diseases and infections.

## WAYS TO INCREASE RESPONSE EXPECTANCIES AND HEIGHTEN THE POWER OF THE PLACEBO EFFECT: A META-ANALYSIS

Kelsey Crawford

Governor's School for Science and Mathematics

Mentor: Cinnamon Stetler, Department of Psychology, Furman University

Advisor: Gary L. Salazar

The placebo effect is very prevalent in today's society. We find it in over-the-counter drugs, experiments, surgeries, and more. It is the power of the mind controlling the outcome the body exhibits. The aim of this meta-analysis is to figure out the best ways to increase these response expectancies, and, therefore, increase the effect of the placebo response. Two reliable databases of scientific journals were searched. After reading through each of the abstracts that the search presents and deciding which fit our four basic criteria, the needed information will be extracted using a specific guideline. The results have yet to be calculated because of the vast amount of work that remains unfinished due to the type of research project this is. Researchers as well as doctors will be able to use the information in the meta-analysis to increase the expectations of their participants and patients in a more beneficial way.

## STROKE AND FORELIMB REHABILITATION EFFECTS ON LOCOMOTION

Tia Curry

Governor's School for Science and Mathematics

Mentor: DeAnna L. Adkins, Department of Neurosciences, Medical University of  
South Carolina

Advisor: Gary L. Salazar

Stroke is an acquired brain disease that often leaves chronic disability or impairment in patients (Palmer et al., p. 285). Rehabilitative training has shown

help in recovering post-stroke, and these efforts have shown improvements in motor function. Studies show recovery in patients through rehabilitation training, but a large percentage of their functionality is still lost post-stroke (Marie-Hélène & Cramer, 2008, p. 1). In one study, rat animal models underwent endurance training, such as a reaching-task and limb placements tasks. Researchers found that individual movements became more precise, which indicates that rehab training has an effect, to a degree, on the recovery on stroke patients (Hui et al., 2006, p. 1). This study aims to specialize these treatments for patients. Specializing treatments could improve the degree to which people will recover post-stroke, and it can help them restore more functionality. In order to specialize treatment, biomarkers are needed to determine patients that will have a better rate of recovery. More specifically they can determine which patients will respond better than others to certain treatments. By studying the behavior of male, Long-Evans rat models, the effect of rehabilitation training can be examined. The first part of the study will look at the acute affects of stroke on a locomotion task, specifically, the horizontal ladder task. The second part will focus on the effect of rehabilitative training on the behavior performed on the same locomotion task.

## VARIOUS WAVELENGTHS INHIBITING THE NOCTURNAL PATTERNS OF THE ACHETA DOMESTICUS CRICKET

Savannah Dale

Dutch Fork High School

Artificial light pollution is currently a major issue for environmentalists because it disrupts the biological balance of invertebrates and other living creatures. Not only does it reduce the visibility of the stars, but it also interrupts insect's internal compass, sense of direction, and eventually lowers their evolutionary fitness. In order to protect the invertebrate population and the environmental equilibrium, it is best to discover which wavelength affects the insects nocturnal habits the least, so humans can balance the use of electricity and the maintenance of the nocturnal environment. Therefore, if four colonies of the common house cricket (*Acheta domesticus*) are exposed to light wavelengths of 665, 550, and 490 nm, then the change in their nocturnal chirps would be least significant with the wavelength of 665 nm because it is the longest wavelength and will therefore have the least impact on the frequency, range of amplitude, and number of pulses of the cricket's chirps. In order to conduct this research, 120 crickets will separated into four distinct colonies; one exposed to no artificial light and the others exposed to the three previous wavelengths. The colonies will receive their treatments simultaneously, and their responding chirps during light exposure will be recorded.

Analysis of the chirping patterns will be used to determine the difference in frequency, amplitude, and wavelength. After further comparison to the control group with no artificial light exposure, it will be determined which wavelength of light impacts the nocturnal patterns of the common house cricket the least in terms of their chirping patterns.

## GENERATION OF POROUS HYDROGELS BY CARBONATION

AYAN DASGUPTA  
HAMMOND SCHOOL

Hydrogels are polymers that have the ability to swell in water or aqueous solutions. The structure of hydrogels is able to retain the solutions in a swollen gel form and will not dissolve due to their cross-linked system. The composition of hydrogels is changed to alter hydrogels' mechanical properties such as swelling rate, density, and porosity. These properties are important for mimicking tissue or muscle, drug loading, and drug delivery. Porosity is especially important because if cells are loaded within a hydrogel, the hydrogel needs to have volume for the cells to grow and become functional. A possible method to increase the porosity is to allow a hydrogel to soak in a carbonated solution in the process of cross-linking. In this presentation, the effect of this method on the porosity of hydrogels is explored.

## EFFECT OF PH ON ARAGONITE DISSOLUTION

Ashley Davis  
Dutch Fork High School

Ocean acidification is becoming a major environmental issue that is threatening the biodiversity of marine life. The large amount of fossil fuels that are burned release CO<sub>2</sub> into the atmosphere, and about 30% of it dissolves into the oceans. The CO<sub>2</sub> reacts with water to form carbonic acid which can dissociate twice. The hydrogen ions that are formed make the seawater more acidic, which harm calcifying organisms like coral, mollusks, and plankton. The calcification process is decreased; therefore, these organisms cannot grow and reproduce at their normal rate. The previously formed CaCO<sub>3</sub> is at risk to dissolve in these acidifying waters. This experiment aims to find the rate of dissolution of aragonite, the most common form of CaCO<sub>3</sub>, in different pH levels of seawater. Aquarium salt was added to distilled water to form seawater with a salinity of approximately 35 ppt. Five five and a half gallon tanks had 20 L of seawater put in them, and then the pH levels were manipulated with 0.1M HCl and NaOH so that there would be pH levels of

6.5, 7, 7.5, 8, and 8.5. Pieces of aragonite were weighed and placed into each tank to sit for 24 hrs. Next, they were taken out to dry for another 24 hrs before being weighed again. This process was repeated two more times for each piece of aragonite. After testing was completed, the rates of dissolution were calculated for each piece. It is anticipated that the aragonite placed in the seawater with the lower pH levels will have higher rates of dissolution.

## EFFECT OF ALLERGY DRUGS ON THE LIFE CYCLE OF *DERMESTES* *MACULATUS*

Victoria Davis

Dutch Fork High School

Forensic entomology, the study of insects and other arthropods for medical/legal purposes, allows for scientists to determine postmortem interval of a body in cases such as suicide, homicide, or unattended death. After death, different insects tend to occupy and feed off of the body during its decomposition, a concept called insect succession. Forensic scientists use this to decide how much time has passed since a human body has gone morbid. But, if an individual takes medications before their death, the substance could contaminate the blood and flesh. This experiment was intended to study the effect of allergy medications, because of their commonality, on the life cycle of a common Dermestid beetle, *Dermestes maculatus*. The allergy medications that were used (Claritin®, Benadryl®, and Allegra®) were all antihistamines. An overdose scenario was used; the victim takes fifty times more than the recommended dose for adults. The loratadine solution was 0.0002 M, the diphenhydramine solution was 0.001 M, and the fexofenadine solution was 0.004 M. Three .454 kg samples of raw pork meat were taken and soaked in each solution for 30 minutes. Each sample was placed in a separate tank that will be room temperature, about 73°F (23°C). Each aquarium tank was observed daily to record the fluctuation in the number of days or weeks that *Dermestes maculatus* lived. The prediction of the experiment was that the beetles' lives will be shortened the most when medicated with fexofenadine because they will be dose the highest with that drug.



## THE EFFECT OF PHONE FUNCTION AND ORIENTATION OF AN IPHONE ON THE POWER DENSITY EMITTED AS MEASURED BY A 3-AXIS RF METER

John Davis

Heathwood Hall Episcopal School

The purpose of this project is to determine the effect of different functions of a cell phone and the orientation of a cell phone on the output power density of the cell phone. The output of power density from each of ten iPhone 4's was measured with a 3 axis RF meter. The measurements were made from both the front and back of the phone while the phone was being used to receive text messages, a voice call, and a web search request. An analysis of the data showed that while calling, 8 of 10 phones had a greater output power density from the back of the phone as compared to the front. While in the process of receiving a text message 8 of 10 phones had a greater power density from the back of the phone as compared to the front. While searching the web, 7 of ten phones had a greater power density from the back of the phone. 10 of 10 phones had calling as the user function that had the greatest output power density regardless of whether measured from the front or from the rear of the phone. Conclusion: From the results these conclusions can be made that 76% of the phones had the greatest power density emitted from the back surface of the phone as compared to the front surface. 100% of the phones had calling as the phone function that generated the greatest output power density.

## EXAMINING THE EFFECTS OF DIFFERENT FORMS OF MUSIC EXPOSURE ON THE DEVELOPING BRAIN

Rachael Dawson

Academic Magnet High School

This thesis seeks to determine how three forms of music exposure individually affect the human brain. In particular, two violinists of different age, gender, ethnicity, and music professionalism experienced quantitative electroencephalogram (qEEG) tests when they actively played the violin, listened to their recordings, and watched the other subject's live violin performance of the "Saint-Saëns Violin Concerto No. 3 in b minor op. 61." Specifically, the computer software NeuroGuide facilitated data analysis that was conducted by an expert neurophysiologist, who was the mentor. Another faction of the experimentation was an online ten-question survey that the researcher created and sent to Charleston County School District (CCSD) elementary school administrators to qualitatively analyze CCSD elementary school music programs. Overall, insufficient levels of subject participation limited the scope of this thesis, but the findings suggest that

every form of music exposure positively affects the brain and that greater attention needs to be directed towards CCSD elementary school music programs to provide students with the most-beneficial music education that enhances both academic achievement and social stability.

## CREATING ENGINEERED LUMBER PRODUCTS FROM KENAF (*HIBISCUS CANNIBINUS* L.) STALKS

Sarah Dellinger

Governor's School for Science and Mathematics

Mentor: Brandon Ross, Glenn Department of Civil Engineering, Clemson University

Advisor: K. Sris

Kenaf (*Hibiscus Cannibinus* L.) is a rapid-growth plant closely related to cotton. The growth of the plant is similar to bamboo (Figure 1), with each plant having a single straight stalk composed of core (inner) and bast (outer) fibers. (Figure 2) These fibers lend certain mechanical properties to the plant that could make it desirable for use in Engineered Lumber Products. Use of Kenaf in lieu of Southern Pine could be environmentally preferable as well, as kenaf produces four times the amount of fiber per acre per year. The purpose of this project was to experimentally determine the mechanical properties of the kenaf fibers. Specifically, tens of fibers were pulled to failure in tension to determine tensile strength and the modulus of elasticity. Testing is ongoing, but the preliminary results indicate kenaf is a reasonable candidate for use in Engineered Lumber Products.

## SYNTHESIS OF NON-ATP COMPETITIVE CYCLIN BINDING GROOVE INHIBITORS

Andrea Detter

Governor's School for Science and Mathematics

Mentor: Campbell McInnes, College of Pharmacy, University of South Carolina

Advisor: Phelesia Jones-Cooper

The inhibition of the Cyclin Dependent Kinase (CDK)4/CyclinD1 and CDK2/CyclinA complexes in the G1(growing) to S(DNA synthesis) phases of the cell cycle can have the effect of forcing transformed cells into apoptosis. Thus they have become the targets of current cancer drug discovery and research. The amino acid sequence HAKRRLIF, which is part of the C-terminal end of a known CDK inhibitor, became the template for our design and creation of small molecules and non-natural amino acids that will be able to mimic the intermolecular interactions of the sequence with the cyclin binding groove on the cyclin. The 3,5-Dichlorophenyl Triazole molecule is currently a promising but not definite replacement for the amino-terminal sequence (HAKR). Using REPLACE methodology, new carboxyl-terminal Ccaps have been found to replace the latter half of the sequence (RLIF). Several of these new dipeptides with optimized Ccaps were synthesized using standard solid phase peptide synthesis on a chlorotriptyl resin. All of the peptides were successfully synthesized or demonstrated no signs of failure. They were identified using High Performance Liquid Chromatography and Mass Spectrophotometry. In future experiments, the effectiveness of these fragment ligated inhibitory peptides (FLIPs) will be tested using Florescence Polarization Assay and in cancerous cell cultures. The FLIPs in this experiment will help to determine the best course of action to modify future peptides as part of continuing research to find a new and affective cancer therapeutic

## IDENTIFYING RISK FACTORS FOR *CLOSTRIDIUM DIFFICILE* INFECTION

Jordan Dimock

The Center for Advanced Technical Studies

*Clostridium difficile* infection is an infection that causes fever, abdominal cramps, and diarrhea. This infection is becoming increasingly prevalent in the hospital setting causing approximately 14,000 American deaths a year. In this research, a data collection form will be used to compare different patient's outcomes and risk factors for acquiring *Clostridium difficile* infection. Examples of the risk factors to be reviewed are: the use and type of antibiotics, over-the-counter medications that affect the stomach's pH, basic demographics such as gender, age, race, and BMI, the

treatment decision based on the severity of the illness which can be classified as mild/moderate, severe, or critically ill, and recurrence which occurs in almost twenty five percent of patients who obtain the illness. So far the data is showing that most people who are infected are exposed to antibiotics prior to the infection. Also, the primary treatment most commonly being given is Metronidazole. The impact of this research could be possible antibiotic stewardship which could cause the pharmacist to either discontinue the medicine or decrease of the length of time on the antibiotic. It could also be found which antibiotic is the most likely to put a person at a higher risk for infection. This could lead to doctors not prescribing certain antibiotics if it could possibly lead to *Clostridium difficile* infection.

## SIMULATIONS OF EVOLUTIONARY GAME THEORY: COMPARING GENERAL AND GENETIC ALGORITHMS

Mary DuBard & Patrick Gorospe

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Advisor: Mark A. Godwin

Simulations of the Prisoner's Dilemma involve a situation where an individual competes and receives one of four different payoffs depending on its decision to either defect or cooperate with another player. In evolutionary game theory, the Prisoner's Dilemma is iterated over a set number of generations and, with a genetic algorithm, the best strategy for given conditions is determined. In comparison, a simulation with general algorithms keeps the same strategy throughout different generations. Three simulations without spatial constraints were constructed using a genetic algorithm so that populations evolved as the game was played. In each simulation, there was 10%, 50%, or 100% chance of two players meeting again. In each, the player that received the highest payoff was able to reproduce and pass its genes on to its offspring, creating a new population with strategies similar to the players with high scores. After comparing generations, it was shown that the strategy that thrived in the 100% simulation copied its opponent's past moves. However, no conclusion could be drawn from the 10% and 50% simulations. CopyCat, a strategy in which a play begins with a random move and then copies its opponents, was found most successful in the 100% simulation.

## SESAME: A NEW BIOINFORMATICS SEMANTIC WORKFLOW DESIGN

Alexander Duvall

Governor's School for Science and Mathematics

Mentor: Feng Luo, School of Computing, Clemson University

Advisor: David Nickles

Bioinformatics is the use of computing to organize, retrieve, and analyze biological data. The current issue with bioinformatics is the heavy emphasis on computing tasks and resources. In order for a biologist to use a bioinformatics tool, he or she needs to have an understanding of a substantial array of computational methods. To address this issue and facilitate proper execution, the complex bioinformatics tasks are often modeled as workflows. Currently, most workflows are designed for the mechanics of execution instead of being semantically representative of the approach. Therefore, deeper computational knowledge is required in order to construct a workflow. The purpose of this project is to create a new semantic workflow design system, as opposed to the current executable design system. A semantic design takes the focus off computational knowledge and pushes biological concepts instead. The design allows for biologists to perform analyses closer to biological research than computer inquiry. In the project, the Java programming language and Google's Google Web Toolkit (GWT) were used to create a web application that uses a semantic workflow system. Specifically this project focused on programming the undo and upload buttons featured in the web application. The undo button allows the user to easily erase the last actions he or she has taken and stores those actions for a redo function to use later. The upload button is designed to allow users to transmit workflows from files stored on their computer to the web service. The project and the web application allow for an illustrative graphical user interface that focuses on an understanding of biological concepts rather than on computational knowledge.

## REMOVING NUTRIENT-BASED WATER CONTAMINANTS WITH NON-WETLAND PLANTS USING TREATMENT WETLAND SYSTEMS

Wilson Edenfield

Dutch Fork High School

Cheap and effective water treatment is a universal and worldwide concern. One of the top new water treatment methods is use of artificial treatment wetlands. While they are effective, green, and aesthetically pleasing, the species in wetlands can be difficult to grow and maintain. Therefore, the purpose of this research is to test the possibility of using non-wetland grasses in a constructed wetland system for water

filtration. To achieve this, several constructed wetland systems were created with non-wetland plants native to South Carolina, and compared to similar constructed wetland systems created with traditional wetland plants. Comparisons of the ability of the systems to filter aqueous phosphate, nitrate, and ammonium from water were used to determine if filtration using non-wetland grasses is feasible. No data has been collected at this point, but it is expected that the non-wetland plants will absorb the nutrients, though not at the rate of the wetland plants, due to the absorption of these nutrients essential to these plant's growth. The wetland plants are better suited to the aqueous hydroponic environment the plants will be grown in, and thus outperform the others.

## TECHNIQUES FOR DIGITAL IMAGE STEGANALYSIS

William Edwards

Spring Valley High School

Steganalysis, the process of detecting messages concealed within more innocuous media, has been increasingly of interest to law enforcement and intelligence groups, as such covert communication has many illicit uses. One common technique for encoding hidden data is by manipulating the noise within digital images in particular patterns known only to the sender and the recipient. Steganalysis must detect the subtle statistical changes in the images in order to separate those images which contain hidden information from those that do not. The purpose of this study was to compare the effectiveness of several machine learning classifiers at distinguishing those images which contain hidden data from those that do not. In the initial phase of experimentation, the discrete wavelet transform was compared with two variants of prediction-error images. Those statistical methods based on prediction-error algorithm described in Shi et al. (2005) were found to be superior. This was confirmed by an ANOVA test,  $F(24, 9900)=1471$ ,  $p < 0.001$ ,  $\alpha=0.05$ , and a post-hoc Tukey test. In the second phase of experimentation, a feed-forward artificial neural network was compared with a linear and a kernel support vector machine. All three classifiers were trained on a training set containing half hidden data and half not. Each classifier was then tested on six groups of 200 images containing hidden data at 0.01, 0.05, 0.1, 0.2, 0.3, and 0.5 bits per pixel respectively and the success of the classifier's decisions was recorded. The data were analyzed using a chi-square analysis which found there to be a significant difference,  $\chi^2=62.37$ ,  $p<0.01$ ,  $\alpha=0.05$ .

## THE EFFECT OF NUTRITIONAL LABELING ON CALORIE INTAKE

Sydney Ellen

Heathwood Hall Episcopal school

In this study, the effect of nutritional labeling on calorie consumption in a high school lunchroom was examined. As obesity in youth has rapidly become a major health issue in the United States, the result of this study would be beneficial in determining the influence nutritional labeling has on food selection and the potential impact it has on encouraging healthier eating habits. Thirty students were asked to view a menu with one of four nutritional labeling conditions: no nutritional labeling, calorie labeling, distance-based physical activity labeling, which displayed the distance of walking required to burn off calories in each food selection, and time-based physical activity labeling, which displayed the time spent walking necessary to burn off the calories in each food item. Then, the participants recorded their food selections in the quantities consumed. This was repeated for the three other conditions to complete trial 1, and repeated for trials 2 and 3. All nutritional labeling conditions resulted in a decrease in calorie intake, and results showed that the average percent decrease in calorie consumption in relation to the control condition of no nutritional labeling was the greatest under the time-based physical activity labeling condition at a 12% decrease in calories. Although 72% of student participants indicated that they felt the nutritional labeling encouraged them to make healthier lunch choices, the ANOVA analysis proved the results to be statistically insignificant.

## THE DESIGN AND CONSTRUCTION OF AN ORNITHOPTER

Mitchell England

Spring Valley High School

Ornithopters have been depicted as far back as the Assyrian stone carvers making concepts of flying chariots. From there, DaVinci designed and sketched a more modernized representation of what the ornithopters are today. Modern examples are the Festo Ornithopter which very closely resembles the flying mechanics of a bird, and then the Aerovironment's Nano Hummingbird which has the ability to hover with active stabilization. The goal of this research is to present a model engineering design of a working basic ornithopter. The frame, constructed of Balsa and Basswood, was built off of the fuselage and electronics of a RC ParkZone Night Vapor. The membrane used on the wings and tail was a mylar. The ornithopter was constructed to propel the flapping motion of the wings by increasing torque from the main motor and then offsetting a strut to connect rods that would put the wings in

motion. The tail functioned as an elevator and was controlled by adjustable servos from the main body electronics. It was concluded that the overall design did not allow flight. The main body frame was not strong enough to support the tension and pressure that would need to be applied to it. The components could not be held together securely enough to support the require motions for flight. The electric motor would also need to be enlarged to support a faster flap rate that would sustain the aircraft through flight.

## THE EFFECT OF NETO1 AND NETO2 ON THE FORMATION OF HETEROMERIC KAINATE RECEPTORS

Jason Erno

Spring Valley High School

There is an increasing problem regarding the 30-40% of people with epilepsy who cannot be treated with antiepileptic drugs. One major cause of epilepsy is an imbalance of inhibitory and excitatory proteins in the brain; one particular receptor that is found to be in overabundance in epileptic hippocampi is the kainate receptor. Two proteins, Neto1 and Neto2, are accessory proteins that interact with kainate receptors and are believed to have a significant impact on the binding of kainate receptor subunits like GluR6 and KA2. Neto 2 is believed to have the ability to inhibit the formation of heteromeric kainate receptors, and thus, can reduce the number of kainate receptors (KARs) in an epileptic hippocampus. The purpose of this study was to better understand kainate receptors and the proteins that affect the formation of the receptors from the subunits. It was hypothesized that if Neto1 and Neto2 are separately present in cells with GluR6 and KA2, then Neto2 will prevent the formation of heteromeric kainate receptors, but Neto1 will not inhibit the formation. In order to conduct the experiment, DNA coding for Neto1 and Neto2 was transfected into separate dishes of HEK293T cells. A Bradford Protein assay was then used during the preparation of the cells for Co-immunoprecipitation to measure the concentration of protein the samples. A Co-IP was conducted to have the KA2 or GluR6 and possible KA2/GluR6 heteromers attach to the polystyrene beads that would then be detected through a Western Blot. ImageJ software was then used to measure the optical densities of the bands from the Western Blot. Using two separate two sample t-tests, they showed that the R6KA2 + Neto2 values were significantly less than the controls values, or the R6KA2 values, for the GluR6 pull-down,  $t(7) = 2.61$ ,  $p = 0.017$ , and that there was no significant difference between the R6KA2 and R6KA2 + Neto1 values in the R6 pull-down,  $t(8) = 1.860$ ,  $p = 0.955$ . These findings support the hypothesis and demonstrate Neto2's possibly therapeutic ability in disrupting formations of KARs.



## A COMPARISON OF FOUR DIFFERENT ROOFING MATERIALS' ABILITY TO CREATE THE COOLEST SURFACE TEMPERATURE

Katherine Evans

Heathwood Hall Episcopal School

In this experiment, different roofing materials' ability to create the coolest surface roof temperature was examined and compared. This information would be beneficial because if the most energy efficient roofing material is found, Americans may be able to conserve energy and save money. In this comparative study, it was hypothesized that if a shingle and tar paper roof, a gravel and tar roof, a green corrugated metal roof, and a green roof with sedum plants are compared, then a green corrugated metal roof would create the coolest surface roof temperature and a green roof with sedum plants would create the hottest surface roof temperature. This was accomplished by setting up a demonstration table with each of the four roofing materials and digital thermometers. The thermometers of each roofing material and ambient air temperature were checked and recorded twice a day, once in the morning and once in the afternoon, for ten days. The temperatures were then analyzed to determine which roofing material had created the coolest and hottest surface roof temperature. After all the data was collected, the AM surface roof temperatures and the PM surface roof temperatures were averaged separately using Microsoft Excel. It was found that the results rejected the hypothesis and overall findings showed that the green roof with sedum plants created the coolest surface roof temperature, and the shingles and tar paper roof created the hottest surface roof temperature. An ANOVA test, at alpha level 0.05, showed that these results are statistically significant.

## THE EFFECT OF TAP WATER RINSE AND FIT® PRODUCE WASH RINSE ON THE RESIDUAL AMOUNT OF MALATHION METHYL REMAINING ON GRANNY SMITH APPLES

Anna Farr

Heathwood Hall

The purpose of this study was to determine the effectiveness of rinsing Granny Smith apples with Fit® produce wash and tap water with respect to the level of malathion methyl residue. Granny Smith apples were soaked in malathion methyl and then washed with either Fit® Fruit and Vegetable Wash or tap water for 3 minutes. The amount of malathion residue remaining after washing was

determined by soaking the apples in distilled water for 20 minutes. All samples were tested for residues using an organophosphate titration test kit. The data suggests that there is no difference in the performance of Fit® Fruit and Vegetable Wash and tap water on the removal of malathion residue on Granny Smith apples, failing to reject the null hypothesis.

THE EFFECT OF POLYPROPYLENE, POLYETHYLENE, AND A  
POLYPROPYLENE-ETHYLENE COPOLYMER ON THE ELECTROCHEMICAL  
POTENTIAL OF SYNTHESIZED SULFUR AND LITHIUM CHLORIDE AS  
LITHIUM-SULFUR BATTERY ELECTRODES

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The increasing demand for nontoxic energy storage devices has been propagated by the global issues of air pollution and ozone depletion. In order to counteract these impending phenomenon, many alternate forms of energy and energy storage have been introduced. This research focused on improving the electrodes of the lithium-sulfur battery in regards to electrochemical potential. The cathodic substance, elemental sulfur, and the anodic substance, lithium chloride, were both individually synthesized with three polymers, polypropylene, polyethylene, and a polypropylene-ethylene copolymer (PPC). Once created, the substances were grouped into nine cathode-anode combinations. Each pair of plastics was tested in a galvanic cell using the porous cup method, the sulfuric substance represented the cathode while the lithium chloride substance represented the anode. A cell using zinc (cathode) and copper (anode) as electrodes was used as a control but was not used in data analysis. The cell was attached to a digital multimeter which was set to DCV 2000 mV. The voltage output was measured every minute for ten minutes. After experimentation, it was found that the null hypothesis was rejected; there was significant difference among the nine electrode combinations:  $F(8,90)=217.98$ ,  $p<0.001$ . In conclusion, it was found that PPC was the most efficient additive for the anode while polypropylene was most efficient as an additive for the sulfuric cathode.

## WASTEWATER SANITIZATION AND NUTRIENT REINTEGRATION VIA SUPERPOROUS FILTRATION

Benjamin Fechter  
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Agricultural effluent contributes significantly to municipal water supply contamination and eutrophication. Pharmaceutical and antibacterial agents that contaminate the effluent negatively impact the health of freshwater ecosystems, acting as carcinogens and affecting biological systems. In this experiment zeolite, granular activated carbon (GAC),  $\text{CaCl}_2$ -adsorbed granular activated carbon ( $\text{CaCl}_2$ -GAC), and silica-based aerogel (SBA) were utilized to filter: ibuprofen, the most common pharmaceutical contaminant; triclosan, a common antibacterial agent; phosphate; nitrate; ammonia from solution in order to evaluate each superporous material's effluent filtration potential. It was hypothesized that triclosan and ibuprofen would be effectively filtered by SBA and GAC, phosphate by  $\text{CaCl}_2$ -GAC, and ammonia by zeolite. Experimentation was accomplished by feeding solutions of triclosan, ibuprofen, phosphate, nitrate, and ammonia through 5cm<sup>3</sup> of each material. Concentrations of triclosan and nitrate were analyzed by evaporation; phosphate by precipitation as  $\text{Ca}_3(\text{PO}_4)_2$ ; and ammonia and ibuprofen by acid-base titration. Furthermore, GAC and  $\text{CaCl}_2$ -GAC filters were integrated into soil of *Brasica rapa* plots to test reintegration of the filters as fertilizer. GAC fertilization was hypothesized to accelerate growth of *Brasica rapa*. Growth rate was determined by dry mass analysis. At  $\alpha=0.05$ , all filters were found to significantly reduce triclosan concentration,  $F(4,145)=669.9$ ,  $p<0.001$ ; ibuprofen concentration,  $F(4,145)=786.96$ ,  $p<0.001$ ; and  $\text{NO}_3^-$  concentration,  $F(4,145)=1306.04$ ,  $p<0.001$ ; zeolite, GAC, and  $\text{CaCl}_2$ -GAC filters were found to significantly reduce  $\text{NH}_3$  concentration,  $F(4,145)=442.61$ ,  $p<0.001$ ; and  $\text{CaCl}_2$ -GAC filters were found to significantly reduce  $\text{PO}_4^{3-}$  concentrations,  $F(4,145)=5423.46$ ,  $p<0.001$ . Furthermore, post-filtration  $\text{CaCl}_2$ -GAC was found to significantly increase the growth of *B. rapa* when used as fertilizer,  $F(3,107)=35.77$ ,  $p<0.001$ .

THE INHIBITORY EFFECT OF COLLOIDAL SILVER NANOPARTICLES ON  
CANDIDA ALBICANS, ENTEROBACTER AEROGENES, ESCHERICHIA COLI,  
AND SACCHAROMYCES CEREVISIAE

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Silver is known to be an antimicrobial agent as an ion ( $\text{Ag}^+$ ), as well as a nanoparticle. Silver nanoparticles are favorable to other antimicrobial agents for their high surface area, controlled rate of application, and the sparsity of microorganisms with resistance. In this study, the antimicrobial properties of Silver nanoparticles were tested as a colloid mixture of 20 ppm in water. A zone of inhibition study was conducted on two fungi, *Candida albicans* and *Saccharomyces cerevisiae*, and two gram-negative bacterium, *Enterobacter aerogenes* and *Escherichia coli*. Experimentation was conducted on a group of four petri dishes per microorganism, three host to the microorganism as well as the colloidal solution, and one a control without the colloidal solution. It was hypothesised that if *Candida albicans*, *Enterobacter aerogenes*, *Escherichia coli*, and *Saccharomyces cerevisiae* were grown in contact with colloidal Silver nanoparticles, all microorganisms would be inhibited equally, was rejected,  $F(2,47) = 15.93$ ,  $p < 0.001$ . Out of the four microorganisms, only *Candida albicans* and *Enterobacter aerogenes* displayed any inhibition. These findings for *Escherichia coli* and *Saccharomyces cerevisiae* are inconsistent with other studies supporting the hypothesis that they would be inhibited by Silver nanoparticles. In conclusion, the study suggests that colloidal Silver nanoparticle solution was ineffective for antimicrobial use. Further testing on Silver nanoparticles should focus on the ambiguity of their antimicrobial properties. Further studies should be conducted on microorganisms shown to be completely resistant to all forms of Silver nanoparticles in order to understand the properties of this novel antimicrobial agent.

THE EFFECT OF WHITE FLUORESCENT, INCANDESCENT, LIGHT-  
EMITTING DIODE (LED) LIGHT SOURCE ON THE HEALTH (HEIGHT,  
NUMBER OF LEAVES, NUMBER OF FLOWER BUDS, NUMBER OF FLOWER  
BUDS BLOOMED, NUMBER OF DEATHS) OF THE BRASSICA RAPA  
COMPARED TO THE HEALTH UNDER THE A

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In this experiment, the effect of three different indoor light sources, Fluorescent, Incandescent, LED on the health of the Brassica rapa was examined. This experiment could be beneficial for understanding which light source would be best for growing the plants indoors. The purpose of this experiment is to determine the effect of different artificial lights on the health (growth-rate, number of leaves, flower buds, flower buds bloomed, and deaths) of the Brassica rapa compared to the Agrosun fluorescent Full Spectrum Grow Light. The hypothesis is that the white Fluorescent, Incandescent, and LED will each have a different effect on the health of the Brassica rapa. Forty seeds were planted (8 seeds per quad) and allowed to germinate and grow under each light source. After germination, one Brassica rapa seedling per quad was removed. The data show that the Fluorescent light source had the greatest positive effect on the Brassica rapa in relation to the growth rate, number of leaves, number of flower buds, and the number of flower buds bloomed. The data show that the LED light source had the greatest effect on the number of deaths.

COMPARING THE EFFECTS OF LAND USE ON STREAM GEOMORPHOLOGY  
AND FISH DIVERSITY AND ABUNDANCE IN THE SALUDA AND SAVANNAH  
RIVER BASINS OF SOUTH CAROLINA

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Mentor: Dennis Haney, Department of Biology, Furman University  
Advisor: Rebecca Heiss

A stream's ecosystem is affected by the way land surrounding the stream is used. Anthropogenic lands uses can have adverse effects on the streams in rural areas just as they do in urban areas, as runoff could carry excess sediment, fertilizer, pesticides, and other human-produced chemicals. This project examined the effects of forest, pasture, and agricultural land covers on streams in the Saluda and Savannah River basins of South Carolina. Utilizing Google Earth, ArcMap, and land covers generated from the USDA's CropScape database, stream sites with

watersheds that had high percentages of agriculture were selected. Hypothetically, land covers with more human use (e.g., agricultural sites) would have greater negative effects on the streams as measured by fish diversity and abundance and stream geomorphological variables. Fish were collected using a backpack electrofisher and a seine for 480 seconds of electrofishing time, identified to species in the laboratory, and an index of biotic integrity (IBI) was determined with the population data. Three sediment samples were taken 35 meters apart and brought back to the lab where they were dried and sieved using a ro-tap. On site, stream widths and depths were measured to calculate stream incision, entrenchment, and width:depth ratios. Results indicate that agricultural sites had a lower average skewness, mean width:depth, mean incision, and mean entrenchment ratios than the forested or pastured sites. Agriculture sites being the outlier of much of the geomorphology data is indicative of the row-crop's effects on the area.

