

# SCAS

South Carolina Academy of Science



**BULLETIN**  
of the  
**South Carolina**  
**Academy of Science**  
**Volume LXXVIII**  
**2016**  
Including the Annual Meeting Program



**WINTHROP**  
UNIVERSITY



1. [Joynes Hall](#) (Visitors Center, Admissions, The Inn, Baruch Room)
3. [Bancroft Hall](#)
5. [Tillman Hall](#)
7. [President's House](#)
9. [Roddey Hall](#)
11. [Courtyard at Winthrop](#)
13. [Operations Center](#)
15. [McBryde Hall](#) (Tuttle Dining Room)
17. [Crawford Building](#)
19. [Kinard Hall](#)
21. [Little Chapel](#)
23. [Sims Science Building](#)
25. [Wofford Hall](#)
27. [Thomson Hall & Dining Center](#)
29. [Macfeat House](#)
31. [Lee Wicker Hall](#)
33. [Stewart House](#)
35. [Withers/W.T.S. Building](#) (Plowden)
37. [Dinkins Hall](#)
39. [Sykes House](#)
41. [Canterbury House](#)
43. [Workman Building](#)

2. [Byrnes Auditorium](#)
4. [Margaret Nance Hall](#)
6. [McLaurin Hall](#) (Lewandowski Student Gallery)
8. [Rutledge Building](#) (Patrick Gallery)
10. [Johnson Hall](#)
12. [Facilities Management Office](#)
14. [West Center](#)
16. [DiGiorgio Campus Center](#)
18. [Owens Hall](#)
20. [Central Energy Plant](#)
22. [Conservatory of Music](#) (Barnes Recital Hall)
24. [Dalton Hall](#) (formerly the Life Sciences Building)
26. [Richardson Hall](#)
28. [Carroll Hall](#)
30. [Thurmond Building](#)
32. [Phelps Hall](#)
34. [Student Activity Center](#)
36. [Dacus Library](#)
38. [Good Building](#)
40. [Sellers House](#)
42. [Parker Building](#)
44. [Louise Pettus Archives](#)

#### Streets

- A. Memorial Circle
- B. Alumni Drive
- C. Tillman Loop
- D. Founders Lane
- E. Presidents Circle
- F. Ebenezer Avenue
- G. Park Avenue
- H. Senior Circle
- J. Scholars Walk
- K. Heritage Lane

**\* Parking**

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

*Its purposes are:*

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

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

**THE SOUTH CAROLINA ACADEMY OF SCIENCE  
FOUNDED 1924, COLUMBIA, SOUTH CAROLINA**

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**COMMITTEES**

Please visit <http://scacademysci.org/> for a full listing of committee memberships

Undergraduate Research	Electronic Journal Committee	Publicity Committee
Membership Committee	Sponsorship Committee	SCJAS Committee
MESAS Committee	Website Committee	Necrology Committee
High School Research Awards	Teacher of the Year Committee	

**Publication information**

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## Welcome to the South Carolina Academy of Science 2016 Annual Meeting

Dear Students, Teachers, Scientists, and Colleagues,

I am very pleased to welcome you to Winthrop University for the 89<sup>th</sup> annual meeting of the South Carolina Academy of Science (SCAS). As the President-Elect of SCAS, it is my privilege to host this year's meeting on our beautiful campus.

The SCAS is a state-wide, interdisciplinary science organization established in 1924. Membership is open to anyone with an interest in science and includes undergraduate and graduate students, faculty, administrators, and related professionals. The Academy also sponsors the South Carolina Junior Academy of Science (SCJAS), which includes high school students and teachers and provides an opportunity for students throughout the state to present original research at the annual meeting. 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.



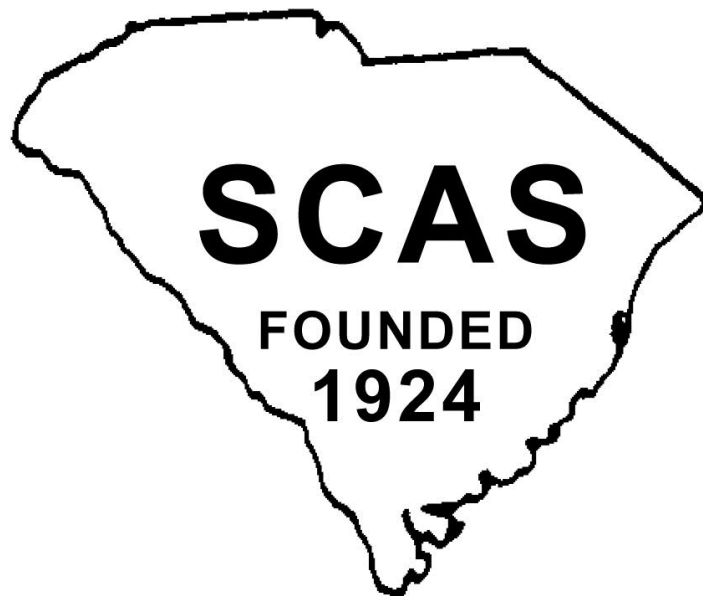
We are thrilled that nearly 500 students, faculty, teachers, and scientists in Biology, Chemistry, Physics, Astronomy, Engineering, Mathematics, Health sciences and more are participating in this year's meeting and sharing their discoveries through oral presentations and poster sessions. We are also excited to present the Governor's Awards for Excellence in Scientific Research and Scientific Awareness. We are thrilled and honored to have as our plenary speaker Dr. Prakash Kara from the Medical University of South Carolina. Dr. Kara will be discussing the revolutionary high resolution imaging techniques his lab uses to examine the vasculature and microanatomy of the brain.

These events do not happen without significant 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 Winthrop University and especially for College of Arts and Sciences Dean Karen Kedrowski's generous hospitality and support for this meeting. While all of the SCAS councilors participate in one way or another in supporting the delivery of our spring meeting I would like to recognize a few individuals specifically. Special thanks to our current and past presidents (Dr. John Kaup and Dr. Laurie Fladd) for guiding me throughout the past year; to Dr. Bill Pirkle for his outstanding leadership and service as judging coordinator for the SCAS; to Dr. David Ferris for his annual delivery of an outstanding program; and to Dr. Edna Steele for her countless hours serving as Treasurer for the SCAS and SCJAS. In addition, a very special thank you to all of the students, teachers, mentors, parents, scientists, and volunteers who have worked so hard to bring us their outstanding work today.

I hope that you enjoy the meeting and look forward to working with you over the next several years as we continue to strengthen and expand our effort as the South Carolina Academy of Science.

*Heather J. Evans Anderson*

Heather J. Evans Anderson  
President–Elect; South Carolina Academy of Science  
Associate Professor of Biology, Winthrop University





**SOUTH CAROLINA ACADEMY OF SCIENCE  
EIGHTY-NINTH ANNUAL MEETING  
SCHEDULE OF EVENTS**

<b>7:30 AM - 10:00 AM</b> <i>7:30 AM – 9:00 AM</i>	<b>SCAS Registration</b> <i>Continental Breakfast</i>	<b>DiGiorgio Student Center</b> <i>served in Atrium</i>
<b>8:30 AM – 11:30 AM</b> Cellular Biology Field Biology Molecular Biology Medicine / Pharmacology / Health Chemistry / Biochemistry Math / Computer Science / Physics / Astronomy <b><i>Judges Conference Room</i></b>	<b>SCAS Oral Sessions</b>	<b>Kinard Hall</b> Room 211 Room 215 Room 201 Room 204 Room 205 Room 207  <i>Room 015</i> (entrance off Scholars Walk)
<b>10:30 AM – 12:30 PM</b>	<b>Poster Session</b>  Posters may be set up anytime between 8 a.m. and 10 a.m. <i>(All posters must be on display by 10:00 a.m.)</i>	<b>Richardson Ballroom; DiGiorgio Student Center</b>
<b>12:30 PM – 1:15 PM</b>	<b>Lunch</b> <i>Ticket is in your badge holder</i> <i>Judges lunch will be served in Kinard 015</i>	<b>Thompson Dining Hall</b>
<b>1:30 PM– 2:15 PM</b>	<b>Plenary Session</b>	<b>Richardson Ballroom; DiGiorgio Student Center</b>
<b>2:15 – 3:00</b>	<b>Governor’s Awards / Undergraduate Awards</b>	<b>Richardson Ballroom; DiGiorgio Student Center</b>





**SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE  
SCHEDULE OF EVENTS**

<b>7:30 AM - 11:00 AM</b> <i>7:30 AM – 9:00 AM</i>	<b>SCJAS Registration</b> <i>Continental Breakfast</i>	<b>DiGiorgio Student Center</b> <i>served in Atrium</i>
<b>8:30 AM – 10:15 PM</b>	<b>SCJAS Oral Session I</b> <i>See SCJAS oral session listing for details &amp; room numbers</i>	<b>Owens Hall</b>
	Judges Conference Room	<b>Kinard Hall Room 015</b>
<b>10:15 AM – 10:30 PM</b>	<b>Break</b>	
<b>10:30 AM – 12:30 PM</b>	<b>SCJAS Oral Session II</b> <i>See SCJAS oral session listing for details &amp; room numbers</i>	<b>Owens Hall</b>
<b>[10:30 AM – 12:30 PM]</b>	<b>SCAS Poster Session</b>	<b>Richardson Ballroom; DiGiorgio Student Center</b>
	<i>Junior Academy members are encouraged to visit SCAS posters</i>	
<b>12:00 PM – 1:15 PM</b>	<b>Lunch</b> <i>Ticket is in your badge holder</i>	<b>Thompson Dining Hall</b>
<b>1:30 PM– 2:15 PM</b>	<b>Plenary Session</b>	<b>Richardson Ballroom; DiGiorgio Student Center</b>
<b>2:30 PM – 3:30 PM</b>	<b>Afternoon SCJAS Activities &amp; Workshops</b> Meet WU student Science Ambassadors in atrium of DIGS)	
Owens G01	<b>Investigating Hidden Biodiversity: Anuran acoustics as a case study</b> Melissa Pilgrim, PhD (USC Upstate)	
Owens G02	<b>Interactive visual neuroscience: how neurons in the brain generate perception</b> Phillip O’Herron PhD (MUSC) :	
Owens 102	<b>Journey to the center of the Atom</b> Bill Wabbersen and Jon Guy (Savannah River Site)	
<b>3:45 PM</b>	<b>SCJAS Awards Ceremony</b>	<b>Richardson Ballroom; DiGiorgio Student Center</b>

## Plenary Session

# How and why neurons talk to blood vessels in the brain—Insights from high resolution imaging

**Prakash Kara PhD**

*Department of Neuroscience, Medical University of South Carolina*

As we dream, talk or make decisions, for example, neurons in different parts of our brain become active. Because there isn't enough blood to send everywhere in the brain at the same time with the optimal levels of oxygen and glucose, the brain has a mechanism for increasing blood flow to regions with increased activity. This increase in blood flow generates signals that can be measured when using functional magnetic resonance imaging (fMRI). While fMRI is non-invasive, it cannot tell us exactly how many neurons are firing at any given time, and which neurons are triggering the changes in blood flow. Dr. Kara will show how the combination of two-photon imaging and the expression of genetically encoded fluorescent sensors in the brain are allowing his team to map changes in blood flow when specific neurons in the brain fire.

### Biography

Dr. Kara received his BS and MS degrees from the University of Cape Town in South Africa. He received his PhD from the University of Alabama at Birmingham and then completed a post-doctoral fellowship as well as became a Research Associate and Instructor at Harvard Medical School. Dr. Kara's research examines sensory stimulus feature selectivity and plasticity in the brain at different spatial scales—from single molecule neuromodulators (nitric oxide, NO), synapses (thalamic vs. intracortical), local microcircuits within the neocortex, and inter-areal functional connectivity. More recently, his laboratory began examining the underpinnings of neurovascular coupling by comparing the feature selectivity of responses in neurons, blood vessels and astrocytes. Dr. Kara co-authored his first paper in systems neuroscience in a report that used two-photon calcium imaging of adjacent neuronal cell bodies to map sensory function *in vivo* (Ohki et al., 2005 Nature). Dr. Kara's lab has since perfected the technique in the neocortex using synthetic dyes in a variety of mammalian species (Kara & Boyd, 2009 Nature; Shen et al., 2012 Nature Methods). More recently, his lab has also successfully used genetically encoded calcium (gCaMP6) and glutamate (iGluSnFr) sensors. Dr. Kara's lab has also performed structural and functional imaging of dendrites *in vivo* (Levy et al., 2012; 2014). Importantly, Dr. Kara's lab discovered the world's first artery-specific dye that is transforming the way neurovascular coupling is studied (Shen et al., 2012). In addition, his laboratory also published a new algorithm to analyze blood velocity data (Chhatbar & Kara, 2013).



**Prakash Kara PhD**

*Department of Neuroscience  
Medical University of South Carolina*

The South Carolina Academy of Science gratefully recognizes 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 Award 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 2015, 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 was sponsored by Michelin North America. 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. The award may be given to an individual or a team. If the award is made to a team, the honorarium will be distributed equally.





## THE DWIGHT CAMPER OUTSTANDING UNDERGRADUATE RESEARCH AWARD

The Dwight Camper Outstanding Undergraduate Research Award honors an undergraduate student or team that has performed outstanding research as an undergraduate student in any of the scientific fields supported by the SC Academy of Science. This award consists of an honorarium of \$300 and a handsomely framed certificate that is presented in a special ceremony at the South Carolina Academy of Sciences annual meeting.

The award is presented in memory of the late Dr. Dwight Camper, Professor Emeritus in Plant Physiology at Clemson University. Dr. Camper served two terms as President of the South Carolina Academy of Science. He taught many graduate-level plant physiology courses as well as a very popular undergraduate class titled Plant Medicine, Magic and Murder. Dr. Camper's course was the first exposure most students had to Plant Medicine and led many students to pursue research projects in his laboratory. These students benefited from his rigorous guidance while learning to use the scientific method to arrive at meaningful conclusions. He appreciated students who demonstrated a passion for research and approached it with an inquisitive mind, creativity and perseverance. Dr. Camper's encouragement and can-do attitude enabled his students to become successful researchers. He felt deeply that research findings should be shared enthusiastically with others and encouraged his students to participate in the South Carolina Academy of Sciences as an avenue to communicate their discoveries. The Dwight Camper Award was presented for the first time in 2011 to a team of three students from Clemson University conducting research with medicinal plants.

### CRITERIA AND APPLICATION PROCEDURES

This prestigious award honors undergraduates with a GPA of 3.0 or better who have engaged in research for at least one year and whose research has or will contribute to the generation of a science publication. The nomination form is available at the Academy's website at [www.scacademysci.org](http://www.scacademysci.org) (click on awards).

A complete application consists of the nomination form, a letter of recommendation from a professor familiar with the student's research, an abstract of their research and a copy of the student's university transcript. To be considered for this award – the nominee must have submitted an abstract to the SCAS Annual Meeting (held annually in April) and have made plans to give an oral presentation of their research at the meeting.

### Past Recipients

2013 Kimberly Klas, Brett Hoover, and Brenna Norton-Baker  
College of Charleston, Department of Chemistry

2014 No entries

2015 McKenzie Perdue, University of South Carolina Columbia

## TOPICAL SESSIONS SCAS

Saturday, April 16<sup>th</sup> 2016

*Only the name of the first presenter is listed for most presentations,  
please see the relevant abstract for full authorship.*

### **BIOLOGY: CELLULAR**

**8:30AM - 11:30AM**

**Kinard Hall 211**

**Judges: Leslie Lovelace and Kathleen Ferris**

- 8:30AM HEAVY METAL BIOREMEDIATION POTENTIAL OF *SERRATIA MARCESCENS*  
Ijeoma Ekpenuma, Claflin University
- 8:45AM CYTOTOXIC EFFECTS OF *AMORPHA FRUTICOSA* LEAF, STEM AND ROOT  
EXTRACTIONS ON PC-12 ADRENAL NEURAL CELLS FROM MALE *RATTUS*  
*NORVEGICUS*  
Mary Kay Murray, Anderson University
- 9:00AM CYTOTOXIC EFFECTS OF *PHYTOLACCA AMERICANA* LEAF, STEM AND ROOT  
EXTRACTIONS ON PC-12 ADRENAL NEURAL CELLS FROM *RATTUS NORVEGUS*  
Emily Campbell and Brianna Dyar, Anderson University
- 9:15AM HISTONE DEACETYLASE INHIBITOR RG2833 REDUCES THE VIABILITY OF  
HUMAN MELANOMA CELL LINES IN VITRO  
Lauren Green, Winthrop University
- 9:30AM OPTIMIZING DECELLULARIZATION PROTOCOLS FOR THE PRODUCTION OF  
PORCINE ACELLULAR MUSCLE MATRIX SCAFFOLDS  
Carolina Pham, Winthrop University
- 9:45AM ENHANCING THE DEVELOPMENTAL POTENTIAL OF MURINE ADIPOSE-  
DERIVED MESENCHYMAL STEM CELLS  
Kathryn V Steverson, Winthrop University
- 10:00AM *BREAK*
- 10:15AM GENETIC ANALYSIS OF ROS-MEDIATED NEURODEGENERATION IN *C. ELEGANS*  
Lyndsay Young, Coastal Carolina University
- 10:30AM OPTIMIZING IN VITRO FERTILIZATION PROCEDURES IN ZEBRAFISH  
Madelyn Wasden, University of South Carolina Aiken
- 10:45AM EXPORTINS: MAPPING THE WAY OUT OF THE NUCLEUS  
Paul Siegwald, College of Charleston
- 11:00AM EXAMINING THE IMMUNE RESPONSE OF *FUNDULUS HETEROCLITUS* TO  
ENVIRONMENTAL PRESSURES  
Ljubitca Fadic and Jacqueline Mayorga, Columbia College

- 11:15AM EXPRESSION OF HEART-SPECIFIC CONSTRUCTS IN *CIONA INTESTINALIS* EMBRYOS  
Katlyn Brumley, Winthrop University
- 11:30AM THE EFFECT OF CHRONIC REISHI TREATMENT ON ENZYME ACTIVITY IN RAT LIVER, SPLEEN, AND BLOOD SERUM  
Kelsey Barber and Deidre Ridings, Converse College

**BIOLOGY: FIELD**

**8:30AM - 9:15AM**

**Kinard Hall 215**

**Judges: Jonathan Storm and Cynthia Tant**

- 8:30 AM ASSESSING PEAK CALLING ACTIVITY OF HYLIDAE: THE EFFECT OF SURVEY DATE ON CALLING ACTIVITY  
Kyle Brown, University of South Carolina Upstate
- 8:45AM EFFECTS OF HABITAT AND COYOTES (*CANIS LATRANS*) ON THE DISTRIBUTION OF WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) AND FERAL CATS (*FELIS CATUS*)  
Amelia Russell, University of South Carolina Upstate
- 9:00AM SPORANGIAL STRUCTURE OF *TAENIOCRADA* FROM THE LOWER DEVONIAN OF NEW BRUNSWICK AND EASTERN QUEBEC  
Klaire Rouse, Converse College
- 9:15AM A PRELIMINARY STUDY OF A SECONDARY GROWTH FOREST AT CALDEON STATE PARK, VIRGINIA  
R. Stalter, St. Johns University
- 9:30AM RECOVERY OF THE BALD EAGLE IN SOUTH CAROLINA  
Fred Kinard

**BIOLOGY: MOLECULAR**

**8:30AM - 11:30AM**

**Kinard Hall 201**

**Judges: Keisha Wilson and Saku Warshmana-Greene**

- 8:30AM CAMP RESISTANCE IN *SERRATIA MARCESCENS*  
Jessica Cole, Claflin University
- 8:45AM INTERACTIONS OF SIRNA FUNCTIONALIZED THERAPEUTIC RNA NANOPARTICLES WITH WHOLE BLOOD AND ISOLATED LYMPHOCYTES  
Kenya Joseph, University of North Carolina Charlotte
- 9:00AM ~~ISOLATION OF MICROSATELLITE PRIMERS FROM *MANAYUNKIA SPECIOSA* USING A MODIFIED PIMA APPROACH~~ *Moved to Poster Session*  
~~Cameron Leyers, Francis Marion University~~
- 9:15AM DEVELOPING MPING-BASED ACTIVATION TAGS  
Stephanie Diaz, University of South Carolina Aiken

- 9:30AM INVESTIGATING X-CHROMOSOME NON-DISJUNCTION IN SU(VAR)3-9  
DROSOPHILA MELANOGASTER MUTANTS  
Cameron Washington, Winthrop University
- 9:45AM DETERMINING THE SEQUENCES THAT INDUCE HYPERACTIVE TRANSPOSITION  
OF MPING  
Daymond Parrilla, University of South Carolina Aiken
- 10:00AM *BREAK*
- 10:15AM CHARACTERIZING THE REPLICATIVE TRANSPOSITION MECHANISM OF THE  
MITE MPING  
David Gilbert, University of South Carolina Aiken
- 10:30AM IDENTIFYING THE GENE UNDERLYING THE B1187 PHENOTYPE IN ZEBRAFISH  
Kayce Vanpelt, University of South Carolina Aiken
- 10:45AM HIV-1 DEPENDENT BICISTRONIC EXPRESSION OF LUCR AND EGFP FROM  
PLTNG(INS2)R  
Natalie Arthur, University of South Carolina Aiken
- 11:00AM BICISTRONIC EXPRESSION FROM A HIV-1-DEPENDENT LENTIVIRAL VECTOR  
Erin M. McLaughlin, University of South Carolina Aiken
- 11:15AM MEASURING THE EFFECTIVENESS OF ANTI-HIV TAT SIRNAS ON HIV  
REPLICATION AND GENE EXPRESSION  
Emily M. Webb, University of South Carolina Aiken
- 11:30AM USING IMMUNOLOGY AND SPECTROFLUOREMETRY TO CREATE A BIOLOGY  
LAB EXERCISE FOR UNDERGRADUATES  
Jasmine Stanley, Columbia College

**MEDICINE / PHARMACOLOGY / PHARMACY / PUBLIC HEALTH**

**8:30AM - 9:30AM**

**Kinard Hall 204**

**Judges: Maria Agsa-Lastra and Carole Oskeritzian**

- 8:30AM THE EFFECT OF MONOSACCHARIDES AND ARTIFICIAL SWEETENERS ON BONE  
DENSITY IN SPRAGUE-DAWLEY RATS  
Christina Thomas, University of South Carolina Aiken
- 8:45AM THE EFFECTS OF NATURAL AND ARTIFICIAL SWEETENERS ON GUT  
MICROBIOME COMPOSITION AND METABOLISM  
Mustafa Elhallaoui, University of South Carolina Aiken
- 9:00AM THE EFFECTS OF NATURAL AND ARTIFICIAL SWEETENERS ON ANXIETY AND  
DEPRESSIVE SYMPTOMS IN MALE SPRAGUE-DAWLEY RATS  
Brandee Desmarais, University of South Carolina Aiken

- 9:15AM THE EFFECTS OF MONOSACCHARIDES AND ARTIFICIAL SWEETENERS ON BODY WEIGHT GAIN, ADIPOSITY, AND BLOOD GLUCOSE LEVELS IN SPRAGUE-DAWLEY RATS  
Heather Jones, University of South Carolina Aiken
- 9:30AM CONTACT LENS HYGIENE PRACTICES AMONG COLLEGE STUDENTS  
Vivian Kalu, Claflin University

**CHEMISTRY / BIOCHEMISTRY**

**8:30AM - 10:15AM**

**Kinard Hall 205**

**Judges: Caryn Outten and Li Ping**

- 8:30AM VISIBLE LIGHT PROMOTED ADDITIONS OF POTASSIUM ORGANOTRIFLUOROBORATES TO CARBONYL COMPOUNDS  
Davis Plasko, Winthrop University
- 8:45AM DEVELOPMENT OF OPTICALLY FLAT SERS SUBSTRATES FOR URANYL MICROPARTICLE DETECTION  
Spencer Tinkey, Univ. of South Carolina Aiken
- 9:00AM CATALYTIC STUDIES INTO THE REDUCTION OF NITRITE BY AN ACID-FUNCTIONALIZED 1,4,7-TRIAZACYCLONONANE COPPER COMPOUND  
Jeremy Weeks, University of South Carolina Aiken
- 9:15AM SYNTHESIS AND CATALYTIC OXIDATION ACTIVITY OF FE(III) AND MN(III) MOF-525  
Manuel Dominguez, University of South Carolina Aiken
- 9:30AM UNDERSTANDING THE ROLE THAT EF24 PLAYS IN PROMOTING ANTI-CANCER ACTIVITY IN COLON CANCER CELLS  
Ashley S. Williams, Winthrop University
- 9:45AM HEAVY METAL CONCENTRATION IN DONAX CLAMS FOUND IN MYRTLE BEACH ANALYZED USING ATOMIC ABSORPTION  
Harley Coates and Larissa Martin, Coastal Carolina University
- 10:00AM HEAVY METAL CONCENTRATION IN DONAX CLAMS FOUND IN MYRTLE BEACH ANALYZED USING ATOMIC ABSORPTION  
Larissa Martin and Harley Coates, Coastal Carolina University
- 10:15AM SYNTHESIS OF NOVEL RARE-EARTH GERMANATES  
Branford Wilkins, University of South Carolina Columbia



**MATH / COMPUTER SCIENCE / PHYSICS / ASTRONOMY**

**8:30AM - 8:45AM**

**Kinard Hall 207**

**Judges: Bryan Lemon, Don Jordan, Neil Miller, and Rich Thomason**

8:30AM DEVELOPING ALGORITHMS TO IMPROVE SPITZER'S THERMAL IMAGING OF  
EXTRASOLAR PLANETS

David Melnick, College of Charleston

8:45AM A SERIES OF FOUR SUMS OF A FIBONACCI NUMBER TO THE FOURTH POWER

Nathan McAnally, The Citadel

## POSTER SESSION

Richardson Ballroom in the DiGiorgio Student Center

10:30 AM-12:30 PM

*Posters set up 8-10 a.m., all posters must be on display by 10:00 a.m.*

### BIOLOGY: CELLULAR

- POSTER #1 RELATIVE EXPRESSION OF DIATOM CHLOROPLAST GENES  
Naquashia Edwards, Coastal Carolina University
- POSTER #2 SURVEY OF ASYMMETRIC DNA SEGREGATION BY CANCER CELL LINES IN VITRO  
Hannah Mace, Clemson University
- POSTER #3 *C. ELEGANS* AS A GENETIC MODEL OF GALACTOSEMIA  
Michelle West, Coastal Carolina University
- POSTER #4 PHARMACOLOGICAL ANALYSIS OF ROS-MEDIATED NEURODEGENERATION IN *C. ELEGANS* (*moved to pharmacology session*)  
Meghan Stickle, Coastal Carolina University
- POSTER #5 A PRELIMINARY INVESTIGATION TO ELUCIDATE ROLES OF KARYOPHERIN BETA IMPORTINS IN THE EARLY DEVELOPMENT OF *LYTECHINUS VARIEGATUS*  
Greg McFadden, College of Charleston
- POSTER #6 DIFFERENTIAL IMPACT OF EBOLA GLYCOPROTEIN UPON IMMUNOSURVEILLANCE OF NATURAL KILLER CELLS  
Bibiana Loza, Converse College
- POSTER #7 BIOREMEDIATION-REDUCTION OF HEXAVALENT CHROMIUM  
Chantel Duscent and Jellisa Ewan, Claflin University
- POSTER #8 ISOLATION AND CHARACTERIZATION OF NON-TUBERCULOUS MYCOBACTERIA AND MYCOBACTERIOPHAGES FROM WATER AND SOIL  
Regine Johnson and Briana Worley, Claflin University
- POSTER #45 PHASE RESETTING CURVES DUE TO RECURSIVE STIMULI IN MORRIS-LECAR MODEL NEURONS  
Dave Austin, College of Charleston
- POSTER #46 NONLINEAR EFFECTS OF STIMULI ON PHASE RESETTING CURVE OF DIFFERENT NEURAL TYPES  
Lindsay Marie Evans, College of Charleston

### BIOLOGY: FIELD

- POSTER #9 SHORELINE PREDATION ON AN INTRODUCED CLAM SPECIES IN THE CONGAREE RIVER  
Amber Irick, Kathy Slice, & Kirt Moody, Columbia College

POSTER #10 USING JMP-SAS TO TEST HYPOTHESIS IN PLANT ECOLOGY  
Sarah Ward, Bob Jones University

POSTER #11 VOC SPATIAL AND TEMPORAL CHANGES ALONG A TCE PLUME FRINGE  
John B. Williams<sup>1</sup>, and Elizabeth Ashley Shull<sup>2</sup>, <sup>1</sup>South Carolina State University,  
<sup>2</sup>Savannah River Nuclear Solutions

### **BIOLOGY: MOLECULAR**

POSTER #12 IDENTIFICATION OF COMMON HUMAN MIRNAS IN INFECTED INFLUENZA  
A INDIVIDUALS  
Britney M. White, James Baldwin, and Samina Noorali, Claflin University

POSTER #13 CATIONIC ANTIMICROBIAL PEPTIDE RESISTANCE IN A SERRATIA  
MARCESCENS KERATITIS STRAIN  
Esther Orji, Claflin University

POSTER #14 MOLECULAR EVIDENCE OF AN UNDESCRIBED CERATONOVA SP.  
(CNIDARIA: MYXOSPOREA) IN THE FRESHWATER POLYCHAETE,  
*MANAYUNKIA SPECIOSA*, FROM WESTERN LAKE ERIE, MICHIGAN  
R. Benjamin Snipes, Francis Marion University

POSTER #15 GENOME-WIDE ANALYSIS OF THE MOLECULAR TURNOVER OF HUMAN  
TRNAS  
Ariel McShane, Eveline Hok and Jensen Tomberlin, College of Charleston

POSTER #16 DEVELOPING TOL2-BASED ACTIVATION TAG CONSTRUCTS  
Allison Swiecki, University of South Carolina Aiken

POSTER #17 DESIGNING TRANSGENIC CONSTRUCTS TO STUDY THE ROLE OF  
OSTEOCLASTS DURING ZEBRAFISH DEVELOPMENT  
Brianna Snelling, University of South Carolina Aiken

POSTER #18 LIGATING THE MEF2CA GENE AND ASSOCIATED REGULATORY SEQUENCE  
IN THE PTARBAC2.1 VECTOR TO DRIVE EGFP  
Kenneth Glenn, University of South Carolina Aiken

POSTER #19 THE ROLE OF PING'S ORF1 REPETITIVE SEQUENCE ON MPING  
TRANSPOSITION  
Lisette Selena Payero, University of South Carolina Aiken

POSTER #20 MPING AS A TOOL FOR TRANSPOSON MUTAGENESIS IN D. RERIO  
Alec Jones and Tina Chandler, University of South Carolina Aiken

POSTER #21 UNDERSTANDING THE FUNCTION OF THE PHF21A COMPLEX USING  
CRISPR/CAS9  
Frances Loyo, University of South Carolina Aiken

POSTER #22 A STRATEGY TO PRODUCE POLLEN-SPECIFIC TRANSPOSITION USING THE  
ARABIDOPSIS THALIANA DLL PROMOTER  
Rachael Jackson, University of South Carolina Aiken

- POSTER #23 OPTIMIZATION OF QPCR VARIABLES IN THE MEASUREMENT OF ANTI-HIV REAGENTS  
Christian Fay and Alyssa Smith, University of South Carolina Aiken
- POSTER #24 DETERMINING THE ROLE OF TERMINAL INVERTED REPEATS IN TRANSPOSITION OF MPING  
Jazmine Benjamin, University of South Carolina Aiken
- POSTER #25 DESIGN AND CLONING OF AN ANTI-HIV 1 VIF SIRNA INTO A RETROVIRAL VECTOR  
Austin N. Worden, University of South Carolina Aiken
- POSTER #26 TESTING A DCAS9 TRANSPOSASE FUSION PROTEIN IN ARABIDOPSIS THALIANA FOR TARGETED INSERTION OF MPING  
Mary Roby, University of South Carolina Aiken
- POSTER #27 DESIGN AND CLONING ANTI-HIV-1 SIRNAS TO INHIBIT VIF FUNCTION  
Rebecca Beaudry and Kirstyn Denney, University of South Carolina Aiken
- POSTER #28 USING CRISPR/CAS9 TO STUDY THE ROLE OF ZMYM2 AND ZMYM3 IN ZEBRAFISH CRANIOFACIAL DEVELOPMENT  
Kasey Kreutz, University of South Carolina Aiken
- POSTER #29 ROLE OF LGR5 SIGNALING IN SKELETAL MUSCLE MYOBLAST CELLS (SKMDC)  
Brooke Harrison, Converse College
- POSTER #30 ISOLATION AND CHARACTERIZATION OF NON-TUBERCULOUS MYCOBACTERIA AND MYCOBACTERIOPHAGES FROM WATER AND SOIL  
Briana Worley Regine Johnson, Claflin University
- POSTER #31 SERRATIA MARCESCENS QUORUM SENSING DEPENDENT BIOFILM FORMATION  
Fallon Stanley, Claflin University
- POSTER #32 IDENTIFICATION OF QUORUM SENSING GENES IN PSEUDOMONAS FLUORESCENS PF5  
Zakariya Ali, Claflin University
- POSTER #47 ISOLATION OF MICROSATELLITE PRIMERS FROM MANAYUNKIA SPECIOSA USING A MODIFIED PIMA APPROACH  
Cameron Leyers, Francis Marion University

### **CHEMISTRY / BIOCHEMISTRY**

- POSTER #33 POLYMER GRAFTED NANOPARTICLES AS DRUG DELIVERY VEHICLES  
Ronald Brock Fletcher, University of South Carolina Columbia
- POSTER #34 AN AMPEROMETRIC BIOSENSOR FOR THE DETECTION OF DIAGNOSTIC MARKERS  
Stephanie Borum, Kelsey Stuhn and William Case, Converse College

- POSTER #35 THE EFFECT OF FUNCTIONALIZED CARBON NANOTUBES IN AN EPOXY-AMINE POLYMER FOR SPIN-CAST EPOXY TELESCOPE MIRRORS  
Mariana Martins, Lander University
- POSTER #36 OPTIMIZATION OF A STANDARD ABSORBANCE ASSAY FOR 2,4'-DIHYDROXYACETOPHENONE DIOXYGENASE ACTIVITY  
Emma Foerster, University of South Carolina Aiken
- POSTER #37 OPTIMIZATION OF THE EXPRESSION AND PURIFICATION OF 2,4'-DIHYDROXYACETOPHENONE DIOXYGENASE (DAD)  
Victoria M. Shores, University of South Carolina Aiken
- POSTER #38 THE METAL-DEPENDENCE OF 2,4'-DIHYDROXYACETOPHENONE DIOXYGENASE (DAD)  
Jason Weeks, University of South Carolina Aiken

**MATH / COMPUTER SCIENCE / PHYSICS / ASTRONOMY**

- POSTER #39 A SERIES OF FOUR SUMS OF A FIBONACCI NUMBER TO THE FOURTH POWER  
Nathan McAnally, The Citadel
- POSTER #40 DEVELOPING ALGORITHMS TO IMPROVE SPITZER'S THERMAL IMAGING OF EXTRASOLAR PLANETS  
David Melnick , College of Charleston
- POSTER #41 CORRELATIVE CHARACTERISTICS OF DOUBLE-PULSED GAMMA-RAY BURSTS  
Maly Taylor, College of Charleston
- POSTER #42 DETERMINING HOW GAMMA-RAY BURST PULSE EVOLUTION CHARACTERISTICS CHANGES WITH ENERGY  
Stephen Lesage, College of Charleston
- POSTER #44 INVESTIGATING NON-EQUILIBRIUM FLUCTUATIONS OF NANOCOLLOIDS IN PRESENCE OF MAGNETIC FIELD USING DIRECT IMAGING AND SHADOWGRAPHY  
Ashley Rice, College of Charleston

**MEDICINE / PHARMACOLOGY / PHARMACY / PUBLIC HEALTH**

- POSTER #43 INVESTIGATING PHAGE ACTIVITY IN THE STUDENT POPULATION AT COASTAL CAROLINA UNIVERSITY  
Amy Powers, Coastal Carolina University
- POSTER #4 PHARMACOLOGICAL ANALYSIS OF ROS-MEDIATED NEURODEGENERATION IN *C. ELEGANS* (*cross-listed in cellular session*)  
Meghan Stickle, Coastal Carolina University

## **UNDERGRADUATE AWARDS JUDGES 2016**

*A special "Thank-You" to all of our judges!*

**Judges' Room: Kinard Hall 015**

### **Cell Biology - Oral Presentation Session**

Kathleen Ferris, University of South Carolina Upstate  
Leslie Lovelace, University of South Carolina Columbia  
Mithil Soni, University of South Carolina Columbia

### **Field Biology - Combined Oral and Poster Presentation Sessions**

Jonathan Storm, University of South Carolina Upstate  
Cynthia Tant, Winthrop University

### **Molecular Biology - Oral Presentation Session**

Saku Warshmana-Greene, South Carolina State University  
Keisha Wilson, University of South Carolina Columbia

### **Chemistry / Biochemistry - Oral Presentation Session**

Ping Li, University of South Carolina Columbia  
Caryn Outten, University of South Carolina Columbia

### **Math / Computer Science / Physics / Astronomy - Combined Oral and Poster Presentation Sessions**

Don Jordan, University of South Carolina Columbia (Mathematics)  
Bryan Lemon, Coastal Carolina University (Computer Science)  
Neil Miller, University of South Carolina Columbia Aiken (Astrophysics)  
Rich Thomason, Savannah River Nuclear Solutions (Physics)

### **Medicine / Pharmacology / Pharmacy / Public Health - Combined Oral and Poster Presentation Sessions**

Maria Agsa-Lastra, Winthrop University  
Carole Oskeritzian, University of South Carolina Medical School

### **Cell Biology - Poster Presentation Session**

Kathleen Ferris, University of South Carolina Upstate  
Laura Glasscock, Winthrop University  
Priyanka Singh, University of South Carolina Columbia

### **Molecular Biology Session I - Poster Presentation Session**

Matt Stern, Winthrop University  
Daniel Williams, Coastal Carolina University

### **Molecular Biology Session II - Poster Presentation Session**

Vicky Frost, Winthrop University  
Vida Mingo, Columbia College

### **Chemistry / Biochemistry - Poster Presentation Session**

Kristen Kull, Winthrop University  
Takita Sumter, Winthrop University  
Ron Ruszczyk, University of South Carolina Aiken

## 2016 SCAS ABSTRACTS

(Listed alphabetically by presenter's last name)

### IDENTIFICATION OF QUORUM SENSING GENES IN *PSEUDOMONAS FLUORESCENS* PF5

Zakariya Ali and Randall H Harris  
Clafin University

Due to the constant release of toxic waste by manufacturing industries into the environment, waste sites with pollutants that cause harm to the environment and to the human body when ingested have been deposited all over the country. The department of energy is now utilizing several means to restore these waste sites or reduce their levels of toxicity. One of these include bioremediation, the use of living organisms and their products to detoxify environmental pollutants. *Pseudomonas fluorescens* pf5 is a bacterium with the ability to reduce toxic chromium (vi) to its less toxic form, chromium (iii). Pf5 also has the ability to form biofilms, which interrupts the bioremediation process when the bacteria are unable to reach deeper into sediments at the waste sites. Quorum sensing is key to biofilm formation in many bacteria. This study uses transposon mutagenesis to identify genes responsible for quorum sensing in *P. fluorescens* pf5. Mutants of pf5 were made after conjugation with *Escherichia coli* carrying the transposon plasmid ptnmod-rkm'. The mutants were then screened against the biosensor *E. coli* (psb406). Pf5 mutants unable to produce the acyl homoserine molecules involved in quorum sensing and required to turn off the biosensor's luminescence were selected, cultured and retested against the biosensor. Two mutants were confirmed and their genomic dna, containing the transposon was isolated. The dna was digested with restriction enzymes and the cut pieces of dna were self-ligated. The dna was then transformed into competent *E. coli* (bw27067). Cells were then selected based on their ability to resist the antibiotic kanamycin. The plasmid dna containing the transposon with the gene of interest and kanamycin resistance marker was isolated and stored. Future research includes sequencing the plasmids, identifying the genes and investigating their involvement in quorum sensing mechanisms and biofilm formation.

### HIV-1 DEPENDENT BICISTRONIC EXPRESSION OF LUCR AND EGFP FROM PLTNG(INS2)R

Natalie Arthur and William H. Jackson  
University of South Carolina Aiken

The Human Immunodeficiency Virus Type 1 (HIV-1) is the causative agent of AIDS (Acquired Immunodeficiency Syndrome) and acts to infect the CD4+ T-Helper lymphocyte subset. The loss of these cells results in a gradual decrease in the ability to mount an effective immune response to pathogens, and ultimately, complete failure of the immune system which is characteristic of AIDS. Although current HIV treatments may reduce viral load, they are not curative. A potential method to reduce virus replication may be the induction of apoptosis in HIV-1-infected cells. The pro-apoptotic gene Bax has been shown to initiate cell death when over-expressed in cells and may be effective in these studies. In order to restrict expression of pro-apoptotic Bax to only HIV-1-positive cells, the lentiviral vector, pLRed(INS2)R was attained. This vector is characterized by multiple HIV-1-control elements including the 5' and 3' long terminal repeats (LTR), the Rev Response Element (RRE), and an inhibitory sequence from the p24 gag region (INS2). These regions limit heterologous gene expression only in the presence of the HIV-1 regulatory proteins tat (trans-activator or transcription) and rev. As a first step in these studies, pLRed(INS2)R was modified to express a Renilla Luciferase/enhanced green fluorescent protein (eGFP) fusion gene under the control of the HIV LTR promoter/enhancer. This new vector, pLTNG(INS2)R, expresses eGFP with a nuclear localization signal, which should allow future nuclear changes associated with apoptosis to be more easily monitored by fluorescent microscopy. Similarly, LucR expression will initially be used to measure the degree to which expression may be initiated in HIV-1-positive cells, prior to the use of apoptotic Bax. Co-transfection into 293T and HeLa cells using pLTNG(INS2)R and pNL4-3.LucR-E- (an HIV-1 replication incompetent clone) showed expression to be highly dependent on HIV-1 tat and rev, and preliminary imaging using confocal microscopy suggests that eGFP expression is localized to the nucleus. The observation of LucR and eGFP expression in pLTNG(INS2)R-transfected cells therefore provided proof of concept to the future use of this vector in expressing pro-apoptotic Bax.

### PHASE RESETTING CURVES DUE TO RECURSIVE STIMULI IN MORRIS-LECAR MODEL NEURONS

Dave Austin, Lindsay Marie Evans, Tristan Aft, Julia Imperatore, and Sorinel Adrian Oprisan  
College of Charleston

Neurons are excitable cells that generate large membrane potential excursions, called action potentials, when electrically or chemically stimulated. Neurons serve as elementary information processing units and they are interconnected in large neural networks. In order to predict the type and the stability of the ring patterns in neural networks we used a simplified model of the neuron that only retains one characteristics of its activity: the percentage change in the ring period due to a stereotypical external stimulus, i.e. the phase resetting curve (PRC). We used a biologically relevant Morris-Lecar (ML) model neuron that replicates the calcium and potassium oscillations in the muscle of a giant barnacle. We used the two-stimulus PRC in a simple feedback circuit and found that the predicted ring pattern was indeed observed experimentally.

## THE EFFECT OF CHRONIC REISHI TREATMENT ON ENZYME ACTIVITY IN RAT LIVER, SPLEEN, AND BLOOD SERUM

Kelsey Barber, Deidre Ridings, and Dr. Neval Erturk  
Converse College

Reishi is an herbal supplement derived from *Ganoderma lucidum*, also known in traditional Chinese medicine as the “mushroom of immortality” for its numerous health benefits. In vitro experiments with reishi have shown a reduction in oxidative stress and cell proliferation, and the induction of apoptosis in cancer cells. Unfortunately, the in-vivo effects of long-term reishi treatment have not been well studied. Oxidative stress enzymes are responsible for maintaining a healthy level of reactive oxygen species in order to prevent oxidative stress. In this study we investigated the effects long-term reishi treatment on enzyme activity of Glutathione Peroxidase (GPx), Xanthine Oxidase (XO), Superoxide Dismutase (SOD), and Catalase in the liver, spleen, and blood serum of rats. An alkaline phosphatase assay was also performed on spleen tissue. The enzyme activity assays in liver tissue showed no difference in activity between control and reishi treated groups for XO and SOD, the two enzymes that catalyze reactions that produce hydrogen peroxide. There was, however, an increase in activity in the reishi treated group for GPx and Catalase, the two enzymes that neutralize H<sub>2</sub>O<sub>2</sub>. There was no significant difference between reishi treated and control groups for any of the enzymes in spleen tissue or blood serum. No changes in the enzyme activity in blood serum and spleen were observed. These results indicate that in liver, reishi could be contributing to oxidative stress because it cannot neutralize H<sub>2</sub>O<sub>2</sub> as efficiently as the control.

## DETERMINING THE ROLE OF TERMINAL INVERTED REPEATS IN TRANSPOSITION OF *mPING*

Jazmine Benjamin and Dr. Nathan Hancock  
University of South Carolina Aiken

Transposable elements (TEs) are DNA sequences that can mobilize to another position in a genome, occasionally resulting in the creation or reversal of mutations. Type II DNA TE's utilize a “cut and paste” mechanism and are composed of three parts: A transposase (TPase) gene, terminal inverted repeats (TIRs) located at the ends, and target site duplications flanking the element. *Ping*, *mPing*, and *Pong* are TEs that were discovered in rice and belong to the same superfamily. They are mobilized by ORF1 and TPase, two proteins that bind to the TIRs and catalyze transposition.

This project aims to determine which of the bases in *mPing*'s TIRs are most important in facilitating transposition and whether the two TIRs play equal roles. To address this question, PCR was used to make modifications to individual TIR bases. These mutated *mPing* sequences were inserted into the ADE2 gene to create a reporter for transposition in yeast. *mPing* excision was determined by the amount of colonies that grew on the CSM-His-Leu-Ura-Ade plates due to the fact that the colonies on these plants required the transposition of *mPing* out of the ADE2 gene to grow. We found that when both TIRs were mutated with the same base change, some mutants showed almost no transposition while other showed moderate rates of transposition. It is expected that analysis of mutations in just one TIR or the other will demonstrate that one TIR may play a more important role in *mPing* transposition than the other.

## AN AMPEROMETRIC BIOSENSOR FOR THE DETECTION OF DIAGNOSTIC MARKERS

Stephanie Borum, Kelsey Stuhn, and William Case  
Converse College

Research into biosensor development continues to gain widespread interest due to its role in several clinical and industrial applications. Enzyme-based, electrochemical biosensors have become a prevalent subdivision of the field and offer a promising method for the signaling of molecules that often serve as biomarkers in disease detection. Specifically, “1st generation” methods are becoming viable strategies for the amperometric sensing of biomolecules. In this scheme, an analyte reacts with a specific oxidase enzyme to generate hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), and the peroxide is subsequently oxidized at a working electrode. The generated signal is therefore an indirect measure of the amount of analyte present.

This poster will present our current findings towards the development of a 1st generation biosensor for the detection of galactose, a sugar molecule implicated in the disease galactosemia. By targeting the sugar indirectly, the biosensor could offer a new clinical method for diagnosis of galactosemia since current clinical methods target the enzymes (vs. the sugar) needed for the metabolism of galactose.

## ASSESSING PEAK CALLING ACTIVITY OF HYLIDAE: THE EFFECT OF SURVEY DATE ON CALLING ACTIVITY

M. Kyle Brown, Amelia L. Russell, Adrian K.O. Hayes, Elliot P. Gibbs, Melissa Ann Pilgrim  
University of South Carolina Upstate

In response to global amphibian decline the scientific community initiated the development of large-scale amphibian inventory and monitoring programs. One such program is the North American Amphibian Monitoring Program (NAAMP). Implementation and maintenance of a protocol that adequately characterizes amphibian calling activity across a continent is challenging. Several previous studies demonstrated that the NAAMP survey protocol can introduce biases into the program's data set. We conducted call surveys using sound files from automated recording systems to determine if the NAAMP protocol misses peak calling activity of Hylidae species (*Acris crepitans*, *Hyla chrysocelis*, and *Hyla cinerea*) in the Piedmont of South Carolina. Our results suggested that 2 of the 3 species (i.e., *H. chrysocelis* and *H. cinerea*) reached peak calling activity



outside of the NAAMP's final sampling period. We suggest that the addition of a later sampling period for the Piedmont may better characterize calling activity of Hylidae in the region. However, addition of a later sampling window would need to be implemented cautiously, as we also determined that call survey noise indices were significantly higher during the late summer months due to insect activity. The higher noise indices may negatively impact call survey accuracy in a later sampling window.

#### EXPRESSION OF HEART-SPECIFIC CONSTRUCTS IN *CIONA INTESTINALIS* EMBRYOS

Katlyn Brumley and Heather Evans-Anderson  
Winthrop University

*Ciona intestinalis* is a useful animal model system for studying developmental processes. It is particularly helpful in studies of heart development since many of the developmental steps and genes are evolutionarily-conserved in *C. intestinalis*. This system replicates early heart development in other chordates, such as vertebrates. In addition to evolutionary conservation of genes and developmental features, there are many advantages to using this model system including rapid development and simple maintenance. Our main focus is the process of myocardial growth in the heart of *C. intestinalis*. In order to monitor the growth of the heart during development, we have constructed an expression vector using a fluorescently-labeled, heart-specific gene (BC030863/Micalcl, transcript model ci0100139114 from the ANISEED database). Previous studies have shown that development of *C. intestinalis* embryos is altered if the PI3K/AKT signaling pathway is disrupted. *Ciona intestinalis* embryos treated with PI3K- or AKT-specific inhibitory drugs at the larval stage just prior to metamorphosis and heart formation have a reduced heart size and delayed development. We will quantitatively assess heart growth using the reporter plasmid we constructed that contains a heart-specific promoter to generate fluorescently labeled hearts in juveniles. In addition, we also have obtained similar reporter constructs from the *C. intestinalis* transgenic line resource (CITRES, Japan). The requested plasmids, pMiCiTnIG and pMiCiTnIGCiprmG, are specifically expressed in muscle cells, including the heart. Electroporation of these plasmids has been successful and we have generated transgenic juveniles. Currently, we are optimizing the inhibitory drug treatments and will monitor heart growth by fluorescence microscopy.

#### CYTOTOXIC EFFECTS OF *PHYTOLACCA AMERICANA* LEAF, STEM AND ROOT EXTRACTS ON PC-12 ADRENAL NEURAL CELLS FROM *RATTUS NORVEGUS*

Emily Campbell, Diana Ivankovic, Dorota Abramovitch, and Donna Weinbrenner  
Anderson University

Because of the known cytotoxic properties of pokeweed (*Phytolacca americana*) that are associated with its pokeweed antiviral protein that inhibits the translation of proteins, pokeweed extracts, both crude and lyophilized, were used as treatments on PC-12 pheochromocytoma cells, a cell line harvested from rat adrenal glands that have a neural cancer. Pokeweed plants were obtained from the southern Piedmont area of North Carolina and subsequently deconstructed for their berries, roots, stems, and leaves. Each component was extracted via the soxhlet method into methanol. Ultimately, the individual extracts underwent rotary evaporation and were used to prepare stock solutions of pokeweed extracts in complete growth media. One trial was then performed by applying dilutions of these stock solutions at concentrations of 0.25 mg/mL, 0.50 mg/mL, 1.0 mg/mL, 2.0 mg/mL, 5.0 mg/mL, 10 mg/mL, and 20 mg/mL to several 96-well plates containing the PC-12 cells and complete growth media. A second trial was then conducted in the same manner and with the same concentrations using stocks of lyophilized extracts. MTS assays were applied to the plates containing the pokeweed treatments and incubated for approximately 3 hours, then read by an ELISA plate reader. The data from the ELISA plate reader indicate that lower concentrations of the pokeweed extract have a mitogenic effect on the PC-12 cells, with concentrations between 5 mg/mL and 10 mg/mL generally marking the extracts' shift from exhibiting mitogenic to cytotoxic effects. While most extracts exhibited this general trend quite well, the lyophilized leaf extracts demonstrated a more drastic drop-off in mitogenic activity between the concentrations of 2 mg/mL and 5 mg/mL. The data reveal that pokeweed may be an avenue of further research for cancer treatments. However, dosage may prove to be a problem since doses that are too low may cause tumor growth instead of tumor decay.

#### HEAVY METAL CONCENTRATION IN *DONAX* CLAMS FOUND IN MYRTLE BEACH ANALYZED USING ATOMIC ABSORPTION

Harley Coates, Larissa Martin, and Kevin McWilliams  
Coastal Carolina University

The coquina clam, *Donax variabilis*, is a ubiquitous invertebrate along the eastern seaboard. Due to its placement in the food chain and intertidal habitat, it is an ideal indicator for the health of the surrounding ecosystem. The clams, along with water and sediment samples, were collected from three separate locations in Myrtle Beach, SC and analyzed for heavy metals using an atomic absorption (AA) instrument. Heavy metal concentration is statistically analyzed and evaluated in terms of chemical composition with regard to zinc, copper, lead, manganese, nickel, iron, and chromium. This is a temporal study to see how the concentration changes with time and human presence. It is hypothesized that the concentrations will increase during the summer months due to increased foot and vehicle traffic from tourists.

## cAMP RESISTANCE IN *SERRATIA MARCESCENS*

Jessica Cole and Randall H. Harris  
Clafin University

According to the Center for Disease Control, 40-90% of contact lens wearers do not follow the proper care instructions for their corrective eyewear. Inadequate cleaning and irregular replacement of contact lens cases may lead to complications, such as keratitis or inflammation of the cornea. Keratitis results in nearly one million doctor and emergency room visits and costs the United States healthcare system \$175 million yearly. *Serratia marcescens* causes 10-15% of bacterial keratitis cases. The bacteria have intrinsic high level resistance to cationic antimicrobial peptides (cAMPs), therefore promoting the infection. cAMPs are secreted by corneal epithelial cells and have a protective role in the human innate immune system. We hypothesize that *S. marcescens* has a set of genes whose products alter the direct interaction of the peptides with the bacteria. To this end, we have generated approximately 9,400 mutants by transposon mutagenesis and screened the mutants for sensitivity to the cAMP polymyxin B. Replica plating identified four mutants that were more sensitive to 100 µg/ml or 500 µg/ml of polymyxin B than the parent strain. The defective genes in the mutants will be cloned and sequenced. Their identity will be determined by comparing their sequences to those in the Genbank database. Identifying which genes are responsible for cAMP-resistance will lead to the development of shorter treatment and recovery times.

## DESIGN AND CLONING ANTI-HIV-1 SIRNAS TO INHIBIT VIF FUNCTION

Rebecca Beaudry, Kirstyn Denney and William H Jackson  
University of South Carolina Aiken

The Human Immunodeficiency Virus (HIV-1) is a virus that infects CD4+ T helper lymphocytes, and it is the destruction of this cell population that results in Acquired Immunodeficiency Syndrome (AIDS). HIV-1 expresses the accessory gene vif, viral infectivity factor, which functions to block the function of apolipoprotein B mRNA editing enzyme-catalytic polypeptide-like 3G. APOBEC3G is a DNA cytosine deaminase, which in the absence of vif is packaged into viral particles and acts to cause hypermutation during reverse transcription in the target cell. In the presence of HIV vif APOBEC3G is ubiquitinated through the formation of the vif-Cullin5-Elongin B-Elongin C complex resulting in its proteosomal degradation thereby blocking the antiviral effect. Our studies are investigating the use of siRNAs to test whether vif-inhibition negatively effects HIV replication. To generate anti vif siRNAs, the HIV-1 NL43 vif gene sequence (Accession Number M19921) was uploaded into the Integrated DNA Technologies (IDT) RNAi Design tool ([www.idtdna.com](http://www.idtdna.com)) which produced several siRNA binding sites. Two of these sequences, located at nucleotides 5111 and 5522 were selected for further study. Short hairpin RNAs (shRNA) were designed by linking each siRNA sense and antisense sequences with a short hairpin linker. The restriction sites BglIII and HindIII were added at the 5' and 3' ends of each shRNA. The resulting shRNA sequences were converted to dsDNA and synthesized prior to cloning into the shuttle vector pSRNG.

## THE EFFECTS OF NATURAL AND ARTIFICIAL SWEETENERS ON ANXIETY AND DEPRESSIVE SYMPTOMS IN MALE SPRAGUE-DAWLEY RATS

Brandee Desmarais and Michelle Vieyra  
University of South Carolina Aiken

The purpose of this study was to determine the effects of natural and artificial sweeteners on anxiety and depressive symptoms in male Sprague-Dawley rats. Previous studies have shown that there is a link between consumption of sucrose and acute anxiety and aggression. Metabolites of aspartame have been shown to increase depressive symptoms in rats. No studies have compared different monosaccharides or looked at the effects of other popular artificial sweeteners such as sucralose. Twenty five male Sprague-Dawley rats were given sugar treatments for an 18 week period. The rats were divided into five groups receiving either: 1)10% dextrose, 2)10% fructose, 3)0.016% sucralose, 4)0.05% aspartame, 5) water. At the beginning of the study baseline data was collected including results of a fur coat state test, light/dark box, and forced swim test. Tests were performed again at the end of the treatment period. Results of this study suggest that the rats who consumed the natural sugars had an increase in depressive symptoms as indicated by fur coat state scores. The artificial sugar groups had fur coat state scores similar to control. In the other two tests, subjects in all groups, including control, showed significantly higher stress levels after the 18 week period as compared to baseline but there were no statistical differences between the groups.

## DEVELOPING mPING-BASED ACTIVATION TAGS

Stephanie Diaz and Dr. Nathan Hancock  
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Transposable elements are mobile DNA sequences referred to as "jumping genes," that move from one location in the genome to another. mPing, a Miniature Inverted Repeat Transposable element discovered in rice, is being used for mutagenesis because it transposes at high-rates and has a preference for insertion near genes. Adding promoter sequences to mPing can cause transcriptional activation of genes it inserts near and reveal their function. This activation tagging approach can be used as a gain of function strategy to identify redundant or lethal genes. To determine the efficacy of mPing-based activation tagging, the transposition of two elements, mmPing20B and mmPing20F, containing enhancer sequences from soybean β-conglycinin and figwort mosaic virus respectively are being studied in yeast and Arabidopsis.

Yeast transposition assays were performed to determine the excision rate of these activation tagging elements compared to mPing. Previous experiments indicate that adding sequences to the mPing element decreases its transposition. To overcome this effect, we have added the enhancer sequences to mmPing20, a hyperactive version of mPing. Because the enhancers used are similar in size, we expect mmPing20B and mmPing20F to show similar rates of transposition.

Based on our results in yeast, we expect these elements to transpose in plants at similar rates to mPing. To test transposition in plants, *Arabidopsis thaliana* was transformed with an mmPing20F-GFP reporter construct using an agrobacterium-mediated floral dip method. Plants homozygous for the mmPing20F-GFP reporter construct will be transformed with a Pong ORF1 and transposase expression construct. The resulting plants will then be screened for GFP expression. Plants with high rates of transposition can then be used to evaluate this new activation tagging system.

#### SYNTHESIS AND CATALYTIC OXIDATION ACTIVITY OF FE(III) AND MN(III) MOF-525

Manuel Dominguez and Gerard Rowe  
University of South Carolina Aiken

Metal Organic Frameworks have been synthesized in a variety of forms for their use in catalysis and gas storage. Porphyrin MOF's are especially favored for their ability to have stable frameworks. MOF-525 is a new tetra(4-carboxyphenyl)porphyrin-based MOF that makes use of a zirconium oxide secondary building unit to link the porphyrin groups. This design allows for a very chemically stable framework due to the use of zirconium nodes. So far, MOF-525 has been applied in limited fashion, so our research aims to explore the catalytic abilities of MOF-525 with varying metal centers (Fe and Mn). The Fe and Mn incorporated MOFs will be screened for their ability to catalyze the oxidation of alkyl C-H bonds using oxygen atom donors.