## THE EFFECT OF *E. COLI* AND *SPIRILLUM VOLUTANS* ON THE INTENSITY FROM *VIBRIO FISCHERI* IN DRINKING WATER

Anthony Frederick  
Spring Valley Highschool

The purpose of the study was to determine if *Vibrio fischeri* is able to detect pathogenic bacteria such as *E. coli* and *S. volutans*. *V. fischeri* is a bioluminescent bacterium that originates from the ocean. *E. coli* is a bacterium that is known for its contamination of spoiled food or improperly cleaned water. *S. volutans* is most common in placid lakes and ponds. *S. volutans* grows in peptone succinate agar, or naturally with other bacteria in the water. The hypothesis of the study was if *E. coli* and *S. volutans* were added to *V. fischeri* in distilled water, then the *V. fischeri* would have a decrease in the intensity of fluorescent emission. The light intensity of *V. fischeri* was measured with a Vernier Pro Spectrophotometer. The *V. fischeri* was measured with *E. coli* added together. The two bacteria were placed in distilled water and swirled. They were then placed under the spectrophotometer and recorded for an hour. *S. volutans* was also placed in the spectrophotometer with *Vibrio fischeri*. The data obtained from the *E. coli* and *S. volutans* was analyzed with a One-Way ANOVA test. A post-hoc test was necessary, so a Tukey test was used. After the data was analyzed, it was concluded that the data supported the hypothesis.

# THE EFFECT OF EBB-AND-FLOW AND TOWER HYDROPONIC SYSTEMS ON THE DRY WEIGHT SHOOT/ROOT RATIO OF PHASEOLUS VULGARIS

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Hydroponics is the method of growing plants using mineral nutrient solutions, in water, with no soil. Hydroponic systems use less money and could be more beneficial than traditional growing methods, since hydroponics are not universally used. The purpose of this experiment was to prove which hydroponic methods could produce healthier plants defined by plant dry weight shoot to root ratio, compared to a regular growing system. It was hypothesized that, if *Phaseolus vulgaris* was placed into the Ebb-and-Flow hydroponic system, Tower hydroponic system, and regular growing system, then the Ebb-and-Flow hydroponic system would produce a higher root to shoot ratio. Meaning that *Phaseolus vulgaris*, was healthier in the Ebb-and Flow hydroponic system. The method of conducting the experiment was to find the *Phaseolus vulgaris* dry weight shoot to root ratio from a Ebb-and-Flow Hydroponic system, a Tower Hydroponic system, and a control group. Plant dry weight is obtained by a plant being taken off its growing system and then the water and carbon contained is measured and is calculated into the plants dry weight, or by drying the plants physically in a controlled environment, evaporating all of the water. When this has happened, the plant is separated into two parts, the shoot and the root. The plant is divided at the line where the soil residue on the roots stops, from the line and above is the shoot, and below is the root. These two parts are then measured individually. The control for this experiment was a regular growing system. Using an Analysis of Variance (ANOVA) test, Tukey test, and a t-test, it was found that the Ebb-and-Flow Hydroponic system had a significant effect on the *Phaseolus vulgaris* shoot to root dry weight ratio. Therefore, the study indicated that an Ebb-and-Flow Hydroponic system had a positive effect on the health of produced *Phaseolus vulgaris*.

## PREPARING AN ELECTRIC SCOOTER FOR THE INSERTION OF A SOLID OXIDE FUEL CELL

Jalen Fuller

Governor's School for Science and Mathematics

Mentor: Kenneth Reifsnider, Department of Mechanical Engineering, University of  
South Carolina

Advisor: David Whitbeck

In order to determine if making a full-sized vehicle powered by a solid oxide fuel cell is a smart decision, a smaller model consisting of an electric scooter and a solid oxide fuel cell must be made. The model would give an accurate estimation of the efficiency of this process and if more research should be invested into making a full-sized model. Before the model of the scooter with the fuel cell inside can be made, it was necessary to test the various aspects of the scooter and the batteries that power the motor. In order to design a harness to mount the fuel cell in the scooter, it was necessary to conduct tests that determined the range of G forces experienced by the scooter. This was done by mounting an accelerometer inside of the scooter and running over various obstructions at various speeds. In order to determine the amount of energy leaving the battery, an inductive coil was used. It is expected that the model with the fuel cell will show that designing in a full sized model would be smart decision.

## RT-QPCR ANALYSIS OF MIRNAS AND PUTATIVE TARGET GENES IN LATERAL ROOTS UNDER DROUGHT STRESS IN UPLAND COTTON (GOSSYPIUM HIRSUTUM)

Caroline Gilmer

Governor's School for Science and Mathematics

Mentor: Todd Campbell, Research Geneticist, USDA-Agricultural Research Service

Advisor: Jennifer Brown

As water resources become more and more limited, it is essential to understand how these changes in climate impact crop production. Cotton is the world's most important natural fiber, and a significant crop economically for the Southeast US. My project focused on using plant genetics and genomics to improve cotton productivity under drought stress conditions by measuring the level of microRNA expression of potential drought response target genes. A RT-qPCR analysis was performed on miRNAs and their target genes in lateral and primary rooting under well watered and drought conditions. Inconsistent RT-qPCR results and improperly designed primers prevented the amplification of target genes. miRNA167 was



observed to be differentially expressed in lateral rooting under drought stress through the use of RT-qPCR. In previous research, miRNA167 has been found to play a role in auxin regulatory pathways that affect plant development. When the cotton plant experiences drought stress, auxin prevents lateral roots growth and promote the primary roots growing deeper into the soil to search for more water and nutrients. These findings can aid plant breeders and geneticists to better understand the hormone pathways that miRNAs help regulate and to develop tools to apply towards cotton improvement.

## WASTEWATER SANITIZATION AND NUTRIENT REINTEGRATION VIA SUPERPOROUS FILTRATION

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Agricultural effluent contributes significantly to municipal water supply contamination and eutrophication. Pharmaceutical and antibacterial agents that contaminate the effluent negatively impact the health of freshwater ecosystems, acting as carcinogens and affecting biological systems. In this experiment zeolite, granular activated carbon (GAC),  $\text{CaCl}_2$ -adsorbed granular activated carbon ( $\text{CaCl}_2$ -GAC), and silica-based aerogel (SBA) were utilized to filter: ibuprofen, the most common pharmaceutical contaminant; triclosan, a common antibacterial agent; phosphate; nitrate; ammonia from solution in order to evaluate each superporous material's effluent filtration potential. It was hypothesized that triclosan and ibuprofen would be effectively filtered by SBA and GAC, phosphate by  $\text{CaCl}_2$ -GAC, and ammonia by zeolite. Experimentation was accomplished by feeding solutions of triclosan, ibuprofen, phosphate, nitrate, and ammonia through 5cm<sup>3</sup> of each material. Concentrations of triclosan and nitrate were analyzed by evaporation; phosphate by precipitation as  $\text{Ca}_3(\text{PO}_4)_2$ ; and ammonia and ibuprofen by acid-base titration. Furthermore, GAC and  $\text{CaCl}_2$ -GAC filters were integrated into soil of *Brasica rapa* plots to test reintegration of the filters as fertilizer. GAC fertilization was hypothesized to accelerate growth of *Brasica rapa*. Growth rate was determined by dry mass analysis. At  $\alpha=0.05$ , all filters were found to significantly reduce triclosan concentration,  $F(4,145)=669.9$ ,  $p<0.001$ ; ibuprofen concentration,  $F(4,145)=786.96$ ,  $p<0.001$ ; and  $\text{NO}_3^-$  concentration,  $F(4,145)=1306.04$ ,  $p<0.001$ ; zeolite, GAC, and  $\text{CaCl}_2$ -GAC filters were found to significantly reduce  $\text{NH}_3$  concentration,  $F(4,145)=442.61$ ,  $p<0.001$ ; and  $\text{CaCl}_2$ -GAC filters were found to significantly reduce  $\text{PO}_4^{3-}$  concentrations,  $F(4,145)=5423.46$ ,  $p<0.001$ . Furthermore, post-filtration  $\text{CaCl}_2$ -GAC was found to significantly increase the growth of *B. rapa* when used as fertilizer,  $F(3,107)=35.77$ ,  $p<0.001$ .

# SURFACE-MEDIATED ELECTROMAGNETIC PROPERTIES OF THIN FILMS

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Advisor: David Whitbeck

Over the past several years, numerous studies have claimed that, upon the application of a Self Assembled Monolayer (SAM), a thin film of gold (20-40 nm) displays para- or even ferromagnetic qualities instead of its usual diamagnetic behavior. Previous reports vary widely in their conclusions, from several micro emu to several hundred emu, so this study aims to ascertain whether or not they are credible through the taking of a large body of accurate data. In addition, the Superconducting Quantum Interference Device (SQuID), an instrument used for previous investigation of this phenomenon, are susceptible to parasite atoms, which might lead to samples reading as if they are not gold, but another metal present in the sample. In addition to taking steps to avoid such contamination, the new Magneto-Resistance Measurement (MaRM) device has been designed and built to measure changes in the samples with sufficient precision to discount whatever error such unwanted traces might cause. As devices such as SQuIDs require the removal of a sample for application of a SAM, an action that can change readings in and of itself, the new machine has been designed for application of SAMs without any change in position. Finally, Atomic Force Microscopy (AFM) scratch tests have been conducted to confirm the ability of the lab to reliably produce SAMs on gold samples. Preliminary analysis would seem to support previous claims, but more data than what is present at this early stage in the experiment is required to interpret any conclusive results.

## THE EFFECT OF DIFFERENT STYLES OF ANKLE TAPING ON ANKLE STABILITY AND PERFORMANCE ON THE SEBT

Casey Glick

Heathwood Hall Episcopal School

The purpose of this experiment is to see which tape, athletic or Kinesio Tape, is most effective for athletes during performance. This information will help athletic trainers, physical therapists, and athletes know which tape will help with overall performance or pain relief. If the ankle is taped with standard athletic tape, then the subject will have a better performance on the SEBT; however, if the ankle is taped with Kinesiotape, then the subject will have an even better performance on the SEBT. If Kinesio Tape is applied to the ankle then the participant will have better ankle stability as measured through the SEBT. The null hypothesis is that there will be no difference in stability if the ankle is taped with Kinesio Tape, standard athletic tape, or no tape at all. The results concluded that there is no significant difference between the two types; however, due to the fact that there is no difference, it was concluded that it would be more cost and time effective to use Kinesio Tape, as it takes up to half a roll of athletic tape to tape an ankle and it only takes two to three strips of Kinesio Tape to tape an ankle, depending on one's preference.

## RANKL INDUCES TRAIL EXPRESSION AND OSTEOCLAST FORMATION IN ORAL CANCER CELLS

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Advisor: Jennifer Taylor

Excessive amounts of osteoclasts cause the bone matrix to break down, allowing cancer to easily spread into the bone. Osteoclasts are cells that remove bone matrix through the process of bone resorption. Osteoclasts are induced by interaction of osteoclasts with cytokines, proteins used to carry signals between cells, specifically the receptor activator of nuclear factor kappa-B ligand (RANKL) and TNF-related apoptosis inducing ligand (TRAIL). TRAIL is a cytokine that induces apoptosis in tumor cells. It has also been shown to increase the formation of osteoclasts. Cancer cells are also known to promote the formation of osteoclasts. Forty percent of head and neck cancers are found in the oral cavity. The oral cancer cells tend to cause jaw bone destruction. Tumor cells have been shown to enhance osteoclast activity in

the tumor-bone environment. We hypothesized that RANKL and TRAIL, which are expressed in oral cancer cells modulate osteoclastogenesis and bone destruction at the tumor microenvironment. Oral Squamous Cell Carcinoma cells OSCC14A were cultured and analyzed using Western Blot Analysis and real-time PCR. SCC14A cells were treated with various concentrations of RANKL and were then assessed for TRAIL expression. Western blot analysis showed that the presence of RANKL increases TRAIL expression. Real-time PCR results also showed that RANKL increases TRAIL mRNA expression. These results show that RANKL increases TRAIL expression in tumor cells. Therefore, RANKL may increase osteoclast formation both directly and indirectly through TRAIL expression, resulting in bone destruction at the tumor-bone environment.

## UNDERSTANDING THE EFFECTS OF OIL AND HYPERBRANCH POLYMERS AS DISPERSANTS ON SYNECHOCYSTIS

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Advisor: Kurt C. Wagner

Interactions between oil dispersants and algae can lead to an inhibiting effect on algal growth. The primary dispersant currently being used in oil spill remediation is Corexit 9500. Corexit was compared to other dispersants to see which of them would be less toxic so that the most environmentally friendly dispersant could be determined and be suggested for use. The other dispersant that were tested against Corexit were hyperbranched polyethylenimine polymers with several different molecular weights of 1.2, 1.8, 10, 70, and 750 kDa (kiloDaltons) (Ladner). The toxicity of these chemicals was tested on Synechocystis, which is an alga that lives in fresh water. The idea behind the experiment was to add different amounts of both oil and dispersant to see if we could observe a difference in the toxicity of the dispersants. The difference in growth of the algae samples indicated whether one combination of dispersant and oil was less toxic than another combination. The experiment resulted in the commonly used Corexit being the least toxic to the algae than the polymers. Only the 70 kDa and the 750 kDa polymers were close to the results of Corexit.

## SIMULATIONS OF EVOLUTIONARY GAME THEORY: COMPARING GENERAL AND GENETIC ALGORITHMS

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Advisor: Mark A. Godwin

Simulations of the Prisoner's Dilemma involve a situation where an individual competes and receives one of four different payoffs depending on its decision to either defect or cooperate with another player. In evolutionary game theory, the Prisoner's Dilemma is iterated over a set number of generations and, with a genetic algorithm, the best strategy for given conditions is determined. In comparison, a simulation with general algorithms keeps the same strategy throughout different generations. Three simulations without spatial constraints were constructed using a genetic algorithm so that populations evolved as the game was played. In each simulation, there was 10%, 50%, or 100% chance of two players meeting again. In each, the player that received the highest payoff was able to reproduce and pass its genes on to its offspring, creating a new population with strategies similar to the players with high scores. After comparing generations, it was shown that the strategy that thrived in the 100% simulation copied its opponent's past moves. However, no conclusion could be drawn from the 10% and 50% simulations. CopyCat, a strategy in which a play begins with a random move and then copies its opponents, was found most successful in the 100% simulation.

## THE EFFECT OF A N-TYPE TiO<sub>2</sub> PHOTOCATHODE WITH A WIDE BAND GAP ON A SHEWANELLA ONEIDENSIS MR-1 MICROBIAL FUEL CELL

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Microbial fuel cells (MFCs) show promise as a renewable energy source that can generate electricity through microbes. The purpose of this study was to compare n-type TiO<sub>2</sub> with 3.2-3.35 eV band gap cathodic electrodes with graphite cathodic electrodes in a MFC. It was hypothesized that the TiO<sub>2</sub> electrodes would increase voltage output due to photoirradiation. Twenty trials and fourteen trials were conducted for the graphite electrodes (Control MFC) and the TiO<sub>2</sub> electrodes (TiO<sub>2</sub> MFCs) respectively. In each trial, the voltage output was collected every minute for five days. Once the bacterium had stabilized, the mean for each trial was calculated. Using a two-sample t-Test with the means, the results showed that Control and

TiO<sub>2</sub> MFCs were from the same population:  $t(32)=1.69$ ,  $p >.05$ . However, without the outliers, the results indicated that the two populations were significantly different:  $t(30)=1.70$ ,  $p <.05$ . The TiO<sub>2</sub> MFCs also had greater Q1, median, and Q3 values for both with and without outliers. This further supported that TiO<sub>2</sub> MFCs produced greater voltage outputs than the control MFCs. As the power density of MFCs continue to increase, they will continue to become a more reliable form of green energy.

## THE EFFECT OF ASPARTAME ON C. ELEGANS IN SOLID AGAR MEDIA

Anjali Gottipaty  
Spring Valley

In recent years there has been speculation on the safety of aspartame, which is used in low calorie products. Aspartame is a combination of phenylalanine, aspartic acid, and methanol and they can cause problems in the brain if taken in large quantities. One neurodegenerative disease that may be caused by aspartame is ALS, amyotrophic lateral sclerosis, which causes atrophy of the muscles and eventually results in death. *C. elegans*, a part of the nematode family, can show signs of ALS and has a genome similar to ours. It is non-parasitic, easy to maintain and cheap. The purpose of this experiment was to see if aspartame caused *C. elegans* to have less mobility, which is one of the symptoms in ALS. It was hypothesized that if the artificial sweetener, aspartame, is fed to *C. elegans*, then *C. elegans* will show signs of reduced mobility. The method was to distribute 2 g of three different sugars into 12 petri dishes with *C. elegans* specific agar. The sugars were, organic sugar, Sugar in the Raw®, and Sweet'N'Low®. The control for this experiment was 12 petri dishes with 2 ml of *C. elegans* specific agar. Using a Tukey Test it was found that the dishes treated with Sweet'N'Low® had significantly lower mobility compared to all the other sugars and the control. The hypothesis was supported, but it could not be concluded that the effect from the sweeteners caused the nematodes to develop ALS, but it did show a negative effect on the worms.

## INVESTIGATION OF SYNTHESIS AND ELECTRICAL PROPERTIES OF INDIUM NITRIDE NANOWIRES

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Nanoscale devices made from semiconducting materials are of special interest because of unique properties such as high surface-to-volume ratio and exceptional electron mobility. Indium nitride is a narrow band gap semiconductor, and nanowires synthesized of this material are ideal for sensing and electronic devices because they have a high surface accumulation of electrons, making them highly sensitive. In this study, we investigate the synthesis of InN nanowires and the electrical characterization of the devices fabricated from these wires. InN nanowires grown using chemical vapor deposition (CVD) with diameters between 10-50 nm and lengths of 5-20  $\mu\text{m}$  were used to create field-effect transistors (FETs) in a back-gate configuration, with gate, source and drain contacts and Si substrate as the back gate. A probe station was then used to measure transconductance in the device when different gate biases were applied. From electrical characterization the maximum transconductance  $dI/dV_g$  was calculated to be  $\sim -0.58 \mu\text{A/V}$  for a drain voltage  $V_d = 2 \text{ V}$  and the average mobility of  $270 \text{ cm}^2/\text{Vs}$ , which is very good for InN nanowires.

## MODELING PEPTIDE CHAINS AND THEIR INTERACTIONS WITH CARBON NANOTUBES (CNTS) AND GRAPHENE SHEETS

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The objective of the project was to observe the interactions of five different peptides with carbon nanotubes and graphene using molecular dynamics simulations to eventually use them in small bio devices, such as a device to quickly test your own blood. The simulations were performed using the program GROMACS on the Palmetto Supercomputer at Clemson University. The output of the simulation was visualized in Virtual Molecular Dynamics (VMD). When attempting to determine

why the individual amino acids within the peptide chain interacted with the nanotube, elements of the amino acids such as oxygen placement, hydrophobic tendencies, and shape were considered. It was shown that hydrophobic amino acids interact with the CNT more than hydrophilic amino acids to reduce the hydrophobic surface area. We found similar trends in our simulations. The hydrophobic residue tryptophan tends to be attracted to the CNT, and the conformation of the peptide on the CNT was determined based on the placement of the hydrophobic residues. Further studies to understand the peptide-CNT and peptide-graphene sheet interactions are in progress.

## EMERGENT PATTERNS IN JOHN CONWAY'S GAME OF LIFE

William Grismore

Dutch Fork High School

Emergence is, in short, the process by which complex patterns and properties emerge from simple underlying laws. John Conway's game of life is classified as a cellular automaton; the only interaction with the 'game' is to set some cells from 'dead' (empty) to alive (filled-in). This configuration then evolves as cells 'die' and are 'born' in accordance with one multi-part underlying law. It is an example of emergence in that complex patterns emerge rapidly from simple laws and a simple initial state. This research will examine the tendency of certain stable, common patterns (called spaceships) to emerge from density-variant, random Life seeds. It is hypothesized that as density of the seed increases, the abundance and complexity of emergent spaceships will likewise increase. Using the density of the seed as the manipulated variable, 100 simulations, ceasing at the 10,000th generation (where the life 'universes' will be examined for spaceships), are to be carried out for every density from .05 to .95, in intervals of .05. Through 380 simulations (20 trials per density, 20% of the full experiment) the abundance and complexity of spaceships seems to be random, and not correlated with the density of the initial configuration. However it must be noted that spaceships are fairly rare phenomena, and not many trials have been carried out; as such, a trend may yet emerge.



## CHARACTERIZATION OF THE HIPPOCAMPAL ACETYLCHOLINE SYSTEM IN A RODENT MODEL OF FETAL ALCOHOL SYNDROME

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School of Medicine

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The behavioral and physical abnormalities that occur as a result of in utero exposure to alcohol are referred to as Fetal Alcohol Spectrum Disorders (FASD) and this disorder is present in an estimated 2-5% of children. Impairments in learning and memory are hallmark symptoms of FASD and the hippocampus is a brain structure that is crucial for learning and memory processes. This structure is undergoing development during the third trimester and receives significant projections from the acetylcholine neurotransmitter system. It was hypothesized that developmental exposure to alcohol will cause impaired acetylcholine neurotransmission in the hippocampus and that this impairment underlies FASD-related learning deficits. It was also hypothesized that galantamine, which is a weak acetylcholinesterase inhibitor and which increases acetylcholine activity, will ameliorate learning deficits caused by alcohol exposure during development. Alcohol was administered to rat pups from postnatal day (PD) 2-10, which is equivalent to the third trimester in humans. To attempt to mitigate learning impairments caused by alcohol, half of the animals were injected with galantamine from PD 11-30. Beginning on PD 30, the animals were tested for contextual recognition, a cognitive function that relies on the hippocampus and that has been previously shown to be impaired by alcohol exposure during development. Following testing, the animals were perfused and their brains were removed to measure markers for presynaptic and postsynaptic acetylcholine function in the hippocampus. Preliminary data in this on-going study will be presented showing the behavioral effects of alcohol exposure during development and galantamine in this study.

## PRODUCING MARKERS TO DETERMINE POSITIONING FOR IN SITU RAMAN SPECTROSCOPY OF A FUEL CELL

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Advisor: Scott Page

Degradation of the polymer electrolyte membrane (PEM) inside of a fuel cell has a significant impact on the efficiency. Understanding the process of degradation would lead to improved and more efficient designs. Raman spectroscopy is a particularly effective technique for analyzing bonds found in the PEM of the fuel cell. Raman spectroscopy allows the user to determine the chemical bonding present in a material by measuring the inelastic scattering of photons from its surface. In situ micro Raman spectroscopy can be used to observe the localized degradation of the PEM in the fuel cell. However, to effectively observe the degradation portions of the PEM, a method for positioning the laser inside the fuel cell was required. We determined that a thin, internal marker layer would serve as a reference to help position the laser. Essentially, the laser would use the thin marker layer to determine what portion of the PEM it is focused on. The process for producing a marker layer involved spraying a few micron layer of the nano-powder onto the PEM. Three nano-powders, cerium oxide, tin oxide and titanium oxide, were tested for their effectiveness as marker layers. An acceptable material shall have Raman Spectra peaks easily differentiable from the peaks of the PEM. Titanium oxide was determined to be the best for the marker layer application. It showed low fluorescence and had Raman Spectra peaks easily differentiable from the PEM. Future testing would involve using the completed marker layer in a prolonged degradation test of the fuel cell.

## THE EFFECT OF DIFFERENT CONDITIONS ON A GOLF COURSE ON THE SIZE PERCEPTION OF A GOLF GREEN

Jackson Hall  
Spring Valley

The experiment's purpose was to see how size perceptions changed from condition to condition on a golf course. The hypothesis was that if a participant was in a fairway bunker on a golf course, then their perception of the width of a green would be smaller than if they were in the rough or on the fairway of a golf course. During the experiment, participants went to three locations: a fairway bunker (sandy area), the rough (thick/tall grass), and the fairway (mowed down/low grass). From these locations about 168 yards from the pin on the green, the participants were supposed to act as if they were going to hit a golf shot, and they gave their size perception of the width of the left side of a green. After giving all the required size perceptions, the participants completed a survey about outside factors that could have affected their size perceptions. To analyze the data to see if the differences in the mean perceived green widths from the locations were significant, a one-way ANOVA was

conducted at a confidence level of  $\alpha = 0.05$ . The null hypothesis that the means were equal was not rejected since the results were  $F(3,36) = 0.06$  and  $p > 0.05$ . Not rejecting the null hypothesis indicated that there was no significant difference in the mean perceived green widths. The outside factors' effects on the size perceptions were not analyzed since there was no significant difference between the mean perceived green widths.

## WIRELESS ENERGY HARNESSING

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Advisor: Clyde J. Smith

A system that could efficiently transfer and harness energy wirelessly was the basic goal. This would be beneficial as doing so would allow for wireless devices such as cell phones or pacemakers to be charged without having to connect them to a power outlet or change the batteries. To accomplish this, a transformer with an air core was developed, and transferred current from one coil to another at a certain frequency. Once the transformer was completed, another circuit was to be built, altering the current to be more stable so that it can be better used. After the current was converted, it was to interact with a signal manipulator. Unfortunately, we were unable to achieve these goals due to time constraints. However, an efficient system for transferring the energy was successfully constructed.

## DETERMINING THE THERMAL CONDUCTIVITIES OF PITCH-DERIVED CARBON FOAMS

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Advisor: Scott Page

The search for alternative fuel sources for vehicles is on the rise while main sources such as petroleum are gradually being depleted. One alternative fuel that can be used is methane, and an effective way to store methane is by using adsorbents. The optimal adsorbent, MOF-5, has a low thermal conductivity, which causes the internal heat of the fuel storage unit to rise quickly. One way to counteract this is

to place the MOF-5 into a material with a higher thermal conductivity. This research investigated the thermal conductivities and thermal diffusivities of the P1, P1HD, and L1200 carbon foams manufactured by Kopper's Inc. The foams were tested according to ASTM thermal conductivity determination standards and were found to have a high thermal conductivity around 150 W/m-K, which is a similar thermal conductivity to other carbon foams manufactured by other companies. The specific heat capacities were found with a differential scanning calorimeter and the skeletal densities of the foams were found through gas displacement. These values were used to find the thermal diffusivities of the foams to further characterize the thermal properties of the foams. The results of these experiments show that the researched carbon foams are suitable for storing MOF-5 to place in the storage system of a methane-powered vehicle.

## AGE, GROWTH, AND REPRODUCTION OF INVASIVE LIONFISH IN BRITISH VIRGIN ISLANDS, CARIBBEAN

Callie Hartsell

Academic Magnet High School

The purpose of this study was to determine the life history of the invasive lionfish *Pterois*, spp., in the British Virgin Islands, Caribbean. The researcher collected and analyzed otolith structures and reproductive tissues from 37 during the summer, from the British Virgin Islands. The researcher used the data collected to determine reproductive and growth rate of the fish, as well as the age of the samples collected. The researcher's hypothesis, that the invasive lionfish is an increasing threat to the Atlantic and Caribbean because of its unchecked growth and reproduction, was proven correct after the data was collected and analyzed. There were various limitations throughout the process, but the researcher was able to draw conclusions from the data collected.

## ANTERIOR CINGULATE CORTEX ACTIVITY IN POST-ERROR AND PREDICTION FUTURE PERFORMRANCE TASKS IN OLDER ADULTS

Storm Harvey

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Advisor: Gary L. Salazar

The Anterior Cingulate Cortex (ACC) is a part of the brain that has a vast range of functions and is activated by most activities. In particular, this part of the brain is responsible for the recognition and correction of errors. This study examines two processes, using activation in this region to predict future performance and the recognition of errors. Recent literature has been split by the development of two different theories in regards to the location of the predicting future performance and post-error response regions in the ACC, using group level analysis. One theory states that the ACC is one multifunctional region that both predicts future performance and responds to errors. Another theory holds that the ACC actually contains two separate regions, one for predicting future performance and another for error response. Unlike other studies, this study looked only at data on the individual level. The results that were found suggest that the predicting future performance and post-error response regions are very closely interrelated, but are two distinct regions within the ACC.

## HUMAN FALL DETECTION: EFFECTS OF DIFFERENT TYPES OF FLOORING ON ACCELEROMETERS

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Advisor: Jenny Salazar

Every year, countless injuries occur to elderly people who live by themselves. There have been several steps taken in order to prevent these falls or detect they occur, yet none of the methods have been ideal. At the Structural Dynamics and Intelligent Infrastructure lab, this problem is being addressed. The lab is developing a system that can detect when dependent people fall in their homes in a way that does not invade personal privacy and does not require the user to activate a signal when he or she falls. The project that this paper addresses focuses on calibrating the system that will be used. The purpose of the experiment is to test whether certain types of flooring affect the signal that the accelerometer captures. If the data collected reveals that different types of flooring do indeed affect the signal, this information can be used to calibrate the sensors for many different environments. This will be useful when installing the sensors into different homes with different types of flooring

## PDA/PLGA NANOPARTICLE-BASED DRUG DELIVERY SYSTEM FOR THE TREATMENT OF CANCER

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Advisor: Phelesia Jones-Cooper

Conventional chemotherapy for the treatment of cancer kills not only the malignant cancer cells, but also healthy cells, resulting in negative side effects. This study aims to develop a nanoparticle-based drug delivery system that causes fewer negative effects than common chemotherapy by targeting cancer cells specifically. The nanoparticles are composed of a mixture of two polymers, Poly[2(pyridin-2-yl)disulfanyl] ethyl acrylate] (PDA) and poly(lactic-co-glycolic acid) (PLGA). These two polymers were used because cancer cells tend to have a lower pH and a higher redox potential than healthy cells. The polymers break down, releasing the drug they hold, in conditions of the cancer cell. When nanoparticles made of PDA were tested for drug encapsulation, it was shown that they held little of the drug that was used, Doxorubicin (Dox). PLGA was known to have a better encapsulation efficacy, so the nanoparticles were partially composed of this polymer. PDA was kept in the mixture because its structure is sensitive to both the lower pH and higher redox potential of cancer cells. The polymers were mixed in a 1:2 ratio of PDA to PLGA. The final nanoparticles had an encapsulation efficacy of about 70%. Future works include making a more effective nanoparticle by increasing the time for each step in the process of formation and encapsulation and testing the drug with cancer cell cultures.

## PHOSPHORYLATION OF DYNAMIN RELATED PROTEIN-1 BY CYCLIN DEPENDENT KINASE-1 RESULTING FROM T-CELL RECEPTOR ACTIVATION

Rusty Hawes

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Advisor: Bhuvana Parameswaran

The purpose of this research was to understand the role of CDK1's phosphorylation of dynamin-related protein 1 (DRP1) in the signal cascade resulting from T-Cell activation. This role was studied using both donated blood and Jurkat-16 T-Cells cultured for different time periods. Activation was stimulated in vitro using the

protein kinase C (PKC) substitute phorbol 12-myristate 13-acetate (PMA) and the calcium ionophore Ionomycin. The effects of the phosphorylation of DRP1 on the signal cascade were tested as follows: a) Western Blot analysis in the presence and absence of CDK1 inhibitor RO-3306 to determine if and when DRP1 becomes phosphorylated; b) flow cytometry to determine reactive oxygen species (ROS) production as a result of DRP1's phosphorylation; c) a luciferase transfection and luminometry to determine the production of the transcription factor NF- $\kappa$ B; d) a qPCR to determine the amount of mRNA coding for the cytokines that result from the signal cascade; e) forward and sideward scatter with FACS to determine cell death as a result of T-Cell activation. It was found that DRP1's maximum phosphorylation occurred after 2 hours of oxidative stress, and that it was phosphorylated by CDK1. When CDK1 is inhibited, there is a clear drop-off in ROS production. It was also found that absence of pDRP1 inhibited production of the transcription factor NF- $\kappa$ B. Equally, the qPCR showed that CDK1 inhibition reduced production of Interleukin-2 and CD95-Ligand. Finally, it was found that inhibition of CDK1 and absence of pDRP1 significantly decreased activation induced cell death in surrounding cells

## AN ACOUSTIC METAMATERIAL FOR HIGH PRECISION MANUFACTURING

Hollin He and Carol Yu

Hammond School

With growing interest in nanotechnology, the manufacturing industries for Micro-Electro-Mechanical Systems (MEMS) and Nano-Electro-Mechanical-Systems (NEMS) are constantly thriving towards extraordinary precision in the machining and etching tools. It is a common practice, during manufacturing, a set of instructions are provided to a manufacturing tool, by actuating the tool at certain frequencies to perform their respective tasks. Every different tasks (e.g. cutting nano-channels, drilling micro-holes, nano-welding etc.) has unique instruction with unique frequency input. However, in our noisy environment (e.g. fluctuation of temperature, external vibration etc.) it is extremely difficult to provide a unique frequency to a tool to perform a task precisely without having any uncertainty. Thus to solve this challenge acoustic metamaterial was envisioned. Based on a theory and a mathematical model it was hypothesized that a mechanical pass band filter, if designed, would be able to provide a unique frequency output that can be input to the manufacturing tools. Such mechanical pass band filter could eventually revolutionize our manufacturing industries. A recently observed phenomenon called local resonance effect is strategically employed to make the metamaterial, using three simple materials aluminum, lead and rubber. As a proof of concept we

manufactured macro size material with dimensions 1"x1" however any smaller size metamaterial could be made. Our material was designed such a way that it supposed to output only 1000Hz, 2000Hz and 4000 Hz, respectively. After manufacturing and testing, we confirmed that the above mentioned frequencies were output from our metamaterial and thus it verifies the original hypothesis. Possible applications of such metamaterials could be endless if used as a hybrid filter (i.e. both pass and stop band filter), e.g. improving hearing aids, cochlea implantation, noise mitigation, quiet air travel, healthy and noise free environment in the construction zones etc.

## THE EFFECT OF AUDITORY AND VISUAL DISTRACTIONS ON TEST GRADES

Annie Heath  
Heathwood Hall

In this experiment, the effect of auditory and visual distractions on test grades was examined. This project would help the world decipher what distractions increased their test grades and which did not. It was hypothesized that if one is given a distraction before a test, then their test grade will be increased. It was accomplished by collecting three different distractions, talking, doodling, or a Rubik Cube plus the control, which was just sitting quietly. Then testing them on seven different subjects. Each subject played with a distraction for ten minuets and then took a Math and English based multiple-choice test. The data was analyzed using a single-way ANOVA test; it showed that there was not a significant difference between the distractions and the control, although the graphs collected showed there was a slight difference.

## THE EFFECT ON BOUNCE HEIGHT OF DIFFERENT TYPES OF BASKETBALLS ON A HARDWOOD BASKETBALL COURT

Julian Hennig IV  
Heathwood Hall

The purpose of this project was to find out which type of basketball bounces highest on a wood basketball court. The dependent variable was the percentage of bounce height, and the independent variable was the different types of basketballs. Leather, composite, and rubber were the types of basketballs that were tested. The experiment consisted of blowing up all of the balls to uniform pressures and dropping them onto the basketball court while a camera was recording the whole experiment. In order to eliminate a large possibility for error, instead of calculating



the bounce height, the percentage of bounce height was measured by using LoggerPro and the video of the experiments. The results were that, on average, the rubber ball bounced the highest, the leather ball was the most consistent, and the composite ball bounced the shortest.

## DETERMINING THE MOST EFFICIENT METHOD TO DIFFERENTIATE STEM CELLS INTO PHOTORECEPTORS

Austin Hensley

Governor's School for Science and Mathematics

Mentor: Valeria Canto-Soler, Department of Ophthalmology, Johns Hopkins University

Advisor: Mark A. Godwin

Stem cells' differentiation into photoreceptors is an important process to master in order for treatment of many retinal diseases. Although stem cells have been differentiated into photoreceptors before, the differentiation process used was highly inefficient. Making this differentiation efficient would allow the cost of treatment to be reasonable, and using human induced pluripotent stem cells to treat such diseases makes the treatment even better and less controversial. This experiment was looked at as a potential platform for drug discovery for a drug that could treat retinal diseases. The work presented here improved the efficiency of differentiation using a variety of substrates and nanofiber scaffolds that have not been looked at in depth in previous experiments. Substrates tested included poly-L-ornithine, poly-D-lysine, and laminin; nanofiber scaffold conditions tested included using no nanofiber scaffold, a 160-180 nm scaffold, and a 600-625 nm scaffold. After testing each combination of conditions, results showed that poly-D-lysine in a condition with no nanofiber scaffold stimulated the most efficient differentiation of human induced pluripotent cells into photoreceptors. Under the best conditions in this experiment, the efficiency was significantly better than the efficiency of differentiation in previous studies.

## DOES AGING AFFECT OUR ABILITY TO RAPIDLY SELECT APPROPRIATE ACTIONS?

Gabriella Herter

Dutch Fork High School

The key reason for which this research was commenced is that it is important for people to be aware that aging is likely one of the key factor in their ability to rapidly

select appropriate actions. This research would be useful in that it would help with understanding the differences between normal deterioration of motor skills and neural diseases and impairments. This would give people better knowledge on their motor skills and how they are affected over time. The hypothesis selected for this research is "I predict that the ability to rapidly select appropriate actions will deteriorate with age". For this research, subjects will be tested in a robot called the KINARM (Kinesiological Instrument for Normal and Altered Reaching Movement) robot. The subjects will complete a task in the robot called the Object Hit and Avoid Task. Using this task, the number of correct objects the subjects they hit, the number of distractor objects hit, their efficiency, as well as their speed will all be recorded. To conduct this research, two age groups will be tested. The first age group will consist of ages 21-30. This group was chosen to represent a younger control group. The second age group consists of ages 50 and above as an older dependent group. As of today, 50 subjects have been tested. The data accumulated so far shows that the younger age group is hitting more correct objects, less distractor objects, executes the task at a greater speed, with a slightly better but similar efficiency. Therefore, the data collected to date shows that my hypothesis is indeed correct in that it shows aging affects our ability to rapidly select appropriate actions.

## THE EFFECTS OF NATURAL VS. CHEMICAL CLEANING AGENTS ON HOUSEHOLD BACTERIA

Brandon Hill

Heathwood Hall Episcopal School

The purpose of this experiment is to measure the effectiveness of different types of chemicals cleaning agents compared to the effectiveness of natural cleaning agents in the killing of common household bacteria. These bacteria will include two commonly found household bacteria, *Staphylococcus Epidermidis* and *Escherichia coli*. The cleaning agents being used will include vinegar, a natural cleaning agent, bleach, a chemical cleaning agent, and ammonia, which will be used as a natural cleaning agent. It is hypothesized that the chemical cleaning agents used for cleaning will be more effective in destroying the bacteria than the natural cleaning agents. The null hypothesis states that there will be no difference in the effectiveness of the chemical cleaners versus natural cleaners. Each cleaning agent was tested on each strain of bacteria 15 separate times for a total of 90 trials. 4 millimeter diameter paper disks were soaked in the cleaning agent and placed it in a petri dish coated with bacteria. The results of the cleaning agents on the bacteria were measured and recorded. In my conclusion it was discovered that there was no

statistical difference between the different types of cleaning agents on how they kill the bacteria.

## GRAVITATIONAL MICROLENSING OF THE QUASAR RXJ 1131-1231

Zachary Hilliard

Academic Magnet High School

We presented the results from observations on the gravitationally microlensed RXJ 1131-1231. We began by collecting the number of counts for each of the four gravitationally lensed images. These values were then used to obtain the flux ratios for each of the images. Lastly we calculated the Excess Variance for each of the flux ratios. We were able to detect a strong microlensing event in the observations for one of the images. This detection allowed us to use two methods for constraining the emission region of the quasar. We were able to constrain the size of the corona to  $9:8 \times 10^{12}$  meters. Through the excess variance calculations we found that the hard X-ray band (2 - 10 keV) had a higher variance than the soft band (0.2 - 2 keV). These results show that the hard band is more compact than the soft band emission region. Lastly, we were clearly able to see the FeK emission line which allows us to assume that the fluorescent Fe line is very compact like the emission region, as well as being in close proximity to the central Supermassive Black Hole.

## THE EFFECT OF COLOR ON THE PERCEPTION OF FLAVOR IN VANILLA ICE CREAM

Savannah Hillmeyer and Olivia C. Price

Heathwood Hall Episcopal School

The purpose of this experiment was to investigate whether or not altering the physical appearance of vanilla ice cream had an effect on the perceived flavor. The results from this study could be hugely beneficial towards consumer affairs. The color of food has a large impact on people's flavor perception; it is a visual element that makes it such a valuable marketing tool. Thus proving that the results from this experiment can service many businesses that promote food or drink. This study uses live simulation, in which humans observed the ice cream and took a pre survey based on observation, then after completing the pre survey they then tasted the ice cream and took a post survey. The color of the ice cream was manipulated and accuracy was measured. The hypothesis was that the color of the vanilla ice cream would effect the perception of flavor. Colors that had several possible flavors, such

as red or blue, were more difficult to perceive. In conclusion, this experiment will benefit consumer affairs by illustrating that the color of a substance is important because it can affect their sales and growth as a business. If their product looks unappealing in color, then people will be reluctant to purchase it.

## THE ALLELOPATHIC EFFECTS OF EUCALYPTUS CINEREA LEAF AND ROOT EXTRACTS ON THE SEED GERMINATION AND SEEDLING GROWTH OF IPOMOEALBA SEEDS

Asheya Hinkle  
Spring Valley High School

Allelopathy is the indirect, or direct/adverse, or beneficial effects of chemicals released from plants or microorganisms on another plant in the environment. It has not been determined if the allelopathic plant, *Eucalyptus cinerea*, inhibits the seed germination and seedling growth of *Ipomoea alba* seeds. The purpose of this project was to determine if *E. cinerea* leaf and root extracts inhibit the seed germination and seedling growth of *I. alba* seeds. It was hypothesized that if *Ipomoea alba* seeds were germinated with leaf and root extracts from *Eucalyptus cinerea*, then the seed germination and seedling growth would be inhibited. Ninety *I. alba* seeds were germinated with the leaf extract and root extract of *E. cinerea*. After one week it was determined how many seeds germinated and how long the hypocotyls grew. Four z-tests were run to determine if the extracts inhibited seed germination and seedling growth. It was shown that the leaf and root extract inhibited seed germination,  $z(30) = -10.07$ ,  $p < 0.05$ ;  $z(30) = -1.83$ ,  $p < 0.05$ , respectively. The leaf extract inhibited seedling growth  $z(30) = -11.05$ ,  $p < 0.05$ , while the root extract did not,  $z(30) = .77$ ,  $p > 0.05$ .

## THE EFFECT OF COLORED CONTACTS ON THE MOISTURE OF A HUMAN EYE AS MEASURED BY THE SCHIRMER AND TEAR BREAK UP TIME TESTS

Sophia Holt  
Heathwood Hall Episcopal School

The purpose of this study was to find out the effect of colored contacts on the moisture in a human eye. It was hypothesized that the colored contacts will cause eyes to be significantly drier than eyes with normal contacts. The null hypothesis is that colored contacts will not affect eye moisture. A one way Anova test was conducted comparing the Schirmer Test with colored and clear contacts. There was a significant difference between the colored and clear contacts ( $p < 0.05$ ). Therefore

the null hypothesis is rejected and the hypothesis is supported. A one way Anova test was conducted comparing the Tear Breakup Time with colored and clear contacts. There was a significant difference between the colored and clear contacts ( $p < 0.05$ ). Therefore the null hypothesis is rejected and the hypothesis is supported.

## MEASURING THE EFFECTIVENESS OF CHIROPRACTIC TREATMENT ON HEADACHES CAUSED BY POST-TRAUMA VERSUS LONG-TERM NECK PAIN

Hannah Hopfensperger

The Center for Advanced Technical Studies

Since headaches plague most people and interfere with their daily lives, people spend a lot of time and effort finding an effective treatment. Finding a treatment that treats the problem at its core rather than masking the problem is essential. In this project, the improvement of headaches in patients seen by a chiropractor was tested in patients that acquired headaches through trauma to the cervical spine versus patients that acquired headaches through built-up misalignments and pain in the cervical spine over time. The treatments performed by the chiropractor include spinal manipulations and strengthening exercises to strengthen the stabilizer muscles around the spine. The disability index acquired from a Headache Disability Index survey that the chiropractor regularly uses both before each patient begins their treatment, and after every ten visits was recorded for patients in the two groups. After the chiropractic mentor found headache patients both old and new in her files, a small sample size was found that prevented definite conclusions. Due to an unexpected small sample size, a survey was conducted that found that 70% of the population turns to over the counter medicine instead of other methods of treating headaches, and 24% are not even aware that chiropractors can treat headaches. It can be concluded that the small sample size is due to unawareness that chiropractors can treat headaches and from people using other methods to treat their headaches.

## AMPLIFICATION AND TRANSFORMATION OF ATRSPK

Paul Hughes

Governor's School for Science and Mathematics

Mentor: Hong Luo, Department of Genetics & Biochemistry, Clemson University

Advisor: Jennifer Brown

Salt stress in agriculture is a common occurrence in agriculture due to farming practices, geographic location of the crop, and drought. Therefore, research into salt

stress responses of model plant species, such as *Arabidopsis thaliana*, can provide insight into how to overcome this stress. The *Arabidopsis thaliana* protein kinase, AtRSPK, has previously been hypothesized to respond salt stress, and help a plant recover from said stress. Therefore, plants that overexpress AtRSPK should also overexpress the genes related to salt tolerance and hypothetically allow the plants to react more strongly to the salt stimuli. In order to test this hypothesis, the gene was overexpressed in the roots in order to shed light on its functional characteristics. This was shown to be successful through gel electrophoresis. Next the gene was ligated to a pGEM—T-Easy Vector to create pHL249, which was confirmed through transformation into *Agrobacterium*. Afterwards, the fragment was extracted, and digested from the *Agrobacterium* and ligated into the pHL651 to generate pHL250, which was again transformed for confirmation. The results were shown to be successful by gel electrophoresis where the experimental DNA fragments were the expected length. These processes are a crucial stepping stone to finding the functional characteristics of AtRSPK, which will later be overexpressed in order to determine the role of AtRSPK in the plant's response mechanisms to salt stress. The overall research has extensive commercial and humanitarian benefits, as it allows for hardier agricultural, and aesthetic crops.

## SYNTHESIS OF NANOPARTICLES FOR THE DEVELOPMENT OF THE ELECTRODE FOR SOLID OXIDE FUEL CELLS BY USING THE GLYCINE- NITRATE COMBUSTION PROCESS

Jimmy Hurst

Governor's School for Science and Mathematics

Mentor: Xiao Dong Zhou, Department of Chemical Engineering, University of South  
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Advisor: Scott Page

The Glycine-Nitrate Process is a fast combustion method that is used to synthesis different perovskites. This process produces flames up to 1400° C. The glycine-nitrate combustion process was used to synthesize nanoparticles in the size range of 30-100 nm. The goal of this research was to optimize the parameters for the Glycine-Nitrate combustion method to obtain the most efficient nanopowder. The controlled variables in this experiment were the ratio of glycine to nitrate, temperature, and the pressure. The effect of these variables on the particle size distribution were measured and analyzed. The nitrate to glycine ratios of 1:5, 1:3, 1:2, 1:1, 1:0.75, 1:0.5, and 1:0.25 were investigated. As the fuel ratio increased (larger than 0.5), greater intensity and duration of the flame was observed. Smaller, quick flames were observed as the fuel ratio decreased below 0.5. X-Ray Diffraction,

in conjunction with the Scherrer equation ( $\tau = K\lambda/(\beta\cos\Theta)$ ) was used to calculate the particle size distribution in each sample of nanoparticles. The effectiveness of each fuel ratio was determined by the calculated particles sizes, with the goal of the experiment to have the smallest particle size. The glycine-nitrate ratio of 1:0.5 was determined to be the most efficient ratio as it produced the smallest and most consistent nanopowders.

## EFFECT OF ACONTIUM NAPELLUS, SULPHUR, AND PHOSPHORUS AS HOMEOPATHIC REMEDIES ON STREPTOCOCCUS

Alexandra Johnson  
Dutch Fork High School

This experiment is studying the effects of common homeopathic remedies, Aconitum napellus, Sulphur and Phosphorus on Streptococcus pneumoniae, a bacteria commonly associated with community-acquired pneumonia. Homeopathy is used as an alternative to damaging and costly antibiotics in order to aid the body in curing itself; however it is a common belief that effects from these remedies are a result from the placebo effect. This experiment either disprove or accepted the hypothesis that as the dose of homeopathic medicine increases, the amount of bacteria left remains unchanged. If the remedies had a positive effect on the bacteria then the Streptococcus pneumoniae will not continue to expand. The methods of this experiment include the application of these homeopathic remedies to the bacteria in varying quantities: the recommended dose, half of the recommended dose and twice the recommended dose. The number of bacteria colonies were counted using one of the following: Gram Stain, Incubator, Hemocytometer, or Spectrophotometer. If the bacteria in the petri dishes diminished or stopped increasing and the T-test stated that the results are statistically significant, then it would be safe to conclude that the used homeopathic remedies did not only treat the body, but also affect the bacteria and further aid the curing process. However if the bacteria continued to increase and the results of the T-test concluded statistical irrelevance, then it can be concluded that the homeopathic remedies used rely solely on aiding the body and/or the placebo effect.

## THE EFFECT OF L-HISTIDINE TREATED STEEL PELLETS SUBJECTED TO 18 M SULFURIC ACID

Revanth Kanumuri  
Spring Valley High School

The longevity of structures made of steel are threatened by corrosion. In response many forms of protections have been made to limit the effect of corrosion on steel. This experiment was performed to determine which concentration of corrosion inhibitor best lowers the corrosion rate and difference of mass in steel pellets. The results of this experiment could be useful in making buildings and vehicles last longer. The hypothesis was that if steel pellets were soaked in a of 9 / 100 ml L-Histidine solution, then the pellets would have the least corrosion. The experiment was performed by first measuring the mass of each pellet before experimentation. The pellets were then soaked in each concentration of L-Histidine, and placed in 18 M sulfuric acid. The mass of the pellets were taken after remaining in the acid for 24 hours. The results showed that all three concentrations performed relatively the same. The statistical analysis showed  $F(2, 87)=1.79$ ,  $p>.05$ . Therefore, this experiment showed no statistical difference between the three experimental concentrations. The results of the experiment showed that different concentrations of L-Histidine do not affect the mass of steel pellets.

## THE EFFECTS OF MONOLINGUALISM AND BILINGUALISM IN TEENAGERS ON THE ACCURACY AND SPEED OF COMPLETION OF MULTITASKING (EXECUTIVE FUNCTIONING) ON THE TRAIL TEST AND STROOP TASK

Sunaina Kapur  
Heathwood Hall

The purpose of this study was to compare monolingual teenagers and bilingual teenagers (teenagers who are fluent in two languages from their youth) with respect to multitasking. It was hypothesized that if bilingual teenagers were given a multitasking test, then their accuracy and speed of completion would be respectively greater and faster than the monolingual teenagers. 30 teenagers (15 monolinguals and 15 bilinguals) were given 2 tests, the Stroop Task and the Trail Test, which are tests that measure one's ability to multitask, an executive function. The accuracy and speed of completion for both these tests were recorded for both the monolinguals and bilinguals. Statistical analysis showed a statistically significant difference between the mean Stroop Task accuracy for the monolinguals and bilinguals ( $p=0.019$ ), between the mean Stroop Task speed of completion for the monolinguals and bilinguals ( $p=0.001$ ), between the mean Trail Test accuracy for



the monolinguals and bilinguals ( $p=0.002$ ), and between the mean Trail Test speed of completion for the monolinguals and bilinguals ( $p=0.002$ ). The bilingual participants had the greatest accuracy and the fastest speed of completion for both the Stroop Task and Trail Test when compared to the monolingual participants. This rejected the null hypothesis, accepting the alternate hypothesis, and confirmed other researchers' findings that bilinguals tend to be better at multitasking than monolinguals.

## A STUDY OF THE PROPERTIES OF DISCHARGING RECHARGEABLE BATTERIES UNDER VARIED CONDITIONS

Cormac Kelly

Governor's School for Science and Mathematics

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Winthrop University  
Advisor: Clyde J. Smith

The following rechargeable batteries were studied: nickel-cadmium, nickel-metal-hydride, and lithium-ion chemistries. The circumstances of each discharge, including resistance and temperature, were varied to determine their effects on the batteries' discharge characteristics. Current through the circuit and voltage across the batteries' terminals were measured at regular intervals during the discharge. These data were compared graphically with data from other discharges to identify any changes with varied circumstances. The lithium-ion batteries were observed to retain the voltage across their terminals slightly longer in higher temperatures.

## CHARACTERIZATION OF THE TOXIN-ANTITOXIN SYSTEM GNSA-YMCE

Reilly Kilpatrick

Governor's School for Science and Mathematics

Mentor: Yong-Mei Zhang, Department of Biochemistry & Molecular Biology,  
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Advisor: Jennifer Taylor

Toxin-antitoxin (TA) systems are ubiquitous systems of regulation in free-living bacteria. They target several fundamental processes in bacteria such as DNA replication machinery and cytoskeletal proteins, often leading to growth inhibition or death. Fatty acid biosynthesis is a vital process to cell survival. It appears to be regulated by a TA system. FabA and FabZ are two enzymes responsible for producing unsaturated and saturated fatty acids respectively. Previous work done

by our collaborators suggests that FabZ is targeted by the toxin GnsA in a TA system. They propose that GnsA is the toxin and YmcE is the antitoxin. The toxin and the antitoxin bind together and exist in equal amounts. If an outside stress acts on the cell, the balance is disturbed, leaving the toxin free to bind to the target instead. We hypothesize that GnsA-YmcE is a TA system that regulates *E. coli* lipid metabolism by targeting FabZ. The goal of this experiment is to determine if FabZ can overcome the action of GnsA. To closely examine the effects on membrane composition of GnsA-YmcE, we used combination vectors. This allowed us to insert *gnsA*, *ymcE*, and *fabZ* in various combinations into the same plasmid and observe the result of their interactions. We constructed several vectors containing our genes of interest (*gnsA*, *ymcE*, *fabZ*, *gnsA+ymcE*, and *gnsA+fabZ*) using PCR, digestion, and ligation and transformed them into *E. coli* cells. Lipids were extracted and analyzed using a gas chromatograph to determine how each combination vector altered the membrane composition of the cell. The effect was measured by the ratio of unsaturated to saturated fatty acids. Overexpression of GnsA and FabZ affected the membrane composition as expected—when GnsA was in excess, more unsaturated fatty acids were produced, and when FabZ was in excess, more saturated fatty acids were produced. More trials will need to be done to obtain a better understanding of this toxin-antitoxin system. This could potentially enable us to alter the membranes of harmful bacteria and therefore induce death of those cells.

## USING FLUORESCENCE CORRELATION SPECTROSCOPY (FCS) TO DETERMINE DIFFUSION COEFFICIENTS OF SSDNA AND DSDNA

Max Kirkpatrick

Governor's School for Science and Mathematics

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Advisor: Mark A. Godwin

Fluorescence Correlation Spectroscopy (FCS) is used to determine physical and chemical properties of a substance on a single molecule level. This is accomplished by exciting a fluorescent dye with a laser and observing the light emitted by the dye. The intensity of this light is recorded over time, and patterns are observed and analyzed to characterize the movements of the dye on a single molecule level. In this experiment, FCS was used to observe the movements of T23 DNA and a T23-A23 DNA duplex. The fluorescent dye Rhodamine 6G (R6G) was used to calibrate the focal volume of the experimental setup. The DNA samples were tagged with the fluorescent dyes Cyanine-3 (Cy3) and 5-TAMRA. These samples were observed

using FCS, and values for diffusion coefficients of the DNA samples in water were calculated. The values calculated for the diffusion coefficients of Cy3-T23 and TAMRA-T23 were  $1.42 \times 10^{-10} \text{ m}^2/\text{s}$  and  $1.28 \times 10^{-10} \text{ m}^2/\text{s}$  respectively. The values for the diffusion coefficients were then tested for validity by comparing ratios of the diffusion coefficients to ratios of the molecular weights of the complexes. For the Cy3-A23-T23 sample, a diffusion coefficient of  $1.12 \times 10^{-10} \text{ m}^2/\text{s}$  was calculated. In all cases except for the 5-TAMRA-T23-A23, an acceptable value for the diffusion coefficient of the complex was found.

## EFFECT OF THE TUNING OF THE PITCH WITH REGARDS TO THE HUMAN EAR

Kristen Klein  
Dutch Fork High School

When a performer is entertaining an audience with their talent one of the key elements is pitch and the tuning of the pitch; if they are not in tune the performance will not be as entertaining for the audience. Each pitch is a specific hertz for example one octave of A is in tune at 440 Hz. If a pitch is high it is sharp (445 Hz), if a pitch is low it is flat (435 Hz). The purpose of this project is to determine whether the human ear can hear sharp or flat better and at what point a person is able to tell that the note is out of tune. The research will be conducted through testing subjects. The tester will play pitches using an oscillator app on the iPad, this app can be found at the Apple Store. A reference pitch will be played first then the note that is out of tune will be played; the subject will then be asked to identify the second pitch as sharp, flat, or in tune. The tester will repeat this for each of the 39 specified notes in the study. This study could give a range for a performer where the audience hears that the performer is in tune when they actually are not and will study the correlation between when the human ear can hear a sharp note versus a flat note. In the data collected thus far about 2 hertz away both sharp and flat is point where the ear can tell. Subjects were able to distinguish flat better than sharp thus far. The subjects were able to correctly distinguish if the pitch was sharp, flat, or in tune for the lowest note F better than the higher note of B. More data will be collected and the anticipated results will be very similar to the results that have already been collected. The use of this data will give performers a range that they can be out of tune before the entire performance is distorted and the experience is not as it should be.

## LAND USE AND MANAGEMENTS EFFECT ON SOIL AND WATER QUALITY ON WATERSHEDS IN IRMO, SC

Jennifer Klett  
Dutch Fork High School

This research explores the effect of land use and the way it is managed on soil and water characteristics that determine quality. This study will be done on several land plots in Irmo, South Carolina studying the designated watershed's quality. The four watersheds are Mussel Creek, Ballentine, Rawles Creek, and Hollingshed Creek. The study will be determining whether if the more developed the land is affects how worse off the water and soil quality will be based on the following characteristics: Nitrogen, pH balance, dissolved oxygen, temperature, Phosphorus, and soil retention. Data of these characteristics are then compared based on the land use of the plot. This is an important experiment because it pertains to environmental impact, a growing issue in today's society. When parts of the environment are damaged or polluted such as soil and water, it is very difficult to reverse the effect. After data collection of one point in each of the water sheds, dissolved oxygen were found to be higher in rural watersheds like Mussel Creek and lower in more developed areas such as Rawles Creek. The watersheds with lower dissolved oxygen started undergoing eutrophication and the nitrogen and phosphorus levels rose causing bacteria to grow. The pH levels were also more acidic in higher developed watersheds. Soil retention was measured because it is an indicator as to how much biodiversity can occur on land. Higher developed areas had lower soil retention. Data is continuing to be gathered and analyzed.

## EFFECT OF INTERIOR PAINT TYPE ON VOLATILE ORGANIC COMPOUND EMISSIONS

Krista Knowles  
Dutch Fork High School

Paint releases volatile organic compounds into the environment which contribute to the general pollution of the atmosphere. This has caused many "low emission" interior paints to appear on the market and in most local hardware stores. The emissions from interior paints have been linked to health problems for people who are exposed to high concentrations of them. The EPA has set guidelines meant to limit the amount of allowable volatile organic compound emissions. Paints with distinctively different solvents, either alkyd or latex based, that are low emission were measured for their emissions of hexane and these results will be compared to the allowed value.

Samples of drywall were painted and placed in sealed containers and then the air within those containers were tested. Paint that is alkyd based generally has a higher emission of VOCs. This information was used to compare environmentally products and whether they were equally successful. Consumers will be able to use this information to make informed decisions that have the potential to impact their health and well-being.

## RELATION OF TURBINE SPEED TO DIFFERENT VARIABLES

Yanni Koutsioukis

Greenville Technical Charter High School

This experiment was conducted to see what variables affect the rotation speed of a turbine. Water placement, angle, and distance from the propeller were tested. To do this a model turbine was constructed and a water hose caused the rotation. It was found that greater surface contact on a blade for the water caused greater rotation. The exact results were a 0° angle on the bottom right of the blade with the water entry as close as possible yielded the greatest speed. These results will be submitted to a hydropower company for them to possibly use while constructing new dams.

## EFFECTS OF AZADIRACTIN ON THE BEHAVIOR AND MORTALITY OF THE SWEET POTATO WHITEFLY, BIOTYPE B

Dana Krzyzaniak

Academic Magnet High School

A study was conducted to determine the effects of foliar sprays of 1.25% Azadiractin on colonization and development by the B-biotype sweetpotato whitefly (*Bemisia tabaci*) on collards. Caged choice, caged no-choice, and y-tube olfactometer assays were conducted on oviposition, survival and adult behavior in response to azadiractin. Data was analyzed using a t-test ( $p = 0.05$ ). In the caged choice study, whiteflies most often chose to colonize and lay eggs on control plants. Decreased numbers of whiteflies were able to continue development in the treatment groups of the caged no choice studies, as compared to the control. Y-tube olfactometer tests indicated that azadiractin has a repellency effect on whiteflies. The findings may be useful in providing a more ecologically sound way to manage populations of the sweetpotato whitefly.

## THE EFFECTS OF ZEOLITE PARTICLE SIZE ON THE REMOVAL OF BACTERIA FROM LAKE WATER USING A ZEOLITE BIOSAND FILTER

Ronit Kulkarni  
Spring Valley High School

Around the world, especially in less developed countries, drinking water is being contaminated by man-made water pollutants. One of the major causes of polluted water may be continuous exposure of water to arsenic and fluoride, or unhygienic sources of drinking water. Even in more developed countries, such as the United States, 15%-30% of gastroenteritis is attributed to unhygienic municipal drinking water. The purpose of this research was to test the efficiency of the zeolite biosand filter with 0.15mm and 3mm zeolite particle width. It was hypothesized that the 0.15mm zeolite biosand filter would remove more bacteria from a contaminated water sample than the 3mm zeolite biosand filter. After filtering the water samples through each of the filters, the final bacteria concentrations for each filter were expressed and it was shown that the overall bacteria concentrations showed a significant difference;  $F(3, 36) = 13.96$ ,  $p < 0.05$ . Tukey tests determined that significant differences were at control 0.15mm versus 0.15mm, control 3mm versus 0.15mm, and mainly 0.15mm versus 3mm. In conclusion, it was shown that the 3mm zeolite biosand filter processed more bacteria than the 0.15mm zeolite biosand filter.

## THE EFFECT OF DIFFERENT CONCENTRATIONS OF MERCURY (II) CHLORIDE, LEAD (II) CHLORIDE, AND CADMIUM CHLORIDE ON THE PRESENCE OF TNF $\alpha$ AND IFN $\gamma$ IN HUMAN PBMC SAMPLES

Nabihah Kumte  
Spring Valley High School

Heavy metal poisoning can lead to several autoimmune diseases by altering cytokine pathways in the human immune system and creating a weaker defense system. The purpose of this experiment was to determine whether there is a presence of cytokines, specifically TNF $\alpha$  and IFN $\gamma$ , in blood cells and heavy metal samples. It was hypothesized that when human PBMCs stimulated under LPS or PMA/Ionomycin are exposed to concentrations of lead (II) chloride, cadmium chloride, and mercury (II) chloride, the presence of both TNF $\alpha$  and IFN $\gamma$  would be greater in samples with the highest heavy metal concentration under either stimulation and there will be a statistical significance between samples. The method included culturing cells with 0 nM (control), 100 nM, 300 nM, and 500 nM concentrations of lead (II) chloride, cadmium chloride, or mercury (II) chloride. The

cells were stimulated using LPS or PMA/Ionomycin, and then an ELISA test was run to find the presence of the cytokines in each sample. Separate two-way ANOVAs were run for the IFN $\gamma$  and the TNF $\alpha$  samples which reported statistical evidence that supported the hypothesis at  $F(11, 48) = 44.66$ ,  $p < 0.001$  and at  $F(11, 48) = 5.66$ ,  $p < 0.001$ , respectively, rejecting the null hypothesis. Post-hoc Tukey Tests found statistical significance between all samples except for the presence of TNF $\alpha$  in the 0 nM concentration of cadmium chloride under the LPS stimulation. However, visual representation of the sample means on an Interaction Plot did not support the hypothesis which stated the presence of cytokines would be greater in the highest heavy metal concentrations. The experiment concluded that the presence of both cytokines is greatest in the lead (II) chloride samples under both simulations and that there is not any specific trend between the concentrations.

## EFFECTS OF HOMOCYSTEINE, AN ALZHEIMER'S DISEASE RISK FACTOR, ON B-AMYLOID METABOLISM

Trent Large

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South Carolina

Advisor: Rebecca Heiss

The accumulation of the  $\beta$ -amyloid (A $\beta$ ) protein in the brain as senile plaques is a signature trademark of Alzheimer's disease (AD). The mechanism of A $\beta$  accumulation and deposition is a subject of intense study and has been considered as the basis for most drug development efforts in the field. However, we still have a poor understanding of the degradation pathways that are responsible for maintaining A $\beta$  homeostasis in healthy people. In this study, extracts of a popular neuronal cell line (SH-SY5Y) have been used to characterize the A $\beta$  degrading pathways in vitro. This study focuses primarily on the effects of homocysteine (HCY), an amino acid known to increase vascular dementia susceptibility, on the degradation of A $\beta$ . The studies revealed that HCY vastly conserves A $\beta$ , causing a substantial buildup of the molecule. Further testing shows that HCY prevents degradation by inhibiting two pools of proteases, thiol and aspartyl proteases at low pH, as well as metallo and serin proteases at neutral pH. After specific testing, this lab determined that HCY primarily prevents A $\beta$  degradation through inhibition of matrix-metalloprotease proteases. These results yield significant insight into the pathology of AD. By understanding the proteases responsible for A $\beta$  degradation,

significant progress could be made towards producing a synthetic pharmacological agent capable of destroying the A $\beta$  plaques.

## THE EFFECT OF INDIGO, AZO DYES, AND BLONDE HAIR DYE ON FUTURE GENERATIONS OF DROSOPHILA

Almeera Lateef  
Spring Valley High School

Carcinogenic chemicals are put into everyday products that are used by many people. These products could be affecting the health of humans. Some of these products are fabric and hair dyes. The purpose of this study was to see if fabric and hair dyes cause any mutations or changes in sex ratio in *Drosophila*, with these chemicals prevalent in the dyes. It was hypothesized that the dyes would instigate mutations or changes in sex ratios in future generations of *Drosophila*. Indigo, azo dye, and blonde hair dye were placed in separate bottles. Each treatment had two culture bottles and the control had two culture bottles. Two nanoliters of a dye were placed in their respective culture bottles. The flies were scored for two to four times over a one and a half week period, depending on how much growth occurred in the culture bottles. The bottles were watered whenever the culture medium seemed dry. The same steps were repeated for F2. A Chi-square analysis showed that the data in F1 was significantly different: Chi-square=(3,n=8)=47.79 p=2.34908e-10. Similar results were shown for F2: Chi-square=(3,n=8)=69.89 p=4.505e-15. This supports that these dyes are having some type of effect on the flies when exposed to the dyes in their culture bottles. The sex ratios of the *Drosophila* in all the treatments changed a significant amount, some to the point where one sex was two times more prevalent than the other sex.