#### BIOREMEDIATION-REDUCTION OF HEXAVALENT CHROMIUM

Chantel Duscent, Jellisa Ewan, Shatresa Bradley, Caleen Hawkins, and Randall H. Harris  
Clafin University

Several sites across the US were built to facilitate the production of nuclear weapons for the nation's defense programs during the cold war. However, the chemical and radioactive wastes that were byproducts of nuclear material production were not disposed of properly. The toxic hexavalent chromium [Cr(VI)] is a major contaminant at these sites but can be reduced to the a less toxic Cr (III). Bioremediation is a method that uses microorganisms to remove contaminants. The purpose of the experiment is therefore to isolate and characterize different bacterial isolates that are capable of reducing Cr (VI) to Cr (III). Sludge samples were taken from the Wastewater Treatment Plant in Orangeburg, SC. The samples were diluted and plated on BHI agar to culture the bacteria. Individual isolates were examined for K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> resistance in BHI medium. Growth curves of the isolates were done to determine which isolates are capable of withstanding high K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> concentrations. Chromium detection assays were carried out over 48 hours to determine the Cr (VI) remaining in the bacterial supernatants. Out of four bacterial isolates, two of them showed tolerance to 200 ppm of chromium and three had 1-7% of Cr (VI) remaining in the culture supernatant after 48 hours. As a result of the experiments that were done on the isolates, they may be used in bioremediation to remove hexavalent chromium from the environment.

#### RELATIVE EXPRESSION OF DIATOM CHLOROPLAST GENES

Nyquashia Edwards and Megan Cevasco  
Coastal Carolina University

Marine diatoms are responsible for an estimated 20% of global carbon fixation and up to 40% of marine primary productivity. Diatoms are abundant in South Carolina coastal marine habitats and have been identified as the chloroplasts donors in kleptoplastic relationships with other marine protists in which the chloroplasts are aquired and functionally retained. The relative expression of chloroplast encoded genes within pure cultures of marine diatoms is essential to understanding the continued functioning of these organelles when in the kleptoplastic condition. Using quantitative PCR techniques the relative expression of multiple diatom chloroplast genes are characterized.

#### HEAVY METAL BIOREMEDIATION POTENTIAL OF SERRATIA MARCESCENS

Ijeoma Ekpenuma and Randal H. Harris  
Clafin University

Heavy metal pollution due to legacy waste from the Cold War nuclear proliferation remains a huge problem at federal and industrial sites. Bioremediation is a promising environmentally friendly, and cost-effective technology to clean up both soils and wastewaters containing organic or inorganic contaminants. My long term goal is to develop a bioremediation strategy to reduce the concentration of heavy metals at polluted sites. To this end, we have demonstrated that a *Serratia marcescens* bacterial isolate was capable of reducing toxic chromium (VI) to non-toxic chromium (III). The purpose of this project is to extend the Cr (VI) reduction studies, examine the effect of Cr (VI) on motility and the potential of the bacterial isolate to resist nickel, zinc, cadmium and copper. The bacteria reduced 80% of the Cr (VI) after 48 hours. Cr (VI) interfered with swimming and swarming motility after 24 hours but the effect was only present after 48 hours for swarming motility. *S. marcescens* showed high level resistance ( $\geq 200$  ppm) to Cd, Cu, Ni, and Zn. Future studies will examine the ability of the bacterial isolate to detoxify Cd, Cu, Ni, and Zn either through adsorption and/or reduction.

## THE EFFECTS OF NATURAL AND ARTIFICIAL SWEETENERS ON GUT MICROBIOME COMPOSITION AND METABOLISM

Mustafa Elhallaoui and Michelle Vieyra  
University of South Carolina Aiken

This study examined whether rat intestinal microbiota populations change in response to consumption of dextrose, fructose, sucralose or aspartame. In recent studies cancer, obesity, diabetes, cognitive impairment and many other diseases have been linked to shifts in the bacterial community structure of the intestinal flora. Diet may greatly influence gut microbiomes. Glucose consumption has been shown to change the intestinal microbiome in dogs. The consumption of aspartame has been shown to modify gut bacteria distribution, which decreased glucose tolerance and consequently promoted the development of diabetes. In this study, twenty-five male Sprague Dawley rats were divided into five diet groups and treated for 18 weeks. The groups received either 10% Dextrose (200ml/day), 10% Fructose (200ml/day), 0.016% Sucralose (200ml/day), 0.05% Aspartame (200ml/day), or water. All animals were provided with access to standard rat chow ad libitum. At the conclusion of the treatment, the rats were sacrificed and fecal and colon tissue specimens were collected. Growth curves of bacteria isolated from fecal matter are being conducted with different sugar media to determine changes in metabolism. Colon tissues are being processed and analyzed using a BioLog protocol to determine gut microbial communities.

## NONLINEAR EFFECTS OF STIMULI ON PHASE RESETTING CURVE OF DIFFERENT NEURAL TYPES

Lindsay Marie Evans, Dave Isaiah Austin, and Sorinel Adrian Oprisan  
College of Charleston

Neurons are excitable cells that are silent most of the time and only briefly produce a burst of electrical activity called action potentials (APs) in response to inputs received from other neurons. Some neurons are intrinsic burster capable of producing a periodic sustained electrical activity. Such spiking neurons are frequently encountered as part of autonomous neural networks responsible for rhythmic activities, such as flying, swimming, walking, chewing, etc., called central pattern generators (CPG). The main mechanism used by neurons to respond and adapt to environmental stimuli is through changing their firing frequency proportional to inputs received. The relationship between the external stimulus timing and the change in the firing rate of the neuron is called a phase resetting curve (PRC). In addition to its application to investigating the mechanisms that allow the same neural network to generate multiple patterns of activities, e.g., the gait network can produce walk, trot, gallop, etc., the PRC can predict the synchronous firing of a large network that occurs during epileptic seizures. We investigated numerically the relationship between the shape of the external perturbation and the PRC. For this purpose, model neurons of different excitability types were used in order to map the effect of external perturbations, such as the amplitude, duration, rate of change of inputs from other neurons, and the PRC.

## OPTIMIZATION OF QPCR VARIABLES IN THE MEASUREMENT OF ANTI-HIV REAGENTS

Christian Fay, Alyssa D. Smith, and William H. Jackson  
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The goal of this study is to use Quantitative Polymerase Chain Reaction (qPCR) to quantify the anti-viral effect of reagents used in our lab to inhibit HIV replication. HIV, the Human Immunodeficiency Virus, infects and destroys CD4+ T Helper lymphocytes. The loss of these cells results in the eventual collapse of the immune system and acquired immune deficiency syndrome (AIDS). Our lab uses various strategies to inhibit HIV replication: (1) anti-HIV siRNAs to target virus gene functions, and (2) induction of apoptosis in HIV-infected cells. Each strategy requires measurements that verify the anti-viral effect. Our studies using siRNAs primarily HIV tat, which acts to upregulate HIV transcription. In these studies, qPCR will be used to measure tat expression in treated cells. Our studies on the induction of apoptosis use eGFP (enhanced Green Fluorescent Protein) as a marker for apoptotic gene expression. In order to properly use qPCR in these studies, several parameters must be optimized: primer design and use, primer annealing temperature ( $T_m$ ), and template concentration. Primer pairs were designed to amplify a 100-170 bp fragment from each template (HIV tat and eGFP) using online primer design tools (Primer3Plus, Perlprimer, Primer/BLAST, or IDT). Three primer pairs in which the forward and reverse primers had calculated  $T_m$ s of 58-60C and ended in a cytosine (C) or guanine (G) were chosen for synthesis and testing. Studies are currently underway to evaluate the use of these primers for qPCR.

## POLYMER GRAFTED NANOPARTICLES AS DRUG DELIVERY VEHICLES

Brock Fletcher, Brian C. Benicewicz, Julia G. Pribyl, Lei Wang, Kristin P. Miller and Alan W. Decho  
University of South Carolina Columbia

In March 2014, the assistant director-general at The World Health Organization, Dr. Keiji Fukuda said "Without urgent, coordinated action by many stakeholders, the world is headed for a post antibiotic era, in which common infection and minor injuries which have been treatable for decades can once again kill." Our research seeks to address this public health issue through the use of nanoparticles as carriers for antibiotics. Previously, penicillin-G (PenG) was non-covalently complexed with monolayer carboxylic acid groups on the surface of silica nanoparticles as well as with poly(methacrylic acid) (PMAA) chains grafted from the surface of the particles. The PenG complexed with monolayer acid groups effectively killed bacteria (including MRSA) which are semi- or strongly resistant to the free antibiotic. Our aim is to further this technology by developing a controlled release system by covalently binding the drug molecules to the nanoparticle and polymer chains grafted to the nanoparticle, generating covalently bound analogues of the previously studied system. Nalidixic acid was

selected as a model drug for this purpose because it is relatively inexpensive and contains a carboxylic acid group in the molecular structure. This moiety is an easily transformable functional group, and opens a host of synthetic routes for bonding and release. So far, we have successfully bound a monolayer of nalidixic acid to 15-nm diameter silica nanoparticles at a variety of graft densities and are now working on a Nalidixic acid functionalized monomer which can be grafted from the surface of the nanoparticle via RAFT polymerization. Controlled release from both of these systems can then occur via selective hydrolysis of amide or ester linkages, or introduction of other hydrolytically sensitive groups between the nanoparticle/ polymer backbone and drug molecule. We also aim to graft PEG chains to the surface which will aid in water dispersibility of the drug-loaded nanoparticles. This may lead to future work testing this platform in conjunction with other existing methods for more controlled release of the attached drug. For example, technologies exist to control delivery via pH, temperature, ultrasound, and magnetism.

#### OPTIMIZATION OF A STANDARD ABSORBANCE ASSAY FOR 2,4'-DIHYDROXYACETOPHENONE DIOXYGENASE ACTIVITY

Emma Foerster and Kenneth Roberts  
University of South Carolina Aiken

The compound 2,4'-dihydroxyacetophenone (DHA) is oxidized to benzoic acid and formic acid by the enzyme 2,4'-dihydroxyacetophenone dioxygenase (DAD). Our group is interested in investigating the mechanism of oxidation by DAD. To this, we have optimized a UV absorbance assay for monitoring the conversion of DHA into benzoic acid. The DHA substrate shows an absorbance maximum at 278 nm that is lost on conversion to benzoic acid, and a shoulder at 320 nm that is similarly lost. Enzyme activity is measured as the change in A278 and A320 vs time. The assay was performed at a variety of temperatures to determine optimal conditions balancing rate and concentration of enzyme.

#### CHARACTERIZING THE REPLICATIVE TRANSPOSITION MECHANISM OF THE MITE mPING

David Gilbert and Dr. Nathan Hancock  
University of South Carolina Aiken

The miniature inverted repeat transposable element (MITE) mPing is a deletion derivative of the autonomous Ping element (PIF/Pong/Harbinger superfamily), and actively transposes in rice. Like other DNA transposable elements, mPing is mobilized using a cut-and-paste mechanism to physically move from one location in the genome to another. Because the element is physically moved, this process should not result in additional copies, however mPing is seen to increase in copy number over time in rice. Using a previously developed yeast transposition assay, we are working to characterize the mechanism underlying this replicative transposition.

Movement of the mPing element results in a double stranded break (DSB) that must be repaired. The repair can occur by either non-homologous end joining (NHEJ) which ligates the broken ends back together, or by homologous recombination repair (HRR) which uses homologous sequences in the genome as a guide to repair the DSB. We hypothesize that replicative transposition may result when HRR is used to repair the transposition induced DSB when mPing is present on both homologous chromosomes (homozygous insertion). In other words, when one element moves, the homologous copy is used as a repair template, inserting mPing back into the site, and increasing the copy number by one.

To test this hypothesis, we first made a stable genomic insertion of an mPing reporter construct in haploid yeast. We then mated this strain to produce a diploid strain with homozygous mPing insertions. We tested how transposition in the diploid strain compares to transposition in the haploid strain. The haploid strain was also mated with a strain with no mPing insertion to create a diploid strain heterozygous for the mPing insertion. We are also developing a HRR-deficient mutant to further test our hypothesis.

#### LIGATING THE MEF2CA GENE AND ASSOCIATED REGULATORY SEQUENCE IN THE PTARBAC2.1 VECTOR TO DRIVE EGFP

Kenneth Glenn and April Delaurier  
University of South Carolina Aiken

The purpose of this research is to trace the expression of the gene *mef2ca* during development in zebrafish. Previous studies have shown that mutating the *mef2ca* gene in zebrafish causes several craniofacial abnormalities in these fish, many of which are fatal because of the degree to which the bones have been deformed. Since *mef2ca* is over 100kb, the entire gene and regulatory sequence does not exist in current BAC "libraries" and thus our objective is generate shorter DNA constructs containing regulatory sequence of *mef2ca* to drive a transgene in an endogenous expression pattern identical to *mef2ca*. Primers to amplify *mef2ca* regulatory sequence will be made in silico using consensus sequence of several kilobases upstream and downstream of *mef2ca*. This PCR product will be digested with the restriction enzyme EcoRI and then ligated into a pTARBAC2.1 vector. The pTARBAC2.1 vector is a variation of bacterial artificial chromosome. The vector will be incorporated into electrochemically competent *E. coli* bacteria which are cultured, plated, and selected against an antibiotic resistance. Commercially available BACs containing sequences within or near *mef2ca* will also be used. pTARBAC2.1 constructs will be homologously recombined with the reporter transgene EGFP, with EGFP being added at the start codon of *mef2ca*. This process will eventually allow the transgene EGFP to be expressed endogenously within a developing zebrafish. After purifying the construct, it will ultimately be microinjected into 1-cell zebrafish embryos (to ensure as close to ubiquitous expression as possible) and the zebrafish will be screened for expression of EGFP. Should this succeed, the timeline of expression of *mef2ca* as well as where it is expressed during zebrafish development will become more apparent.

HISTONE DEACETYLASE INHIBITOR RG2833 REDUCES THE VIABILITY OF HUMAN MELANOMA  
CELL LINES IN VITRO

Lauren Green and Matthew Stern  
Winthrop University

Histone deacetylases (HDACs) play an important role in the epigenetic control of gene expression in both normal and cancer cells. Previous studies have demonstrated that pharmaceutical inhibition of HDACs can kill and/or suppress the growth of cancer cells. RG2833 is a HDAC inhibitor that targets specific HDACs known to be active in cancer cells. Melanoma cells have previously been shown to respond to HDAC inhibitors that are structurally similar to RG2833. We hypothesized that the inhibition of HDAC activity by RG2833 would result in the reduced growth and/or death of cells from the malignant melanoma cell lines SK-MEL-5 and SK-MEL-28. To test our hypothesis, we exposed SK-MEL-5 and SK-MEL-28 cells to increasing concentrations of RG2833. We found that concentrations of RG2833 that effectively inhibited HDAC activity in melanoma cells also resulted in altered gene expression profiles and reduced cell proliferation and viability. In our studies, we employed three different and commonly used assays to measure cell viability: 1) SRB, which measures total cellular protein, 2) alamarBlue®, which is reduced to a fluorescent product in live cells, and 3) CellTiter-Glo®, which generates a luminescent signal proportional to the amount of cellular ATP present. Interestingly, the choice of assay used to measure cell viability had a significant impact on the results with the more sensitive assays yielding results that indicate a greater sensitivity of the melanoma cells to RG2833. Together, these results demonstrate the effectiveness of RG2833 in altering gene expression and reducing the growth and viability of malignant melanoma cells in vitro and warrant further investigation of the potential therapeutic use of RG2833 and related compounds in the battle against cancer.

ROLE OF LGR5 SIGNALING IN SKELETAL MUSCLE MYOBLAST CELLS (SKMDC)

Kaitlyn Brooke Harrison and Stephan Brown  
Converse College

Leucine-rich repeat-containing G-protein coupled receptor 5 (LGR5) serves as a stem cell marker and is expressed in areas of cell proliferation. These receptors are located within the crypts of the intestinal tract, near the base of hair follicles, as well as other exclusively regenerative areas of the body. In these regenerative areas LGR5 is connected with the body's ability to proliferate and organize itself, in a mechanism incredibly similar to that of stem cells. Currently, LGR5 research focuses on both its role as an adult stem cell marker and as a marker for cancer. LGR5 may also be a global marker within the body for adult stem cells and is frequently used during hospital screenings as an indicator for cancer.

The role of LGR5 in disease and development can be studied by removing LGR5 activity by creating negative cells (LGR5<sup>-</sup>). The goal of my project is to create LGR5-knockdown myoblasts by using Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) technology. Myoblasts are muscle stem cells that normally express LGR5 prior to differentiation and they can be used to study LGR5's role in normal cell development. The use of adenocarcinoma cells allows for the observation of LGR5's role in the proliferation of cancerous tissue. Lastly, with LGR5's direct purpose largely unknown, the removal of LGR5 in both cell types will allow for better insight into what LGR5 affects, how much of a role it plays and what that specific role may be.

Through experimentation, the expression of LGR5 on myoblasts has been shown to maintain the cells in a pluripotent state. Myoblast with LGR5-knockdown showed decreased expression of pluripotent factors compared to wild-type. Additionally, LGR5-knockdown cells showed different morphology from wild-type, suggesting that the presence of LGR5 locked the cells into a more precursor form. Once LGR5 has been removed, the cells formed mature myotubes. LGR5 signaling is unique, does not depend on G-protein-i activation or utilize G-protein-i mechanism. Pertussis toxin did not inhibit myoblast GTPase activity. Increased LGR5 expression in colon cancers may be a sign of increased pluripotent cell activity.

SHORELINE PREDATION ON AN INTRODUCED CLAM SPECIES IN THE CONGAREE RIVER

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Columbia College

The Asiatic clam, *Corbicula fluminea* is present in high densities in the shallow water of the upper Congaree River in South Carolina. This invasive species has been studied globally and is widely associated with disruption of aquatic ecosystems and fouling of industrial and municipal water flow. Empty clam shells found in shallow water and along the shore of the Congaree provide an opportunity to examine patterns and sources of mortality in this population. We collected clam shells and live clams - noting densities, size frequencies, and indicators of predation. Our observations suggest that a major source of mortality for these clams is predation by mammals of the riparian shoreline (muskrats, raccoons, and otters). Although our research was disrupted by flooding, we hope to renew our efforts soon and examine any changes to the population that have occurred during this time when shoreline predators have been excluded.

A STRATEGY TO PRODUCE POLLEN-SPECIFIC TRANSPOSITION USING THE  
*ARABIDOPSIS THALIANA* DLL PROMOTER

Rachael Jackson and Nathan Hancock  
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Transposons are mobile DNA elements that jump within the genome through a cut and paste mechanism. One such element, mPing, is a deletion derivative of the larger autonomous Ping element and its transposition is mediated by the two proteins, ORF1 and Transposase (TPase). Due to the element's high transposition rate and preference for insertion near genes, it is an ideal candidate for mutagenesis. Mutagenesis is the process of changing the expression of a gene in order to determine that gene's function. We are trying to induce mPing transposition to occur only in pollen, potentially increasing the rate of heritable mutations and preventing transposition in somatic tissues. This would be an important improvement of our gene discovery system. Our strategy is to use a DLL promoter which has been previously shown to only induce expression in pollen. We made a plasmid construct with DLL and GmUbi promoters driving expression of TPase and ORF1 genes respectively. The control plasmid has both genes' expression driven by constitutive GmUbi promoters. The constructs were transformed into *Arabidopsis thaliana* containing an mPing:GFP reporter construct. Transposition analysis will then be checked in both the T1 and T2 generation by measuring the GFP fluorescence, indicating if transposition has occurred or not. In the T1 generation, plants with the DLL promoter did not show GFP expression while 30% of GmUbi control plants showed GFP expression. This result is consistent with our expectations because in the T1 generation, we expected to see little to no transposition in the plants with the DLL construct, and a relatively higher rate of transposition in the GmUbi control plants. If pollen-specific transposition is occurring as planned during the formation of the T2 generation, we expect to see a very low rate of germinal transposition in the control plants and a high rate of germinal transposition in plants with the DLL construct.

SPORANGIAL STRUCTURE OF TAENIOCRADA FROM THE LOWER DEVONIAN OF NEW BRUNSWICK AND  
EASTERN QUEBEC

Klaire Rouse and Douglas Jensen  
Converse College

*Taeniochrada* is an early vascular plant fossil found in rocks that range through the Devonian period (419-359 Ma). It is characterized as having dichotomously branching, naked ribbon-like stems, and a distinct central strand. Because *Taeniochrada* is typically found sterile, it is considered a form genus, and as fertile specimens are discovered, they are described as natural species. Most of them are placed in the genera *Huvenia* and *Stockmansella*. Specimens collected from the Lower Devonian of New Brunswick and Gaspé are identified as conforming to the description of *Taeniochrada*. Some of these specimens contained sporangia, so they were prepared for further study by dégageement. These fossils exhibit two different reproductive morphologies. Some specimens have solitary or paired sporangia attached directly to the stem. The sporangia are 1.0-4.5 mm in length ( $\bar{x}$  = 3.0 mm; n = 24) and 1.0-3.0 mm in width ( $\bar{x}$  = 2.0 mm; n = 24) with a single longitudinal slit or a single dehiscence line. We assign these specimens to *Stockmansella*, which is characterized by the direct attachment of solitary or paired sporangia to the stem. The other specimens have sporangia attached to special lateral branches that grow off the main stem. The sporangia are 2.0-4.0 mm in length ( $\bar{x}$  = 2.8 mm; n = 90) and 1.0-4.0 mm in width ( $\bar{x}$  = 2.0mm; n = 90) with a single, longitudinal dehiscence line and longitudinal striations. We assign these specimens to *Huvenia* because of the attachment of sporangia on special lateral branches, and not directly on the stem like *Stockmansella*. These specimens are the first recorded in North American occurrences of *Huvenia* and *Stockmansella*.

ISOLATION AND CHARACTERIZATION OF NON-TUBERCULOUS MYCOBACTERIA AND MYCOBACTERIOPHAGES  
FROM WATER AND SOIL

Regine Johnson, Briana Worley and Kim Borges  
Claffin University

The purpose of this study was to isolate and characterize non-tuberculous mycobacteria (NTM) and mycobacteriophages from natural water and tap water, in order to gain insights into their diversity. The NTM are natural inhabitants of waterways and soil. Bacteria from this group have been found to colonize municipal drinking water and plumbing fixtures. Some species of NTM are also opportunistic human pathogens that can cause pulmonary, wound, and systemic infections. Mycobacteriophages are viruses that infect and kill specific host species of mycobacteria. Very little is known about the diversity of aquatic NTMs and their phages, despite their medical and environmental significance. In this study, NTM were cultured from plumbing and natural water samples from Orangeburg, SC, and were characterized to species level using a PCR-restriction enzyme cleavage method. Several distinct NTM species were isolated from each water sample. Mycobacteriophages previously isolated from soil samples using the host *Mycobacterium smegmatis* were tested by plaque assay to determine if they would infect these newly-isolated NTMs as well as four known NTM species. The different mycobacteriophages showed distinctive host specificities, with some only able to infect one NTM host, and others able to infect more than three hosts. Enrichment cultures to isolate new mycobacteriophages from water were also prepared, but no mycobacteriophages were successfully isolated from either plumbing or natural water samples.

## THE EFFECTS OF MONOSACCHARIDES AND ARTIFICIAL SWEETENERS ON BODY WEIGHT GAIN, ADIPOSITY, AND BLOOD GLUCOSE LEVELS IN SPRAGUE DAW

Heather Jones and Michelle Vieyra  
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The objective of this study was to examine body weight gain, adiposity, and blood glucose levels in rats who consumed natural or artificial sugar treatments equivalent to one can of regular or diet soda. Many studies show a link between sugar-sweetened beverages and the obesity epidemic. Studies of artificial sweeteners show that they produce less weight gain than sugary beverages however there is a lack of studies that compare natural and artificial sweeteners to a water control. Twenty-five male Sprague-Dawley rats were given a 200mL sugar treatment for an 18-week period. Rats were divided into five groups: 1) 10% dextrose 2) 10% fructose 3) 0.016% sucralose 4) 0.05% aspartame 5) water. Baseline weights and blood glucose levels were taken and weights were recorded continuously throughout the study. Post-diet blood glucose levels were taken. At the conclusion of the study rats were euthanized and fat was collected from the body wall and genital region. Results suggest that consumption of sucralose produced body weight gain equivalent to that of the groups consuming fructose or dextrose. The aspartame group had body weight gain matching the control. Both natural sugar groups had a higher body fat percentage than the artificial sugar groups or control. Sucralose was equivalent to aspartame and control for body fat percentage. Blood glucose tests are still being analyzed. This study suggests that sucralose consumption may increase body weight gain but this could not be accounted for by body fat percentages.

## mPING AS A TOOL FOR TRANSPOSON MUTAGENESIS IN *D. RERIO*

Alec Jones, Tiana Chandler, C. Nathan Hancock, and April DeLaurier  
University of South Carolina Aiken

The goal of this project is to demonstrate the successful *in vivo* transposition of the mobile element *mPing*, from *Oryza sativa* (rice), in *Danio rerio* (zebrafish). *mPing* is a 430-bp, class II miniature inverted-repeat transposable element (MITE), which is mobilized by ORF1 and TPase enzymes. *mPing*, like many invertebrate transposons, has yet to be tested for activity in a vertebrate organism, yet may serve as an effective tool for transposon mutagenesis in vertebrates, such as zebrafish. Two *iTol2* expression vectors were constructed via Gateway recombination, each containing a 5' element, middle element, and 3' element. The 5' element contained the  $\beta$ -actin promoter (*p5E-bactin2*), the middle element was either *ORF1* or *TPase* (*pME-MCS*), and the 3' element included IRES-driven *EGFP* (disrupted by *mPing*) and an SV40 late polyA signal (*p3E-IRES-EGFPpA*). The three vectors were recombined into a single destination vector (*pDestTol2pA2*). Both vectors will be co-injected with *Tol2* mRNA into one-cell stage zebrafish embryos. We hypothesize that once the vectors integrate into the host genome, co-expression of *ORF1* and *TPase* will mobilize *mPing*, resulting in reconstitution of *EGFP* by non-homologous end joining. Zebrafish will be screened for insertion of transgenes by PCR and for mobilization of *mPing* by expression of *EGFP*. Inverse PCR will be used to characterize the insertion site preference of *mPing* in stable germlines. The ultimate goal of this project will be to use *mPing* as a tool for forward genetics analysis by transposon mutagenesis.

## INTERACTIONS OF SIRNA FUNCTIONALIZED THERAPEUTIC RNA NANOPARTICLES WITH WHOLE BLOOD AND ISOLATED LYMPHOCYTES

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University of North Carolina Charlotte

The newest frontier of drug delivery and disease treatment is nanotechnology utilizing therapeutic nucleic acids, which are proving to be customizable, programmable and carry multiple functionalities. Nucleic acid based nanoparticles functionalized with multiple short interference RNAs (siRNAs), or other therapeutic oligonucleotides and formulated with lipid-like carriers for efficient intracellular delivery can act as an active pharmaceutical ingredient. Due to the route of administration, it is important to study how this new therapeutic technology interacts with blood and lymphocytes to elucidate possible undesirable side-effects.

This investigation examines the cellular uptake by whole blood and by lymphocyte isolations from human donors of several fluorescently tagged functional RNA nanoparticles selected from the laboratory library. Lymphocytes are isolated from each whole blood sample and siRNA nanoparticles formulated with polycationic carriers are introduced to both the whole blood and lymphocyte isolation. Fluorescence changes indicating the relative uptake of nano-formulations by blood cells are measured via flow cytometry and further analyzed. Experimentation has shown a marked difference in nanoparticle uptake when the formulation is introduced after the samples are serially diluted as opposed to introduction to undiluted human blood samples. This may indicate that the currently used experimental protocol may affect apoptosis and cell morphology of lymphocytes thus promoting their interaction with nanoparticles. Further experimentation aims to examine which constructs and cells have the most efficient cellular uptake by blood cells, which lipid-like carrier works best for uptake and mechanisms for cellular entry.



## CONTACT LENS HYGIENE PRACTICES AMONG COLLEGE STUDENTS

Vivian Kalu and Randall H Harris  
Claffin University

Microbial keratitis or corneal ulcer is an infection of the cornea associated with a risk of permanent visual impairment. This potentially blinding condition represents the most severe complication related to contact lens wear in developed nations. Gram-negative, rod-shaped bacteria are more prevalent in contact lens-related microbial keratitis compared with non-contact lens-related microbial keratitis. The goal of this research was to investigate contact lens hygiene practices among college students in Claffin University and determine if aspects of the survey data correlate with the presence of bacteria in contact lens cases. Student volunteers who attend Claffin University and stay on campus were recruited for this study. A questionnaire was used to obtain demographic data and information about contact lens and case hygiene, eye care medical history, type of contact lens, intended wear and actual wear. A total of 58 students who wear contact lens completed the Contact lens Hygiene Survey of which 66% of the participants were females. Cross tabulation was used to determine the associations between contact lens wearers demographic and lens care habits. SPSS 19.0 for Windows 7 and Microsoft Excel 2007 was also used. In terms of wearing pattern, 55% of the participants changed their contact lens solution daily, 67% rinsed contact lens before inserting into the eyes and 55% rinsed contact lens before storage. The findings in this study also show the lack of awareness as a risk factor for contact lens related microbial keratitis. Only 31% of the participants knew that lens solution should only be used for 3 months, 26% use expired contact lens solution, and 47% followed the contact lens replacement schedule as advised by the manufacturer. In terms of contact lens hygiene, 62% wear their lenses after its fallen into the sink and 74% wash their hands thoroughly before inserting/removing contact lens. The analysis from the study also showed that 26% use disposable lens twice or more and 34% use contact lens beyond expiration date. However, only eleven of the total 58 participants gave a history of eye infection (18%). Volunteers were asked to donate their contact lens cases and a unique code was assigned to each volunteer and the matched donated case to determine if there was a correlation with the survey results and bacterial growth and biofilm results. No bacteria grew from saline rinses of one of the wells of the donated contact lens cases. The other well in the cases was stained with crystal violet to detect bacterial biofilms. The crystal violet absorbance values ranged from 0.008 to 1.099 with a mean of 0.15. The more the organic matter present in the contact lens case, the greater the crystal violet absorbance. The variables measured, however, did not correlate significantly with the absorbance values of crystal violet.

## USING CRISPR/CAS9 TO STUDY THE ROLE OF ZMYM2 AND ZMYM3 IN ZEBRAFISH CRANIOFACIAL DEVELOPMENT

Kasey Kreutz and April Delaurier  
University of South Carolina Aiken

Potocki-Shaffer Syndrome (PSS) is a developmental disorder in humans that results in craniofacial abnormalities, benign bone tumors known as exostoses, bilateral parietal foramina, and intellectual disability. As a contiguous gene deletion syndrome, these symptoms arise from microdeletions involving several different genes located on the short arm of the 11th chromosome. The focus of this study revolves around understanding the role of the PHF21a repressor complex in craniofacial development with a goal of understanding how disruption of the complex may underlie PSS. Previous research has implicated that PHF21A works in complex with KDM1A, ZMYM2, and ZMYM3 proteins to repress transcription. By using the clustered regularly-interspersed short palindromic repeat (CRISPR) and associated Caspase 9 (Cas9) system to edit the genome of zebrafish, this study aims to isolate and examine the various components of the Phf21a protein complex, one deleted gene at a time, in order to analyze their individual roles and interactions during craniofacial development. Guide RNAs (gRNAs) were designed to target zmym2 and zmym3 genes and co-injected with Cas9 mRNA. Injected and uninjected control embryos were euthanized at 24 hours post-fertilization pooled, lysed, and PCR amplified for DNA around the target site of mutation. PCR products were digested using T7E1 Endonuclease to identify mismatches representing insertions or deletions (indels) in zmym2 and zmym3.

## DETERMINING HOW GAMMA-RAY BURST PULSE EVOLUTION CHARACTERISTICS CHANGES WITH ENERGY

Stephen Lesage and Jon Hakkila  
College of Charleston

An analysis of how Gamma-Ray Burst (GRB) pulse evolution changes with energy was conducted by studying GRB data from NASA's Burst And Transient Source Experiment (BATSE). Selected bright burst light curves were fitted in four separate energy channels by first modifying an existing pulse-fitting algorithm, extracting the residuals, and fitting these multi-channel residuals with another modified algorithm. For each pulse analyzed, the residuals for all energy channels were compared to one another by examining the variations in rise and decay time, duration, amplitude, fluence, peak flux, and lag. These findings will lead to a better understanding of pulse evolutionary behavior. Preliminary results will be presented.

## ISOLATION OF MICROSATELLITE PRIMERS FROM MANAYUNKIA SPECIOSA USING A MODIFIED PIMA APPROACH

Cameron Leyers and David Malakauskas  
Francis Marion University

Microsatellites are short segments of repeated sequences of DNA that occur throughout organismal genomes, and are used to examine relatively recent evolutionary genetic changes in populations. The objective of our study is to develop microsatellite markers for *Manayunkia speciosa*, a freshwater polychaete, found in the Laurentian Great Lakes and coastal areas of the United States. This will be done by isolating DNA from *Manayunkia speciosa* and amplifying random sections of its genome for screening using RAPD PCR. The resultant amplicons will be inserted into the plasmids pUC19 and pGEM3-Z using sticky end and T/A cloning techniques. Positive clones will be isolated with blue-white selection. Diagnostic multiplex PCR will be used to screen putatively positive clones for the presence of microsatellite markers. Clones believed to contain microsatellite markers will be sent for sequencing, and data acquired will be used to design 12 to 15 microsatellite primer pairs. Our microsatellite primers will be used for future population genetic studies such as determining the geographic origin of the potentially exotic Lake Erie population of *M. speciosa*.

## UNDERSTANDING THE FUNCTION OF THE PHF21A COMPLEX USING CRISPR/CAS9

Frances Loyo-Rosado and April DeLaurier  
University of South Carolina Aiken

The purpose of this research is to understand the function of the components of the *PHF21A* complex in human Potocki Shaffer Syndrome using the clustered regularly-interspersed short palindromic repeat (CRISPR) and associated Caspase 9 (Cas9) system in zebrafish. Potocki Shaffer Syndrome is a genetic disorder caused by a deletion on chromosome 11. This disease causes intellectual disabilities, craniofacial abnormalities, exostoses, and foramina. The objective of this study is to make zebrafish mutants for all of the genes associated with the *PHF21A* complex (*Phf21aa*, *Phf21ab*, *Kdm1a*, *Zmym2*, and *Zmym3*) and to use these mutagenic fish to determine the role of each gene in craniofacial development. Guide RNAs (gRNAs) were designed to target *Phf21aa*, *Phf21ab*, and *Kdm1a* genes and co-injected with Cas9 mRNA to generate potential F0 founder lines. F0 fish were outcrossed to uninjected siblings and F1 embryos were collected. Embryos were then euthanized at 24 hours post-fertilization, lysed, and PCR amplified for DNA around the target site of mutation in *Phf21aa*, *Phf21ab*, and *Kdm1a* to check for germline transmission of mutations. PCR products were digested using T7E1 Endonuclease to identify mismatches representing insertions or deletions (indels) in these genes. F1 fish will be raised to outcross in order to generate F2 lines for future study.

## DIFFERENTIAL IMPACT OF EBOLA GLYCOPROTEIN UPON IMMUNOSURVEILLANCE OF NATURAL KILLER CELLS

Bibiana Loza and Randal Gregg  
Converse College

The recent devastating outbreak of Ebola in Africa has exposed how little is understood about the viral pathogenesis, and prompted many questions about the lack of treatment options. The Ebola enveloped virion is coated in glycoprotein (GP), which is also secreted in high quantities in the blood. Natural Killer (NK) cells are a part of the innate immune response and possess the ability to lyse virus-infected host cells, and are therefore a target of interest in anti-viral therapies. There are many different strains of Ebola virus, with varying mortality rates. We hypothesized that the secreted Ebola virus GP (sGP) inhibits the NK cell response. We also hypothesize that the sGP from the Zaire strain, which has a higher mortality rate, will inhibit the NK cell response more than the sGP from the Sudan strain.

When the human NK cell line, NK92MI, was challenged with either the purified Zaire or Sudan strain sGP, the production of interferon gamma (IFN $\gamma$ ) was significantly decreased in a dose-dependent manner. Higher concentrations of Sudan sGP demonstrated an even greater inhibition on NK92MI IFN $\gamma$  production than sGP from the Zaire strain, which is interesting given Zaire disease outbreaks carry increased mortality. The Zaire strain sGP substantially decreased the killing capacity of the NK92MI cells. Certain cytokines (IL-12, IL-15, and IL-21) are important stimulants for NK cell IFN $\gamma$  production and cytotoxicity in vivo. However, addition of these cytokines seven hours following sGP exposure was unable to rescue the dampened NK92MI cell response suggesting that the sGP influence may be long-lasting.

Thus, the Ebola virus glycoprotein might have significant inhibitory effects on non-infected NK cells within the patient. Future studies will examine the signaling pathways impacted by sGP encounter, especially those involved in effector functions of NK cells and may reveal a potential therapeutic approach to stabilize NK cell function during infection and reduce loss of life.

## SURVEY OF ASYMMETRIC DNA SEGREGATION BY CANCER CELL LINES IN VITRO

Hannah Mace, Buckley McCall, Connor McPartland, Julia Mook, Halford Warlick, Brian Booth, and Donna Weinbrenner  
Clemson University

Stem cells of somatic tissues are hypothesized to protect themselves from mutation and cancer risk through a process of selective segregation of their template DNA strands. Many cancers and tumors arise from tumor initiating cells or cancer stem cells (CSCs). One CSC can give rise to a new tumor when transplanted into a host animal. The hypothesis tested here is that cancer cell lines contain a population of CSCs and these CSCs maintain the normal stem cell characteristic of selective segregation of DNA. To test the hypothesis, CSCs that form during exponential growth phases in vitro were labeled with the

thymidine analogs, either 5-bromodeoxyuridine (5BrdU) or 5-ethyl-2'-deoxyuridine (EdU). Proliferating cells incorporate the 5BrdU or EdU into their newly synthesized DNA strands. During subsequent cell divisions the labeled DNA will either be randomly segregated between daughter cells, or in the case of stem cells, selectively segregated to the stem cell with non-labeled DNA transferred to the newly formed daughter cell. Following the initial pulse of DNA label, the cells were chased for up to six passages with no additional DNA labels added. Cells containing the 5BrdU or EdU labels were imaged and quantified at various timepoints. We found that the number of label-retaining cells (LRCs) was cell line dependent. LRCs were found in all cell lines at most of the timepoints investigated suggesting CSCs are present in all the cell lines and the CSCs exhibit some selective DNA segregation.

#### THE EFFECT OF FUNCTIONALIZED CARBON NANOTUBES IN AN EPOXY-AMINE POLYMER FOR SPIN-CAST EPOXY TELESCOPE MIRRORS

Mariana Martins and Lisa Brodhacker  
Lander University

Various materials have been used to create molds for spin-cast epoxy telescope mirrors. Although an aluminum mold has shown the greatest potential for a stiff mirror, the aluminum and epoxy shrink at different rates resulting in major cracks in the mirror. If the molds were of materials with the same coefficient of thermal expansion (CTE) as the epoxy, this problem would not occur. Unfortunately, epoxy alone is not strong enough and tends to bend under its own weight especially as the mirrors get larger. Incorporating carbon nanotubes into the epoxy-amine mixture will provide strength and uniform CTE for the mirrors.

Great care must be taken to properly disperse the nanotubes so they do not agglomerate which results in inadequate distribution of the particles. The work for this research concentrated on functionalized multi-walled carbon nanotubes (MWCNTs) which covalently bond to the polymer removing the challenge of creating uniform dispersion.

Test samples with varying amount of MWCNTs (0.5%, 1%, 3% and 5%) were made and tested for the CTEs and glass transition temperatures. Results show that as amount of CNTs increase, the CTE decreases and the glass transition temperature increases.

#### EXAMINING THE IMMUNE RESPONSE OF *FUNDULUS HETEROCLITUS* TO ENVIRONMENTAL PRESSURES

Jacqueline Mayorga, Ljubitca Fadic, and Marlee B. Marsh  
Columbia College

The immune system is one of the most important organ systems in living organisms; its purpose is to protect against infection to minimize disease and illness. Fish innate immune responses are routinely evaluated as indicators of immune function and immunotoxicant exposure. *Fundulus heteroclitus*, commonly known as the mummichog, is an estuarine fish commonly used as a model in immunotoxicological studies. Fifty fish were collected from Belle Baruch Marine Sanctuary in Georgetown, SC and immunohistochemistry was performed on the liver, GI tract and spleen. A variety of monoclonal antibodies (mAb) were used to probe serum proteins and the tissues mentioned above. Fish immune protein levels were examined using SDS-PAGE and Western blotting. Western Blot was performed with the antibody mAb m24-2, which specifically recognizes lysozyme, a protein found in neutrophils and macrophages. Western Blotting showed that fish with parasites have serum lysozyme levels that seemed to be suppressed compared to the serum of fish that had no parasites. Liver tissue was probed with mAb CX5-3, which is specific for cyclooxygenase-2 (COX-2) an enzyme produced in various cells during inflammation. There was an increase of COX-2 expression in infected fish livers. The G.I. tract was probed with mAb 2C11, which recognizes proteins in eosinophilic granular cells which are thought to have anti-parasite activity in fish. Infected fish showed more 2C11 positive staining cells in the GI tract than non-infected fish. The liver and G.I. tract were both probed with mAb 5B6, which recognizes Aryl Hydrocarbon Receptor 2, which is upregulated in the presence of toxic compounds in the environment. The liver and G.I. tract did not seem to be impacted by environmental toxicants based on the results of 5B6 positive cells, which was expected because the fish came from a pristine estuary. The spleen was probed with mAbs m24-2 and CX5-3. There did not appear to be a difference between m24-2 positive and CX5-3 positive cells between infected and non-infected fish. However, in the spleen, the number of MelanoMacrophage Centers (MMC) correlated with parasite load.

#### A SERIES OF FOUR SUMS OF A FIBONACCI NUMBER TO THE FOURTH POWER

Nathan Mcanally, R. Florez and A. Mukherjee  
The Citadel

The Fibonacci Numbers provide a unique sequence observable in many different areas of nature and applicable in a significant portion of theoretical mathematics. These numbers provide a definition for the aesthetically appealing golden ratio and can define the growth of a population. They can be heard in music and observed in the petals of a flower. Due to the numerous applications of this sequence in the physical world and theoretical mathematics, it is important to find identities related to this unique set of numbers.

In 1965 Graham published a closed formula for the sequence of four sums of squares of Fibonacci numbers. Since then, as far as I know, there has been no other similar results for these type of natural questions. However, in 2015 the Fibonacci Quarterly proposed a problem, which was classified by the journal as an Advanced Problem related to Graham's result. In the problem, instead of power two, the Fibonacci number was raised to power four. I found a proof for the proposed problem and also found that it gives rise to a potential future research problem. In this poster I discuss the proof of the problem described above.

A PRELIMINARY INVESTIGATION TO ELUCIDATE ROLES OF KARYOPHERIN BETA IMPORTINS IN THE EARLY DEVELOPMENT OF *LYTECHINUS VARIEGATUS*

James Gregory McFadden, Paul Siegwald, Devon Hathaway, Melanie Overcash, and Christine Byrum  
College of Charleston

Different karyopherin  $\beta$  importins are specialized to transfer specific cargo such as transcription factors or other macromolecules into the nuclei of eukaryotic cells. These proteins therefore play an important role in intracellular activities and may be critical to developmental processes such as cell differentiation in early stages. Using the sea urchin embryo as a valuable model for this study, we are cloning genes to synthesize wholemount *in situ* hybridization (WMISH) probes of the karyopherin  $\beta$  importins KPNB1, IPO4, IPO5, IPO7/8, IPO9, IPO11, and IPO13 as well as the transportins TNPO1/2 and TNPO3. WMISH will be used to observe spatiotemporal expression of each at key intervals from the 60-cell to early pluteus stages and will reveal whether expression of importin mRNAs is overlapping or mutually exclusive. It is hoped that examining the spatiotemporal distributions will reveal the importance of particular nuclear transport proteins in *L. variegatus* developmental processes.

BICISTRONIC EXPRESSION FROM A HIV-1-DEPENDENT LENTIVIRAL VECTOR

Erin McLaughlin and William H. Jackson  
University of South Carolina Aiken

The Human Immunodeficiency Virus Type 1 (HIV-1) infects and destroys CD4+ T-Helper lymphocytes. The loss of these cells results in a decrease in the ability to fight disease and ultimately complete failure of the immune system, a factor leading to Acquired Immunodeficiency Syndrome (AIDS). Current HIV treatments may reduce viral load in individuals, but these treatments are not ultimately curative. Gene therapy has the potential to be a more effective and permanent method of controlling HIV infection. One gene therapy approach involves the delivery of genes to induce apoptosis only in the presence of HIV Tat (transactivator of transcription). Tat works to increase expression of viral genes through the HIV promoter. Research into this approach has been previously conducted in our lab by testing expression of eGFP from a HIV Tat-dependent plasmid. However, initial proof of concept experiments revealed basal levels of expression, indicating that eGFP expression was not completely "shut off" in the absence of HIV Tat. This project focuses on the use of the recently obtained plasmid, pLRed(INS2)R, which has been shown to express the dsRed reporter gene only in the presence of HIV. This is because, in addition to Tat-dependence, pLRed(INS2)R also contains the HIV Rev Response Element (RRE), and an inhibitory region from the HIV gag gene that reduces expression of genes from the plasmid in the absence of HIV Tat and Rev. A fusion gene consisting of Renilla luciferase (LucR) and eGFP separated by the *Thosea asigna* virus T2A cleavage sequence was cloned into pLRed(INS2)R, generating the plasmid pLTG(INS2)R, to test HIV-dependence. Initial studies in 293T cells cotransfected with pLTG(INS2)R and the HIV replication-incompetent HIV-1 genomic clone, pNL4-3.Luc.R-E- have shown that expression of both eGFP and LucR is highly dependent on HIV functions.

DEVELOPING ALGORITHMS TO IMPROVE SPITZER'S THERMAL IMAGING OF EXTRASOLAR PLANETS

David Melnick and Joseph Carson  
College of Charleston

Spitzer Space Telescope's exoplanet imaging campaign is paving the way for a new generation of NASA explorations. In our particular Spitzer investigation, we detect and analyze faint sources around nearby stars to confirm them as true exoplanets or unrelated background sources. To do this, we developed a new image processing pipeline, currently being tested on archival images of Fomalhaut and also newly arriving observations of Vega, which were competitively awarded to our group. Our overall aim is to directly image planets in wide-separation orbits ( $> 40$  AU). Our pipeline uses powerful statistical methods to intelligently remove signal outliers and to enhance sub-pixel features, while also applying Principal Component Analysis to digitally remove the interfering glare from the parent star. These methods achieve a sensitivity boost that native Spitzer imaging was never imagined to fulfill. Our efforts assist in building an accurate census of planet populations- a NASA mission directorate.

CYTOTOXIC EFFECTS OF *AMORPHA FRUTICOSA* LEAF, STEM AND ROOT EXTRACTIONS ON PC-12 ADRENAL NEURAL CELLS FROM MALE *RATTUS NORVEGICUS*

Mary Kay Murray, Diana Ivankovic, Dorota Abramovitch, and Donna Weinbrenner  
Anderson University

The present study sought to examine the cytotoxic properties of the extractions from various *Amorpha fruticosa* structures as applied to carcinogenic PC-12 adrenal neural cells. Leaf, stem, and root extractions from *Amorpha fruticosa* were retrieved via soxhlet extractor, using methanol as the chosen solvent. Sterilized extractions of each plant component were applied in increasing concentrations of 0.25, 0.5, 1, 2, 5, 10, and 20 mg/ml. MTS assay was utilized to view absorbency readings at 450 nm in an ELISA plate reader. Data from the experimental trials were collected, demonstrating a steady increase in death rate of the PC-12 cells. Particularly, when exposed to leaf and root extractions, the cells exhibited similar absorbency readings as compared to the cell death controls produced from the addition of either cyclohexamide or 3% hydrogen peroxide. Moreover, the leaf, stem and root extractions underwent lyophilization and further chemical analysis utilizing GC/MS. The study concluded that the leaf and root extractions of *Amorpha fruticosa* provided the greatest potency in their cytotoxicity against PC-

12 adrenal cells. These results could encourage further exploration of other segments of *Amorpha fruticosa*, including the plant's seeds and fruit, in relation to their anti-carcinogenic effects on the PC-12 adrenal neural cell line.

#### CATIONIC ANTIMICROBIAL PEPTIDE RESISTANCE IN A *SERRATIA MARCESCENS* KERATITIS STRAIN

Esther Orji and Randall H. Harris  
Clafin University

Keratitis is the inflammation of the cornea of the eye. It is the second most common cause of legal blindness worldwide. One of the major risk factors for keratitis in the United States is contact lens wear. 3 out of 4 people in the U.S. have vision correction, and of those people, 22% wear contacts and 73% prefer to wear glasses or contacts while driving. Although largely preventable with hygienic contact lens care, the CDC reports that annually, keratitis and contact lens disorders result in about \$175 million in direct healthcare costs. One cause of keratitis is the bacterium *Serratia marcescens* which has developed resistance to cationic antimicrobial peptides (CAMPs) secreted by the cornea that play a major role in the human immune system. The purpose of this research is to identify CAMP resistance genes in *S. marcescens* mutants, study the mechanisms used by bacteria to cause resistance to CAMPs and develop treatments for this serious condition against these gene targets. Through transposon mutagenesis, about 7800 mutants were generated and three were found to be sensitive to the CAMP polymyxin B, an antibiotic primarily used for resistant infections of this type. Disk diffusion results showed that only two of these mutants were sensitive to polymyxin B. The mutated gene will be sequenced and compared to the National Center for Biotechnology GenBank database to determine the gene that was mutated. Once the genes are determined and characterized, finding a preventive or curative treatment for contact lens associated bacterial keratitis will be less challenging. This will greatly reduce the impact of vision impairment and enhance the quality of lives.

#### DETERMINING THE SEQUENCES THAT INDUCE HYPERACTIVE TRANSPOSITION OF mPING

Daymond Parrilla and C. 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 for mutagenesis and gene discovery. The focus of this study is, mPing, a 430-bp deletion derivative of the natural occurring Ping element from rice. It exhibits high transposition activity and can reach a high copy number in plants. In contrast, an artificial deletion derivative of the natural occurring Pong element that shares approximately 80% identity to mPing exhibits low transposition activity. The overall question we are trying to address is what sequences are important for mPing's transposition? To answer this, we screened a library of mutagenized mPing elements and identified high and low activity mutants. The high activity mutant, mmPing20, has seven base changes from the original mPing. Interestingly, four of these mutations are found within 100 bp, at positions 303, 307, 313, and 375. Our hypothesis was that one, or a combination of these mutations, are enhancing mPing's transposition activity. To further determine which of these bases is affecting transposition of mPing, we are making mutants with various combinations of these base changes. In order to test the transposition rate, we are performing yeast transposition assays. Based on these results, we hope to find clues about which regions are important for recruiting the transposase proteins and promoting formation of the transposition complex. Not only this, but determining the specific bases that affect transposition activity can be used to increase mPing's mutagenesis efficiency.

#### THE ROLE OF PING'S ORF1 REPETITIVE SEQUENCE ON MPING TRANSPOSITION

Lisette Payero and C. Nathan Hancock  
University of South Carolina Aiken

Transposons are mobile segments of DNA that hop from one genomic location to another. The transposon superfamily, PIF/Harbinger, includes members such as the autonomous elements Ping and Pong. Members of the PIF/Harbinger family also mobilize Tourist-like miniature inverted repeat transposable elements such as mPing. A deletion derivative of the autonomous Ping element; mPing has been shown to be highly active in rice. Two proteins, ORF1 and Transposase, have been shown to be necessary in mobilizing members of the PIF/Harbinger family. The Pong ORF1 and Transposase proteins were shown to be more effective at facilitating transposition of mPing than their Ping counterparts. Interestingly, the Ping ORF1 gene has a short repetitive sequence towards the start of the gene that is not found in the homologous Pong ORF1. The importance of this repetitive sequence was tested by performing a yeast transposition assays using ORF1 proteins with either one or two copies of the repetitive sequence. Our results showed that mPing transposed at higher frequencies when mobilized by the one repeat version, suggesting that the second repeat is at least partially responsible for the difference in activity observed between the Ping and Pong proteins.

#### OPTIMIZING DECELLULARIZATION PROTOCOLS FOR THE PRODUCTION OF PORCINE ACELLULAR MUSCLE MATRIX SCAFFOLDS

Carolina Pham and Matthew Stern  
Winthrop University

Skeletal muscle tissue is one of the most common sites of traumatic injury in the human body. A variety of biomaterials that facilitate muscle regeneration are in development; however, few are able to provide the structural and biochemical cues

present in the tissue's native scaffolding, its extracellular matrix. We hypothesized that the process of decellularization, which removes the cellular content of a tissue or organ while leaving the extracellular matrix intact, could be used to produce biomaterial scaffolds of a clinically relevant size from porcine skeletal muscle tissue. To test this hypothesis, we systematically evaluated the effectiveness of ten decellularization protocols, each of which used a different combination and/or order of decellularization agents. Qualitative histological examination, scanning electron microscopy, and quantification of DNA content of the different forms of the material produced revealed a spectrum of effectiveness among the methods tested. Each protocol yielded a different combination of a) removal of cellular content and b) retention of extracellular matrix content and architecture. At least two protocols appear to produce scaffolds that are completely decellularized while retaining extracellular matrix elements and architecture. Future work will seek to quantify histological differences among and mechanical properties of the different forms of the material. Those forms exhibiting sufficient decellularization and retention of extracellular matrix will be termed Porcine Acellular Muscle Matrix (PAMM) and will be used in subsequent studies testing their ability to support the growth and differentiation of different populations of myogenic cells.

#### VISIBLE LIGHT PROMOTED ADDITIONS OF POTASSIUM ORGANOTRIFLUOROBORATES TO CARBONYL COMPOUNDS

Davis P. Plasko and James M. Hanna, Jr.  
Winthrop University

Visible light photoredox catalysis has become a significant area of organic chemistry research since 2008 when the Macmillan, Yoon, and Stephenson groups independently employed the redox properties of photoexcited  $\text{Ru}(\text{bpy})_3^{2+}$  in the development of novel approaches to several important synthetic transformations. This new paradigm has since been exploited in the creation of new synthetic pathways, allowing access to transformations not previously available. Our research group is interested in the application of this strategy to reactions of potassium organotrifluoroborates, which have been shown to be oxidized to organic radicals by excited-state iridium complexes. In our laboratory, using the addition of potassium benzyltrifluoroborate to benzaldehyde as a model system, we have found that the desired coupling is promoted by the use of visible light in the presence of a suitably ligated iridium catalyst, whereas in the absence of the catalyst, very little to no coupling occurs. This approach has potential advantages over typical reactions of organometallics with carbonyl compounds due to the mild conditions employed and the functional group tolerance of potassium organotrifluoroborates. In this presentation, we will describe our progress in this area.

#### INVESTIGATING PHAGE ACTIVITY IN THE STUDENT POPULATION AT COASTAL CAROLINA UNIVERSITY

Amy Powers and Paul E. Richardson  
Coastal Carolina University

The discovery of antibiotics has dramatically 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.

The rise in antibiotic resistant bacteria has inspired bacteriophage research as an alternative to antibiotics. Bacteriophages are host-specific viruses that solely infect and lyse bacteria without harming the supraorganism. 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), and subsequently filtered. Then the sample was introduced into a solution of log phase pathogenic bacteria to amplify the bacteriophages present within the sample. The presence of bacteriophages, within a sample, was determined by plaque assay. If zones of inhibition were present the sample was considered to be positive. PCR was performed on the positive samples, which allowed for further identification and characterization of the sequestered phages.

#### INVESTIGATING NON-EQUILIBRIUM FLUCTUATIONS OF NANOCOLLOIDS IN PRESENCE OF MAGNETIC FIELD USING DIRECT IMAGING AND SHADOWGRAPHY

Ashley Rice<sup>1</sup>, Ana Oprisan<sup>1</sup>, Fabrizio Croccolo<sup>2</sup>, Cédric Giraudet<sup>3</sup>, Sorinel Oprisan<sup>1</sup>

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Nanoparticles of iron oxide have a high surface area and can be controlled by an external magnetic field. Since they have a fast response to the applied magnetic field, these systems have been used for numerous in vivo applications, such as MRI contrast enhancement, tissue repair, immunoassay, detoxification of biological fluids, hyperthermia, drug delivery, and cell separation. We performed direct imaging experiments in order to investigate the nonequilibrium concentration-driven fluctuations using iron oxide nanoparticles. The results from direct imaging are compared against our experimental data using shadowgraph visualization technique for the same magnetic nanoparticles. Our direct experimental setup involved a

sample cell unit (SCU) filled with magnetic nanocolloidal suspension and water with the concentration gradient oriented against the gravitational field, a superluminescent diode (SLD) as the light source, and a collimator. For direct imaging, we added a microscope objective in front of the CCD camera whereas for the shadowgraph technique we only use one achromatic lens between the SCU and the camera. A differential dynamic structure factor algorithm for image processing was used to extract the structure factor and to find the power law exponents. Further research will use the correlation time to approximate the diffusion coefficient for the free diffusion experiment.

#### TESTING A DCAS9 TRANSPOSASE FUSION PROTEIN IN *ARABIDOPSIS THALIANA* FOR TARGETED INSERTION OF mPING

Mary Roby and Nathan Hancock  
University of South Carolina Aiken

Transposable elements are mobile DNA sequences that move from one place into another within the genome. My project focuses on mPing, a 430bp miniature inverted repeat transposable element. mPing is mobilized by two proteins known as ORF1 and Transposase. The goal of my research is to produce targeted insertion of the transposable element mPing in plants. This technology could then be used in applications such as genome engineering, making it easier for desired phenotypes in crop species to be achieved. We plan to induce targeted insertion by joining the Cas9 protein, which will function as a DNA binding domain, to the N-terminus of the Transposase (TPase) protein. Targeted mutagenesis will be achieved through a guide RNA (gRNA) directing Cas9 to the target site, resulting in the Cas9/TPase fusion protein being recruited to the desired DNA site. We hypothesize that mPing will be inserted near the gRNA binding site because the Cas9/TPase fusion protein will be recruited to the target site by the gRNA. In previous research, we discovered that the Cas9/TPase fusion protein is lethal in bacteria. However, we propose that if Cas9 and TPase are interrupted by an intron it will negate the lethality of the construct. To achieve this, the catalase intron from the pCambia GUS Plus gene will be inserted between the Cas9 and TPase genes using restriction digests and ligation. Once this is accomplished, the construct will be verified by PCR and sequencing. We expect that the construct will no longer be lethal in bacteria due to the disruption of the fusion protein. Following this, we hope to successfully insert the fusion protein construct into *Arabidopsis thaliana* to test the transposition rate and ability to induce targeted insertion.

#### EFFECTS OF HABITAT AND COYOTES (*CANIS LATRANS*) ON THE DISTRIBUTION OF WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) AND FERAL CATS

Amelia L. Russell, Brandon Bui, Sahib Dev, Brianna Spruell, Briget Doyle and Jonathan J. Storm  
University of South Carolina Upstate

Coyotes (*Canis latrans*) are a highly adaptable species that has recently expanded its distribution range into the southeastern United States. Although they are primarily a predator of rabbits and mice, it is possible that coyotes may also reduce populations of white-tail deer (*Odocoileus virginianus*) and feral cats (*Felis catus*). We sought to determine how coyote presence influenced the occupancy status of white-tail deer and feral or domestic cats within Spartanburg County, SC. During 2011-2015, we placed wildlife cameras within 17 rural forests and 10 urban greenways. We used ArcGIS to categorize the habitat within a 1 km radius at each site in order to determine whether available habitat influence the site occupancy by each species. We found that coyote presence did not have a significant effect on the occupancy status of either white-tail deer or feral cats. We detected coyotes at 63% of our study sites and none of the habitat variables had a significant effect on the occupancy status of coyotes. For white-tail deer, there was a trend for occupancy status to increase with the amount of forested habitat around the site, but the effect was not statistically significant. The habitat generalist nature of coyotes and white-tailed deer likely leads to a lack of strong habitat effects on their occupancy. We found that feral cats were significantly more likely to occupy sites in residential and commercial areas that had reduced forest cover. Our results suggest that coyotes are a habitat generalist in Upstate South Carolina, and they do not have effect on the distribution of white-tail deer and feral cats.