## THE EFFECT OF UNSATURATED, OMEGA FAMILY FATTY ACIDS ON THE ZONE OF INHIBITION OF ESCHERICHIA COLI IN SPINACIA OLERACEA CULTURES

Azalfa Lateef  
Spring Valley High School

Food pathogens, such as *Escherichia coli* and *Salmonella*, are present on the surfaces of processed foods, causing pathogenic outbreaks throughout the world. Omega fatty acids are proposed to potentially minimize or possibly annihilate pathogens found on the surfaces of processed foods. It was hypothesized, that the higher the concentration of Omega-3, the larger the zone of inhibition. Two



concentrations of Omega-3 were made, the first one was 50% and the second one was a 25% concentration. An inoculating loop was dipped into E.coli K12 and then onto spinach, which was then streaked on the agar. Zone of inhibition disks were soaked into the concentrations and then placed on the top of the agar plates, which were then incubated at 37 ° C for 24 hours. The zones of inhibition were then measured in cm. ANOVA and Tukey tests were conducted, which showed the three yield rates were significantly different,  $F(2,123)=178.91$ ,  $p<0.001$ . The hypothesis was supported because the p-value was lower than the alpha value, .05. Concentration 1 (  $M=5.696$ ,  $SD=1.430$ ) produced a larger zone of inhibitions than Concentration 2 ( $M=4.140$   $SD=.841$ ). Both of them had an effect on the zone of inhibitions when compared to the Control ( $M=2.000$ ,  $SD=0.000$ ). In conclusion, the experiment indicated, that the Omega-3 fatty acid, did prevent the E.coli from growing when the Omega-3 fatty acid concentration was higher.

## DESIGNING A LONG RANGE TASER TO REPLACE RUBBER BULLETS

Edward Leber

Academic Magnet High School

In this thesis, the researcher sought to design a long range taser to replace rubber bullets in military usage and riot control. The rubber bullet has long been used to incapacitate targets, but has major negative implications on the victims shot with it. This report contains five chapters, including an introduction, review of past literature on both rubber bullets and stun guns, in depth explanation of the researcher's methods, a presentation of findings, and a concluding discussion chapter.

## THE EFFECT OF 17 $\beta$ -ESTRADIOL ON THE FECUNDITY AND SEX RATIO OF DROSOPHILA MELANOGASTER

Crystal Lee

Spring Valley High School

The most potent naturally occurring estrogen, 17 $\beta$ -estradiol has been found in insecticides, drugs, natural compounds, and industrial sewage worldwide. Estradiol is a sex hormone that is necessary for reproductive organ growth. However, high levels of estradiol have been shown to be correlated with conditions such as breast cancer, gynecomastia, and the premature close of the epiphyses. The purpose of this study was to observe how exposure to estradiol affected *Drosophila melanogaster* sex ratios and fecundity. It was hypothesized that as the amounts of estradiol

exposure increased, the number of offspring and number of male flies would increase as well. The experiment was accomplished by raising *Drosophila melanogaster* in fly medium mixed with 20 mL of 1.0 mg/L, 10.0 mg/L, 25.0 mg/L, and 50.0 mg/L of estradiol concentrated solutions. Data were statistically analyzed using Chi-square contingency tables at  $\alpha=0.05$ , revealing that estradiol did not significantly affect sex ratio for the first generation;  $\chi^2$  (4, N=10) = 4.4516,  $p=0.3483$ . However, estradiol did significantly affect the sex ratio of the second generation;  $\chi^2$  (4, N=10) = 12.104,  $p=0.0166$ . In the second generation, the population of flies also increased. Therefore, the estradiol did affect the sex ratios and fecundity of *Drosophila melanogaster*.

## DEVELOPMENT OF NOVEL FLUORSECENT SENSORS FOR HYDROGEN SULFIDE

Francis Lee (Jeong Mok Lee)  
Dutch Fork High School

At physiological levels, H<sub>2</sub>S is engaged in diseases, such as arterial and pulmonary hypertension, Alzheimer's disease, gastric mucosal injury, and liver cirrhosis. Therefore, it is very meaningful to create novel fluorescent sensor for detection and imaging of intracellular hydrogen sulfide (H<sub>2</sub>S). If the organic dye is synthesized according to intermolecular charge transfer (ICT) properties, the color dye would successfully detect the hydrogen sulfide in human body.

Synthesis of a Noble Fluorophore, DCP

DCP, a noble fluorophore for sensing H<sub>2</sub>S, was obtained from the two step reactions. Commercially available starting compound, acenaphthalenequinone (AQ), was reacted with malonitrile in acetonitrile by Knoevenagel condensation to give acenaphthylenylidene malononitrile (ACN), which is successively transformed to DCP by the base-catalyzed nucleophilic ring expansion reaction. DCP is suitably designed to have structural requisition, i.e. pi-conjugation system (benzene), working as a structure where electron can be transferred and electron-withdrawing CN group.

The two step reaction from acenaphthalenequinone (AQ) with high yield gives a noble fluorophore, 3-oxo-3H-phenalene-1,2-dicarbonitrile (DCP), which shows suitable spectroscopic properties, longer wavelength emission spectra in the range of visible range and fluorescent.

DCP is a potentially used in the detection of biomolecules such as amino acids with amine and thiol functionality in the living body. In further study, DCP will be tested in bio-sensing and bio-imaging for dihydrogen shlfide (H<sub>2</sub>S).

# THE EFFECTS OF POLYURETHANE, PORON® PERFORMANCE URETHANE, AND FORCEBLOC® POLYETHYLENE ON THE REDUCTION OF FORCE FROM HEAD-TO-HEAD AND HEAD-TO-GROUND CONTACT IN SOCCER PLAYERS

Andrew Levitt

Spring Valley High School

The purpose of this experiment was to test the efficacy of polyurethane, PORON® performance urethane, and ForceBloc® polyethylene foams at reducing impact from head-to-head impact trauma in order to potentially utilize subject materials in a viable protective headgear for soccer players. It was hypothesized that the polyethylene foam would perform the best at reducing impact as it is already being manufactured by the market's leading soccer protective headgear brand, Full90™. A boxing dummy was fitted with a foam sample around its head and tilted to the minimum angle required to fall and strike a Vernier Force Plate with what would symbolize its frontal bone. The maximum force value and impulse of the each trial's force function were statistically analyzed with two ANOVA tests at  $\alpha=0.05$  to determine if there were any statistically significant differences between the performances of the select materials in each aspect. There was sufficient statistical evidence to reject the null hypotheses that there were no differences between each of the four test groups for the maximum force values  $F(3,116)=87.85$   $p<0.001$  as well as the impulse values  $F(3,116)=15.72$   $p<0.001$ . Post-hoc Tukey Tests were conducted to see which of the differences between each of the test groups were statistically significant from each other. The maximum force Tukey Test concluded that the differences between all of the four treatments were statistically significant ( $p<0.05$ ) except for the polyurethane foam and the ForceBloc® polyethylene foam ( $p>0.05$ ). The results from the impulse Tukey Test indicated the differences between the PORON® performance urethane foam and the other three treatments as being statistically significant ( $p<0.05$ ). Therefore, from this statistical evidence, it can be concluded that the PORON® performance urethane would not be a viable alternative to the polyethylene already being utilized in today's headgears and that polyurethane would be a homologous alternative to the polyethylene.

THE EFFECT OF MIRACLE-GRO ALL PURPOSE PLANT FOOD WITH EISENIA FOETIDA, MIRACLE-GRO ORGANIC CHOICE BLOOD MEAL FERTILIZER WITH EISENIA FOETIDA, AND EISENIA FOETIDA ON THE PLANT HEIGHT, NUMBER OF FLOWERS, AND CO<sub>2</sub> EMISSIONS OF BRASSICA RAPA

Priscilla Li

Spring Valley High School

The rapid rise of carbon dioxide and other greenhouse gases (GHG) in the Earth's atmosphere has caused an imbalance in many natural ecosystems. A meta-analysis suggests that earthworms are contributing to the rise in greenhouse-gas emissions due to increased rates of nitrogen and carbon cycling. This study emphasized the importance of studying belowground interactions. An important industry that greatly contributes to GHG levels is agriculture, which relies heavily on the use of fertilizers. The purpose of this research was to address the ongoing rise of GHGs, particularly CO<sub>2</sub>, in the agriculture industry. Three different soil amendments were tested (Miracle-Gro All Purpose Plant Food with *Eisenia foetida*, Miracle-Gro Organic Choice Blood meal fertilizer with *E. foetida*, and *E. foetida*) to determine which would reduce CO<sub>2</sub> emissions and be agriculturally productive. 25 trials were performed for each soil amendment using *Brassica rapa* (Wisconsin Fast Plants). The plant height and number of flowers of the *B. rapa* were statistically analyzed with an ANOVA, and CO<sub>2</sub> emissions were analyzed with a general linear model. The number of flowers ( $F(3,90)=2.4$ ,  $p=0.073$ ) and the CO<sub>2</sub> emissions ( $F(3,93)=1.62$ ,  $p=0.189$ ) were not significantly different between the control and experimental groups. There was a significant difference in the plant heights,  $F(3,91)=7.52$ ,  $p<0.05$ . However, the post-hoc Scheffé test did not detect any differences; descriptive statistics showed differences between the control and independent variables. The results suggest that the three amendments tested are inappropriate for field use.

THE EFFECT OF SWIMMING DISTANCE ON RESPIRATORY FATIGUE

Carl Lobitz

Spring Valley High School

This study was conducted in order to determine the difference in respiratory fatigue associated with varying distances of the freestyle stroke. Its ultimate goal was to test whether a sprinting, short, distanced event or a paced, long, distanced caused more respiratory fatigue proportional to the distance swam. It was hypothesized that the 200 yard (182.88 meters) distance of freestyle would cause the most respiratory fatigue proportional to the distance swam and that as the distances of

the event decreased so would the respiratory fatigue. In this experiment, 11 experienced swimmers had their at-rest vital lung capacity measured at-rest and after swimming 50, 100, 150, and 200 yards using spirometers. The post-swim measurements taken via Vernier spirometer were compared to the at-rest vital capacity to determine the total fatigue experienced. These were then set proportional to the distance swam. The data were analyzed using an ANOVA test, and then further analyzed by a Tukey test. It was concluded that the 200 yard swim caused the most respiratory fatigue overall, but the least per yard. This conclusion supports the notion that as one participates in greater amounts of physical activity, one would experience more respiratory fatigue, but sprinting and engaging in a more rigorous activity for short times causes more respiratory fatigue in comparison to the distance swim.

## SPECIFIC INTERACTIONS BETWEEN 10-FORMYLTETRAHYDROFOLATE DEHYDROGENASE AND APOPTOTIC PROTEINS JNK 1/ JNK 2 IN FOLATE METABOLISM IN VITRO

Christopher Loe

Governor's School for Science and Mathematics

Mentor: Sergey Krupenko, Department of Biochemistry & Molecular Biology,  
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Advisor: Bhuvana Parameswaran

Science has extensively publicized the significance of appropriate dietary folate intake in the past several decades. Grain product fortification with folic acid was initially intended to reduce the rate of neural tube defects in the embryos of pregnant women. However, despite its success, the influence of folate fortification on diet, other than the intended target, is unknown. Therefore, it is important to understand the possible and potential side effects that folic acid supplementation can have on the remaining populations that consume fortified products. Recent research has shown that the once thought to be harmless vitamin, folic acid, does indeed cause certain potentially harmful side effects. The most prominent negative side effect of folate consumption is the possibility of increasing the potency of tumors as well as influencing metastasis. Curiously, a folate binding protein called 10-Formyltetrahydrofolate Dehydrogenase, FDH, has shown to reverse metastasis and cause cell death. In order to understand the role of folate in humans and the molecular pathways that FDH might take to bring about apoptosis in cancer cells, an investigation into the interactions of FDH and apoptotic proteins JNK 1/JNK 2. This was achieved by crosslinking FDH antibodies to sepharose beads followed by co-immunoprecipitation with JNK in order to potentially pull down the binding

proteins. The preliminary Western Blot analyses indicate that there is an interaction between FDH and JNK 2. Whether this indicates a role in apoptosis still needs to be determined.

## THE EFFECT OF MONOLAYERS FORMED BY HEXADECANOL AND OCTADECANOL ON THE RATE OF EVAPORATION OF WATER

David Long  
Spring Valley High School

As water becomes a scarcer resource, ways to conserve it are becoming more and more important. One way to conserve our most precious resource is to reduce the amount of water which is allowed to evaporate while it is being stored. The purpose of this research was to determine if monolayers formed by hexadecanol or octadecanol could be applied in a meaningful way to water storage systems. If a strong retardation of evaporation could be detected, then the monolayer could be used on water storage systems in order to reduce water loss, especially in arid climates where evaporation causes a staggering loss of water from open water storages. It was hypothesized that the octadecanol by itself would reduce evaporation most significantly, but hexadecanol would also slow evaporation of the water as compared to the control group. The methods for this research included three test groups. Each group contained 15 jars which were all prepared using the same method. The first group had no monolayer added to 100 mL of water in a 16 OZ glass jar, the second had 0.5 grams of hexadecanol added to the 100 mL of water, and the final group had 0.5 grams of octadecanol to the 100 mL of water. A packet of 6.0 grams of  $\text{CaCl}_2$  was then taped to the inside of the jars' lids. The jars were then sealed and left at room temperature for twelve days. Then each packet of calcium chloride was removed from the jars, and their masses were recorded. After collecting the data, a minuscule variation in the mean of the change of mass of the  $\text{CaCl}_2$  was detected. After performing a one-way ANOVA on the change of the mass of the  $\text{CaCl}_2$  at  $\alpha = 0.05$ , the results showed that there were not any statistically significant differences between any of the means. The insignificant differences meant that each of the three types of monolayers allowed only negligible differences in the average evaporation of water during the 12 days of the study.

## SESAME: A NEW BIOINFORMATICS SEMANTIC WORKFLOW DESIGN SYSTEM

Jonathan Lowe

Governor's School for Science and Mathematics

Mentor: Feng Luo, School of Computing, Clemson University

Advisor: David Nickles

Today, biologists have become increasingly dependent on bioinformatics tools to interpret their data. The number, variety and complexity of these bioinformatics tools have increased dramatically and the tools have become more and more computationally complex, expensive and resource intensive. An increasing trend is to model the complex bioinformatics tasks as workflows. A number of systems already exist, but many of them require advanced computer knowledge before they can be used efficiently. In order to simplify the learning curve for new users, we have developed a new Bioinformatics Semantic Workflow Design System (BSWDS) to facilitate the execution of complex bioinformatics tasks. Using our BSWDS biologists will create a semantic workflow that mirrors the biological concepts and their relationships instead of mirroring the computer processes. A new graphical user interface (GUI) was also developed to provide the users the flexibility to compose, execute, and check the workflow. The GUI lacked undo and redo functionalities, which are a vital part of providing a usable environment. These functionalities were added using the Eclipse IDE with the Google Web Toolkit (GWT) plugin, as well as the Smart GWT library. Providing undo and redo functions will help create a more streamlined and user-friendly GUI by allowing users to undo and redo actions instead of starting their workflow from scratch each time they make a mistake. Overall this will help provide a simpler computer environment for biologists to use in their research.

## HOW DO BIODIESEL BLENDS EFFECT FUEL EFFICIENCY AND ENGINE LUBRICITY?

Manning Lumpkin

The Center for Advanced Technical Studies

The research involved in this project demonstrates the lubricity of the engine and fuel efficiency when comparing different biodiesel blends in a commercially available diesel engine. The project tests the consumption of biodiesel at various RPM measures using a load-free experimental method. Results obtained through this experimentation will allow consumers and commercial gas companies to better understand the benefits and problems involved with running straight petroleum

diesel fuel compared to biodiesel blends. Extension studies are planned to analyze the environmental impacts, longevity of the engine, as well as the economic factors involved for consumers. The project began with the titration of waste and virgin vegetable oil in order to measure initial free fatty acid level concentration. Next, sodium hydroxide and methanol were mixed with the oil so that the mixture undergoes trans-esterification and produces biodiesel and glycerol. After separation of the biodiesel and glycerol with several washes, the biodiesel was successfully synthesized. The fuel then undergoes acid number tests, clarity tests, and yeast/mold tests before running in the commercial engine. The fuel is then blended with diesel to produce the various blends for testing. The fuel is then run through a Hatz Diesel engine on a mounted tabletop at 1 RPMs, 2.5 RPMs and 3 RPMs for 30 minute runs. The engine block was measured for exothermic temperature readings in order to understand the lubricity of each fuel blend while fuel filters, valves and exhaust were all examined for buildup. The fuel is drained and quantified for fuel consumption analysis.

## ECOLOGY AND SYSTEMATICS OF MARINE MEIOFAUNA: USING PCR TO IDENTIFY FOOD COMSUMPTION

Hanna Maghsoud

Governor's School for Science and Mathematics

Mentor: Julian Smith III, Department of Biology, Winthrop University

Advisor: Rebecca Heiss

This study tested a PCR technique to determine what sea creature it was that flatworms were consuming. In order to identify the food that meiofaunal flatworms are eating, primers were created from the predator's DNA sequences. The identification of these prey items increases information known on the meiofaunal food chain. PCR application can be used in future studies to further analyze this food chain. This study confirms a PCR technique to identify meiofaunal flatworm's diets by amplifying prey sequences where there is an abundance of predator DNA present.



## THE EFFECT OF FOOT STRIKE PATTERNS ON THE AMOUNT OF PRESSURE EXERTED ON THE LOWER LEG

Lanesa Mahon  
Spring Valley High School

Shin splints account for 20% of running injuries making them one of the most common running related problems. Many treatments and prevention methods have been tested, but no cures have been found for shin splints. Foot strike patterns are the way a runner's foot hits the ground while running. There are 3 types forefoot strike mid-foot strike, and heel strike. While not having been considered by many, it has the potential to significantly reduce the amount of running related injuries. For this experiment, girls from the Spring Valley cross cross country team were asked to jog down 40 meters of a 100 meter straightaway and over a force plate, so that the pressure readings could be taken. The largest force reading was taken from each trial to perform a statistical analysis. It was concluded that there was no significant difference in the force exertions between the foot strike pattern groups,  $F(2,18)=1.49$   $p=.251$ . From these results, it can be concluded that using a specific foot strike pattern does not reduce the amount of pressure placed on the lower leg. This disproves previous theories that state that a forefoot strike pattern is more beneficial for preventing shin splints than other foot strike patterns.

## BRANDING BLUFFTON: A CASE STUDY

Joe Marazzo  
Governor's School for Science and Mathematics  
Mentor: Simon Hudson, College of Hospitality, Retail & Sport Management,  
University of South Carolina  
Advisors: Robert Fletcher and Jeff Wisdom

Branding is the business strategy of creating an image or slogan to differentiate a product, idea, or even a destination (Aaker, 1991). One notable example of branding a destination is the marketing campaign "What happens in Vegas, stays in Vegas." The goal of this research is to develop a destination brand for Bluffton, a small, fast growing town in South Carolina. The purpose of the brand is to attract new businesses, residents and tourists, and differentiate Bluffton from its larger neighbor, Hilton Head Island. The first step in brand development is a qualitative investigation into the core values of Bluffton. This is accomplished by interviewing 30 decision-makers, who have a vested interest in how the town is branded, such as town council members, local business owners, and long term residents. The goals of the interviews are to determine the interviewee's vision of Bluffton's future, as well

as strategies Bluffton can implement to attract new businesses and residents. Next, charrettes, a group planning activity, are conducted for Bluffton-area volunteers. During the charrettes, focus groups answer questions about the perceived personality of Bluffton, how they envision the future of Bluffton, and comment on the strengths of Bluffton through appreciative inquiry. The interviews were transcribed, and the charrette-generated responses were analyzed to identify keywords and recurrent themes. The characteristics that distinguished Bluffton and should be included in the destination brand are: The charm and uniqueness of Bluffton's 'Old Town,' the natural environment surrounding Bluffton, Bluffton's accessibility to major tourist locations, and the connectedness between the allure of its past, with the economic opportunities of its future. Based on the results of the first step, an advertising firm will synthesize the results into a brand. Residents will be shown the proposed brand, and a final survey will be sent to existing residents, visitors, businesses in Bluffton, as well as potential residents, visitors, and businesses to determine if the branding achieved its goal: differentiating Bluffton, and making it more attractive and desirable destination.

## BIOCHEMICAL CHARACTERIZATION OF ALPHA-SYNUCLEIN CONTAINING PROTEIN AGGREGATES IN A YEAST MODEL FOR PARKINSON'S DISEASE

Madison Massengale-Roberts

Governor's School for Science and Mathematics

Mentor: Renee Chosed, Department of Biology, Furman University

Advisor: Jenny Salazar

Parkinson's disease is a neurodegenerative disease caused by an over expression of the protein alpha-synuclein. This over expression causes protein clumps called aggregates to be formed in the neurons of the brain. This causes loss of motor control, coordination and tremors. These aggregates were thought to be the sole cause of Parkinson's disease until patients were discovered without having the aggregates in the neurons of their brains. Recent research has indicated the existence of smaller, soluble protein clumps named toxic oligomers. These toxic oligomers would be too small to be seen under the microscope, but would give a new possibility as to what causes Parkinson's disease to develop. This research sought to distinguish between the aggregates and toxic oligomers. This was done by cloning the alpha-synuclein gene into yeast plasmids, using procedures similar to those done by the Linquist Lab at MIT. After the gene was cloned into the cells, the yeast were allowed to grow, and samples were taken. Finally, alpha-synuclein was extracted from the yeast in order to analyze the yeast cells further. The samples were analyzed using Western Blot techniques as well as Colloidal Blue staining.

# THE RELATIVE EFFECTIVENESS OF GERANIUM, CITRONELLA, LEMON GRASS, AND LEMON EUCALYPTUS OILS AT REPELLING MOSQUITOES

James Mayson

Heathwood Hall Episcopal School

The purpose of this experiment was to determine which essential oil out of lemon grass, lemon eucalyptus, geranium, and citronella was the most effective at repelling mosquitoes. These four oils were chosen as these oils appeared frequently in my research. It was hypothesized that if the oils were swabbed onto the inner cone of a trap, the oils would have varied effectiveness at repelling. The null hypothesis stated that if the essential oils were added, there would be no difference of mosquitoes attracted. Hatching chambers were constructed of 2 L bottles. The mosquitoes hatched from dehydrated. The mosquitoes matured and traps were constructed from 500 mL bottles and the baited. Each essential oil was applied to the entrance of one trap, with a trap left over for control, which were labeled and put in a large aquarium with the hatching chambers. The aquarium was covered with a screen. The mosquitoes entered the traps and were counted. The results were that few mosquitoes entered traps. Two mosquitoes in the control, one mosquito in lemon grass, lemon eucalyptus, and citronella oils, and zero mosquitoes in the geranium oil trap. The results were analyzed using an ANOVA single variable test and there was no significant difference between the oils, likely because of the small amount of mosquitoes that actually entered the traps. The data failed to support my hypothesis of the oils varying in effectiveness and failed to reject my null hypothesis of no difference between the amount of mosquitoes in each trap.

## SCREENING OF GENES THAT MIGHT BE ESSENTIAL FOR CRANBERRY EXTRACT MEDIATED PROTECTION AGAINST ALZHEIMER'S DISEASE IN CAENORHABDITIS ELEGANS

Atiana McBride-Tobiere

Governor's School for Science and Mathematics

Mentor: Yuqing Dong, Department of Biological Sciences, Clemson University

Advisor: Stephen Kaczkowski

In recent studies, cranberries (*Vaccinium macrocarpon*) along with other nutraceuticals have been shown to promote healthy living and reduce the effects of aging and stress in various model organisms. Our lab's findings have suggested that supplementation of cranberry extract (CBE) at an optimum concentration not only increases the lifespan of the worms, but also helps them survive under various stresses. CBE supplementation was tested to see how it may affect worm populations at different ages and to observed its effects improved cognition skills in aged worms. In the same study we have shown that CBE supplementation increases lifespan and stress resistance by acting through the insulin/IGF signaling pathway via DAF-16 and components of p-38 MAP kinase pathway. Here we observed that CBE helps combat the progression of Alzheimer's disease (AD) in transgenic worms in which this disease has been modeled. We saw delayed paralysis in CBE treated nematodes that occurred due to AD mediated pathology. We further investigated the pathways that might be involved in bringing about this protective phenomenon by conducting a small RNAi screen. We knocked down *daf-16* and *hsp 16.2* expressions and checked if they were involved by carrying out a paralysis assay. We found out that neither gene was essential for CBE mediated protection against AD.

## THE EFFECT OF CELL DENSITY ON HYDROGEN GAS PRODUCTION OF CHLAMYDOMONAS REINHARDTII VIA SULFUR DEPRIVATION

Hannah McCall

Spring Valley High School

Currently, the availability of fossil fuels, which constitute two-thirds of the pollution in earth's atmosphere, is rapidly decreasing. Hydrogen energy is an ideal alternative fuel because it is clean and reliable. When *Chlamydomonas reinhardtii* is deprived of oxygen (O<sub>2</sub>), the enzyme Fe-hydrogenase is expressed and recombines electrons and protons, yielded by photosystem II (PSII), to form hydrogen gas (H<sub>2</sub>). In order for H<sub>2</sub> to be produced, *C. reinhardtii* must also be deprived of sulfur because a lack of sulfur results in damaged D1 proteins, lowering PSII activity,

which then, in turn, causes a decrease in O<sub>2</sub> production. Since the small amount of O<sub>2</sub> produced can be consumed by the algae, there is no excess O<sub>2</sub> to inhibit the expression of Fe-hydrogenase. The purpose of this experiment was to maximize the amount of H<sub>2</sub> produced by *C. reinhardtii*. It was hypothesized that as the density of *C. reinhardtii* increased, the amount of H<sub>2</sub> produced would also increase. The cell densities used were 3 million cells/mL, 6 million cells/mL and 9 million cells/mL; these densities were measured with a hemacytometer. To carry out this experiment, *C. reinhardtii* cultures were grown in a freshwater medium. When the cultures reached the needed cell densities, they were centrifuged and re-suspended in TAP-S medium, containing no sulfur. The H<sub>2</sub> production of each culture was measured via water displacement. An ANOVA test  $F(2,31)=1.71$ ,  $p=0.179$  at  $\alpha=0.05$  was conducted. Because  $p=0.179>\alpha=0.05$ , the null hypothesis that the means of each of the three groups are equal was unable to be rejected. However, there is a graphical correlation such that as the cell density of the *C. reinhardtii* culture increases, the amount of H<sub>2</sub> produced also increases, suggesting that higher densities of *C. reinhardtii* produce more H<sub>2</sub> than lower densities do.

## THE EFFECTS OF POLLUTANTS ON PYROCYSTIS FUSIFORMIS

Melissa McClure  
Dutch Fork High School

Oceans are becoming more polluted every year. Polluted oceans are detrimental to human health so more efforts to clean the oceans must be made. To aid in research that relates to marine pollution, scientists use bio-indicators such as bioluminescent algae. *Pyrocystis fusiformis* is a large unicellular bioluminescent dinoflagellate that can be used for such a purpose. By studying more about how pollution affects the environment, scientists can limit marine pollution. In this study, antifreeze was hypothesized to diminish the bioluminescence of the algae the most.

To analyze the effects of various pollutants on *pyrocystis fusiformis*, it was grown in 125 ml Erlenmeyer flasks purposefully polluted with common pollutants such as motor oil, antifreeze (ethylene glycol), and acrylic paint. Each experimental flask contained 50 ml of algae, 70 ml of seawater, and 5 ml of the given pollutant. Each control flask contained 50 ml of algae and 70 ml of seawater. Motor oil was hypothesized to diminish the bioluminescence of the second most while acrylic paint the least. The bioluminescence is influenced by the pH of algae's surroundings. Antifreeze (a base with pH 9.5 to 10.0) affected the pH the most. *Pyrocystis fusiformis* bioluminesced when the pH decreased to 5.7.

The results of these findings may give scientists an idea of how best to save bioluminescent algae (and other species) from population decline. Algae are

essential to both local and global ecosystems. They are the primary food sources for many organisms and also produce a majority of the world's oxygen.

## DESIGN OF A LAPAROSCOPIC SURGERY SIMULATOR

Madeline McHugh

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Mentor: David Kwartowitz, Department of Bioengineering, Clemson University

Advisor: Jenny Salazar

Laparoscopic surgery is a relatively new method for performing surgery. As surgeons cannot physically see the area they are operating on with this method, practice is necessary to ensure the accuracy of the surgery. A major problem in this budding field is the lack of simulators to practice for pediatric patients. Pediatric laparoscopy is still limited, and the anatomy varies widely in children. Practice needs to be specific to a child's size, so a pediatric simulator was necessary. As this simulator is much smaller than most, it gives a better replica of a child's size, which will allow more precision. A lot of research went into the size and usefulness of this product, and the size is now an average infant's size. SolidWorks, which is a program that is used to design models, allowed confirmation of this size before the actual product was created. After creation, it was determined that this product successfully allows laparoscopic surgery simulation. With many replaceable parts the simulator also allows many different types of surgery to simulate. Therefore, this simulator can mimic many aspects of the human body. This is necessary because multiple surgeries can be practiced on one simulator. Different pieces can be added in to replicate organs and different tops can be added to replicate the different ports necessary for the respective surgeries.

## VISION-BASED CONTROL OF A QUADROTOR

Foster McLane

Governor's School for Science and Mathematics

Mentor: Yue Wang, Department of Mechanical Engineering, Clemson University

Advisor: Elizabeth L. Bunn

This project considers the problem of implementing vision-based control for the Parrot AR.Drone 2.0 quadrotor. Quadrotors are flying robots that have four rotors connected to a central hub. In this project, the quadrotor incorporated two cameras, a front-facing one and a bottom-facing one, and a set of navigational sensors including a gyroscope and an accelerometer. The two cameras were used to analyze

the quadrotor's environment and perform tasks such as line following. To accomplish this, OpenCV was used for image processing. Images captured by one of the cameras were passed to OpenCV to find contours, detect optical flow (relative motion of the scene and camera) and track objects. This data was parsed by an autonomous control program that gave the control system a point. Based on point, the controller sent horizontal and rotational velocity commands to the quadrotor and used the quadrotor's other sensors for corrective control.

## THERMAL CONDUCTIVITY OF SPARK PLASMAS SINTERED ZNSE NANOPOWDER

Eric McLean

Governor's School for Science and Mathematics

Mentor: Jian He, Department of Physics & Astronomy, Clemson University

Advisor: David Whitbeck

Zinc Selenide (ZnSe) is a wide band gap semiconductor well known for its potential applications in blue-green emitters in optoelectronics and also spin-filters spintronics. The physical properties of ZnSe are sensitive to its characteristic size. In this work we focus on the thermal conductivity of nanostructured ZnSe. ZnSe nanopowders are hydrothermally synthesized in Prof. C.-J. Liu's lab in Taiwan and then spark plasma sintered (SPSed) at 840 C for 5 minutes. The as-sintered pellet has a packing density of 5.12 g/cc, as compared to the theoretical density of 5.23 g/cc. X-ray diffraction, scanning electron microscopy, and energy dispersive X-ray spectroscopy measurements are conducted to probe the phase, micro-morphology and composition. In addition, the thermal conductivity is measured on a bar cut from the sintered pellet as a function of temperature between 15 K and 300 K. The measured thermal conductivity data has been compared with those of single crystalline and micro-grained polycrystalline samples in order to gain insight on the grain boundary scattering.

## THE EFFECT OF LATHERIN ON THE GROWTH AND DEVELOPMENT OF CANDIDA ALBICANS FUNGUS AND ESCHERICHIA COLI BACTERIA

Veronica McLean

Spring Valley High School

Latherin was chosen for study because of its possible antibiofilm capabilities. Further studies in antibiofilm and antimicrobial agents are vital to strengthening defenses against biofilms and unwanted growths in the human body. The purpose of

this project was to determine the effect of latherin on the growth and development of *Candida albicans* fungus and *Escherichia coli* bacteria. This was important because it could demonstrate that horses have natural antimicrobial properties in the latherin in their sweat and saliva, which could be instrumental in further research regarding antibiotics and other antimicrobial agents for members of the Equidae family. It was hypothesized that if latherin was applied to *C. albicans* fungus or *E. coli* bacteria, than the growth of the fungus or bacteria would be inhibited. The experiment was performed by applying latherin in the form of saliva to *C. albicans* fungus and *E. coli* bacteria in petri dishes, and measuring the zone of inhibition around the latherin. A control group was tested without latherin. No difference was discovered between the Control and Experimental groups 1 and 2. There was no zone of inhibition in any of the plates, thus the hypothesis was not supported. This could be a result of multiple sources of error, including possible contamination.

## THE COMPARISON OF HIGH SCHOOL STUDENTS JUNG TYPOLOGY TEST WITH THEIR MATHEMATICS CAPABILITIES

Caroline McManus  
Spring Valley High School

Science, technology, engineering, and mathematics (STEM) careers are on the rise in the world and there has been much controversy over stereotyping the type of people that are generally better at these careers. This experiment's purpose was to investigate those stereotypes, and show the correlation between personality type and mathematics ability. The Myers Briggs Personality Test has been proven to be a strong indicator of a person's personality type. The experiment composed the Myers Briggs four letter combination personality type to math scores. Students were given a random number as to keep all data confidential. They were asked to give their gender, age, and current math class. Each student completed the Jung Typology Test, which is a shortened version of the Myers Briggs Test. Students then took a Geometry level test composed of fifteen questions to test their ability in the subject. A linear regression graph was used to calculate a correlation, followed by t-tests between each of the pairs of personality types. There was no significant difference found. A slight difference was shown between intuition and sensing; ( $t(df)=31, p=.0191$ ).