#### OPTIMIZATION OF THE EXPRESSION AND PURIFICATION OF 2,4'-DIHYDROXYACETOPHENONE DIOXYGENASE (DAD)

Victoria Shores and Kenneth Roberts  
University of South Carolina Aiken

The enzyme 2,4'-dihydroxyacetophenone dioxygenase (DAD) catalyzes the oxidative cleavage of 2,4'-dihydroxyacetophenone into benzoic acid and formic acid. Our research is focused on understanding the mechanism of oxidation by DAD. In our efforts to investigate the enzymatic reaction, we are currently optimizing the expression and purification of DAD for maximal yield and activity for use in in vitro studies. To this, we have tested a range of different conditions including: varying expression times, expression volumes, and addition of exogenous iron; optimizing ammonium sulfate precipitation and a heat shock purification step; and developing a chromatographic method.

EXPORTINS: MAPPING THE WAY OUT OF THE NUCLEUS  
Paul Siegwald and Christine Byrum  
College of Charleston

Members of the karyopherin  $\beta$  family strongly influence the nucleocytoplasmic transport of large molecules. Since eukaryotes partition cellular activities (e.g. DNA replication and transcription occurs primarily in the nucleus whereas translation takes place in the cytoplasm), understanding roles of nuclear transport proteins, such as the exportins, is critical for explaining the movement of developmentally relevant cargo. Much of the current research on exportins is done using cell lines, though this method is not always ideal for observing significant embryonic changes. Using the sea urchin embryo as an intact organism to better characterize individual roles of the exportins, we introduce a valuable model for studying similar processes in human health and embryonic development. Our project maps the spatiotemporal distribution of exportins vital for proper development of the sea urchin embryo. This is an important initial step towards utilizing the sea urchin model and will help us identify which transport factors participate in developmental processes at specific times and places within the sea urchin embryo.

EXPORTINS: MAPPING THE WAY OUT OF THE NUCLEUS  
Paul Siegwald, Devon Hathaway, James G. McFadden, and Christine Byrum  
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DESIGNING TRANSGENIC CONSTRUCTS TO STUDY THE ROLE OF OSTEOCLASTS DURING ZEBRAFISH  
DEVELOPMENT

Brianna Snelling and April Delaurier  
University of South Carolina Aiken

The goal of this project is to use transgenic lines to study the activity of osteoclasts (bone-resorbing cells) in the developing zebrafish. Fluorescent reporter lines that tag specific genes in cell populations allow for specialized study of cells and cell functions during development. This project aims to use EGFP or mCherry as reporter genes for cathepsin K (*ctsk*), which is a gene specifically associated with osteoclasts. These fluorescent tags will allow observation of *ctsk* and osteoclast activity in the developing embryo. Genetic constructs will be made containing the upstream regulatory elements of *ctsk* to drive the expression of either EGFP or mCherry, along with a transposable element *iTol2*. The completed construct will be co-injected with *iTol2* transposase mRNA into 1-cell stage zebrafish embryos to generate germ lines of fish expressing EGFP or mCherry. This will allow us to observe the role of osteoclasts during development. These lines can then be crossed with a previously constructed transgenic line that labels osteoblasts (bone forming cells; *sp7:EGFP*), and we can use the resulting transgenic lines to study how osteoclasts and osteoblasts work together during development and through adulthood. Understanding this mechanism has implications for future study of the role of osteoclastic resorption during development, and forms a model for studying human diseases involving resorption, such as osteoporosis.

MOLECULAR EVIDENCE OF UNDESCRIBED *CERATONOVA* SP. (CNIDARIA: MYXOSPOREA) IN FRESHWATER  
POLYCHAETE, *MANAYUNKIA SPECIOSA*, FROM WESTERN LAKE ERIE, MICHIGAN

Rob Snipes<sup>1</sup>, David Malakauskas<sup>1</sup>, Ann M. Thompson<sup>1</sup>, and Donald W. Schloesser<sup>2</sup>

<sup>1</sup>Francis Marion University

<sup>2</sup>U.S. Geological Survey, Great Lakes Science Center

We used PCR to screen pooled individuals of the freshwater polychaete, *Manayunkia speciosa*, from western Lake Erie, Michigan, USA for myxosporean parasites. Amplicons from positive PCRs were sequenced and showed *Ceratonova* infects an estimated 1.2% (95% CI = 0.53%, 1.9%) of *M. speciosa* individuals. We sequenced 18S, ITS1, 5.8S, ITS2 and most of the 28S rDNA regions of this *Ceratonova* sp. and part of the protein-coding EF2 gene. Phylogenetic analyses of ribosomal and EF2 sequences showed Lake Erie *Ceratonova* are most similar to, but genetically distinct from, *C. shasta*. Marked interspecific polymorphism in all genes examined, including the ITS barcoding genes, along with geographic location suggests this is an undescribed *Ceratonova* species. This finding represents the fourth known myxozoan hosted by *M. speciosa*, and the third known parasite in the genus *Ceratonova*.



## A PRELIMINARY STUDY OF A SECONDARY GROWTH FOREST AT CALDEON STATE PARK, VIRGINIA.

R. Stalter, C. Anozie, K. Arjune, T. Arruda, K. Crevani, A. Gonzalez, R. E. Mieses,  
M. Montesdeoca, and A. Wu  
St. Johns University

The objective of this preliminary study was to determine the dominant trees at two second growth forest sites, the Eagle Wildlife Area, July 2015 and Fern Hollow, October 2015 at Caledon State Park, Virginia, a 1044 hectare park ( 38 21' 09 N, 77 07' 58 W) bordering the Potomac River. Trees were sampled at both sites with 20 ten by ten meter quadrats; smaller eight meter<sup>2</sup> quadrats nested in the right corner of the larger quadrats were used to sample tree saplings, shrubs and lianas while one meter quadrats were used to sample herbaceous vegetation. Yellow poplar, Liriodendron tulipifera and sweet gum, Liquidambar styraciflua were the dominant trees at both sites. Dogwood, Cornus florida and American Holly, Ilex opaca were the dominant sub-canopy species. The most frequently encountered saplings were Ilex opaca, Liriodendron tulipifera, and Liquidambar styraciflua occurring in 45% 30% and 20% of the smaller quadrats respectively. Non-native wineberry, Rubus phoenicolasius was the dominant shrub at both sites with alien Japanese stilt grass, Microstegium vimineum the dominant herbaceous taxon occurring on all quadrats at the Eagle Wildlife Area and 85% of the quadrats at Fern Hollow. A preliminary list of the vascular plant species includes 306 species in 193 genera within 98 families.

## USING IMMUNOLOGY AND SPECTROFLUOREMETRY TO CREATE A BIOLOGY LAB EXERCISE FOR UNDERGRADUATES

Jasmine Stanley and Marlee B. Marsh  
Columbia College

*Fundulus heteroclitus* (mummichog) have the ability to withstand extreme chemical and physical conditions. Due to these qualities, this type of fish is routinely used as a model in immunological, physiological, and toxicological research. Here, the immune response of *Fundulus heteroclitus* is explored in response to infection by various parasites. The blood serum of infected and uninfected fish was extracted and lysozyme levels will be compared using an enzyme-linked immunosorbent assay. The fish lysozymes will be primarily detected by an anti-fish lysozyme antibody produced in a mouse. A goat anti-mouse IgG tagged with FITC will be used as the secondary antibody to detect the primary mouse antibody. These results will be visualized with spectrofluorometry. Data collection and experimentation is ongoing, but will be completed before the date of the conference. This research is being conducted to develop a laboratory exercise that will be used in an undergraduate biology course. Both the fluorometer data and the lab experiment will be presented.

## *SERRATIA MARCESCENS* QUORUM SENSING DEPENDENT BIOFILM FORMATION

Fallon Stanley and Randall H. Harris  
Clafin University

Heavy metals are harmful and they cannot be biodegraded easily. *Serratia marcescens* reduces the heavy metal chromium (VI) to the less toxic chromium (III). However, *S. marcescens* biofilm formation can prevent bacterial movement through contaminated soils, decreasing the amount of bioremediation. This research is focused on investigating quorum sensing dependent biofilm formation to improve the bioremediation capacity of *S. marcescens*. Quorum sensing enables bacteria to act as one living system by the release of the signaling molecule acyl homoserine lactone (AHL) to coordinate their behavior and execute a phenotypic change such as biofilm formation. Understanding this process will allow us to devise methods to manipulate it to enhance bioremediation. Transposon mutagenesis generated ~5000 mutants that were screened for loss of AHL production using the *Chromobacterium violaceum* biosensor CV026. Five mutants were isolated that had reduced biofilm formation after 6 hours demonstrated through a biofilm assay. The mutated genes in these mutants will be identified.

## ENHANCING THE DEVELOPMENTAL POTENTIAL OF MURINE ADIPOSE-DERIVED MESENCHYMAL STEM CELLS

Kathryn Steverson and Matthew Stern  
Winthrop University

Adipose-derived stem cells (ADSCs) are multipotent somatic stem cells obtained from the microvasculature of adipose tissue. ADSCs cannot match the differentiation potential of pluripotent embryonic stem cells (ES cells). However, previous studies have suggested that the non-traditional method of culturing ADSCs as three-dimensional spheroids can induce the expression of factors associated with pluripotency, including the transcription factor Oct-4. We hypothesize that nontraditional, three-dimensional spheroid culturing of ADSCs can upregulate the expression of several genes associated with pluripotency as well as increase the differentiation potential of ADSCs. Here we show that murine ES cells cultured in our lab maintain expression of genes associated with the pluripotent state and known to be expressed in ES cells, thereby validating our ES cell culture conditions for future studies. We also show that ADSCs cultured under traditional two-dimensional conditions do not express markers of pluripotency. Interestingly, the expression of several genes known to be expressed in populations of somatic stem cells does vary with the level of confluence of ADSCs and is also affected by medium supplementation with murine leukemia inhibitory factor (mLIF), which is used to maintain pluripotency in cultured murine ES cells. Future work will examine the expression of the same subset of genes in ADSCs cultured as three-dimensional spheroids in the presence/absence of mLIF and murine embryonic fibroblast feeder cells.

## PHARMACOLOGICAL ANALYSIS OF ROS-MEDIATED NEURODEGENERATION IN *C. ELEGANS*

Meghan Stickle and Daniel Williams  
Coastal Carolina University

The hallmark of many neurodegenerative diseases is the progressive loss of neuronal structure and ultimately neuronal death. Despite the substantial impact on human health, our understanding of the cellular and molecular mechanisms of neurodegeneration is poorly understood. Reactive oxygen species (ROS) can cause cellular damage and have been implicated in many neurodegenerative disorders. Our lab studies ROS-mediated neurodegeneration using activation of KillerRed in specific neurons of the model organism *C. elegans*. We are complementing genetic analysis in the worm through pharmacological perturbation to study the role of  $Ca^{2+}$  in ROS-mediated neurodegeneration. These results contribute to understanding the significance of  $Ca^{2+}$  in neurodegeneration pathways.

## DEVELOPING TOL2-BASED ACTIVATION TAG CONSTRUCTS

Allison Swiecki and Nathan Hancock  
University of South Carolina Aiken

Transposons are segments of DNA that can move from one region to another in the genome. The Tol2 transposon from Medaka fish has successfully been used for transgenesis, integrating foreign DNA, into a wide variety of vertebrates. Mutagenesis by transposon insertion, called transposon tagging, enables the discovery and analysis of gene function. One type of transposon tagging involves positioning strong enhancers within the transposon to produce an activation tag. Insertion of an activation tag near a gene causes overexpression of the gene. Activation tagging is used to learn about the function of genes, which may otherwise be hard to study because of lethality or redundancy. Zebrafish serves as a model for development in vertebrates, therefore using an activation tag in zebrafish allows for the identification of genes that are common to other vertebrates. Activation tagging has never been used for zebrafish, but it is commonly used for gene discovery in plants. We are developing a Tol2 transposon-based activation tag for gene discovery in zebrafish. Our strategy is to create a construct that has a promoter inserted in the middle of Tol2 terminal inverted repeats. Once this construct is made, we will perform additional studies to measure the transposition of this element in zebrafish. Populations of fish showing active transposition of this element will then be screened for mutant phenotypes.

## CORRELATIVE CHARACTERISTICS OF DOUBLE-PULSED GAMMA-RAY BURSTS

Maly Taylor and Jon Hakkila  
College of Charleston

Using data taken by the Burst And Transient Source Experiment on gamma-ray bursts, properties of over 250 double-pulsed bursts are analyzed. With a code written in the Interactive Data Language, chosen bursts are fit as two pulses using a simple four-parameter empirical model. Based on characteristics such as duration, shape, and flux, the bursts are sorted into one of five distinctive pulse classes. A second code is used to extract the residuals of the fits by subtracting out each pulse and analyzing its defining pulse characteristics, e.g. start time, amplitude, and peak flux. These residuals are produced in order to evaluate the quality of the original fits. Preliminary results will be presented.

## THE EFFECT OF MONOSACCHARIDES AND ARTIFICIAL SWEETENERS ON BONE DENSITY IN SPRAGUE-DAWLEY RATS

Christina Thomas and Michelle Vieyra  
University of South Carolina Aiken

The objective of this study is to examine the effects of the monosaccharides, dextrose and fructose, and the artificial sweeteners, sucralose and aspartame, on bone density in male Sprague-Dawley rats. Previous studies have shown that consumption of sugar caused poor glucose control which consequently lead to the development of type II diabetes. Type II diabetes has been known to cause a decrease in bone density, secondarily. Little work has been done on artificial sweeteners and how they effect bone density, however, some studies have shown that artificial sweetener consumption leads to the development of type II diabetes, so similar decreases in bone density may occur. Twenty-five male Sprague-Dawley rats were divided into five treatment groups: 1) a 10% dextrose solution 2) a 10% sucrose solution 3) a 0.016% sucralose solution 4) a 0.05% aspartame solution 5) control consuming tap water. Each rat was provided 200mL of the designated solution daily for 18 weeks and the amount of solution consumed was recorded daily. At the conclusion of the treatment period, the rats were sacrificed and the hind limbs were collected for further examination. The right rear legs were X-rayed and bone density was calculated using imagej software. The left rear legs were stripped of flesh and measurements of length and diameter were taken at specific points. X-ray analysis and measurements are ongoing.

DEVELOPMENT OF OPTICALLY FLAT SERS SUBSTRATES FOR URANYL MICROPARTICLE DETECTION  
Spencer Tinkey<sup>1</sup>, Chitravati Choony<sup>1</sup>, Alex Paczynski<sup>1</sup>, Jennifer Pittman<sup>2</sup>, Glenn Fugate<sup>2</sup>, Michael DeVore<sup>2</sup>, Sheldon Nichols<sup>2</sup>,  
Ross Smith<sup>2</sup>, Michael Summer<sup>2</sup>, Maria Kriz<sup>2</sup>, Matthew Wellons<sup>2</sup>, and Chad L. Leverette<sup>1</sup>

<sup>1</sup>University of South Carolina Aiken  
<sup>2</sup>Savannah River National Laboratory

The U.S. Department of Energy, through its national laboratories, has a continuing need for novel, ultra-sensitive, sensor technology for various applications. In this study, through a collaboration with the Savannah River National Laboratory, optically flat, surface-enhanced Raman spectroscopy (SERS) substrates, composed of a 4 nm nanostructured gold layer vapor deposited onto Si wafers, were developed for the trace detection of uranyl oxalate microparticles (<5 microns in diameter). This study is one of the first conducted to analyze these types of uranyl microparticles. The initial substrates were characterized using common SERS reporter molecules in terms of overall sensitivity and reproducibility. Morphology and surface plasmon measurements were also conducted to characterize the surface of the SERS substrates. Film thickness dependence was also determined and will be discussed. A comparison of the overall sensitivity of these substrates compared to other optimal SERS substrate designs was also performed. The uranyl oxalate microparticle SERS spectra suggest that these substrates are potentially viable as sensors for uranyl microparticle analysis.

GENOME-WIDE ANALYSIS OF THE MOLECULAR TURNOVER OF HUMAN TRNAS

Ariel McShane, Eveline Hok, Jensen Tomberlin and Renaud Geslain  
College of Charleston

Genetic translation is the universal mechanism that allows the biosynthesis of cellular proteins; some of the most prominent actors in this process are transfer RNAs. Paradoxically, little is known about the stability of individual tRNA species because of the practical challenges that represent precise and systematic tRNA identification. This work describes a new technical and conceptual in vivo approach named MAHT (Microarray Analysis of Human tRNAs) designed to study the stability of human tRNA at the genomic level. The overall half-life for the entire pool of human tRNAs was estimated at 43 hours, suggesting that most tRNAs are passed down from parent to daughter cells during cell cycle. Interestingly, five tRNAs specific for Leu, Gly, Glu, Pro and His amino acids were found to be significantly less stable. We describe here our technical approach and discuss the potential physiological implications of our findings.

IDENTIFYING THE GENE UNDERLYING THE B1187 PHENOTYPE IN ZEBRAFISH

Kayce Vanpelt and April Delaurier  
University of South Carolina Aiken

A line of mutant zebrafish was detected in a forward genetics screen that has a jaw defect including fusions and abnormal shaping of bone and cartilage elements. Previous research has narrowed the location of the mutation to be between 29.1 Mb and 30.9 Mb on chromosome 19. Several genes within this region of the chromosome have already been sequenced in mutant and (non-mutant) wild-type sibling cDNA; however, none of the gene sequences have shown significant differences between mutants and wild-types. Further sequencing has been performed by PCR amplifying further candidate genes, and those sequences are being analyzed for possible mutations. Sequence analysis was performed on mutant and wild-type cDNA for the *tmem222b* (transmembrane protein 222b) gene, which is expressed in connective tissue. The mutant cDNA sequence for *tmem222b* contains no significant differences compared to the wild-type sequence. Two additional genes are currently being sequenced, *sh3brgl3* (sh3 domain binding glutamic acid-rich protein like 3) and *epb41a* (erythrocyte membrane protein band 4.1a), also expressed in connective tissue or involved in jaw development. Continuation of this project involves a reverse genetics approach by employing the CRISPR/Cas9 system as a mutagenesis tool to target specific candidate genes in the region. CRISPR/Cas9 should induce double stranded breaks in the *ldlrp1a* (low density lipoprotein receptor adaptor protein 1a) gene, a gene involved with skeletal patterning and formation. After mutations are induced, the phenotypes of the zebrafish will be observed for the *b1187* phenotype, which if present could conclude that *ldlrp1a* is the gene underlying the mutation. This study has the potential to reveal an entirely new gene or gene pathway involved in skeletal joint formation in the zebrafish.

USING JMP-SAS TO TEST HYPOTHESIS IN PLANT ECOLOGY

Sarah Ward and Vincenzo Antignani  
Bob Jones University

Plants rely on basic elements such as water, sunlight, carbon dioxide, and minerals from the soil in order to be able to synthesize nutrients for themselves and grow. In environments where these and other density-dependent factors are not present in large enough quantities, plants will compete to obtain these life-giving items. The more fit a plant is, the more likely it is to obtain the materials it needs. This study sought to investigate the fitness of *Plantago* spp. plants that competed with *Trifolium repens* and *Lotus corniculatus* plants, to see if the presence of competitors would negatively affect the *Plantago* plants, as determined by the statistical analysis of data points collected. The first hypothesis of this study states that increasing numbers of competitors present will affect the morphology of each *Plantago* plant. The second hypothesis states that a high number of competitors will result in the total size of the *Plantago* plants being smaller, with more and shorter leaves. The data collected was analyzed using JMP Software, to allow for appropriate statistical evaluation. Taking the distribution for each of the experimental variables showed that the data collected was normal [ $p < 0.05$ ]. Using the JMP

Software, chi-square values were calculated for each level of competition, one-way analyses were run, and a Competition Index (CI) was proposed. It was demonstrated that as the number of competitors increased, the number of leaves per individual *Plantago* plant also increased, while average leaf and stem lengths decreased. These results indicate that number of competing individuals directly affects the morphology of *Plantago* plants, which supports both of the hypotheses of this study.

#### OPTIMIZING IN VITRO FERTILIZATION PROCEDURES IN ZEBRAFISH

Madelyn Wasden and April Delaurier  
University of South Carolina Aiken

There are currently over 20,000 mutant and transgenic zebrafish lines used to study genetics, toxicology, and human medicine. Due to constraints on space and resources, not all lines can be maintained as adult fish, so sperm is frozen and lines are retrieved by in vitro fertilization (IVF). By not having an in vitro process that consistently yields successful fertilization, many of these lines are at risk. My goal is to increase the success and reliability of our in vitro protocol, specifically the sperm freezing and thawing process, so that we are able to continue Dr. DeLaurier's invaluable work and research with zebrafish. I will begin by applying principles of cryobiology as well as errors in gamete handling and pooling to the protocol. After identifying problem areas in the procedure that are affecting fertilization, I will begin isolating each method and testing it for success. By doing this, I hope to narrow down the various elements of sperm cryopreservation methods that are crucial to egg fertilization. Once I have established a protocol that yields consistent and effective fertilization, Dr. DeLaurier, future lab members, and the zebrafish community will have a standardized system by which to further these mutant and transgenic lines. Research so far has shown a significant increase in sperm quality and quantity with male separation prior to collection, as well as possible variations in fertility rates between wild type lines and across different ages.

#### INVESTIGATING X-CHROMOSOME NON-DISJUNCTION IN SU(VAR)3-9 DROSOPHILA MELANOGASTER MUTANTS

Cameron Washington and Kathryn Kohl  
Winthrop University

Meiosis is the process by which homologous chromosomes segregate to form four, genetically diverse haploid gametes. In most organisms, crossing over between all homologous chromosomes must occur accurately and efficiently to ensure the proper segregation of chromosomes. However, in the model organism *Drosophila melanogaster*, meiotic crossover events do not occur on the 4th chromosome for reasons still unclear. Since *Drosophila* chromosome 4 is primarily heterochromatic at ~70%, with respect to the other *Drosophila* chromosomes at ~30%, we hypothesize that the abundance of heterochromatin may be responsible for preventing meiotic crossing over on chromosome 4. To test this hypothesis, a mutant of one of the genes responsible for production of heterochromatin, *su(var)3-9*, was used to understand the effects of decreased heterochromatin levels on the number of cross over events.

To begin, we confirmed the presence of a mutation within *su(var)3-9* via Sanger sequencing. Next, we created allele-specific primers using the WASP tool and designed a PCR protocol to more accurately identify mutant flies at the molecular level. Forthcoming, we will measure levels of non-disjunction on the X chromosome in wild-type and *su(var)3-9* mutants to gain insight into the effect of heterochromatin on meiotic chromosome dynamics.

#### MEASURING THE EFFECTIVENESS OF ANTI-HIV TAT SIRNAS ON HIV REPLICATION AND GENE EXPRESSION

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

The Human Immunodeficiency Virus (HIV) is a retrovirus that infects CD4+ T lymphocytes causing progressive destruction of the immune system and its functions. Ultimately, the loss of immune function results in the Acquired Immunodeficiency Syndrome (AIDS). Because current treatment options are not curative, it is necessary for further investigations into ways to combat HIV. Recently, there have been a number of studies concentrating on the use of short-interfering RNAs (siRNAs) to silence viral genes through RNA interference (RNAi). RNAi is an innate pathway that results in post-transcriptional gene silencing which is initiated by siRNAs and is facilitated by the RNA-induced silencing complex (RISC). A major focus in our lab is to take advantage of this pathway to target the HIV *tat* gene, which encodes an essential viral regulatory protein. The presence of *tat* is not only required to up-regulate viral transcription, it is also necessary for successful HIV replication. To test if inhibition of *tat* expression results in inhibition of viral replication, we designed four siRNAs that each target specific sites within NL4-3 HIV-1 *tat* sequence (Accession number: M19221): si5834, si5860, si5892, and si6010.

These anti-HIV *tat* siRNAs were subsequently converted to shRNAs, double-stranded DNA, and cloned into a retroviral vector under the control of the RNA polymerase III H1 promoter. Preliminary results involving co-transfection of 293T cells with si5892 and a HIV genomic clone (pNL-LucR.T2A) suggests downregulation in the expression of *tat*, resulting in reduced viral replication. Currently, our research is focusing on measuring all of the anti-HIV *tat* siRNAs activities through multiple replication and gene expression assays.

CATALYTIC STUDIES INTO THE REDUCTION OF NITRITE BY AN ACID-FUNCTIONALIZED 1,4,7-  
TRIAZACYCLONONANE COPPER COMPOUND

Jeremy Weeks and Gerard Rowe  
University of South Carolina Aiken

The purpose of this research was to further characterize an acid functionalized 1,4,7-triazacyclononane copper compound previously synthesized in our lab to mimic the active site of type-2-copper nitrite reductase. Its ability to catalytically reduce nitrite to nitric oxide was also studied. In addition, the rate of nitrite reduction as a function of pH was tested using a colorimetric NO assay utilizing Fe-EDTA. The redox and catalytic data for the acidic form of the compound was then compared to the non-acid form in order to establish major differences. The cut off pH for when the acidic and non-acidic forms of the compound reduced nitrite at the same rate was also determined.

THE METAL-DEPENDENCE OF 2,4'-DIHYDROXYACETOPHENONE DIOXYGENASE (DAD)

Jason Weeks and Kenneth Roberts  
University of South Carolina Aiken

The oxidative cleavage of 2,4'-dihydroxyacetophenone (DHA) is catalyzed by the enzyme 2,4'-dihydroxyacetophenone dioxygenase (DAD). The structure of DAD has recently been determined by X-ray diffraction of a protein crystal. This structure showed that the enzyme contains a single metal-center identified as an iron and believed to be necessary for the enzymatic reaction. In this study, we evaluated the metal's role in enzyme activity and its identity. Specifically, the rate of DHA-cleavage by DAD was measured in the presence of a variety of metal ions. The results are report herein.

C. *ELEGANS* AS A GENETIC MODEL OF GALACTOSEMIA

Michelle West and Daniel C. Williams  
Coastal Carolina University

Galactosemia is an inherited disorder resulting from the inability to metabolize the simple sugar galactose. Although dietary removal of galactose can diminish the severity of galactosemia symptoms, patients still suffer long-term complications such as poor growth and neurological disorders. To better understand disease pathogenesis of galactosemia, we have identified the *C. elegans* homolog of *GALT*, one of three enzymes defective in galactosemia patients. Like their human counterparts, worms with mutations in *GALT* fail to develop when exposed to a galactose-rich diet. In addition, *GALT* mutants have other phenotypes that suggest abnormal neuronal function and longevity. These results demonstrate the utility of *C. elegans* as a genetic model organism to better understand the mechanism of galactosemia pathology.

IDENTIFICATION OF COMMON HUMAN MIRNAS IN INFECTED INFLUENZA A INDIVIDUALS

Brtiney White<sup>1</sup>, James Baldwin<sup>2</sup>, Samina Noorali<sup>1</sup>

<sup>1</sup>Department of Biology, Claflin University

<sup>2</sup>Applied Technology and Genomics Division, USAFSAM/FHT

Background: Influenza (flu) is a contagious respiratory virus causing significant morbidity and 0.5 million deaths per year. The Flu virus spreads seasonally and is vectored by bioaerosols and close contact. The influenza A subtypes most prevalent are H1N1 and H3N2 (CDC report 2014-2015). Currently, vaccination is the best protection against flu. However as new strains emerge, repeat vaccinations are required. Consequently, there is a need for identifying anti-viral agents that will treat the spectrum of influenza A subtypes. Aim: The aim of this research was to identify up-regulated and down-regulated microRNAs (miRNAs) in individuals infected with the Influenza A subtypes H1N1 and H3N2. Methodology: Of 128 nasal wash samples, qRT-PCR confirmed H1N1 and H3N2 in 52 male and female, ages 18-65 years. RNA from 52 samples were profiled for 2402 miRNAs with miScript miRNA PCR Array Human miRNome V21.0. Results: We identified five common up-regulated and down-regulated miRNAs: hsa-miR-3154, hsa-miR-3173-3p, hsa-let-7e-5p, hsa-miR-3691-5p and hsa-miR-101-5p and hsa-miR-1233-5p, hsa-miR-7847-3p, hsa-miR-6875-3p, hsa-miR-6832-5p, and hsa-miR-7114-3p, respectively. Future Work: Madin-Darby Canine Kidney (MDCK) will be infected with H1N1 and H3N2 and then treated with miRNAs functionalized with fluorochrome and a polyarginine peptide, to see the effect of these miRNAs on the viral load by qRT-PCR.

## SYNTHESIS OF NOVEL RARE-EARTH GERMANATES

Branford Wilkins and Hans-Conrad Zur Loye  
University of South Carolina Columbia

Several novel rare-earth element-containing germanates were synthesized utilizing various molten alkali halide fluxes. These compounds include K<sub>5</sub>Y<sub>2</sub>Ge<sub>4</sub>O<sub>13</sub>F, K<sub>5</sub>Er<sub>2</sub>Ge<sub>4</sub>O<sub>13</sub>F, K<sub>5</sub>Ho<sub>2</sub>Ge<sub>4</sub>O<sub>13</sub>F, and K<sub>5</sub>Yb<sub>2</sub>Ge<sub>4</sub>O<sub>13</sub>F, as well as Cs<sub>2</sub>CeGe<sub>3</sub>O<sub>9</sub> and Rb<sub>2</sub>CeGe<sub>3</sub>O<sub>9</sub>. The structures of these rare-earth germanates were determined via single crystal X-ray diffraction. The oxyfluoride rare-earth germanates are of particular interest because the two rare-earth elements are adjacent in the structure and this could lead to interesting magnetic properties which will be investigated in the future. These oxyfluoride compounds may also have enhanced luminescent properties due to the fluorine atom contained in the structure; the luminescence of these compounds will also be investigated in the future. Silicon-containing analogues of the structures mentioned do exist but this research is significant in that getting germanium to take the place of silicon in rare-earth element-containing compounds has often presented a considerable challenge due to the larger size of the germanium cation.

## UNDERSTANDING THE ROLE THAT EF24 PLAYS IN PROMOTING ANTI-CANCER ACTIVITY IN COLON CANCER CELLS

Ashley Williams and Takita Felder Sumter  
Winthrop University

Cancer is a highly aggressive disease, accounting for nearly 1 out of every 4 deaths in the United States. Studies show that an unhealthy diet can contribute to the development of cancer, leading to the investigation of dietary substances, such as curcumin, to aid in cancer prevention or treatment. Curcumin is a polyphenolic compound found in a dietary spice, and has been identified as a potent anti-inflammatory agent and antioxidant. Preclinical studies involving curcumin have shown its ability to inhibit carcinogenesis in various types of cancer including colorectal cancer; however, its clinical applications have been hindered due to toxicity and a low bioavailability following administration. EF24, a curcumin analog, has shown potential as an anti-cancer agent; however, its mechanism of action is largely unknown. EF24 acts, in part, by inhibiting NF- $\kappa$ B, a transcription factor whose activity is regulated by the high mobility group A1 (HMGA1) proteins. The high mobility group A (HMGA) family, comprised of HMGA1 and HMGA2 subtypes, of proteins has been studied over the past few decades due to their role in the development and metastasis of cancer. A recent study has shown that HMGA2 activity is suppressed by EF24, yet HMGA1 has not been investigated for its potential inhibition by this curcumin analog. This research project will explore the role of HMGA1 in the context of EF24 activity. The results of this study will expand upon the community's understanding of the EF24 mechanism of action while concurrently investigating potential mechanisms of drug resistance.

## VOC SPATIAL AND TEMPORAL CHANGES ALONG A TCE PLUME FRINGE

John B. Williams<sup>1</sup> and Elizabeth Ashley Shull<sup>2</sup>

<sup>1</sup>South Carolina State University

<sup>2</sup>Savannah River Nuclear Solutions

In order to monitor the suitability of natural attenuation for remediating the Chemicals, Metals, Pesticides (CMP) Pits plume fringe, intensive sampling of shallow groundwater for different reaches of Pen Branch was conducted from 2005 to 2014. Volatile organic compounds (VOC) were analyzed for the critical hyporheic zone beneath Pen Branch and adjacent floodplain. These sampling efforts were assisting larger-scale SRNS compliance monitoring in accordance with EPA guidelines. 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. The study plume originated from CMP Pits, a waste disposal area in operation from 1971 to 1979, when the pits were closed and backfilled. 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 reducing the contaminant load. For this reason, our stations were located along the Pen Branch reach bordering the modelled plume fringe. In general, VOC was highest at sampling stations in the middle study zone. Moderate VOC levels were detected at upstream stations and lowest VOC was found at downstream stations. Electrical resistance heating (ERH) conducted by SRNS from 2008 to 2010 at the filled CMP Pits helped to reduce overall new plume concentrations. Collectively PCE, TCE, and their degradation products displayed a favorable yearly trend of contaminant reduction. Total VOC concentrations at some stations declined by >25% and concentrations of vinyl chloride (VC), a nearly-final stage degradation product increased from 0.0 ppb to >20 ppb. Temporal patterns display a continued reduction of VOC, while spatial patterns may indicate a slow progression of the plume downstream along Pen Branch. 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

## DESIGN AND CLONING OF AN ANTI-HIV 1 VIF SIRNA INTO A RETROVIRAL VECTOR

Austin Worden and William H. Jackson  
University of South Carolina Aiken

The Human Immunodeficiency Virus (HIV) infects and destroys CD4+ T lymphocytes, ultimately resulting in the loss of immune function. The end stage of HIV infection is Acquired Immunodeficiency Syndrome (AIDS), which is characterized by a CD4+ T helper cell count below 200 cells/mm<sup>3</sup> and the presence of one or more opportunistic infections. In recent years, numerous studies have focused on using small interfering RNAs (siRNAs) to silence target genes through the RNA interference (RNAi) pathway. Our studies have focused on utilizing this pathway to downregulate expression of a number of HIV genes, including the viral infectivity factor (Vif). Vif is important in HIV replication due to its role in targeting an important host anti-retroviral enzyme, Apolipoprotein B mRNA editing Enzyme Catalytic polypeptide-like 3G (APOBEC3G), for proteosomal degradation. In the absence of Vif, APOBEC3G is packaged into viral particles and acts to inhibit subsequent infection by generating Cytosine to Uracil hypermutations during Reverse Transcription. To test if inhibition of Vif function results in reduced viral replication, a series of shRNAs (short hairpin RNAs) were designed to target three sites within the HIV Vif mRNA. One of these, Vifsi5551, was synthesized as a double-stranded DNA and cloned into the shuttle vector, pSRNG, placing its expression under the control of the RNA Polymerase III H1 promoter. The H1.Vifsi5551 expression cassette was removed subsequently from pSRNG and inserted into the retroviral vector, pLGN, which also expresses eGFP and neomycin phosphotransferase from the Moloney MSV promoter. This new vector pLGN.Vifsi5551, will next be used to verify downregulation of Vif expression.

## GENETIC ANALYSIS OF ROS-MEDIATED NEURODEGENERATION IN *C. ELEGANS*

Lyndsay Young and Daniel C. Williams  
Coastal Carolina University

Neurodegeneration has significant impacts on human health, but the molecular mechanisms of degeneration are not well understood. Our lab uses the model organism *C. elegans* to study the genes and molecules that are involved in the degeneration process. Specifically, we trigger reactive oxygen species (ROS)-mediated neurodegeneration using the optogenetic photosensitizer KillerRed. We previously found that ROS-mediated cell death is independent of the worm ryanodine receptor, which is encoded by the gene *unc-68*. As this gene has been shown to be necessary for other paradigms of neurodegeneration, our results suggest there are multiple pathways of neurodegeneration. We are expanding our genetic analysis by testing the requirement other genes involved in intracellular Ca<sup>2+</sup> signaling for ROS-mediated neurodegeneration. Through this genetic dissection, we hope to further define the role of Ca<sup>2+</sup> in ROS-mediated neurodegeneration.

**END**

SC Academy of Science Abstracts  
(Sr. Academy)



**SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE  
SCHEDULE OF EVENTS**

<b>7:30 AM - 11:00 AM</b> <i>7:30 AM – 9:00 AM</i>	<b>SCJAS Registration</b> <i>Continental Breakfast</i>	<b>DiGiorgio Student Center</b> <i>served in Atrium</i>
<b>8:30 AM – 10:15 PM</b>	<b>SCJAS Oral Session I</b> <i>See SCJAS oral session listing for details &amp; room numbers</i>	<b>Owens Hall</b>
	Judges Conference Room	<b>Kinard Hall</b> Room 015
<b>10:15 AM – 10:30 PM</b>	<b>Break</b>	
<b>10:30 AM – 12:30 PM</b>	<b>SCJAS Oral Session II</b> <i>See SCJAS oral session listing for details &amp; room numbers</i>	<b>Owens Hall</b>
<b>[10:30 AM – 12:30 PM]</b>	<b>SCAS Poster Session</b>	<b>Richardson Ballroom;</b> <b>DiGiorgio Student Center</b>
	<i>Junior Academy members are encouraged to visit SCAS posters</i>	
<b>12:00 PM – 1:15 PM</b>	<b>Lunch</b> <i>Ticket is in your badge holder</i>	<b>Thompson Dining Hall</b>
<b>1:30 PM– 2:15 PM</b>	<b>Plenary Session</b>	<b>Richardson Ballroom;</b> <b>DiGiorgio Student Center</b>
<b>2:30 PM – 3:30 PM</b>	<b>Afternoon SCJAS Activities &amp; Workshops</b> Meet WU student Science Ambassadors in atrium of DIGS)	
Owens G01	<b>Investigating Hidden Biodiversity: Anuran acoustics as a case study</b> Melissa Pilgrim, PhD (USC Upstate)	
Owens G02	<b>Interactive visual neuroscience: how neurons in the brain generate perception</b> Phillip O'Herron PhD (MUSC) :	
Owens 102	<b>Journey to the center of the Atom</b> Bill Wabbersen and Jon Guy (Savannah River Site)	
<b>3:45 PM</b>	<b>SCJAS Awards Ceremony</b>	<b>Richardson Ballroom;</b> <b>DiGiorgio Student Center</b>





## Afternoon Workshops 2:30-3:30PM

*Please meet Science Ambassadors in Atrium of DIGS*

Owens G01 Melissa Pilgrim, PhD (USC Upstate) :

### Investigating Hidden Biodiversity: Anuran acoustics as a case study



Owens G02 Phillip O'Herron PhD (MUSC) :

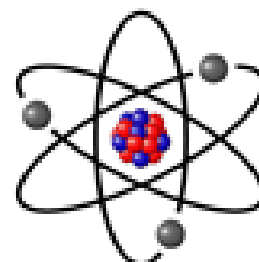
*[Note: Dr O'Herron works with Dr Kara our Plenary Speaker]*

### Interactive visual neuroscience: How neurons in the brain generate perception



Owens 102 Bill Wabbersen (Savannah River Site) :

### Journey to the center of the Atom



**SCJAS 2016 ANNUAL MEETING ORAL PRESENTATIONS  
WINTHROP UNIVERSITY, APRIL 16, 2016**

**Biochemistry / Mentored  
Owens 203**

- 9:00AM Selen Berkman, Governor's School for Science and Math  
THERMODYNAMIC MODELING OF PHASE EQUILIBRIA IN TERNARY  
PSM/POPC/CHOLESTEROL MIXTURES
- 9:15AM Matthew Berry, Governor's School for Science and Math  
THE DEVELOPMENT AND ANALYSIS OF CORE-SHELL BIO-NANOPARTICLES  
USING P4V4 AND TRANSFERRIN FOR DRUG DELIVERY
- 9:30AM Kaileigh Collins, Governor's School for Science and Math  
DETERMINING THE ROLE OF MTM1 IN GLUTATHIONE METABOLISM
- 9:45AM Frances Davenport, Governor's School for Science and Math  
DESIGN AND SYNTHESIS OF A NOVEL LSD-1 INHIBITOR AS A POTENTIAL ANTI-  
TUMOR AGENT
- 10:00AM Valerie Hinsch, Governor's School for Science and Math  
INFLUENCE OF PYRUVATE AND SODIUM BICARBONATE ON THE INDUCTION  
OF PIGMENTATION IN ARISING RETINAL PIGMENTED EPITHELIAL-19 CELLS  
(ARPE-19)
- 10:30AM Zachary Klein, Governor's School for Science and Math  
CREATING A MATHEMATICAL MODEL OF THREE-COMPONENT  
DPPC/DOPC/CHOLESTEROL MODEL LIPID BILAYERS
- 10:45AM Emily Milz, Governor's School for Science and Math  
IN VITRO EFFICACY OF DOXORUBICIN ENCAPSULATED IN THERMOSENSITIVE  
LIPOSOMES (TSL)
- 11:00AM Hannah Mitchum, Governor's School for Science and Math  
TARGETING RGD-INTEGRINS IN U87 CELLS TO ENHANCE THE DELIVERY OF  
MICELLE-ENCAPSULATED TEMOZOLOMIDE
- 11:15AM John Robert Peterson, Governor's School for Science and Math  
DETERMINING THE 3-DIMENSIONAL FOLDING STRUCTURE OF A CITRUS  
CANKAR CAUSING PROTEIN PRODUCED BY THE XANTHOMONAS AXONOPODIS  
BACTERIA
- 11:30AM Catherine Powell, Governor's School for Science and Math  
THE EFFECT OF GANODERIC ACID DM ON INDUCING CELL DEATH IN DIFFUSE  
LARGE B-CELL LYMPHOMA
- 11:45AM Jacqueline Tobin, Governor's School for Science and Math  
THEORETICALLY REPRODUCING EXPERIMENTALLY DRAWN PHASE  
DIAGRAMS OF DOPC-PSM-CHOLESTEROL

**Biochemistry / Non-Mentored**  
**Owens 204**

- 8:30AM Dillon Harper, Center for Advanced Technical Studies  
FINDING AN OPTIMAL BIO-PETROL DIESEL BLEND
- 8:45AM Josh Ranta and Richard Zhao, Dutch Fork High School  
THE EFFECT OF DI(2-ETHYLHEXYL) ADIPATE (DEHA) ON THE AVERAGE FERTILITY OF SUBSEQUENT GENERATIONS OF DANIO RERIO /
- 9:00AM Leila Barwick, Heathwood Hall Episcopal School  
THE EFFECT OF HYDROGEN-PEROXIDE ON ENZYME ACTIVITY IN SWINE BLOOD MEASURED BY THE AMOUNT OF OXYGEN PRESENT
- 9:15AM Nina Valenti, Dutch Fork High School  
THE EFFECTS OF VITAMIN E AND VITAMIN B (THIAMINE) ON THE GROWTH RATE AND FINAL WEIGHT OF TENEBRIO MOLITOR LARVAE
- 9:30AM Jaylen Davis, Heathwood Hall Episcopal School  
THE EFFECT OF CHLORINE AND BLEACH ON THE COLOR INTENSITY OF PIG SKIN
- 9:45AM Noah Mervak, Chapin High School  
THE LC50'S FOR NITRATE AND SULFATE
- 10:00AM Josh Holmstrom and Austin Cox, Heathwood Hall Episcopal School  
THE EFFECT OF ENZYME CONCENTRATION, PRESENCE OR ABSENCE OF AN ENZYME, PH LEVEL, AND THE PRESENCE AND ABSENCE OF SUBSTRATES ON ENZYME REACTION RATE AND THE DETERMINATION OF WHAT LEVELS EACH VARIABLE MUST BE TO HAVE AN OPTIMAL REACTION RATE FOR ALGAE-BASED

**Botany / Mentored**  
**Kinard 115**

- 8:30AM John Collins, Governor's School for Science and Math  
CLONING AND FUNCTIONAL CHARACTERIZATION OF A NEW POTASSIUM TRANSPORTER GENE FROM CREEPING BENTGRASS
- 8:45AM Clare DuVal, Governor's School for Science and Math  
EFFECT OF SOIL NITROGEN AVAILABILITY ON THE PHENOLIC PROFILE OF SOILS INVADED BY JAPANESE KNOTWEED (FALLOPIA JAPONICA)
- 9:00AM Anna Kulangara, Governor's School for Science and Math  
RENEWABLE ENERGY SOURCES; LOCATING THE NM2448 MUTANT GENE FOR SENESCENCE IN MAIZE (ZEA MAYS L.) CELLS TO LENGTHEN THE LIFESPAN OF THE CROP FOR USE IN BIOFUELS
- 9:15AM Marlin McKnight, Governor's School for Science and Math  
THE EFFECTS OF NITROGEN ON THE PHENOLIC COMPOSITION OF JAPANESE KNOTWEED

- 9:30AM Alec Popichak, Governor's School for Science and Math  
MAPPING OF GENES CONTROLLING SENESCENCE IN MAIZE (ZEA MAYS L.)
- 9:45AM Savannah Ruano, Governor's School for Science and Math  
RESPONSES TO MULTIPLE STIMULI IN TOMATO AND ARABIDOPSIS PLANTS
- 10:00AM Kenneth Yarborough, Governor's School for Science and Math  
DEVELOPMENT OF MOLECULAR MARKERS IN REDBAY

**Botany / Non-Mentored**  
**Kinard 115**

- 10:30AM Matt Watford, Heathwood Hall Episcopal School  
THE EFFECT OF CARBARYL, PERMETHRIN, AND BIFENTHRIN ON THE GROWTH OF BRASSICA RAPA
- 10:45AM Emma Shealy and Alyce Petit, Heathwood Hall Episcopal School  
THE EFFECT OF VARIOUS HYDROPONIC FERTILIZERS ON THE EMISSION OF GAS IN BRASSICA RAPA NIPPOSINICA PLANTS
- 11:00AM Isaac Lee, Spring Valley High School  
THE EFFECT OF CITRIC ACID ON REDUCTION OF ALUMINUM STRESS ON LEMNA MINOR
- 11:15AM Pippa Richter, Heathwood Hall Episcopal School  
THE EFFECT OF POLLUTANTS ON THE HEALTH AND GROWTH OF DISTICHLIS SPICATA
- 11:30AM Kate Nassab and Lawson Leidinger, Heathwood Hall Episcopal School  
THE EFFECT OF PROCESSING BEANS ON THE AMOUNT OF PROTEIN
- 11:45AM Meghan Murphy, Dutch Fork High School  
THE EFFECT OF SOIL ADDITIVES ON THE LEVEL OF VITAMIN A IN PIPER BETEL
- 12:00PM Julia Faulds, Heathwood Hall Episcopal School  
THE EFFECT DIFFERENT COLORED LIGHT WAVELENGTHS HAVE ON WISCONSIN FAST PLANTS
- 12:15PM Caroline Bunch, Heathwood Hall Episcopal School  
CAN AN ANTACID TABLET LIKE TUMS OR ALKA-SELTZER BE USED TO NEUTRALIZE ACIDIC SOIL, AND DOES ONE WORK MORE EFFICIENTLY THAN THE OTHER?

**Cell and Molecular Biology / Mentored (Session I)**  
**Owens 201**

- 8:30AM Eric Chen, Dutch Fork High School  
THE EFFECTS OF STROMAL CELLS ON TUMOR CELL GROWTH UNDER LOW OXYGENIC CONDITIONS

- 8:45AM Hannah Addis, Governor's School for Science and Math  
THE ESTABLISHMENT OF GREEN FLUORESCENT CLONES OF A549 HUMAN LUNG CARCINOMA CELLS
- 9:00AM Savannah Bradley, Governor's School for Science and Math  
EFFECTS OF THROMBIN AND BRADYKININ ON ASTROCYTE REACTIVITY
- 9:15AM Crystal Carpenter, Governor's School for Science and Math  
DELIVERY OF O6-BENZYLGUANINE AND CAFFEINE VIA PH-RESPONSIVE, FUSOGENIC LIPOSOMES INTO BRAIN TUMOR CELL LINES
- 9:30AM Elizabeth Carpenter, Governor's School for Science and Math  
BIOCHEMICAL CHARACTERIZATION OF ALPHA-SYNUCLEIN CONTAINING PROTEIN AGGREGATES IN A YEAST MODEL FOR PARKINSON'S DISEASE
- 9:45AM Savanah Dale, Governor's School for Science and Math  
AMPLIFYING CALCIUM/CALMODULIN DEPENDENT PROTEIN KINASE II DELTA VARIANT 9 IN HEALTHY AND DILATED CARDIOMYOPATHY HUMAN CARDIAC FIBROBLASTS
- 10:00AM Harper English, Governor's School for Science and Math  
EXPRESSION OF ST2 SOLUBLE RECEPTOR IN MC38 AND CT26 COLON CANCER CELLS
- 10:30AM Kylie Fletcher, Governor's School for Science and Math  
EFFECT OF MICROTUBULE DISASSEMBLY ON P0071 PROTEIN DISTRIBUTION IN CACO-2 CELL LINES
- 10:45AM Austin Moore, Governor's School for Science and Math  
PROTEIN-PEPTIDE INTERACTION PATTERNS OF M-10 AND INHIBITORY EFFECTS ON COLLAGEN EXPRESSION BY M-10 PEPTIDE IN SSC LUNG FIBROBLASTS
- 11:00AM Cayla Odom, Governor's School for Science and Math  
MPING TRANSPOSITION REQUIRES NUCLEOTIDE SPECIFIC INTERACTIONS WITH THE TERMINAL INVERTED REPEATS
- 11:15AM Asia Paguntalan, Governor's School for Science and Math  
TRANSPOSABLE ELEMENTS CONTAINING BINDING SITES FOR PLURIPOTENCY TRANSCRIPTION FACTORS FUNCTION AS ENHANCERS IN MOUSE EMBRYONIC STEMS CELLS
- 11:30AM Tammy Ray, Governor's School for Science and Math  
THE EFFECT OF TRANSPOSABLE ELEMENTS AND TRANSCRIPTION FACTOR BINDING SITES ON GENE EXPRESSION
- 11:45AM Erin Scott, Governor's School for Science and Math  
THE EFFECT OF A SMALL MOLECULE INHIBITOR IN COMBINATION WITH EVE ON GROWTH OF CANCER CELLS

**Cell and Molecular Biology / Mentored (Session II)**

**Owens 202**

- 8:30AM Julia Sequerth, Governor's School for Science and Math  
EFFECTS OF ETHANOL ON LIGHT-ACTIVATED CURRENT FLOW IN HEK293  
CELLS EXPRESSING CHANNELRHODOPSIN-2
- 8:45AM Shreya Shankar, Governor's School for Science and Math  
EXPRESSION AND LOCALIZATION OF ERBB RECEPTOR BIOMARKERS IN  
BREAST CANCER CELL LINES
- 9:00AM Brittany Shook, Governor's School for Science and Math  
INTERLEUKIN-2 AND INTERLEUKIN-15 DIFFERENTIALLY IMPACT THE  
TRANSITION OF EFFECTOR CD8+ T CELLS INTO EFFECTOR- AND CENTRAL-  
MEMORY PHENOTYPE CELLS
- 9:15AM Amanda Steel, Governor's School for Science and Math  
THE EFFECT OF SIGNALING FACTORS ON THE DIFFERENTIATION OF  
PROGENITOR CELLS
- 9:30AM Rebecca Wang, Governor's School for Science and Math  
CTLA-4'S ROLE IN THE DYSREGULATION OF T-CELL FUNCTION IN  
SARCOIDOSIS
- 9:45AM Nicole Wyman, Governor's School for Science and Math  
THE EFFECT OF IN VITRO SILICA TREATMENT ON LUNG FIBROBLASTS
- 10:00AM Wenxin Fan, Spring Valley High School  
THE EFFECTS OF EMODIN ON MACROPHAGE-CANCER CELL INTERACTION
- 10:30AM Shakthika Saravanan, Spring Valley High School  
THE EFFECT OF TIME TREATMENT OF PANAX QUINQUEFOLIUS ON NRF2 AND  
NQO1 LEVELS IN ANA-1 CELLS

**Cell and Molecular Biology / Non-Mentored**

**Owens 202**

- 10:45AM Matthew Heron, Center for Advanced Technical Studies  
QUANTIFYING ERYTHROCYTE CARBOHYDRATE SURFACE ANTIGEN  
CONCENTRATION IN LIPID RAFTS
- 11:00AM Tyler Carnes, Dutch Fork High School  
THE EFFECT OF TARTRAZINE AND ALLURA RED ON SACCHAROMYCES  
CEREVISIAE METABOLISM

**Chemistry / Mentored**

**Owens 101**

- 8:45AM Hailey Areheart, Governor's School for Science and Math  
LIGHT HARVESTING AND ENERGY TRANSFER IN METAL-ORGANIC  
FRAMEWORKS

- 9:00AM Albert Wang, Dutch Fork High School  
MOLECULAR DYNAMICS ON OLIGOPEPTIDES TO ASSOCIATE VIBRATIONAL DENSITY OF STATES WITH RAMAN SPECTRA
- 9:15AM Leland Hartzog, Governor's School for Science and Math  
ANALYZING THE EFFECTS OF SUPERCRITICAL AND LIQUID CARBON DIOXIDE ON COLLAGEN FIBERS
- 9:30AM Lydia Henderson, Governor's School for Science and Math  
POLYMER STRUCTURED ELECTRODES FOR SOLAR WATER SPLITTING
- 9:45AM Katherine Kilgore, Governor's School for Science and Math  
AN EXPERIMENTAL STUDY OF THE FORENSIC LUMINOL TEST FOR DETECTION OF BLOODSTAINS
- 10:00AM Allison McLane, Governor's School for Science and Math  
DESIGN AND SYNTHESIS OF A 3,5-DIAMINO-1,2,4-TRIAZOLE AS A LYSINE SPECIFIC DEMETHYLASE-1 INHIBITOR FOR THERAPEUTIC USE IN CANCER

**Chemistry / Non-Mentored**  
**Owens 101**

- 10:30AM Julia Lauterbach and Beverly Hennig, Heathwood Hall Episcopal School  
BY BURNING DIFFERENT BIOMASS SUBSTANCES, WHICH MATERIAL CREATES THE LARGEST AMOUNT OF ELECTRICITY FOR LIGHTING A LIGHT BULB?
- 10:45AM Christopher Kong, Spring Valley High School  
THE EFFECT OF ZEOLITE-GRAVEL MIXTURES ON THE CONCENTRATION OF LEACHATE /
- 11:00AM Jake Sawyer, Heathwood Hall Episcopal School  
THE EFFECT OF NEUTRALIZATION ON HEAT CHANGE AND ENTROPY

**Consumer Science / Mentored**  
**Owens 102**

- 8:30AM Alexander Adams, Governor's School for Science and Math  
RMT ANALYSIS OF CHINA'S SHANGHAI STOCK EXCHANGE
- 8:45AM Hamza Ahmed, Governor's School for Science and Math  
RMT ANALYSIS OF CHINA'S SHANGHAI STOCK EXCHANGE
- 9:00AM Tristan Cromer, Governor's School for Science and Math  
DIFFERENCES BETWEEN NATIONAL AND STATE LEVEL SMALL BUSINESS PROGRAMS
- 9:15AM Collin Edwards, Governor's School for Science and Math  
THE LINK BETWEEN A REGION'S ENTREPRENEURIAL DYNAMISM AND POVERTY

- 9:30AM Benjamin Epstein, Governor's School for Science and Math  
DEVELOPING ECONOMIC EDUCATION RESOURCES
- 9:45AM Thomas-Roy Holt, Governor's School for Science and Math  
ANALYSIS OF OLYMPIC GAMES PARTICIPATION AND SUCCESS USING  
STATISTICAL METHODS
- 10:00AM Lotta Keller, Governor's School for Science and Math  
COMPETITIVENESS OF SOUTH CAROLINIAN AEROSPACE EDUCATION
- 10:30AM Zachary Laprise, Governor's School for Science and Math  
ENTREPRENEURSHIP "ECOSYSTEM" INPUTS NEEDED IN THE GREENVILLE  
AREA TO FOSTER MORE ENTREPRENEURIAL ACTIVITY AND SUCCESS.
- 10:45AM Quannadon Moses, Governor's School for Science and Math  
CONSUMER ANALYSIS AND MARKETING STRATEGY: CULMINATING METHODS  
TO PROCURE THE MAXIMUM EXTENT OF CLIENTS AT NORTH DARGAN  
INNOVATION CENTER
- 11:00AM Ryan Moughan, Governor's School for Science and Math  
QUANTITATIVE ANALYSIS ON CHARLESTON'S ENTREPRENEURIAL SECTOR
- 11:15AM Samuel Sisney, Governor's School for Science and Math  
DETERMINATION OF TARGET GEORGRAPHIC AREAS FOR MARKETING KIDS  
CAN GIVE TOO
- 11:30AM Jeffrey Sizemore, Governor's School for Science and Math  
AFRICAN AMERICAN TOURISM PATTERNS AND MARKETING ETHNICALLY  
FOCUSED TOURISM IN SOUTH CAROLINA
- 11:45AM Joshua Trill, Governor's School for Science and Math  
AN ANALYSIS OF THE ECONOMIC IMPACTS OF ACCESS MANAGEMENT  
STRATEGIES ALONG SELECT CORRIDORS

**Consumer Science / Non-Mentored**  
**Owens 103**

- 8:30AM Alex Cox and Mitesh Das, Heathwood Hall Episcopal School  
THE EFFECT OF STORAGE METHOD ON VITAMIN C LEVELS IN ORANGE JUICE  
OVER TIME
- 8:45AM Paris Tomlin and Sonali Patel, Heathwood Hall Episcopal School  
THE EFFECTS AND CHEMISTRY OF NATURAL REPELLANTS VERSUS  
CHEMICALLY FORMULATED REPELLENTS ON MELITTOBIA DIGITATA
- 9:00AM Melina Manos, Heathwood Hall Episcopal School  
THE EFFECT OF CHLORINE ON THE DURABILITY OF SWIMSUIT MATERIAL
- 9:15AM Hunter Stalker, Center for Advanced Technical Studies  
THE REDESIGN OF AN ADHESIVE BANDAGE FOR THE PALM
- 9:30AM Emmye Mullins and Amelia Robinson Brown, Heathwood Hall Episcopal School  
THE EFFECT OF VARIOUS SUNSCREENS ON UV SENSITIVE YEAST



9:45AM Moji Awe, Spring Valley High School  
THE EFFECTS OF VARIOUS PROMOTIONAL METHODS ON RECYCLING BEHAVIORS

10:00AM Hailey Nicks and Kathleen Powers, Heathwood Hall Episcopal School  
EFFECT OF TIME IN A MICROWAVE ON MICROCOCCUS LUTEUS

**Engineering / Mentored**  
**Owens G07**

8:30AM Elaine Patterson, Spring Valley High School  
OPTIMAL POINT DENSITY FOR ACCELEROMETER CALIBRATION AND CONSIDERATIONS FOR CONTINUED USE OF ACCELEROMETER SYSTEMS TO LOCATE AND CLASSIFY EVENTS BY MONITORING STRUCTURAL VIBRATIONS

8:45AM Ridsen Altman, Governor's School for Science and Math  
FLOW RESISTANCES AT INTENSE BED SHEAR STRESSES

9:00AM Garrett Buchmann, Governor's School for Science and Math  
DEVELOPING A LOW-COST TEMPERATURE CONTROLLER USING A RASPBERRY PI MICROCONTROLLER

9:15AM Noah Dammers, Governor's School for Science and Math  
STUDY ON THE DISTILLATION OF WATER VIA THE USE OF SEMI-PERMEABLE MEMBRANES

9:30AM Mikayla Drost, Governor's School for Science and Math  
ADDITIVE MANUFACTURING ON A BUDGET: BUILDING A 3D PRINTER

9:45AM Nathan Dubrouillet, Governor's School for Science and Math  
SYNTHESIS, PROCESSING AND CHARACTERIZATION OF BIOPOLYMER DERIVED CERAMICS

10:00AM Ross Ferguson, Governor's School for Science and Math  
CAPACITY DEGRADATION IN LITHIUM-ION BATTERIES

10:30AM Henry Hardin, Governor's School for Science and Math  
NONDESTRUCTIVE EVALUATION USING PIEZOELECTRIC WAFER ACTIVE SENSORS

10:45AM Tsung-Wei Hsu, Governor's School for Science and Math  
ROBOTICS MATERIAL HANDLING: METHODS IN WHICH ROBOTS CAN PACKAGE ZIPPER STORAGE BAGS INTO RETAIL BOXES

11:00AM James Kahng, Governor's School for Science and Math  
EFFICIENCY CHARACTERIZATION IN LITHIUM-ION BATTERIES

11:15AM Mario Krussig, Governor's School for Science and Math  
MECHANICAL AND THERMAL PROPERTIES OF EPOXIDIZED PINE OIL AND ACRYLATED EPOXIDIZED SOYBEAN OIL BLENDS

- 11:30AM Grant Kuczler, Governor's School for Science and Math  
ADVANCING HUMAN FALL DETECTION BY SIMULATING FALLS WITH A BALLISTICS GELATIN TORSO
- 11:45AM Ali Maclay, Governor's School for Science and Math  
THE TRANSFORMATION AND MODIFICATION OF INKJET PRINTERS INTO LOW-COST BIOPRINTERS FOR THE CHARACTERIZATION OF PRECISE CELL PATTERNING
- 12:00PM Christopher Chaplin, Academic Magnet High School  
HIGH SPEED 3D IMAGING WITH TWO-PHOTON LIGHT SHEET MICROSCOPY
- 1:30PM Michael Ott, Governor's School for Science and Math  
DESIGN AND IMPLEMENTATION OF HUMAN-TO-SWARM ROBOTICS SIMULATOR AND INTERFACE
- 1:45PM Madelinne Pope, Governor's School for Science and Math  
CO<sub>2</sub> PERMEATION FLUX OF SILVER CARBONATE DUAL PHASE MEMBRANES MODIFIED BY ATOMIC LAYER DEPOSITION
- 2:00PM Karan Sah, Governor's School for Science and Math  
ATOMIC FORCE MICROSCOPY STUDY OF 4-HEXANGONAL SILICON CARBIDE
- 2:15PM Jack Tabb, Governor's School for Science and Math  
POLYMER DERIVED SIOC CERAMIC VIA THERMOLYSIS OF PHOTOCROSSLINKED POLYMETHYLHYDROSILOXANE (PMHS)
- 2:30PM Kiara Tompkins, Governor's School for Science and Math  
SUPER RESOLUTION NANOSCOPY FOR BIO-IMAGING BASED ON CW LASER STED MICROSCOPY
- 2:45PM Ariel Moore, Governor's School for Science and Math  
TRANSFORMATION AND CHARACTERIZATION OF DESKJET PRINTERS INTO LOW-COST BIOPRINTERS FOR DRUG SCREENING AND CELL PRINTING

**Engineering / Non-Mentored**  
**Owens G08**

- 8:30AM Kayla Blankenship and Paul Keeler, Center for Advanced Technical Studies  
EASY STEP SHOES: SHOES THAT PUT THEMSELVES ON
- 8:45AM Jacob Cooney, Spring Valley High School  
THE EFFECT OF THE INTERNAL DESIGN OF AN ABSORPTIVE MUFFLER ON CAR EXHAUST SOUND LEVELS /
- 9:00AM Cookie Desai, Center for Advanced Technical Studies  
CREATING A SAFER SURGERY: A CHAIR FOR SURGEONS
- 9:15AM Frederick Drescher, Spring Valley High School  
THE EFFECT OF A DESICCANT-BASED DEHUMIDIFYING AIR INTAKE SYSTEM ON THE POWER OUTPUT OF A GASOLINE INTERNAL COMBUSTION ENGINE

- 9:30AM Lee Sightler, Center for Advanced Technical Studies  
EFFECT OF BATTERY MEMORY ON DIFFERENT TYPES OF ELECTRIC VEHICLE BATTERIES
- 9:45AM Cody Foster, Spring Valley High School  
THE EFFECT OF STRENUOUS ACTIVITY ON THE ELECTRICAL OUTPUT OF A THERMOELECTRIC WRISTBAND
- 10:00AM Robert Gradel, Chapin High School  
THE EFFECT OF CURRENT LEVEL ON ANGLE OF ANKLE EXTENSION IN EUTHENIZED FROGS TREATED WITH HIGH VOLTAGE PULSED CURRENT
- 10:30AM Evan Johnson, Spring Valley High School  
THE EFFECT OF AN ANION REPELLING VIBRATING CATHODE ON THE AMOUNT OF HYDROGEN GAS PRODUCED IN WATER ELECTROLYSIS
- 10:45AM Davis Buchanan and Jim Blair, Heathwood Hall Episcopal School  
PH NEUTRALIZATION AS A MODEL FOR AN ELECTROMECHANICAL PANCREAS
- 11:00AM Breanna Murrin, Spring Valley High School  
A COMPARISON OF GASOLINE AND HYDROGEN USAGE IN AN R/C ENGINE FOR THE RETURN ON INVESTMENT
- 11:15AM Sofia StMarie, Center for Advanced Technical Studies  
INCREASING INDEPENDENCE FOR THE VISUALLY IMPAIRED: DEVELOPMENT OF A SONAR EQUIPPED CANE
- 11:30AM Edoardo Tremolada, Spring Valley High School  
THE EFFECT OF IMPLEMENTING HONEYCOMB STRUCTURES IN A PHONE CASE AND ANALYZING THEIR INTEGRITY /
- 11:45AM Lamar Dawkins, III, Heathwood Hall Episcopal School  
THE EFFECT THAT "CORKING" A BASEBALL BAT HAS ON THE DISTANCE TRAVELED IN THE AIR BY A STRUCK BALL WITH A CONSTANT VELOCITY
- 12:00PM Thomas Wigley, Spring Valley High School  
THE EFFECT OF DIFFERENT CONFIGURATIONS OF NEODYMIUM MAGNETS ON THE AMOUNT OF MILLIVOLTS(MV) PRODUCED IN A KINETIC GENERATOR. /
- 1:30PM Ishita Kapoor, Spring Valley High School  
EXPLORING DESIGN POSSIBILITIES FOR ENHANCING DELIVERY EFFICIENCY OF A NEBULIZER
- 1:45PM Ben Mathews, Heathwood Hall Episcopal School  
THE EFFECT OF DIFFERENT WAVE HEIGHTS ON VOLTAGE PRODUCED
- 2:00PM Tyler Wrenn, Center for Advanced Technical Studies  
OPTIMIZING UNDERWATER TURBINE BLADES TO IMPROVE THE EFFICIENCY OF OCEAN ENERGY GENERATION

**Environmental Science / Mentored**  
**Owens 208**

- 8:30AM Ashley Boone, Governor's School for Science and Math  
CONTAMINANT LOADS IN BLACK AND TURKEY VULTURES OF THE  
SOUTHEASTERN UNITED STATES
- 8:45AM Christina Byun, Dutch Fork High School  
THE EFFECT OF COLORED LIGHT EXPOSED TO RHODOMONAS SALINA ON ITS  
GROWTH /
- 9:00AM Nicole Johnson, Governor's School for Science and Math  
BATCH SCALE-UP SYNTHESIS OF PVP COATED IRON OXIDE NANOPARTICLES  
FOR OIL REMEDIATION
- 9:15AM Sally Cannon, Seneca High School  
THE EFFECT OF WEATHERING BULLETS ON THE CONCENTRATION OF LEAD  
IN RUNOFF BY TYPE
- 9:30AM Lauren Yam, Governor's School for Science and Math  
ESTROGENICITY OF PERSONAL CARE PRODUCTS AS MEASURED IN A YEAST  
ESTROGEN SCREEN
- 9:45AM Hosam Arammash, Spring Valley High School  
EVALUATING THE EFFICIENCY OF BANANA PEELS AS A SOURCE OF  
REMOVING METHYLENE BLUE DYE FROM WATER.
- 10:00AM Jasmine Marie Flora, Spring Valley High School  
THE EFFECT OF THE DURATION OF SONICATION ON THE ADSORPTION  
CAPACITY OF FOOD WASTE HYDROCHAR FOR ATRAZINE

**Environmental Science / Non-Mentored (Session I)**  
**Owens 208**

- 10:30AM Roscoe Burk-Moody, Heathwood Hall Episcopal School  
THE EFFECT OF RADIO WAVE EXPOSURE ON THE RATE OF GROWTH OF  
VEGETATION
- 10:45AM Rachel Rorie and Amelia Wilks, Dutch Fork High School  
THE EFFECT OF NITRATE ON THE GROWTH AND DEVELOPMENT OF THE  
DANIO RERIO
- 11:00AM Sarayu Das, Spring Valley High School  
THE EFFECT OF TRISPRINTEC AND METFORMIN AND THEIR DOSES ON THE  
MORTALITY AND REPRODUCTION OF AMPULLARIIDAE, DAPHNIA MAGNA, AND  
LEMNOIDEAE & THE HEART RATE OF DAPHNIA MAGNA IN AQUATIC  
ECOSYSTEMS
- 11:15AM Treveon Myers, Spring Valley High School  
THE EFFECT OF COOKING OIL ON PM2.5 PRODUCTION

11:30AM Catie Johnson and Landon Louthian, Heathwood Hall Episcopal School  
THE EFFECT OF THE HISTORIC FLOOD OF 2015 ON MERCURY, DISSOLVED OXYGEN, AND PH LEVELS OF THE GILLS CREEK WATERSHED

11:45AM Sarayu Parise, Spring Valley High School  
THE EFFECT OF BRASSICA JUNCEA PHYTOREMEDIATION USING SOIL DOPED WITH CONCENTRATIONS OF COPPER (II) SULFATE SOLUTION ON SOIL NITRATE CONTENT

12:00PM Camille Bryant, Center For Advanced Technical Studies  
MITIGATION OF LANDFILL GAS BY DONATING EDIBLE FOOD WASTE TO CHARITY

**Environmental Science / Non-Mentored (Session II)**  
**Owens 210**

8:30AM Zahida Ashroff, Spring Valley High School  
THE EFFECT OF DIFFERENT LEVELS OF FERTILIZING NUTRIENTS ON THE OIL BIOREMEDIATION PROPERTIES OF PLANKTONIC MARINE BACTERIA

8:45AM Kate Willhide, Heathwood Hall Episcopal School  
A COMPARISON OF PHOSPHATE AND TOTAL DISSOLVED SOLID LEVELS IN CITY WATER AND WELL WATER IN SOUTH CAROLINA

9:00AM Allen Wilbur, Dutch Fork High School  
THE EFFECT OF PHOTOVOLTAIC CELLS ON ELECTRICITY COSTS

9:15AM Victoria Hopkins, Spring Valley High School  
THE CORRELATION BETWEEN TIME AND THE AMOUNT OF PARTICULATE MATTER PRODUCED BY CEILING TILES

9:30AM Carter Smith, Heathwood Hall Episcopal School  
THE EFFECT OF THE THICKNESS OF A LAYERED COMPOST ON THE RATE OF DECOMPOSITION AND TEMPERATURE CHANGE

9:45AM Nerielle Legaspi, Spring Valley High School  
THE INHIBITORY EFFECT OF ACESULFAME POTASSIUM ON THE GROWTH OF RHODOSPIRILLUM RUBRUM

10:00AM Saad Iftikhar, Dutch Fork High School  
EFFECT OF FLOW RATE ON UVLED INDUCED BACTERIA ANNIHILATION IN WATER SAMPLES

10:30AM Spencer O'Connor, Spring Valley High School  
D-LIMONENE DERIVED FROM ORANGE PEELS AND ITS EFFECTS ON ETHANOL PRODUCTION

10:45AM Hayden Spencer, Center for Advanced Technical Studies  
GEOTHERMAL HEATING AND COOLING IN K-12 SCHOOLS

11:00AM Spencer Hann, Heathwood Hall Episcopal School  
THE EFFECT OF DIFFERENT TYPES OF OIL REMEDIATION ON THE AMOUNT OF OIL REMOVED FROM SALTWATER

- 11:15AM Rakib Siddique, Spring Valley High School  
REMOVAL OF HAZARDOUS WASTES FROM AQUEOUS SOLUTIONS VIA ADSORPTION USING THE COMMON DANDELION /
- 11:30AM Sreeja Varanasi, Spring Valley High School  
THE EFFECT OF COPPER AND SILVER NANOPARTICLES ON ESCHERICHIA COLI K-12
- 11:45AM Jasdeep Singh, Spring Valley High School  
THE EFFECTS OF TEMPERATURE ON THE BIODEGRADATION OF POLYSTYRENE FOAM BY WOOD ROTTING FUNGI

**Math and Computer Science / Mentored**  
**Owens 207**

- 8:30AM Emily Babb, Governor's School for Science and Math  
DEVELOPING A DOCUMENT CLASSIFIER USING A PART OF SPEECH TAGGER
- 8:45AM Blaine Billings, Governor's School for Science and Math  
GDD( $N_1+N_2$ , 3;  $\Lambda_1$ ,  $\Lambda_2$ ) WITH EQUAL NUMBER OF BLOCKS OF TWO CONFIGURATIONS
- 9:00AM Grace Brueggman, Governor's School for Science and Math  
K-12 ROBOTICS PROGRAMMING CURRICULUM DEVELOPMENT AND ASSESSMENT
- 9:15AM Eleanor Burch, Governor's School for Science and Math  
ANALYSIS OF HISTORICAL DOCUMENTS THROUGH THE USE OF OPTICAL CHARACTER RECOGNITION
- 9:30AM Kaitlyn Campbell, Governor's School for Science and Math  
CLUSTERING GENE CELLS USING HIERARCHICAL CLUSTERING
- 9:45AM Frances Dickson-Vandervelde, Governor's School for Science and Math  
GENOME 3D VIEWER: A 3D MODEL OF THE HUMAN GENOME USING UNITY 3D
- 10:00AM Vinita Cheepurupalli, Spring Valley High School  
COMPARISON OF SVD AND FFT IN IMAGE COMPRESSION
- 10:30AM Tiger Mou, Governor's School for Science and Math  
CONCEPT AND IMPLEMENTATION OF A CRUISE CONTROL APPLICATION AND TEST ENVIRONMENT FOR A SAFETY CRITICAL EMBEDDED DYNAMIC APP-DOWNLOAD PLATFORM
- 10:45AM Dhaval Patel, Governor's School for Science and Math  
DESTINATION BASED ROUTING IN LINUX SYSTEMS TO ACCESS LOCAL SERVICES REMOTELY
- 11:00AM Shane Ragusa, Governor's School for Science and Math  
USER EXPERIENCE TESTING THROUGH THE DEVELOPMENT OF AN APPLE WATCH APP

- 11:15AM Thomas McLean, Spring Valley High School  
THE EFFECT OF IMAGE OVERLAP ON ACCURACY OF PHOTOGRAMMETRY USING UAVS
- 11:30AM Elaina Stuckey, Governor's School for Science and Math  
THE USE AND REDESIGN OF DATA ACQUISITION SOFTWARE IN PYTHON
- 11:45AM Justin Smith, Governor's School for Science and Math  
THE STORYTELLER'S AIDE: AN INDEX OF COMPOSITIONAL PROPERTIES IN CINEMA
- 12:00PM Xiang Li, Governor's School for Science and Math  
CLUSTERING OF SINGLE CELL USING LOCALITY PRESERVING PROJECTION

**Math and Computer Science / Non-Mentored**  
**Owens 204**

- 8:45AM Preston Carlton, Spring Valley High School  
THE EFFECT OF A USER'S FIRST PROGRAMMING LANGUAGE ON THEIR ABILITY TO PROGRAM OVERALL
- 9:00AM Tanner Senn and William Scouten, Heathwood Hall Episcopal School  
THE EFFECT OF DIFFERENT OBJECTS ON WIFI STRENGTH
- 9:15AM Rishi Suresh, Spring Valley High School  
THE EFFECT OF DECREASED CHAOS IN MELODY GENERATION ON ITS CONFORMITY TO COMMON CHORD PROGRESSIONS
- 9:30AM Hannah Stewart, Chapin High School  
ANALYSIS OF TENNIS WINNING SHOTS
- 9:45AM Athreya Murali, Heathwood Hall Episcopal School  
THE EFFECT OF R-FACTOR ON THE SUMMATION OF CANTOR'S DUST IN THE CANTOR FRACTAL
- 10:00AM Vijay Tripathi, Spring Valley High School  
THE EFFECTS OF A THUNDERBOLT 3 BASED LAN ON THE JAIN'S FAIRNESS INDEX OF THE NETWORK

**Microbiology / Mentored**  
**Owens 110**

- 8:30AM Aman Pitalia, Spring Valley High School  
THE EFFECT OF PHENOLIC COMPOUNDS (BENZOIC ACID AND GALLIC ACID) ON THE SUSCEPTIBILITY OF S. AUREUS TO TRIMETHOPRIM-SULFAMETHOXAZOLE.
- 8:45AM Daniel Arega, Governor's School for Science and Math  
THE CERAMIDASE INHIBITOR, CARMOFUR, SIGNIFICANTLY DISRUPTS REPRODUCTION IN DAPHNIA MAGNA

- 9:00AM Max Land, Dutch Fork High School  
MICROBIAL DIVERSITY TRENDS IN THE FECAL MATTER OF H. CAROLINENSIS AND R. RABIDA
- 9:15AM Lisa Qu, Spring Valley High School  
THE EFFECT OF NUTMEG ESSENTIAL OIL, LAVENDER ESSENTIAL OIL, ONION ESSENTIAL OIL, AND CLOVE ESSENTIAL OIL ON THE QUORUM SENSING ABILITY AND ANTIBIOTIC RESISTANCE OF CHROMOBACTERIUM VIOLACEUM
- 9:30AM Olivia Walkowiak, Governor's School for Science and Math  
CONNECTIONS BETWEEN INHIBITION OF ATP PRODUCTION AND FATTY ACID UPTAKE IN PROCYCLIC TRYPANOSOMA BRUCEI BRUCEI
- 9:45AM Walker McDonald, Dutch Fork High School  
THE TRANSFER OF ENDOSPORES ON U.S. CURRENCY
- 10:00AM Johnny Wood, Governor's School for Science and Math  
MTF-1 AS AN ACTIVATOR OF HEAVY METAL HOMEOSTASIS IN SCHISTOSOMA MANSONI

**Microbiology / Non-Mentored**  
**Owens 110**

- 10:30AM Olivia Moran, Heathwood Hall Episcopal School  
THE EFFECT OF CIPROFLOXACIN ON ESCHERICHIA COLI, AQUASPIRILLUM SERPENS, AND STAPHYLOCOCCUS EPIDERMIDIS
- 10:45AM Vinay Penmetsa, Spring Valley High School  
THE EFFECT OF THE INHIBITORY EFFECTS OF BENFOTIAMINE, L ASCORBIC ACID, AND A LIPOIC ACID ON THE PRODUCTION OF ADVANCED GLYCATION END PRODUCTS IN CAENORHABDITIS ELEGANS /
- 11:00AM Julia Tenhover, Heathwood Hall Episcopal School  
THE EFFECT OF THE NUMBER OF HOURS HORSES ARE KEPT STALLED PER DAY ON THE NUMBER OF STRONGYLE TYPE EGGS AND LARVAE PRESENT IN MANURE
- 11:15AM Madeline Kirton, Dutch Fork High School  
EFFECTS OF BROMATE AND CHLORITE ON ESCHERICHIA COLI RESISTANCE TO GENTAMICIN
- 11:30AM Flinn Christian, Heathwood Hall Episcopal School  
THE EFFECTS OF BACTERIAL GROWTH IN LIQUID MAKEUP FOUNDATION VS THE BACTERIAL GROWTH FROM THE FOUNDATION BRUSH APPLICATOR ON PIG SKIN
- 11:45AM Roann Abdeladl, Greenville Technical Charter High School  
DETERMINING THE ABILITY OF PSEUDOMONAS FLUORESCENS TO DEVELOP INTO BACTERIAL BIOFILM ON VARIOUS MEDIUMS
- 1:30PM Riley Branham, Chapin High School  
THE EFFECT OF HEAVY METALS ON BACTERIA GROWTH



1:45PM Benjamin Wuori , Spring Valley High School  
THE EFFECT OF PARAMECIUM MULTIMICRONUCLEATUM ON ENTEROBACTER  
AEROGENES POPULATIONS

2:00PM Marie Charlotte Demetriades, Heathwood Hall Episcopal School  
THE EFFECT OF SANITIZERS ON BACTERIA

**Physics / Mentored**  
**Owens 104**

9:00AM Narae Lee, Governor's School for Science and Math  
THE EFFECTS OF CATIONS ON THE DYNAMICS OF SINGLE STRANDED DNA

9:15AM Wesley Williams, Governor's School for Science and Math  
PLANAR HALL EFFECT IN THIN FERROMAGNETIC FILM'S DEPENDENCE UPON  
EXTERNAL MAGNETIC FIELD ANGLES

9:30AM Marlena Kolesinska, Governor's School for Science and Math  
NON-UNIFORM MAGNETIC FIELD-INDUCED INSTABILITIES BETWEEN  
FERROFLUID AND DEIONIZED WATER THROUGH A T-SHAPED  
MICROCHANNEL

9:45AM Jeffrey Chen, Governor's School for Science and Math  
EVALUTATING CP-VIOLATION IN THE B-MESON DECAY MODE

10:00AM Zachary Johnson, Governor's School for Science and Math  
THE ROLE OF CONDUCTIVITY ON INSTABILITIES OF FERROFLUIDS IN  
MICROCHANNELS

**Physics / Non-Mentored**  
**Owens 104**

10:30AM Jim Xue, Heathwood Hall Episcopal School  
THE EFFECT OF HYDROGEN CONSUMED AS FUEL ON THE ENERGY OUTPUT  
FROM A MODEL HYDROGEN FUEL CELL CAR

10:45AM Krishna Gorrepati, Spring Valley High School  
THE EFFECT OF A NOVEL P-N TiO<sub>2</sub>/Cu<sub>2</sub>O/ITO COMPOSITE JUNCTION VERSUS A  
Cu<sub>2</sub>O/ITO JUNCTION CREATED USING ELECTRON BEAM EVAPORATION ON A  
SHEWANELLA ONEIDENSIS MR-1 POWERED MICROBIAL COUPLED  
PHOTOELECTROCHEMICAL FUEL CELL

11:00AM Mika McAnally, Spring Valley High School  
THE EFFECT OF SOCCER BALL VELOCITIES ON A MODEL HEAD AS VIDEOED  
BY A CELL PHONE CAMERA

11:15AM Dylan McCormick, Spring Valley High School  
THE EFFECT OF MUSICAL INSTRUMENT ON THE ABILITY TO HEAR  
DIFFERENCES IN INTONATION

11:30AM Dandavikranth Reddy, Spring Valley High School  
THE EFFECT OF WEIGHTS ON THE VIBRATION REDUCTION OF A RADIO-CONTROLLED HELICOPTER

11:45AM Caitlin Kunchur, Dutch Fork Middle School  
A PERFECT PICTURE: EFFECT OF CAMERA SETTINGS ON EXPOSURE

**Physiology and Health / Mentored**  
**Owens 107**

8:30AM Emilia Ballou, Governor's School for Science and Math  
THE EFFECT OF OVARIECTOMY ON SKELETAL MUSCLE AUTOPHAGY SIGNALING IN THE FEMALE APCMIN/+ MOUSE

8:45AM Gabriella Barry, Governor's School for Science and Math  
ROLE OF PRIMARY CILIA ON EPICARDIAL CELLS LOCATED IN THE ATRIOVENTRICULAR JUNCTION

9:00AM Ashton Lancaster, Governor's School for Science and Math  
FIBROMODULIN (FOMD) AND LUMICAN (LUM) IN ADULT MOUSE CARDIAC VALVE DEVELOPMENT

9:15AM Tanvi Mehta, Spring Valley High School  
THE IMPACT AND SUSTAINABILITY OF INFECTIOUS DISEASE PHARMACIST INTERVENTIONS ON REDUCING ANTIRETROVIRAL ERRORS AND ERROR DURATION IN A CRITICALLY ILL HIV-INFECTED POPULATION OVER A FIVE-YEAR INTERVENTION PERIOD /

9:30AM Dhruw Maisuria, Governor's School for Science and Math  
CELL-CELL INTERACTIONS OF HUMAN UMBILICAL VEIN ENDOTHELIAL CELLS (HUVEC) AND AORTIC SMOOTH MUSCLE CELLS ON CULTISPHER BEAD SCAFFOLDING

9:45AM Konnor McDowell, Governor's School for Science and Math  
DIFFERENTIAL EFFECTS OF MPEP+JNJ-16259685 MICROINJECTIONS INTO THE VTA ON COCAINE-INDUCED LOCOMOTOR SENSITIZATION IN SALINE-EXPOSED RATS AND RATS WITH REPEATED TRAUMATIC PREDATOR ODOR EXPOSURE (TMT)

10:00AM Veronica McLeod, Governor's School for Science and Math  
ALDA-1 ATTENUATES HEPATIC ISCHEMIA/REPERFUSION INJURY

10:30AM Sarah Mott, Spring Valley High School  
AN ANIMAL MODEL OF PTSD FOLLOWING SOCIAL STRESS

10:45AM Joshua Nguyen, Governor's School for Science and Math  
THE EFFECT OF CILIA ON CARDIAC VALVE DISEASES

- 11:00AM Hemani Patel, Governor's School for Science and Math  
GLYCOPROTEIN (GP130) PROTEIN EXPRESSION DURING MOUSE SKELETAL MUSCLE DISUSE ATROPHY
- 11:15AM Jacob Rabinovitch, Governor's School for Science and Math  
THE EFFECT OF POLY(I:C) AND 5-FLUOROURACIL ON HSC AND ENDOTHELIAL CELL CYCLE ACTIVATION FOLLOWING AN 8-DAY RECOVERY PERIOD
- 11:30AM Grace Rhodes, Governor's School for Science and Math  
DIFFERENCES IN LIPID DISTRIBUTION IN LIVERS BETWEEN SPECIFIC PATHOGEN FREE AND GNOTOBIOTIC MICE
- 11:45AM Isabelle Schroeder, Governor's School for Science and Math  
EFFECTIVENESS OF BEHAVIORAL VOICE THERAPY IN PATIENTS WITH DYSPHONIA
- 12:00PM Madison Williamson, Governor's School for Science and Math  
G418 TREATMENT OF PATIENTS WITH A NONSENSE MUTATION IN THE X-LINKED CUL4B GENE

**Physiology and Health / Non-Mentored (Session I)**  
**Owens G01**

- 8:30AM Jaelen King, Heathwood Hall Episcopal School  
THE EFFECT OF AEROBIC EXERCISE ON SHORT TERM MEMORY
- 8:45AM Steven Andreen, Spring Valley High School  
THE EFFECT OF BODY MASS INDEX ON SWEAT PRODUCTION IN 15-18 YEAR OLD MALE HIGH SCHOOL PHYSICAL EDUCATION STUDENTS /
- 9:00AM Kenny Kim, Spring Valley High School  
THE EFFECT OF FERMENTATION ON THE PRODUCTION OF LACTIC ACID
- 9:15AM Karisha Desai, Center for Advanced Technical Studies  
THE CORRELATION BETWEEN CORTICOSTERONE LEVELS AND TELOMERE LENGTH IN RATS
- 9:30AM Savannah Hillmeyer, Heathwood Hall Episcopal School  
THE EFFECT OF A SWIMMER'S ORIENTATION ON VELOCITY IN UNDERWATER KICKING
- 9:45AM Joanna Dyches, Chapin High School  
DOCTORS AND PHARMACISTS PERSPECTIVES ON PRESCRIPTION DRUG ABUSE
- 10:00AM Cherilyn Heintz, Chapin High School  
EFFECTS OF ASHTANGA YOGA ON ADOLESCENT FLEXIBILITY
- 10:30AM Hillary Melton, Center for Advanced Technical Studies  
DESIGNING A STRETCHING DEVICE TO IMPROVE EFFICIENCY OF CONGENITAL MUSCULAR TORTICOLLIS TREATMENT

- 10:45AM Ipsita Pradhan, Center for Advanced Technical Studies  
DEVELOPMENT OF A PREGNANCY ASSISTANCE KIT TO HELP REDUCE  
MATERNAL MORTALITY RATES
- 11:00AM Jamie Milliff, Chapin High School  
GEMINI: A STUDY OF THE DUALITY IN BEHAVIOR ANALYSES ASSESMENTS
- 11:15AM Shreya Sidhu, Center for Advanced Technical Studies  
INCREASING THE LIFE SPAN OF DONOR ORGANS
- 11:30AM Bianca Huet, Chapin High School  
THE CORRELATION BETWEEN PATTERN RECOGNITION AND STANDARDIZED  
TEST SCORES
- 11:45AM Kinsey Meggett, Center for Advanced Technical Studies  
A DANGEROUS CURVE: THE EFFECTS OF TECHNOLOGY ON THE CERVICAL  
VERTEBRAE /
- 12:00PM Kelsey Krusen, Chapin Middle School  
BE ALARMED: CAN PEOPLE AGES 60 AND OLDER HEAR SMOKE DETECTORS?

**Physiology and Health / Non-Mentored (Session II)**  
**Owens G02**

- 8:30AM Royce Frye, Spring Valley High School  
THE EFFECT OF ELECTRODE PLACEMENT ON THE DETECTION OF MUSCLE  
ELECTRIC POTENTIAL
- 8:45AM Andrew Huang, Spring Valley High School  
THE EFFECTS OF PHYSICAL EXERCISE ON THE SHORT TERM MEMORY OF  
ADOLESCENTS
- 9:00AM Priyanka Rao, Spring Valley High School  
THE EFFECT OF VARIOUS ANTIDEPRESSANTS ON ACTION POTENTIAL  
CHARACTERISTICS IN LUMBRICUS TERRESTRIS
- 9:15AM Philip Brewer, Heathwood Hall Episcopal School  
CAFFEINE'S EFFECT ON LONG TERM MEMORY
- 9:30AM Matthew Reupke, Spring Valley High School  
THE EFFECT OF INAUDIBLE HIGH-FREQUENCY SOUNDS RANGING FROM 20-  
100 KILOHERTZ ON THE VISUAL ACCURACY OF TEENAGE HOMO SAPIENS.
- 9:45AM Andrew Martin, Dutch Fork High School  
ACL INJURY RISKS OF FEMALE DANCERS VERSUS NON-DANCERS BASED ON A  
BIOMECHANICAL LANDING /
- 10:00AM Aniruth Sivakumar, Spring Valley High School  
THE EFFECT OF THE DURATION OF LAVENDER AROMATHERAPY ON LEVEL OF  
STRESS /

- 10:30AM Coleman Couick, Heathwood Hall Episcopal School  
COMPARING THE EFFECTS OF NO LIQUID INTAKE VS. WATER INTAKE VS. GATORADE INTAKE ON RUNNERS DURING A WORKOUT
- 10:45AM Allison Stanek, Spring Valley High School  
THE EFFECT OF MACULAR PIGMENT ON COLOR DIFFERENTIATION IN HEALTHY ADOLESCENTS /
- 11:00AM Alexa Eyring and Kayla Shine, Center for Advanced Technical Studies  
DESIGNING AN ADAPTIVE UNIVERSAL HAND CUFF FOR CEREBRAL PALSY
- 11:15AM Katie Miller, Chapin High School  
EFFECT OF CONCUSSION KNOWLEDGE ON HIGH SCHOOL AHLETES LIKELINESS TO REPORT CONCUSSIONS
- 11:30AM Megan Johnson, Center for Advanced Technical Studies  
THE PROPULSION POW!: REDUCING ENERGY EXPENDITURE AMONG WHEELCHAIR USERS
- 11:45AM Angelica Walker and Stephanie Hals, Chapin High School  
RELATIONSHIP BETWEEN GROWTH PLATE DEVELOPMENT AND POINTE RELATED INJURIES

**Psychology and Sociology / Mentored**  
**Owens 108**

- 8:45AM Jacob Bhoi, Governor's School for Science and Math  
A STUDY ON THE EFFECT OF MESSAGE SENSATION VALUE ON THE MEMORY OF ANTI-DRUG MEDIA MESSAGES USING EYETRACKING SOFTWARE
- 9:00AM Emma Harris, Governor's School for Science and Math  
ASSOCIATIONS BETWEEN RATE OF SPEECH AND CARDIAC AROUSAL WITHIN FEMALES THAT EXPRESS THE FMR1 PREMUTATION
- 9:15AM Rebecca Kerr, Governor's School for Science and Math  
EFFECTS THAT INFLUENCE CHILDREN'S TRUST WHEN NONVERBAL DISPLAYS OF DOMINANCE ARE A FACTOR.
- 9:30AM Mariana Obando Velez, Governor's School for Science and Math  
AN EVIDENCE-BASED EDUCATION INTERVENTION PROGRAM FOR DISPARITIES IN CLINICAL RESEARCH
- 9:45AM Samuel Seigler, Governor's School for Science and Math  
THE EFFECTIVENESS OF ELECTRODE PLACEMENT DURING PAIRED ASSOCIATIVE STIMULATION
- 10:00AM Taylor Widener, Governor's School for Science and Math  
THE EFFECT OF SOCIALIZATION AND ISOLATION ON BINGE DRINKING IN C57 MICE

**Psychology and Sociology / Non-Mentored (Session I)**  
**Owens 109**

- 8:30AM Adam Abdulrahman, Chapin High School  
ASSOCIATION OF GRAPHEME-COLOR SYNESTHESIA TO SAT SCORES
- 8:45AM Jake Breland, Chapin High School  
THE OPTIMAL LENGTH AND FREQUENCY OF PRACTICE IN MASTERING THE GUITAR
- 9:00AM Raegan Brizek, Chapin High School  
SECONDARY TEACHERS' PERCEPTION ON THE EDUCATIONAL USE OF SOCIAL MEDIA: A QUALITATIVE STUDY
- 9:15AM Gabriel Corn, Spring Valley High School  
THE APPLICATION OF THE PRISONER'S DILEMMA IN AN ONLINE SCENARIO TO TEST ONE'S ABILITY TO TRUST OTHERS /
- 9:30AM Jessica Cole, Chapin High School  
THE EFFECTS PSYCHOLOGICAL PRIMING ON HIGH SCHOOL STUDENTS' COGNITIVE FUNCTIONS
- 9:45AM Emily Franklin, Chapin High School  
ASSOCIATION BETWEEN PRIVATE LESSONS AND SUCCESS IN MUSIC
- 10:00AM Rachel Janis, Chapin High School  
EFFECT OF GRADE LEVEL ON THE TYPE OF HELP REQUESTED IN A WRITING LAB
- 10:30AM Taylor Ferguson, Spring Valley High School  
A CORRELATIONAL ANALYSIS ON THE RELIGIOUS KNOWLEDGE AND RELIGION BASED DISCRIMINATORY TENDENCIES OF ADULTS AFFILIATED WITH VARIOUS FAITHS
- 10:45AM Wesley Hankinson, Spring Valley High School  
THE CORRELATION BETWEEN ADOLESCENTS' PHONE ADDICTION LEVEL AND ATTACHMENT TO THEIR PHONE
- 11:00AM Amy Loy, Chapin High School  
THE EFFECT OF COLORING MANDALAS FOR TWENTY MINUTES ON TEEN STUDENT'S ANXIETY LEVELS
- 11:30AM Catherine O'Leary, Chapin High School  
EFFECT OF DATING VIOLENCE PRESENTATION ON THE ATTITUDS OF 8TH GRADE GIRLS
- 11:45AM Christopher Juhn, Spring Valley High School  
THE EFFECT OF VARIOUS FREQUENCIES OF NOTES ON THE PERCEPTION OF PITCH OF BOTH MUSICALLY AND NON-MUSICALLY TRAINED STUDENTS
- 12:00PM Michael Spicer, Spring Valley High School  
THE DIFFERENCE BETWEEN RUSSIAN & AMERICAN MEDIA FRAMING TECHNIQUES ON THE RUSSIAN CRIMEAN ANNEXATION

**Psychology and Sociology / Non-Mentored (Session II)**  
**Owens 108**

- 10:30PM Gloria Kim, Spring Valley High School  
THE EFFECT OF INDUCED POSITIVE, NEGATIVE, AND NEUTRAL EMOTIONS ON SUSCEPTIBILITY OF ACCEPTING MISLEADING INFORMATION ABOUT AN IMAGE DEPICTING A NEGATIVE EVENT
- 10:45PM Zachary Young, Spring Valley High School  
THE EFFECT OF VARIOUS VIDEO GAME GENRES ON THE AGGRESSION LEVELS OF ADOLESCENTS
- 11:00PM Madison Owen, Chapin High School  
ELEMENTARY SCHOOL MUSIC STUDENTS AND THE EFFECTS OF INCORPORATING LEARNING STYLES IN THE CLASSROOM
- 11:15PM Krystal Pasciak, Chapin High School  
EFFECT OF GENRE ON THE LIKELIHOOD OF STUDENTS READING ASSIGNED MATERIALS
- 11:30PM Caleb Taylor and Cooper Woodham, Chapin High School  
THE PSYCHOLOGICAL EFFECTS OF ELIMINATING SOCIAL MEDIA ON EVERYDAY LIFE
- 11:45PM Allison Wilson and Sarah Hudson, Heathwood Hall Episcopal School  
HEARING COLOR AND SEEING SOUNDS: TO WHAT EXTENT DOES COLOR REPETITION OCCUR IN SONG SELECTION INVOLVING MALES AND FEMALES
- 12:00PM Dev Ramesh, Spring Valley High School  
THE CORRELATION BETWEEN TWITTER SENTIMENTS AND POLLING RESULTS FOR THE 2016 PRESIDENTIAL RACE

**Zoology / Mentored**  
**Kinard 119**

- 10:30AM Morgan Jones, Governor's School for Science and Math  
A BIOLOGICAL STUDY ON THE DIFFERENCES BETWEEN MOSQUITO AND BLACK FLY PHYSIOLOGY VIA THE TRANSPLANTATION OF TRICHOMYCETES
- 10:45AM Tanner Maharrey, Governor's School for Science and Math  
A SURVEY OF THE INSECT POPULATIONS OF THREE DIFFERENT BEACHES ALONG THE SOUTH CAROLINA COAST
- 11:00AM Joshua Dunford, Governor's School for Science and Math  
THE ATTRACTIVNESS OF LIGHT WITHIN THE VISIBLE SPECTRUM TO THE BEETLE GENERA PHYLLOPHAGA, PHANAEUS, AND THE FAMILY CARABIDAE
- 11:15AM Ashley McVicker, Governor's School for Science and Math  
THE ECOLOGY AND REPRODUCTIVE HABITS OF THE DIAMONDBACK TERRAPIN IN AND AROUND THE CHARLESTON HARBOR
- 11:30AM Claire Bernardo, Governor's School for Science and Math  
A BIOLOGICAL STUDY ON THE MIDGUTS OF BLACK FLIES AND MOSQUITOS

11:45AM Bailey Fallon, Governor's School for Science and Math  
LETHAL AND SUBLETHAL EFFECTS OF ELEVATED SALINITY ON THE LARVAE  
OF ANAXYRUS TERRESTRIS, HYLASQUIRELLA, AND GASTROPHRYNE  
CAROLINENSIS

12:00PM Neelia Heath, Governor's School for Science and Math  
THE BIODIVERSITY OF DRAGONFLIES AND DAMSELFLIES: THE SPECIES AND  
BEHAVIORS OF ODONATA INHABITING THE COOPER LIBRARY POND

**Zoology / Non-Mentored**  
**Kinard 119**

9:15AM Noah Wells, Spring Valley High School  
THE EFFECT OF MAGNETISM ON THE REGENERATION RATE OF DUGESIA  
TIGRINA

9:30AM Isha Desai, Center for Advanced Technical Studies  
CANINE PROSTHETIC

9:45AM Sean Denis and Coleman Upton, Chapin High School  
LEARNING CURVE COMPARED TO AGE IN BORDER COLLIE BREEDS

10:00AM Matthew Payne, Spring Valley High School  
THE EFFECT OF BISPHENOL-A CONCENTRATIONS ON THE HEART RATE OF  
DAPHNIA MAGNA



## SCJAS ABSTRACTS

(Listed alphabetically by presenter's last name)

### DETERMINING THE ABILITY OF PSEUDOMONAS FLUORESCENS TO DEVELOP INTO BACTERIAL BIOFILM ON VARIOUS MEDIUMS

Roann Abdeladl  
Greenville Technical Charter High School

Bacterial biofilms can prove helpful in water purification or nutrient cycling but can also prove harmful as they can cause persistent infections in humans and clog pipes or medical devices. The purpose of this project is to test the ability of biofilm to form on different surfaces; utilizing a "model" bacteria similar to the one which forms into biofilm, I will test the ability of bacterial biofilm to grow on glass slides, as well as everyday surfaces like steel, polyester, and different fabrics. Upon completion of the experiment, one can implement the acquired data and discover which mediums must be properly maintained to prevent formation of bacterial biofilm, and once can apply this knowledge to other areas of microbiology.

### ASSOCIATION OF GRAPHEME-COLOR SYNESTHESIA TO SAT SCORES

Adam Abdulrahman  
Chapin High School

A survey was given to look for an association between Grapheme-Color Synesthesia, the neurological overlap between colors and graphemes (letters and numbers), and SAT scores in all 3 sections (Writing, Reading, and Math). The survey was given randomly to 51 Juniors or Seniors through their homeroom classes throughout Chapin High School, 5 of which showed having synesthesia. The survey was comprised of questions which would determine whether or not a student had synesthesia, by evidence of association and consistency, as well as their average SAT score range in all 3 subjects. The students were compared in each category and score range, through a 2 Proportions Z Test, between those who did and didn't show synesthesia. All association resulted in nonsignificant data, with the exception of the 500-590 (the national average) range in the English section, with subjects with synesthesia showing a stronger association to this score range than non synesthetes, with a p-value=0.03. This suggests that the processes involved with answering SAT questions is different than those involved in the associations made in synesthetes. This was surprising as both color and academic skills are associated with the Parietal Lobe. This may suggest that, although these skills are similar in location, they are fundamentally different, where the associations made in synesthesia are independent of the processing necessary to complete tasks in reading, writing, and mathematics.

### RMT ANALYSIS OF CHINA'S SHANGHAI STOCK EXCHANGE

Alexander Adams  
Governor's School for Science and Math  
Mentor: Dr. Lim; Department of Physics, Korean Advanced Institute for Science and Technology

We analyzed the structure of cross-correlation in China's Shanghai Stock Exchange by examining daily price changes of nearly 1000 stocks for the time period between January 1, 2005 and July 15, 2015. We determined characteristics of the Chinese stock market during times of crisis by examining the 2008 crash and the 2015 crash. By determining the probability distribution of yearly cross-correlation matrices, we ascertained that during times of crisis, stocks become highly correlated with one another. We also calculated deviating eigenvalues for four year time periods with a two year sliding window in order to find the magnitude of these correlations. Recognizing that the market wide effect clouds true correlations, we first calculated that China has a large market wide effect through inverse participation ratios, and then removed the effect through regression. After removing the market wide effect, we constructed network analysis diagrams for time periods of four years with a two year sliding window to show how different business sectors interact with each other before, during, and after times of crisis. Because there were fewer correlations in the Shanghai Stock Exchange during the 2015 crash, we concluded that the recent downturn is not as severe as the 2008 crash.

### THE ESTABLISHMENT OF GREEN FLUORESCENT CLONES OF A549 HUMAN LUNG CARCINOMA CELLS

Hannah Addis  
Governor's School for Science and Math  
Mentor: Dr. Wei; Department of Biology, Clemson University

A549 human lung carcinoma cells are widely used in animal model studies for human anticancer therapy development. The detection of A549 tumor cells in animals requires complicated reagents and procedures. The goal of this project is to create clones of A549 cells that express green fluorescent protein (GFP) so that the tumor cells can be easily recognized in vivo. A549 cells were cultured and plated in a six-well plate. The cells were then transfected with plasmid pcDNA3.1-GFP/zeo+ via Lipofectamine 2000. After transfection, a selection media containing zeocin was used to select transfected cells. The fluorescent imaging results demonstrated that A549 cells were successfully transfected with GFP. Many colonies resistant to zeocin were established but did not express GFP. Further attempts to obtain stable colonies will be explored.

## RMT ANALYSIS OF CHINA'S SHANGHAI STOCK EXCHANGE

Hamza Ahmed

Governor's School for Science and Math

Mentor: Dr. Lim; Department of Physics, Korean Advanced Institute for Science and Technology

We analyzed the structure of cross-correlation in China's Shanghai Stock Exchange by examining daily price changes of nearly 1000 stocks for the time period between January 1, 2005 and July 15, 2015. We determined characteristics in the Chinese stock market during times of crisis by examining the 2008 crash and the 2015 crash. By determining the probability distribution of yearly cross-correlation matrices, we ascertained that during times of crisis, stocks become highly correlated with one another. We also calculated deviating eigenvalues for four year time periods with a two year sliding window in order to find the magnitude of these correlations. Recognizing that the market wide effect clouds true correlations, we first calculated that China has a large market wide effect through inverse participation ratios, and then removed the effect through regression. After removing the market wide effect, we constructed network analysis diagrams for time periods of four years with a two year sliding window to show how different business sectors interact with each other before, during, and after times of crisis. Because there were fewer correlations in the Shanghai Stock Exchange during the 2015 crash, we concluded that the recent downturn is not as severe as the 2008 crash.

## FLOW RESISTANCES AT INTENSE BED SHEAR STRESSES

Risden Altman

Governor's School for Science and Math

Mentor: Dr. Viparelli; Department of Civil and Environmental Engineering, University of South Carolina

The flow of sediments in water is a subject of interest to both engineers and geologists with the resistances to the flow of water and the formation of sediment waves being of particular interest. Our research investigated the formation of these waves under sheer stress. We ran multiple experiments where water and sand was run through a sediment-feed flume at varying sediment feed rates and measured the roughness height of the water and sediment. Once this data was collected and charted, transitions between types of sediment waves appeared. These trends were compared to data from other experiments and appear to show a transition from triangular waves to rounded waves.

## THE EFFECT OF BODY MASS INDEX ON SWEAT PRODUCTION IN 15-18 YEAR OLD MALE HIGH SCHOOL PHYSICAL EDUCATION STUDENTS /

Steven Andreen

Spring Valley High School

In the world where people are trying to stay fit and sweating while they do it, the need to replace what people sweat out has an ever-growing emphasis. The purpose of this project was to determine a correlation between body mass index and sweat production to help people know how much fluid they would need to replace. It was hypothesized that a higher body mass index (BMI) would result in a lower amount of sweat produced. To test this hypothesis participants were asked to complete a 10 minute standing and a 10 minute running trial at 10 min/mile pace. A piece of gauze was attached to their left bicep and was massed after the conclusion of the trial on a thousandths scale. The data collected did not show a linear relationship and showed no significant difference between bmi level and sweat production ( $F(2,13)=2.83, p=.291$ ).

## EVALUATING THE EFFICIENCY OF BANANA PEELS AS A SOURCE OF REMOVING METHYLENE BLUE DYE FROM WATER.

Hosam Arammash

Spring Valley High School

Mentor: Dr. Samuel Darko; Benedict College

In this study, banana peels were examined as a source of removing methylene blue, a commercial dye, from water. The banana peels were cut into small pieces and then dried in an oven at 120°C for 13 hours. Once dried the banana peels were removed and ground; half were ground using a coffee grinder and the other half with a ball mill. The coffee ground banana peels were taken and HTC (Hydrothermal Carbonization) was applied one with green tea extract as the solvent and the other with water as the solvent. For the ball mill the same processes was repeated. The banana peel samples were then run through a sieve to obtain four particle sizes, 250, 125, 63, and <63µm. For this study only 250 and 125µm were studied. To obtain the contaminant, 0.01 grams of methylene blue was diluted in one liter of water. For each trial only 100 mL of the solution was used, as well as 1 gram of the banana peel sample. It was hypothesized that the HTC (Green Tea) Ball mill would have the largest average mean and have a significant difference from the other samples. A UV-VIS was used to measure percent transmittance which was then used to calculate percent removal. After comparing the average means, the HTC(Green Tea) Ball mill had the highest percent removal of methylene blue. However, a one-way ANOVA showed that HTC (Green Tea) Ball mill had a significant difference from all the samples except two (HTC (Green Tea) Coffee ground 125µm/250µm). The hypothesis was partially supported with the HTC (Green Tea) Ball mill having the highest percent removal, but it was not significantly different from all other samples. /

## DESIGN AND IMPLEMENTATION OF A ZOOM SYSTEM USING ACTIVE LENSES

Mohammad Arammash  
Spring Valley High School

Mentor: Dr. Kamal Youcef-Toumi; Massachusetts Institute of Technology

A zoom lens is an optical system that can vary the focal length while keeping the image plane stationary. In order to optically vary the magnification of an imaging system, continuous mechanical zoom lenses require multiple optical elements and use fine mechanical motion to precisely adjust the separations between individual or groups of lenses. By incorporating active elements into the optical design, one can eliminate the need to change the spacing between lenses and create an imaging system with variable optical magnification that has no translational moving parts. Changing the effective focal length can be accomplished by positioning two or more active optics in the optical design and adjusting the power of the lens accordingly. The active optics used and designed in this application are variable focal length lenses. Active optics technology is essential for improving the capabilities of imaging systems while reducing size, weight, and increasing speed. The structure and principle of the lens system are introduced. Detailed calculations and simulation examples are presented to show that this zoom lens system appears viable as the next-generation zoom lens. By using multiple active optics a system that can achieve a 2.2x zoom with no translational moving parts was designed. Through the creation of active optical elements the range of focal length and aperture diameter can be controlled to achieve a desired higher zoom and depth of focus.

## THE CERAMIDASE INHIBITOR, CARMOFUR, SIGNIFICANTLY DISRUPTS REPRODUCTION IN DAPHNIA MAGNA

Daniel Arega

Governor's School for Science and Math

Mentor: Dr. Baldwin; Department of Toxicology, Clemson University

Sphingomyelinase converts sphingomyelin to ceramide and ceramidase converts ceramide to sphingosine. We used inhibitors of these enzymes to determine the potential role of ceramide and sphingosine in *Daphnia magna*. We used the ceramidase inhibitor, Carmofur that blocks sphingosine production and the sphingomyelinase inhibitor, GW4869 that blocks ceramide production in toxicity tests. The daphnids were exposed to different concentrations of the toxicants in order to determine their effects on reproduction. We hypothesized that both inhibitors will significantly decrease reproduction in *D. magna*. We ran 48-hour acute toxicity tests on < 24 hour old *D. magna*. Concentrations up to 1000 µg/L of GW4869 caused no toxicity, and only the 1000 µg/L concentration decreased survival in the Carmofur group (50%). We also performed 21-day chronic toxicity tests to study the effect of these chemicals on survival and reproduction. Unexposed daphnids reproduced at 8 days old, but 100 and 200µg/L Carmofur-exposed daphnids did not reproduce until 15 days old. GW4869 did not have observable effects. The expression of ceramidase and sphingomyelinase genes in *D. magna* at 2, 4, 7 and 14 days old through Polymerase Chain Reaction (PCR) were also assessed. The results showed that the ceramidase gene was highly expressed in grown daphnids capable of reproduction (Zheng, 2012).

## LIGHT HARVESTING AND ENERGY TRANSFER IN METAL-ORGANIC FRAMEWORKS

Hailey Areheart

Governor's School for Science and Math

Mentor: Dr. Shustova; Department of Chemistry and Biochemistry, University of South Carolina

The purpose of this investigation is to find a solution to society's dependency on fossil fuels since they aren't renewable and are harmful to our environment. The collective arrangement around a reaction center and ensemble chromophore behavior is precisely depended on the light-harvesting efficiency of the natural photosystem. Chromophore behavior, which is observed in the natural photosystem, has the possibility of being replicated by metal-organic frameworks (MOFs). MOFs are remarkably organized, crystalline, self-assembled materials which can be used as a platform to study light harvesting and energy transfer systems. Energy transfer and light harvesting capabilities can also be controlled using external stimuli. Using MOFs as a platform, we were able to use a photoswitch to control light harvesting and energy transfer via irradiation of different types of light. To synthesize the MOF, bis(5-pyridyl-2-methyl-3-thienyl)-cyclopentene (BPMTc) was immobilized inside the MOF. To confirm that the MOF was synthesized, <sup>1</sup>H NMR, Powder X-ray Diffraction, Mass-Spectrometry, Diffuse Reflectance Spectra, and Emission Intensity was utilized, and indicated that the MOF did harvest light and transfer energy while possessing the ability to turn "on" and "off". The results of this project can lead researchers in many directions, for example investigating a less costly and more effective photoswitch. This project was successful in creating a MOF and is the first step in finding an easier and more effective way to power our society.

## THE EFFECT OF DIFFERENT LEVELS OF FERTILIZING NUTRIENTS ON THE OIL BIOREMEDIATION PROPERTIES OF PLANKTONIC MARINE BACTERIA

Zahida Ashroff  
Spring Valley High School

Oil spills can be extremely hazardous and pose a significant threat to the marine environment (McKew et al., 2007). Bioremediation is the process of using living microorganisms to clean up contaminated environments, like oil spills. The purpose of this study was to determine what levels of nutrients would enhance the growth of bacteria, thereby increasing the bioremediation of oil. This will provide a better understanding of how to enhance bioremediation, without altering the natural process of bioremediation and the indigenous bacterial community dynamic. It was hypothesized that the addition of nutrients would increase the remediation of oil and the greater the nutrients, the greater the biodegradation of the oil. In this study, different levels of three specific elements, nitrogen, phosphate and phosphorous, were added to natural seawater containing marine bacteria and observed over a period of time. The amount of remediated oil was calculated and a one-way ANOVA F-test was conducted to analyze the data. None of the nutrient levels lead to a significant difference of oil remediation, as the one-way ANOVA revealed a p-value of 1.07, which is greater than the alpha at 0.05. As the amount of remediation of the bacteria getting additional nutrients and the bacteria not receiving any nutrients was not significantly different, it was concluded that bioremediation is not a viable method for cleaning up oil spills over short periods of time. /

## THE EFFECTS OF VARIOUS PROMOTIONAL METHODS ON RECYCLING BEHAVIORS

Moji Awe  
Spring Valley High School

Recycling is beneficial to the environment by reducing waste entering landfills. Many people have the ability to recycle, but it may become difficult if the members of the community do not have a basic understanding of recycling guidelines. The purpose of this experiment was to determine whether promoting the appropriate items to recycle would increase the number of correct items that were recycled. It was hypothesized that after the promotions, more correct items would be recycled. The experiment was conducted at a public high school, where a randomly selected number of classrooms were chosen to participate. The different advertising methods were a brochure (Group A), a video (Group B), manipulating the location of the recycling bins (Group C), and the control group (Group D). A total of four classrooms were selected for each of the groups, but only two of the classrooms were collected from in the end. There was a collection two weeks prior to the advertisements, one week prior to the advertisements and one week after the advertisements. The results from the items collected before and after the promotions were analyzed. A two-sample t-test was performed and showed that the number of correct items collected before the advertisements ( $M = 2.625$ ,  $SD = 0.619$ ) was not significantly different than correct items collected after the advertisements ( $M = 2.500$ ,  $SD = 1.195$ ),  $t(12) = 0.28$ ,  $p = 0.788$ . Another two-sample t-test was performed and showed that the number of incorrect items collected before advertisements ( $M = 1.125$ ,  $SD = 0.719$ ) was not significantly different than the incorrect items collected after the advertisements ( $M = 0.875$ ,  $SD = 0.835$ ),  $t(12) = 0.72$ ,  $p = 0.483$ .

## DEVELOPING A DOCUMENT CLASSIFIER USING A PART OF SPEECH TAGGER

Emily Babb  
Governor's School for Science and Math  
Mentor: Dr. Rashid; Knowledge Management, German Research Center for Artificial Intelligence

Natural language processing is a form of artificial intelligence, in which human language is interpreted and examined. In natural language processing, researchers have the ability to summarize a document of text into a paragraph of text, to translate text from one language to another, and to give an answer to provided question. The Natural Language Toolkit1 (NLTK) is a python software library that offers helpful methods in this subset of artificial intelligence. The overall goal of the research was to develop a classifier, which could sort documents into type, such as email, essay, or joke, and its tone towards a subject by tagging the words in the document with their respective parts of speech. As research progressed, it could be seen that the part of speech tagger was not tagging with a high accuracy using the NLTK software. Therefore, I began to examine the NLTK part of speech tagger. Many documents, all of different types, were tagged using the NLTK toolkit. Those same documents were then manually tagged using a dictionary. Then, the percent accuracy of the NLTK part of speech tagger was determined, and steps were taken to improve the tagger, which was critical to the success of the classifier.

## THE EFFECT OF OVARECTOMY ON SKELETAL MUSCLE AUTOPHAGY SIGNALING IN THE FEMALE APCMIN/+ MOUSE

Emilia Ballou  
Governor's School for Science and Math  
Mentor: Dr. Carson; Department of Exercise Science, University of South Carolina

Metabolic abnormalities and inflammation in cancer lead to cancer cachexia, a deadly loss in fat and skeletal mass. While the mechanisms of cancer cachexia are well defined in males, very little is known about this etiology in female. Autophagy plays a role in muscle wasting in male ApcMin/+ mice; however, the role of autophagy has not been investigated in the female. Previous studies have found that while some muscle proteins involved in inflammatory signaling decreased in cachectic males, they increased in cachectic females. It is known that the hormone estrogen inhibits the signaling of IL6, a proinflammatory signal. The purpose of this study was to determine the effect of ovarian function on autophagy signaling

during cachexia progression in the ApcMin/+ mouse. We manipulated the variables of cancer and ovarian function and analyzed their effects on the autophagy markers Bax and Cathepsin. We used three experimental groups; ovaries-intact ApcMin/+ and B6 mice, and ovariectomized ApcMin/+ mice. Results from this study indicated that cancer increased autophagy signaling in the female, but ovariectomy did not cause a further change.

#### ROLE OF PRIMARY CILIA ON EPICARDIAL CELLS LOCATED IN THE ATRIOVENTRICULAR JUNCTION

Gabriella Barry

Governor's School for Science and Math

Mentor: Dr. Wessels; Department of Regenerative Medicine and Cell Biology, Medical University of South Carolina

Primary cilia are essential for the proper development of mammalian tissue. By signaling through the hedgehog pathway, cilia act as a signaling hub in order to coordinate many processes during development. Previous research has shown cilia are involved in coordinating L-R asymmetry of the heart (Koefoed, 2013). The goal of this research is to clarify the role that epicardial cells play in the development of the heart. Epicardial cells migrate inwards through the atrioventricular junction (AV junction) as the heart develops. It was hypothesized that primary cilia play a role in the migration of epicardial cells through the AV junction. In order to determine if epicardial cells have primary cilia, immunohistochemistry was used. Fifteen  $\mu\text{m}$  thick sections of embryos from a WT1cre+/Rosa26ff mouse were stained to locate epicardial cells and primary cilia. Three-dimensional reconstructions were generated using images taken of these stained sections. The results showed localization of primary cilia to epicardial cells. In further research, WT1cre+/Rosa26ff/IFT88ff mice will be used to determine how the AV junction develops in the absence of cilia, predicting that this would lead to abnormalities of the tissues to which the epicardial cells typically contribute.