THE EFFECT OF ALLIUM SATIVUM EXTRACT AND AZADIRACHTA INDICA  
EXTRACT AS A NATURAL BACTERIAL AGENT ON THE ZONE OF  
INHIBITION ON ESCHERICHIA COLI K-12

Pranathi Meda  
Spring Valley High School

The purpose of this research was to see which of the two extracts, *Allium sativum* and *Azadirachta Indica* extract, would inhibit the most amount of *E.coli* K-12 growth. *Azadirachta indica*, known as neem, is found in the Mahogany family, and is known to have many medicinal properties. The parts of the tree that are used in medicinal treatments include the leaves and fruit. *Allium sativum*, known as garlic, is renowned throughout the world for its distinctive flavour as well and its remedial properties. The bulbs are the most frequently used part of this plant. *Escherichia coli* is part of the family Enterobacteriaceae, are known to be anaerobic gram-negative rods that live in the intestines of humans and animals. It was hypothesized that the zone of inhibition resulting from the .2% concentrated *Azadirachta indica* extract applied petri-dishes would have a larger zone of inhibition than the petri-dishes containing the four concentrations (.2%, .4%, .6%, .8%) of the *Allium sativum* extract. The petri-dishes, inoculated with *Escherichia coli* K-12, contained disks soaked in specific concentrations. They were incubated for 48 hours at 37 degrees celsius. An ANOVA was conducted at  $\alpha = 0.05$ , and the null hypothesis was rejected,  $F(7, 232)=2.61$ ,  $P=0.013$ . A Tukey test was conducted to see which extract varied most from the other and the result contained one significant difference between the .2% concentrated *Allium sativum* and the .6% concentrated *Allium sativum*.

DETERMINING THE SUBSTRATE SPECIFICITY OF THE GLYCOSIDASE  
ACTIVITY OF NEISSERIA GONORRHOEAE BY AMIDASE C

Jamal Merritt  
Governor's School for Science and Mathematics  
Mentor: Christopher Davies, Department of Biochemistry, Medical University of  
South Carolina  
Advisor: Scott Page

*Niesseria gonorrhoea* is an incredibly antibiotic-resistant bacteria that causes gonorrhoeae. *N. gonorrhoea* is a gram-negative bacteria. During cellular division, it uses the enzyme amidase c to cleave the bonds in its peptidoglycan layer. The N terminal domain of Amidase C cuts the bond connecting L-alanine and N-acetylmuramic acid. The C terminal domain shows glycosidase activity and is

shown to cut the bond connecting N-acetylmuramic acid and N-acetylglucosamine. The direction of the cut is unknown. Finding the specific area where the N terminal domain performs its hydrolase activity will help in the development of drugs against gram negative bacteria like N gonorrhea by targeting their AmiC-NTD protein. By purifying Amidase C from E-coli and incubating the protein with insoluble peptidoglycan, we were able to run the sample over the High Performance Liquid Chromatography and find that the N terminal domain of Amidase C cleaves the bond in the direction of N-acetylglucosamine to N-acetylmuramic acid.

## THE EFFECTS OF VARYING FRESHWATER LEVELS ON THE POPULATION OF CLADOPHORA AEGAGROPILA

Paige Mewborn  
Dutch Fork High School

This project tested the effects of varying freshwater levels on the population of *Cladophora aegagropila* or marimo moss balls. The freshwater was altered in three ways, affecting a sample of the population in numeric value. Data was collected and analyzed based on the number of moss balls remaining after eight weeks. The *Cladophora aegagropila* is a specific type of algae, whose population is large at the bottom of Lake Akan in Japan. Because of a hydroelectric power plant built on the Akan River in 1920, water levels have decreased significantly. This loss of water negatively affected the population. The people living in the area at the time did not realize this effect until 1940, after most of the population died out. The people released a campaign to help recover the population, but the success was small. The purpose of this project is to determine the optimal water level at which the marimo population can sustain. To test this, six ecozones were filled with room temperature tap water; two ecozones with 500 mL, two ecozones with 1000 mL, and two ecozones with 1500 mL. The pH of each ecozone was checked, making sure that the pH of 6.8 is achieved. Five *Cladophora aegagropila* were placed in each ecozone. The ecozones were observed every other day, for color and size. The water was changed in each ecozone every eight days. The data was collected by measuring the circumference of each marimo ball and observing the number of marimo balls and their color.

## THE EFFECTS OF SUPEROXIDES ON THE AFLATOXIN PRODUCTION IN ASPERGILLUS PARASITICUS

Isabelle Mikell  
Hammond School

*Aspergillus parasiticus* is a toxic fungus that contaminates our food and environment by secreting a liver carcinogen, aflatoxin, resulting in 16,600 new cases of aflatoxin-induced liver cancer per year in the United States and an annual loss of \$276 - \$709 million to US agriculture. In an attempt to understand why the fungus makes this deadly toxin, a study was conducted to test the hypothesis that aflatoxin synthesis reduces the load of superoxide radicals in *Aspergillus* cells and hence addition of superoxide radicals would increase aflatoxin synthesis. To test this hypothesis, the effect of increased superoxide on aflatoxin synthesis was investigated. Superoxide radicals in the growth medium were elevated by addition of hydrogen peroxide. The levels of superoxide (the independent variables in the experiment) were measured using dichloro-dihydro-fluorescein diacetate assay and the resultant aflatoxin levels (the dependent variables in the study) were monitored using thin layer chromatography. The results showed that aflatoxin synthesis increased upon elevating superoxide radicals in the fungal cells. The study suggests that novel chemicals that reduce superoxide radicals accumulation in cells can be used to inhibit aflatoxin synthesis in these toxic fungi.

## A STUDY ON THE EFFECTS OF ER:YAG LASER BEAM-SHAPING ON BIOLOGICAL TISSUE

Jonah Miller

Governor's School for Science and Mathematics

Mentor: Eric Johnson, Department of Electrical Engineering, Clemson University

Advisor: David Whitbeck

Recently, lasers have been adapted into tools used for clinical surgery. The Er:YAG laser (Erbium-doped Yttrium Aluminum Garnet) is especially popular because its wavelength lies at the water absorption peak, enabling it to make accurate ablations without causing excess damage to the surrounding tissue. However, the ability of this laser to cut remains limited. In this study, the shape of the Er:YAG laser was altered using optics to create a "necklace beam" shape. The laser was fired at the sample tissue both with and without the optic. Experiments were conducted on soft tissue (gelatin), and hard tissue (antler). Afterwards, the beam was focused using a 40 mm lens and fired at the antler to determine the effects of a more powerful beam on the sample. The results were analyzed after experimentation, and the necklace beam was found to be viable for ablating hard tissue, but less suitable for cutting softer tissue.

## THE CORRELATION BETWEEN ATTACHMENT STYLE AND FACIAL EMOTION RECOGNITION IN 9TH GRADE MAGNET STUDENTS

Lindsey Miller  
Spring Valley High School

Human-to-human relationships have been shown to be a vital component of one's physical, mental, and emotional well being. There is a large variation of how individuals behave in relationships, which can be accounted for by attachment style, a key component of relationships. Emotion recognition also plays a huge role in the health of a relationship. By finding the correlation between attachment style and emotion recognition, insight on one's emotional health may be obtained. The purpose of this study was to find the correlation between facial emotion recognition and attachment style. It was hypothesized that secure attachment would be associated with a greater level of facial emotion recognition and that insecure attachment would be associated with a much lower level of facial emotion recognition. This was done by administering two tests to 9th grade magnet students, one identifying participants' level of facial emotion recognition, and the other identifying participants' attachment style. Data were statistically analyzed through the use of a correlation test and linear regression t-tests at  $\alpha=0.05$ . Results displayed no correlation between facial emotion recognition and attachment style. However, significant negative correlations between secure and ambivalent attachment ( $r=-0.677$ ,  $p<0.001$ ), and also between secure and avoidant attachment ( $r=-0.754$ ,  $p<0.001$ ) were found. It was concluded that there was no relationship between facial emotion recognition and style of attachment. It was also concluded that individuals were likely to possess either insecure attachment or secure attachment, and rarely show signs of ambiguity.

## THE EFFECT OF THE ANTIBACTERIAL PROPERTIES OF CERUMEN ON THE REPRODUCTION OF EVOLVING PATHOGEN AND NOSOCOMIAL INFECTION, STAPHYLOCOCCUS EPIDERMIDIS.

Alyssia Mitchell  
Spring Valley High School

Staphylococcus epidermidis grows on human skin, respiratory, and mucous membrane surfaces. It is responsible for device related infections that often infect the bloodstream. The purpose of this experiment is to find a cost efficient cure for the device related infection, staphylococcus epidermidis. Due to its strong resistance to antibiotics, a medicine has not yet been found to rid the patient of this infection. It was hypothesized that if staphylococcus epidermidis was treated by cerumen

suspended in a 3% glycerol bicarbonate buffer solution for 24 hours, then the optical density of the bacteria would be higher than if the staphylococcus epidermidis was treated for 48 hours or 72 hours. The method of conducting the experiment was to extract cerumen from human subjects with an earwax hook and suspend it into 3% glycerol bicarbonate buffer solution. Treatment disks were placed into the solution and then onto the bacteria. After the prescribed time, the optical density was found and recorded. Using a Scheffé test it was found that there was no significant difference between the control and the 24 hour, 48 hour, and 72 hour treatments. However, there was a significant difference between the means of the 24 hour treatment and the 72 hour treatment and the 48 hour treatment and the 72 hour treatment. The difference in these means led to the conclusion that cerumen suspended in a 3% glycerol sodium bicarbonate buffer does not have an effect on the reproduction of staphylococcus epidermidis.

## DETERMINING THE EXISTENCE OF SUPERSYMMETRY THROUGH MONTE CARLO EVENTS OF PROTON COLLISIONS

Neil Monga

Governor's School for Science and Mathematics

Mentor: Milind V. Purohit, Department of Physics & Astronomy, University of South Carolina

Advisor: Mark A. Godwin

The ATLAS detector at the Large Hadron Collider in Geneva, Switzerland, has been delivering data from proton collisions that implies that the total final energy in many of these collisions does not equal the total initial energy of the particles collided. This means that the Standard Model needs to be revised. However, to understand what particles were missing requires simulation since technology has not advanced far enough to detect these energies. Through the use of PYTHIA, a high-energy simulation software, Fourteen Monte Carlo events were performed. The decays of proton collisions in seven qualified events were examined, plotted on histograms using ROOT, and were compared to standard decay models proposed by supersymmetry. These missing particles had an energy almost equal to the most energetic detected jet. In comparison to the energy of the system, the total missing energy of these particles was measured to be approximately eighty percent of the total energy. Since technology has not advanced far enough for any particle collider to detect possible supersymmetric particles, this data must then wait until a detector or collider has the capability of being able to create and detect supersymmetric particles

## THE EFFECT OF FRESHLY EXTRACTED ALOE VERA VERSUS BOTTLED ALOE VERA ON CANDIDA ALBICANS

Taylor Motlong  
Spring Valley High School

Dental hygiene is important, and sometimes very expensive. Scientists are always trying to find new, easier ways to cure common infections. The purpose of this experiment was to do just that, create a new, easy way to cure oral thrush, a mucosal infection that causes inflammation and discomfort. It was hypothesized that fresh Aloe vera would have the largest zone of inhibition on *Candida albicans*, the bacteria that causes oral thrush, when compared to bottled Aloe vera. After streaking the plates and applying the treatments, the plates were left to incubate for a day. The fresh Aloe vera showed a significant difference from the control and bottled Aloe vera groups, rejecting the null hypothesis  $F((2,87) = 4.41, p = 0.015)$ . The fresh Aloe vera was shown to have the greatest, and only, effect on *Candida albicans*.

## THE EXPRESSION OF THE CREEPING BENTGRASS' HEAT SHOCK PROTEIN GENE, HSP 26.8, IN ARABIDOPSIS PLANTS.

Justice Mullen  
Governor's School for Science and Mathematics  
Mentor: Hong Luo, Department of Genetics & Biochemistry, Clemson University  
Advisor: K. Sris

Heat shock proteins (HSPs) play an important role in the way plants respond to environmental stress. A new HSP gene, HSP 26.8 from Creeping bentgrass, will be cloned for this experiment. The objective of this research is to understand the expression profile of the HSP 26.8 by promoter-GUS reporter gene analysis in transgenic *Arabidopsis* plants. GUS staining assay in transgenic plants will allow the visualization HSP 26.8 gene expression in various plant tissues and at different plant developmental stages as well as in response to environmental stress. The HSP 26.8 promoter sequence was released from the T-Easy vector and placed in front of the GUS reporter gene. The recombined gene construct was then moved into *Agrobacteria* and used for *Arabidopsis* transformation by floral dip.

# THE EFFECT OF ORGANIC FERTILIZER (MOLASSES) COMPARED TO COMMERCIAL FERTILIZER (MILORGANITE) ON THE GROWTH OF LETTUCE PLANTS

Margaret Mullins  
Heathwood Hall Episcopal School

The purpose of this project is to determine the effect of different fertilizers on the growth of lettuce plants. The hypothesis was if lettuce plants were treated with a molasses fertilizer, a commercial fertilizer (Milorganite), and no fertilizer and tested to see which helps the plant flourish the most, then molasses will provide the best nutrition for the plant, making it grow the best. The individual variable is the different fertilizers, and the dependent variable is the lettuce plants health based on the height. Fifteen plants were divided into three groups of five. One group was given a molasses fertilizer, one group was given a commercial fertilizer (Milorganite), and the last group was not given anything to keep it as a control group. The height of every plant was taken every day for twenty days. The results showed that by the end of the experiment the plants treated with the molasses fertilizer has grown the best, second was the plants treated by the commercial fertilizer, and last the plants who prospered the least was the control group. The heights were averaged together for every group and put into Microsoft Excel. An ANOVA test was conducted to average and analyze the results, and it was concluded that the results were not statistically significant because the F-critical value was higher then the F-value.

# A STUDY OF THE POLY(ACRYLAMIDE) HYDROGEL, THE POLY(2- ACRYLAMIDO-2-METHYLPROPANESULFONIC ACID)/ POLY(ACRYLAMIDE) DOUBLE-NETWORK HYDROGEL, THE POLY(2-ACRYLAMIDO-2- METHYLPROPANESULFONIC ACID) HYDROGEL, AND THE THE POLY(2- ACRYLAMIDO-2-METHYLPROPANESULFONIC A

Lance Murphy  
Spring Valley High School

The degeneration of articular cartilage, cartilage in joints such as the knees and the hands, is a prevalent problem. A potential way of solving this problem can be seen in hydrogels which are linked polymer chains of which 99.9% of their weight can be given by water when water swollen. The purpose of this experiment was to find a suitable replacement for articular cartilage by testing the compressive strengths of different hydrogels. The hydrogels used in this experiment were the poly(2-acrylamido-2-methylpropanesulfonic acid) (PAMPS)/ poly(acrylamide) (PAM)

double-network hydrogel, the PAMPS single-network hydrogel, the PAM single-network hydrogel, and the PAMPS/PAM composite hydrogel. These hydrogels were chosen because of the different structures they have. The PAMPS/PAM double-network hydrogel has more dense interlinked polymer chains than the PAMPS/PAM composite hydrogel which has more dense interlinked polymer chains than the single-network hydrogels. The hydrogels were prepared in eight-millimeter molds, and they were measured using the Bose machine at USC. The hydrogels were tested for compressive strength to represent the ability of the gel to withstand the compressive forces found in the joint. Because the compressive strength could not be measured, the slopes of the modified stress-strain curves were evaluated and a One-way Anova test was run. With a  $p$ -value $<.05$ , it was determined that there was a significant difference between the groups. The PAM single-network hydrogel was the strongest of the four, followed by the PAMPS single-network hydrogel, the PAMPS/PAM double-network hydrogel, and the PAMPS/PAM composite hydrogel, in that order.

## SYNTHESIS, STRUCTURE DETERMINATION, AND OPTICAL PROPERTIES OF RARE-EARTH (RE) SILICATES (RE= EU, Y, LA, SM, IN)

Alexis Myers

Governor's School for Science and Mathematics

Mentor: Hans Conrad zur Loye, Department of Chemistry & Biochemistry,

University of South Carolina

Advisor: Phelesia Jones-Cooper

Fluorescent lighting used today incorporates elemental mercury which is both inefficient when compared to other lighting technologies and overexposure can result in death. Rare-earth phosphors, such as europium, are characterized by their partially filled 4f orbitals which allow for small but essential transitions between these energy levels in order to emit light. Rare-earth containing inorganic compounds have the potential to aid in the development of new solid state lighting technologies, such as fluorescent lights and light emitting diodes (LEDs). Through this investigation, new rare-earth silicates,  $K_3RESi_2O_7$  (RE=Eu, Y, Sc),  $K_5Y_2FSi_4O_{13}$ ,  $K_5RE_4F(SiO_4)_4$  (RE= Y, La),  $Sm_{4.66}(SiO_4)_3O$ , and  $K_5In_3Si_7O_{21}$  were synthesized using both solid state and flux crystal growth methods. Reactions with a potassium fluoride flux yielded clear and colorless hexagonal, monoclinic, and tetragonal crystals. When employing the solid state method, a stoichiometric ratio of reactants was ground together and heated yielding the powdered form of  $K_3EuSi_2O_7$  and  $K_3YSi_2O_7$ . The fluorescence spectrum of  $K_3EuSi_2O_7$  powder indicated a red emission at 612 nm, which is similar to the emission of  $Eu_2O_3$  at



608 nm. Our ability to synthesize this compound rather easily through various methods could aid the manufacturing of the product on a larger scale.

## THE EFFECT OF PH LEVELS OF 5, 7, 9, AND 10 ON THE RATE OF METAMORPHOSIS OF AEDES ALBOPICTUS MOSQUITOS

Caroline Nassab

Heathwood Hall Episcopal School

This study investigated the effect of pH levels of 5, 7, 9, and 10 on the rate of metamorphosis of Asian Tiger Mosquitos, *Aedes albopictus*. This knowledge could help predict, or possibly control, mosquito populations to prevent them from becoming a public health issue. Fifty mosquito eggs were placed into each of twelve mosquito chambers, there were 3 chamber per each pH range. An equal amount of a solution of rabbit food and distilled water was added to each chamber, and then the pH was altered using ammonia to make an alkaline solution and vinegar to make an acidic solution. The mosquitos in each chamber were counted every day for 3 weeks. An ANOVA test shows a statistically significant difference between the rates of metamorphosis among the different pH levels for the egg, larva and pupa stages because the f value was greater than the f critical value. The results from the adult stage show that there was not a statistically significant difference; this may be due to the fact that at the end of 3 weeks every chamber had a pH of 7. The pH of 7 had on average, 0.5 adult mosquitos on day 21 while the pH of 5 had 0.2 adult mosquitos; the pH of 9 had 0.4 adult mosquitos; and the pH of 10 had 0 adult mosquitos. These results reject the hypothesis that, if mosquitos are exposed to pH of 10, or a more alkaline pH in water, then their rate of metamorphosis from egg to adult will be increased.

## THE SHORT-TERM EFFECTS OF HEAD IMPACTS ON STUDENT ATHLETES

Tyler Nguyen

Dutch Fork High

In recent years, increasing awareness of head injuries is occurring in contact sports, especially in football and lacrosse where contact is most prominent. Many young players are generally not taught the correct way to tackle, or taught the incorrect way, causing a myriad of head injuries in most cases. The purpose of this study is to be able to quantify a concussion by counting the number of hits a player receives, and directly correlate that to the amount of concussive symptoms. The qualification of a hit or impact is given an operational definition to standardize contact made by

the players. A positive correlation is predicted that as the number of impacts a player executes/receives increase, the severity of concussive symptoms will increase. The methodology involved the Dutch Fork High School Varsity Lacrosse team. Ten players from the team were monitored during practices as well as games, and the number of times the players received/made hits were counted. Once the practice or game was over, a section of the SCAT2, or Sports Concussion Assessment Test 2, called the General Symptoms Checklist, was conducted on each player. This a list of symptoms rating them on severity on a scale of 1 to 6. The numbers and scores from the assessment were analyzed and used to determine which symptoms were common right after contact, practices and games. It is anticipated that through this study, correlating the number of hits student players receive to the level of concussive severity will aid in eventually preventing and treating athletes with concussions and other head injuries. Through this experiment it is hoped to shed light on the short-term effects of head impacts on student athletes of contact sports.

## ELECTROPORATION OF FLUORESCENT PLASMIDS IN CIONA INTESTINALIS

Bailey Nicolas

Governor's School for Science and Mathematics

Mentor: Heather Evans-Anderson, Department of Biology, Winthrop University

Advisor: Jennifer Taylor

*Ciona intestinalis*, confirmed to be the closest living invertebrate relative to vertebrates, are widely used as model organisms to study developmental genetics and evolution. *Ciona intestinalis* is emerging as a popular model organism because its basic genome is relatively streamlined across the species and has not undergone the duplications seen in vertebrates. Genetic screens, germline transgenesis, microinjection of mRNA and plasmid DNA, and electroporation of plasmid DNA are routinely used when studying gene expression, gene function, and also control of protein production in *Ciona*. They are commonly used for cardiac studies, however, their hearts are clear, making it difficult to accurately observe them and quantify measurements. The purpose of this research was to improve *Ciona* as a model organism for cardiac studies by making them take up fluorescent DNA marker plasmids. Marker plasmids, pMiCiTnlG and pMiCTniGCiprmG, which specifically target heart muscles were obtained from CITRES Lab in Japan. Dechorionated embryos were electroporated with these plasmids using .05 kV, 1.00  $\mu$ F x 1000 (capitance). The electroporations received volts between 48-49 V and the time constants ranging between 6-36 ms. It will be important to successfully incorporate the GFP-expressing plasmids to facilitate studies of cardiac injury and treatment.

## DETERMINING THE CORTICAL EXCITABILITY OF MEDITATORS USING TRANSCRANIAL MAGNETIC STIMULATION (TMS)

Jessa Norton

Governor's School for Science and Mathematics

Mentor: Donna Roberts, Department of Biomedicine, Medical University of South  
Carolina

Advisor: Gary L. Salazar

The goal of the experiment was to use Transcranial Magnetic Stimulation (TMS) to determine the effects of meditation on the cortical excitability of meditators. After reviewing published imaging studies, we hypothesized that subjects who underwent meditation would have higher cortical excitabilities because they were concentrating heavily on breathing in and out. We recorded Motor Evoked Potentials (MEPs) over a range of TMS intensities for ten experienced meditators and ten non-meditators. The ten meditators performed twenty-minute periods of meditation and the ten non-meditators performed twenty-minute periods of rest. TMS recruitment curves (RCs) were then created by plotting the MEP values over a range of TMS intensities. The slope of the RCs reflected changes in cortical excitability. The meditators showed a decreasing RC slope after twenty-minute meditation periods in comparison with their RC slope before meditation. The meditators also showed decreased cortical activity after the twenty-minute periods. Although the functional significance of motor cortex activation during meditation is unknown, perhaps motor systems play a role in a more complex circuit activated during meditation.

## X-RAY RADIATION DOSE RESPONSE OF ARTICULAR CARTILAGE

Kelli Nugent

Governor's School for Science and Mathematics

Mentor: Delphine Dean, Department of Bioengineering, Clemson University

Advisor: K. Sris

One of the methods for treating cancer is radiation therapy, which destroys both unhealthy and healthy cells. Furthermore, radiation therapy may potentially damage the body. Articular cartilage absorbs the pressure applied by joints which would otherwise cause pain. Arthritis occurs due to weakened cartilage that no longer absorbs as much pressure. This makes it difficult for patients to move. This project focuses on the effects of radiation on articular cartilage and targeting the cellular or physical changes within the cartilage. The changes could occur either in the cellular matrix or the cell chondrocytes. A porcine foot was dissected and

samples of cartilage were extracted to test with doses of two Gray. The samples' elastic modulus was tested with the use of an Atomic Force Microscope before and after radiation. The media, which holds the samples, was changed and the old media was placed in a tube on zero, one, three, five, and seven days. The media analyzed a Dimethylene Blue Assay which showed the amount of glycosaminoglycans released into the media. Lastly, the samples received a Hematoxylin & Eosin staining which examines the chondrocytes. The research showed that the articular cartilage weakened after radiation. Also the glycosaminoglycan count inside the media was higher on the first day for the radiated samples than the control samples. More research must be conducted to examine the changes to the cartilage to help prevent cartilage weakening from radiation.

## THE ABSORBENCY OF SIX BRANDS OF PAPER TOWELS

Jordan Nwanagu

Heathwood Hall Episcopal School

The purpose of this experiment is to determine, which of six paper towel brands has the best absorbency. This will be to determine whether a paper towel of the same size will have the same amount of water it can absorb. The independent variables were the paper towel brands used and the dependent variable was the amount of water absorbed by the paper towels. After the testing, results show that Brawny had the highest absorbency per 11 inch by 6 inch sheets. With a mean of 22.8 mL, Brawny has the highest absorbency.

## STRUCTURAL HEALTH MONITORING IN PLATE-LIKE STRUCTURES USING PIEZOELECTRIC WAFER ACTIVE SENSORS

Bailey Oedewaldt

Governor's School for Science and Mathematics

Mentor: Lingyu Yu, Department of Mechanical Engineering, University of South Carolina

Advisor: Stephen Kaczkowski

Structural Health Monitoring with Piezoelectric Wafer Active Sensors (PWAS) provides an effective and affordable in-situ method for damage detection and provides a proactive method of damage detection in aging aerospace structures. The Piezoelectric Wafer Active Sensors use changes in the symmetric and anti-symmetric LAMB wave modes to detect damage. These wave modes were measured

on a pristine steel plate and graphed. Varying types of damage were then simulated on steel plates, and the graphs created from changes in the waveforms were compared to the pristine case graphs. These graphs provide a highly visual comparison that allows Piezoelectric Wafer Active Sensors to be used to detect damage between routine system checks and can thus prevent undetected damage in plate-like structures.

## UTILIZATION OF NON-WOODY BIOMASS AS A LOCAL FUEL SOURCE

Abraham Oh

The Center for Advanced Technical Studies

Biomass pellets today are seeing increased use and recognition throughout the world. Commercially available pellets are commonly made from local hard and soft woods in the area; sometimes agricultural waste, such as corn stover, is also used. However mass production of woody biomass pellets requires trees to be cut down while the non-woody biomass is obtained as a waste product. Many experiments have been conducted to determine the best source for local biomass pellets from local flora, mainly in other countries such as Ireland. Biomass selected in the midlands regional area of South Carolina for this study includes corn stover, bamboo, pine straw, and hydrilla. The efficiency of non-woody biomass was tested against woody biomass that is commercially sold to create a study that provides a local alternative to woody biomass. The biomass was torrefied for various time intervals due to initial moisture content. After blending and sifting the biomass, pellets were made with a ratio of five grams of biomass and three grams of paraffin wax binder. The pellets were placed into a modified paint can so that the pellets would heat up a 250 mL beaker of distilled water that is suspended through the lid. The change in temperature of the water was used to determine the specific energy of the pellets. All of the non-woody biomass showed to have higher specific energies than the wood pellets.

# THE EFFECT OF MEMBRANE CURVATURE ON THE ANCHORING OF THE H-RAS PROTEIN

Daniel Ott

The Center of Advanced Technical Studies

Mentor: Mark Uline, College of Engineering and Computing, University of South Carolina

Lipid rafts are domains in the cell membrane characterized by having higher cholesterol concentrations than other domains. Because certain proteins are suggested to consistently partition in rafts, it is hypothesized that rafts facilitate proteins' activity. Literature suggests that Ras proteins anchor in the raft phase. However, previous research conducted with a planar model membrane shows that the N-Ras protein actually has no significant preference for the liquid-ordered (raft) phase over the liquid disordered (non-raft) phase of the membrane. Unpublished experimental data shows that N-Ras prefers to anchor in the raft phase over the non-raft phase at higher membrane curvatures. The hypothesis here is that the same will hold true for the H-Ras protein. A theoretical approach was used. Because biological systems proceed towards thermodynamic equilibrium, computations to minimize the free-energy and entropy cost of a system can be used to see which processes will most likely occur. A computer program was created using Fortran to create a model membrane and measure the ratio of the mole fractions of the anchors associated with N-Ras and H-Ras in the liquid ordered phase to the mole fraction of these anchors in the liquid disordered phase ( $X_{lo}/X_{ld}$ ). First, the effect of curvature on N-Ras was computed and compared to experimental data to validate the theory. Then, computations were carried out for H-Ras. The data strongly confirmed the hypothesis by showing that H-Ras has a significant preference for the liquid ordered phase over the liquid disordered phase in more highly curved membranes. This supports the contentious raft hypothesis by showing that H-Ras would prefer to partition in rafts in curved membranes (which are more realistic than planar membranes). This is also significant in showing that proteins' anchors (rather than the protein as a whole) play the major role in determining where the proteins anchor as the experimental data (which took into account the entire protein) agreed with the theory (which took into account only the anchors).

# THE EFFECT OF CRUSHED CONTAINER GLASS AGGREGATE ON THE FLEXURAL STRENGTH OF CONCRETE

Campbell Paine

Heathwood Hall Episcopal School

Concrete is the most common and most efficient building material today. However, some of the materials used in concrete (Portland cement, gravel, sand, and water) are not as easily found in developing countries. The purpose of this experiment is to determine if crushed container glass will be an effective replacement for gravel and or sand, the aggregates in concrete. The hypotheses of this experiment are:

1) Adding crushed container glass to the traditional concrete mixture will increase the flexural strength of concrete; 2) Replacing the sand component of concrete with crushed container glass will increase the flexural strength of concrete; Experimental 3) Replacing the gravel component of concrete with crushed container glass will increase the flexural strength of concrete. The null hypothesis is that the glass will have no effect or an adverse effect on the flexural strength of the concrete. To test these hypotheses, a total of 30 samples of concrete using glass in place of or in addition to the usual aggregates were tested against 10 control samples using a testing method adopted from industrial methods. The unit of measure will be pounds per square inch (psi). The experiment Groups of this test will be: control (Portland cement, gravel, sand, and water), Experimental Group One (Portland cement, gravel, sand, water and glass), Experimental Group Two (Portland cement, glass, sand, and water), and Experimental Group Three (Portland cement, gravel, glass, and water). The testing platform consisted of two lower support beams laid on their wider axis and on a separate deck, a piece of wood laid on its thinner axis. Each concrete sample was placed on the two support beams and the third piece of wood was centered on the sample and applied force to the concrete. The control Group had an average flexural strength of 6.2 psi. Experimental Group one's average was 4.3 psi. Experimental Group two's average was 2.8 psi. Experimental Group three's average was 0.6 psi. After the testing, none of the hypotheses were supported by the data. Therefore, the null hypothesis was unable to be rejected. Even though the data did not support the original hypotheses, the concrete with gravel replaced with glass could be an effective building material for light building support. However, Experimental Group Three (no sand) was a very ineffective load-bearing material and would not be suitable for construction.

## GENDER DISPARITIES IN KIDNEY TRANSPLANTS

Taylor Pannal

The Center for Advanced Technical Studies

Patients that have End Stage Renal Disease are greatly encouraged to get a kidney transplant rather than having life-long dialysis treatment. There are many steps to obtaining a kidney transplant: medical suitability, interest in transplant, referral to a transplant center, first visit to center, transplant workup, confirmation as a successful candidate, being put on a waiting list or identify living donor and receiving the transplant. However, all of these steps can be a barrier. The surveys sent to Georgia, South Carolina and North Carolina will be analyzed and categorized to get their opinion on women's barriers they may face.

## A STUDY OF THE AMOUNT OF BACTERIA THAT LINGERS ON DIFFERENT CUTTING BOARD MATERIALS

Sonali Parmar

Heathwood Hall Episcopal School

The purpose of this study is to determine whether the type of cutting board (wood, glass, rubber, and plastic) is associated with the amount of bacterial colonies that are present. This study is beneficial to chefs or anyone working in the kitchen who might be concerned about keeping working conditions safe and sterile. The hypothesis was, "If a wooden cutting board is contaminated with a ground turkey nutrient broth, then the amount of bacteria on the wooden cutting board will be greater compared to the amount of bacteria on the plastic, glass, and rubber cutting boards." The null hypothesis was, "If a wooden cutting board is contaminated with a ground turkey nutrient broth, then the amount of bacteria on the four boards will not differ from each other." Wood, glass, rubber, and plastic cutting boards were contaminated with a ground turkey and nutrient broth solution. Each cutting board had its own control group, which was spread with nutrient broth. The boards were then washed with 100 mL of sterile water and the rinse water was plated. The dishes were placed in the incubator for 24-48 hours. The results of this experiment contained significant variation among each trial. After running several ANOVA tests it was determined that the differences in bacterial growth were not statistically significant. Therefore, the null hypothesis was accepted.