#### THE EFFECT OF HYDROGEN-PEROXIDE ON ENZYME ACTIVITY IN SWINE BLOOD MEASURED BY THE AMOUNT OF OXYGEN PRESENT

Leila Barwick

Heathwood Hall Episcopal School

Throughout the world today, many people use Hydrogen Peroxide as a disinfectant for lacerations, but many people are unaware of how this commonly used solution affects your blood. The purpose of this study was to investigate the effect of Hydrogen Peroxide ( $\text{H}_2\text{O}_2$ ) on oxygen levels in blood. The hypothesis is when hydrogen-peroxide is added to the swine blood, the enzyme activity will change, which will be shown by an increase or a decrease in the amount of  $\text{O}_2$  in the swine blood. The null hypothesis is when the hydrogen-peroxide is added to the swine blood, the enzyme activity will not change, which will be shown by a consistent  $\text{O}_2$  level in the blood. In order to keep this study ethical, swine blood was used. 50 mL of blood was poured into a 250 mL beaker, the blood was then stirred with the Oxygen sensor, which measured the amount of dissolved oxygen in ppm, for 180 seconds to collect the control group data. Then the beakers were divided into 3 groups. Next, one beaker from each group was chosen, one 1 mL, another 2mL, and lastly 3 mL of Hydrogen Peroxide. Each solution was stirred for 15 seconds before adding the hydrogen peroxide while continuously stirring until the 180 seconds ended. The results of this study showed an increase in oxygen levels of at least 1 ppm for each mL added. The conclusion of this study is that the hypothesis can be accepted, and the null hypothesis can be rejected.

#### THE EFFECT OF PARAMECIUM MULTIMICRONUCLEATUM ON ENTEROBACTER AEROGENES POPULATIONS

Wuori Benjamin

Spring Valley High School

The purpose of this experiment was to determine if Paramecium multimicronucleatum could reduce the population of Enterobacter aerogenes should they contaminate a water source, as a means to combat antibiotic-resistant bacteria. It was hypothesized that if P. multimicronucleatum were exposed to E. aerogenes, the Paramecia would reduce the bacterial population while increasing their own population. Petri dishes were filled with distilled water before having drops from a culture of Paramecia added to both groups, and additional drops from a broth solution with E. aerogenes were added to the experimental group. Random spaces on the petri dishes were examined for Paramecia counts and water from the dishes was spread on agar plates and incubated for 24 hours before being rated on a scale of 0-5 with zero being the lowest. A significant difference was found between the Paramecia experimental and control groups on day three,  $t(28.67)=119.883$ ,  $p=.0003$ , and day seven,  $t(25.6)=183.44$ ,  $p=6.17 \times 10^{-7}$ . This could be because the smaller bacterial population died off in the control trial, leaving less food. This supports the part of the hypothesis that states that Paramecia thrive with extra bacteria. Another t-test between the sixth and thirteenth days of the experimental bacteria counts shows a statistically significant drop between the days,  $t(14.7)=1.87119$ ,  $p=.0034$ . However, descriptive statistics suggested that bacteria overcome Paramecia after about two weeks, despite the Paramecia seeming to exert some strain on the bacterial populations between days six and thirteen.

## THERMODYNAMIC MODELING OF PHASE EQUILIBRIA IN TERNARY PSM/POPC/CHOLESTEROL MIXTURES

Selen Berkman

Governor's School for Science and Math

Mentor: Dr. Uline; Department of Chemical Engineering, University of South Carolina

In order to increase understanding of lipid rafts, we created a computational model of a ternary PSM/POPC/cholesterol system. We based the model off of the laws of thermodynamics and used coefficients from the Putzel and Schick model to describe interactions between saturated and unsaturated lipids and cholesterol. Using this model, we created a theoretical phase diagram that was aimed to mimic a phase diagram created from experimental data. We found that both the theoretical phase diagram and the experimental phase diagram formed closed loops, which indicated that phase separation into three phases only occurred when all three components of the system were present and not when there was only a binary system. Our model and the experimental model were similar in terms of size, shape, and tie-lines. This overall similarity may suggest that the formation of lipid rafts is due to thermodynamic phase separation. In future work, the thermodynamic consistence of this model should be examined.

## A BIOLOGICAL STUDY ON THE MIDGUTS OF BLACK FLIES AND MOSQUITOS

Claire Bernardo

Governor's School for Science and Math

Mentor: Dr. Beard; Department of Agricultural and Environmental Sciences, Clemson University

Simuliidae (black flies) and Culicidae (mosquitos) act as vectors for infectious diseases such as river blindness, malaria, yellow fever, and West Nile virus. As both Simuliidae and Culicidae belong to the Diptera family, the insects share similar physical characteristics. Simuliidae act as hosts to the symbiotic trichomycete fungus known as *Harpella melusinae*. This fungus attaches to the peritrophic matrix located in the midgut of Simuliidae and other aquatic Diptera larvae. The Simuliidae larvae release trichomycete spores into their environment. Culicidae share very similar looking midguts with the Simuliidae, yet they do not naturally harbor midgut trichomycetes such as *H. melusinae*. The purpose of this research was to collect preliminary data to determine why this fungus does not grow in the midguts of mosquitoes. For this study, four different species of Culicidae larvae were exposed to *H. melusinae* spores collected from black flies using four different methods. The midguts of the Culicidae were then inspected in order to assay whether or not *H. melusinae* colonized the midgut. After inspection of fifty eight individuals, four Culicidae showed a trichomycete spore in their midguts. These data supports the hypothesis that Culicidae midguts are capable of housing *H. melusinae*. However, greater sample size is required in order to support these preliminary results. Overall, this research provides scientists and entomologists with more information on how Culicidae midguts differ from other aquatic Diptera midguts.

## THE DEVELOPMENT AND ANALYSIS OF CORE-SHELL BIO-NANOPARTICLES USING P4V4 AND TRANSFERRIN FOR DRUG DELIVERY

Matthew Berry

Governor's School for Science and Math

Mentor: Dr. Wang; Department of Chemistry and Biochemistry, University of South Carolina

It is observed that cancer killing drugs have no mechanism for reaching a tumor itself. This project utilized the binding of proteins to polymers to create core-shell bio-nanoparticles in order to conceal the cancer drug. With the protein as the shell, the protein would be able to recognize and bind to the walls of the specified cancer tumors and disperse the concealed drug from the polymer. A total of three polymers were tested for the binding of transferrin as well as the effects on the secondary folding structure of the protein. By testing transferrin with P4VP and PCL-py, the binding of proteins to hydrophobic as well as hydrophilic polymers could be studied in order to understand how they would adsorb to each other. PCL-(PCL-Py), was bound to doxorubicin and then adsorbed to the protein. Through dynamic light scattering, size shifts in the nanoparticles were found to be based on the amount of protein added compared to polymer. Using circular dichroism spectroscopy, it was found that the secondary folding structure was relatively unaffected by the binding of the protein to the polymer. With the ability to manipulate the size of nanoparticles while keeping them stable, smaller tumors can be found.

## A STUDY ON THE EFFECT OF MESSAGE SENSATION VALUE ON THE MEMORY OF ANTI-DRUG MEDIA MESSAGES USING EYETRACKING SOFTWARE

Jacob Bhoi

Governor's School for Science and Math

Mentor: Dr. Joseph; Department of Neuroscience, Medical University of South Carolina

Many programs have been created to reduce the prevalence of drug abuse. One approach is through the use of public service announcements (PSAs) targeted towards high sensation seekers (HSSs), who are high risk individuals. Therefore, these targeted PSAs incorporate high sensation value (HSV) elements such as novel ideas, intense or fast-paced scenes, ambiguity, suspense, or graphic images. Previous research has shown that PSAs targeted to HSSs through the incorporation of HSV elements help decrease the incidence of drug abuse. The aims of this research were (a) to analyze the attentive processing of PSAs, by analyzing eye tracking data as they watched the PSAs and then making mixed ANOVAs, analysis of variance, and (b) to determine the role of sensation value in memory of the persuasive message, by subjecting the participants to an incidental memory test seven weeks after the viewing of the PSAs and then correlating it with sensation value. It was

hypothesized that the HSSs would be more attentive to HSV messages than to low sensation value (LSV) messages and the opposite or the same for low sensation seekers (LSSs). Similarly, increased attention, indicated by eye tracking measures, would correlate with better memory of the persuasive message of the PSAs. This research indicated that HSSs were more attentive to HSV PSAs and less attentive for LSSs. It also indicated there is a positive correlation between eye fixations and memory and a negative correlation between saccade amplitude (average distance between two fixations) and memory.

#### GDD( $n_1+n_2$ , 3; $\lambda_1$ , $\lambda_2$ ) WITH EQUAL NUMBER OF BLOCKS OF TWO CONFIGURATIONS

Blaine Billings

Governor's School for Science and Math

Mentor: Dr. Sarvate; Department of Mathematics, College of Charleston

A GDD( $n_1+n_2$ , 3;  $\lambda_1$ ,  $\lambda_2$ ) is a group divisible design with two groups of sizes  $n_1$  and  $n_2$  with block size 3 such that each pair of distinct elements from the same group occurs in  $\lambda_1$  blocks and each pair of elements from different groups occurs in  $\lambda_2$  blocks. We prove that necessary conditions are sufficient for the existence of group divisible designs GDD( $n_1+n_2$ , 3;  $\lambda_1$ ,  $\lambda_2$ ) with equal number of blocks of configuration (1,2) and (0,3) for  $n_1+n_2 \leq 20$  and in general for  $n_1=1,2,4$ ,  $n_2-1$  and  $n_2-2$ . We also give near complete results of  $n_1=3$ .

#### EASY STEP SHOES: SHOES THAT PUT THEMSELVES ON

Kayla Blankenship and Paul Keeler

Center for Advanced Technical Studies

Stable orthopedic shoes are a necessity for elderly people and those with circulatory problems. However, many orthopedic shoes are difficult to put on due to complications induced by the health issues of these groups. Previous research has concluded that between 60% and 80% of patients prescribed with orthopedic shoes cease use of their shoes after six months of having had them. The top three reasons for this occurrence are the discomfort of the shoes, the undesired appearance of the shoe, and the inability to physically put on the orthopedics. In order to fix this, a shoe can be made that is easy for people to put on without the need to sit or bend over.

#### CONTAMINANT LOADS IN BLACK AND TURKEY VULTURES OF THE SOUTHEASTERN UNITED STATES

Ashley Boone

Governor's School for Science and Math

Mentor: Dr. Beasley; Savannah River Ecology Laboratory, University of Georgia

Vultures play a key role in the ecosystem worldwide, and serve as top-level consumers. Analyzing the contaminants present within vulture populations as a whole can serve as a baseline guide as to what is in the environment and what is affecting the wildlife within. Blood and feathers were collected from 295 vultures and analyzed for heavy metal loads including lead, mercury, and arsenic. These results were then compared between samples as well as between species. Black vultures (*Coragyps atratus*) showed significantly higher contamination levels than Turkey vultures (*Cathartes aura*), which was expected. Also, contamination levels in the feather samples were much higher than that of the blood samples, which was also expected. However, the degree to which these values differed was very surprising. Some vultures showed lead and mercury intoxication levels synonymous with death, but were living completely normal lives. Using vultures as an environmental sentinel to show what contaminants are presently affecting the ecosystem is important in many ways, especially regarding conservation efforts. Vultures are going extinct worldwide due to ecosystem contamination, and looking at and interpreting this data will aid in efforts worldwide to reduce contaminant load within the ecosystem.

#### EFFECTS OF THROMBIN AND BRADYKININ ON ASTROCYTE REACTIVITY

Savannah Bradley

Governor's School for Science and Math

Mentor: Dr. Turgeon; Department of Neuroscience, Furman University

During a spinal cord injury (SCI), the nervous system enters a state of disarray with the formation of glial scars and a loss of neurons, which can damage an axon's ability to repair or regenerate. This damage creates a hostile environment for the cells. In addition, astrocytes will become reactive during this time. In normal SCI research, the mixture of cells are removed from their hostile environment then filtered to examine a specific cell type. This analysis has revealed that the axons are actually able to regenerate and regrow. Furman's research includes an analysis of the effects of thrombin, a protease responsible for cleaving fibrinogen into fibrin, on axon regeneration in mixed cell cultures. At low doses, thrombin can be shown to stimulate outgrowth and proliferation in astrocytes. At high doses, it is known to kill astrocytes. (Vaughan, 1995) To understand more about the results of thrombin on astrocyte growth and shape, cells were exposed to hostile and controlled environments. To induce a hostile environment on astrocytes, 19  $\mu$ l of thrombin (2.12  $\mu$ M) and 40  $\mu$ l of bradykinin (1  $\mu$ M), an inflammatory mediator produced during a SCI, were added to the wells. They were then examined at different times to monitor the astrocyte response. The results indicated that thrombin and a mixture of bradykinin and thrombin result in a clear increase in astrocyte reactivity.

## THE EFFECT OF HEAVY METALS ON BACTERIA GROWTH

Riley Branham  
Chapin High School

I will be looking at the growth of bacteria that are resistant to heavy metals when they are introduced to Zinc, Cadmium, or Copper. The bacteria being used are ME4, ME6, CB15, AVE, and DS20. High levels of heavy metals can harm the environment. If these bacteria are able to grow in the presence of these metals, they would provide an option for bioremediation. I am continuing the research of Bianca, a biomedical engineer at USC. The knowledge obtained from this experiment could help us preserve our environment by identifying helpful bacteria to regrow environments as a result of environmental disasters.

## THE OPTIMAL LENGTH AND FREQUENCY OF PRACTICE IN MASTERING THE GUITAR

Jake Breland  
Chapin High School

This study will attempt to draw a correlation between frequency of practice session and progress made playing guitar. For this project, a survey will be issued to the existing beginner guitar class at Chapin High School to discover existing practice habits and experience for potential participants. Each participant will be given a song and a practice schedule to follow for a week. They will all be given a song of the same difficulty but will receive a practice schedule that varies in frequency of practice session. After a week, participants will play the song assigned and progress will be measured based on how well they perform. Preliminary survey results suggest that more experienced participants practice longer and more frequent than less experienced guitarists. Results of this study are important because it will allow newer guitarists to know the practice schedule which will yield optimal results. Not only would these results assist new guitarists, but it would also allow guitar teachers to combine already confirmed techniques with a practice schedule that they know will be effective for their students.

## CAFFEINE'S EFFECT ON LONG TERM MEMORY

Philip Brewer  
Heathwood Hall Episcopal School

This study's purpose was to determine if Caffeine has any effect on long term memory. The materials used were 35 different pictures, human consent forms, and pre-survey forms. The study was done through showing each test subject 20 pictures and then adding 15 new and similar photos to the group after two hours and testing to see how many photos the test subjects answered correctly as new similar or old. The two groups of people consisted of 20 non caffeine drinkers, and 20 caffeine drinkers. The results of my study show that there was not a significant enough difference between the data of the two groups to prove that it was because of the caffeine. In conclusion, The results supported my null hypothesis that, if someone drinks at least 2 cups of coffee/caffeinated beverages, then they will not answer photos more accurately than those who do not drink caffeine.

## SECONDARY TEACHERS' PERCEPTION ON THE EDUCATIONAL USE OF SOCIAL MEDIA: A QUALITATIVE STUDY

Raegan Brizek  
Chapin High School

The penetration of different social networking platforms and tools is increasing rapidly among Internet users across the world. Given the dynamic and rapidly evolving nature of online education and social networking, it is felt that there is a need for further research into different issues that may act as encouraging factors, or barriers to, the use of SMSs (Social Media Sites) as educational tools. Rapid increase in the use of mobile computing devices, especially among the youth, has opened up new opportunities for imparting education. Sites such as Twitter, Facebook, and YouTube have the ability to create a different learning environment for students in this day of age. Being a qualitative study, teachers will be observed and surveyed to determine the attitude of teachers towards the use of SMS tools and platforms in online education. One on one interview will be scheduled with the English teachers to gather a more thorough response. The results will be recorded and coded to reflect the original hypothesis, can new opportunities for imparting education online be created by the understanding and acknowledgment of English teachers within the classroom. Responses that have certain 'flair' to them such as negative, positive, neutral, and questioning will be evaluated. Relating these responses to teacher demographics will also help understand the test group while keeping their confidentiality. Determining the resistant factors that affect the studies goal will be conducted with teachers within Chapin High School, where the researcher is located.

## K-12 ROBOTICS PROGRAMMING CURRICULUM DEVELOPMENT AND ASSESSMENT

Grace Brueggman  
Governor's School for Science and Math  
Mentor: Dr. Kantor; Robotics Institute, Carnegie Mellon University

Due to the growing fields in Science, Technology, Engineering, and Mathematics, (STEM) it is ever more important to educate youth in these subjects to prepare them for the workforce. However, teaching the subject of robotics is difficult because of the depth and breadth of knowledge required to comprehend it. Previous research has shown that hands-on experience is



effective, but when used in conjunction with lectures and written instructions, three learning styles (auditory, visual, and experience) are utilized and maximum efficiency of learning can be reached. If the ultimate goal of educating youth in robotics is to encourage them to pursue a career in STEM, then not only does a robotics education need to increase student's competence in robotics, but increase their confidence in their understanding and maintain or improve their feelings towards STEM as well. The purpose of this study was to determine the effects of lectures, hands-on experience, and written instructions on the three categories of knowledge, confidence, and attitude towards STEM. In order to conduct this experiment, a two week long camp for Chinese high school students, was held in which a survey was taken at the beginning and end of the camp, assessing the students in the three categories. The hypothesis was that students who attended the camp would improve in all three categories after two weeks of instruction, regardless of any prior robotics experience. It was found that 100% of the 17 students in the camp improved or remained the same in each of the categories.

#### MITIGATION OF LANDFILL GAS BY DONATING EDIBLE FOOD WASTE TO CHARITY

Camille Bryant  
Center for Advanced Technical Studies

The objective of this study is to determine if diverting edible the food waste of grocery stores from landfills have a significant impact on the amount of methane gas produced by landfills. Currently, 14% of American households are food insecure while 40% of all the food produced within the United States is sent to the landfills. The large amount organic material in landfills results in large amounts of methane gas entering the atmosphere, which has 25 times more global warming potential than carbon dioxide. / Five landfill profiles were constructed with respective retail food amounts of 100%, 75%, 50%, 25%, and 0%. The profiles are contained in flasks connected with tubing to inverted graduated cylinders filled with water so that as the gas enters, it pushes the water down and the gas can be measured by subtraction. Each trial will run for about a month and there will be at least 3 trials. The data will be collected every other day and will be recorded and reported as change-over time. It is anticipated that in each trial, that amount of produced will be less for profiles with smaller amounts of food inside. The tests will be done at the Center for Advanced Technical Studies in Chapin. /

#### PH NEUTRALIZATION AS A MODEL FOR AN ELECTROMECHANICAL PANCREAS

Davis Buchanan and Jim Blair  
Heathwood Hall Episcopal School

A robotic monitor's ability to also pump insulin, while simultaneously monitoring blood glucose levels is the principle of this experiment. Type I diabetes affects over twenty-nine million people in the United States alone, and is the seventh leading cause of death among Americans. Future treatment models look to improve the lives of the close to ten percent of Americans affected by Type I diabetes. First, a model was constructed, and for the purpose of this experiment baking soda was used to represent insulin, and a vinegar solution represented blood glucose. It was hypothesized that the model's shut-off time and initial pH of the vinegar would have no correlation with the final pH. Different vinegar solutions of different acidities were neutralized by the model using the same baking soda solution, and would shut off on its own when the model seemed to be neutralized; the time and initial and final pH of each solution were recorded. The hypothesis was correct, because inferential statistics showed that there was no correlation between time and final pH and initial pH and final pH.

#### DEVELOPING A LOW-COST TEMPERATURE CONTROLLER USING A RASPBERRY PI MICROCONTROLLER

Garrett Buchmann  
Governor's School for Science and Math  
Mentor: Dr. Lauterbach; Department of Chemical Engineering, University of South Carolina

Most lab grade temperature controllers cost hundreds of dollars, while this project resulted in a design with the same capabilities and accuracy that can be built for less than one hundred. This project used the Raspberry Pi, a low cost, credit card-sized computer that was created by a nonprofit organization in the United Kingdom to help teach people around the world about computer science and electronics, to design a replicable temperature controller for controlling lab oil baths. Both the hardware and software for the controller were designed during this project. Raspberry Pi uses a Linux-based operating system, and the script for the actual controller functions was written in Python using the IDLE development environment. A Raspberry Pi unit was used for the computer processes, while a Texas Instruments temperature relay and thermocouple were used to measure and interpret the temperature of the oil bath. The controller designed in this project was able to maintain a temperature with a 1-degree Celsius oscillation about the set temperature, which is equal to the precision of the commercial controller, and was also able to function effectively at the complete temperature range of the commercial controller. The results of this testing show that the Raspberry Pi controller designed in this project can provide the same functionality as the commercial controller, and can be produced at less than one third of the cost.

CAN AN ANTACID TABLET LIKE TUMS OR ALKA-SELTZER BE USED TO NEUTRALIZE ACIDIC SOIL,  
AND DOES ONE WORK MORE EFFICIENTLY THAN THE OTHER?

Caroline Bunch  
Heathwood Hall Episcopal School

The purpose of this project was to study the effect of acid rain on Wisconsin Fast Plants (*Brassica rapa*), and determine whether or not an antacid tablet like Tums or Alka-seltzer could be used to neutralize the pH level of the soil once the acid rain had been added. In order to perform the experiment, there were five groups of Wisconsin Fast Plants (*Brassica rapa*) set up, one with plain soil and regular water (9 plants), one with plain soil and acid rain (6 plants), one with Alka-seltzer and plain water (15 plants), one with Alka-seltzer and acid rain (15 plants), one with Tums and plain water (15 plants), and one with Tums and acid rain (15 plants). The groups that needed it were watered with acid rain, which contained distilled water and about 13 drops of sulfuric acid, every third day, and data was taken on the same days using a Kelway pH meter. The qualitative results of this experiment showed that the antacid tablet Tums was able to neutralize the soil pH, but the plants' appearances were notably less verdant than those of the controlled group. The Alka-seltzer groups had no plant growth, therefore they cannot be compared to the other groups (though their soil pH levels were significantly lower than the other groups').

ANALYSIS OF HISTORICAL DOCUMENTS THROUGH THE USE OF OPTICAL CHARACTER RECOGNITION

Eleanor Burch  
Governor's School for Science and Math  
Mentor: Dr. Saqib Bukhari; Knowledge Management, German Research Center for Artificial Intelligence

As our world enters an electronic era, it has become important to be able to quickly and easily preserve documents in an electronic format. The purpose of this project was to build upon a preexisting optical character recognition (OCR) system in order to be able to analyze and recognize the text in handwritten historical documents. The preexisting system, called OCRopus and created by researchers from the German Research Center for Artificial Intelligence in Kaiserslautern, Germany, was designed to recognize computer created documents that have a specific font and spacing between words and characters. However, historical documents are handwritten, with varied spacing between words and characters, and contain characters that no longer exist in the modern alphabet. In order to examine handwritten documents, a program was written to divide lines of text into words. While individual characters can be recognized by finding the blank space between characters, the spacing between words varies. The average spacing between words was found in order to accurately divide lines into words. In addition, the grayscale images of text were binarized into black and white images in a way that eliminated as many random marks, or noise, on the page as possible.

THE EFFECT OF RADIO WAVE EXPOSURE ON THE RATE OF GROWTH OF VEGETATION

Roscoe Burk-Moody  
Heathwood Hall Episcopal School

The purpose of this experiment was to determine the effect that long-term radio wave exposure could have on the growth rate of vegetal organisms. The specimens used in this experiment were *Brassica rapa*, or Wisconsin Fast Plants. A Samsung mobile phone was set to stream constantly throughout the trials, providing the EM waves used for study. The independent variable for this study was ..... The dependent variable was ..... The hypothesis was if..., then .... Three trials were included in this experiment. The first trial involved Wisconsin Fast plants that were placed in direct exposure to a constantly streaming mobile device. The second trial placed the Fast Plants a longer distance away from the radio wave emitter. The third and final trial focused on the specimens surrounded by tinfoil, unexposed to the EM signals being emitted by the device. In all three trials, the *Brassica rapa* were placed in similar environments, with identical temperatures, light, water supplies, and soil. Their height, in mm., was recorded by day for one week. Afterwards, the data was interpreted into position vs. time graphs. After being cut and dried, the aboveground biomass of each specimen was also recorded at the end of the experiment. It was found that both the growth and germination rate of the *Brassica rapa* was much higher in an environment unexposed to the mobile device. The aboveground biomass showed no noticeable tendencies. These results supported (?) or did not support (?) the hypothesis.

THE EFFECT OF COLORED LIGHT EXPOSED TO RHODOMONAS SALINA ON ITS GROWTH /

Christina Byun  
Dutch Fork High School  
Mentor: Tammi Richardson; University of South Carolina

Phytoplankton play a vital role in our ecosystem because they serve as the foundations of the aquatic food web and also produce 50% of the global oxygen through photosynthesis. Phytoplankton growth is affected by factors such as temperature, light, and nutrient availability; however the color of light exposed to the organisms also affect phytoplankton growth because specific pigments absorb and use specific colors of light to photosynthesize. Depending on the factors affecting the environment around the phytoplankton, the color of light emitted in the water can change. The cryptophyte species *Rhodomonas salina* contains the light-harvesting pigment phycoerythrin, which successfully absorbs blue light but fails to absorb red light well; therefore, *R. salina* grows and photosynthesizes more efficiently in environments that reflect red light because phycoerythrin is able to absorb red light effectually and use it to photosynthesize and grow. If the color of light

exposed to the *R. salina* species is changed from the color of light exposed in natural ecosystems, they will be able to adapt to the new environment due to their fast growth rate. /

#### CLUSTERING GENE CELLS USING HIERARCHICAL CLUSTERING

Kaitlyn Campbell

Governor's School for Science and Math

Mentor: Dr. Luo; School of Computing, Clemson University

Over the years the amount of genetic data that needs to be analyzed has increased. With all this extra data, faster and more efficient algorithms are needed to process it. The Dynamically Growing Self Organizing Tree (DGSOT) algorithm, a Java program published in 2004, is one of the many algorithms used to group genes using a method called hierarchical clustering. The goal of this algorithm is to overcome the drawbacks of other clustering algorithms. The research goal for this project is to test the DGSOT algorithm on multiple well-known datasets to determine its accuracy and efficiency. The algorithm was run on several sets of data, containing genetic data from different cell types. The algorithm clustered the data into anywhere from ten to twelve clusters, showing a similar number of clusters as the Shared Nearest Neighbor (SNN) and Locality Preserving Projection (LPP) algorithms. Using the number of clusters, the Adjusted Rand Index (ARI) was calculated. The ARI is a commonly used clustering validation program that returns a number less than one. As the ARI value gets closer to one, the accuracy of the algorithm is shown to be higher. Despite the similar number of clusters, the DGSOT algorithm was shown to be the least accurate of the three that were tested due to the significantly lower ARI value.

#### THE EFFECT OF WEATHERING BULLETS ON THE CONCENTRATION OF LEAD IN RUNOFF BY BRAND

Sally Cannon

Seneca High School

Mentor: Ethan Cox; Seneca High School

The purpose of this experiment is to determine if the lead concentration in runoff water from ground with weathering bullets is significantly different between different brands of bullets. To determine this, two samples of three major brands of bullets were shot and collected, then a simulation of weathering takes place using acid on these and two control samples, and runoff water from the soil samples of the weathered bullets is tested for lead concentration. Afterwards, the data is analyzed to determine if there is significant difference in lead concentration between brands. This experiment is still in progress, and no results have been achieved yet. The experiment matters because the recent push for protection against lead poisoning due to lead in bullets could lead environmentalists to require that outdoors men and women consider the most environmentally friendly brand of bullet to use when hunting.

#### THE EFFECT OF A USER'S FIRST PROGRAMMING LANGUAGE ON THEIR ABILITY TO PROGRAM OVERALL

Preston Carlton

Spring Valley High School

The purpose of this experiment was to determine whether or not a programmer's first programming language had an effect on their interpretation of the language. It was hypothesized that the users learning Javascript would perform better on the final test than those that learned Ruby or Python. This was tested by using Codecademy.com to teach all of the 30 subjects the languages randomly assigned to them. After taking a few weeks to learn the languages, the subjects were then given a final test that was formatted the same but had different questions for each language. An analysis of variance (ANOVA) test was run at an alpha value of 0.05, and it was found that a user's FPL did not have an effect on their ability to program. The p value (0.547) was greater than the alpha, thus suggesting there is no significant difference between the means. This greatly helps the computer programming world, because it tells us that there is no need to worry so much over what programming language someone learns first, as it has no significant effect on what they will be able to learn, or what is easier for them to learn.

#### THE EFFECT OF TARTRAZINE AND ALLURA RED ON SACCHAROMYCES CEREVISIAE METABOLISM

Tyler Carnes

Dutch Fork High School

In America in recent years, consumption of tartrazine and allura red food dye, also known as red 40 and yellow 5 food dye, has reached an all time high. These dyes have been known to affect the metabolism of vitamins like B6, which results in less of the nutrient available for use. This gives reason to believe that they could affect the metabolism of yeast cells. In this study, tartrazine and allura red food dye will be introduced to multiple yeast cell colonies to observe their effect on the difference in metabolism of the colonies. The predicted results of the study will show that both dyes will cause an increase in the metabolism of the cell colonies, just as the dyes do to the metabolism of vitamin B6. This predicted increase in metabolism is critical to humans because it could lead to the development and spread of more diseases and infections.

## DELIVERY OF O6-BENZYLGUANINE AND CAFFEINE VIA PH-RESPONSIVE, FUSOGENIC LIPOSOMES INTO BRAIN TUMOR CELL LINES

Crystal Carpenter

Governor's School for Science and Math

Mentor: Dr. Broome; Department of Radiology and Radiological Science, Medical University of South Carolina

Glioblastoma are incurable brain tumors that contribute to 40-67% of primary brain tumors. The current treatment for glioblastoma is temozolomide which prevents replication of glioblastoma DNA. Delivery of chemotherapy drugs to glioblastoma is an issue because of rejection by the immune system due to the blood-brain barrier along with the buildup of resistant tumor cells due to expression of methylguanine DNA methyl transferase (MGMT), an enzyme that repairs DNA. The aim of this research is to create novel fusogenic, pH-responsive liposomes containing either O6-benzylguanine, an MGMT inhibitor, and/or caffeine, a natural stimulatory compound, which can be delivered and internalized into brain tumor cell lines. The liposomes were self-assembled with caffeine or O6-benzylguanine and four varieties of lipids and tagged with Dylite 755 and Dylite 680. These liposomes were then sized through UV-Visible spectroscopy, Dynamic Light Scattering indicated fluorophore attachment, and zeta potential analysis indicated charge of the liposomes. Two glioblastoma lines, U87 MG (MGMT-) and LN229 (MGMT+), were cultured on coverslips overnight and treated with 0.5  $\mu\text{M}$  of O6-benzylguanine liposomes for various time points up to twenty-four hours, and this was repeated with 0.5  $\mu\text{M}$  of caffeine only and 0.5  $\mu\text{M}$  of both caffeine/O6-benzylguanine. Fluorescence microscopy of the slides showed an increase in uptake with time. Quantitative analysis showed that LN229 cells are more efficient in uptake than U87 MG cells. Results also indicated that the larger, more negative liposomes had less cellular uptake. Potential future directions include a pH-stability assay and varying the concentration of liposomes.

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

Elizabeth Carpenter

Governor's School for Science and Math

Mentor: Dr. Chosed; Department of Biology, Furman University

Parkinson's disease (PD) is a neurological disorder that affects dopaminergic neurons in the midbrain, which causes loss of motor control and muscle spasms in afflicted individuals. Post-mortem examinations of the brains from PD patients yield large aggregates and oligomers of the protein alpha-synuclein within these neurons. These alpha-synuclein aggregates lead to the atrophy of the affected neurons causing the loss of motor control in patients. To investigate possible pathways that can reduce the levels of the alpha-synuclein protein and its aggregated state, a model using *Saccharomyces cerevisiae* was designed. One pathway we explored was the ubiquitin-proteasome pathway to determine how alterations of this pathway affect levels of alpha-synuclein. We treated alpha-synuclein expressing yeast with MG132, a proteasome inhibitor, and with PR619, a deubiquinating enzyme inhibitor, to determine if the levels of alpha-synuclein differed from control PD yeast. Results indicated that the levels of alpha-synuclein were altered when treated with the inhibitors implicating the enzymes of the ubiquitin-proteasome pathway in alpha-synuclein regulation. These investigations will help elucidate possible measures that could be taken to prevent the buildup of alpha-synuclein in people suffering from PD.

## HIGH SPEED 3D IMAGING WITH TWO-PHOTON LIGHT SHEET MICROSCOPY

Christopher Chaplin

Academic Magnet High School

Mentor: Dr. Tong Ye; Clemson/MUSC

The current image speed of multi-photon microscopy is not enough for fast biological processes such as molecular diffusion, so improvements were made to existing optical designs. Two-photon microscopy and light sheet fluorescent microscopy were combined and used to create the two-photon light sheet microscope which offers optical sectioning at a much faster speed than previous designs. The capabilities of the microscope were used to perform the first three-dimensional Fluorescent Recovery After Photobleaching experiment, as well as image cardiomyocyte spheroid cells. The microscope is shown to be the fastest method for imaging fast biological processes in three-dimensions.

## COMPARISON OF SVD AND FFT IN IMAGE COMPRESSION

Vinita Cheepurupalli

Spring Valley High School

Mentor: Dr. Naima Naheed; Benedict College

Image compression is an growing area of research that is essential for quick transmission, processing and storage of images in professional fields like communication engineering and medical imaging. While many methods of image compression exist, it is unsure which methods are more effective in having a lower distortion of the image. In this experiment, Singular Value Decomposition (SVD) and Fast Fourier Transform (FFT) were compared at various compression ratios to see which method had lower distortion. It was hypothesized that, when an image was compressed at the same compression ratio using the two methods, using the Fast Fourier Transform method would result in a lower distortion rate compared to using the Singular Value Decomposition method. The images pelicans.tif, wombats.tif, twins.tif, pumpkins.tif, newborn.tif, iguana.tif, and flowers.tif were tested with the two methods using the software MATLAB 7.0. Different singular values (for the Singular

Value Decomposition method) and different threshold values (for the Fast Fourier Transform) were selected such that a range of distortion was recorded. The distortion of images when applying Singular Value Decomposition and Fast Fourier Transform was compared with a t-test at  $\alpha = 0.05$ , and the data supported the hypothesis that the Fast Fourier Transform method would have lower distortion rates. In fields where image compression is used, the Fast Fourier Transform method would be more effective in compressing images and reducing distortion.

#### THE EFFECTS OF STROMAL CELLS ON TUMOR CELL GROWTH UNDER LOW OXYGENIC CONDITIONS

Eric Chen  
Dutch Fork High School  
Mentor: Dr Peisheng Xu; Univeristy of South Carolina

Cancer is a major cause of death, and considerable research has been done to determine factors for its diagnosis and prognosis. As cancer tumor cells rapidly reproduce, they use up the available oxygen in an area, creating a condition known as hypoxia. Normal cells, like immune cells, are unable to tolerate this, but tumor cells continue to proliferate. Current research indicates that tumor cells are able to change their metabolism and energy production pathways to cope with hypoxia. However, research also indicates that stromal cells interact closely with tumor cells, with potentially significant consequences that may affect their survival. My project shows that under hypoxia, tumor cells survive better when cocultured with their associated fibroblasts than when cultured alone. Fibroblasts, on the other hand, did not undergo noticeable change. This suggests that interactions between the cells significantly affected the tumor cells' ability to withstand hypoxia. Future research will identify this interaction, and ultimately eliminate it to make tumor cells more sensitive to treatments.

#### EVALUTATING CP-VIOLATION IN THE B-MESON DECAY MODE

Jeffrey Chen  
Governor's School for Science and Math  
Mentor: Dr. Purohit; Department of Physics and Astronomy, University of South Carolina

It has been postulated that there were equal amounts of matter and anti-matter during the creation of the universe. This matter and anti-matter annihilated together to form pure energy (photons), but not all of the matter was annihilated into photons, which resulted in the predominance of matter over antimatter in the universe. A study of CP-violation, the violation of the combination of charge-conjugation symmetry and parity symmetry, can be used to understand this phenomenon. However, CP-violation is very difficult to detect due to its rare occurrence, approximately 0.1% of interactions, and the presence of background noise during detection. In my research, I created a decay simulation using a fraction of the B-meson decay mode, whose data was obtained from the Belle Detector at the asymmetric positron-electron collider KEKB in Japan. The objective was to determine the number of events required to yield a definite distinction between the decays of the B<sup>+</sup> and B<sup>-</sup> mesons by using relativistic Breit-Wigner distributions. Through statistical fits to the resulting data, the experiment found that it takes approximately 15000 events to reliably determine an occurrence of CP-violation in the decays of charged B-mesons. An additional simulation was run to detect CP-violation in a different, arbitrary decay mode, but it did not prove to be a valid method.

#### THE EFFECTS OF BACTERIAL GROWTH IN LIQUID MAKEUP FOUNDATION VS THE BACTERIAL GROWTH FROM THE FOUNDATION BRUSH APPLICATOR ON PIG SKIN

Flinn Christian  
Heathwood Hall Episcopal School

The purpose of this experiment was to determine if there was a difference between the bacterial growth on pig skin with liquid foundation applied and the bacterial growth on pig skin with nothing applied. This is important because people, mostly women, use foundation to complete their daily makeup routines or to cover up blemishes and it can keep acne from healing. The hypothesis of this experiment was the pig skin with foundation applied using the foundation brush applicator would produce more bacterial colonies than the pig skin with foundation applied using sterile swabs and the control experiment. Out of three trials, trial one was a control experiment with no foundation applied to the pig skin. Trial two included the foundation being applied to new pieces of pig skin using sterile cotton swabs. Trial three included the foundation being applied to more pieces of pig skin using a foundation brush. After waiting twenty four hours petri dishes were swabbed with what was on the pig skin. The pictures from the second group of dishes were uploaded to a computer and Imagej software was used to count the number of bacterial colonies in each of them. Data was analyzed in Minitab where an Anova test was run. The results showed there was a significant difference in the amount of bacterial colonies from the foundation coated pig skin and the pig skin alone; therefore, the hypothesis was not supported. Future research could be done by testing different foundations such as powder or cream.

#### THE EFFECTS PSYCHOLOGICAL PRIMING ON HIGH SCHOOL STUDENTS' COGNITIVE FUNCTIONS

Jessica Cole  
Chapin High School

This study is focused on the effects psychological priming has on academically gifted juniors and senior high school students, as it pertains to their cognitive functions. Psychological priming is the environment and the information the students are given directly or indirectly which affects their mindset at a subconscious level. Prior studies have found that the subconscious

can often control not only one's mood, but also one's actions and thoughts (Bargh, J., & Williams, E. 2005). In "Brain Games", published by Cambridge Brain Sciences from Cambridge University, the study measures the student's memory, planning, reasoning, and concentration functions. When the students received no prior priming (the control group), performance in memory decreased 6.67 % , increased 1.65 % in concentration, decreased 14.70% in reasoning, and increased 32.77% in planning. When the students were "primed" a success story, performance in memory increased 44.63 %, increased 24.12 % in concentration, increased 119.58% in reasoning, and increased 99.04% in planning. This data is found by comparing the average students' change from their preliminary testing to their post testing, when priming was given. The data has also suggested the most effective way to increase cognitive functions in students is to give them an inspiring story of someone who did not let his humble beginning define the trajectory of his life. This study is significant, because finding that success stories optimize the majority of high school students leads to ways to overcome the (gender, race, age, etc.) stereotypes that hinder students' performances.

#### CLONING AND FUNCTIONAL CHARACTERIZATION OF A NEW POTASSIUM TRANSPORTER GENE FROM CREEPING BENTGRASS

John Collins

Governor's School for Science and Math

Mentor: Dr. Luo; Department of Genetics and Biochemistry, Clemson University

Plants that are more resistant to abiotic stresses such as salinity can be achieved through manipulation of their DNA and could be advantageous in agriculture. Previous studies show that the gene, AsHAK5, derived from creeping bentgrass (*Agrostis stolonifera*), appears to regulate the Na<sup>+</sup> and K<sup>+</sup> ion ratio in plants, contributing to salt tolerance. While the underlying mechanism is not entirely clear, AsHAK5 is part of the KP/HAK/KT transporter family that codes for both K<sup>+</sup> ion channels and transporters. This particular gene supposedly codes for a K<sup>+</sup> transporter that controls the uptake of K<sup>+</sup> ions from the soil; this theory will be tested through cloning of the gene and manipulation of its expression in *Arabidopsis thaliana*. The full length cDNA of the gene AsHAK5 from creeping bentgrass was sub-cloned into the binary vector PSBbarB-Ubi, to create an expression vector for AsHAK5 overexpression. The expression vector will be transformed into *Agrobacterium* for *Arabidopsis* infection by floral dip method to deliver the chimeric gene construct. Transgenic plants will be tested for the expression of the inserted gene and its impact on plant response to salt stress. Information obtained may help develop new strategy to genetically engineer crops for enhanced tolerance to abiotic stresses.

#### DETERMINING THE ROLE OF MTM1 IN GLUTATHIONE METABOLISM

Kaileigh Collins

Governor's School for Science and Math

Mentor: Dr. Outten; Department of Chemistry and Biochemistry, University of South Carolina

Mitochondria are compartmentalized into the outer and inner membranes, the intermediate space (IMS), and the matrix. It contains specific sets of proteins and mitochondrial DNA. Most of the mitochondrial proteins are synthesized as precursors in the cytoplasm and transported across the mitochondrial membranes. As the major site of cellular respiration, mitochondrion is subjected to harmful reactive oxygen species that are combatted by cellular antioxidant mechanisms comprising of Superoxide Dimutase 2 (SOD2) and Glutathione (GSH). Mtm1 is a metal carrier protein in model eukaryote *S. Cerevisae* that is reported to activate mitochondrial SOD2. The mitochondrial glutathione pool comprises 10-15% of the cellular glutathione and is derived from the transport of cytosolic glutathione across the mitochondrial membranes. While there are many studies of SOD2, not much is known about GSH and its transport into the mitochondria. Since Mtm1 is found to be involved in mitochondrial redox homeostasis, it is suspected to have a role in Glutathione metabolism. In a Wild Type BY4741 *S. Cerevisae* yeast strain, Mtm1 was deleted through Lithium Acetate transformation. Transformed and control strains were grown and a mitochondrial isolation was performed. The levels of GSH were analyzed through a Glutathione assay. When Mtm1 was deleted, Glutathione complies in the Post-Mitochondrial Supernatant (PMS). There was a decrease in levels of GSH in the mitochondria when comparing the transformed strain to the BY4741 strain. In short, Mtm1 is a carrier protein for Glutathione. In the future, Glutathione Disulfide (GSSG) will be tested for because it reduces the loss of GSH.

#### THE EFFECT OF THE INTERNAL DESIGN OF AN ABSORPTIVE MUFFLER ON CAR EXHAUST SOUND LEVELS /

Jacob Cooney

Spring Valley High School

Noise pollution in large urban or suburban areas can be associated with causing various health problems, such as hypertension, general worsened cardiovascular and mental health, and increased stress levels. Large amounts of this noise pollution can be attributed to the exhaust systems of cars. In this experiment, it was thought that comparing different designs for an absorptive muffler would yield noticeable differences in the exhaust's loudness. The inside tubes of the absorptive muffler were 1.5 inches in outer diameter and 9 inches long, and were wrapped with ¼ inch of wool to act as the sound absorbing component. The first muffler design consisted of 11 rows of 7 evenly spaced holes, each with a diameter of 9 mm. The second muffler design contained 14 9 mm x 25 mm channels , arranged in 7 rows of 2 channels. Each channel row had one 9 mm hole, also evenly spaced. In between each row of channels on this design was a row of 7 evenly spaced holes, totaling 42 holes. These two designs were tested against the stock exhaust system. Sound level measuring points were set up at two locations, point A being 6 inches from the tip of the exhaust, at a 45 degree angle, and point B being 10 feet behind the exhaust in a garage, to mimic the reflective effect of buildings in a city. The car's engine was revved to intervals of 500 rpm

from Idle (1000 rpm) to 4000 rpm, with data measurements being taken from each location. The tubes were switched out, and the same processes was repeated a total of 30 times. ANOVAs and Tukey HSD tests were conducted with  $\alpha=0.05$  for each RPM interval of the testing groups at points A and B. It was found that both experimental pipes had significantly lower sound levels than the stock exhaust, but Pipe 2 was only marginally quieter than Pipe 1, and not significantly so in most cases. Because of this, more testing is necessary to determine the most effective design of an absorptive muffler.

THE APPLICATION OF THE PRISONER'S DILEMMA IN AN ONLINE SCENARIO TO TEST ONE'S ABILITY TO TRUST  
OTHERS /  
Gabriel Corn  
Spring Valley High School

With the rise of the internet more people are beginning to rely on it. People may be more likely now to trust someone on the internet even if they had previous bad experiences. It was hypothesized that someone is more likely to change their answers based on what their previous partner chose. This research was to find if a person will continue to choose the same answer even if they are betrayed in another experience. A group of high school student were assembled and told after the project was completed they would get a reward based on how many points they earned and were told the rules to the prisoner's dilemma. They were told to fill out forms saying whether they would sell out their partner or keep quiet, and after this they were told what their partner answered. This was repeated with randomized partners nine more times, but the survey also asked if their last partner's decision affected them. A T test was completed to test how many changed their answer and what they were more likely to choose. Results indicate a significant partner changed their answer ( $M=-1.226$ ,  $SD =2.30$ ) than they changed their answer  $t(30)=-1.702$ ,  $P=0.0046$ . Showing that the participants did not change their answers as often as their partners did.

COMPARING THE EFFECTS OF NO LIQUID INTAKE VS. WATER INTAKE VS. GATORADE INTAKE ON RUNNERS  
DURING A WORKOUT  
Coleman Couick  
Heathwood Hall Episcopal School

The topic of this experiment is comparing the effects of a certain liquid intake on runners during a workout. The purpose was to test if there was a correlation between consuming no liquid, Water, or gatorade and the intensity of the discomfort felt by the runners. The mean for no liquid was 2.9, water was 2.7, and gatorade was 2.3. The standard error for no liquid was 0.277, water was 0.473, and gatorade was 0.335. The median for no liquid was 3, the water was 2.5, and the gatorade was 2. Both the no liquid and gatorade had a mode of 2, and the water had a mode of 4. The results show that the data supported the null hypothesis because there was no variance in the t-tests.

THE EFFECT OF STORAGE METHOD ON VITAMIN C LEVELS IN ORANGE JUICE OVER TIME  
Alex Cox and Mitesh Das  
Heathwood Hall Episcopal School

The experiment was designed to affect the relationship of time storage method on the Vitamin C levels in orange juice. This will show how quickly the Vitamin C in orange juice wears down, and which container a person should buy their orange juice from to get the most Vitamin C from the orange juice possible. Diluted iodine was used to find the Vitamin C levels. The graphical analysis showed that the vitamin c level in the cardboard container dropped more over time that the vitamin c level in the plastic container. The descriptive statistics showed, however, showed that there was more vitamin c in the plastic container than the cardboard container. The inferential statistics was found out that our alternative hypothesis was correct and Vitamin C levels in a cardboard orange juice container deteriorate quicker than the Vitamin C levels in a plastic orange juice container.

DIFFERENCES BETWEEN NATIONAL AND STATE LEVEL SMALL BUSINESS PROGRAMS  
Tristan Cromer  
Governor's School for Science and Math  
Mentor: Dr. Osborne; Director, Harbor Entrepreneur Center

I performed business research to find major differences between small business programs within the state (specifically South Carolina) and small business programs that operate nationally. In order to form their businesses, entrepreneurs have basic requirements such as capital, leadership, market knowledge, networking, etc. Small business programs and incubators serve to help and provide new companies with these essentials. After extensive research and analysis, state programs appear to focus on educating entrepreneurs through seminars and mentors, giving them the necessary knowledge to run a business. On the other hand, national entrepreneur programs focus on investing money into businesses through grants, venture capital, angel investors, and loans. What I did provides a basis for further research into entrepreneurship and programs revolving around small business. The difference between national and state business programs shows that education and capital are two major needs of entrepreneurs. In order to make the small business programs operate with a maximum efficiency, the most vital requirement for an entrepreneur needs to be determined. More in-depth research can be done to determine which type of small business program is the most effective. Once done, these programs can be designed around this requirement,

allowing for an overall better entrepreneurial environment and industry. The goal in this research was to create a base for further questioning that will help improve the economy through entrepreneurship.

#### AMPLIFYING CALCIUM/CALMODULIN DEPENDENT PROTEIN KINASE II DELTA VARIANT 9 IN HEALTHY AND DILATED CARDIOMYOPATHY HUMAN CARDIAC FIBROBLASTS

Savanah Dale

Governor's School for Science and Math

Mentor: Dr. McDermott; Department of Medicine, Medical University of South Carolina

Human Cardiac Fibroblasts make up the majority of cells in the human heart. These cells contain Calcium/Calmodulin Dependent Protein Kinase II Delta (CAMKIID). This protein kinase it codes for is activated by a calcium modulated protein, calmodulin, and it targets calcium ion channels in heart muscle tissues, which allows the release of calcium ions that are necessary for muscle contraction. CAMKIID variants 2 and 3 have been linked to dilated cardiomyopathy in previous studies with mouse cardiac fibroblasts. Dilated cardiomyopathy is a disease in which the left ventricle of the heart enlarges, stretching the muscle and causing the heart to become less efficient; this is the leading cause of heart failure. CAMKIID variant 9 is expressed in mouse cardiac fibroblasts, but it is unknown if it is expressed in human cardiac fibroblasts, nor is it known if it correlates to dilated cardiomyopathy. We used Reverse-Transcriptase Polymerase to determine if CAMKIID variant 9 is expressed in human cardiac fibroblasts. We hypothesized that CAMKIID variant 9 would be expressed in the human cardiac fibroblasts. CAMKIID variant 9 was expressed in both healthy human cardiac fibroblasts as well as in human cardiac fibroblasts affected by dilated cardiomyopathy. Knowing that CAMKIID variant 9 is expressed in cardiac fibroblasts will facilitate future research to determine its role in the development of dilated cardiomyopathy.

#### STUDY ON THE DISTILLATION OF WATER VIA THE USE OF SEMI-PERMEABLE MEMBRANES

Noah Dammers

Governor's School for Science and Math

Mentor: Dr. Huang; Department of Mechanical Engineering, University of South Carolina

Water distillation is a high-energy process requiring expensive machinery and large amounts of capital to create facilities. Because of the high costs of distillation, research was conducted on membranes consisting of cellguard pp2068 and hydrophobic carbon cloth. These filters require less complex infrastructure to put in place making them cheaper. In this experiment water was heated on one side of the membrane, water vapor passes through but liquid water cannot. Due to this property water was to be distilled to a high quality but low energy input in total compared to reverse osmosis. Salt water was heated on one side and the output was collected on the other for an hour per test. On average 5.5 millimeters were collected and there was appreciable salt rejection by the membrane meaning it was very efficient at contaminant rejection.

#### THE EFFECT OF TRISPRINTEC AND METFORMIN AND THEIR DOSES ON THE MORTALITY AND REPRODUCTION OF AMPULLARIIDAE, DAPHNIA MAGNA, AND LEMNOIDEAE & THE HEART RATE OF DAPHNIA MAGNA IN AQUATIC ECOSYSTEMS

Sarayu Das

Spring Valley High School

In recent years, an increasing level of pharmaceuticals has been detected in rivers and streams. The purpose of this experiment was to test the effect of two of the most common drugs found at the Congaree National Park in South Carolina, metformin and tri-sprintec, on three prevalent aquatic species, snails (Ampullariidae), plants (Lemnoideae), and fleas (Daphnia magna). This experiment was done in two stages: phase one to study the effect of pharmaceuticals on the organisms and phase two to find the maximum threshold of pharmaceuticals affecting the lifespan of these species. It was hypothesized that when the dosage of pharmaceuticals increased, the Daphnia magna would experience increased heart rate, and the mortality and reproduction of these organisms would be negatively affected. This was achieved by placing the organisms in separate habitats, and three different doses of tri-sprintec and metformin were gradually added to their environments over three weeks. An ANOVA test of  $F(2,8)=15.88$ ,  $p=0.002$  for the heart rate of Daphnia magna and a linear regression t-test of  $R(3)=0.97$ ,  $p<0.01$  for the natural increase rate (NIR) of Daphnia magna showed that the pharmaceuticals did have a significant impact on these organisms. Furthermore, a linear regression t-test ( $R(3)=0.88$ ,  $p<0.04$ ) was run for Lemnoideae with metformin, and indicated that increased doses of pharmaceuticals did have a greater impact on the organisms. A brochure was circulated throughout neighborhoods to bring awareness about the best practices of disposing unused pharmaceuticals. This community outreach was a success and the researcher plans to continue conducting classes to the public and achieving the full potential of this experiment, thus reducing this environmental problem at the source.

#### DESIGN AND SYNTHESIS OF A NOVEL LSD-1 INHIBITOR AS A POTENTIAL ANTI-TUMOR AGENT

Frances Davenport

Governor's School for Science and Math

Mentor: Dr. Woster; Department of Drug Discovery and Biomedical Sciences, Medical University of South Carolina

Compound C1 successfully occupies the enzyme pocket of Lysine-specific demethylase (LSD1) and prevents the demethylation of histone tails. Histone demethylase causes tumor suppressor genes to be turned off. For this reason, LSD1 inhibitors show



potential as antitumor agents. Many of the currently known LSD1 inhibitors are poor drug candidates. The purpose of this study was to create a derivative of a known LSD1 inhibitor that is both more active than the original and soluble in water. These properties will allow the compound to be used for tumor-suppressing drugs.

#### THE EFFECT OF CHLORINE AND BLEACH ON THE COLOR INTENSITY PIG SKIN

Jaylen Davis  
Heathwood Hall Episcopal School

The purpose of this experiment is to investigate the effect of chlorine and bleach on pigskin, which is similar to human skin. This project will help people who enjoy pools, to determine the effect of commonly used pool chemicals on their skin. It is hypothesized that if chlorine reacts with pigskin to a greater extent than bleach, it will make the pigskin lighter than the other variable will. 30 samples of pig skin were cut and were measured for light intensity, using imagej. They were then placed in petri dishes, where they were soaked in the water from the chlorine pool simulation for 45 minutes. After this, they were rinsed, and their light intensity was measured. The chlorine pool simulation consisted of .0198 grams of chlorine, 1 gallon of water and .0181 grams of soda ash. The same process was repeated in the water from the bleach pool simulation. The bleach pool simulation consisted of .0189 grams of bleach, 1 gallon of water and .0181 grams of soda ash. Although chlorine had a greater effect on the color intensity, a T-test showed that the effect was not significant. This proves the null hypothesis, which is that chlorine reacts with pigskin the same as or to a lesser extent than bleach, it will make the pigskin lighter than bleach.

#### THE EFFECT THAT "CORKING" A BASEBALL BAT HAS ON THE DISTANCE TRAVELED IN THE AIR BY A STRUCK BALL WITH A CONSTANT VELOCITY

Lamar Dawkins, III  
Heathwood Hall Episcopal School

A corked bat is believed by many to give a batter an advantage over the pitcher while at bat. This theory was tested by measuring the distance that two identical bats hit the balls before and after being drilled and corked. A skeet shooter was modified to fit this need. Three identical baseball bats of same length that were made by the same company took twenty-five swings on a modified skeet shooter. When this process occurred, the bat speeds were constant as the speed of the bat was 65 mph. Each distance the ball traveled away from the tee was recorded in meters. A hole three-fourths of an inch in diameter and five inches deep was drilled through the center of the bats. Three wine corks were then pressed down into the hole. Each bat then took twenty-five swings with the distances having been recorded in meters. The data then showed that the cork did affect the ball by allowing the ball to travel 5.6% shorter than the wooden bat.

#### THE EFFECT OF SANITIZERS ON BACTERIA

Marie Charlotte Demetriades  
Heathwood Hall Episcopal School

In this study, the efficacy of gel and foam sanitizers were studied in comparison to hand soap. The purpose was to find an alternative for hand soap in everyday situations. To test the sanitizers, cleansers covered a blank sterile discs and were placed on petri dishes pre-contaminated with Streptococcus bacteria. Twenty trials, each with four sterile discs, were run for the gel and foam sanitizers, as well as the hand soap. The data showed that the gel sanitizer was more effective than both the foam sanitizer and the hand soap. Therefore, gel sanitizer should be used as a replacement for hand soap.

#### LEARNING CURVE COMPARED TO AGE IN BORDER COLLIE BREEDS

Sean Denis and Coleman Upton  
Chapin High School

It was hypothesized that the older the dog, the more intelligent it would be. Six simple tests were for each individual dog: test 1 the dog needs to get a treat from under the soup can. In test 2 the dog would have a towel over the head and is timed to see how long it can get it off. Test 3: you stand about a meter away, count 3-5 seconds, then smile and see if the dog comes towards you. Test 4 you need to see how long it takes your dog to get a treat out from under a small hand towel. Test 5 you place a treat under a small table and see how long the dog takes to get the treat. The final test you stand about 2 meters away from your dog and say random words to try to call your toward you. Each test has a point value system that you give each time. After the final test add up all the points and the dog with most points has the highest IQ. After testing 5 different Border Collies our hypothesis was proven to be partially true and partially not true. It was proved that the hypothesis was incorrect, because the oldest dog had the least amount of intelligence because he had the least amount of training. Therefore, training was actually proven to be the most significant and effective variable in intelligence.

## CREATING A SAFER SURGERY: A CHAIR FOR SURGEONS

Cookie Desai

Center for Advanced Technical Studies

With the numerous consequences and effects of standing for long periods of time, surgeons need a chair to rest in momentarily during long surgeries. Implementing a chair for surgeons during surgeries will remove the harmful effects of standing all day, enabling surgeons to perform surgeries for longer periods of times while still maintaining the range of motion and precision required to successfully complete multiple surgeries. / Once multiple sketches of a possible chair design were drawn, a single design was chosen. After sending surveys to doctors in order to poll and record the suggested attributes of the chair, various surgeries were observed to determine a more specific demographic. A computer program was used to finalize a three-dimensional design for the prototype which was then used to create a small-scale working prototype. Once the prototype design was finalized, various materials for the chair were tested to find the best material in relation to the chair. In order to test the strength and efficiency of the chair, multiple tests were conducted, including both flexibility tests and durability tests, designed to quantify the strength of the chair. Due to its small scale, the structural strength of the prototype would not accurately reflect the full-scale chair and so the durability and flexibility was scaled for the full sized chair as well. The quality of the chair when tested in surgical environments as well as the observations taken when tested were vital to the data collected and were used to improve the design.

## CANINE PROSTHETIC

Isha Desai

Center for Advanced Technical Studies

This purpose of this project is to create a prosthetic leg for a tripod canine and to create a prosthetic leg that will be best suited to create movement similar to that of a normal canine. Animal prosthetics is a growing field, as they aid as a replacement for amputated animals or aid as assistance to a deformed or mutate limb. The most common prosthetics are in canines. There are many ways to create prosthetic limbs and by finding which maker, as well as what materials that can be used, that are the most effective as well as saving patient owners hundreds of dollars. 3D printing is a new technology that is being more commonly used to substitute more expensive materials, it is not only as efficient but cheaper to create and fix mistakes. The ten day trial with the two test subjects will be done to makes sure the results are constant. Results will show which prosthetic leg created will help the tripod canine move more like a quadruped canine. / / /

## THE CORRELATION BETWEEN CORTICOSTERONE LEVELS AND TELOMERE LENGTH IN RATS

Karisha Desai

Center for Advanced Technical Studies

From the Babylonian epic of Gilgamesh to Ponce de Leon seeking the “Fountain of Youth” to the widely practiced taboo of drinking urine in middle-eastern countries, the world refuses to accept the process of aging. It was not until recently that researchers discovered the “blueprints” of aging, or in other words, Telomeres. Telomeres are the caps at the end of each strand of DNA that protect our chromosomes. Telomeres are an essential part of cells that affect how our cells age. Current research on cellular division has highlighted the significance of Telomeres in the aging process and the revealing of an individual’s molecular age. However, new studies have found that there is more to Telomere shortening and aging than cellular division such as lifestyles. Lifestyles also play a big role in Telomere shortening and a rapid aging process. Research has shown the use of tobacco and heavy drinking will results in a faster rate of telomere shortening. One lifestyle that is frequently overlooked but is responsible for consuming an individual’s lives is stress. The majority of times stress is seen as a psychological problem and often not taken seriously due to the little effect it may have on the human body. Therefore, the impact stress has on telomeres is rarely looked at which could lead to a misleading molecular age.

## GENOME 3D VIEWER: A 3D MODEL OF THE HUMAN GENOME USING UNITY 3D

Frances Dickson-Vandervelde

Governor's School for Science and Math

Mentor: Dr. Tang; Department of Computer Science and Engineering, University of South Carolina

The 3D Genome viewer is a 3D model of the Human Genome rendered using the Unity Game Engine that allows the user to manipulate the image as if going through a video game. The first versions of the viewer, completed May 2014 and May 2015 were very slow. It was proposed that the speed could be improved if a technique called threading was implemented. The times for the old and new program to render 500, 1000, and 10,000 base pairs and the new program was shown to have a significant improvement.

## THE EFFECT OF A DESICCANT-BASED DEHUMIDIFYING AIR INTAKE SYSTEM ON THE POWER OUTPUT OF A GASOLINE INTERNAL COMBUSTION ENGINE

Frederick Drescher  
Spring Valley High School

Since automobiles were first introduced to the public, consumers have been trying to make them more powerful. In the modern age of technology, there are many ways to significantly increase the power of internal combustion engines used in automobiles, but most are quite expensive. Because of this, there is always a market for low cost options for improving performance. The purpose of this study was to determine if implementing a dehumidifying desiccant system in the air intake of the engine of an automobile could serve as an inexpensive method of improving engine performance. This was tested by designing such a system for a 1994 Mazda Miata, and implementing that system with different levels of activated alumina, a common desiccant, during timed acceleration tests. The vehicle's acceleration from 2,000 r.p.m. to 6,000 r.p.m. was timed a total of 90 times. 30 times with no desiccant, 30 times with one kilogram of desiccant, and 30 times with one and a half kilograms of desiccant. It was hypothesized that one kilogram of activated alumina would give the highest power increase. The acceleration was timed by recording a video of the tachometer at  $\frac{1}{4}$  speed and using the timestamp of the video to determine the acceleration time. These values were then analyzed using a one way ANOVA test with correlated samples in order to negate any variance in the data caused by changing weather conditions over the course of testing. At  $\alpha = 0.05$ , it was found that there was a significant difference between the mean times of at least two groups,  $F(3,16) = 7.53$ ,  $p = 0.0012$ . A Tukey test was then conducted to determine and determined that the only significant difference was between the control tests and the 1.5 kg tests, with a p value of  $p < 0.01$ . Based on this, the hypothesis that one kilogram would perform the best was not supported. However, the concept of implementing a desiccant in the air intake of an engine to produce more power was significantly supported.

## ADDITIVE MANUFACTURING ON A BUDGET: BUILDING A 3D PRINTER

Mikayla Drost  
Governor's School for Science and Math  
Mentor: Dr. Hattrick-Simpers; Department of Chemical Engineering, University of South Carolina

Additive manufacturing is the process by which three dimensional images are used to create an object by using a 3D printer to build it layer by layer. The question addressed in this research was whether a student with no prior knowledge in the field of additive manufacturing could build a working 3D printer while maintaining a budget of less than \$100. Two students were given six weeks to test this hypothesis. It was predicted that it would be possible to build the working printer, and the objective became to determine the steps in the process so that other students, tasked with the same project, would be able to succeed. The original two students did build a 3D printer for under \$100 in a little longer than the original six week timeline of the project. While it was not as functional as anticipated, it did print a blob, and with more time and calibration it may be able to print better and bigger objects

## SYNTHESIS, PROCESSING AND CHARACTERIZATION OF BIOPOLYMER DERIVED CERAMICS

Nathan Dubrouillet  
Governor's School for Science and Math  
Mentor: Dr. Pilla; Department of Automotive Engineering, Clemson University

Polymer-derived ceramics (PDCs) are at the forefront of ceramics research due to their energy- and cost-efficient processing. PDCs also offer a wide array of tunable properties, as well as lower density than conventional ceramics. However, current polymers are derived from non-renewable resources. In order to improve sustainability, this work aims at producing a polymeric blend with a biopolymer as one of the constituents. Varying amounts (5 – 80 wt%) of epoxidized pine oil (EPO) were added to polyhydromethylsiloxane (PHMS) to obtain a polymeric blend. During crosslinking, the polymer foams due to the evolution of a gaseous byproduct, H<sub>2</sub>. The volumetric expansion ratio of the foamed blend was ascertained. The as-foamed polymer was characterized using thermogravimetric analysis to determine the thermolysis temperature and the ceramic yield. The as-foamed polymeric blend was thermolyzed at 1000°C, attained with a heating rate of 5°C/min for 1 hour in an inert atmosphere to obtain a SiOC ceramic. Density, open porosity, and closed porosity were determined for both the as-foamed polymer and the as-thermolized ceramic. The as-thermolized ceramic was characterized using XRD to determine the crystallinity, and SEM to determine the porosity, pore size, and pore distribution. The PDC's created in this study are now ready for further investigation, such as Raman spectroscopy to determine the presence of excess free carbon, as well as mechanical and thermoelectric properties ascertained as a function of porosity.

## THE ATTRACTIVENESS OF LIGHT WITHIN THE VISIBLE SPECTRUM TO THE BEETLE GENERA PHYLLOPHAGA, PHANAEUS, AND THE FAMILY CARABIDAE

Joshua Dunford  
Governor's School for Science and Math  
Mentor: Dr. Culin; Department of Entomology, Clemson University

The attractiveness of light to insects is an issue that affects households across America. The issue of the porch light becoming a gathering place for insects creates a nuisance for the porch owner. Three taxa of beetles are particularly attracted to the lights used in this study. These beetles; May beetles (Genus: Phyllophaga), Scarab Beetles (Genus: Phanaeus), and Ground

Beetles (Family: Carabidae), are able to be tested in order to see how insects are attracted to light, and what colors and types are the most attractive. The beetles were attracted and trapped by a light trap created by Dr. Joseph Culin out of recyclable materials. The individual traps had lights along the spectrum of visible light, 380 to 740 nm. These lights had the colors of red, orange, yellow, blue, green, and white. These traps were then used for three consecutive nights with different types of colored bulbs. The bulb types used were incandescent (25 W, GE Incandescent Bulb), fluorescent (25 W, Sylvania Fluorescent Bulb), and LED (25 W, GE LED Bulb). The objective of this experiment is to determine which type of bulb and which colors are most efficient in terms of attraction of insects, specifically with these three species of beetles. Within the scientific community it allows etymologists to infer what lights can be used within bug traps in order to obtain the greatest yield of specimen.

EFFECT OF SOIL NITROGEN AVAILABILITY ON THE PHENOLIC PROFILE OF SOILS INVADED BY JAPANESE  
KNOTWEED (FALLOPIA JAPONICA)

Clare DuVal

Governor's School for Science and Math

Mentor: Dr. Tharayil; School of Agriculture, Forestry and Environmental Sciences, Clemson University

Japanese Knotweed is an aggressive rhizomatous invasive species that alters its soil's chemistry. Phenolic compounds play an important role in the plant's aggressiveness. By breaking down the soil into separate fractions, we can determine the percentage of phenols held by each bond – free, ester, and ether. To do this, Japanese knotweed plants were collected from the Musser Farm Research Farm at Clemson University. This included samples of nitrogen treated, untreated, and unaffected soils. Samples were subjected to a series of base hydrolyses at increasing temperatures to break the strong bonds. The samples were then derivatized and analyzed using a gas chromatograph mass spectrometer. The phenolic compounds in the samples were identified using respective standards and their percentages were calculated. The percentages of similar compounds of the different samples were analyzed and compared between the treatments and fractions. Upon analysis, it was found that there is a higher concentration of ester bound phenols in nitrogen rich soil. More ether bound phenols were found in nitrogen deficient soil. Moving forward, scientists can use these findings to devise methods to restrict the soil composition of invasive species.

DOCTORS AND PHARMACISTS PERSPECTIVES ON PRESCRIPTION DRUG ABUSE

Joanna Dyches

Chapin High School

There are many problems in the medical world facing unidentified substance abuse. A main reason the problem is occurring however are the strict rules and regulations on doctors and pharmacists to ensure they do not deny patients in pain. My hypothesis is that pharmacists see more abuse patterns than doctors do via early refills. The abuse of narcotics is a prevalent issue in today's society and there needs to be a better way to more easily identify the patients abusing narcotics. This study will target human participants with suspected abuse problems by the pharmacist or doctor. Although the patient's information will be kept anonymous, the doctors and pharmacists have the right to talk to each other according to their privacy policies. The survey asks the medical professionals questions about prescribing controlled substances, how often they think the medication is abused and what they think would be a good solution to the problem from their point of view. The information gathered can help evaluate why the problem is occurring and is continuing to occur due to what the medical professionals are picking up within their work. This study shows an issue in the system regarding DHEC and HIPPA laws and presents a problem for medical professionals and limits their ability to limit the problems occurring within the medical field due to abused controlled substances by prescribed patients by proving that doctors do not see the issue as important as pharmacists throughout the answers to their surveys.

THE LINK BETWEEN A REGION'S ENTREPRENEURIAL DYNAMISM AND POVERTY

Collin Edwards

Governor's School for Science and Math

Mentor: Dr. Moore; President, NEXT Innovation Center

This research shows how an increase of vibrancy in entrepreneurship can lead to poverty reduction in an area. Entrepreneurship is important because it provides jobs and increase the amount of income that is circulated in an economy. The concept of poverty is an ever-going cycle that can only be reduced in an area and not totally eliminated. Research is conducted to develop an entrepreneurial model to help reduce the cycle of poverty. The thesis supports the idea that entrepreneurship has a direct and immediate effect on the reduction of poverty. One significant point that is highlighted is the reduction of poverty through education. It is a necessity for students to build skills to be "career-ready" and acquire jobs. Exposure to corporate America is also important in the teaching of students. The exposure will allow students to get ideas about the various careers that they can pursue. Therefore, to create jobs, there needs to be a promotion of entrepreneurship to create more opportunities. In less than a decade, Greenville has experienced tremendous growth downtown. Job have been created and, as a result, Greenville has become an attractive place to live. However, along with the growth of the city, Greenville still faces the problem of poverty. Within the vibrant city of Greenville, there are patches of impoverished areas. The solution to this underlying problem is more emphasis on entrepreneurship and education through the city of Greenville, which will spread to the rest of Greenville and eventually the state of South Carolina.

## EXPRESSION OF ST2 SOLUBLE RECEPTOR IN MC38 AND CT26 COLON CANCER CELLS

Harper English

Governor's School for Science and Math

Mentor: Dr. Marjorette Peña; Department of Biology, University of South Carolina

Colorectal cancer is the second leading cause of cancer related deaths in the United States, accounting for almost 10% of the deaths associated with cancer. The ultimate cause of death is typically liver metastasis. Survival rates drop from 90% to less than 10% within the first five years of metastasis formation. Metastasis results from signaling caused by the binding of receptors on the cancer cell. The signaling of receptors like IL1R1/ST2 in cancer cells will lead to mast cell degranulation. Interleukin-33 (IL-33), a cytokine, binds to IL1R1/ST2 receptors on the cancer cell. There are two variants of the ST2 receptor, membrane embedded ST2L and soluble sST2. If IL-33 binds to ST2L on the cell membrane, pathways are activated speeding up metastasis formation. If IL-33 binds to the soluble form, sST2 acts as a decoy receptor preventing signaling across the cell membrane. Increasing sST2 levels in CT26 and MC38 colon cancer cells may decrease IL-33 signaling and reduce the probability of metastasis. We constructed an overexpression plasmid containing sST2 cDNA under the control of a cytomegalovirus (CMV) promoter. We verified the plasmid construction by gel electrophoresis. The sST2 overexpression plasmid was transformed into the CT26 and MC38 cancer cells. sST2 transcription increased approximately 10-12 fold in transformed cells, as determined by RealTime PCR. We verified overexpression of the sST2 protein by Western blot. With a plasmid that now generates an overexpression of sST2, it can now be tested on mice to determine if the chances of metastasis formation are lowered.

## DEVELOPING ECONOMIC EDUCATION RESOURCES

Benjamin Epstein

Governor's School for Science and Math

Mentor: Dr. Morris; CEO, SC Economics

I worked with SC Economics is a statewide nonprofit organization whose goals are to stimulate and perpetuate economic education. My project focused on the financial literacy aspect of SC Economics' curriculum. There are several programs that this nonprofit provided which addressed this issue. Gen i Revolution and EverFi are both online resources that I explored. I assessed their effectiveness by comparing their curriculum to the standards set forth in the Financial Literacy Act of 2005. I sent out a survey to teachers and students who have used this product which asked if it met each of the thirteen standards. The majority stated that these online options do not address all requisite aspects. With this information, I created a new, all-inclusive, immersive project modeled after a life simulation initiative.

## DESIGNING AN ADAPTIVE UNIVERSAL HAND CUFF FOR CEREBRAL PALSY

Alexa Eyring and Kayla Shine

Center for Advanced Technical Studies

Cerebral Palsy is a congenital disorder of movement, muscle tone, or posture caused by birth injuries that affect the Central Nervous System. This disorder occurs when there is abnormal development or damage to areas of the brain that control motor function therefore it primarily affects body movement and muscle coordination. It is also defined as a neurological disorder caused by a non-progressive brain injury or malformation that occurs while the brain is developing. Cerebral Palsy inhibits the range of fine motor skills which increases the difficulty of the individual and independent feeding. The purpose of the hand cuff is to stabilize the hand with adaptive utensils. The handle of the handcuff will have counter weights which will serve as the stabilizing aspect of the hand cuff. The attachment for bendable utensils will allow the child to bend the head of the utensil at a personalized angle thus promoting independent eating. The adaptive hand cuff will also have a plastic arch that will also stabilize the hand for feeding purposes.

## LETHAL AND SUBLETHAL EFFECTS OF ELEVATED SALINITY ON THE LARVAE OF ANAXYRUS TERRESTRIS, HYLA SQUIRELLA, AND GASTROPHRYNE CAROLINENSIS

Bailey Fallon

Governor's School for Science and Math

Mentor: Dr. Welch; Department of Biology, College of Charleston

Salinization of freshwater habitats is a concern for aquatic organisms. As salt concentrations in freshwater increase due largely to anthropogenic causes, many freshwater species are becoming exposed to elevated salinity levels. Amphibians are of particular concern because their permeable skin and fully aquatic eggs and larvae bring them in direct contact with the aquatic environment. Consequently, studies investigating the effects of elevated salinity are necessary to determine the susceptibility of these species to the newly altered ecosystems. In the present study, tadpoles of the species *Anaxyrus terrestris*, *Hyla squirella*, and *Gastrophryne carolinensis* were exposed to several salinity concentrations to test the lethal and sublethal effects of such conditions. Salinities of 8 ppt (parts per thousand) and above were completely lethal for all three species. At 6 ppt, survival was diminished for all three species, though survival of *Hyla squirella* was also low at 0.4 ppt. Tadpoles of *Gastrophryne carolinensis* and *Hyla squirella* showed reduced growth at 4 and 6 ppt. *Hyla squirella* tadpoles also showed reduced activity at 6 ppt. These results suggest that salinities of 4 ppt and higher can negatively affect these

amphibian species in the tadpole stage, although individual variation exists in salinity tolerance. Consequently, salinization of freshwater habitats due to anthropogenic causes poses a potential threat to these species in their natural environment.

#### THE EFFECTS OF EMODIN ON MACROPHAGE-CANCER CELL INTERACTION

Wenxin Fan

Spring Valley High School

Mentor: Dr. Angela Murphy; University of South Carolina School of Medicine

Cancer results from mutations that cause alterations in cell function, growth and division. Malignant tumors formed of cancerous cells can lead to disruptions in systemic functions. A growing method of treatment for cancer is immunotherapy. The purpose of this study was to explore the potential of emodin as an anti-tumor treatment through modulating immune cell-cancer cell interaction. The specific mechanisms by which emodin affects cancer cell interactions were examined, including its impact on the expression of mannose receptor (MR), a protein found on the surface of macrophages. It was hypothesized that if emodin is used to treat macrophages, a lower concentration of MR would be produced in comparison to macrophages that were not treated with emodin. It was also hypothesized that if emodin-treated macrophages were applied to cancer cells, a lower number of adherences would occur. A positive correlation of higher MR concentration to higher adherence may indicate a possible mechanism behind cancer cell and macrophage interaction. Emodin concentrations of 0  $\mu$ M, 10  $\mu$ M, and 30  $\mu$ M were used to treat macrophages and real-time PCR was conducted to measure the relative expression levels of MR. An ANOVA determined that the groups were significantly different;  $F(3,8)=80.8$ ,  $p<0.05$ , and that emodin at the highest concentration significantly reduced the expression of MR on macrophages. Macrophages treated with the various concentrations of emodin were applied to cancer cells and allowed them to interact and adhere to each other. Non-adherent macrophages were subsequently washed away and the adherent macrophages were examined and counted under a microscope. An ANOVA determined that the counts among the groups were significantly different;  $F(3,156)=8.04$ ,  $p<0.05$ , and in particular, the highest emodin concentration treatment suppressed the adhesion between macrophages and cancer cells. In conclusion, the hypotheses were supported and emodin may be used as a therapy for cancer.

#### THE EFFECT DIFFERENT COLORED LIGHT WAVELENGTHS HAVE ON WISCONSIN FAST PLANTS

Julia Faulds

Heathwood Hall Episcopal School

The purpose of this project is to determine the effect different colored wavelengths have on Wisconsin Fast Plant growth. In this project, 18 Wisconsin fast plants were grown underneath four different colored wavelengths. The wavelengths tested were blue light (475 nm), green light (510 nm), red light (650 nm), and white light (400-700 nm). The plants were tested and measured until the end of their life cycle, four weeks later. In the first two weeks of the plant's life the green plants were significantly behind the other plants, they were averaging about 3 or 4 inches, while most of the plants were 6 to 7 inches. The blue plants had an average of 7.0 inches and the white plants were averaging 6.5 inches, the red plants averaging about 5.8 inches. Two weeks later the green plants measured about 5 inches. The blue plants were still about 7.0 inches and the red plants were about 7.0 inches. The white plants, were the only ones that ended up reaching 10-12 inches and they were also the only plants that flowered. In conclusion, plants grown with all wavelengths of light will show more growth than plants only using one wavelength.

#### CAPACITY DEGRADATION IN LITHIUM-ION BATTERIES

Ross Ferguson

Governor's School for Science and Math

Mentor: Dr. Onori; Department of Automotive Engineering, Clemson University

Due to increasing gas prices and the dwindling of our planet's finite oil resources, the hope for the future is to utilize electric vehicles. However, in the early transition stage of vehicle electrification, electric vehicles are more expensive than vehicles operating on internal combustion engines. Lithium-ion batteries are used because they exhibit high energy density, superior energy-to-weight ratio, and low-self discharge. However, safety issues and performance degradation due to aging related factors have become obstacles to the full market penetration of vehicles adopting this battery technology. As a result, consumers are reluctant to buy without knowing how long their investment will last. Recognizing this issue, several lithium-ion battery cells were tested in order to understand the aging of lithium-ion cells. One symptom of the aging process is capacity loss. Over time, the battery will be unable to retain as much capacity as compared to new, and eventually it becomes inapplicable. The cells underwent testing in a Peltier junction, and were subjected to different conditions of temperatures and charge/discharge that a battery would undergo in an electric vehicle. The capacity of these cells were measured once every few weeks using the Arbin BT-2000 tester attached to the Peltier junctions. This capacity is determined in ampere-hours and is visualized in MATLAB. In the end, this knowledge of capacity degradation will help give the consumers the understanding of electric vehicles for them to make an informed purchase.

## A CORRELATIONAL ANALYSIS ON THE RELIGIOUS KNOWLEDGE AND RELIGION BASED DISCRIMINATORY TENDENCIES OF ADULTS AFFILIATED WITH VARIOUS FAITHS

Taylor Ferguson  
Spring Valley High School

Religious freedom and the extent of one's religious freedom has become a highly controversial topic in recent years. The line between religious freedom and discrimination is obscure and open for debate. In this experiment, adults were surveyed to determine their level of religious knowledge/awareness of various faiths and their tendency to discriminate against others on the pretenses of their religious beliefs. It was hypothesized that more than half (50%) of the respondents would incorrectly answer the multiple choice portion and that the majority of respondents would have an overall discriminatory ranking of three. Surveys were electronically completed by 67 adults that consisted of three parts; the first being demographic questions, the second being multiple choice questions, and the third being an opinionated portion in which respondents could rank their agreeance with a statement from one to five. Neither hypothesis was supported as more than half of the respondents correctly answered the multiple choice questions and the overall discriminatory tendency rating was one. In conclusion, this sample of adults had a higher knowledge of religious knowledge with a lower tendency for discriminatory tendency.

## EFFECT OF MICROTUBULE DISASSEMBLY ON P0071 PROTEIN DISTRIBUTION IN CACO-2 CELL LINES

Kylie Fletcher  
Governor's School for Science and Math  
Mentor: Dr. Hofmann; Vascular Oncology, German Cancer Research Center

In cancer cells, malfunctions of various signaling pathways of protein interactions lead to uncontrolled cell growth. p0071 is a protein that is a member of the p120-subfamily of armadillo proteins. It has a dual localization in both adherens junctions and in the cytoplasm of epithelial cells. While the function of p0071 in adherens junctions is known, the function of p0071 in the signaling pathways in the cytoplasm is unknown. Microtubules, proteins of the cytoskeleton, are suspected to interact with p0071 in a signaling pathway. The aim of this research is to determine the interaction between p0071 and microtubules. This was achieved by destroying the microtubule network by placing the CaCo-2 cells on ice for two hours. Immunofluorescence microscopy techniques were then performed on the treated cells for the proteins CK8-18, desmoplakin, and Cingulin as controls, and alpha tubulin and p0071 as the respective independent and dependent variables. The preliminary data indicates an accumulation of p0071 around the cell borders of some, but not all, of the treated cells, whereas the untreated cells show an even distribution of p0071 throughout. This might indicate an interaction between p0071 and microtubules, but more research is needed to confirm the results. If confirmed, the relationship will allow a better understanding of the protein interactions involved in the cancer signaling pathway.

## THE EFFECT OF THE DURATION OF SONICATION ON THE ADSORPTION CAPACITY OF FOOD WASTE HYDROCHAR FOR ATRAZINE /

Jasmine Marie Flora  
Spring Valley High School  
Mentor: Dr Joseph Flora; Univeristy of South Carolina

The consumption of water that has been contaminated by pesticides and herbicides can cause people to be in danger of various health risks, such as reproductive disorders, cancers, birth defects, and cardiovascular issues. To avoid putting people at risk of these issues, hydrochar is used in soil to adsorb contaminants and keep them from entering water. The purpose of this experiment was to improve the adsorptive capacity of food waste hydrochar through sonication. It was hypothesized that sonicating food waste hydrochar for 40 minutes will be more effective in increasing adsorptive capacity than 20 minutes, 10 minutes, or 5 minutes. The hydrochar was sonicated in beakers and exposed to atrazine, a commonly used herbicide, in vials. After two weeks, the final solutions were measured for the concentration of atrazine and the adsorptive capacity of the hydrochar was calculated. The results of the mean adsorptive capacity were that hydrochar sonicated for 0 minutes was 0.22 mg/g, 5 minutes and 10 minutes were 0.25 mg/g, 20 minutes was 0.27 mg/g, and 40 minutes was 0.31 mg/g. The variation between the hydrochar was significant, as indicated by ANOVA,  $F(4,15)=54.64047$ ,  $p<0.05$ . A Tukey test indicated that there was a significant difference between the hydrochar sonicated for 0 minutes and the hydrochar sonicated for 40 minutes. It was concluded that sonicating the hydrochar for 40 minutes significantly improved adsorptive capacity, thus making the hydrochar more efficient and effective.

## THE EFFECT OF STRENUOUS ACTIVITY ON THE ELECTRICAL OUTPUT OF A THERMOELECTRIC WRISTBAND

Cody Foster  
Spring Valley High School

Society today is governed by the timeline of battery life in electronic devices. Research was done to experiment with the use of the human body's ambient energy potential as an alternative energy source in the form of thermoelectricity. The purpose of this experiment was to see which strenuous activity generates the most electric energy in millivolts (mV). It was hypothesized that jogging would generate the most millivolts. The participants wore a TEG wristband and partook in five differing activity levels. The results were sitting had a mean mV output of 6.713, walkings mean was 7.839, joggins mean was 10.383, push-ups means was 26.120, and sit-ups mean was 34.600. The variation between the activities was found significant, as indicated by ANOVA,  $F(4,110)=50.39$ ,  $p<0.05$ . A Tukey test indicated that the significant difference was between push-ups and sitting,

walking, and jogging and between sit-ups and sitting, walking, and jogging. This indicates that sit-ups and push-ups yielded the most millivolts. /

#### ASSOCIATION BETWEEN PRIVATE LESSONS AND SUCCESS IN MUSIC

Emily Franklin  
Chapin High School

Private music lessons are known for helping students improve musically, but they are often difficult to afford for the average high school music student. Since they are expensive and a time commitment, this project works to discover if lessons are actually worth the time and money, especially when it comes to how music students perform in auditions for region or state honor bands.

#### THE EFFECT OF ELECTRODE PLACEMENT ON THE DETECTION OF MUSCLE ELECTRIC POTENTIAL

Royce Frye  
Spring Valley High School

There are many people in the world who have lost limbs, and this makes life extremely difficult for them. 1.7 million people in the U.S. have lost a limb, and many prosthetics are uncomfortable, can result in muscle injury, and are expensive. In order to create a functional, less expensive, universal myoelectric hand, the placement of electrodes on the forearm cannot be critical to the detection of muscle electric potential. It was hypothesized that the placement of electrodes is not crucial to the detection of muscle electric potential. Electrodes were placed on thirty subjects of 15-16 years of age, and the muscle electric potential was measured in three different places. The Analysis of Variance test was used to find a difference between any group, and at  $\alpha = 0.10$  it was shown that there was no difference. Therefore the hypothesis that there would be no difference was supported.

#### THE EFFECT OF A NOVEL P-N TiO<sub>2</sub>/Cu<sub>2</sub>O/ITO COMPOSITE JUNCTION VERSUS A Cu<sub>2</sub>O/ITO JUNCTION CREATED USING ELECTRON BEAM EVAPORATION ON A SHEWANELLA ONEIDENSIS MR-1 POWERED MICROBIAL COUPLED PHOTOELECTROCHEMICAL FUEL CELL

Krishna Gorrepati  
Spring Valley High School

Microbial fuel cells (MFCs) show promise as a renewable energy source that can generate electricity through microbes but suffer from low power densities. A photocathode or photoelectrochemical cell is proposed to be substituted with the cathodic electrode in a MFC to create a microbial photoelectrochemical cell (MPC). It was hypothesized that a novel TiO<sub>2</sub>/Cu<sub>2</sub>O/ITO composite photocathode would provide greater voltage outputs when compared to those of a plain Cu<sub>2</sub>O photocathode developed by Qian, Wang, and Li (2010) or an ITO glass cathodic electrode. The stability of TiO<sub>2</sub> with the wide absorption spectrum of Cu<sub>2</sub>O would increase efficiency because the composite band gap setup correlates to an npn transistor and includes p-n junctions. Twenty and thirty trials were conducted for the plain Cu<sub>2</sub>O/ITO MPCs and the TiO<sub>2</sub>/Cu<sub>2</sub>O/ITO composite MPCs respectively. In each trial, the voltage output was collected every minute for one week. Using a two-sample t-Test with the means, the results indicated that Cu<sub>2</sub>O/ITO MPCs and novel MPCs were significantly different:  $t(48)=16.04$ ,  $p < 0.001$ . The novel MPC provided a 800% increase in voltage outputs when compared to those of the Cu<sub>2</sub>O/ITO MPCs and had greater Q1, median, mean, and Q3 values. Based off the results, a scalable single cell MPC prototype was produced that could generate electricity using waste from wastewater plants. As the power density of MPCs continue to increase, they can eventually become a scalable and reliable form of green energy.

#### THE EFFECT OF CURRENT LEVEL ON ANGLE OF ANKLE EXTENSION IN EUTHENIZED FROGS TREATED WITH HIGH VOLTAGE PULSED CURRENT

Robert Gradel  
Chapin High School

This engineering project is a continuation of previous research, which focused on producing a more economically attainable Functional Electrical Stimulation (FES) device for the treatment of neuropathy. The device has been redesigned to produce a waveform comparable to that of the typical high-voltage pulsed current (HVPC) waveform, which is more conducive to muscle contraction. HVPC is a means of electrical stimulation which provides high currents for short durations in order to initialize an action potential to create quick and targeted muscle contractions. The prototype reduces cost by altering the method of determining the timing of the pulse with relation to the timing of the patient's stride. It uses a microprocessor and a momentary switch to determine when to deliver the stimulating pulse. A second circuit stores high voltage in two capacitors whose discharge is toggled by MOSFET transistors used as ground switches. When the microprocessor delivers an output, the base is electrified and the connection to ground is completed. Testing and development was completed on euthenized lab dissection frogs and focused on optimizing the angle of knee extension. Based on the results of this test, it is estimated that the prototype offers a 90% discount over current solutions, while maintaining comparable functionality, thus allowing patients to affordably receive the treatment necessary.



## THE CORRELATION BETWEEN ADOLESCENTS' PHONE ADDICTION LEVEL AND ATTACHMENT TO THEIR PHONE

Wesley Hankinson  
Spring Valley High School

Mobile phone use has become very prevalent in the past few years, especially in adolescents. With this increase in usage, there is talk about the potential danger of using a mobile phone, and in some cases even becoming addicted. This study focused on two main ideas that are associated with phone use, addiction, and emotional attachment. The purpose was to gain more information about this new and fastly growing topic, and to study the effects of mobile phones on adolescents. It was hypothesized that the addiction and attachment scores would have a positive correlation. These scores were measured using slightly modified versions of the Mobile Phone Problematic Use Scale and the Consumer-Product Attachment Scale, to which the participants, aged 14 to 15 years old, answered using a 7-point Likert Scale. Seven extra questions were also added to the survey to collect more data. The addiction and attachment scores did have a positive correlation, ( $r(32)=0.742$ ,  $p=5.1 \times 10^{-7}$ ). The extra questions allowed for further observations including types of phones utilized and gender differences.

## THE EFFECT OF DIFFERENT TYPES OF OIL REMEDIATION ON THE AMOUNT OF OIL REMOVED FROM SALTWATER

Spencer Hann  
Heathwood Hall Episcopal School

This experiment evaluates the effect of various remediation methods on the amount of oil removed from seawater. The purpose of this experiment is to tell which method of remediation is best for removing oil from seawater. It was hypothesized that if bioremediation methods were used to degrade oil in Seawater, then they would perform better than non-biological remediation methods. This was tested by using *Pseudomonas* sp., *Penicillium* sp., sawdust, and perlite to remediate oil from a saltwater solution in a jar. *Pseudomonas* sp., a bacteria species, had the largest amount of oil remediated, *Penicillium* sp., a species of fungus, had the second most amount of oil removed, Sawdust remediated the third most amount of oil, and perlite came in significantly behind the others in with the least amount of oil removed. Overall, the bioremediation methods outperformed the other non-biological remediation methods, supporting the hypothesis. The results were analyzed using descriptive statistics and an ANOVA single factor test, and the results were found have a statistically significant relationship.

## NONDESTRUCTIVE EVALUATION USING PIEZOELECTRIC WAFER ACTIVE SENSORS

Henry Hardin  
Governor's School for Science and Math  
Mentor: Dr. Yu; Department of Mechanical Engineering, University of South Carolina

The purpose of this research was to test methods of structural health monitoring using piezoelectric sensors. Piezoelectric wafer active sensors were used to detect water level and the presence of damage in a water tank. A pair of sensors was attached to the tank and a function generator was used to transmit an ultrasonic wave through the tank. This wave was analyzed to determine water level inside the tank and the presence of damage. Water level could be detected to within 0.5 cm and damage could be reliably detected, however, damage position could not be. An additional pair of sensors was added to allow water level and damage position to be changed simultaneously. With this additional set of sensors, changes in the wave reading due to water level could be differentiated from those due to damage.

## FINDING AN OPTIMAL BIO-PETROL DIESEL BLEND

Dillon Harper  
Center for Advanced Technical Studies

Bio-diesel is produced using waste vegetable oil (WVO) to create a fuel that can be used in a diesel engine. This study's objective is to find the optimal blend of bio-diesel and use this optimal blend to record data on engine performance under load. In this project tests will be performed to determine horsepower, torque, emissions, and the fuel efficiency of various blends of fuel. These tests will be done using a dynamometer to allow for real world load testing. A HATZ 1B20 engine will be used to determine fuel efficiency in the beginning phases. The performance of the blended biodiesel will hopefully be equal with standard petroleum diesel, if not better.

## ASSOCIATIONS BETWEEN RATE OF SPEECH AND CARDIAC AROUSAL WITHIN FEMALES THAT EXPRESS THE FMR1 PREMUTATION

Emma Harris  
Governor's School for Science and Math  
Mentor: Dr. Klusek; Department of Psychology, University of South Carolina

The focus of this research is on women who have the FMR1 gene premutation. Those with the premutation are "carriers" of the fragile X mutation. The FMR1 premutation is highly prevalent within the United States, affecting 1 in every 151 women. The impact of the premutation can be far reaching. For example, the National Fragile X Foundation explains, "We now know that some women with premutation have infertility or fragile X-associated tremor ataxia syndrome (FXTAS), while those with full mutations may have learning or psychiatric issues." Many women with this condition have average or above average

intelligence, but suffer with anxiety or high amounts of shyness. Individuals with the full mutation on the FMR1 gene, or fragile X syndrome, have fast rates of speech that are thought to be caused by anxiety and hyperarousal. This study aims to determine the relationship between cardiac arousal and rate of speech in women with the FMR1 premutation. Rate of speech will be measured as the average number of words used per minute in a five minute language sample. Cardiac arousal will be measured by the average heart rate during that same span. The findings should contribute to our understanding of the language phenotype of the FMR1 premutation and its mechanisms, as well as inform potential relationships between hyperarousal and rapid rate of speech in children with fragile X syndrome.

#### ANALYZING THE EFFECTS OF SUPERCRITICAL AND LIQUID CARBON DIOXIDE ON COLLAGEN FIBERS

Leland Hartzog

Governor's School for Science and Math

Mentor: Dr. Matthews; Department of Chemical Engineering, University of South Carolina

Collagen is the most abundant protein in the human body and is a component in heart valves, ligaments, tendons, and blood vessels. In recent years, collagen has been processed using heat, ultraviolet light, and aqueous or organic solvents for various purposes, from shoes to sausage casings. The objective of this project is to specifically tailor collagen fibers to create naturally derived tissue engineering scaffolds. To do this, a method of processing collagen using dense phase carbon dioxide was proposed with the goal of increasing the mechanical strength and slowing biodegradation, all without denaturing the fibers. The fibers were treated in an environmental chamber under both supercritical and liquid conditions. The fibers were tested for thermal stability and visible damage using differential calorimetry and stereomicroscopy, respectively. Results from the differential scanning calorimetry convey that thermal stability remained consistent between supercritical carbon dioxide treated and untreated fibers, however, the results from the liquid carbon dioxide treated fibers showed significantly more damage as a result of the treatment process. Stereomicroscopy supported these findings, as the triple helical structure of the collagen fibers remained intact in the supercritical carbon dioxide treated fibers and was comparable to the untreated fibers, whereas the liquid carbon dioxide treated fibers lost all visible macromolecular structure. From this work it can be deduced that supercritical carbon dioxide remains a viable method of processing collagen and in the future hopefully more tests, such as a circular dichroism and SDS-PAGE, can be done to assess its effects on collagen fibers.

#### THE BIODIVERSITY OF DRAGONFLIES AND DAMSELFLIES: THE SPECIES AND BEHAVIORS OF ODONATA INHABITING THE COOPER LIBRARY POND

Neelia Heath

Governor's School for Science and Math

Mentor: Dr. Culin; Department of Entomology, Clemson University

The overall purpose of this project was to determine the biodiversity of Odonata, dragonflies and damselflies, in the area around the reflection pond in front of the campus library of Clemson University. Observations were made M-F during 2 or 3 30-minute sessions, and ethograms of the multiple thirty minute sessions were conducted. Biodiversity of the local dragonfly and damselfly species included both species' composition and their behavioral patterns, such as: mating routines, perching patterns, and flying areas. The study also considered certain biases such as the effect of the temperature, wind, and the area which they inhabit. The results will be showcased in the campus library to inform and entertain students and visitors about these carnivorous insects that inhabit the Clemson University library pond.

#### EFFECTS OF ASHTANGA YOGA ON ADOLESCENT FLEXIBILITY

Cherilyn Heintz

Chapin High School

According to the British Broadcasting Channel, over 30 million people regularly practice yoga worldwide. The Yoga Journal states many yoga poses promote flexibility, prompting the question will practicing Ashtanga yoga for 30 minutes for two days, consecutively, increase flexibility in adolescent participants? In this observational study, participants were asked to volunteer to commit to the yoga sessions and measurements. A consent form was handed out and collected from the participants. The study had three trials with four days for each trial. All of these following actions took place during the first half hour of a one hour lunch/enrichment period. Monday pre-flexibility measurements were taken using the sit and reach device. Tuesday and Wednesday a half hour yoga class focusing on the Ashtanga method. A certified yoga teacher led the yoga sessions. Thursday the post-flexibility measurements were taken. This process was repeated over 3 different weeks. A matched pairs t test was performed on the data to determine the significance and form a solid conclusion. The mean of the first trial was 40.01 centimeters and the p value was 1.00 which doesn't show significance. The mean of the second trial differed by 1.90 centimeters with a p-value of 0.215 this also doesn't show significance. The mean of the third trial differed by 1.90 centimeters with a p-value of .058 which shows significance at the 90% confidence level. The four students did increase their flexibility with the two days of Ashtanga yoga.

## POLYMER STRUCTURED ELECTRODES FOR SOLAR WATER SPLITTING

Lydia Henderson

Governor's School for Science and Math

Mentor: Dr. Stefik; Department of Chemistry and Biochemistry, University of South Carolina

Devices that allow electrolysis to occur using energy from the sun, or solar water splitting cells, have been successfully synthesized using copolymers to assemble a mesoporous film. The inorganic/organic ratios were changed to determine the ratio that created the most highly ordered structure. The films were synthesized using polymer self-assembly, with bismuth vanadate (BiVO<sub>4</sub>) as the photo-catalyst and polystyrene-block-poly(ethyl oxide) as the di-block copolymer. The samples were made by dissolving all the precursors in a solution, then spin-coated onto various substrates and calcined. Small Angle X-ray Scattering and Scanning Electron Microscope images were used to analyze the structures. None of the target crystalline structure or mesoporous morphology were observed in the samples. Continued experimentation with the various inorganic/organic ratios must be investigated in order to synthesize a structured film.

## QUANTIFYING ERYTHROCYTE CARBOHYDRATE SURFACE ANTIGEN CONCENTRATION IN LIPID RAFTS

Matthew Heron

Center for Advanced Technical Studies

The lack of sufficient blood stores is a major problem facing modern medicine. In the United States alone, blood transfusion volume sums to roughly thirty million pints of blood being utilized each year. A complication thus arises in maintaining sufficient blood stores to meet this growing demand. To exacerbate an already precarious condition, blood types further attenuate the supply of blood in proportion to those who need it. The purpose of this project is to aide current research targeted at neutralizing blood antigens. Since surface antigens are carbohydrate molecules that bind to glycolipids and glycoproteins, it is hypothesized that surface antigens will be concentrated on or around lipid rafts in the cell membrane of erythrocytes where there are increased concentrations of sphingolipids. Lipid rafts will be isolated from the plasma membrane using serial buffer dilution. Concentration of N-acetylgalactosamine and galactose will then be measured using biotinylated wisteria floribunda lectins in biotin concentration assay. Statistical computations will determine if there is a significantly greater concentration of antigens in lipid rafts.

## THE EFFECT OF A SWIMMER'S ORIENTATION ON VELOCITY IN UNDERWATER KICKING

Savannah Hillmeyer

Heathwood Hall Episcopal School

The purpose of this experiment was to investigate the relationship between a swimmer's orientation and velocity when dolphin kicking. Two underwater kicking styles were compared, underwater dolphins on back, and underwater dolphins on stomach. One of the largest uncertainties in the competitive swimming world is which type of underwater kick is fastest. Therefore, the results of this study could help clear the air of some of this controversy, by showing which type of kick is fastest for competitive swimming, especially in the freestyle events. The subjects used in this were asked to swim at least fifteen meters using their designated kick, and they were timed using stopwatches to measure how long it took them to kick fifteen meters of their designated kick. The hypothesis of this experiment was if a swimmer's orientation is changed (on their back or on their stomach) when dolphin kicking, then they will have a greater velocity on their back than on their stomach. The results of this experiment supported the null hypothesis. In conclusion, this experiment will benefit the swimming community by displaying which orientation for underwater kick for freestyle has the greatest velocity.

## INFLUENCE OF PYRUVATE AND SODIUM BICARBONATE ON THE INDUCTION OF PIGMENTATION IN ARISING RETINAL PIGMENTED EPITHELIAL-19 CELLS (ARPE-19)

Valerie Hinsch

Governor's School for Science and Math

Mentor: Dr. Ablonczy; Department of Ophthalmology, Medical University of South Carolina

The retinal pigment epithelium (RPE) is responsible for the metabolic maintenance of the photoreceptors in the eye. Dysfunction of this tissue can induce conditions like macular edema which are currently without clinical treatment, creating the need for accurate models of RPE for successful development of treatments. ARPE-19 cells, the most widely used researched cell line, lack the differentiation required to accurately model in vivo properties of the tissue, especially pigmentation. Multiple studies to reestablish ARPE-19 cell qualities have remained unsuccessful. However, a recent paper reported the desired repigmentation of the cells (Ahmado et al., 2010), due to the presence of high concentrations of pyruvate and sodium bicarbonate in the media. The goal of this research was to replicate these experiments while testing the development of barrier function and the secretion of vascular endothelial growth factor (VEGF), expressed by RPE to maintain the ocular vasculature. This aim was achieved by growing the cells in two different media (DMEM/F-12 and DMEM/Pyruvate) with the same amount of sodium bicarbonate (3.7 g/L) and different amounts of pyruvate (55 and 110 mg/L). Barrier function was tested through transepithelial resistance using an epithelial volttohmmeter and VEGF secretion was determined from collecting the apical and basal media once a week. VEGF could not be tested due to time constraints, but results indicate that there was no pigmentation and a reduction in barrier function in the presence of pyruvate. This research did not validate previous work, and therefore must be repeated.

THE EFFECT OF ENZYME CONCENTRATION, PRESENCE OR ABSENCE OF AN ENZYME, PH LEVEL, AND THE PRESENCE AND ABSENCE OF SUBSTRATES ON ENZYME REACTION RATE AND THE DETERMINATION OF WHAT LEVELS EACH VARIABLE MUST BE TO HAVE AN OPTIMAL REACTION RATE FOR ALGAE-BASED

Josh Holmstrom and Austin Cox  
Heathwood Hall Episcopal School

Enzyme functionality encompasses all facets of life on Earth. Whether in a single celled organism, or an organism as complex as humans, enzyme functionality and production is vital to life. This staple function in all living things can be studied, and even used to benefit society and the environment. Today's world requires the production of energy. By way of burning fossil fuels, using the powerful flow of water from the Colorado River, or using the heat from the innards of the Earth, energy production is a necessity today, and will be for generations to come. Another way to produce fuel, one cleaner than burning fossil fuels and maybe more practical than hydroelectric and geothermal energy, is the consumption of biofuels. Biofuels is a category that encompasses a massive amount of different fuels, but we will focus more on those biofuels that are produced by algae. If we can better understand the enzymes in algae that break things down to produce biofuels, an optimal condition for these enzymes can be found to maximize production of this biofuel. The purpose of this study was to determine the effect of enzyme concentration, presence and absence of enzymes, pH level, and the presence and absence of substrates on enzyme reaction rate and the determination of what levels each variable must be at to have an optimal reaction rate for algae-based biofuel production. The tested independent variables for this study were the Enzyme concentration, Presence or absence of an enzyme, pH level, and Substrate concentration. The dependent variable was the biofuel enzyme reaction rate. The hypothesis was that If an optimal condition for an enzyme reaction can be projected, then data from enzyme reaction rates where pH, Enzyme concentration, Substrate concentration, and the presence and absence of the enzyme can help determine an optimal condition. The results did support this hypothesis. When the enzyme and its substrate reacted, a yellow coloring became present in the solution. Using a spectrophotometer, we used the amount of yellow coloring to quantify the level of the reaction that took place. From the data we gathered, we can hypothesize on what optimal conditions for this particular enzyme to function at its peak potential.

ANALYSIS OF OLYMPIC GAMES PARTICIPATION AND SUCCESS USING STATISTICAL METHODS

Thomas-Roy Holt  
Governor's School for Science and Math  
Mentor: Dr. Sankaran; Department of Economics, University of South Carolina

The modern Olympic Games have occurred since 1896 with only a couple instances of cancellation (largely due to issues of a political nature). In this analysis we attempt to find if the Olympics can be used as an apparatus to measure country success on an international scale. Specifically, we use statistical methods (linear and multilinear regression analysis) to analyze potential correlations between economic data and quantity of medals a country receives in a single Olympic game. It became clear with relatively little analysis that while the variables chosen were indeed correlated in some manner, a major change either in the mathematical nature or the method of gathering data is needed.

THE CORRELATION BETWEEN TIME AND THE AMOUNT OF PARTICULATE MATTER PRODUCED BY CEILING TILES

Victoria Hopkins  
Spring Valley High School

The correlation between time and the amount of particulate matter produced by ceiling tiles / Victoria Hopkins / Environmental Science / / Particulate matter is one of the six criteria pollutants listed by the Environmental Protection Agency, or EPA, and has been known to cause many conditions, with acute lower respiratory infections being one. The purpose of this research was to investigate the correlation between particles produced by ceiling tiles and time. It was hypothesized that as time went on, the amount of particles found would decrease. Over a 10-day period of 5 trials, each lasting 2 days, particles were collected using EPA air strips then counted manually. An ANOVA was run to see if there was significant variation between any of the 5 trials observed. The test found that although the lowest particle value was on the last trial, there was not a significant difference between any of the 5 trials ( $F(4,195)=2.22$ ,  $p>0.05$ ). This experiment found that over the course of 10 days, there would not be a significant difference in particles produced, thus not supporting the original hypothesis. This would mean that there would not be a significant difference in 10 days, however the data suggests that there may be a significant difference in reduction of particulates released over a test period of more than 10 days.

ROBOTICS MATERIAL HANDLING: METHODS IN WHICH ROBOTS CAN PACKAGE ZIPPER STORAGE BAGS INTO RETAIL BOXES

Tsung-Wei Hsu  
Governor's School for Science and Math  
Mentor: Dr. Askins; Director of Sales and Marketing, Integrated Systems Inc.

Robots are becoming more and more integrated into the production world as well as the consumer sector. However, regardless of what is widely perceived, robots only complete tasks based on specific instructions. The main goal of the study is to determine the most optimal way to bundle zip-lock bags in bulk to be shipped to America and the most optimal way to extract

the zip-lock bags to be repackaged into retail boxes. At the same time, the cost of the whole assembly must be paid back in two years or less. The packaging methods evaluated consists of alternating stacks, divided boxes, and random assortment. The extraction methods evaluated consists of air, vibration, rotary placers, and claws. In the end, the combination of divided boxes and robot claws were the most effective at extracting the bags. It had the largest success rate with the biggest room for expansion.

#### THE EFFECTS OF PHYSICAL EXERCISE ON THE SHORT TERM MEMORY OF ADOLESCENTS

Andrew Huang  
Spring Valley High School

Physical exercise can improve memory by increasing blood flow and increasing hippocampal neurogenesis. There are 2 types of exercises, aerobic and anaerobic. In this experiment, aerobic exercise was used to measure the short term memory in adolescents aged 14-16. It was predicted that the experimental group would outperform the control group with a significant increase in test speed. Experimentation was accomplished by splitting subjects into two groups, one control and one experimental. The experimental group did 10 minutes of exercise, while the control group did zero minutes of exercise. Both groups did the same maze before and after the 10 minutes, and a difference was calculated by subtracting the two scores. The difference was then rounded and graphed. The data supported the hypothesis that the experimental group would complete the test faster than the control group. The mean and standard deviation for the control group was higher than the experimental group, which supported the hypothesis. In conclusion, physical exercise improved short term memory in adolescents aged 14-16 based on an unpooled independent t-test with an alpha of 0.05. /

#### THE CORRELATION BETWEEN PATTERN RECOGNITION AND STANDARDIZED TEST SCORES

Bianca Huet  
Chapin High School

A random selection of AP high school students are tested on pattern recognition, as well as giving their following overall SAT score. The data is used to analyze the correlation between how well a student performs on standardized tests and their ability to recognize patterns within sequences. The data demonstrates a positive correlation, illustrating that students who did better on the SAT in both Critical Reading and Math, tended to do better in recognizing patterns within a text or a sequence. The results calculated prove to emphasize important significance, and a correlation is found between pattern recognition and SAT critical thinking. This proves that the brain, specifically the neocortex, is a crucial part in taking the SAT and analyzing patterns within it, and that the mind's ability to think critically is an important factor in standardized test taking.

#### EFFECT OF FLOW RATE ON UVLED INDUCED BACTERIA ANNIHILATION IN WATER SAMPLES

Saad Iftikhar  
Dutch Fork High School

The world of water purification has advanced leaps and bounds in the past several decades, with one of the most groundbreaking discoveries in the field being the use of Ultraviolet Light Emitting Diodes (UVLEDs) to effectively kill bacteria both safely and effectively (Boudenne). This advance has also allowed for a more environmentally friendly approach to water purification, as UVLEDs leave very little byproduct and can be used for extended periods of time without replacement (Bauer). / Though small scale UVLED purification has become more efficient and portable, large scale UVLED water purification systems remain unoptimized to their maximum potential, unable to find a balance between effectiveness and efficiency (Oppenländer). When mass quantities of water need to be purified, the UVLED process is difficult to use, as water must be processed in smaller, individually treated units. This therefore creates the problem of the imbalance of efficiency and effectiveness of water treatment and purification. / In order to solve this large scale problem, I plan to set up and test a UVLED water purification apparatus to find the optimum flow rate at which water can be purified most efficiently, without sacrificing effectiveness of bacteria annihilation. This will be done by altering flow rates at varying intervals and running water at that rate through a UVLED purification system, then measuring the percentage of bacteria killed in each test until the optimum flow rate is found.

#### EFFECT OF GRADE LEVEL ON THE TYPE OF HELP REQUESTED IN A WRITING LAB

Rachel Janis  
Chapin High School

Surveys will be used to determine if there's a correlation between the grade level of a student and the type of help they ask for in a writing lab. Students will make appointments to come to the lab and will bring their writing to the editors for revisions. Before editing begins, the student will take a pre lab survey to determine what they think they need help with and how confident they are in their writing. After editing has taken place, the student will take a post lab survey to determine the success of the lab. The data from the first survey, asking their grade level and what they needed help with, will be put into a spreadsheet to determine if there is a correlation or not. If there is a correlation, teachers of that grade will have the opportunity to incorporate aspects of writing into the curriculum.

## THE EFFECT OF THE HISTORIC FLOOD OF 2015 ON MERCURY, DISSOLVED OXYGEN, AND PH LEVELS OF THE GILLS CREEK WATERSHED

Catie Johnson and Landon Louthian  
Heathwood Hall Episcopal School

The purpose of this project was to determine how pollutants in the Gills Creek Watershed changed after the historic 500 year flood in October of 2015 in Columbia, South Carolina. This experiment could show whether or not floods flush out toxins from the water, or bring them in by means of local surface runoff. The dependent variables tested in this experiment were the pH, dissolved oxygen, and mercury levels in the water of Gills Creek. There was no control group due to the unpredictability of the flood. Over a period of 50 days post flooding, 10 sampling days were chosen and 5 samples of each variable were taken from the Gills Creek watershed each sampling day. Hypothesis 1 was that if there was a major flood, the levels of pollutants in the water would go up. The second hypothesis was that if there was a major flood, the levels of pollutants in the water would go down. The null hypothesis was that if there was a major flood, the levels of pollutants in the water would not change over a course of 50 days. The results supported the null hypothesis with each variable remaining the almost constant over the course of the experiment. In conclusion, no changes in the pollutants tested could be found.

## THE EFFECT OF AN ANION REPELLING VIBRATING CATHODE ON THE AMOUNT OF HYDROGEN GAS PRODUCED IN WATER ELECTROLYSIS

Evan Johnson  
Spring Valley High School

Humanity's dependence on fossil fuels and nonrenewable energy sources is a problem that needs to be faced for the continued existence of life on earth. The purpose of this experiment was to determine the effect of a vibrating cathode on H<sub>2</sub> gas production during electrolysis, and to see what RPM level affected electrolyzer efficiency the most. An electrolyzer with no vibrating cathode was run for 30, 5 minute trials. 30 trials were then performed with a 11,000 RPM motor, 16,000 RPM motor and 20 were performed with a 30,000 RPM motor. The H<sub>2</sub> gas production for no motor had M = 9.083 cm<sup>3</sup> SD = 2.003 cm<sup>3</sup>. 11,000 RPM motor H<sub>2</sub> gas production had M = 7.747 cm<sup>3</sup> and SD = 0.914 cm<sup>3</sup>. 16,000 RPM motor H<sub>2</sub> gas production had M = 7.803 cm<sup>3</sup> and SD = 1.325 cm<sup>3</sup>. 30,000 RPM motor H<sub>2</sub> gas production had M = 7.195 cm<sup>3</sup> and SD = 0.831 cm<sup>3</sup>. The results found were statistically significant, as indicated by an ANOVA, F(3,110)=8.84, p<0.05), and Scheffe tests determined that significant differences lie between the no motor results and the 30,000 RPM results. The results did not support the hypothesis because the no motor trials showed significantly higher H<sub>2</sub> gas production.

## THE PROPULSION POW!: REDUCING ENERGY EXPENDITURE AMONG WHEELCHAIR USERS

Megan Johnson  
Center for Advanced Technical Studies

Wheelchairs are a growing medical intervention that aids those who cannot use their lower extremities due to illness, old age, and most commonly, spinal cord injuries. However, wheelchair propulsion presents a problem, causing upper extremity pain and overuse injuries, resulting from high amounts of energy expenditure due to the excessive and repetitive rotational motion. With the use of the Propulsion POW! energy expenditure will be reduced, by the use of a pulley mechanism, and the risk of upper extremity pain and over-use injuries will be avoided.

## BATCH SCALE-UP SYNTHESIS OF PVP COATED IRON OXIDE NANOPARTICLES FOR OIL REMEDIATION

Nicole Johnson  
Governor's School for Science and Math  
Mentor: Dr. Lead; Department of Environmental Health Sciences, University of South Carolina

Oil spills have disastrous effects on the environment, and traditional oil spill cleanup is expensive and inefficient. Magnetic polymer coated iron oxide nanoparticles have been developed to adsorb this oil and be collected easily with the use of magnets. However, these nanoparticles have only been used on the lab scale and are in the process of being scaled up for commercial production and use. This study focuses on the batch scale up of polyvinylpyrrolidone (PVP) coated iron oxide nanoparticles while maintaining the efficiency of the nanoparticles in oil remediation. In this study the PVP coated iron oxide nanoparticles were synthesized with increased volumes and concentrations of the precursor materials which resulted in larger quantities of nanoparticles produced. These PVP coated nanoparticles were then tested, and it was found that although the efficiency of these nanoparticles were still high, they were not as efficient as the original batch.

## THE ROLE OF CONDUCTIVITY ON INSTABILITIES OF FERROFLUIDS IN MICROCHANNELS

Zachary Johnson  
Governor's School for Science and Math  
Mentor: Dr. Xuan; Department of Mechanical Engineering, Clemson University

The process of creating instabilities with ferrofluids (water-based solutions that contain magnetic nanoparticles) via lab-on-a-chip devices has proved to be very efficient for mixing solutions on a microscopic scale. The compact size of these chips enables easy transport, and can lead to various cost-effective medical applications. Studies have already been carried out to

create electrokinetic instabilities using ferrofluids and deionized (DI) water in a T-shaped microchannel. These instabilities occur at the interface of the channel and form finger-like structures as the fluids continue to flow because the solutions react differently to the applied electric field. This experiment shows that the levels of conductivity of the solutions are critical to maintaining the instabilities at low voltages, and therefore low temperatures. By increasing the concentration of the ferrofluid, thus giving it a higher level of conductivity than the DI water in the channel, lower threshold electric field-induced instabilities were created. The ability to form instabilities at low voltages allows for rapid microfluidic mixing without damaging the channel which may occur due to the joule-heating effect resulting from higher voltages. This experiment has led to further studies regarding the joule-heating effect on micro channels. Specifically, whether or not joule heating inhibits instabilities from forming, or if it forms thermal instabilities at higher temperatures.

#### A BIOLOGICAL STUDY ON THE DIFFERENCES BETWEEN MOSQUITO AND BLACK FLY PHYSIOLOGY VIA THE TRANSPLANTATION OF TRICHOMYCETES

Morgan Jones

Governor's School for Science and Math

Mentor: Dr. Beard; Department of Agricultural and Environmental Sciences, Clemson University

Black flies and mosquitos are both common vectors of disease. They are structurally similar in their peritrophic matrices. Within the larvae of the black flies grows a symbiotic trichomycete fungus known as *Harpella melusinae*. It readily grows in the midguts of black fly larvae and releases spores into the water, but it does not seem to adapt well to the midguts of mosquito larvae. We asked if we could successfully transplant *H. melusinae* into mosquito larvae. Wild black fly larvae, *Simulium innoxium*, were captured to secure spores to transplant into mosquito larvae. We attempted to transplant the *H. melusinae* into four mosquito species, *Aedes aegypti*, *Aedes albopictus*, *Culex quinquefasciatus*, and *Anopheles quadrimaculatus*, by four different methods, three of which directly fed the spores to mosquito species. Exposed mosquitoes were dissected and their peritrophic matrices were observed for trichomycete presence. Some *H. melusinae* spores and sprouts were found inside the mosquitoes' matrices; however, not enough spores or sprouts were found to make any conclusions as to whether *Harpella melusinae* can truly grow inside mosquitoes. The next step in the study is to repeat the experiment with more mosquitoes, to determine if the results are viable or not.

#### THE EFFECT OF VARIOUS FREQUENCIES OF NOTES ON THE PERCEPTION OF PITCH OF BOTH MUSICALLY AND NON-MUSICALLY TRAINED STUDENTS

Christopher Juhn

Spring Valley High School

One of the most important components in a musical performance is the tuning of the pitch. A live performance experience could be significantly downgraded if a performer is out of tune. This study was done to determine the range where most people believed a note was in tune, and whether that differed between musicians and non-musicians. It was hypothesized that participants would generally recognize a flat note before a sharp note, and that musicians would be faster at recognizing out of tune pitches. In the experiment, an oscillator app was used to produce the frequencies required to generate the pitches of the note, and students were required to answer when they thought a note was out of tune. This process was repeated for all 12 notes of the octave. t-Tests were used to compare results between flat and sharp notes as well as the results between the musicians and non-musicians. The hypothesis was partially supported as musicians were better at recognizing out of tune pitches compared to non-musicians, but there was not a statistically significant difference between when both groups could hear a flat note and a sharp note. In conclusion, musicians were better at recognizing out of tune pitches but there was not a significant difference in recognizing sharp and flat notes with both groups.