## KRUPPEL-LIKE FACTOR KLF4 DEFICIENCY DECREASES FIBROBLAST CONTRACTION

Parmida Parsa

Governor's School for Science and Mathematics

Mentor: Walden Ai , Department of Pathology, Microbiology & Immunology,  
University of South Carolina School of Medicine

Advisor: Jennifer Taylor

There are over 51 million surgeries in the United States annually which makes the skin recovery process a concern among many Americans. Wound healing takes place after any cut or burn to the skin. Contraction by cells called fibroblasts is critical to the wound closure process. In addition, it has been shown that the expression of Kruppel-like factor 4 (KLF4), a transcriptional factor, “in mouse hair bulge stem cells plays an important role in cutaneous wound healing” (Li et al., 2012). However, it is unclear which specific cells at the wound site are affected by KLF4. We hypothesize that KLF4 promotes wound healing by regulating fibroblast function since it has been previously shown to affect the control the function of pulmonary fibroblasts (Jean et al., 2013). To test this hypothesis, we performed a contraction gel assay using fibroblasts purified from the skin of KLF4 knockout mice. Using a combination of 1:4 and 1:1 cell to gel ratios as well as 0.5 mL and 1mL gel volumes, optimal conditions for future contraction assays were determined. The assay showed that the 1:1 ratio and 1mL volume combination most clearly demonstrated the effect of KLF4 knockout on fibroblast contraction. The contraction assay at 1:1 ratio and 1mL volume revealed that KLF4 deficiency decreases contraction, confirming that KLF4 regulates the function of fibroblasts in contraction, a critical component of wound healing. In the future, these findings could be used to identify therapeutic strategies to accelerate wound recovery by targeting the KLF4 in fibroblasts

## EFFECT OF DIFFERENT CONCENTRATIONS OF LEMON JUICE AS FACIAL ASTRINGENT AGAINST PROPIONIBACTERIUM ACNES

Tulsi Patel

Dutch Fork High School

People of all ages are afflicted by extensive skin acne. Current medications such as tetracycline and benzoyl peroxide can harm sensitive skin and be costly. Lemon juice is a home remedy that can be effective against acne due to its acidity. Other home remedies that have been previously researched include turmeric, tea tree oil, and lavender oil due to excellent antimicrobial properties. Remedies against acne

target bacteria in the sebaceous glands. This study will test the effects of lemon juice as a facial astringent by applying different concentrations of lemon juice to *Staphylococcus aureus*, a bacterium of the skin known to cause acne. The nutrient medium will be prepared to mimic skin conditions via maintaining skin pH, oil levels, and temperature. Using the Kirby-Bauer disk diffusion method, the effectiveness of the remedy will be quantified by the radius of inhibition. This study will ideally yield an effective treatment for acne due to the controlled environment of bacterial growth.

## THE EFFECT OF DIFFERENT INTENSITIES OF UVB LIGHT VS DIFFERENT INTENSITIES OF FULL SPECTRUM GROW LIGHTS ON THE GROWTH RATE OF RAPHANUS SATIVUS

Will Pertile  
Heathwood Hall

The purpose of this project was to ascertain if different intensities of UVB and the grow lights effected the height of Rapid Radishes. This topic is important because it helps agriculturists know how to protect their plants from harm. The hypothesis examined is if the level of the intensities are increased/decreased, then it will positively/negatively affect the plants height. To do this project one must buy 200 rapid radish seeds, set up 2 tables with correct lights and intensities in each, prepare seeds, make sure to have 33 cells per plant group, fill soil  $\frac{3}{4}$  way full in each cell, put 2-3 seeds per cell, add fertilizer, dampen soil, use water-lick system with wick and all, make sure water system is working, check growth height every 1-3 days, and one must do this for about 20 days or until plants are fully grown. The results of this experiment proved that the hypothesis proposed was supported and that the data collected rejected the null hypothesis proposed. The 100% and 50% grow light plant groups had the tallest plants but the 50% grow light plants had the lowest germination rate out of all the plants. The 100% and 50% UVB plants weren't as tall as the other two grow light groups. Additionally, the 100% UVB plants died before any of the other group's plants did. That is all the facts about the data collected in this experiment. One can conclude that the different intensities of the lights do affect the plants growth rate.

## THE PURIFICATION AND CHARACTERIZATION OF MAZF, A BIOLOGICAL SCISSOR IN ESCHERICHIA COLI

Ashley Peterson  
Governor's School for Science and Mathematics  
Mentor: Tzuen-Rong Tzeng, Department of Biological Sciences, Clemson University  
Advisor: Lance Riddle

The goal of this research is to purify and characterize MazF so that its mRNA cleaving properties can be used to develop a more effective treatment against human proliferative diseases. MazF is a bacterial toxin found in various kinds of bacteria, e.g. Escherichia coli, Bacillus subtilis. It is typically produced along with the anti-toxin MazE during the lag and log phases of bacterial growth. However, when MazE is not present during the stationary phase, MazF has the ability to inhibit mRNA translation by cleaving mRNA at the ACA sequence. This induces

apoptosis and can be used to help control cell proliferation in diseases such as cancer. In this experiment, the *mazF* gene was amplified through PCR with specific primers and run through a gel electrophoresis in order to validate the presence of the gene. The plasmid was electroporated with electrocompetent cells in order to transform JM109 *E. coli* cells and maintain the plasmid. Then the electroporated bacteria was first cultured on LB + Ampicillin plates to ensure that only successfully transformed cells could survive. After being transferred to LB plates and then back to LB + Ampicillin plates again, the *mazF* plasmid was extracted and purified in order to determine the transformation efficacy and eventually verify the function of the gene.

## ANALYZING THE ROLE OF NEUROPILIN 2 AND ITS ISOFORMS IN THE EPITHELIAL MESENCHYMAL TRANSITION PROCESS BY SHORT-HAIRPIN RNA TECHNIQUE

Kendell Peterson

Mentor: Robert Gemmill, Department of Medicine, Medical University of South  
Carolina

Advisor: Bhuvana Parameswaran

Neuropilin 2(NRP2) is a membrane bound protein that is a receptor for ligands, which are signal triggering molecules. The induction of NRP2 is important in the EMT process, as it is crucial to the conversion of non-aggressive tumors to aggressive tumors. To analyze its role in EMT the endogenous Neuropilin 2 must be knocked down. The knockdown of the cell's own NRP2 gene insures that the only NRP2 present is from a Neuropilin gene containing vector. The RNA molecule shRNA is used to knockdown the NRP2 gene. However, shRNA cannot distinguish between the endogenous gene and the exogenous so mutations must be made in NRP2 that would make the exogenous gene resistant to shRNA knockdown. To accomplish this result QuikChange site- mutagenesis technique was employed. PCR analysis of NRP2a and NRP2b clones was done to check for the mutant DNA. The clones that contained the DNA were sent out to be sequenced. Western blot analysis was also done on genetically modified cell lines that contained the mutant NRP2 to check if the cells contained NRP2 in the exogenous region, but not in the endogenous. Out of the six clones that were sent out to sequencing four of them were correct. The mutants were identified on the gel and the cell lines generated exogenous NRP2.

## THE EFFECT OF SAND, WATER, OR CONCRETE ON THE THERMAL CAPACITY OF A SOLAR HEAT CAPTURING DEVICE

Payton Phillips

Heathwood Hall Episcopal School

The purpose of this research project was to analyze the effectiveness of water, sand, and concrete as thermal storage materials in a solar heating device; to explore the possibility of supplying inexpensive heat to a room. Tests were conducted to determine which material would store the most thermal energy and release the most energy as heat. The device was designed to be placed against a window, which allowed the materials to capture the sun's energy as heat during the day. The device consisted of four separate twelve by twelve inch boxes and was surrounded with insulation except for the window side. Fans on the back of the device pushed air through each box continuously. A temperature probe was placed in front of each intake and output opening exiting into the room. The purpose of this design was to allow measurement and comparison of the input and output air temperature. The temperature was measured every fifteen minutes for nine days. Data were averaged and analyzed using a one-way ANOVA test( $\alpha=0.05$ ). The mean of the change in temperature ( $^{\circ}\text{C}$ ) for the control was 0.662, concrete 0.778, sand 0.785, and water 1.136. The results showed water had the greatest change of temperature and held the heat energy the longest during the time when it was not exposed to sunlight. This experiment provides validation of an inexpensive solar heat capturing device and tested materials that can provide an efficient way to heat a room finding water to be the most efficient material.

## THE DISCREPANCIES IN BALLERINAS' ACTUAL AND PERCEIVED KNEE HYPERMOBILITY

Kathryn Phipps

Dutch Fork High School

Hypermobility in ballet is aesthetically desirable for dancers and choreographers as they are obsessed with the lines dancers' bodies make. Unfortunately, however, the hypermobile knee joint is more susceptible to injury, especially in the already strenuous physicality of dance. Dancers may be overextending their knees to try to obtain more desirable lines, which could be leading to the high knee-injury rates seen in dance. Therefore, it was hypothesized that ballerinas would overestimate their knee hypermobility. Ballerinas manipulated a Vici doll to measure their perceived hypermobility and their actual hypermobility was measured with a goniometer. Through statistical analysis of discrepancies between these

measurements, with considerations of demographic information collected in a questionnaire, it was expected that this study would reveal a psychological bias towards the hyperextended line. The information from this study could lead to further studies looking at the psychology of dance rather than solely on the physiology of the technique.

## SURVEY DESIGN TO EFFECTIVELY MEASURE TECHNOLOGY INTEGRATION IN SOUTH CAROLINA SECONDARY SCHOOLS

Franklin Piedade

Governor's School for Science and Mathematics

Mentor: Laura McKinney, New Carolina

Advisors: Robert Fletcher, Jeff Wisdom

Technology is in widespread use throughout South Carolina's secondary classrooms, but whether or not it is used effectively is unclear. New Carolina, a thinktank in South Carolina, sought to uncover student's opinions regarding the use of technology in the classroom. This research developed and tested a survey for this purpose. The results of this small survey are intended to be used as a test trial of a much larger survey aimed at all of South Carolina's high school students. The research included designing test questions for an online survey as well as design of the suggested methodology of presenting the results. The trial was conducted with a small sample of students from the South Carolina's Governor's School for Science and Mathematics, with whom the researcher had immediate access. Despite the small sample, the response rate was 69%. This compares to an accepted average response rate of 30%, also noting that the accepted valid number of responses is 45. The research also indicated that the best way to detail results is through graphical analysis. This trial survey provides insight regarding survey response rates and response times, albeit likely a best case scenario.

## THE EFFECT OF HYDROGEN PEROXIDE, SODIUM PERCARBONATE, AND VINEGAR SATURATED COFFEE FILTER ON THE GROWTH OF BACILLUS CEREUS

Andres Pineda  
Spring Valley High School

Knowledge about antibacterial agents is starting to reach new people and places, which sparks a search for easy and efficient filtration systems. The purpose of this experiment was to find a safe and efficient process to purify drinking water by using vinegar, hydrogen peroxide, and sodium percarbonate saturated in a coffee filter. It was hypothesized that filters soaked in sodium percarbonate would have significantly less amount of colonies than compared to the control group not affected by the chemicals. The data collected for this experiment were obtained by counting the colonies of *Bacillus cereus* grown after a day of incubation. A one-way ANOVA test was performed, showing that the three filters were statistically different compared to the control group, rejecting the null hypothesis  $F(3,116) = 357.51$ ;  $p < 0.001$ . In conclusion, the study indicates that all of the chemicals the coffee filter was saturated in had a positive effect towards controlling bacterial growth.

## IN VITRO STUDIES TO EVALUATE THE SPECIFICITY OF ADHESIN SPECIFIC BIO-FUNCTIONALIZED IRON-OXIDE

Ronak Pipaliya  
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Mentor: Tzuen-Rong Tzeng, Department of Biological Sciences, Clemson University  
Advisor: Lance Riddle

The purpose of this project is to determine the specificity of Iron-Oxide nanoparticles functionalized with GM3 towards the adhesin molecule on *E. coli* 13762, which causes bloody diarrhea in newborn piglets and calves. The bio-functionalized nanoparticles form aggregates in the presence of *E. coli* 13762, acting as a competitive inhibitor for the pathogen and cell interaction. Results of this research will determine if the use of Iron-Oxide nanoparticles as a non-antibiotic approach to microbial infections is effective. The optimal ratio between nanoparticles and bacteria will be determined eventually through serial dilutions of *E. coli* 13762 and nanoparticle. By looking at each dilution under the microscope to observe aggregation induced by the bio-functionalized nanoparticles we can compare the ratios to find the best one. Calculations of the CFU/mL and a Live/Dead assay will be used to eventually determine the inherent toxicity of the nanoparticles, and a mixed culture assay will determine the specificity of the bio-

functionalized nanoparticles. In attempting to find the optimal ratio no aggregation was present at the dilutions, however, we do expect to find the best ratio. The preliminary research on toxicity shows that the nanoparticles are not toxic because there was no reduction in the concentration of the cells. This implies that the Live/Dead and luminescence assays may indicate the non-toxicity of the nanoparticles. It is expected that *E. coli* 13762 will show specificity in the mixed culture assay that will be developed.

## THE EFFECT OF ENVIRONMENTAL AND TRADITIONAL CARPET CLEANERS ON RED WINE CARPET STAINS

Samantha Piper

Heathwood Hall Episcopal School

The purpose of this research is to compare the ability of eco-friendly cleaners with respect to traditional cleaners on red wine carpet stains. The experiment is carpet squares stained with shiraz (red wine) which is then cleaned with two traditional cleaners and two environmental cleaners. The independent variable is the type of cleaner, whether it is a traditional or environmental cleaner. The dependent variable is how clean the two different types of cleaner make the carpet square after the stain is cleaned. The results conclude that traditional cleaners do not perform better than environmental cleaners. All of the cleaners were successful though at clearing a majority of the stain.

## THE EFFECT OF DISCHARGE ON SPECIFIC CONDUCTANCE FROM THREE DIFFERENT SITES WITHIN THE SANTEE RIVER BASIN

Madison Pobis

Spring Valley High School

Water quality is classified based on numerous factors, but many of the factors cannot always be continuously monitored in every part of a given watershed. Two of the most commonly collected data points include streamflow, or discharge, and specific conductance. Finding a correlation between some of these common variables could help scientists more closely monitor water quality without specialty testing, labs, or expensive equipment. The purpose of this experiment was to determine if there was a statistically significant correlation between discharge and specific conductance values at various sites in the Wateree watershed. It was hypothesized that there would be a significant correlation between discharge and specific conductance and that the resulting regressions would be able to determine an



approximate value of specific conductance. Using the National Water Information System, data from August, September, and October 2012 for both discharge and specific conductance were used to create quadratic regressions for each of the three sites selected. The hypothesis that discharge and specific conductance were significantly correlated was found to be significant at the Wateree and Enoree river sites,  $F(2, 91)=80.05$ ,  $p<0.01$ ,  $F(2, 91)=132.08$ ,  $p<0.01$ , but not at the Broad river site. It was found that only the observed and predicted values at the Enoree river site did not show a significant difference,  $F(1,183)=0.01$ ,  $p=0.939$  at  $\alpha=0.05$ , which supported that the regression was a valid predictor. Thus, an accurate regression was found to predict conductivity at the Enoree site, but these regressions should not be used as a determinant for water pollution.

### OPTIMAL FORAGING THEORY WITH WRITING SPIDERS (AURANTIA ARGIOPE)

John Price

Greenville Technical Charter High School

This experiment will test the Optimal Foraging Theory; it states that an organism will feed on the prey that produces the most calories, while taking the least amount of time. Cannibalism is very prominent in the wild with spiders, technically a spider's sibling has all the nutrients that the spider needs to survive and grow. This theory will be tested by placing a spider with different prey than it would face in wild, including one of its siblings. This will prove what the spider's optimal prey would be, whether it is a fruit fly, mealworm, or its sibling. This can be done by separating the spiders I have in captivity into their own containers and adding different prey: flightless fruit fly, mealworm, and one of its siblings. If the spider eats the sibling over the other prey, then that would be its optimal prey.

### THE EFFECT OF COLOR ON THE PERCEPTION OF FLAVOR IN VANILLA ICE CREAM

Olivia Price

Heathwood Hall

The purpose of this experiment was to investigate whether or not altering the physical appearance of vanilla ice cream had an effect on the perceived flavor. The results from this study could be hugely beneficial towards consumer affairs. The color of food has a large impact on people's flavor perception; it is a visual element that makes it such a valuable marketing tool. Thus proving that the results from

this experiment can service many businesses that promote food or drink. This study uses live simulation, in which humans observed the ice cream and took a pre survey based on observation, then after completing the pre survey they then tasted the ice cream and took a post survey. The color of the ice cream was manipulated and accuracy was measured. The hypothesis was that the color of the vanilla ice cream would effect the perception of flavor. Colors that had several possible flavors, such as red or blue, were more difficult to perceive. In conclusion, this experiment will benefit consumer affairs by illustrating that the color of a substance is important because it can affect their sales and growth as a business. If their product looks unappealing in color then people will be reluctant to purchase it.

## SONAR FOR THE VISUALLY IMPAIRED

Matthew Quan

Heathwood Hall

This project studies the effectiveness a device that the visually impaired may use in place of a blind cane to detect physical obstructions such as chair legs and tables. In the past many visually impaired have used white tipped canes to detect objects in their surroundings. But the problem with the canes is they cannot be used to detect elevated objects such as a chair. The device constructed consists of a sonar sensor coupled to an Arduino Uno Prototyping Board. Sensory data was interpreted to the user via pulses from a TENS unit (Transcutaneous electrical nerve stimulation). This is the first recorded device that uses a TENS unit to interpret sensory data. For this experiment test subjects walked towards the various sides of a chair and a face of a wall with a sonar device connected to their arm. They were asked to stop when they could feel a pulse in their arm that was created by small electrical pulses that came from a TENS unit. The results show that the TENS unit was able to transmit the sensory data to the test subjects well. The front of the chair had a 96% detection rate. The back of the chair had a 92% detection rate. The side of the chair had a 46% detection rate, and the wall had an 84% detection rate.

## THE EFFECT OF A FERMENTING YEAST MOSQUITO TRAP ON THE CAPTURING OF MOSQUITOES IN COLUMBIA, SOUTH CAROLINA

Nicolas Quan

Heathwood Hall Episcopal School

Female mosquitoes are not only a nuisance for their bites that leave itchy bumps on your skin, but also for their possibility of transmitting diseases to you. Because of both of these problems, mosquito traps are used to capture mosquitoes and specifically mosquitoes carrying malaria or yellow fever such as *Anopheles gambiae* and *Aedes aegypti* respectively. There are many commercial mosquito traps, but they can be expensive and are not environmentally friendly. In this study, the use of a cheaper and more environmentally friendly mosquito trap using fermenting yeast was investigated to see if the trap could catch mosquitoes, and if it would be a good alternative to the commercial traps. The fermenting yeast mosquito traps were created from one-liter bottles, and solutions of sugar, water, and yeast were placed inside. Over the course of nine days, the yeast fermented in the sugar water, producing carbon dioxide to attract mosquitoes. The results for all nine of the days showed that no mosquitoes were caught; however, some fruit flies were caught. It was concluded that the fermenting yeast trap does not work for catching mosquitoes in Columbia, South Carolina, but does work as a fruit fly trap. Mosquito species in other areas could respond to the fermenting yeast and be caught with this trap, but not the ones in Columbia, South Carolina.

## MARKER ASSISTED SELECTION FOR RED COLORATION IN PEACH [PRUNUS PERSICA]

Rachel Quick

Governor's School for Science and Mathematics

Mentor: Ksenija Gasic, School of Agriculture, Forestry & Environmental Sciences,  
Clemson University

Advisor: Jennifer Brown

Red skin coloration, or blush, is an important trait for fresh market peaches. High red skin coloration is appealing to the consumer's eye and the anthocyanin compound associated with blush provides flavor and nutrients important in daily human diet. Blush is quantitatively inherited and presents practical challenges in selection. To overcome the limitations of traditional breeding in developing high blush peach cultivars, application of molecular marker(s) associated with the blush development via marker-assisted selection (MAS) is evaluated. Previous research reported a major QTL locus, *Blush.Pp.ZC-3.1*, is associated with the blush in peach.

There are four functional alleles at blush locus that determine high, moderate, and low blush phenotypes. Two single nucleotide polymorphism (SNP) sites flank the blush QTL, SNP\_IGA\_341962 and SNP\_3\_12878608, distinguish each functional allele and were tested for early determination of blush phenotypes. Two of the function alleles, a and b, are hypothesized to relate to the high blush phenotypes and low blush phenotypes, respectively. These two SNPs were converted into Cleaved Amplified Polymorphic Sequence (CAPS) markers, B1 and B2, respectively, and tested for their MAS potential in peach. Allele a is hypothesized to be AA in B1 or TT in B2, being associated with a high blush. While allele b is hypothesized to be GG, with a lower blush, in the blush segregating F2 progeny. The markers were also tested on peach germplasm to evaluate their potential to predict level of blush. Further research will be necessary in order to determine whether these markers may become a useful molecular tool for identifying the level of blush prior to the phenotyping methods currently used at peach tree maturity

## EFFECT OF VARIOUS ELECTROLYTES ON THE ELECTROLYSIS OF WATER

Jacob Rabinovitch

Greenville Technical Charter High School

Electrolysis is a general term used to describe the process in which an aqueous solution or compound is decomposed into the elements that comprise it. In the case of water, this is done by passing an electrical current through the liquid in order to decompose  $H_2O$  into the diatomic gasses Hydrogen ( $H_2$ ) and Oxygen ( $O_2$ ). However, the actual process is more intricate with regards to the voltage, current, type of electrodes, and perhaps most importantly, the electrolyte. Pure water by itself does not ionize freely, which is necessary in order for ions to travel to the oppositely charged electrode. Because of this, another substance needs to be added to the water in order to enable the solution to conduct electricity. My experiment tests various ionic salts and substances in order to observe the effects that each has on the quantity of gas that is synthesized in a given time under constant conditions, such as electrode type, voltage, amperage, measure of added substance, and measure of distilled water.

## A MORE CREDIBLE ARTIFICIAL INTELLIGENCE PROGRAM

Edwin Rachwal

Dutch Fork

This project deals with designing a basic artificial intelligence program that is able to obtain more credible websites for a user who does not wish to be bothered with results from websites such as Twitter or Facebook. Artificial intelligence programs such as Watson of IBM and Siri of Apple have revolutionized the AI world, but we are still a long way away from AI units being able to 100% function and “think” like humans. This program will assist people who are working on school projects, for example, and need to find credible and useful information that will aid them in completing their task. The user interface for this project will be fairly simple and will consist of solely a field in which to type what the user is looking for and an area that will display the results of the search after invalid sources have been filtered out.

## THE COMPARISON OF THE MINIMUM INHIBITORY CONCENTRATIONS OF ALLIUM SATIVUM, TRACHYSpermum AMMI, AND HYDRASTIS CANADENSIS ON ENTEROBACTER AEROGENES.

Teebro Rahman

Spring Valley High School

As humans continue to use antibiotics to fight off bacterial infections, bacteria are quickly evolving to gain stronger resistances to many of the antibiotics we use. An alternative is needed that is cost-effective, has potent antibacterial properties, but one that does not cause the bacteria to gain resistances quickly and render it ineffective. The purpose of this experiment was to find botanical alternatives to many of the common antibiotics we use in today's society. So, 3 different plant extracts were compared, using minimum inhibitory concentration tests. The plant extracts were made into 3 different standard solutions e.g. 100%, 25%, and 6.25% for each of the 3 plant types, and then compared with each other along with a control group to find the lowest concentration of each plant extract that contained bactericidal properties. 10 trials were done for each of the 10 treatments. This was done by applying 0.3 mL of a treatment to a microtiter well and then inoculating it with bacteria, and counting the subsequent colonies. The lowest concentration with a statistically significant mean colony count was considered to be the MIC. An one-way ANOVA was performed,  $F(9,91)=2.01$ ,  $p=.047$ , and since  $P\text{-value} < \alpha$  value(.05), a significant statistical difference among treatment types was detected. However, post-hoc analysis Scheffe tests could not find any specific significant

differences for *E. aerogenes* colonies among treatment types, therefore no minimum inhibitory concentrations could be conclusively determined in this study.

## THE DESIGN AND EX-SITU TESTING OF A PROTOTYPE CHOPPED LASER REFLECTIVITY TOOL FOR USE IN ULTRA-HIGH VACUUM

Alyssa Ralph

Governor's School for Science and Mathematics

Mentor: Chad Sosolik, Department of Physics & Astronomy, Clemson University

Advisor: Clyde J. Smith

Traditional diamond growth involves high-pressure and high-temperature techniques which are both complex and expensive to implement. As part of an effort to explore new growth methods which utilize lower pressures and energetic ions, flexible techniques for monitoring growth are required. Laser reflectivity is one candidate method to measure diamond growth rates and structural changes in an ultra-high vacuum environment. In particular, laser reflectivity has the advantage of providing measurements without breaking vacuum or removing the growth substrate. In order to implement this method in-situ, baseline tabletop measurements of the behavior and interactions of a He-Ne laser and associated equipment were made ex-situ. The experimental set-up included a mechanically chopped He-Ne laser which was reflected from materials under various conditions such as cleaned and dosed surfaces, different metals, surfaces under heat application, and measurements with artificially introduced light pollution. The chopped laser reflected from these surfaces was detected using a photodetector plus lock-in amplifier set-up. The lock-in-measured voltages gave peak voltage values consistent with non-interference from light pollution. Additionally, the set-up gave voltage vs. time plots which were time-stable and insensitive to ambient conditions at a level which warrants a transition of the design for future testing in-situ. If successful, this will provide a low-cost, non-destructive method for tracking diamond and other thin film growth.

## A COOL LOOK AT EFFICIENT ROOFING

Samuel Rennick

The Center for Advanced Technical Studies

The research involved in this project attempts to answer the fundamental question, if dark colors absorb heat then why are the roofs on almost all of South Carolina houses black? The project focuses on the differences in the thermodynamic properties of various roofing materials. This study will enable consumers to make informed decisions concerning potential savings in utility costs for cooling homes in the hot summer months, while reducing the stress on the cooling system of a house and indirectly eliminating greenhouse gas emissions. The project began with a proof of concept experimentation using a small foam board house with black and white interchangeable roofs. Sixteen minute trials were conducted using high intensity lamps and multiple temperature probe recording devices in the scale house. Each trial begins with one minute with no lamps on to obtain a baseline temperature for the house interior, attic space, and roof surface temperature. Results from these tests show that white-colored roofs reach a significantly lower maximum temperature than compared to black-colored roofs. The next experimental phase consisted of building large, interchangeable wood roof pallets to fit a wood scale-model home. A black asphalt shingle roof, white shingle roof, galvanized steel roof, and a white metal roof were constructed. Experimental trials were designed using two 1,200 Watt halogen lamps to act as an indoor, controlled sun. The experimental trials consisted of a five minute base temperature acquisition, a nine hour interval under the lamps and a four hour cool-down interval. The trials have so far concluded that the white metal roof is up to 40% cooler than the black shingled roof.

## THE GENE HSF-1 IS REQUIRED FOR CBE MEDIATED PROTECTION AGAINST ALZHEIMER'S DISEASE IN CAENORHABDITIS ELEGANS

Logan Richardson

Governor's School for Science and Mathematics

Mentor: Yuquing Dong, Department of Biological Sciences, Clemson University

Advisor: Stephen Kaczkowski

Aging remains an unavoidable process associated with numerous medical complications such as Alzheimer's disease (AD), Parkinson's disease (PD), and Huntington's disease (HD), but certain Nutraceuticals have been found to reduce the effect of aging and stress in various model organisms. Recent studies from our lab have suggested that cranberry extract (CBE) at an optimum concentration has

an anti-aging and anti-stress effect in the nematode model system *Caenorhabditis elegans*. CBE supplementation acts through the insulin/IGF-signaling pathway via DAF-16 and components of p-38 MAP kinase pathway. In our study, we observed that CBE can ameliorate the symptoms of Ab1-42 mediated toxicity in transgenic *Caenorhabditis elegans* where Alzheimer's disease was modeled. There was a delay in Alzheimer's disease mediated paralysis in CBE treated nematodes. Using an RNAi feeding library, various genes were silenced in worms including *hsf-1*. A paralysis assay was carried out to check to see if the genes were involved. *hsf-1* was found to be essential for CBE mediated protection against AD.

THE EFFECT OF SCARIFICATION WITH 3% HYDROGEN PEROXIDE  
SOLUTION, 3% HYDROCHLORIC ACID SOLUTION, OR 3% ISOPROPYL  
ALCOHOL SOLUTION ON THE SEEDS GERMINATION RATE OF WISCONSIN  
FAST PLANTS (*BRASSICA RAPA*)

Isabelle Robinson  
Heathwood Hall

This study investigated the effect of scarification with 3% hydrogen peroxide, 3% hydrochloric acid, and 3% isopropyl alcohol, on the germination rate of Wisconsin fast plant seeds. This study is beneficial for gardeners and botanist that desire to know what chemicals negatively affect germination rate of Wisconsin fast plant seeds. This investigation could make an impact in what gardeners or botanist use for the planting of Wisconsin fast plant seeds. The motivation in doing this project was to discover how seed growth can be influenced by outside chemicals. The problem that was being studied was the rate at which a Wisconsin Fast Plant seeds germinated in regard to the liquid that the seed was presoaked in. In order to make progress in solving our problem the seeds were soaked the seeds in 3% hydrogen peroxide, 3% hydrochloric acid, and 3% isopropyl alcohol solutions, and then they were planted. The amount of seeds germinated was then measured every day for the next week. The hypothesis was, if a Wisconsin fast plant seed was scarified in 3% hydrochloric acid, then the germination rate would be more negatively affected than if the seed were scarified in 3% hydrogen peroxide, or 3% isopropyl alcohol. The results, supporting the hypothesis, indicate that the only liquid that affected the germination rate of the Wisconsin fast plant seeds was 3% hydrochloric acid. This was also the conclusion of the experiment. These results will prove beneficial to a small group of people, if they are beneficial at all.



## ANALYZING THE PROFITS OF BITCOIN MINING IN RESPECT TO POOL CONTRIBUTION

Derek Rodriguez  
Dutch Fork High School

Recent years have shown the rise of cryptographically enforced currencies, the most notable of these being bitcoin. Instead of relying on a central organization to regulate the currency to ensure its functionality, anonymous computer systems work together in the form of pools to verify transactions by processing their respective cryptographic hashes to verify the integrity of the transaction. Computers that verify these transactions are rewarded with a payout in bitcoins. This research will consist of using an application-specific integrated circuit (ASIC) to verify bitcoin transactions in these pools to determine the relationship between the payout system of the pool and the workload contribution that the specific ASIC grants to the server. The hypothesis based on current theoretical information is that there should be a zero-order correlation between contribution and data, because larger pools with more processors must divide payout rewards into smaller portions, whereas smaller pools spend more time working on the hashing and less time queuing for a new transaction. Therefore, over extended periods of time, change in the percentage contribution should not affect the net bitcoin revenue of the ASIC. However, analyzing the data using Pearson's product-moment correlation produces an r-value of -0.35, and visualizations suggest a negative correlation, which does not agree with the current hypothesis.

## THE EFFECT OF WHITENING PRODUCTS ON THE COLORATION OF TEETH

Sharmila Samuel  
Greenville Technical Charter High School

Many people use whitening products in hope of whiter smiles, but not all products work the same way. One brand of whitening strips may white faster compared to another whitening strip based on the amount of hydrogen peroxide used. In this experiment, the effectiveness of different over-the-counter teeth whitening products will be tested. The products will consist of whitening strips, whitening paste, and home-made whitening. Each brand contains a different amount of hydrogen peroxide, which has the most effect on the quality and time of the whitening. To test this, teeth will be stained and the chosen whitening product will be used to remove the stain. The products will be used for approximately two weeks, close to the approximate amount of time required to use these products to see results. After the

treatments, the teeth will be compared to a color chart as well and a fully stained tooth

## UNDERSTANDING THE IN VIVO ROLE OF FZLC IN BACTERIAL CELL DIVISION THROUGH A LONG TERM GROWTH COMPETITION

Maddie Sansbury

Governor's School for Science and Mathematics

Mentor: Erin Goley, Department of Biochemistry, Johns Hopkins University

Advisor: Jennifer Taylor

Understanding the mechanisms behind cell division allow for multiple improvements to be made in the biochemical field. *Caulobacter Crescentus*, an aquatic bacterium is a distinct example of asymmetric cell division. *Caulobacter Crescentus* divides using a Z ring composed of the GTPase FtsZ. FtsZ is known to localize the inner membrane division protein, FzlC, to mid-cell. FzlC is thought to tether FtsZ to the cell wall but is not necessary for cell division. When FzlC is removed from *Caulobacter Crescentus*, the cells maintain proper function and morphology. The exact mechanism FzlC plays in cell division is unknown. To better understand the role FzlC plays in *Caulobacter Crescentus* cells, we conducted a long term growth competition assay. This was used to test whether cells containing FzlC had a growth advantage over cells lacking FzlC ( $\Delta fzlC$ ). Based on previous experiments, our hypothesis was that over a long period of time, wild type cells would eventually out compete the  $\Delta fzlC$  cells. Our results did not support our hypothesis and showed that there is no significant difference between wild type cells and  $\Delta fzlC$  cells. Perhaps, one explanation for this result is that FzlC works with another protein in the cell. If this were the case, removing only FzlC would have no effect but removing FzlC and another protein would cause a change in the cell. In the future, after a better understanding is reached, knowledge of the divisome will better help us assess known issues with cell division.

## THE EFFECT OF LEPTIN RECEPTOR ANTAGONIST ADMINISTRATION ON RAT SKELETAL MUSCLE METABOLIC GENE REGULATION

Mathias Schreiner

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Mentor: James Carson, Department of Exercise Science, University of South  
Carolina

Advisor: Bhuvana Parameswaran

In 2010, the obesity epidemic claimed the lives of almost 80,000 Americans and was the 7th leading cause of death in the country. A better understanding of leptin's role in obesity should bring scientists closer to identifying therapies that successfully prevent or treat the condition. Leptin regulates metabolism and hunger, and increases proportionally to adiposity. Leptin receptor antagonists (LRA) block the activity of the leptin receptor (Ob-R). The purpose of this study is to determine the effects of LRA on skeletal muscle metabolic gene expression. We hypothesize that rats injected with LRA will have lower expression of skeletal muscle metabolic genes than rats given placebo treatment. Male rats were injected with either leptin antagonist or a vehicle every day for 16 days. A subset of rats were removed from the antagonist treatment and sacrificed ten days later. A leptin injection was administered to all treatment groups 45 minutes before sacrifice. Muscle was harvested for analysis during sacrifice. mRNA levels of mitochondrial biogenesis (PGC1) and glucose transport (GLUT4) genes were measured by quantitative PCR. LRA administration significantly increased rat body weight,  $p < 0.02$ . Removal from antagonist treatment normalized body weights to control levels. Increase in fat weight accounted for much of the overall weight increase,  $p < 0.05$ . Muscle: weight ratios were significantly lower in LRA-treated mice than in other groups,  $p < 0.01$ . A better understanding of the leptin receptor's role could eventually lead to better treatment options for patients.