#### EFFICIENCY CHARACTERIZATION IN LITHIUM-ION BATTERIES

James Kahng

Governor's School for Science and Math

Mentor: Dr. Onori; Department of Automotive Engineering, Clemson University

Lithium-ion batteries have been widely used since its introduction in 1990's due to its high energy and power density, wide operating temperature range, and lack of memory effect. They are used in many portable electronics applications such as phones and laptops. Automotive companies have been developing hybrid, plug-in hybrid, and fully electric vehicles using lithium-ion batteries recently because of the declining amount of oil reserves to power conventional combustion engines, and the advantages that this battery technology offers. However, the electrification of vehicles is more expensive compared to internal combustion engine-powered cars due to the high price of lithium-ion batteries. In addition, lithium-ion batteries age due to usage and time, which degrade their performance. Because of the high initial costs, automotive companies must have a clear understanding of the performance of lithium-ion batteries in order to reduce maintenance costs and foresee the life expectancy of the battery. The efficiency characterization in lithium-ion battery cells were analyzed using MATLAB to extract data from the aging experiments of cells. The experiments were conducted using an Arbin BT-2000 tester and Peltier junctions to create different battery usage patterns, such as different operating temperatures and charge/discharge rates. This data was used to measure the battery efficiency as the batteries aged. The understanding and correlation of aging of lithium-ion cells on its energy efficiency will provide automotive manufacturers a better understanding of the characteristics of the battery under usage.

## EXPLORING DESIGN POSSIBILITIES FOR ENHANCING DELIVERY EFFICIENCY OF A NEBULIZER

Ishita Kapoor  
Spring Valley High School

Aerosol therapy is the most common respiratory treatment for lung related diseases, where the drug is atomized or is in solid micro-particles, allowing it to reach different parts of the respiratory tract. Nebulizers are the most commonly preferred method of asthma treatment for children or patients in critical care, and with firsthand personal experience. Typical treatment time ranges between 10 to 20 minutes. Recent research has shown that drug delivery from nebulizers ranges between one to twenty percent and the rest is wasted, making it an inefficient method in both cost and treatment time. In response, this research was aimed at modifying the current nebulizers and creating a timed nebulization delivery system. First modification included the addition of a baffle for faster impaction of the particle to be re-nebulized. Secondly, two timed drug nebulization systems to match the inhalation period of a breathing cycle were created using an Arduino controller. A solenoid valve was attached to a compressed air nebulizer to turn on and off the nebulization cycle, and a stepper motor was used that controlled the speed at which the syringe released liquid to an ultrasonic mesh atomizer. The time to nebulize 3cc of sodium chloride solution with the modification had a statistically significant difference  $F(6, 28)=185.71$ ,  $p<0.001$  when compared to original nebulizers. Residual volume of the nebulizers with and without the modification had no statistically significant difference. Cost calculations revealed a huge potential for savings for patients and providers related to use of nebulizers.

## COMPETITIVENESS OF SOUTH CAROLINIAN AEROSPACE EDUCATION

Lotta Keller  
Governor's School for Science and Math  
Mentor: Dr. Cameron; South Carolina Council on Competitiveness

Since 2006, South Carolina's aerospace cluster has grown in a manner reminiscent of the early growth of its automotive cluster. Given the success of the latter, the South Carolina Council on Competitiveness has begun to research how the aerospace cluster can achieve the same progress. A properly educated and skilled workforce was found to be a key element of growth. To create this resource, at least one quality aerospace education or training program should exist in a geographic area. This research sought to determine whether South Carolina has sufficient training programs to maximize growth by comparing the state to two others with more developed aerospace sectors. By compiling lists of several types of programs in South Carolina, Alabama, and Georgia, it was found that the total amount of programs offered in South Carolina is comparatively subpar, as it offers less than Alabama and far less than Florida. These data provide insight into the state's strengths and weaknesses and lead to research ideas that will identify existing variables while identifying models for South Carolinian growth.

## EFFECTS THAT INFLUENCE CHILDREN'S TRUST WHEN NONVERBAL DISPLAYS OF DOMINANCE ARE A FACTOR.

Rebecca Kerr  
Governor's School for Science and Math  
Mentor: Dr. Hahn; Department of Psychology, Furman University

Much of what young children know, they learned from other people. Preschoolers, however, do not trust just anyone for information. For example, they prefer informants who are of the same gender, have the same accent, or are more attractive. This project is based on an ongoing study investigating whether 3- and 4-year-old children consider body posture when deciding whom to trust for new information. Preliminary analyses indicated that preschool boys trust people who assume a dominant or expansive posture, whereas preschool girls did not appear to show a posture preference. The goal of this project was to examine data from that study to determine if there were factors besides dominance that could have affected whom children trusted. The statistical package SPSS was used to conduct an analysis on the data collected from 39 children. The analysis found that children's performance in the assigned task was not attributable to left-right side preferences, nor did the specific actors used in the study influence children's choices. The data did indicate that gender mattered. Specifically, preschool boys showed a preference towards high power females over those of high power males. Moreover, it was found that children preferred to endorse the actor that they had not initially preferred. Overall, the results of this research can change the way people present themselves to children in order to acquire their trust.

## AN EXPERIMENTAL STUDY OF THE FORENSIC LUMINOL TEST FOR DETECTION OF BLOODSTAINS

Katherine Kilgore  
Governor's School for Science and Math  
Mentor: Dr. Morgan; Department of Chemistry and Biochemistry, University of South Carolina

Bluestar® is a new latent blood detection reagent used by criminologists as a presumptive test for blood at crime scenes. It is a patented formula of luminol, which has been used for over 60 years. There have been no reproducible experiments done in a controlled setting to find the limit of detection (LOD). LODs previously reported range from 1:100 – 1:5,000,000 dilute. Furthermore, published studies have not explored the relationship between bloodstain concentration and chemiluminescent intensity. Not knowing the detection agent potential is a problem in investigations because blood evidence could be dismissed or not detected. We implemented stain barriers and measured the chemiluminescent responses of different bloodstain



dilutions on cotton swatches using a camera and program which quantify data from photos. This experimental design renders a reproducible way to find an accurate limit of detection and proves a linear relationship between bloodstain dilution and chemiluminescent response. A limit of detection for the Bluestar® response to bloodstains on Fruit of the Loom cotton t-shirts was found to be 1:101,384 dilute using a calibration curve consisting of triplicate bloodstains 1:5,000 - 1:16,666 and blanks. These results help forensic criminologists know to look for dilute bloodstains, and will help less evidence be overlooked or dismissed.

#### THE EFFECT OF INDUCED POSITIVE, NEGATIVE, AND NEUTRAL EMOTIONS ON SUSCEPTIBILITY OF ACCEPTING MISLEADING INFORMATION ABOUT AN IMAGE DEPICTING A NEGATIVE EVENT

Gloria Kim  
Spring Valley High School

Memories are influenced by cognitive and social factors after witnessing or experiencing an event. It is important to minimize these influences in order to receive the most accurate retrieval of the event, especially when it involves the verdict of a person in a court trial. Altered memories can result in wrongful conviction. In this experiment, mood-induction was performed to see its effect on subjects' ability to reject misleading information and recall details. It was hypothesized that the negative emotion group would recall the original details of the negative image more accurately and reject the misleading information more often. Thirty-six subjects were randomly separated into groups labeled positive, neutral, and negative. The original image was shown and rated by the subjects. A filler task was assigned before showing the altered image. The group was revisited 48 hours later. Subjects viewed and rated the selected mood-induction video before being distributed a questionnaire. Responses were scored using an answer key. This process was repeated for the other groups. At  $\alpha = 0.05$ , the ANOVA analysis of the questionnaire scores gave a p-value of 0.1198. Since  $p = 0.1198 > \alpha = 0.05$ , there was no significant difference between the groups' means. Therefore, the hypothesis was not supported. However, due to an unexpected change made to the time delay, the results are not as accurate as intended. In conclusion, the negative emotion group did not outperform the neutral and positive group in recalling the original details of the image and rejecting the misleading information.

#### THE EFFECT OF FERMENTATION ON THE PRODUCTION OF LACTIC ACID

Kenny Kim  
Spring Valley High School

Lactic acid is a powerful probiotic with many health benefits to humans, such as anti-aging, reducing obesity and preventing cancer. Lactic acid also contains antioxidant properties. These properties can help promote skin health, brain health and immunity to certain diseases. The consumption of lactic acid may aid in the reduction of these issues. To produce adequate amounts of lactic acid with all the benefits included, foods have to be fermented and left for prolonged periods of time. In this experiment, four different foods were fermented and tested for the levels of lactic acid created following the fermentation. The purpose of this experiment was to determine which of the four foods, kimchi, yogurt, soybean paste or pickles could produce the highest level of lactic acid in specific times for them to be considered fully fermented. It was hypothesized that the kimchi would produce the highest level of lactic acid due to the ingredients, which are capable of producing greater amounts of lactic acid. The four foods were placed in jars and left to ferment until fermentation was complete. After the foods completed fermentation, a Accuvin AV-L-Lactic Acid Test Kit was used to measure the levels of lactic acid production. From this test, it was concluded that the kimchi produced the most lactic acid with levels of up to 80 g/mL. The kimchi produced statistically ( $F(3,36)=28.98, p<0,001$ ) more lactic acid than soybean paste, pickles, and yogurt.

#### THE EFFECT OF AEROBIC EXERCISE ON SHORT TERM MEMORY

Jaelen King  
Heathwood Hall Episcopal School

The purpose of this experiment was to measure the effect that aerobic exercise had on memory. The procedure was a fairly simple one. The subjects would first perform a baseline memory test, then complete 200 meters on the track at four increasing speeds. After each run, subjects would take the same online test. The results of the experiment were not statistically significant. While there was an average increase in the subjects' score after each trial compared to the baseline, the subjects' scores did not increase compared to the trial before them in every case. The varying scores were simply due to the subjects' natural variation in memory. The aerobic exercise did not seem to change the subjects' respective scores. It is assumed that the hippocampus was not given a long enough time to expand to significantly increase the subjects' memory. Further testing where either the time interval after the run was completed but before the subject took the test was longer would be beneficial in seeing if a longer wait time would cause greater and more consistent memory growth. The results did not support the hypothesis that if the intensity of the exercise increased, then the subject's memory would also increase.

#### EFFECTS OF BROMATE AND CHLORITE ON ESCHERICHIA COLI RESISTANCE TO GENTAMICIN

Madeline Kirton  
Dutch Fork High School

Bromate and chlorite are two byproducts of chemicals used to disinfect water in water treatment plants. By themselves, they are known to have serious affects on humans' health. As antibacterial resistance becomes more of a pressing issue, the effects

of these pollutants should be observed. In this experiment, the effects of chlorite and bromate on the resistance of gentamicin in *Escherichia coli* are observed. Chlorite and bromate will be introduced. The amount of gentamicin needed to kill off the bacteria in the presence of the chemicals will be compared to the control of no added chemicals. It is expected that bromate and chlorite will make *E. coli* more resistant to the antibiotic. This is because it has been proven to do this in similar experiments. /

#### CREATING A MATHEMATICAL MODEL OF THREE-COMPONENT DPPC/DOPC/CHOLESTEROL MODEL LIPID BILAYERS

Zachary Klein

Governor's School for Science and Math

Mentor: Dr. Uline; Department of Chemical Engineering, University of South Carolina

The purpose of the research conducted was to find a mathematical model of a three-component lipid bilayer composed of a saturated lipid, unsaturated lipid, and cholesterol (DPPC, DOPC, and cholesterol, respectively). The discovery of distinct, separate domains in lipid bilayers in 1982 led to a new understanding of lipid bilayers and cell membranes. A rather controversial theory known as lipid raft theory was introduced soon after that served to explain this behavior, suggesting that rafts of the liquid-ordered domain exist, and that certain proteins are raft-associating. The implications of this are massive in several fields – if it were possible to control the composition and formation of these rafts, then certain diseases could be cured or prevented. As such, this research served to help create a better understanding of how the compositions in the liquid-ordered and liquid-disordered domains are related. The model was based on Putzel and Schick's mathematical model of three-component systems in different phases. Using Fortran, the compositions of each phase were computed, and the resulting diagram formed a closed phase region resembling that of the experimentally created diagram. Future research is needed to confirm the model's thermodynamic validity.

#### NON-UNIFORM MAGNETIC FIELD-INDUCED INSTABILITIES BETWEEN FERROFLUID AND DEIONIZED WATER THROUGH A T-SHAPED MICROCHANNEL

Marlena Kolesinska

Governor's School for Science and Math

Mentor: Dr. Xuan; Department of Mechanical Engineering, Clemson University

Ferrofluid contains magnetic nanoparticles in water-based solution that can interact with non-uniform magnetic fields on a lab-on-a-chip device. Due to the difference in magnetization between a ferrofluid and deionized (DI) water, an instability is produced under an applied magnetic field within this device, which is important in achieving rapid microfluidic mixing. Instabilities occur because of the attraction of the magnetic nanoparticles to the magnets, creating bulk flow of the ferrofluid towards the magnetic source, while the pressure-driven flow of the water pushes the ferrofluid down through the channel, creating fingerlike fluctuations. In this flow system, different factors, such as the fluid flow speed, location of the magnets, and ferrofluid concentration, were tested for mixing efficiency via magnetic field-induced instabilities in a T-shaped microchannel. This experiment showed that the following factors showed a high mixing efficiency within the LOC device: low-flow rate, leftward magnet position below the T-junction, and high ferrofluid concentration. This study potentially provides a blueprint for lab-on-a-chip devices that is efficient, cost effective, wireless, and free of the joule heating effect from applied electrokinetic flow. This experiment also creates the need for further study on the phenomenon that occurs when a paramagnet is placed on top of the microchannel to form noninteracting strata of water and ferrofluid that correspond to the magnetic field lines.

#### THE EFFECT OF ZEOLITE-GRAVEL MIXTURES ON THE CONCENTRATION OF LEACHATE /

Christopher Kong

Spring Valley High School

Over the years, continued production of waste in landfills has led to detrimental effects on the environment. One of said effects was the creation of sludge-like wastewater that had accumulated at the bottom of landfills. Research was conducted to find a potential solution to treating the wastewater, otherwise as known as leachate, using zeolites, an aluminosilicate, crystalline structure, and gravel. The purpose of this experiment was to find whether combining zeolites and gravel into a mixture would treat and purify leachate effectively. It was hypothesized that as the zeolite ratio decreases, the percent transmittance would increase for the post-treated solution. Treatment was carried out by pouring a leachate solution, composed of distilled water, 28% ammonium hydroxide, 100% cuprous oxide powder, and 99% phenolphthalein powder through a zeolite-gravel mixture which was then tested to see how effective the treatment was. The results found that the control group (M = 6.751%, SD = 2.487%), the 100%-0% group (M = 19.670%, SD = 10.100%), the 75%-25% group (M = 16.630%, SD = 3.070%), and the 50%-50% group (M = 6.827%, SD = 1.700%) were statistically significant ( $F(3,93) =$ ,  $p < 0.001$ ). Scheffé test found that the test values for the control group (n = 30, M = 6.751%, SD = 2.487%) and the 50%-50% group (n = 30, M = 6.827%, SD = 1.700%) had statistically significant differences between the 100%-0% group (n = 30, M = 19.67%, SD = 10.100%) and the 75%-25% group (n = 7, M = 16.630%, SD = 3.070%) for both the control and the 50%-50%. The hypothesis was not supported, but data indicates that a higher ratio of zeolite to gravel performed better compared to the other experimental groups.

## BE ALARMED: CAN PEOPLE AGES 60 AND OLDER HEAR SMOKE DETECTORS?

Kelsey Krusen  
Chapin Middle School

The problem can people ages 60 and older hear the frequencies of smoke detectors. The hypothesis of "if played a tone at the frequency of 3100 Hertz, then 75% of senior participants will not be able to hear the tone" was not supported. Sixty percent of the 20 participants could hear the frequency of 3100 Hertz.

## MECHANICAL AND THERMAL PROPERTIES OF EPOXIDIZED PINE OIL AND ACRYLATED EPOXIDIZED SOYBEAN OIL BLENDS

Mario Krussig  
Governor's School for Science and Math  
Mentor: Dr. Pilla; Department of Automotive Engineering, Clemson University

Synthetic polymers are used in many applications throughout various industries because they offer tailor-made solutions to suit specific requirements and enormous weight savings. However, synthetic polymers are produced from petroleum-based resources, which are non-renewable and directly contribute to anthropogenic climate change. Increased environmental regulations designed to tackle climate change have led to renewed interests in the development of bio-sourced polymers. Although biopolymers, as they are commonly called, advance sustainability, their widespread application is limited due to inferior mechanical properties. A plausible and cost-effective way to enhance the properties of pure biopolymers is to blend them with polymers with superior characteristics and/or reinforce them with high-strength and stiffened fibers. This study investigates the thermophysical properties of bio-based polymeric blends made from epoxidized pine oil (EPO) and acrylate epoxidized soybean oil (AESO). The blends were prepared using a solvent casting method in five different ratios, namely, 100%EPO, 90%EPO-10%AESO, 80%EPO-20%AESO, 70%EPO-30%AESO, and 100%AESO. The thermophysical properties of the blends were characterized using tensile testing, differential scanning calorimetry, dynamic mechanical analysis, infrared spectroscopy, and thermogravimetric analysis. The morphology of the fractured specimens was investigated using scanning electron microscopy. These tests will help to establish the structure-property relationships of these unique blends.

## ADVANCING HUMAN FALL DETECTION BY SIMULATING FALLS WITH A BALLISTICS GELATIN TORSO

Grant Kuczler  
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Mentor: Dr. Caicedo; Department of Civil and Environmental Engineering, University of South Carolina

One in three senior citizens falls annually (National Center for Injury Prevention, 2015). These falls often go unreported and are a serious health and safety concern for the elderly (Independence, 2012). Companies, such as Life Alert, attempt to assist elderly people who fall but cannot help those who are unconscious or do not have their help button on them. A sensor-based program was developed to better assist fall victims. Using accelerometers, data acquisition software and a program to call for help, this system measures the acceleration in vibrations caused by movement around the sensors. The goal of the program is to distinguish among the vibrations made when someone is walking, bouncing a ball, has dropped something, or has fallen and needs assistance. This feature of the program, determining whether vibration pattern is a fall, is still being developed. Young, healthy volunteers have been used in past studies, but yielded dissimilar results to data collected from actual fall victims (Klenk et al., 2010). Beef gelatin, when mixed in the correct proportions, can accurately model the density of the human body. Jerk and acceleration are the two metrics used to compare this test's results to real-world falls. The gelatin model generates similar acceleration signals, but very different jerk and variance of acceleration values. This project shows that gelatin cannot correctly model the human torso when only the density is adjusted. However, if the gelatin model is modified, by adding more structure, it could serve as one of the most accurate fall simulants.

## RENEWABLE ENERGY SOURCES; LOCATING THE NM2448 MUTANT GENE FOR SENESCENCE IN MAIZE (ZEA MAYS L.) CELLS TO LENGTHEN THE LIFESPAN OF THE CROP FOR USE IN BIOFUELS

Anna Kulangara  
Governor's School for Science and Math  
Mentor: Dr. Sekhon; Department of Genetics and Biochemistry, Clemson University

Senescence in Zea mays or maize plants is the programmed death of leaves and other organs that occurs at the end of a plant's lifespan, seen in most plants during the autumn season. The goal of this project was to locate the genes controlling senescence in the leaves of maize in order to lengthen the crop's lifespan and to allow plants to make more sugars through photosynthesis. The sugars in the grain or seed will be used as human and animal feed, while sugars in the leaves, stems, and other plant parts can be used for animal feed and as renewable energy sources. This project included fieldwork as well as laboratory work. The primary purpose of the fieldwork was to self-pollinate each corn plant and prevent contamination of the mutant corn plants' genes. DNA of many mutant plants, that showed early senescence, was amplified through PCR reactions and then evaluated during gel electrophoresis in the laboratory. The specific mutant NM2448 was studied by using linkage mapping in order to locate the mutation in the nucleotide sequence. The results indicated that the NM2448 mutant gene was not located on chromosomes 2 or 3 and further research must be conducted on the remaining 8 corn chromosomes to locate the senescence gene.

## A PERFECT PICTURE: EFFECT OF CAMERA SETTINGS ON EXPOSURE

Caitlin Kunchur  
Dutch Fork Middle School

Purpose: Pictures represent scenes by recording different brightnesses at different locations. A camera has a sensor with many pixels. In each pixel there is stored electric charge that leaks out when light falls onto it, showing the exposure. Besides the scene's brightness, exposure also depends on shutter speed, aperture, light sensitivity (ISO), and resolution (megapixels). Understanding these settings are necessary in order to achieve the best picture possible. / Procedure: For each experiment take pictures and use GetRGB software to find the mean and standard deviation for all pixels. For each experiment vary only the settings mentioned below while keeping the other settings fixed. / 1) Vary the shutter speed from the fastest to slowest setting. 2) Decrease the aperture and increase the shutter speed so that different combinations maintain a correct exposure. 3) Take three pictures at the lowest, middle, and highest ISO settings, while maintaining a correct exposure. 4) Repeat last experiment changing only the number of megapixels. / Results and Conclusions: 1) At shutter speed of  $\frac{1}{4}$ " the exposure reached its maximum indicating that all charge leaked out 2) Combinations of shutter speed and aperture area when inversely proportional had constant exposures proving reciprocity. 3) As the ISO and number of megapixels increased, the noise increased as well. This was expected because at higher ISOs, less charge is amplified more so any variation or noise will be much more apparent. With fewer pixels, different exposures should be averaged in order to reduce size. This is contrary to the belief that more pixels are better.

## FIBROMODULIN (FOMD) AND LUMICAN (LUM) IN ADULT MOUSE CARDIAC VALVE DEVELOPMENT

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Mentor: Dr. Kern; Department of Regenerative Medicine, Medical University of South Carolina

Cardiac valve disease is widespread, yet uncured. The Small Leucine Rich Proteoglycans Fibromodulin (fomd) and Lumican (lum), found in the Extracellular Matrix, are expressed in developing cardiac valves. Previous studies have shown that lum promotes the development of the valves, but not much research has been done on the role of fomd. To determine their impact on valve development and disease, the right and left coronary cusps of the aortic valve were compared between knock out and wild type mice. Mice deficient in both fomd and lum were found to have smaller distal portions of the left and right cusps in their aortic valves than their wild type counterparts. Fomd and lum were both found to play a role in aortic valve development, which was previously undetermined. This information could be used to develop drugs to treat cardiac valve disease.

## MICROBIAL DIVERSITY TRENDS IN THE FECAL MATTER OF H. CAROLINENSIS AND R. RABIDA

Max Land  
Dutch Fork High School  
Mentor: Robert Wolff; South University

With over 16,900 endangered species today, illegal wildlife trade is the largest direct threat to the future of endangered species since prior efforts to stop smugglers that evade law enforcement have proved futile. Wild *H. carolinensis*, Carolina wolf spiders and *Rabidosa rabida*--result of genetic similarities-- are used as a substitute for Theraphosidae, tarantulas: highly valued commodities in wildlife crime. In this study, a novel method of analyzing microbial diversity in fecal matter as forensic evidence is reported, with the goal of determining substantial evidence to convict the smuggling of trafficking wildlife. The goal is to collect *H. carolinensis* in the wild and raise them in captivity. We will then analyze the microbial diversity of fecal matter using pyrosequencing. A decrease in microbial diversity provides law enforcement a straightforward forensic technique to supplement the battle against wildlife trafficking. /

## ENTREPRENEURSHIP "ECOSYSTEM" INPUTS NEEDED IN THE GREENVILLE AREA TO FOSTER MORE ENTREPRENEURIAL ACTIVITY AND SUCCESS.

Zachary Laprise  
Governor's School for Science and Math  
Mentor: Dr. Moore; President, NEXT Innovation Center

Greenville, SC has experienced massive economic growth within the last ten years. The revitalized and flourishing downtown area has drawn thousands of young engineers to the area to pursue new jobs at large corporations such as Michelin, GE, and BMW. As a result, Greenville has been named one of the fastest growing cities in the US. Despite this substantial economic growth, Greenville's economy still lacks compared to other large cities in the region. The unemployment rate suffers above the US average and Greenville's GDP and per capita income are among the lowest of similarly sized metropolitan areas. To determine how Greenville could become more of a substantial factor in the region's economy, attention was turned toward high-impact entrepreneurship and entrepreneurial inputs that were missing from the area. First quantitative data was gathered through the benchmarking of Greenville against comparable cities like Charleston, Columbia, Greensboro, Durham, Raleigh, Charlotte, Richmond, and Austin. Qualitative data was then gathered through personal interviews with local high-impact entrepreneurs. The entrepreneurs were asked a variety of questions aimed towards determining the advantages and disadvantages of running start-up businesses in Greenville. After consideration of the data, it was found that Greenville

mostly suffered from lack of capital, talent, and business incubation facilities. Further research was conducted to determine the causes of these problems and possible solutions to resolve them.

#### BY BURNING DIFFERENT BIOMASS SUBSTANCES, WHICH MATERIAL CREATES THE LARGEST AMOUNT OF ELECTRICITY FOR LIGHTING A LIGHT BULB?

Julia Lauterbach and Beverly Hennig  
Heathwood Hall Episcopal School

This project examines the effect of burning different types of biomass substances on the amount of heat and ultimately millivolts produced through a thermoelectric element. The biomass substances that were used were pine straw, torrefied wood, dry leaves, and wood chips or also known as mulch. Each biomass substances had first been dried in a vacuum oven for 48 hours. Each biomass substance was lit above a sterno burner, then was quickly placed underneath a metal can filled with room temperature water. Also, another metal can placed with room temperature water was placed on the other side, while the thermoelectric element was placed between the two cans. Two thermocouples were used to measure the difference between in the water temperatures, which through the thermoelectric element created a small amount of voltage. After the experiment was finished, it was found that pine straw created the most amount of voltage the fastest but also lost its flame the fastest at about 1:00 minute in almost every run done. The other biomass samples all had flames burn longer than 1 minute and 15 seconds.

#### THE EFFECT OF CITRIC ACID ON REDUCTION OF ALUMINUM STRESS ON LEMNA MINOR

Isaac Lee  
Spring Valley High School

Heavy metal pollution in bodies of water has become a major problem in major industrial areas, such as China. Pollution is often hard to clean up due to the major expenses and dangers to local flora and fauna that are not already affected. An alternate solution to counter heavy metal pollution in the form of aluminum nitrate is proposed: citric acid, which was hypothesized to neutralize the basic aluminum nitrate. Lemna minor, also known as duckweed, was placed in bowls to both simulate a water environment and to act as an indicator of the toxicity of the water. The bowls were filled with citric acid solution of varying concentrations and half of the bowls were given aluminum nitrate to act as water pollution. Since duckweed is too small to be feasibly separated into specific numbers, the duckweed growth was measured by taking the initial amount and finding the difference between the final sample. The mean differences of each treatment was analyzed using ANOVA at  $\alpha = 0.05$  level. There was significant differences among the treatments  $F(9, 27) = 28.44$ ,  $p < 0.001$ . Results also indicated that citric acid was detrimental toward the growth of the Lemna, and that the combination of both citric acid and aluminum nitrate grew the Lemna better than citric acid by itself.

#### THE EFFECTS OF CATIONS ON THE DYNAMICS OF SINGLE STRANDED DNA

Narae Lee  
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Mentor: Dr. Jeong; Department of Physics, Korean Advanced Institute for Science and Technology

The nucleic acids, RNA and DNA, perform several important functions within cells in coding, decoding, regulation, and expression of genes. The physical properties of nucleic acids, including their size and electronegativity, contribute to their varying patterns of folding and dynamics in dissimilar conditions. Our research was conducted using fluorescent correlation spectroscopy to observe how cation concentration and type changes the flexibility of single-stranded DNA, measured by calculating persistence length. Varying cation type resulted in a difference in the concentration at which the persistence length transitioned from high to low. The experiment found that the divalent cations  $Mg^{2+}$  and  $Ca^{2+}$  transitioned at a much lower concentration than the monovalent cation  $K^{+}$  did. Between the divalent cations,  $Mg^{2+}$  appeared to transition at a slightly lower concentration than  $Ca^{2+}$ , but the difference was much smaller. The observations led to the claims that charge is a major factor in the transition between persistence lengths, while ionic radius may be only a minor factor. The latter claim would need to be confirmed or disproved by further experiments as the data for the divalent cations was less accurate. The research helps to deepen the understanding of folding behavior and dynamics of single stranded nucleic acids in vivo.

#### THE INHIBITORY EFFECT OF ACESULFAME POTASSIUM ON THE GROWTH OF RHODOSPIRILLUM RUBRUM

Nerielle Legaspi  
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Acesulfame potassium is an artificial sweetener that can pass through the human body and wastewater treatment systems non-degraded. As a result, its presence in bodies of water is growing. It has even been proposed that it be used as a wastewater tracer in bodies of water, but it is mostly unknown how this artificial sweetener affects aquatic environments. The purpose of this experiment is to determine if the presence of acesulfame potassium would have any effect on aquatic environments by testing to see if it would inhibit the growth of *Rhodospirillum rubrum*, an environmental bacterium. It was hypothesized that as the concentration of acesulfame potassium gets larger in the bacterial cultures' nutrient broth, the greater the inhibition of the growth of the *R. rubrum*. For experimentation, solutions with the acesulfame potassium concentrations of 0, 10, 20, 30, 40, and 50  $\mu\text{g/L}$  were made. In the experiment, each nutrient broth solution with acesulfame

potassium was placed into six test tubes along with *R. rubrum*. The test tubes were left for the bacteria to culture for ninety-six hours, during which 1 mL samples of each bacterial culture were taken every twenty-four hours and placed into cuvettes. The samples were analyzed using a SpectroVis to analyze the rate of growth of the bacterial cultures by measuring %T. This process was repeated four more times for a total of five trials. The data was statistically analyzed at alpha equal to 0.05 with a one-way ANOVA.

#### CLUSTERING OF SINGLE CELL USING LOCALITY PRESERVING PROJECTION

Xiang Li

Governor's School for Science and Math

Mentor: Dr. Luo; School of Computing, Clemson University

Clustering is a technique used to separate a collection of data into groups or clusters based on their attributes. Often large datasets come with unnecessary characteristics that outweigh the components that actually matter when clustering. K-means clustering is a learning algorithm most well-known for its simple method of calculation. However, due to that simplicity, unnecessary characteristics in a dataset, referred to as noise, often outweigh the fundamental characteristics. Therefore, k-means clustering is most efficient when processing a dataset with a lower dimensionality. In order to optimize the performance of k-means, a dataset must be processed through a dimensionality-reduction algorithm to lower its dimensionality. Locality Preserving Projection (LPP), one of the more accepted algorithms for dimensionality-reduction, processes the data from different cells to reduce the size of the dataset from thousands down to tens, making the process more efficient. An Adjusted Rand Index (ARI) evaluation test is run to determine the accuracy of the clustering process. ARI values measure the similarities between two clusters, so by comparing a manually clustered set of data, used as an index, to one generated by k-means clustering, an accuracy score can be assigned. A higher ARI score means the resulting clustering is closer to the perfect clusters. Clustering was performed on both the unaltered and dimensionality-reduced datasets. Results of each were compared to the manually created index clusters and ARI scores calculated. It was found that the ARI of the LPP-processed data was considerably higher and the processing speed was significantly reduced.

#### THE EFFECT OF COLORING MANDALAS FOR TWENTY MINUTES ON TEEN STUDENT'S ANXIETY LEVELS

Amy Loy

Chapin High School

High school students are exposed to numerous stress factors such as homework, extracurricular activities, work, sports, etc. Finding a good stress reliever that is easy and cost effective is crucial. Therapeutic coloring can decrease stress and anxiety in teens, improving overall health and increasing happiness. This study aims to determine how controlled coloring for 20 minutes affects stress and anxiety levels in teen students. Their stress and anxiety levels are expected to decrease if the student colors. To assess the stress and anxiety levels, a pre-test is given before coloring, and a post-test is given after coloring for 20 minutes. The original pre and post tests are based on a subset of questions from an official analytic psychosis test, and both pre and post tests contain the same content: 11 questions, all true or false. A new pretest and posttest were created with short term, self-evaluation questions. The pretest and posttest responses are analyzed and scored, and then compared in a matched pairs t test. Preliminary data shows that the anxiety and stress levels do not decrease enough to be statistically significant, with a p-value of .271. Follow up data shows stress levels are statistically significant, with a p-value of .001. Coloring is an effective creative outlet, helping teens get through high school with better health by promoting mindfulness.

#### THE TRANSFORMATION AND MODIFICATION OF INKJET PRINTERS INTO LOW-COST BIOPRINTERS FOR THE CHARACTERIZATION OF PRECISE CELL PATTERNING

Ali Maclay

Governor's School for Science and Math

Mentor: Dr. Rodriguez-Devora; Department of Bioengineering, Clemson University

Bioprinting is a relatively new technological advancement. Recently, high throughput bioscreening has allowed for a quick screening of the biological or biochemical activity of a large number of compounds against biological targets. Transforming regular inkjet printers into bioprinters allows for a faster and cheaper way to screen the biological effects of various compounds. Therefore, it is important that inkjet bioprinters are characterized in order to further research in areas such as cell-based diagnostics, drug allocating, and tissue engineering. For this research, a HP Deskjet 600 printer was converted into a bioprinter. The fluid printing capabilities were calibrated for different printed shapes, fluid viscosities, and shades of black/gray printed. The performance of the printer in cell printing applications was assessed for MCF-7 and 3T3 cells using a live/dead cell assay, a cell-volume calibration, a cell proliferation assay, and by printing precise patterns. The results of these various tests determine that modified inkjet printing is a viable technique for bioprinting, including cell patterning. This study also identifies future avenues for research, such as tissue engineering or personalized cell-based diagnostics.

## A SURVEY OF THE INSECT POPULATIONS OF THREE DIFFERENT BEACHES ALONG THE SOUTH CAROLINA COAST

Tanner Maharrey

Governor's School for Science and Math

Mentor: Dr. McElroy; Department of Biology, College of Charleston

The Texas Horned lizard (*Phrynosoma cornutum*) is a species that was introduced to the coast of South Carolina in the last few decades, and inhabits dry, semi-arid areas such as the sand dunes located on Edisto Beach, Sullivan's Island, and Isle of Palms. Little is known about the South Carolina populations other than the fact that they don't seem to be invasive, or harmful to the local habitats. An important part of locating the origin of this population is identifying what their diets consist of, and that requires knowing what insects are found along the sand dunes. This project proposes that the number of insect species present in a specific habitat will be proportionate to the size of the lizard population in that area. A survey was conducted of the insect population by collection and identification of each species over one summer. These values were then compared to the number of lizards found during the same time period. We found that the number of insect species present was not actually related to the size of the lizard population in that area. This information will be used in accompaniment with another project to determine what the lizards eat by comparing the total insect population to the number of species found in fecal samples collected from the lizards to determine what they eat.

## CELL-CELL INTERACTIONS OF HUMAN UMBILICAL VEIN ENDOTHELIAL CELLS (HUVEC) AND AORTIC SMOOTH MUSCLE CELLS ON CULTISPHER BEAD SCAFFOLDING

Dhruw Maisuria

Governor's School for Science and Math

Mentor: Dr. Hammad; Department of Regenerative Medicine and Cell Biology, Medical University of South Carolina

The human population has started to live for longer periods of time indicating that there might be a need for donor organs for transplant. Due to the limitations in the number of organs, patients are unable to survive and also there is the risk of immune rejection of a donated organ. This can be avoided if the patients own cells can be used to make the organs. The major aim of the project is to ultimately be able to produce artificial blood vessels for humans as well as to determine a technique by which blood vessels can be surgically implanted into humans. The aim of this research is to generate preliminary data on cell-cell interactions in blood vessels. The cells used in this research are Aortic smooth muscle and Human Umbilical Vein Endothelial (HUVEC) cells. The cells were incubated with gelatinous macro porous spheres called cultispheres, as they were the best material to grow cells. The cells were grown independently in Fetal Bovine Serum (FBS) media for two days, and they were then mixed together into wells and were incubated for a total of nine days. The cells were then stained with Cell Tracker CMFDA and observed under confocal microscopy and bright field microscopy. The resulting images showed that when cells were grown together they had web-like cells growth in the areas between the beads and connected the beads together as compared to cells grown independently, but this was not confirmed, by confocal microscopy as the stain antibody was ineffective.

## THE EFFECT OF CHLORINE ON THE DURABILITY OF SWIMSUIT MATERIAL

Melina Manos

Heathwood Hall Episcopal School

The purpose of this research is to investigate swimsuit materials with respect to chlorine and to determine which fabric is more easily disintegrated by chlorine exposure. The independent variable is the swimsuit material; the dependent variables are strength, color, and elasticity. Five swimsuit fabrics were tested: 80% Nylon/ 20% Lycra, 78% Econyl/ 22% Lycra Extra Life Spandex, 50% Polyester/ 50% PBT, 51% PBT/ 49% Polyester, 85% Polyester/ 15% Spandex. Each swimsuit fabric was cut into square pieces, stretched in embroidery hoops, and then placed in chlorinated water. The hypothesis for this study was that if nylon, polyester, PBT/Polyester, and econyl materials are exposed to chlorine, then the 50% Polyester/ 50% PBT material will be the most resistant to disintegration by the chlorine. The null hypothesis was that if nylon, polyester, and PBT and polyester suits are exposed to chlorine, then there will be no difference between the materials after being placed in the chlorine. The importance of this project is now swimmers can know what type of suit to buy that will last them a longer time than a less durable fabric. In conclusion, it was found that the data was statistically significant and supported the hypothesis. Therefore the null hypothesis was rejected.

## ACL INJURY RISKS OF FEMALE DANCERS VERSUS NON-DANCERS BASED ON A BIOMECHANICAL LANDING /

Andrew Martin

Dutch Fork High School

ACL injuries occur 200,000 times annually and in most cases the injury is obtained through sports. Many of these injuries can be prevented with knowledge of how to correctly land without damaging the muscle. This study will test female dancers compared to female non-dancers to see the angle their knees bend using Hudl video analysis technology to observe if there is an association. If the study is successful, video analysis of the angle of displacement of Dancers will be less severe than non-dancers will when asked to jump off of a 25 cm platform and land on one foot and perform a cutting motion between a 85 cm gap. /

## THE EFFECT OF DIFFERENT WAVE HEIGHTS ON VOLTAGE PRODUCED

Ben Mathews  
Heathwood Hall Episcopal School

The purpose of this experiment was to test if waves generated by a fan would affect the amount of voltage produced using homemade and commercial hydroelectric generators. There were 24 tests run in total, with each generator running 12 tests and each of the 12 consisting of 3 categories of trials, four trials with 1 centimeter waves, four trials with 2 centimeter waves, and four trials with 3 centimeter waves. The hypothesis for the experiment is the energy output in voltage of the generators will increase as the wave heights increase, with the commercial generator producing more voltage than the homemade generator. The purpose of having a homemade generator and a commercial generator is to compare and contrast the effectiveness of a generator buildable at home against a purchasable generator. The data collected supports the hypothesis, and through statistical analysis, the comparison between generators revealed the stark advantage of using a purchasable generator rather than a homemade generator.

## THE EFFECT OF SOCCER BALL VELOCITIES ON A MODEL HEAD AS VIDEOED BY A CELL PHONE CAMERA /

Mika McAnally  
Spring Valley High School

The purpose of this study was to determine if a cell phone camera could be used to correlate soccer ball impact velocity to "model head" impact force. The results could be correlated to head impact criteria developed by other researchers to predict concussion potential. It was hypothesized that the soccer ball velocity at impact would positively correlate with impact force to the model head. The investigation involved two stages: (1) vertical ball drop from three heights to correlate the cell phone video analysis to the calculated velocity using an equation of motion; and (2) horizontal impact trials to correlate ball velocity to impact force to the "model head," which was partially filled with different amounts of sand to provide a range of "effective head masses". The linear travel distance after impact with the ball was measured by analyzing the videos. The impact force was calculated by a form of Newton's Law based on effective mass, the measured linear travel distance, and measured time. Linear regression t-tests showed a strong relationship in Stage 1 between the calculated and measured velocity ( $r^2 = 0.9894$ ) and a weak correlation in Stage 2 between measured horizontal velocity at impact and the calculated impact force. Because  $R(39) = .989$ ,  $p = <.001$ , the null hypothesis was rejected indicating a strong correlation between the soccer ball velocity and impact force for stage 1, and because  $R(55) = .2167$ ,  $p = <.001$ , the null hypothesis was rejected indicating a weak correlation between the soccer ball velocity and impact force.

## THE EFFECT OF MUSICAL INSTRUMENT ON THE ABILITY TO HEAR DIFFERENCES IN INTONATION.

Dylan McCormick  
Spring Valley High School

The purpose of this study was to determine if the instrument one plays affects his or her ability to hear the differences in notes that are close in frequency. It was hypothesized that students that play brass instruments would be able to hear differences in Bb easier, while students that play woodwind instruments would be able to hear differences in A easier. Sixty different trials were conducted for each student subject. A drone was played and then a seconds pitch of 20 hz higher or lower, 10 hz higher or lower, or of the same frequency was played so that students could attempt to hear the difference. The data showed that there was not much difference in the values that each section tested. An ANOVA was conducted to see if there was a significant difference in the data collected for each section. The data showed that there was no significant difference ( $p > 0.05$ ). The hypothesis was not supported.

## THE TRANSFER OF ENDOSPORES ON U.S. CURRENCY

Walker McDonald  
Dutch Fork High School  
Mentor: Robert Wolff; South University

Bacterial endospores are highly resistant forms of cellular life that use various methods of transportation to relocate to more nutrient-rich environments. However, these spores can not control where they conclude their journey. The presence of bacterial endospores on U.S. currency indicates an unprecedented proximity to humans, and the necessity to examine dollar bills for this presence. In this study, bills are heated to kill vegetative bacteria and sampled for spores. Special media will then be utilized to detect *Bacillus cereus*. The reason *Bacillus cereus* is the one being examined is due to it's ability to produce enterotoxins and emetic toxins. These toxins are known to cause food poisoning, and are mainly produced during vegetative growth. The discovery of an endosporic presence indicates the ability of these spores to spread to humans on a widespread scale, a forewarning for global epidemics.



DIFFERENTIAL EFFECTS OF MPEP+JNJ-16259685 MICROINJECTIONS INTO THE VTA ON COCAINE-INDUCED LOCOMOTOR SENSITIZATION IN SALINE-EXPOSED RATS AND RATS WITH REPEATED TRAUMATIC PREDATOR ODOR EXPOSURE (TMT)

Konnor McDowell

Governor's School for Science and Math

Mentor: Dr. Riegel; Department of Neuroscience, Medical University of South Carolina

Cocaine is the second most commonly used illegal drug in the United States [NIDA]. The National Institute on Drug Abuse has shown that cocaine users have a sixty one percent chance of relapse after their first administration of cocaine. Lab animals exhibit a similar chance of relapse, and also display an increased rate of horizontal activity [Kauer et al., 2007]. This increase of horizontal activity, called sensitization, is thought to be due to neurobiological changes in the mesocorticolimbic system, as seen by tonic to phasic neuronal firing from the ventral tegmental area [Chen et al., 2015]. Stress is also hypothesized to increase locomotor sensitization to cocaine [Kauer et al., 2007]. In an attempt to decrease the locomotor sensitization to cocaine over time, two groups of rats were subjected to MPEP+JNJ-16259685, a solution of mGluR antagonists. The two groups of rats consisted of a saline exposed group and a group exposed to trimethylthiazoline, which was used to stimulate corticotrophin releasing factors. The group of animals exposed to trimethylthiazoline were then separated into sub-groups depending on their interaction with the filter paper; the subgroups being aggressive interaction (shredders) and passive interaction (non-shredders). A visual, but statistically insignificant, reduction in horizontal activity in all groups of animals was observed on the day of the injection of our vehicle. It is anticipated that additional trials with a larger sample size will result in a statistically significant effect.

THE EFFECTS OF NITROGEN ON THE PHENOLIC COMPOSITION OF JAPANESE KNOTWEED

Marlin McKnight

Governor's School for Science and Math

Mentor: Dr. Tharayil; School of Agriculture, Forestry and Environmental Sciences, Clemson University

The phenolic compounds found in soils and plants play an important role in nutrient usage and growth capabilities. Japanese knotweed (*Fallopia japonica*) is a species of plant that is native to Eastern Asia, Japan, China, and Korea; however, in the U.S and in several other countries, this plant species is classified as an invasive species due to its aggressive nature and its capability to overgrow indigenous plants. The rate at which Japanese knotweed grows can disrupt other plant species that surround it, mainly by taking over space and nutrients. Japanese Knotweed can cause damage to buildings, grow through weak spots in concrete, damage underground pipes and sewers, and even knock down boundaries such as fences. In order for us to understand how the plant is able to wreak havoc on the environment, we must analyze what is inside of the plant. The inner parts of the plant that we are concerned with are the Ester, Ether, and Lignin bonds that bind all the compounds that we need to analyze. We had three treatment groups: S (no nitrogen based fertilizer added), NS (Nitrogen based fertilizer added), and C (nothing touched). Adding fertilizer to a treatment group simulates what the plant will do in nutrient sufficient soil. By comparing and contrasting the data found in these groups, we could then understand the behaviors and properties of the plant. Understanding the plant would allow us to isolate the growth factor and eliminate it.

DESIGN AND SYNTHESIS OF A 3,5-DIAMINO-1,2,4-TRIAZOLE AS A LYSINE SPECIFIC DEMETHYLASE-1 INHIBITOR FOR THERAPEUTIC USE IN CANCER

Allison McLane

Governor's School for Science and Math

Mentor: Dr. Woster; Department of Drug Discovery and Organic Synthesis, Medical University of South Carolina

Pancreatic Cancer is one of the most lethal of all cancers and new therapeutic treatments are needed. Pancreatic cancer is one of the many cancers in which a chromatin remodeling amine oxidase enzyme, lysine specific demethylase 1 (LSD1) is over expressed. LSD1 is an enzyme that causes the change in histone density in order to control gene suppression. When bonded with a corepressor protein (CoREST) to form the protein complex, LSD1 demethylates the epigenetic markers on histone 3 lysine 4 (H3K4) and silences tumor suppressor genes. These epigenetic modifications allow H3K4 to be a common site for tumor growth in cancerous cells. The epigenetic markers on a histone determine the density of the chromatin complex and whether or not a gene will be read and sequenced. Epigenetic drug discovery is important to the advancement of cancer research because abnormal gene modification can be lethal. Discovered previously by virtual screening, 3,5-diamino-1,2,4-triazole was found to be a very effective LSD1 inhibitor. It is hypothesized that synthetic analogs of 3,5-diamino-1,2,4-triazole as lysine-specific demethylase 1 (LSD1) inhibitors will decrease demethylation of histone lysine residues and increase tumor suppressor gene expression in cancer cells, thereby having a therapeutic use in cancer treatments. To test this hypothesis, synthetic analog N5-(2-(2-(benzyloxy)phenoxy)-6-chlorobenzyl)-1H-1,2,4-triazole-3,5-diamine was successfully synthesized. Future directions for this project are to test this compound against PANC-1 pancreatic cancer cells for LSD1 activity and compare the results to other analogs of 3,5-diamino-1,2,4-triazole for their LSD1 inhibition.

## THE EFFECT OF IMAGE OVERLAP ON ACCURACY OF PHOTOGRAMMETRY USING UAVS

Thomas McLean

Spring Valley High School

Mentor: Dr. Kenny McLean; CDS Corporation

Image overlap is a variable in photogrammetry. It determines the amount of overlap that two parallel images have when creating a photogrammetric model. There is both longitudinal and latitudinal overlap. The purpose of this experiment was to find a percentage of image overlap that created the most accurate model in photogrammetry. It was hypothesized that an image overlap of 80%-75% would be the most accurate in creating a photogrammetric model, because it would create the most overlap between the images. Nine different ratios of image overlap were tested to see which were the most accurate. A diamond of markers, 200 ft apart from each other was first placed in an open field. They were first input into a flight plan for the Unmanned Aerial Vehicle (UAV) through a computer. Once this was done the drone was launched and the data from the flight was collected and saved. The image pool from the flight, along with the mission area, the lens data, and the CMOS data were then loaded into a project in Pix4d. From these data sets, the software understood the projection. From there, the pictures were exported into Global Mapper where they were measured to see the distance between them and then compared to the known distance of 60.96 m (200 ft). These methods were repeated for all nine overlaps. Four of the tests failed to create an image due to insignificant image overlap. All of the other tests successfully created an image and could be analyzed to see which were the most accurate. The first flight had the smallest average variance between the established and the measured distance, thus making it the most accurate of the flights. A one-way ANOVA test was run on the results to establish if there was a significant difference in between the variances. It was determined that there was not because  $p = 0.144 > \alpha = 0.05$ . Thus, the conclusion was made that the overlap did not affect the accuracy, it just determined whether it would have enough information to create an image.

## ALDA-1 ATTENUATES HEPATIC ISCHEMIA/REPERFUSION INJURY

Veronica McLeod

Governor's School for Science and Math

Mentor: Dr. Zhong; College of Pharmacy, Medical University of South Carolina

Advisor: Lance Riddle

Ischemia/reperfusion (I/R) injury is the tissue damage caused when blood flow returns (reperfusion) after a period of lack of blood flow (ischemia). Oxidative stress occurs during I/R and causes the formation of toxic aldehydes. Mitochondrial aldehyde dehydrogenase (ALDH2) is the major enzyme for degradation of these toxic aldehydes, and Alda-1 is a small molecule that increases the activity of ALDH2. While Alda-1 has been known to reduce different oxidative stress-related diseases such as radiation dermatitis and I/R in the heart and brain, its effect in the liver is unknown. We examined the effects of Alda-1 using a mouse warm I/R model (1 hour ischemia to 70% of liver before ischemia).

## THE ECOLOGY AND REPRODUCTIVE HABITS OF THE DIAMONDBACK TERRAPIN IN AND AROUND THE CHARLESTON HARBOR

Ashley McVicker

Governor's School for Science and Math

Mentor: Dr. Grosse; Wildlife and Fisheries Department, SC Department of Natural Resources

Male and Female eggs of the diamondback terrapin were incubated and observed to determine the average time between when the hatchling cracks the egg and when the hatchling absorbs the yolk. This time was found to be about a day between egg cracking and when the hatchling exits the egg. The average time for yolk absorption was six days. This allows us to determine the optimal release time of hatchlings to increase survivability.

## A DANGEROUS CURVE: THE EFFECTS OF TECHNOLOGY ON THE CERVICAL VERTEBRAE /

Kinsey Meggett

Center for Advanced Technical Studies

For my research project, I intend to bring awareness to the long term effects that technology has on the neck curvature. The idea of "Tech Neck" is that technology has caused an increase in the curvature of the neck and the spine. This is due to the incorrect posture that goes along with using these devices. Tech Neck has become an increasing problem in the past few years as increased productivity of technology continues to grow. The term Text Neck comes from the extended neck curvature that occurs when one looks down at any mobile or technical device. When the head is level, it weighs 10 pounds, at an angle of 15 degrees, it weighs 27 pounds, at an angle of 30 degrees it weighs 40 pounds, at an angle of 45 degrees, it weighs 49 pounds, and at an angle of 60 degrees, it weighs 60 pounds. The neck is the support structure of the head and when the head is tilted down at an angle, it adds weight to the neck causing a major curving of the cervical vertebrae. This is a new problem that is escalating quickly in the medical field. Because there is little known about the future of technologies course, it is important to bring awareness of the Text Neck that is present now and develop steps to decrease the issue.

THE IMPACT AND SUSTAINABILITY OF INFECTIOUS DISEASE PHARMACIST INTERVENTIONS ON REDUCING ANTIRETROVIRAL ERRORS AND ERROR DURATION IN A CRITICALLY ILL HIV-INFECTED POPULATION OVER A FIVE-YEAR INTERVENTION PERIOD /

Tanvi Mehta

Spring Valley High School

Mentor: Dr Brandon Bookstaver; South Carolina College of Pharmacy and Palmetto Health Richland

Antiretroviral (ARV) medications have been used to reduce the mortality and severity of illnesses that accompany Human immunodeficiency virus (HIV), but ARV medication errors pose a serious threat for reducing effectiveness and harming HIV patients. Many of these patients require hospital admission, and a substantial portion require management in an intensive care unit (ICU). Those admitted in the ICU may have a particularly higher risk for medication errors. The primary purpose of this study is to determine the percentage of HIV patients in the ICU who experienced ARV-associated errors. A retrospective chart review was conducted among patients who had HIV or AIDS in the ICU. Patient charts were reviewed for demographic information, medication history, and medical information. ARV-related errors were identified and classified. It was found that over 67% of patients were male, over 85% were African-American, and almost 30% of patients were not placed on an ARV regimen. Preliminary results show that there were 118 patients with errors and 190 total errors, with some patients having multiple errors. In total 60.2% of patients experienced some type of medication error. Further analysis showed that the most common error was a dose omission (32.6% of the errors). Other common errors include complete regimen omissions (24.7%) and dosing errors (16.3%). Further analysis will be completed to verify drug-drug interactions, crushable medication errors, and analyze risk factors. A future study will be aimed to determine if errors that occur in the ICU cause an increase in patients' viral loads.

DESIGNING A STRETCHING DEVICE TO IMPROVE EFFICIENCY OF CONGENITAL MUSCULAR TORTICOLLIS TREATMENT

Hillary Melton

Center for Advanced Technical Studies

Congenital muscular torticollis causes the head to tilt towards one side resulting in limited range of motion. This condition occurs in approximately one in every three hundred births. There is not a device used during stretching to lessen the stress associated with the treatment and to make the treatment more engaging for patients. If a versatile, freestanding device that support congenital muscular torticollis patients during their stretching period is created, then the infants will become more engaged in the treatment— lessening the stress and direct engagement of the caregiver. During physical therapy consultations, patients will participate in traditional stretching methods, and they will test the stretching device prototype. Data is collected from parents completing a survey. The survey addresses the diagnosis of congenital muscular torticollis, parents' stress level, execution of the stretch, and infant engagement. Survey results will be analyzed and a redesigned prototype will be tested if necessary. It is anticipated that physical therapists and parent involvement will decrease with the prototype while infant engagement, execution of the stretch, and equipment accessibility will improve.

THE LC50'S FOR NITRATE AND SULFATE

Noah Mervak

Chapin High School

The goal of this project was to find the LC50 (lethal concentration required to kill 50% of the animals) for nitrate and sulfate for ceriodaphnia dubia (water flea). This was done by performing 8 acute toxicity tests; 5 conducted with NaNO<sub>3</sub> (sodium nitrate) in dilution water, and 3 conducted with CaSO<sub>4</sub> (calcium sulfate) in dilution water. Data yielded by NaNO<sub>3</sub> acute toxicity tests were considered conclusive when a concentration of NaNO<sub>3</sub> killed less than 50% of the water fleas (ceriodaphnia dubia) and a concentration of NaNO<sub>3</sub> killed greater than 50% of the water fleas. Data yielded by CaSO<sub>4</sub> acute toxicity tests were considered conclusive when a concentration of CaSO<sub>4</sub> killed less than 50% of the water fleas and a concentration of CaSO<sub>4</sub> killed greater than 50% of the water fleas. According to these standards, 2 of the 5 NaNO<sub>3</sub> acute toxicity tests were conclusive and 2 of the 3 CaSO<sub>4</sub> acute toxicity tests were conclusive. Using the acute toxicity tests considered to have conclusive data, 2 graphs were made, one for NaNO<sub>3</sub> and one for CaSO<sub>4</sub>. Based on the 2 graphs made, the LC50 for NaNO<sub>3</sub> was calculated as 3.05g/L and the LC50 for CaSO<sub>3</sub> was calculated as 5.95g/L. Based on the LC50s for NaNO<sub>3</sub> (3.05g/L) and CaSO<sub>4</sub> (5.95g/L), the LC50 for nitrate was calculated as 2.22467g/L and the LC50 for sulfate was calculated as 4.19832g/L.

EFFECT OF CONCUSSION KNOWLEDGE ON HIGH SCHOOL ATHLETES LIKELINESS TO REPORT CONCUSSIONS

Katie Miller

Chapin High School

A survey was given to 68 students at Chapin High School. It was found that 97% of the athletes incorrectly identified the risks of concussions. The data also revealed that athletes would not report concussions due a lengthy recovery time and a loss of playing time. Athletic directors of multiple schools were contacted and asked to provide any concussion related information that is given to the athletes of that particular school. The data collected from each school will be paired with survey responses from the athletes of that particular school to find correlations between the concussion related information provided to the athlete and the likeliness of that athlete reporting a concussion. The survey will be similar to the one given at Chapin High School and will be administered to athletes attending the SMART physical day at USC on April 22.

## GEMINI: A STUDY OF THE DUALITY IN BEHAVIOR ANALYSES ASSESMENTS

Jamie Milliff  
Chapin High School

The purpose of this project was to develop an proactive threat assessment that could be used to determine patterns of threatening behavior to public safety before a crime was committed. This assessment would use pre-existing criminal profiling techniques and a wide variety of psychological findings from the past century to determine patterns of behavior leading up to criminal actions. Over the course of this research, it was discovered that this type of assessment could not be used in a Criminal Justice setting, as it was initially intended, due to its requirement of highly sensitive personal information to complete a full analysis. Collecting this information would break privacy laws and violate privacy rights afforded to citizens in most civilized nations. The focus of the research then shifted to developing a threat assessment that could be used by lay people such as administrators and parents without training in profiling techniques who may be worried about a student or child. Interviews with members of faculty from local high schools and law enforcement departments are pending. The data collected from these interviews would be used to show how useful this kind of assessment might be in preventing tragedies like school shootings or adolescent homicides and suicides. This has implications in the safety of institutions, and may be able to provide a firmer understanding and handling of atypical behavior throughout society.

## IN VITRO EFFICACY OF DOXORUBICIN ENCAPSULATED IN THERMOSENSITIVE LIPOSOMES (TSL)

Emily Milz  
Governor's School for Science and Math  
Mentor: Dr. Haemmerich; Department of Pediatrics, Medical University of South Carolina

Drug delivery systems aim to reduce the side effects of cytotoxic chemotherapy drugs by targeting tumor cells. Thermosensitive liposomes (TSL) act as one such system by encapsulating chemotherapy drugs until heated to 42°C. This research focuses on TSL that encapsulate doxorubicin, a chemotherapy drug used to treat aggressive cancers. Our goal was to demonstrate that unheated TSL will not release their doxorubicin contents and have the potential to reduce doxorubicin's side effects. We treated two microplates, one heated and one non-heated, of Lewis lung carcinoma (LLC) cells with concentrations of either unencapsulated doxorubicin or TSL encapsulated doxorubicin ranging from 10 nM to 100000 nM. We then performed viability assays to determine percent remaining viable cells at different doxorubicin concentrations. Lower percentages of cells remained viable in the heated microplate compared to the non-heated microplate, which indicates that more doxorubicin was released from TSL when heated. In both microplates, fewer cells remained alive in wells treated with unencapsulated doxorubicin compared to those treated with TSL encapsulated doxorubicin. Although these results support our hypothesis that TSL encapsulated doxorubicin would be the least cytotoxic, the slight percent decrease in remaining viable cells after treatment with TSL encapsulated doxorubicin in non-heated conditions indicates that some doxorubicin was released from the TSL even without a heat trigger. This suggests that fragile TSL do not completely eradicate doxorubicin's side effects due to drug leakage. In future experiments, a wider range of low doxorubicin concentrations could be tested to evaluate the extent of TSL leakage.