## CLOT OR NOT? COMPLICATIONS OF WARFARIN AND ANTIBIOTICS

Anna Scott

The Center for Advanced Technical Studies

Many patients are on the blood thinner warfarin and antibiotics at the same time. This could be potentially dangerous to the patient if they are not closely monitored by a doctor. Depending on the antibiotic, the blood could become too thin or too thick leading to excessive bleeding or a clot. These issues would cause the patient to stay in the hospital for a longer time period to keep them safe. Information will be collected from many patients who have been prescribed warfarin. If patients are

over the age of 18, have been on warfarin for greater than 48 hours, and their INR (blood thickness) is in range, they will be included in research. The patients that are collected will then be separated into two groups, one with patients just on warfarin and the other with patients on warfarin and antibiotics. No significant data has been collected yet. After looking at the patient information, the expected outcome is when patients are on warfarin and antibiotics, their medication dosage will be adjusted. If the dosage is not adjusted quickly enough, it is expected that the patient will stay in the hospital longer because the blood is out of range.

## SYNTHESIS OF AG-AU-AG CORE-SHELL-SHELL NANOPARTICLES

Olivia Sequerth

Governor's School for Science and Mathematics

Mentor: Jamie Lead, Department of Environmental Health Services, University of  
South Carolina

Advisor: Kurt C. Wagner

Nanoparticles are now being used in a wide range of products due to their unique physical and chemical characteristics. Silver nanoparticles are one of the most popular due to their antimicrobial properties. With the amount of silver nanoparticles increasing in use, it is useful for us to look at the environmental impact they have, which, in the majority of cases, has shown to be toxic. To lessen their impact without stopping their production completely, we synthesized a silver nanoparticle that consisted of a three layer structure. A silver core was coated with a gold shell and capped with a second silver layer. The gold layer has a low solubility in water and so should reduce the risk of the nanoparticle completely dissolving and reducing the release of ions into the environment. The experiment started with the creation of a silver seed particle, which would later become the core, using a mixture of silver nitrate, sodium borohydride, and disodium citrate dihydrate. The concentrations were varied to produce a range of sizes until we could produce them with the same consistently. Next, we added a gold layer and then another silver layer of a different isotope so that we would be able to detect whether the gold layer prevented the silver core from dissolving into the environment. The AFM, UV-Vis, and DLS were used to determine the size, absorbance peak, and images of the nanoparticles throughout the process.

## EFFECT OF SALINITY ON THALASSIA TESTUDINUM GROWTH

Ryann Shealy  
Dutch Fork High School

*Thalassia testudinum* is a marine grass that grows along the coast of the Gulf of Mexico. It is the main food source of many different species of endangered turtles, which are key animals in the ecosystem's food web. Climate change melts glaciers which causes the salinity of the ocean to decrease. If this change in salinity affects *Thalassia testudinum*, then it could negatively affect the several populations and disturb the ecosystem. It is hypothesized that as the salinity increases or decreases, the growth of *Thalassia testudinum* will decrease. *Thalassia testudinum* was grown in varying salinities between 0.00 ppt and 60.0 ppt and a pH of 8. If the results show that the growth of *Thalassia testudinum* is decreased by salinity change, then global climate change could affect the ecosystem through *Thalassia testudinum*. If these results were concluded, then it would create a greater awareness for global climate change.

## THE EFFECT OF THE ADDITION OF ZINC SULFATE HEPTAHYDRATE ON INHIBITING THE REPLICATION OF COLIPHAGE T4(T4R+)

Nigam Sheth  
Spring Valley High School

Recently there has been great talk about Zinc as a natural alternative to today's harsh, chemically manufactured antiviral drugs. It's a relatively new field of antiviral medicine but shows great promise from studies. The purpose of this experiment was to observe if zinc sulfate heptahydrate could inhibit the replication of the Coliphage T4(T4r+) virus. It was hypothesized that the zinc sulfate heptahydrate would inhibit the replication of the virus, because it would deem cell membranes impermeable to the viral sheaths. The methods used in this experiment were to prepare 32 petri dishes with nutrient agar and culture E.Coli B on each plate as a medium to observe the inhibitory effects of the zinc sulfate heptahydrate. The dishes were then infected with the virus, given a prescribed amount of zinc, and overlayed with an agarose solution to develop plaques, which is how the inhibition was quantified. The control dish received all the aforementioned procedures except for the addition of zinc sulfate heptahydrate. By finding a correlation coefficient it was found that 92.73% of the inhibition was due to the zinc sulfate heptahydrate. A regression analysis was also done finding a strong negative correlation in the number of plaques per dish with a higher concentration of zinc sulfate

heptahydrate. Therefore, it can be concluded that zinc sulfate heptahydrate had significant power to inhibit the replication of Coliphage T4(T4r+).

## ROLE OF NRF2 TARGET GENES IN RESPONSE TO THYMIDYLATE SYNTHASE INHIBITORS IN HUMAN COLON CANCER

Paul Shim

Governor's School for Science and Mathematics

Mentor: Franklin Berger, Department of Biological Sciences, University of South  
Carolina

Advisor: Jennifer Taylor

Thymidylate synthase (TS) is involved in the de novo synthesis of thymidine-5'-monophosphate (TMP) and is the target for the chemotherapeutic agent, 5'-fluoro-2'-deoxyuridine (FdUrd). The effectiveness of FdUrd chemotherapy is often hindered by the development of drug resistance commonly associated with increased levels of TS. It has recently been shown that NF-E2 related factor (Nrf2), a master regulator of antioxidant response, is involved in resistance to chemotherapy including FdUrd. In this study, we examined the expression levels of several Nrf2 target genes in various colorectal cancer cell lines that have developed resistance to FdUrd. In most of the cell lines in which the levels of TS were increased, the levels of the Nrf2 target gene expression were downregulated. Resistance to chemotherapy tends to correlate with an increase in TS levels but a decrease in Nrf2 levels. Further studies will allow us to determine if Nrf2 target gene downregulation is mechanistically linked to FdUrd resistance.

## DEVELOPMENT OF A SYSTEM TO ANALYZE CHANGING THIN FILM SUBSTANCES ON A REFLECTING SURFACE

Andrew Shore

Governor's School for Science and Mathematics

Mentor: Chad Sosolik, Department of Physics & Astronomy, Clemson University

Advisor: Clyde J. Smith

Diamonds can be grown by various methods using large force and/or energy. One method of doing this is bombarding a surface with highly charged ions in an ultra-high vacuum environment to promote the formation of carbon into the sp<sup>3</sup> or diamond-hybridized form. The purpose of this study is to understand the optimal mechanics of designing a system to analyze the change of a thin film on a surface, with the ultimate goal of analyzing carbon films. The design was created in steps,

starting with the testing of the He-Ne laser using a Michelson interferometer, then the effectiveness of a photodetector using an oscilloscope, and finally a chopper wheel and lock-in amplifier were added in replacement of the oscilloscope to find the most effective frequency and number of slits on the chopper wheel. The system was evaluated by creating a series of voltage vs. time graphs to analyze the system with a nearly continuous data stream. A comparison with a plain sample (control), water film, and ethanol film was used to see how different films evaporated. Each film, and the control, was then heated to see how temperature affects the change in film over time. Results show that the film does alter the voltage reading and that heat speeds up the reaction but can also lower the output voltage due to warping of the reflecting material. This process will be used in situ to analyze the change of films on surfaces without having to break vacuum or otherwise contaminate the sample.

## THE EFFECT OF VANITY AND HEALTH MOTIVATION ON WEIGHT LOSS

Rachel Shroyer

Spring Valley High School

Obesity is now almost classified as an epidemic. The purpose of this research was to discover how to motivate obese or overweight individuals to lose more weight. This will help decrease the obesity rates around the world. It was hypothesized that if a person's motivation to lose weight was vanity based, then they would lose more weight than a person whose motivation to lose weight was because of health. A questionnaire was developed asking the age, gender, and primary motivation for each new patient admitted to Waistlines, a weight loss clinic. All patients that started the program after January 2013 were asked to participate. Body mass index (BMI) and blood pressure were collected every two weeks for three months. The primary motivation in the questionnaire was categorized as either health or vanity. All but two males were motivated by health. There was no significant BMI difference between health or vanity,  $F(2,65)= 1.64$ ,  $p=0.203$ . However, there was a slight difference in BMI that suggested that health-motivated participants had a lower BMI than vanity-motivated participants. The results suggested that both males and females are most likely to lose weight for health reasons.

## THE EFFECT OF MOTOR OIL CONCENTRATION ON THE COLONY COUNTS OF PSEUDOMONAS FLUORESCENS AND PSEUDOMONAS PUTIDA

Rakib Siddique  
Spring Valley High School

The use of natural agents to break down hydrocarbons, known as bioremediation, became of increased relevance in several studies after its proven efficiency as an alternative cleanup method for the 1989 Exxon Valdez oil spill. The purpose of this research was to determine the concentration of motor oil at which the most bacterial growth occurred as evidence that the bacteria were able to utilize petroleum hydrocarbons as an alternative source of nutrition. It was hypothesized that more colonies would grow in petri dishes containing relatively light concentrations of motor oil. Each petri dish, with exception to those in an unpolluted control group, contained either a light or heavy concentration of motor oil mixed with non-nutritive agar and was then randomly inoculated with either *Pseudomonas fluorescens* or *Pseudomonas putida*. It was found that the colony counts were significantly different for the petri dishes that were incubated with *Pseudomonas putida*;  $F(2,28)=97.63$ ,  $p<0.05$ , and a Scheffe test showed there were significant differences between pairs control versus light concentration, control versus heavy concentration, and light concentration versus heavy concentration. It was also found that colony counts were significantly different for the petri dishes incubated with *Pseudomonas fluorescens*;  $F(2,26)=159.81$ ,  $p<0.05$ , and a Scheffe test showed there were significant differences between pairs control versus light concentration and control versus heavy concentration. Future research evaluating the potential of bioremediation can study the effect of environmental factors, such as temperature and nutrients, on the ability of various organisms to consume petroleum hydrocarbons.

## THE EFFECTS OF CRANBERRY ON SILENCING SKN-1 AND PMK-1 PATHWAYS IN THE AGING OF C. ELEGAN WORMS

Ronak Sitapara  
Governor's School for Science and Mathematics  
Mentor: Yuqing Dong, Department of Biological Sciences, Clemson University  
Advisor: Stephen Kaczkowski

One of the best model organisms to study aging, stress response, and age related pathologies is the *Caenorhabditis Elegan* due to its short lifespan and ease of handling. These nematodes are used as model organisms to study numerous age related pathologies including protein build up that leads to Alzheimer's Disease



(AD). In this study, it was observed that Cranberry extract (CBE) protects the worms against A-beta mediated paralysis as well as what pathways might play a key role in this process. RNAi mechanisms were used to silence certain genes of interest and a paralysis assay was performed to check for the progression of the paralysis phenotype. This assay involved an observation of the worms every 2 hours to see the progression of paralysis, and this would provide an idea about the rate of paralysis. Previously, it was hypothesized that *skn-1* and *pmk-1* mediated pathways played a key role in this process. The study showed that these factors were not involved in this protection process provided by CBE.

## THE EFFECT OF POMACEA DIFFUSA SNAIL MUCUS ON THE INHIBITION OF ESCHERICHIA COLI

Adiv Sivakumar  
Spring Valley High School

Infections are a common occurrence with wounds because various pathogens find an open wound to be a fitting breeding ground. More feasible and abundant sources of protection against such infections would be quite helpful to medical institutions and people around the world. The purpose of this study was to see if snail mucus could serve as a potential inhibitor of *E. coli*. It was hypothesized that if *Pomacea diffusa* snail mucus is smeared on dishes of *E. coli*, then the snail mucus would inhibit the growth of the *E. coli*. This experiment was carried out by having 2 groups: the control group with no treatment and the independent variable group with the snail mucus treatment. Each group had 5 petri dishes each divided into 4 zones cultured with *E. coli* bacteria. The mucus treatment was applied to the independent variable group, and all the petri dishes for both groups were incubated for at least 24 hours. The dishes were then taken out to determine the zones of inhibition of the *E. coli* for the treatment and to calculate the average for each group. A t-test was conducted to compare the averages of the two groups and see if there was a significant difference. Because the p-value (0.4370) was greater than  $\alpha$  (0.05), the null hypothesis that the sample means were equal was not rejected. The mucus treatment did not significantly inhibit the *E. coli* growth.

## ROLE OF QUANTUM EFFECTS IN THE INTRAMOLECULAR PROTON TRANSFER IN 10-HYDROXYBENZO[H]QUINOLINE

Michael Slattery

Governor's School for Science and Mathematics

Mentor: Sophya Garashchuk, Department of Chemistry & Biochemistry, University  
of South Carolina

Advisor: Phelesia Jones-Cooper

When 10-hydroxybenzo[h]quinolone (HBQ) is in an excited state, proton transfer within the molecule is possible. Our research aims to replicate the proton transfer studies of Lee et al. using HBQ. The primary focus of the investigation was to verify the theoretical predictions of proton transfer. The structure of this heterocyclic system, HBQ, was most suitable for the study of excited state intramolecular proton transfer. The state of the molecule during the proton transfer was studied using computer simulations. In this study, proton transfer was found to occur when the molecule was in a triplet electron spin configuration and tunneling occurred when using deuterium. We concluded that tunneling was dependent on energy as well the mass of a transferred particle. Furthermore, the proton transfer only occurred in an excited state. Future experiments are projected that will involve more in depth investigation on the tunneling effects.

## THE CORRELATION BETWEEN LEVEL OF SPIRITUAL/RELIGIOUS STRENGTH AND LEVEL OF PERCEIVED SOCIAL SUPPORT IN VETERANS DIAGNOSED WITH POST-TRAUMATIC STRESS DISORDER

Dorothy Smith

Spring Valley High School

Throughout history, the number of men and women diagnosed with post-traumatic stress disorder (PTSD), a disorder caused by enduring a traumatic event, "outside the range of usual human experience," has rapidly increased (Chamberlin, 2012). As a result of current wars, twenty to thirty percent of veterans return with PTSD. Because there is no definite cure for PTSD, the correlation between two known variables, such as religious strength and perceived social support, is important to know for application and manipulation. It was hypothesized that there would be a positive correlation between the two variables. Surveys were compiled using the Multidimensional Scale of Perceived Social Support and the Duke University Religious Index and distributed to 30 veterans with the diagnosis of PTSD and 57 without. Of the fourteen correlation coefficients

found between the subscales of the survey, three showed a significant correlation; perceived social support (PSS) and religious strength,  $r(30) = -0.402$ ,  $p < 0.02$ , PSS from friends and non-organizational religious activity,  $r(30) = 0.514$ ,  $p < 0.02$ , and PSS and intrinsic religiosity,  $r(30) = -0.487$ ,  $p < 0.02$ . It was also found that veterans with the diagnosis of PTSD have significantly lower levels of PSS and of religious strength than those without. ( $z(57, 30) = 2.335$ ,  $p < 0.02$ , and  $z(57, 30) = -4.410$ ,  $p < 0.02$ , respectively) Because of the insignificant/unexplained correlations, it was concluded that the hypothesis was only somewhat supported by the data and further research is necessary.

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Carter Smith

Heathwood Hall Episcopal School

This study investigated the effect of scarification with 3% hydrogen peroxide, 3% hydrochloric acid, and 3% isopropyl alcohol, on the germination rate of Wisconsin fast plant seeds. This study is beneficial for gardeners and botanist that desire to know what chemicals negatively affect germination rate of Wisconsin fast plant seeds. This investigation could make an impact in what gardeners or botanist use for the planting of Wisconsin fast plant seeds. The motivation in doing this project was to discover how seed growth can be influenced by outside chemicals. The problem that was being studied was the rate the a Wisconsin Fast Plant seeds germinated in regard to the liquid that the seed was presoaked in. In order to make progress in solving our problem the seeds were soaked the seeds in 3% hydrogen peroxide, 3% hydrochloric acid, and 3% isopropyl alcohol solutions, and then they were planted. The amount of seeds germinated was then measured every day for the next week. The hypothesis was, if a Wisconsin fast plant seed was scarified in 3% hydrochloric acid, then the germination rate would be more negatively affected than if the seed were scarified in 3% hydrogen peroxide, or 3% isopropyl alcohol. The results, supporting the hypothesis, indicate that the only liquid that affected the germination rate of the Wisconsin fast plant seeds was 3% hydrochloric acid. This was also the conclusion of the experiment. These results will prove beneficial to a small group of people, if they are beneficial at all.

## THE EFFECT OF ROSMARINUS OFFICINALIS EXTRACT AND THYMUS VULGARIS EXTRACT ON THE GROWTH OF CYANOBACTERIA

Arya Soman  
Spring Valley High School

Eutrophication is the excessive load of nutrients within a body of water, causing excessive phytoplankton growth, while killing the other organisms that inhabit the environment. Cyanobacteria are a type of phytoplankton that thrive in eutrophic waters. Cyanobacterial blooms produce toxins which make the body of water uninhabitable for other organisms. Current methods of inhibiting cyanobacterial growth are often expensive and cause more harm to the environment. The purpose of this experiment was to find an environmentally friendly method for reducing cyanobacterial blooms and improving water quality by using natural plant extracts. It was hypothesized that the highest amount of *Rosmarinus officinalis* extract (5 mL) would be the most efficient for inhibiting cyanobacterial growth. *Microcystis aeruginosa* was inoculated into bowls and was grown for 13 days. The rosemary and thyme extracts were then prepared by adding 10.95 g of each herb into 500 mL of distilled water and boiling it for about 35 minutes. Each amount of extract (0 mL, 1 mL, 3 mL, and 5 mL) was then pipetted into their respective test tubes containing the *Microcystis aeruginosa* and were grown for an additional two days. Then the %Absorbance of each test tube was measured using a spectrophotometer. Data were statistically analyzed at alpha equal to 0.05 with an ANOVA. There was not enough evidence to suggest that there was a difference between the means of each amount of the extracts,  $F(7, 97)=1.095$ ,  $p= 0.373$ , therefore the hypothesis was not supported.

## STATEWIDE OCCUPATIONAL TRENDS IN SOUTH CAROLINA INFORMATION TECHNOLOGY

Kayla Sommers  
Governor's School for Science and Mathematics  
Mentors: Karl McColleston, IT-oLogy  
Advisor: Robert Fletcher and Jeff Wisdom

From 2010 to 2012, the total number of jobs in the United States grew by 2.5%, to 130 million, while wages for these jobs grew by 3.1%, to \$45,790. This study focused on whether the same growth rates held true in the IT job market of the United States and, more specifically, in South Carolina. In the U.S., IT job growth outpaced overall job growth, increasing at 7.6%, leading IT jobs to rise as a percentage of total jobs, from 4.8% to 5.1%. While IT wage growth slightly trailed that of the overall job

market, growing at only 2.1% percent, IT wages remained significantly higher than the average wage by 52.6%. In South Carolina, researchers examined the three largest Metropolitan Statistical Areas (MSAs): Charleston, Columbia, and Greenville. Findings from this research, in summary, revealed that (1) the MSA with the greatest IT job increase was Charleston, which grew at 5.9% to 10,284; (2) the MSA with the greatest IT wage increase was Greenville, which grew by 6.9% to \$59,361; and (3) the MSA with the greatest percent of IT jobs in the state was, for all three years, Columbia, however, its lead declined from 26.3% to 23.3%.

## EFFECT OF FREE TUBULIN ON VOLTAGE-DEPENDENT ANION CHANNEL DURING RESPIRATION IN CANCER CELLS

Gina Song

Governor's School for Science and Mathematics

Mentor: John J. Lemasters, Department of Drug Discovery & Biomedical Sciences,  
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Advisor: Bhuvana Parameswaran

Two mechanisms of cellular respiration are glycolysis and mitochondrial metabolism. In the Warburg phenomenon, proliferating cells, including cancer cells, mostly generate ATP through increased aerobic glycolysis and not through mitochondrial oxidative phosphorylation. Since previous research has shown that free tubulin regulates VDAC's conductance and mitochondrial metabolism in cancer cells, the hypothesis of this research states that high free tubulin in cancer cells blocks VDAC and suppresses respiration in the Warburg metabolism and that reversal of tubulin inhibition of VDAC will have an anti-Warburg effect that enhances respiration and decreases glycolysis. The aim of this research is to determine the role of free tubulin for Oxygen Consumption Rate (OCR) and Extracellular Acidification Rate (ECAR) using a XF Seahorse Analyzer in increasing or decreasing respiration in cancer cells in the presence or absence of drugs that stabilize or destabilize microtubule polymerization. The HepG2 cells were treated with three different drugs: 10 $\mu$ m Nocodazole, 10 $\mu$ m Colchicine, and 10 $\mu$ m Paclitaxel respectively. The results indicate that the tubulin drugs had no effect on Oxygen Consumption Rate and Extracellular Acidification Rate. Therefore, closing VDAC had no effect on respiration. These results indicate that proliferating cells shut out oxidative phosphorylation by a different mechanism. For future research, one could consider altering the drug dosage concentration for each microtubule destabilizer and stabilizer or using different tubulin drugs to see if they have a different effect on HepG2 cells.

## EFFECT OF ACONTIUM NAPELLUS, SULPHUR, AND PHOSPHORUS AS HOMEOPATHIC REMEDIES ON STREPTOCOCCUS PNEUMONIAE

Morgan Sox  
Dutch Fork High School

This experiment is studying the effects of common homeopathic remedies, Aconitum napellus, Sulphur and Phosphorus on Streptococcus pneumoniae, a bacteria commonly associated with community-acquired pneumonia. Homeopathy is used as an alternative to damaging and costly antibiotics in order to aid the body in curing itself; however it is a common belief that effects from these remedies are a result from the placebo effect. This experiment either disprove or accepted the hypothesis that as the dose of homeopathic medicine increases, the amount of bacteria left remains unchanged. If the remedies had a positive effect on the bacteria then the Streptococcus pneumoniae will not continue to expand. The methods of this experiment include the application of these homeopathic remedies to the bacteria in varying quantities: the recommended dose, half of the recommended dose and twice the recommended dose. The number of bacteria colonies were counted using one of the following: Gram Stain, Incubator, Hemocytometer, or Spectrophotometer. If the bacteria in the petri dishes diminished or stopped increasing and the T-test stated that the results are statistically significant, then it would be safe to conclude that the used homeopathic remedies did not only treat the body, but also affect the bacteria and further aid the curing process. However if the bacteria continued to increase and the results of the T-test concluded statistical irrelevance, then it can be concluded that the homeopathic remedies used rely solely on aiding the body and/or the placebo effect. Keywords: Streptococcus Pneumoniae, Homeopathy, Aconite, Sulphur, Phosphorus

## USING SIMON AS AN EFFECTIVE SCREENING TOOL FOR COGNITIVE IMPAIRMENT

Rose Steptoe  
Dutch Fork High School

Cognitive impairment is a growing problem in the U.S. as the population of the elderly increases. Cognitive impairment has many indicating tests with varying levels of accuracy and efficiency; however, there may be other tools that are faster or more sensitive. This study focused on the use of the Simon Game, a game which tests memory while simultaneously incorporating spatial and learning skills, as a screening tool for cognitive impairment. Simon was administered to 100

participants over the age of 65, with a brief, standardized explanation before the screening. All patients were also administered the Mini Mental Status Examination (MMSE), a current, widespread screening tool used to test for cognitive impairment. All patients' Simon scores were compared to their MMSE scores, and then the correlation between the two was determined. It was hypothesized that the Simon game scores and MMSE scores of the 100 participants would have a positive correlation. A positive correlation would indicate the potential of Simon as a screening tool.

## DOES INDIVIDUAL AND ENVIRONMENTAL SIMILARITY AFFECT PROBLEM SOLVING SKILLS?

Hunter Street  
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The effect of surrounding similarity does not improve or decrease the amount of problem solving skills taking place in a classroom. While similar clothing might improve the interaction and treatment of fellow students, as other studies have concluded, decreasing the amount of stimulation and increasing individual similarity has no affect. Therefore, I have concluded that problem solving skills is a combination of personality and idea construction during the time of mental development.

## DOCTOR-PATIENT CONNECTION FROM A MOBILE APPLICATION TO A WEB SERVICE: CONNECTIONMD

Adaya Sturkey  
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Mentor: Tom Finnegan, Center for Innovation & Entrepreneurism, Medical  
University of South Carolina  
Advisor: Elizabeth L. Bunn

The goal of this project was to create a system that connects a smart phone glucometer mobile application to a database and display the information on a web service that is accessible by physicians. The mobile application, which this system was based upon, is an existing application that has a corresponding external device used to gather the information for the application. Microsoft SQL Server was used to create the four-table database. Microsoft Visual Studios was used to create the web service, which consisted of five separate web forms. A business plan was created consisting of five major components. All of the components of the project

were not finished and there are still several projections for the project for the future.

## THE EFFECT OF THE ANGLE OF ATTACK OF THE GOLF SWING ON THE TOTAL DISTANCE THE BALL TRAVELS

William Sullivan  
Spring Valley High School

Every golfer is on a constant quest to hit the golf ball farther. There are many factors that influence the total distance the ball travels. This research focused on the effect of changing the angle of attack. The purpose of this experiment was to discover the angle of attack that would produce the most distance. The angle of attack is the angle relative to the ground of the club head path at impact. This experiment tested angles of attack of -6 degrees, -3 degrees, 0 degrees, 3 degrees, and 6 degrees. It was hypothesized that 6 degree angle of attack would produce a greater total distance than any of the other four angles. Three different participants were used and each participant hit ten shots for each angle of attack. The data for each shot was recorded with a Vector Pro launch monitor device. The 6 degree ( $M = 260.1$ ,  $SD = 13.8$ ) and 3 degree ( $M = 253.5$ ,  $SD = 10.6$ ) angles of attack yielded more distance than the 0 degree angle of attack ( $M = 245.1$ ,  $SD = 11.1$ ), which averaged longer than the -3 degree angle of attack ( $M = 229.4$ ,  $SD = 12.3$ ), and the -6 degree angle of attack ( $M = 213.7$ ,  $SD = 11.1$ ) averaged the shortest total distance. There was a statistical difference from each angle of attack, ( $F(4,145) = 75.77$ ,  $p < .001$ ). Tukey tests were performed and it was found that the 3 degree and 6 degree angles of attack produced the farthest distance.

## HOW HOMEMADE REPELLENTS AFFECT *BLATELLA GERMANICA* ACTIVITY

Caleb Thomas  
Dutch Fork High School

What this project is attempting is to find a cheap alternative to professional exterminators, of which the price most homeowners are unwilling to pay. This project plans to conduct experimentation on the cockroaches and the effectiveness of homemade repellents, such as mint, bay leaves, garlic, to determine which cheap repellent is the most effective. This will be done by creating a controlled environment in which the cockroaches can't escape, and in which to reach food, the cockroaches must cross a line of repellent that is drawn across the walls, ceiling,



and floor of the environment. The effectiveness of each of the repellents is based on the percentage of cockroaches that cross the repellent within a certain amount of time. So far the data collected has shown that garlic clearly does not work as a repellent, as all of the cockroaches crossed the line. Experimentation has not begun with mint and bay leaves, as supplies are currently being mailed to the research center. Conclusions cannot be deduced from the results so far, as it is not yet clear which repellent is the most effective at repelling.

## CO-CRYSTALLIZING PYRIDYL BIS-UREA MACROCYCLES WITH ALCOHOL GUEST MOLECULES

Graham Tindall

Governor's School for Science and Mathematics

Mentor: Linda Shimizu, Department of Chemistry & Biochemistry, University of  
South Carolina

Advisor: Phelesia Jones-Cooper

The organization of molecules within a crystal can determine their physical properties including melting point and solubility as well as their optical and electronic properties. Shimizu et al. has identified a disk like macrocycle that stacks on top of one another to form vertical, crystalline columns. These columns are packed close together and one might expect that the crystals would be non-porous, but they have been found to absorb gas in a gas absorption test. It was proposed that these columns move apart in order to absorb the gaseous particles and guest molecules that contain a hydrogen bond donor. The purpose of this investigation was to determine if this macrocycle could organize aromatic alcohols by forming co-crystals. The synthesis and purification conditions of the macrocycles were optimized and then different crystallization conditions were tested with a series of alcohol containing guest molecules. Solid state analysis of the co-crystals will reveal more about the optical, electrical and porosity that this compound. It will also exhibit and provide insights into relationships between the crystalline structure and the optical properties.

## THE EFFECT OF DIFFERENT SOIL TYPES ON THE SOUND PRESSURE OF A SOUND WAVE

Prithvi Tippabhatla  
Spring Valley High School

Nowadays, engineers are now able to design more stable buildings that are less likely to collapse if an earthquake were to hit. The rationale of this experiment is that the integrity of a building can be affected greatly by the stability of its foundation. If a building has a weak foundation, it will topple easily and be susceptible to various types of damage. By using soils that utilize their natural characteristics to slow propagation, a building can be assured to have a sturdier foundation upon which the structure and framework is built. It was hypothesized that if peat soil was placed in a box through which sound waves were propagated, then the highest sound pressure values would be exerted. The method of testing was to place each of the soils in an acrylic box through which 1200 Hz sound waves were propagated. Data was collected at ten second increments. Using an ANOVA test (followed by a Tukey test), it was found that the sandy soil, not the peat soil, exerted the largest sound pressure values. At a confidence interval of 90%,  $F(3, 36)$ ,  $p \geq 0.05$ , so it can be concluded that the hypothesis is to be rejected. In conclusion, this experiment confirmed that the soil with the largest sound pressure values were exerted from the sandy soil.

## FUNCTIONAL CHARACTERIZATION OF OSMIR408: A RICE MICRORNA POTENTIALLY INVOLVED IN PLANT RESPONSE TO ENVIRONMENTAL STRESS

Jensen Tomberlin  
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Mentor: Hong Luo, Department of Genetics & Biochemistry, Clemson University  
Advisor: K. Sris

Plant microRNAs (miRNAs) are a category of endogenous non-coding RNAs that impact biological processes, including plant responses to environmental stresses and plant development. The purpose of this research project is to subclone the rice microRNA gene OsmiR408 into a binary vector, and then transform it into *Arabidopsis* via *Agrobacterium* mediated transformation for future analysis. To do this, a 1066 bp of genomic DNA fragment containing full-length cDNA of the OsmiR408 was subcloned into an expression vector, and transformed into *Agrobacterium* via electroporation. The results show that the 1066 bp of DNA fragment was successfully subcloned into the binary vector, pHL651, and the vector

was transformed into *Agrobacterium*. The chimeric vector containing the OsmiR408 was delivered into *Arabidopsis* plant using the floral dip approach. In this research, DNA ligation, DNA digestion, *E. coli* and *Agrobacterium* transformation, colony PCR, plasmid DNA isolation, gel electrophoresis and floral dip transformation techniques were used to conduct the experiments, and determine the results.

## COMPARING MØLLER SCATTERING, MOTT SCATTERING, AND ELASTIC ELECTRON-PROTON SCATTERING

Michael Tuten

Governor's School for Science and Mathematics

Mentor: Steffen Strauch, Department of Physics & Astronomy, University of South  
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Advisor: Mark A. Godwin

This research focused on determining a more accurate proton charge radius. The goal was to use GEANT4 simulation software to design an experiment to measure the radius of the proton, and then perform said experiment in the future to measure the radius. The experiment was set up in the following manner: A particle beam consisting of millions of electrons, positrons, and muons was aimed towards a liquid hydrogen target, and was set so that each particle obtained a momentum of  $100 \text{ MeV}/c$ . A fraction of these particles reacted with the protons within the target, and scattered at various angles. Multiple detectors are positioned around the target, measuring the scattering angle and energy of the scattered particle. Scattered particles with energies of  $10 \text{ MeV}$  or more were of interest and were the focus of data analysis. For particles of interest, the scattering angle and energy data were sent to ROOT data analysis software, which graphed the data and made it interpretable. After interpreting the data, it was found that the simulated data did not agree with theorized data, leading to the conclusion that further modifications need to be made in order to accurately simulate the experiment. These steps may include the use of a different physics package, or a change in the program itself. The research was successful in determining what future action needs to be taken.

## A STUDY OF HYPERBRANCHED POLYMERS AS A LESS TOXIC ALTERNATIVE TO COREXIT IN THE ALGAL SPECIES DUNALIELLA

Reagan Ulmer

Governor's School for Science and Mathematics

Mentor: David Ladner, Department of Environmental Engineering & Earth  
Sciences, Clemson University

Advisor: Kurt C. Wagner

This research intends to test the toxicity of hyperbranch polymers, of molecular weights 1200, 1800, 10000, 70000, and 750000. The polymers were compared to the toxicity of Corexit, a dispersant used in the Deepwater Horizon oil spill of 2008. We performed these tests on Dunaliella, which is a standard saltwater algal species. If hyperbranch polymers prove to be less toxic than Corexit, then they may be able to replace Corexit as the preferred dispersant. To test toxicity, a spectrophotometer was used to measure the optical density of the algae in solution. There was also a group of controls since the dispersants would cause optical disturbance of their own, one of the controls was just algae and media. Since different levels of dispersant would affect the algae differently, several different dispersant to oil ratios were tested; 1:25, 1:50, and 1:100. Each sample was tested in triplicate to minimize error. Each dispersant was also tested with no oil, keeping the different ratios but the second number was the amount of distilled water. The optical density values over the growth period of the algae will show the toxicity of the algae's environment, whether hyperbranch polymers or Corexit hinder algal growth more. This research is in conjunction with a project testing the effectiveness of the different dispersants in oil.

## WIRELESS ENERGY SENSING USING INDUCTIVE COILS

Neal Vaughn

Governor's School for Science and Mathematics

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Carolina

Advisor: Clyde J. Smith

The goal of the research is to sense wireless energy using constructed inductive coils hooked up to a measurement device, which in this case is an oscilloscope. The inductive coils are created by wrapping magnetic copper wire around a cylindrical object such as a soda can. One inductive coil is placed into a breadboard, with wires connecting it to the oscilloscope. A base line wave is then recorded and a second inductive coil is brought near to the first without touching. The goal is to see if there

is a noticeable change in the wave, and to see how adding turns to or changing the diameter of, the secondary coil affects the change in the wave. This can be applied eventually to wirelessly charge devices or to sense a change in a circuit remotely

## PORTABLE THERMAL ENERGY STORAGE IN ZEOLITE ADSORBENT BEDS

Aaron Vincent

The Center for Advanced Technical Studies

This study's objective is to determine the feasibility of the development of an efficient adsorption thermal energy storage system. It is through the reversible process of adsorption in which excess thermal energy can be stored and released for heat. In this study, water was chosen as the adsorbate and different zeolite adsorbents will be tested to determine the effect of pore size on the amount and rate of energy release from the device. Zeolite 3A, 4A, 5A, and 13X will be used as adsorbents. Preliminary tests conducted utilizing zeolite 13X as a control determined that the adsorbent bed device that produces the least heat loss to the surroundings is constructed of Sharkbite PVC and 1 inch thick rubber insulation. This device was used to conduct the remaining tests to determine the effect of pore size on the energy release from the device. It was hypothesized that the energy density would be greater as the pore size of the zeolite approaches the size of a water molecule ( $3\text{\AA}$ ). While zeolite 13X had the highest average energy density of 118.5 kWh/m<sup>3</sup>, it was determined that more data needs to be collected to strengthen the results. This type of technology is desirable due to the reverse process of desorption, which allows the material to be used again and again with no loss of thermal storage efficiency. With the development of such a renewable energy storage device, excess energy can be stored until needed, such as in the solar industry.

## ANALYSIS OF SYNERGISTIC BEHAVIOR OF BIOCIDES AGAINST BIOFILMS IN DRINKING WATER SYSTEMS

Himabindu Vinnakota

Spring Valley High School

Biofilms are responsible for up to sixty percent of all infections in humans. In fact, biofilms are up to 1000 times more resistant to antibiotics than planktonic, or free-floating, bacteria. Several mechanisms are thought to create this resistance, including an altered bacterial metabolic state, the formation of persister cells, and poor penetration of the matrix when antimicrobial treatments are performed on

biofilms. Hence, the need to find methods of effectively preventing and inactivating harmful biofilms is great. Biocides, such as hydrogen peroxide and copper sulfate have succeeded in achieving what antibiotics alone failed to do in eradicating biofilms in water. It was then hypothesized that using a combination of biocides, instead of a single one, would be more effective in eradication. The biofilm was grown in a pilot system developed by researchers that mimicked water's path through plumbing. Hydrogen peroxide, sodium hypochlorite, and free nitrous acid were studied individually and in combination. Heterotrophic plate count (HPC) was used to analyze the presence of bacteria in the drinking water. Residual biocide material was also analyzed using the iodometric method. Lack of significant growth in the biofilm reactor inhibited the results of the experiment. The results recorded were inconclusive among the six treatment with p-values greater than the  $\alpha$  value of 0.05. In conclusion, the hypothesis was refuted. These results will be further analyzed to better the design of the reactor and test different biocide treatments.

## EMOTIONAL ANALYSIS THROUGH ART: SADNESS

Kylie Walker

Dutch Fork High School

Since psychological concepts have been analyzed, psychologists have been trying to define emotions. In recent years the need of these definitions has increased, especially in the behavioral and social sciences. This study analyzes the relationship between the subject's emotional state and the presence sadness imagery in their drawings. One-hundred subjects ages 14-18 of various ethnicities, class difficulty and gender are involved in this study. The participants were then asked to draw their perception of sadness. These drawings were then evaluated according to the colors, themes and line elements that correlate with sadness. After the subjects completed their drawings they took the Emotional State Questionnaire (EST-Q) in order to determine whether the subjects possess high levels of sadness. It was hypothesized that those who have a higher score of sadness on the EST-Q would produce drawings with increased sadness imagery. This connection can be analyzed with techniques of art therapy. Art therapy is the contemporary psychology field that combines psychotherapy and visual arts to help individuals cope with mental and emotional issues. The findings from this study have the potential facilitate professionals when helping their clients cope with their emotions.

## THE ALLELOPATHIC POTENTIAL OF IPOMOEA BATATAS ON THE GROWTH OF DIGITARIA SANGUINALIS

Sara Wallam  
Spring Valley High School

Allelopathy is the ability of plants to affect the growth and development of other plants by releasing allelochemicals into the environment (Ayeni & Kayode, 2013). The purpose of this experiment was to research and test allelopathy and to determine the allelopathic potential of *I. batatas*, sweet potato, on the inhibition of *D. sanguinalis*, crabgrass. Sweet potato plants have allelopathic potential because they contain allelochemicals such as phenolic compounds. It was hypothesized that sweet potato aqueous extracts would inhibit the growth of crabgrass plants and seeds, and root solutions would be the most inhibitory. Sweet potato leaves, stems, and roots were used to make leaf, stem, and root solutions of different concentrations. These solutions were tested on crabgrass seeds and plants for two weeks. The seeds' seed lengths and plants' dry masses were measured. Two one-way ANOVA tests were conducted. Both null hypotheses were rejected because  $F(9, 890) = 326.88$ ,  $p < 0.05$  and  $F(9, 790) = 540.65$ ,  $p < 0.05$ . It was determined that there were significant differences between the dry masses and seed lengths of the crabgrass plants in the different solutions. The results of the Tukey tests showed that all the plants in the solutions were significantly different from the control plants, indicating that crabgrass was inhibited by all of the sweet potato solutions. It was determined that stem solutions were most inhibitory. These results were significant because it was concluded that sweet potato was an effective plant to use to inhibit the growth of crabgrass. This information could be used to make natural herbicides to inhibit weeds.

## THE EFFECTS OF SIGNIFICANT WAVE-HEIGHT ON THE EFFICIENCY OF A LINEAR GENERATOR BUOY

Zachary Wallick  
Spring Valley High School

Linear generators are an effective way to harness transverse ocean wave energy into usable power for electrical appliances. However, significant wave heights are constantly changing with varying weather systems and tides. Because of this, it is necessary to develop an accurate model of the relationship between the wave height, and the relative efficiency of a linear generator designed for harnessing the wave energy. Therefore, in this experiment, a constructed linear generator, utilizing Faraday's law for magnetic induction, was monitored for voltage propagated when

the piston was attached to a peg with a specific radius distance from the axle on an AC gearmotor. The radius, at a certain distance from the center, dependent on the intended wave height, was representative of a sinusoidal wave function. The radius measurements used, which determined the amplitude of the model waves, were one, two, three and four centimeters, comparable to significant wave-heights of two meters, four meters, six meters, and eight meters, respectively. For each radii, 30 trials were conducted. The gearmotor which powered the rotation of the point of attachment, and, therefore, the linear generator, had a speed of 10 rotations per minute. Thus, each modeled wave had a constant period of six seconds. The hypothesis that as the model significant wave-height increases, the voltage generated by the linear generator would increase, but experience lower increases after a certain level, resembling a logistic function, was rejected. It was found that a linear function more closely resembled the correlation of the wave amplitude and voltage produced,  $t(118) = 16.89$ ,  $p < .001$ .

## EDUCATIONAL CORAL REEF GAME

Kevin Wang

Governor's School for Science and Mathematics

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Advisor: Elizabeth L. Bunn

It is often said that people learn better when having fun. Educational video games are designed to be both fun and informative. However, many educational video games are neither fun nor informative. ReefQuest, the game that we created, attempts to be both fun and informative by using the Unity 3D engine to developing an educational coral reef video based on the commercially successful game FarmVille. The game is based on material from the marine biology class at the University of South Carolina. The educational value of the game was then studied by having people play this game and fill in a survey about what they had learned. The results from out pilot study show that, in the same amount of time, people who learn about coral reefs through this game perform better on a test than people who used traditional methods, such as by reading.



## HOW THE AMERICAN SHAD (ALOSA SAPIDISSIMA) REACTS TO BEING INTRODUCED INTO THE BROAD RIVER

Tal Wanish  
Dutch Fork High School

Overfishing for American shad, *Alosa sapidissima*, is a problem that has been getting a lot of attention in recent years. Hunted for their oils and farmed for their young to be used as baits, the numbers of the American shad had declined rapidly, and many fish hatcheries in the United States have been focusing on reintroducing the shad and strengthening their numbers in various rivers around the country. This project studies the conditions of the Broad river, things such as turbidity, water temperature and pH, and will compare them with the vitality of shad later to see if it can work as a habitat for these fish. To find these measurements I will be using a dissolved oxygen meter and a water pH meter to get the required data. I will record the data myself and send a copy to my mentor at the Bears Bluff National Fish Hatchery in Bears Bluff, South Carolina. This experiment will provide evidence as to whether or not the Broad river is a good area to try and reintroduce the American shad, what factors may be affecting the vitality of the fish, and how quickly the population of the fish can grow to reach its previous size.

## THE EFFECT OF AGE AND GENDER ON TIME PERCEPTION

Matt Watford  
Heathwood Hall Episcopal School

The purpose of this project was to determine the effect of age and gender on time perception. First human consent forms were gathered from the test subjects, the testing room was set up to specific requirements, and the subjects were tested in a silent room for 2.5 minutes. After that, the subjects wrote down how much time they estimated has passed. This project has 41 pieces of data that were analyzed and that were put into the graphs and ANOVA analysis. In the real data five groups were tested including: males, females, teens, 30 year olds, and 50 year olds. Those groups were subdivided into two bigger groups that were: males and females together and then teens, 30's, and 50's. The independent variables were the age and genders of the test subjects and the dependent variable was how long they perceived the test to be. For the males and females, the  $F$ , .54, was less than the  $F$ -Critical, 4.41, meaning the two groups being tested weren't statistically different and they two variables did not make that much of a difference. For the second group of tests the  $F$ , 1.43, was also less than the  $F$ -critical, 3.55, meaning the two groups were not statistically different. This data and analysis does not support my hypothesis that

was: a.) If the subject is male, then they will think the time passes by faster. b.) If the test subject is older, then they will think time passes by faster than the younger test subjects.

## THE EFFECT OF AMBIENT TEMPERATURE ON THE EFFICIENCY OF A FUEL CELL

John Weiss  
Heathwood Hall

The purpose of this research is to determine the efficiency of a fuel cell with an ambient temperature of 22.4° and 40.1° Celsius. The procedure involved the process to electrolysis using AA batteries to separate hydrogen and oxygen from water. Then the electrons from the hydrogen were used to power a small motor with electricity. Voltage, current, and time readings were taken during each of the two sections of the procedure, and each section was done ten times. A series of equations were done to get ten efficiency readings. Then all ten efficiency readings were averaged to create an average efficiency. This was done for the fuel cell under each temperature.

The fuel cell proved to be just as efficient for both temperatures, despite the massive difference in current readings. The average efficiency was determined to be 32.2% for both temperatures. The voltage readings proved to be about the same for both temperatures, but the current readings were significantly higher for the increased temperature. Therefore, all calculated data points for this temperature were significantly higher due to bigger, small numbers. It is important to recognize that when you multiply many different small numbers together, the product can vary, and the current readings were the smallest numbers. Although the calculated data was higher at 40.1°, the average efficiency was the same as room temperature. This is possible because two numbers generated a percentage created from a quotient. This is the same reason that  $8/4$  is the same as  $100/50$ .

## MOBILE MEDICATION ADHERENCE APPLICATIONS

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Advisor: Elizabeth L. Bunn

Mobile medication adherence applications are mobile apps that remind users when to take their medication. A product was developed that connects users with their respective doctors, which allows both of them to keep track of the medication. During the development of this product a .NET web service was used to connect a database in Microsoft SQL Server to web forms in Microsoft Visual Studios. The resulting app, iRX Tracker, was then analyzed financially and pitched to potential investors and customers. The medication adherence app market is already consists of hundreds of similar apps. Therefore, to introduce this application a business plan was developed to distinguish the app's functions.

## THE EFFECT OF THE RATIO OF THE HORIZONTAL AND DIAGONAL MEMBERS IN A WARREN TRUSS ON THE ABILITY OF THE TRUSS TO WITHSTAND LOADS

Matthew White

Spring Valley High School

The purpose of the study was to determine a ratio of diagonal to horizontal truss members that caused the bridge to best support a load. It was hypothesized that if the ratio were increased, then the truss would be better able to support the load because the load would be distributed over a longer distance of the member material. The bridges were modelled using West Point Bridge Designer 2013. 8 bridge trusses were tested in this manner These ratios were  $\frac{3}{4}$ ,  $\frac{5}{6}$ , 1,  $\frac{7}{6}$ ,  $\frac{4}{3}$ ,  $\frac{3}{2}$ ,  $\frac{5}{3}$ . Of these 8, the 5 that underwent the least stress were constructed using wood and nails. The ratios selected were  $\frac{5}{6}$ , ,  $\frac{7}{6}$ ,  $\frac{4}{3}$ , and  $\frac{5}{3}$ . These were subjected to destructive testing using an AMT Structural Stress Analyzer 1000 and the maximum supported load was collected. The data showed that the more extreme ratios tended to support the load less well, while the more moderate trusses performed better. The ratio that supported the load best in the computer program was 1. The ratio that supported the load best in the destructive testing was  $\frac{4}{3}$ . The hypothesis was not supported by the data collected. It was concluded that a higher ratio worked better for the destructive testing because the materials for the member were much lighter and therefore the truss did not undergo as much stress to

supporting its own weight. Possible sources of error included variation in construction and the use of a small sample size.

## HEART MODEL FOR IMAGE-GUIDED ASD REPAIRS

Savanah Whitten

Governor's School for Science and Mathematics

Mentor: David Kwartowitz, Department of Bioengineering, Clemson University

Advisor: Jenny Salazar

Congenital heart disease occurs in 1076 out of 100,000 live births. Atrial Septal Defects (ASD), defects resulting in a hole between two of the atrium, account for 10% of these conditions. Currently, the standard method for fixing this defect is a transcatheter occlusion procedure. This procedure involves sending a catheter into the heart to fix the issue. Although this method fixes the problem, the patient is exposed to copious amounts of radiation from fluoroscopy. This exposure increases the likelihood of medical conditions associated with radiation for these patients in the future. To reduce the amount of exposure to radiation, and improve the surgical technique overall, an image-guided navigation system has been created. In order to test this image-guided navigation system, a phantom heart was created to emulate a human heart. Because a child's body is smaller, and radiation dose is cumulative, children are at greater risk from this exposure. Therefore, the phantom heart was created on the scale of a child's heart. This human heart model can be used for testing how long it takes to run the catheter through the body. Further investigation and a series of mock clinical experiments will be performed to design procedures for inserting devices into the heart while minimizing fluoroscopy use.

## THE EFFECT OF POLYETHYLENE, POLYVINYL CHLORIDE, POLYPROPYLENE, AND POLYSTYRENE FOAM ON THE PH LEVEL OF SALTWATER

Austin Wieseahn

Spring Valley High School

The purpose for experimentation was to observe if plastic pollution has an effect on ocean acidification. It was hypothesized that when polyethylene, polyvinyl chloride, polypropylene, and polystyrene foam are placed in test tubes filled with saltwater, then the pH level of the saltwater would become more acidic. Rectangular strips of plastics were placed into separate test tubes with 10 milliliters of saltwater and set under a UV lamp. The results of this experiment were collected by using a pH

probe after the two week time period. The null hypothesis that the pH of the control, polyethylene, polyvinyl chloride, polypropylene, and polystyrene foam were the same was rejected ( $F(4,145)=39.69$ ,  $p<0.001$ ). This indicates that the four variables were statistically significant compared to the control group. Tukey post test showed that all of the household plastics used had an effect on ocean acidification.

## THE EFFECT OF ORIGINAL AND BLACK AND WHITE PAINTINGS AND PAINTING STYLES ON EYE MOVEMENTS AND FIXATIONS OF THE SUBJECTS PERCEIVING THEM.

Mary Wilgis  
Heathwood Hall

In this experiment is the effect of original and black and white paintings and painting styles on eye movements and fixations of the subjects perceiving them. This information could benefit the both artists and Ophthalmologists by providing insight into how the eye perceives black and white versus colored images, as well as images of varying styles. It was hypothesized that there will be a difference between color and black and white images with respect to eye movement and fixations of the subjects perceiving them. It was also hypothesized that there will be a difference between painting styles with respect to eye movement and fixations of the subjects perceiving them. This was accomplished by first gathering human subjects. These subjects were then asked to sit in front of a computer in a controlled environment and observe a set of fifty randomized images. The images that the subjects were exposed to included twenty-five black and white images and twenty-five original, colored images, and one white image. Within the original image category there were five Modernism, five Impressionism, five Baroque, five Surrealism, and five Expressionism images. These same images were converted to black and white for the contrasting category. The subjects' eye movements and fixations were measured by software and computer systems, which were provided by Sensory Motoric Instruments, including SMI BeGaze™, SMI iView X™, and RED500. The revisits, average fixation (ms), average first fixation (ms), and average number of fixations was determined for each image using SMI BeGaze™. Also, a gridded AOI was created for each image. This data was analyzed using excel. Because none of the P-values were  $>0.05$ , the null hypothesis failed to be rejected, therefore the hypothesis was not supported.

## THE EFFECT OF RADIOFREQUENCY EMFS EMITTED BY APPLE IPAD MINI© ON THE POPULATION GROWTH OF LEMNA MINOR

David Williams  
Heathwood Hall

With the recent surge in the widespread use of electronic devices that emit non-ionizing radio frequency radiation, many people have become concerned with the possible harmful effects of exposure to these radio and microwave frequency electromagnetic fields (EMFs). A large number of studies have been conducted recently to assess whether adverse health effects to humans can result from the use of mobile phones, but only a small number of studies have been conducted to assess the effects on plants. Previous studies suggest that exposure to EMFs can have negative effects on plants. In this experiment, it was hypothesized that if Lemna minor are exposed to radiofrequency EMF waves emitted by an Apple Ipad mini© continuously for 12 days, their population growth would be significantly less than that of Lemna minor not exposed to radiofrequency EMFs. The effects of exposing Lemna minor to radiation of power density 191.0 microwatts/m<sup>2</sup> at a frequency of 5 GHz was determined by exposing Lemna minor continuously to these levels of radiation from an Apple Ipad mini© connected to a 5 GHz Wi-Fi network. Radiation from the Apple Ipad mini© was measured using an Extech© 3.5 GHz EMF meter. 8 petri dishes, each starting out with 20 fronds, were assigned to the exposure group and the control group and population growth (number of fronds) was measured for each dish every day over a period of 12 days. Based on measured values of population growth, it was determined that there was no statistically significant difference in population growth between the exposure group and the control.

## BISB THERMOELECTRIC MATERIAL: SYNTHESIS, CRYSTAL STRUCTURE, MICROSTRUCTURES, AND TRANSPORT PROPERTIES

MeKhayla Williams  
Governor's School for Science and Mathematics  
Mentor: Jian He, Department of Physics & Astronomy, Clemson University  
Advisor: David Whitbeck

Thermoelectric materials can be used in direct electrical power generation from waste heat, and also vice versa in heat management. Heat management is the ability of a compound to cool a solid state surface. Bismuth Antimonide is one of a few thermoelectric materials that work at temperatures below room temperature for spot size solid state refrigeration. We in this project adopted a Spark Plasma Sintering (SPS) technique to synthesize Bismuth Antimonide alloy at a nominal

atomic ratio of 88:12. The packing density, micro-morphology, composition, phase structure, and crystallinity of the as-sintered sample have been analyzed using an x-ray diffraction chamber and a Scanning Electron Microscope, followed by the measurements of electrical resistivity, thermopower (i.e., Seebeck coefficient), and thermal conductivity between 15 K and 300 K. The thermoelectric figure of merit, ZT, has been obtained. The ZT has been used to determine how productively Bismuth Antimonide turns waste heat into electrical power.

## THE EFFECT OF USING SODIUM HYPOCHLORITE VS. SODIUM PERCARBONATE BLEACH TO INTERFERE WITH THE DETECTION OF BLOOD RESIDUE BY A BLUESTAR MAGNUM LUMINOL TEST

Jordan Withycombe

Heathwood Hall

This study is relevant to the field of forensic science. The purpose of this experiment was to determine the ability of a luminol test to detect blood residue on denim that was washed using chlorine bleach vs. that washed in oxygen bleach. Three test groups each contained 20 swatches of blood stained denim fabric were used. As a control, one test group was washed using water only. The second group was washed using Clorox while the third group was washed in OxiClean. After a double rinse cycle for each group the fabric was allowed to dry for 48 hours. A luminol solution was then applied to each swatch and the chemiluminescence reaction was photographed using a Nikon d3200 camera. A positive light reaction was noted in all three groups; however, there was a notable difference between the Clorox cleaned and the OxiClean bleach cleaned groups. Due to a chemical cross reaction between luminol and Clorox bleach, this group of fabric squares displayed a stronger and longer lasting chemiluminescence, when compared to the other two groups. This finding supports the alternate hypothesis that there that there will be a difference in a luminol test's ability to detect blood stains on denim that is cleaned in oxygen bleach vs. chlorine bleach. The results of this study have implications to the field of forensic science in that it demonstrates that crime scene investigators can detect cleaned latent blood stains on denim using luminol.

## MOLTEN CARBONATE RETENTION EFFECT STUDY OF MIXED ELECTRIC AND CARBONATE ION CONDUCTOR FOR CO<sub>2</sub> SEPARATION

Jacob Yaggie

Governor's School for Science and Mathematics

Mentor: Kevin Huang, Department of Mechanical Engineering, University of South  
Carolina

Advisor: Kurt C. Wagner

In this paper, it is demonstrated that a silver-carbonate CO<sub>2</sub> permeation membrane with a silver matrix surface modified by a coating of Al<sub>2</sub>O<sub>3</sub> can improve the flux stability over a long period of time. The flux densities of CO<sub>2</sub> and O<sub>2</sub> maintained >90% of its original value for the 130 hours of testing. Much longer compared to the old membrane with dropped to around 33% of its original value after only 60 hours of testing. Overall, surface modification of a silver matrix using an Al<sub>2</sub>O<sub>3</sub> coating is a viable method to fabricate stable silver-carbonate mixed electric and carbonate ion conductor membranes to electrochemically capture CO<sub>2</sub> from flue gases.

## THE EFFECT OF TRIHALOMETHANES (THMS) ON THE LIFE-CYCLES AND COLOR OF ARTEMIA

Yi Yang

Dutch Fork High School

The objective of this project was to test the effects of Trihalomethanes (THMs) on the species *Artemia* in order to see if the species could be used as an indicator for THMs since THMS are a common pollutant found in freshwater, and *Artemia* are freshwater shrimp that are extremely sensitive to environmental change. The hypothesis was that "If the amount of Trihalomethanes in the water was above 80 ppb, then the *Artemia* will change physically." For the methods, five ten-gallon tanks were prepared, with twenty *Artemia* in each tank, then 0 g of chloroform, .00756 g of chloroform, .01512 g of chloroform, .02268 g of chloroform, and .03024 g of chloroform were placed in each tank respectively, since chloroform is one of the chemical forms of TMHs, and is soluble in water at 20 degrees Celsius. Qualitative data was collected every two days for a month, and the *Artemia* were fed 2 g of food every two days. The predicted results were that increased exposure to chloroform will have a harmful effect on the shrimp, which may include color change, weight change, or death. It was predicted that the chloroform would have an effect on the shrimp, since the shrimp are very sensitive to environmental change, which would allow the chloroform to easily effect the shrimp physically.



## DETECTING ALLERGENIC PROTEINS THAT TRIGGER ASTHMA IN INDOOR ENVIRONMENTS

Summer York

Governor's School for Science and Mathematics

Mentor: Michael Matthews, Department of Chemical Engineering, University of South Carolina

Advisor: Clyde J. Smith

The goal of this research is to develop effective means to remove multiple allergenic proteins from the indoor environment. The hazardous allergenic proteins attach to dust and other fine particles and can be inhaled when airborne as “bioaerosols,” which trigger allergies, asthma, and other respiratory diseases. Asthma is increasing in prevalence and is the most common chronic illness among children. The research on indoor allergens will not only aid general allergy sufferers, but also reduce the frequency of clinical emergencies caused by increased asthma symptoms with indoor allergens. The base of the project worked with proteins such as cat and dust mites allergens. Household dust was sampled and the proteins were extracted through a biochemical technique called ELISA. In ELISA, an unknown amount of antigen is affixed to a surface, and then a specific antibody is applied so that it can bind to the antigen. This antibody is linked to an enzyme, and in the final step a substance is added so the enzyme can convert to some detectable signal, most commonly a color change in a chemical substrate. After the proteins were extracted, they were then analyzed with a plate reader. Through comparing the dust samples to the standards, the amount of allergens in the samples were shown. The dust samples were taken from different locations to find signs of allergens. It is believed that homes with pets or non-organized pre-schools are more likely to have allergens present.

## USING COCAINE TO CREATE A CONDITIONED PLACE PREFERENCE IN MICE

Madeline Young

Governor's School for Science and Mathematics

Mentor: Onarae Rice, Department of Psychology, Furman University

Advisor: Rebecca Heiss

Many people who become addicted to drugs, such as cocaine, check into rehabilitation centers seeking help to rid themselves of the cravings associated with the addiction. After leaving rehab, many return to the same places they were in

before entering rehab. It is thought that a large percentage of those who relapse do so because the environment in which they once used the drug has conditioned the brain to crave the drug when they return to that environment once more. If animals are given rewarding drugs they will also produce a strong preference to an environment. In order to test the degree to which an animal will make these conditioned place preferences to drugs, mice were injected (intraperitoneally) with a rewarding drug in one environmental compartment of a box and a control in a distinctively different but adjacent compartment of the same box. Animals were then allowed to choose the environment in which they would like to spend time. Results indicate that the mice typically spend more time in the compartment where they received the drug suggesting they've now associated the pleasant "high" feeling with a particular compartment. This mimics what occurs in humans and may help scientists to better understand the human tendency to relapse.

## FALLING OBJECTS, FALLING PEOPLE – AN ANALYSIS OF THE DYNAMICS OF FALLING

Jennifer Yu

Governor's School for Science and Mathematics

Mentor: Juan Caicedo, Department of Civil & Environmental Engineering,  
University of South Carolina

Advisor: Stephen Kaczkowski

Vibrations associated with human falls have characteristics that are markedly different than vibrations associated with certain dropped objects. To quantify these differences, a series of experiments were performed that used acoustic sensor data to record and monitor various patterns of vibrations. Objects such as basketballs and bags filled with Kinects were used initially and the resulting data were recorded using four sensors. Applied mathematical software programs written from MatLab received and plotted the data on acceleration versus frequency diagrams. A total of five locations were used to record data on dropped objects and on vibrations from a person jumping. The results from these five locations were compared to each other to determine similarities and differences associated with these vibrations. Differences in the signals of human jumping and falling objects were recorded with the goal of minimizing what the computer deems as a fall. In the future this recorded data will help prevent an overload of information so that the computer program can quickly assess whether or not a given signal is associated with an actual human fall. The end goal of this work on human fall analysis is to allow the elderly live independently for a longer period of time.

# THE EFFECT OF DISKS LARGE HOMOLOG 1 (DLG1) AND DISKS LARGE HOMOLOG 5 (DLG5) GENES ON ADIPOGENESIS IN MESENCHYMAL STEM CELLS

Lydia Zeiler

Governor's School for Science and Mathematics

Mentor: Michael Suchanek & Michael Boutros, German Cancer Research Center

Advisor: Bhuvana Parameswaran

Mesenchymal Stem Cells are adult stem cells able to differentiate into several cell lineages. Because of their multipotency, these cells show high potential for use in stem cell therapy. Adipogenesis, or the creation of fat cells, occurs through Mesenchymal Stem Cells. The differentiation of MSCs are known to be regulated by interactions with extracellular mediators and previous research has found that the activation of the Wnt (wingless-related integration) signaling pathway inhibits adipogenesis in MSCs. Two genes, disks large homolog 1 (DLG1) and DLG5, identified by a high-throughput screen, were seen to play some role in adipogenesis in MSCs and were therefore studied in this project in order to further understand the differentiation process and the role of the Wnt signaling pathway. Human bone marrow derived MSCs were cultured and subjected to siRNA treatment in order to destroy the mRNA of the DLG1 and DLG5 genes. Adipogenesis was then induced and differentiation was determined after 14 days. Quantitative PCR was also performed in order to ensure the effectiveness of siRNA treatment and to determine the role of the genes in the Wnt signaling pathway. According to the results obtained, DLG1 inhibits adipogenesis, while DLG5 showed no inhibition. However, the siRNA treatment of DLG5 proved to be of no effectiveness and therefore the function in adipogenesis cannot be determined by this study. Also, both DLG1 and DLG5 showed no role in the Wnt signaling pathway. To further characterize these two genes and their role in adipogenesis in MSCs and in the Wnt signaling pathway, this study and its projects should be repeated. To further investigate, in vivo studies in animals should also be performed.

# THE EFFECT OF BALLET SHOE TYPE ON GROUND FORCE REACTION

Abbie Zvejnieks

Spring Valley High School

In recent years, the number of lower-limb injuries such as shin splints has been steadily increasing in athletes especially ballet dancers. Many factors contribute to this growing problem, but the shoe the dancers wear could possibly effect the

ground force reaction. It has been shown that decreasing ground force reaction does decrease one's risk for lower limb injury. In this experiment, 20 dancers were tested using four different types of footwear: flat ballet shoes, brand new pointe shoes, broken in pointe shoes, and dead pointe shoes. It was hypothesized that the brand new pointe shoes will have the most ground reaction; therefore wearing brand new pointe shoes will give the dancer the highest risk for lower extremity injury. An ANOVA test showed that there was a significant difference between the five groups  $F(100)=64.34$   $p<0.001$ . A Tukey test showed that there were statistically significant differences in all of the treatments except for barefoot vs. flat shoes, barefoot vs. broken in pointe shoes, and flat shoes vs. broken in pointe shoes. The dead pointe shoes had the least ground force reaction, and the brand new pointe shoes had the greatest ground force reaction. Therefore, it was concluded that brand new pointe shoes do pose a greater risk for lower extremity injury in dancers.

## THE EFFECT OF COPPER(II) SULFATE (CUSO4) MOLARITY INCREASE ON PARAMECIUM CAUDATUM CONCENTRATIONS

Ali

Spring Valley High School

As a result of increased industry, copper ion levels in lakes have been increasing. This increase demands research on its impacts on freshwater habitats. This experiment was done to isolate its impact on an essential freshwater organism, *Paramecium caudatum*, which helps in maintaining bacterial levels in lakes. It was hypothesized that if copper(II) sulfate ( $\text{CuSO}_4$ ) molarity was increased in *P. caudatum* cultures, then the resulting *P. caudatum* concentrations would be lower than what resulted from cultures with lesser to no  $\text{CuSO}_4$ . The procedures involved adding  $\text{CuSO}_4$  to culture dishes to make different solutions: 0.0065 M, 0.0125 M, and 0.0188 M solutions, as well as having a control with no  $\text{CuSO}_4$ . The culture dishes were then each inoculated with *P. caudatum* and after a day were sampled. The results maintained that treatments with  $\text{CuSO}_4$  had 0 *P. caudatum*/ml, while the control trials had a mean of 9.93 *P. caudatum*/ml. An ANOVA and Tukey Test were used to compare the different treatments to each other. The ANOVA test showed that at least one of the treatments was different from the others,  $F(3,9) = 10.49$ ,  $p < 0.05$ . The Tukey Test showed that those differences were between the control and the other treatments. As a result,  $\text{CuSO}_4$  was found to have a significant negative impact on *P. caudatum* populations. Thus, precautions must be taken to help ensure the survival of these essential organisms as they help ensure the stability of freshwater ecosystems.

**END**  
**SCJAS ABSTRACTS**

## SCAS PAST PRESIDENTS

1924	G.C. Mance	1962	J.C. Loftin	1998	Dwight Camper
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1926	A.C. Moore	1964	C.S. Patterson	2000	Jane P. Ellis
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1928	S.A. Ives	1966	R.H. Gadsden	2002	William Pirkle
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1940	J.R. Sampey, Jr	1978	Gilbert W. Fairbanks	<b>2014</b>	<b>Laurie Fladd</b>
1941-44	<i>SCAS inactive</i>	1979	George P. Sawyer		<b>(President-Elect)</b>
	<i>(WWII)</i>	1980	Daniel J. Antion		
1945	F.W. Kinard	1981	Donna Richter		
1946	Belma D. Matthews	1982	Jack Turner		
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1952	Robert H. Coleman	1988	Manuel Keepler		
1953	J.E. Copenhaver	1989	Lisle Mitchell		
1954	Elsie Taber	1990	Gordon Sproul		
1955	G.M. Armstrong	1991	Sharon Hahs		
1956	I.S.H. Metcalf	1992	Joseph Cicero		
1957	H.W. Davis	1993	Don Jordan		
1958	H.W. Freeman	1994	William Pirkle		
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