## TARGETING RGD-INTEGRINS IN U87 CELLS TO ENHANCE THE DELIVERY OF MICELLE-ENCAPSULATED TEMOZOLOMIDE

Hannah Mitchum  
Governor's School for Science and Math  
Mentor: Dr. Broome; Department of Radiology and Radiological Science, Medical University of South Carolina

The Blood Brain Barrier (BBB) is a major obstacle when treating brain diseases. Glioblastoma tumor have been particularly devastating as they are nearly impossible to treat with surgery and/or chemotherapy. The FDA approved drug, Temozolomide (TMZ), is effective at destroying U87 brain tumor cell lines in vitro. But in vivo, TMZ is unable to access the tumor efficiently due to charge, size and lipophilicity. Patients administered TMZ have a 10% chance of surviving two years while suffering severe side effects. Clinical research has proven micelle packages are capable of delivering encapsulated drugs across the BBB. The aims of this research is to enhance TMZ delivery and reducing off site side effects using cRGD conjugated micelles. The micelle, composed of PEG-PE-amine and PHC are conjugated with the peptide cRGD and dylite 680 to the amine group by sonication. The cRGD peptide is specific for the RGD integrin seen in U87 tumor cell lines. The micelles showed TMZ encapsulation with dylite 680 tagging using Ultra-Violet Visible Spectroscopy and Dynamic Light Scattering confirmed particle size. U87 cells were treated for varying times, with targeted micelle (RMTMZ) and non-targeted (MTMZ) in the presence or absence of Brefeldin A (BA), an inhibitor of receptor mediated endocytosis. Epi-florescent microscopy showed that RMTMZ without BA had a 77% greater intensity compared to RMTMZ with BA, and 56% greater intensity than MTMZ. Cytotoxicity assay indicated RMTMZ was 71% more proficient at killing U87 cell lines. RMTMZ can now be tested in vivo followed by a pH stability assay.

## TRANSFORMATION AND CHARACTERIZATION OF DESKJET PRINTERS INTO LOW-COST BIOPRINTERS FOR DRUG SCREENING AND CELL PRINTING

Ariel Moore

Governor's School for Science and Math

Mentor: Dr. Rodriguez-Devora; Department of Bioengineering, Clemson University

Drug development is a timely and risky industry. High throughput drug-screening using inkjet printing technology could be the solution to the problems that arise during drug trials. This work shows the modifications made to an inkjet printer in order to make it fit to be used to print anti-cancer drugs. An HP Deskjet 600 printer was characterized in order to establish what volume of a liquid could be printed for different pixel sizes, liquid viscosities and colors. MCF-7 cells and 3T3 cells and an anti-cancer drug were pipetted into one cell plate while cells were pipetted but the anti-cancer drug was printed into another cell plate. The cells in both cell plates were counted using CellTiter 96® Aqueous One Solution Assay each day from day 0 – day 4. Then the effect of the pipetted anti-cancer drug was compared to the effect of the printed anti-cancer drug on the cells. This work has the potential to lead to further development in high throughput bioprinting technology.

## PROTEIN-PEPTIDE INTERACTION PATTERNS OF M-10 AND INHIBITORY EFFECTS ON COLLAGEN EXPRESSION BY M-10 PEPTIDE IN SSC LUNG FIBROBLASTS

Austin Moore

Governor's School for Science and Math

Mentor: Dr. Bogatkevich; Department of Rheumatology and Immunology, Medical University of South Carolina

It is known that the M-10 peptide has an antifibrotic effect on fibroblasts that have Systemic Sclerosis (SSc) Lung Fibrosis. This paper focuses on how a modified M-10 peptide would interact with the fibroblasts. A caspase 3 inhibitor was added to the peptide to enable more control over the diseased cell. However, the impact of the addition of this caspase 3 inhibitor on the cell was unknown. A Western Blot was performed to test if this modified M-10 peptide would still reduce collagen levels in fibroblasts, therefore, inhibiting fibrosis. A standard staining experiment was also performed to determine if the modified M-10 peptide was able to enter the nucleus so that it could have an impact on the cell by inhibiting collagen expression. The fibroblast cells used were MRC5, A549, and N9 cells. The results from the Western Blot were successful since collagen expression was reduced in fibroblasts with the M-10 peptide and TGF- $\beta$  when compared to fibroblasts with only TGF- $\beta$ . The staining experiment was also successful because under a fluorescent microscope, the red-stained peptide was clearly visible throughout the cell and nucleus, therefore it would be able to interact with and impact the cell to inhibit fibrosis.

## THE EFFECT OF CIPROFLOXACIN ON ESCHERICHIA COLI, AQUASPIRILLUM SERPENS, AND STAPHYLOCOCCUS EPIDERMIDIS

Olivia Moran

Heathwood Hall Episcopal School

The purpose of this experiment is to attempt to induce bacterial resistance to Ciprofloxacin. Three different bacteria were put to the test as the independent variables: Escherichia coli, Aquaspirillum serpens, and Staphylococcus epidermidis. The dependent variable is the bacterial growth when exposed to Ciprofloxacin. The hypothesis is that if Escherichia coli, Aquaspirillum serpens, and Staphylococcus epidermidis are exposed to Ciprofloxacin, but not completely exterminated, they will all become resistant to the antibiotic. The null hypothesis is if Escherichia coli, Aquaspirillum serpens, and Staphylococcus epidermidis are exposed to Ciprofloxacin, but not completely exterminated, they will not become resistant to the antibiotic. Research was conducted, a procedure was established. Materials including Ciprofloxacin, Escherichia coli, Aquaspirillum serpens, and Staphylococcus epidermidis were purchased. First, Agar was made and poured into the petri dishes and left to set/cool. They were then refrigerated. When the bacteria arrived, a streaking method was first applied to culture the bacteria from slants. They were left to grow for 2-3 days. Next, the Ciprofloxacin was placed in the petri dishes. There were 18 dishes of each bacteria: 15 were exposed, and 3 were left to be the controls for each trial. The dishes were exposed for 48 hours. Pictures were taken, the antibiotic was then removed, and the next round of bacteria was cultured. This process was repeated for 2 additional trials, and then a new method of culturing was applied. A bacterial lawn made the zone of inhibition easier to observe. The experiment was yielding limited results so paper discs soaked in Clorox bleach were placed into the dishes to prove the antibiotic discs faulty. However, none of the bacteria died from the Clorox bleach, which leads us to proclaim this trial inconclusive.

CONSUMER ANALYSIS AND MARKETING STRATEGY: CULMINATING METHODS TO PROCURE THE MAXIMUM  
EXTENT OF CLIENTS AT NORTH DARGAN INNOVATION CENTER

Quannadon Moses

Governor's School for Science and Math

Mentor: Dr. Hill; President, HillSouth iT Solutions, North Dargan Innovation Center

Marketing is a hit or miss when it comes to businesses. It depends on how consumers react to the product or service offered. Therefore, it is the sole responsibility of the business to promote and advertise their amenities effectively. A business incubator is not the average, everyday product being marketed, but they are on the rise. Because an incubator is different, one must use different methods to appeal and extend the service to clients. The most helpful method is simply digital marketing. With today's extensive technological capabilities, digital marketing is essentially limitless. Thus, the best way to acquire a client's attention is to use cell phones and other portable communication devices. At the incubator, almost all of its current clients completed their work on some sort of device. They all used a computer in one way or another. At one point these clients had to network to meet new people and gain opportunities. One way they did so was by social media. Today, many people attach their social media accounts to their smartphones, which usually is always within arm's reach. This observation led me to conclude that the best ways to sell the incubator was using video marketing, text marketing, and social media marketing. Conveniently, all of these methods are connected to each other by way of technology. Today, technology is the primary source of distraction and therefore, is the best way to reach clients which is known as interruptive marketing.

AN ANIMAL MODEL OF PTSD FOLLOWING SOCIAL STRESS

Sarah Mott

Spring Valley High School

Mentor: Dr. Susan Wood; University of South Carolina School of Medicine

PTSD is a mental illness that can develop after someone experiences a major traumatic event. PTSD plagues about 7-8% of the American population. Animal models can be used to better understand this disease and to help develop a cure. The purpose of the present investigation was to develop an animal model of the changes that occur during PTSD and to determine whether an individual's coping strategy to stress was correlated with the development of these PTSD symptoms. The hypotheses presented in the investigation were that exposure to social stress would produce increases in blood pressure and yohimbine responsiveness that are similar to those seen in patients with PTSD and that the vulnerability of the animal to these cardiovascular effects of social stress would depend upon its coping strategy. These hypotheses were tested using the resident-intruder paradigm of social stress (Wood & Bhatnagar, 2015). In addition, the effect of the social stress on blood pressure responses to yohimbine was measured 12 days after social defeat in order to assess longer term effects of the stressor that are relevant to PTSD. These results were correlated with behavioral response of the animal to assess the effect of coping strategy. The hypotheses were both supported. A One-way ANOVA test revealed that social defeat significantly enhanced the effect of yohimbine on mean arterial pressure and the animal's vulnerability to these cardiovascular changes directly correlated to its coping strategy in the resident-intruder model. At  $\alpha = 0.05$ ,  $F(2,12) = 6.38576$ ,  $p = 0.01633$ . These results support the conclusion that this model accurately represented cardiovascular changes associated with PTSD.

CONCEPT AND IMPLEMENTATION OF A CRUISE CONTROL APPLICATION AND TEST ENVIRONMENT FOR A  
SAFETY CRITICAL EMBEDDED DYNAMIC APP-DOWNLOAD PLATFORM

Tiger Mou

Governor's School for Science and Math

Mentor: Dr. Dropmann; Embedded Systems Quality Assurance, Fraunhofer Institute for Experimental Software Engineering

The researchers at the Fraunhofer IESE had developed and improved upon the ConceptCar platform as an educational research platform. The ConceptCar platform uses low resource embedded controllers to operate a remotely controlled electric car. The controllers communicate through the Controller Area Network (CAN), similar to in modern cars. The controller runs a dynamic application platform, coded in C. Applications installed on the system control certain aspects of the car such as the engine, sensors, and multimedia. However, the only applications available prior to this research were simple math applications and LED blinker applications. These applications are not realistic or appealing to researchers or industries who want to utilize similar technologies. To assist with the researchers' work, a PID cruise control application was developed for the embedded controller. However, testing such an application is difficult on a real car, and even the ConceptCar. To make testing and work with the application more convenient, an engine model was developed in Eclipse Modeling Framework using Java. This engine simulation test environment is a tool that provides a graphical user interface for convenient data viewing and control of test environment variables such as the speed. The model runs on a host computer and communicates with the controller through the CAN network. Messages are sent back and forth in real time. The creation of the application and test environment allows for more realistic and advanced testing and unlocks opportunities for ongoing and future research regarding embedded controllers.

## QUANTITATIVE ANALYSIS ON CHARLESTON'S ENTREPRENEURIAL SECTOR

Ryan Moughan

Governor's School for Science and Math

Mentor: Dr. Osborne; Director, Harbor Entrepreneur Center

Silicon Valley is the world leader for new technology and innovation, mainly because of entrepreneurship. Charleston, South Carolina is looking to mimic this success in order to grow both the greater Charleston region and the state of South Carolina as a whole. In order to do so, the history of Silicon Valley was examined in order to find factors that most influenced its success. From there, a quantitative evaluation, mainly using regression analysis, was performed to examine each variable. The prevailing factor of startup hubs appeared to be the presence of high-level computer science universities, so the relationship between top computer science universities and startup outputs such as Initial Public Offerings (IPOs), Mergers and Acquisitions (M&As), and Patents was studied, which resulted in strong correlations. After finding that South Carolina severely lacked the universities to perform research or attract talent, Poaching Theory was developed.

## THE EFFECT OF VARIOUS SUNSCREENS ON UV SENSITIVE YEAST

Emmye Mullins and Amelia Robinson Brown

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The purpose of this experiment was to determine the effectiveness of various sunscreen brands to protect yeast cells against UV radiation. Yeast cells were chosen because they are a good model of human cells. UV sensitive yeast (*Saccharomyces cerevisiae*) were grown on Petri dishes. Then different sunscreen brands: Banana Boat, Coppertone, Hawaiian Tropic, and Neutrogena were applied to plastic wrap and placed over different Petri dishes. The Petri dishes were exposed to UV radiation for one hour with one half of each Petri dish exposed and the other half covered with aluminum foil. Petri dishes were photographed and then using ImageJ software, the average pixel color intensity in candelas per square meter of the exposed side was compared to the covered side. These numbers were used to find the percent of yeast cells lost in each Petri dish. It was hypothesized that if the Coppertone Clearly Sheer For Sunny Days Sunscreen Lotion SPF 30 is applied to the UV sensitive yeast cells, then it will protect the cells more than the other brands of sunscreen because it contains the highest percentage of active ingredients. The null hypothesis was that the brand of sunscreen would have no effect on the protection of yeast cells against UV radiation. Neither of these hypotheses were supported by the data. Instead, the data showed that Hawaiian Tropic best protected the yeast cells from UV radiation.

## THE EFFECT OF R-FACTOR ON THE SUMMATION OF CANTOR'S DUST IN THE CANTOR FRACTAL

Athreya Murali

Heathwood Hall Episcopal School

The purpose of this research is to determine the relationship between the r-factor of a Cantor Fractal C and the approached value of the summated lengths of removed line segments from each iteration of C. This was performed on a Python 2.5.1 program, where a recursive function returned the number of lines segments removed at the iteration and the total lengths of these removed line segments, starting at the first iteration. This is done by indirectly using an L-system. The mean, median, and mode were found to have values of approximately 1. With a range of 0.135297701585457, the minimum of the dependent variable was found to be 0.864702298414543 and the maximum 1. The standard deviation was 0.02609877259. After performing the ANOVA test, it was found that the data was not statistically significant, as the F-value was less than the F-critical value, rejecting the hypothesis. Thus, there was no correlation between the r-factor and the approached lengths of the summated removed line segments for any Cantor Fractal C, and the null hypothesis was accepted.

## THE EFFECT OF SOIL ADDITIVES ON THE LEVEL OF VITAMIN A IN PIPER BETEL

Meghan Murphy

Dutch Fork High School

Many women and children in Cambodia are dying prematurely due to a vitamin A deficiency within their diet; this is known because of the prevalence of night-blindness which is a common symptom. Piper Betel is a plant that is commonly eaten in southeast Asia and all parts of the plant are eaten. If various substances containing high levels of vitamin A are added to the soil of Piper Betel then the level of vitamin A within the Piper Betel will increase. The materials needed for this experiment are nine Piper Betel plants, nine potting containers, heat lamps, syringes, mortar and pestle, oysters, carrots, and a fluorometer. The nine Piper Betel plants will be kept in three groups of three with one being the control. Each of the other two groups will either receive five grams of oysters or carrots every three days along with the same amount of water. As the plants mature the level of Vitamin A will be tested using a fluorometer by taking five grams of the leaves from a plant and crushing that sample using a mortar and pestle and combining it with liquid from the plant, this substance will then be put into the fluorometer for a measurement of the amount of light reflected off of the proteins within the vitamin A.

## A COMPARISON OF GASOLINE AND HYDROGEN USAGE IN AN R/C ENGINE FOR THE RETURN ON INVESTMENT

Breanna Murrin  
Spring Valley High School

Vehicular exhausts are responsible for more than half of the carbon dioxide emissions in the Earth's atmosphere. In response to this, researchers have been looking at hydrogen as a replacement for gasoline because its only byproduct is water, and this significantly reduces carbon dioxide emissions. This research focuses on a comparison of gasoline and hydrogen efficiency and the return on investment for each. It was hypothesized that the gas-hydrogen motor would be more work efficient. Hydrogen is more combustible than gasoline and would be less expensive in the long run. For the gas-hydrogen one would only have to pay for the hydrogen kit and smaller amounts of fuel whereas for gasoline only one would have to continuously pay for larger amounts of gasoline. Trials were run for the engine using gasoline only and for the engine using a combination of gasoline and hydrogen. A hydrogen production kit was added to the regular gasoline engine to make it a hybrid for the gasoline-hydrogen trials. Fuel efficiency was tested by timing how long it took for 25 mL of fuel to be consumed. Hydrogen, produced through water electrolysis, was included in the fuel consumption by introduction through the air intake. The gasoline motor had a run-time mean of 11.490 minutes and a standard deviation of 0.885 minutes. The gas-hydrogen motor had a run-time mean of 17.564 minutes and a standard deviation of 0.928 minutes. A two-sample t-test was  $[t(-18.65), p < 0.001]$  indicated that the gas-hydrogen motor had a significantly longer run-time than the gasoline motor. The hypothesis was supported for the gas-hydrogen model was more efficient, and its practicality in the real world is probable.

## THE EFFECT OF COOKING OIL ON PM2.5 PRODUCTION

Treveen Myers  
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Particulate matter (PM) is a small particle of airborne pollution that is the size of a microgram. Over the years, PM production has accumulated and has caused several health problems, which can range from mild bronchitis to death. One of the ways it is created is by cooking or burning foods. The purpose of the experiment was to show the effects of cooking oil on PM2.5 production, and which kind of cooking oil produces the least amount. It was hypothesized that canola oil would produce the least amount of PM2.5. The independent variables were the different types of cooking oils. Canola, corn, and safflower oil were used to fry ground beef in a frying pan for two minutes on an electric stove's medium setting. The control was cooking with no oil. The data showed that the hypothesis was supported with canola oil producing the least amount of PM2.5, and the control of no oil producing the most. In order from greatest to least, no oil had a total of 18.8 micrograms, corn oil had a total of 14.1 micrograms, safflower oil made a total of 7.5 micrograms, and canola oil created an average of 4 micrograms of PM2.5. An ANOVA test was run to determine the significance of the means and a Tukey test was used to find the sources of variance between each mean. In conclusion, with respect to corn and safflower oil, canola oil had the least impact on the PM2.5 level.

## THE EFFECT OF PROCESSING BEANS ON THE AMOUNT OF PROTEIN

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Considering that beans are an essential source of protein for many people all over the world, it is important to find a way to purchase the most protein rich and nutritious beans. The decision between purchasing canned vs. dry beans may seem insignificant, however there are many benefits to purchasing dried beans instead. The purpose of this experiment was to investigate the effect that the process of canning can have on the protein levels in kidney, black, and pinto beans. In this study, the protein levels of canned kidney beans were compared to dried kidney beans, the same was done for black beans and pinto beans. The independent variable was the type of bean tested, The dependent variable was the amount of protein measured. For this study the hypothesis was, if the protein content of dry beans are compared with canned beans, then the dry beans will have a higher protein content. The null hypothesis was that there would be no measurable difference in the protein content of dry versus canned beans. The first step in beginning the project was to run a test using a set of protein standards with a variety of concentrations. Then the beans were made into a paste and filtered through a vortex, the remaining bean supernatant was placed into a spectrophotometer cuvette. The beans were then placed into a spectrophotometer with a wavelength set at 595 nm and the absorbency levels of each of the solutions were compared to the protein standards analyzed in the beginning of the experiment. Once an ANOVA test was conducted the results were shown to be statistically significant. The results suggest that the dried kidney, black, and pinto beans had higher levels of protein than the canned beans.

## THE EFFECT OF CILIA ON CARDIAC VALVE DISEASES

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Governor's School for Science and Math

Mentor: Dr. Norris; Department of Regenerative Medicine and Cell Biology, Medical University of South Carolina

Cardiac valve diseases are found in roughly 10% percent of the population, forcing many people to undergo surgery (Norris, 2015). Previous studies have shown that the cardiac valve diseases were related to a gene called DZIP1, which is necessary for primary cilia formation (Durst, et. al, 2015). This project focused on observing and showing primary cilia is required for cell differentiation. Immunohistochemical stains on wild type and cilia knockout mice were performed and 3D reconstructions were used to observe valve structure and volume. There was an increase Sox 9 and Runx 2 in the knockout, suggesting that



differentiation is affected by loss of cilia. The results of the 3D reconstruction showed that the knockout valve had an increase in volume and shape compared the wild type valve. This work has capitalized on genetic data from patients with cardiac valve diseases and shows how primary cilia are important as a previously unrecognized contributor to valve disease.

#### EFFECT OF TIME IN A MICROWAVE ON MICROCOCOCCUS LUTEUS

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This experiment studied the effect of time in a microwave on growth of *Micrococcus luteus*. *Micrococcus luteus* was introduced onto pieces of turkey to be microwaved (1350 W). The hypothesis is that the turkey in the microwaved for 0 seconds would have more growth than on the 25 second turkey slices did. These pieces of turkey were cut into congruent circles. The bacterial broth was mixed with two 125 mL bottles of nutrient broth to increase the amount of bacteria that was used. The broths incubated for two days in 25°C. The slices of turkey were fully submerged in the bacterial broth. The new infected slices of turkey were microwaved for four different times with four slices for each time. These times were 10 seconds, 15 seconds, 20 seconds, 25 seconds, and 0 seconds. The petri dishes were introduced to the bacteria from the turkey using an inoculation loop. The petri dishes incubated for four days at 25°C. The colonies were hand counted. The petri dishes that had been inoculated with turkey that were microwaved for 0 seconds have colony counts of 8, 5, 100, and 163. The 10 second dishes' counts are 4,2,1, and 1. The 25 second dishes' counts are 0,0,1,1. The 20 second dishes' counts are 0, 0, 2, and 1. The 25 second dishes' counts are 0, 1, 3, and 3. These results show that the shorter times (10 seconds) has more bacterial growth than the longer times (20 seconds, 25 seconds).

#### AN EVIDENCE-BASED EDUCATION INTERVENTION PROGRAM FOR DISPARITIES IN CLINICAL RESEARCH

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Governor's School for Science and Math  
Mentor: Dr. Lackland; Department of Neuroscience, Medical University of South Carolina

The existence of racial disparities in hypertension related outcomes including stroke, chronic kidney disease and heart failure, as well as in hypertension prevalence, awareness, treatment and control are well documented. Strategies to prevent and manage high blood pressure (HBP) in the population have been proven to be successful, but there continues to be a lack of reduction in the disparities between sub-groups of the population including non-Hispanic whites, non-Hispanic blacks, and Hispanics/Latinos. A particular concern is the potential knowledge gap in health professionals regarding their understanding of the factors contributing to these disparities, and as a result a health professional education program called 2013: Social Determinants of Health was developed. The aim of this research was to further develop the program by determining whether each of the eight one hour long program videos contained relevant information concerning indicators such as HBP prevalence, awareness, treatment, and control, in which disparities exist. A summary and a post exam composed of ten questions were created for each module, and knowledge, behavior, and outcome gaps were identified in each video. Results from the video summaries suggest that the 2013: Social Determinants of Health program can serve as a tool for educating providers on the topic of disparities. The key elements of this program are its easy accessibility to all health professionals online and the evidence-based presentations given by nationally recognized experts in the medical field.

#### D-LIMONENE DERIVED FROM ORANGE PEELS AND ITS EFFECTS ON ETHANOL PRODUCTION

Spencer O'Connor  
Spring Valley High School

The use of corn for ethanol production is a pertinent issue in the transportation and fuel industry as well as an issue for the economy and environment, being used in greater demand for ethanol production than for feedstock. A shift towards second generation biofuels, created using non food biomass, such as orange peels, is arguably a necessary change. This experiment was conducted to confirm ethanol production from orange peels, and it was hypothesized that undistilled orange peels that are fermented, would be capable of producing ethanol due to the essential oils present in the peels, specifically D-limonene. For the experiment, the undistilled orange peels were fermented along with distilled orange peels for comparison. Twelve bottles were used with orange peel powder (OPP) percentages of 5, 10, and 20 percent. It was found that fermented orange peels were capable of producing ethanol, measured in alcohol-by-volume (ABV), for all of the trials. The results more importantly showed that there was a difference between the ABV of the distilled and undistilled bottles of OPP and that the undistilled OPP bottles produced more ethanol. /

#### MPING TRANSPOSITION REQUIRES NUCLEOTIDE SPECIFIC INTERACTIONS WITH THE TERMINAL INVERTED REPEATS

Cayla Odom  
Governor's School for Science and Math  
Mentor: Dr. Nathan Hancock; Department of Biology and Geology, University of South Carolina Aiken

Since their discovery in maize in the 1950's, the roles and characteristics of transposable elements (TEs) have continued to be focal areas of research for their roles in genome evolution. Transposable elements are pieces of DNA that can move, or transpose, throughout a genome. Our experiment further analyzed transposition by investigating the base interactions in the

rice TE Ping. Our focal region flanked the element in an area known as the terminal inverted repeats (TIRs). We hypothesized that highly conserved bases play a key role in transposition, testing the fifteen bases of the Ping TIRs. We PCR amplified the region using mutated primers to create fifteen constructs, each with a different mutated base. Two rounds of PCR were performed, one to make one base unreadable due to mutation and another to attach an additional sequence, which allowed for construct transformation into yeast. A yeast transposition assay was performed to identify successful transposition for each mutated base, as colonies only grow if the element transposes. Higher colony counts indicated greater rates of transposition. According the resulting transposition rates from the assay, all TIR bases were important for transposition. The conserved bases, save one at base position 5, had a lower transposition rate compared to the control construct. The element could not transpose when a conserved base was made unreadable through mutation. These results show that the transposition requires require specific nucleotides. It also suggests that certain transposable element bases remained conserved due to their role in transposition.

#### EFFECT OF DATING VIOLENCE PRESENTATION ON THE ATTITUDS OF 8TH GRADE GIRLS

Catherine O'Leary  
Chapin High School

In 2013, the Violence Policy Center ranked South Carolina number one in rate of women killed by men with a rate that is more than double the national average. According to the Center for Disease Control, nearly 1.5 million high school students in the United States experience dating violence from a boyfriend or girlfriend annually. A study tested the change in attitudes of Chapin Middle School 8th grade females about dating violence before and after an educational presentation on dating violence. A survey on Google forms was administered to the 8th grade girls assessing their knowledge and attitudes on dating violence. An educational slide show and video will be presented, and then one week following the presentation, the students took an identical survey on Google Forms. The change in the student's attitudes will be assessed using a Matched Pairs T Test. The test yielded a P Value of .02, yielding that the change in the subjects attitude with a specific decrease in their acceptance of dating violence. The results demonstrated that minimal and cost effective education about dating and domestic violence changes the attitudes of students and reduce acceptance of dating violence.

#### DESIGN AND IMPLEMENTATION OF HUMAN-TO-SWARM ROBOTICS SIMULATOR AND INTERFACE

Michael Ott  
Governor's School for Science and Math  
Mentor: Dr. Wang; Department of Mechanical Engineering, Clemson University

The purpose of our research was to test the interaction between humans and swarm robots along with using the new EEG sensor. For this study, an omnidirectional robot for use in Gazebo, the 3D simulator used for our research, was chosen. A joystick control was developed to control a leader robot within the swarm using velocity commands. A control system was then implemented to sync these robots together using velocity and position feedback loops, and simple collision detection was added. Then, an interface with the new EMOTIV EEG sensor was developed in order to both control the robots and to test for cognitive load on the teleoperator. The EEG sensor was able to send unidirectional commands to the robots. After the EEG sensor was correctly interfaced with, cognitive load of the human teleoperator was tested under varying conditions using the EEG device. Different situations such as varying topologies or number of robots was used to test changes in cognitive load of the human. Based on the results, the frustration signal was a good indicator of the cognitive load.

#### ELEMENTARY SCHOOL MUSIC STUDENTS AND THE EFFECTS OF INCORPORATING LEARNING STYLES IN THE CLASSROOM

Madison Owen  
Chapin High School

As learning styles are beginning to be incorporated into classrooms for more personalized learning, it is important for teachers to learn multiple different ways to present material so that way all of their students are reached. This study focuses on the VAK model, which includes the visual, auditory, and kinesthetic styles. In most cases, students do not identify their own learning style is until they are in high school, simply because they are more aware of how they learn the best. It is crucial for a teacher to understand their students particular learning preferences, and adapt to them so that they can help the child perform their best at any age. The question this project answers is, "How do elementary school music teachers embrace varying learning styles in a classroom so that their students maximize their potential to understand the lesson?" To conduct this study, a survey with a set of questions will be sent out to elementary school music teachers in District 5 to identify how they feel learning styles are addressed in their own classroom. These methods can then be shared among teachers, and which is important to the improvement of the quality of music education.

## TRANSPOSABLE ELEMENTS CONTAINING BINDING SITES FOR PLURIPOTENCY TRANSCRIPTION FACTORS FUNCTION AS ENHANCERS IN MOUSE EMBRYONIC STEMS CELLS

Asia Paguntalan

Governor's School for Science and Math

Mentor: Dr. Wang; Center for Genome Sciences and Systems Biology, Washington University School of Medicine

Transposable elements (TEs) make up nearly half of the human genome, but until the 1950's were considered "junk DNA." Barbara McClintock's seminal maize experiments established TEs as key regulatory components due to their ability to move about the genome. More recent studies demonstrate that TEs are enriched for binding sites for cell-specific transcription factors (TFs). This study examines the extent to which a TE with binding sites for multiple pluripotency TFs regulates differential gene expression in mouse embryonic stem (ES) cells. Three potential regulatory regions consisting of a TE with multiple binding sites, a non-TE region with multiple binding sites, and a TE without binding sites were cloned from the mouse genome and inserted into luciferase reporter vectors. These vectors were transfected into cells and luciferase assays were conducted to measure the regulatory potential of these three regions, along with positive and negative controls. The results of these assays indicate that a TE bound with multiple TFs enhances cell-specific expression of a nearby gene to a greater extent than a TE without TF binding sites or a non-TE region bound with multiple TFs. In conclusion, these findings highlight the role of TEs in enhancing differential gene expression in conjunction with cell-specific TFs. However, further research is needed to investigate role of TEs bound by cell-specific TFs in gene regulatory networks.

## THE EFFECT OF BRASSICA JUNCEA PHYTOREMEDIATION USING SOIL DOPED WITH CONCENTRATIONS OF COPPER (II) SULFATE SOLUTION ON SOIL NITRATE CONTENT

Sarayu Parise

Spring Valley High School

Phytoremediation is a remediation strategy that is used to restore soil quality. The process was proven by many other researchers to be more efficient, environmentally-friendly, and less expensive compared to other methods. In this experiment, phytoremediation was modeled with contamination from different concentrations of copper (II) sulfate solutions and Brassica juncea plants. Nitrate content was measured before and after the planting to see the effect that phytoremediation might have on the beneficial aspects of soil. It was hypothesized that if the soil was mixed with a 0.0015963 M solution of copper (II) sulfate, it would have the highest nitrate content in the soil left after the model phytoremediation. The different concentrations of the solutions were made by measuring three different amounts of copper (II) sulfate and mixing them into distilled water to make different molar concentrations. The soil was doped, left undisturbed for three weeks, and then the nitrate content was measured using nitrate strips. The Brassica juncea were sowed into the planter trays with the contaminated soil, placed under grow lights, and watered every weekday for three weeks. The nitrate content was measured again and both sets of data were plugged into a formula for exact nitrate content in soil. The hypothesis was rejected when the data depicted that the 0.0047688 M group of soil samples had higher nitrate content overall after phytoremediation instead of the 0.0015963 M group. At  $\alpha = 0.05$ , ANOVA tests indicated that the nitrate content per each soil sample was significantly different both before,  $F(3, 56) = 17.15$ ,  $p < 0.0001$  ( $r = 0.48$ ), and after phytoremediation,  $F(3, 56) = 5.54$ ,  $p = 0.0021$  ( $r = 3.00$ ). It was concluded that the phytoremediation process either did not effect the nitrate content in the soil at all, or affected it negatively.

## EFFECT OF GENRE ON THE LIKELIHOOD OF STUDENTS READING ASSIGNED MATERIALS

Krystal Pasciak

Chapin High School

To determine if there is a correlation between the genre of a book and the likelihood of students reading the assignment, three separate surveys were administered to Chapin High School homeroom students over the course of three weeks. Each survey contained questions of varying specificity toward the effect genre has on assigned reading. Results from the surveys were collected online over an anonymous Google form where they were analyzed and compared against one another. A statistical analysis was also performed to determine if the data collected was of significant value. The results collected show a trend toward students being more likely to read assigned materials that falls into the fiction genre. This data gives educators insight to what their students will read, which gives them the opportunity to implement books in these genres when the opportunity presents itself.

## DESTINATION BASED ROUTING IN LINUX SYSTEMS TO ACCESS LOCAL SERVICES REMOTELY

Dhaval Patel

Governor's School for Science and Math

Mentor: Dr. Haynes; Chief Executive Officer, Sabai Technologies

As of 2014, an estimated 8.7 million United States citizens live overseas (USDS). Many of these individuals would like to enjoy an internet browsing experience similar to the one they had in the United States. To address this concern, Virtual Private Networks (VPNs) are used; however, they are inconvenient if one wishes to access something in the country they are in, such as their local bank or a local video player. This results in a great deal of inefficiency and needlessly slows down a residential network. The technology to seamlessly integrate a solution to this issue is currently under development at Sabai Technologies, where this project was conducted. The implementation of destination-based routing seeks to create a method

where individuals can utilize a VPN and only tunnel websites that they know they wish to access via a United States through the private network, and everything else would be tunneled through the local network. This would increase the marketability of any software where it is implemented as it would significantly decrease the amount of steps consumers would have to take to enjoy any content on the internet. A service that many consumers enjoy is the British Broadcasting Company's online iPlayer. This service is not ordinarily available to people who are not in the United Kingdom. Using various routing methods and a VPN, one is able to route all traffic going to the iPlayer through the tunnel, and allow all other traffic to go through the local network.

#### GLYCOPROTEIN (GP130) PROTEIN EXPRESSION DURING MOUSE SKELETAL MUSCLE DISUSE ATROPHY

Hemani Patel  
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Mentor: Dr. Carson; Department of Exercise Science, University of South Carolina

Physical inactivity, bed rest, and immobilization result in skeletal muscle disuse atrophy, which can negatively affect physical function and quality of life. The IL-6 cytokine's signaling through the gp130 receptor has established roles in both muscle growth and atrophy. While muscle gp130/STAT3 signaling has been implicated in mechanical ventilation-induced diaphragm atrophy, less is known about gp130 protein expression during hindlimb muscle unloading atrophy. The purpose of this study is to examine gp130 protein expression during mouse skeletal muscle disuse atrophy. It was hypothesized that muscle gp130 protein expression would increase in skeletal muscle undergoing disuse atrophy. Female 10-week C57BL/6 mice underwent hindlimb suspension (HS; N=6) for 5 days, while loadbearing mice served as cage controls (CC; N=6). Hindlimb suspension decreased relative RF muscle mass compared to cage control. Data analysis showed that gp130 protein expression decreased in the rectus femoris of the hindlimb suspended mice. Hindlimb unloading did not alter in gp130 downstream target proteins STAT3 and ERK 1/2. The results concluded that disuse muscle atrophy causes different gp130 protein expressions for various parts of the body. National Institutes of Health Grant: NCI R01-CA121249 to James A. Carson funded this research.

#### OPTIMAL POINT DENSITY FOR ACCELEROMETER CALIBRATION AND CONSIDERATIONS FOR CONTINUED USE OF ACCELEROMETER SYSTEMS TO LOCATE AND CLASSIFY EVENTS BY MONITORING STRUCTURAL VIBRATIONS /

Elaine Patterson  
Spring Valley High School  
Mentor: Dr. Juan Caicedo; University of South Carolina

Every event that occurs has a reaction, whether it be a pebble causing ripples in a pond or a bullet distressing a wall. Within a structure, these vibrations caused by a specific event in a medium can be measured with an accelerometer, and just as the vibrations caused by a bullet observably differ from those caused by a pebble, vibrations caused by walking vary from those caused by falling, running or jumping. To the eye, these differences are slight to severe, but when that signal is dissected, it is identifiably unique by its cause and location with extensive applications from home security to behavior analysis for medical care to commercial analysis of foot traffic. For the calibration of such a system, there must be reference events for later events to be compared to because every area is unique in the way it reacts to and carries vibrations. This experiment aimed to determine how furniture rearrangements within a room affect calibration and how calibration locations affect the ability of a system to characterize events. It was hypothesized that furniture placement would significantly affect calibration, and this was supported through comparison of two calibrations with different furniture arrangements. It was also hypothesized that more points would increase the accuracy of a system to identify the location of events, but there was not a major increase in accuracy when more points were used for calibration,  $r = 0.143$ ; this study suggests two points in an area of 64 ft<sup>2</sup> would provide sufficient calibration.

#### THE EFFECT OF BISPENOL-A CONCENTRATIONS ON THE HEART RATE OF DAPHNIA MAGNA /

Matthew Payne  
Spring Valley High School

For the past 15 years, the presence of Bisphenol-A in plastics has been a concern for many Americans. It is proven to be an endocrine disruptor and is credited with problems in the reproductive system. Recent studies have linked it to the development of cardiovascular disease. Daphnia magna were exposed to BPA to see if there was a link to symptoms of cardiovascular disease, especially fluctuating heart rate and mortality. This would open doors to more cardiovascular awareness. It was hypothesized that the treated Daphnia magna would return heart rates that would be significantly different than the mean. BPA was placed in water with concentrations 0.28ng/ml, 1.385ng/ml, and 2.49ng/ml. The water was placed in containers and applied to the groups containing 10 organisms. After 30 minutes, then after 1 hour, the heart rate was counted for 10 seconds and multiplied by 6 to get the beats per minute and averaged for all 10 Daphnia magna in the group. This study found that there were significant differences ( $F(9,85) = 3.23, p=.002$ ) in the means between treatment groups containing 0.28ng/ml of BPA and 1.385ng/ml. It was concluded that the BPA altered the heart rates of the Daphnia magna and the same results could potentially be seen in humans. /

THE EFFECT OF THE INHIBITORY EFFECTS OF BENFOTIAMINE, L ASCORBIC ACID, AND A LIPOIC ACID ON THE PRODUCTION OF ADVANCED GLYCATION END PRODUCTS IN CAENORHABDITIS ELEGANS /

Vinay Penmetta  
Spring Valley High School

The average human lifespan is around 71 years of age, with females living slightly longer than males. As humans grow older, the homeostatic processes in the body progressively becomes less and less effective, which leaves the body vulnerable to many diseases. One of the contributing factors to growing older is advanced glycation end products, otherwise known as AGEs. This experiment gives Benfotiamine, A-Lipoic acid, and L-Ascorbic acid, which have been proven to be effective at reducing the production of AGEs, to *Caenorhabditis elegans* to see if it increases their lifespan. The lifespan of the *C. elegans* was counted over a three week period, and was counted daily. The hypothesis of giving drugs to *C. elegans* increasing their lifespan was proven to be supported. At an alpha level of 0.05, the three drugs had a significantly different lifespan than the control,  $F(3, 354)=15.68$ ,  $p<0.05$ , supported by a Tukey test.. Comparing the drugs to each other, L-Ascorbic acid had the highest average lifespan, with Benfotiamine and A-Lipoic acid having similar results. The control group had the lowest lifespan, with almost a one day difference between it and the lowest drug. In conclusion, the drugs did have a significant effect on the lifespan of the *C. elegans* and it can be suggested that it is because of their effect on the production of AGEs in the *C. elegans*. / /

DETERMINING THE 3-DIMENSIONAL FOLDING STRUCTURE OF A CITRUS CANKAR CAUSING PROTEIN PRODUCED BY THE XANTHOMONAS AXONOPODIS BACTERIA

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Mentor: Dr. Hurlbert; Department of Chemistry, Biochemistry, Physics, and Geology, Winthrop University

A protein produced by the *Xanthomonas axanopodis* bacterium causes citrus canker. The determination of the 3-dimensional folding structure of this protein would be a key step in developing a cure for this disease. To determine the 3-dimensional folding structure of a protein, the protein must first be produced in sufficient quantities. The goal of this research was to identify an appropriate strain of *E. coli* to produce the protein and to develop a purification protocol so that, in later experiments, the structure could be found by performing X-ray crystallography. Several transformed strains of *E. coli* were tested for their ability to manufacture the protein and *E. coli* Rosetta 2 was found to produce the highest levels. A Fast Protein Liquid Chromatography (FPLC) purification protocol was developed and a 38 kDa band of the putative protein was identified. This band has the same molecular weight as the *Xanthomonas Axanopodis* protein. Future work would include verifying the identity of this protein band by amino acid sequencing and the optimization of this protocol to produce sufficient quantities for crystallography.

THE EFFECT OF PHENOLIC COMPOUNDS (BENZOIC ACID AND GALLIC ACID) ON THE SUSCEPTIBILITY OF *S. AUREUS* TO TRIMETHOPRIM-SULFAMETHOXAZOLE.

Aman Pitalia  
Spring Valley High School  
Mentor: Dr. Xiaoming Yang; University of South Carolina School of Medicine: Pathology, Microbiology, & Immunology

Benzoic Acid and gallic acid are common phenolic phytochemicals found in the natural environment. Both phenols have been found to increase the susceptibility of resistant microbes, making it more feasible to kill the microbe by antibiotics. The experiment modeled the effects of phenolic acids by placing them into an agar medium and exposing them to *S. aureus*. The antibiotic [Bactrim] disc was placed on the top and then the inhibition zone was measured after 24 hours to determine the antimicrobial effects of the phenols. It was predicted that higher concentrations of phenols would increase the susceptibility of the microbe, allowing the Bactrim to kill the *S. aureus*. The group consisting solely of the antibiotic and *S. aureus* served as a control for the experiment. The experimental group concentrations increased at similar levels for each phenol; gallic acid included further concentrations of 1200  $\mu\text{g/ml}$  and 1600  $\mu\text{g/ml}$ . The hypothesis that higher concentrations of each phenol would increase the susceptibility of the microbe, allowing the antibiotic to kill it, was supported by the benzoic acid; however, it was not supported by the gallic acid. At  $\alpha=0.05$ , the benzoic acid significantly increased the susceptibility of the microbe, with a  $p < 0.001$ ,  $f\text{-crit} = 3.4780497$ . The gallic acid proposed a larger zone size at lower concentrations, than significantly decreasing in zone size at higher concentrations with a  $p < 0.001$ , and  $f\text{-crit} = 2.847726$ . Benzoic acid seemed to have greater antimicrobial effects than gallic acid; however, smaller doses of gallic acid could still be effective against resistant strains.

CO<sub>2</sub> PERMEATION FLUX OF SILVER CARBONATE DUAL PHASE MEMBRANES MODIFIED BY ATOMIC LAYER DEPOSITION

Madelinne Pope  
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Mentor: Dr. Huang; Department of Mechanical Engineering, University of South Carolina

The detrimental effect on our environment from CO<sub>2</sub> emitted by fossil fuels has become a topic of great concern. One way to reduce environmental degradation is to capture the emitted CO<sub>2</sub> from power plants. There are multiple types of carbon capture technologies. Electrochemical carbon capture membranes have gained attention recently due to their low cost and low energy consumption. Mixed electronic and molten carbonate conductor (MECC) are one important type of carbon capture membrane. Previous work has shown that depositing Al<sub>2</sub>O<sub>3</sub> coating on a silver matrix could greatly improve the long term

stability of the membrane. In this work, atomic layer deposition (ALD) has been used to coat the silver matrix with Al<sub>2</sub>O<sub>3</sub>. Membranes with three different thicknesses of the Al<sub>2</sub>O<sub>3</sub> coating were fabricated and tested and the effects of three different ALD cycles on CO<sub>2</sub> and O<sub>2</sub> flux have been studied.

#### MAPPING OF GENES CONTROLLING SENESCENCE IN MAIZE (ZEA MAYS L.)

Alec Popichak

Governor's School for Science and Math

Mentor: Dr. Sekhon; Department of Genetics and Biochemistry, Clemson University

The goal of this project was to use linkage mapping to locate the gene associated with senescence in maize. Senescence is a highly regulated process of cellular death in which as many resources are recycled as possible. It occurs naturally for a multitude of reasons but, after the grains mature in the maize plant, the leaves begin to senesce. The mutagen ethyl methanesulfonate (EMS) was added to maize in order to produce random nucleotide substitutions in the maize's genome. Plants that showed early senescence were identified by visual screening. PCR was used to amplify the DNA of non-mutated and mutated plants and the results were visualized by gel electrophoresis. The mutants were then scored to determine their genetic makeup followed by linkage mapping to locate the mutated gene. The exact location of the gene was not identified but it was determined that it lies on maize's second chromosome.

#### THE EFFECT OF GANODERIC ACID DM ON INDUCING CELL DEATH IN DIFFUSE LARGE B-CELL LYMPHOMA

Catherine Powell

Governor's School for Science and Math

Mentor: Dr. Haque; Department of Microbiology and Immunology, Medical University of South Carolina

Ganoderic Acid DM, GA-DM, is a triterpenoid that has been collected from a mushroom originating in Eastern Asia called *Ganoderma lucidum*. GA-DM has been effective in inducing cell death through the processes of autophagy and apoptosis in melanoma. The goal of this project was to determine whether GA-DM induces cell death in Diffuse Large B-Cell Lymphoma, DLBCL, via the apoptotic pathway. The project used the human DB cell line. Apoptosis was achieved by treating these cells with 15-25 microliters concentration of GA-DM and followed by MTS Cell Proliferation Assay, Western Blot analysis of apoptosis proteins, and p53 densitometric analysis. The results indicated that when GA-DM is added to DLBCL, cell death is induced. Analysis of Caspase 3 indicated cleavage of the protein suggesting apoptosis. The Caspase 3 western blot analysis indicated that it is being cleaved which suggests that apoptosis is occurring since Caspase 3 assists in the completion of apoptosis. The p53 western blot analysis and densitometric analysis indicate that it is being up regulated, which suggests that p53 is acting as a tumor suppressor, and finally the MET western blot analysis indicated that MET is being down regulated, which suggests that GA-DM is capable of inhibiting invasive cell growth. Future directions for this project are to investigate other apoptosis inducing molecules in the pathway and to test autophagy.

#### DEVELOPMENT OF A PREGNANCY ASSISTANCE KIT TO HELP REDUCE MATERNAL MORTALITY RATES

Ipsita Pradhan

Center for Advanced Technical Studies

The whole purpose of this project is to research the most cost effective and overall medically effective drugs and vitamins that can be included in the kit to help the mother most during pregnancy. The kit has to be effective but at the same time it cannot use the most expensive medicines because people in developing countries cannot afford the kit if it uses the higher price range materials. / Another part of the research is figuring out the most effective and cost efficient antimicrobial agent to coat the razor that cuts the umbilical cord with. This antibacterial agent needs to be able to effectively coat the razor as well as be cheap and effective against bacteria in order to reduce the chance of infection in the mother. /

#### THE EFFECT OF NUTMEG ESSENTIAL OIL, LAVENDER ESSENTIAL OIL, ONION ESSENTIAL OIL, AND CLOVE ESSENTIAL OIL ON THE QUORUM SENSING ABILITY AND ANTIBIOTIC RESISTANCE OF CHROMOBACTERIUM VIOLACEUM

Lisa Qu

Spring Valley High School

Mentor: Dr. Fang Wang; University of South Carolina School of Medicine

As bacteria have evolved to become more resistant to antibiotics, researchers have begun searching for alternative methods to combat bacterial-caused diseases. One such way is by targeting quorum sensing (QS), which is defined as the way that bacterial cells communicate with one another through the use of small signaling molecules. QS is used to regulate many bacterial functions, including virulence factor secretion. *Chromobacterium violaceum*, a gram-negative bacteria, produces a purple pigment called violaceum when active in quorum sensing. The purpose of this study was to find a quorum sensing inhibitor that successfully decreased antibiotic resistance of *Chromobacterium violaceum*. The hypothesis was that if nutmeg essential oil, onion essential oil, clove essential oil, and lavender essential oil were used when growing *Chromobacterium violaceum*, then the antibiotic resistance of the bacteria would decrease and the quorum sensing mechanisms of the bacteria would not be able to function properly, causing the violaceum production to decrease, as compared to the control. Nutmeg essential oil, onion essential oil, lavender essential oil, and clove essential oil were added to *Chromobacterium violaceum* at

different concentrations, and the antibiotic resistance and optical density of the bacteria at each of these different variables were measured using a plate reader. A growth curve was also constructed to determine how the different cell receptors involved in quorum sensing responded to the essential oils.

#### THE EFFECT OF POLY(I:C) AND 5-FLUOROURACIL ON HSC AND ENDOTHELIAL CELL CYCLE ACTIVATION FOLLOWING AN 8-DAY RECOVERY PERIOD

Jacob Rabinovitch

Governor's School for Science and Math

Mentor: Dr. Sohn; Department of Stem Cells and Cancer, German Cancer Research Center

A proper functioning blood system relies upon the self-renewal and differentiation capabilities of hematopoietic stem cells (HSC's). In response to inflammation, the cell releases various cytokines, for example interferon-alpha (IFN $\alpha$ ), which signal to HSC's to exit a state of quiescence and enter the cell cycle. This work examined the recovery of bone marrow after 8 days rest following the induced activation of HSC's by the interferon mimetic poly(I:C), and chemotherapeutic treatment by the drug 5-fluorouracil (5-FU), which alone leads to massive cell death. Mice were injected with poly(I:C), which effectively stimulates dormant HSC's such that they can be targeted with 5-FU. Following a double injection of 5-FU and poly(I:C), the animals were allowed a recovery period and their bone marrow was harvested. Cells were then quantified, immunostained, and measured using flow cytometry. The results indicate that bone marrow tissue is able to partially recover following 8 days. This is indicated by an approximate 77% decrease in Sca-1 expression in endothelial cells from mice co-treated with poly(I:C) and 5-FU than in endothelial cells from mice treated with 5-FU alone. This supports the hypothesis that there is a relationship between hematopoietic stem cells and their endothelial niche, which has implications regarding blood vessel growth following inflammation.

#### USER EXPERIENCE TESTING THROUGH THE DEVELOPMENT OF AN APPLE WATCH APP

Shane Ragusa

Governor's School for Science and Math

Mentor: Dr. Hess; Mobile Software Engineering, Fraunhofer Institute for Experimental Software Engineering

Apple, creator of the iPhone, iPad, and Mac computers, recently developed a new piece of technology, the Apple Watch. When it was originally released in April of 2015, reviewers called the device a luxury item, having no practical, everyday use associated with them. In June of 2015, Apple announced WatchOS 2, an update to the Apple Watch's operating system, and with it, they also announced many new programming resources, allowing software developers to access more of the watch's hardware. If these new resources are utilized properly, the watch can become a practical machine and rid itself of its "luxury item" connotation. The goal of this research was to explore the newly released Apple Watch programming resources in order to create an app that would give people a reason to use the device on an everyday basis. One of the main features explored was the watch's heart rate sensor, and it was eventually incorporated to create a health app, programmed in Swift, that would motivate users to exercise and regulate their heart rate. Having an abnormal heart rate can lead to future heart diseases, so an app that monitors health helps make the Apple Watch more of a utility. In order to predict this measure of success, the theory of Diffusion of Technology and the Technology Acceptance Model were considered while creating the app. From this, an app that has the potential to positively impact the Apple Watch market was developed.

#### THE CORRELATION BETWEEN TWITTER SENTIMENTS AND POLLING RESULTS FOR THE 2016 PRESIDENTIAL RACE /

Dev Ramesh

Spring Valley High School

The correlation between Twitter sentiments and polling results for the 2016 presidential race / Dev Ramesh / Behavioral Sciences / / The 2016 presidential race is beginning to attract a large amount of attention as the election draws near. Due to voter curiosity as to which candidates are preferred more by the general populous, an effective tool to gauge the rankings of presidential nominees was sought out. The prevalent technique being employed currently is polling, an assessment of public opinion obtained by surveying a population sample. While effective in determining public opinion, this method is not cost efficient and is very time consuming. To replace this unpractical procedure, the implementation of Twitter sentiments to determine the general emotion towards each candidate has been proposed. The objective of this research was to establish the correlation of the sentiments from Twitter to the presidential polling results to suggest it as an alternative. It was hypothesized that Twitter sentiment would have a positive correlation with polling percentages. To collect the Twitter data for each candidate, the plugin NodeXL for Microsoft Excel was utilized, and to calculate the sentiment, the plugin Text2Data also for Microsoft Excel was used. Polling data was collected from realeclearpolitics.com. This research found that positive changes in sentiment generally corresponded to positive changes in polling percentage, and negative changes in sentiment generally equated to negative changes in polling percentage. The two variables were strongly correlated,  $r(68) = .6073$ ,  $p < 0.001$  suggesting that Twitter sentiments could be utilized as a substitute for polls.

THE EFFECT OF DI(2-ETHYLHEXYL) ADIPATE (DEHA) ON THE AVERAGE FERTILITY OF SUBSEQUENT GENERATIONS OF DANIO RERIO /

Josh Ranta and Richard Zhao  
Dutch Fork High School

Phthalates and phthalate substitutes can leach from disposable water bottles, contaminating the water within with chemicals that disrupt endocrine systems and negatively affect reproductivity (Sax 2011). In this study, we will investigate subsequent generations of Danio rerio and the effect that the common phthalate substitute and non-FDA regulated toxin, Di(2-ethylhexyl) Adipate (DEHA), has on the production of offspring by using a mature fish to viable offspring ratio to quantify our results. We expect to see a decrease in the rate of production of offspring in subsequent generations of zebrafish as DEHA concentration increases in the water supply. This study is crucial to the safety of Americans due to the genome of Danio rerio is 80% similar to humans (Barbazuk); therefore, the adverse effects on its fertility will be comparable to that of a human exposed to this same chemical. /

THE EFFECT OF VARIOUS ANTIDEPRESSANTS ON ACTION POTENTIAL CHARACTERISTICS IN LUMBRICUS TERRESTRIS

Priyanka Rao  
Spring Valley High School

Antidepressants are medications that are known to treat depression. There are several types of antidepressants such as Tricyclic antidepressants (TCA), and some more recent ones such as Selective Serotonin Reuptake Inhibitors (SSRIs). TCAs were the first antidepressant to be used, but were quickly replaced with SSRIs when it was shown to cause severe side effects. In this experiment, SSRIs and TCAs were compared to see which medication would cause the most decrease in action potential of the earthworm. It was first hypothesized that if nerve action potentials are tested in earthworms, injected with antidepressants, then the antidepressants will cause suppressed action potentials. It is also hypothesized that if nerve action potentials are tested in earthworms, injected with two types of antidepressants, then the tricyclic antidepressant will cause more suppression of action potentials than the SSRI, Fluoxetine. To test this, a reflex habituation test was conducted on each of the sixty earthworms, which were subsequently injected with four different substances: Distilled water, Lidocaine, and the antidepressants. After the earthworms were injected, a spatial dimensions test of the action potential wave was conducted. After recording, the duration and peak voltage of the action potential spikes were measured. A one-way ANOVA test was conducted for each experiment. It was found that the reflex habituation test was not significant,  $F(3, 48)=0.95$ ,  $p>0.05$ . But, the one-way ANOVA test was significant for the spatial dimensions experiment between all four substances,  $F(3, 56)=3.5$ ,  $p<0.05$  and distilled water, SSRI and TCA,  $F(3, 56)=3.5$ . A Tukey test was conducted showing differences between distilled water and the SSRI and between distilled water and Lidocaine. It was concluded that antidepressants can suppress action potentials, but there was no evidence indicating that the TCA drug caused more suppression of action potentials compared to the SSRI drug. /

THE EFFECT OF TRANSPOSABLE ELEMENTS AND TRANSCRIPTION FACTOR BINDING SITES ON GENE EXPRESSION

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Mentor: Dr. Wang; Center for Genome Sciences and Systems Biology, Washington University School of Medicine

Genetic variations in gene regulation are a leading cause of many common diseases. Recently, the scientific community has investigated the relationship between transposable elements (TE's) and gene expression. TE's are segments of DNA that have can move around the genome, excising themselves from one segment of DNA and implanting themselves into another. TE's make up 45% of the human genome, but do not code for proteins. Previous studies show that they act as enhancers under certain abiotic stress. It's also been shown that close relatives of TE's, conserved noncoding sequences, act as enhancers in embryotic zebrafish. However, no studies have been done on the regulatory abilities of TE's in cells similar to human cells under normal conditions. This study specifically tests the ability of TE's to act as enhancers in mouse embryotic stem cells. Three segments were found in mouse genomic DNA: one containing a TE and transcription factor binding sites (TFBS), one with a TE outside of TFBS, and one with TFBS only. These three segments were isolated from the mouse genomic DNA and an assay tested levels of gene expression of each segment. The assay showed that TE's alone do not enhance gene expression, but TE's with TFBS increase gene expression compared to basal transcription. The segment with TFBS outside a TE showed an increase in gene expression in one orientation of the gene and a decrease in the reverse orientation.

THE EFFECT OF WEIGHTS ON THE VIBRATION REDUCTION OF A RADIO-CONTROLLED HELICOPTER

Dandavikranth Reddy  
Spring Valley High School

Helicopters are aircraft whose rotors supply lift and thrust, to vertically land or take-off. With this attribute, helicopters have the rare ability to land and take-off in places of congestion and danger, indicating the efficiency and speed of the device. Helicopters are also prone to vibrations, caused by the main rotor of the aircraft. The device, in usual cases, experiences normal amounts of vibration during steady flight. But in cases of high speeds, rapid ascents/descents, and other maneuvers, the helicopter faces a great amount of vibration, causing harm to the aircraft and the passengers traveling. The purpose of



this study was to determine if weights could reduce the amount of vibration being produced during different modes of flight. It was predicted that the weights would serve as a suppressing device, and reduce vibration by creating equilibrium. Experimentation was accomplished by performing three different flight tests, 50 trials without weights attached (control) and 50 trials with weights attached. Each flight test determined a different mode of flight, at different intensities, for a period of 60 seconds. To record data, a Vernier 3-Axis accelerometer was used. For each flight test, the accelerometer was attached to the nose and the tail, to determine and compare the different vibration levels. After conducting 50 trials for each flight test without weights and with weights, and attaching the accelerometer to the nose and tail, the collected data was analyzed using a One-way ANOVA.

#### THE EFFECT OF INAUDIBLE HIGH-FREQUENCY SOUNDS RANGING FROM 20-100 KILOHERTZ ON THE VISUAL ACCURACY OF TEENAGE HOMO SAPIENS.

Matthew Reupke  
Spring Valley High School

This study was conducted in order to determine if inaudible high-frequencies have any effect on the human brain. A reaction was found to take place in the thalamus, which is the reception center for the senses of touch, taste, sight and sound. The hypothesis was that if teenage Homo sapiens listened to inaudible frequencies from 20 kilohertz to 22 kilohertz, then there would be greater visual inaccuracy at the 22 kilohertz frequency. The subjects were randomly assigned a number and tested individually. All participants complete a trial with no frequency that acted as the control. The first experimental trial used the twenty kilohertz inaudible frequency and the remaining frequencies were played in a random order. The ANOVA showed that  $F(6, 119)=1.578$ ,  $p=0.159$ . The p-value was less than  $\alpha=0.05$ , meaning that there was not a significant difference between the frequencies and the number of letters that were missed on the Snellen Chart. Each trial also included a color blindness test at each frequency. All participants passed the color blindness test for each frequency. Inaudible high-frequency sounds do not have an effect on the visual accuracy of a Homo sapien. /

#### DIFFERENCES IN LIPID DISTRIBUTION IN LIVERS BETWEEN SPECIFIC PATHOGEN FREE AND GNOTOBIOTIC MICE

Grace Rhodes  
Governor's School for Science and Math  
Mentor: Dr. Chavin; Department of Surgery, Medical University of South Carolina

Nonalcoholic steatohepatitis (NASH) and nonalcoholic fatty liver disease (NAFLD) are increasing problems in today's society. Diet and gut bacteria have been proven to effect and cause NASH and NAFLD. Studies on mice have been completed to determine the affect of lipids on the gut bacteria. It was determined that mice fed low fat diets did not develop NASH or NAFLD, while mice on the unsaturated (lard fat) diet only developed NAFLD and not NASH. The mice on milk fat diets (saturated fats) developed NASH because the saturated fats created a favorable environment for the gut bacteria that causes the chain reaction leading to NASH. Further studies were performed comparing specific pathogen free (SPF) mice and gnotobiotic mice on all three diets. It was discovered that the gnotobiotic mice would develop NAFLD on the milk and lard fat diets, but not NASH. This led to the question of whether or not the actual lipids found in the gnotobiotic and SPF mice were different. This exploratory study examined the livers of gnotobiotic and SPF mice on the control low fat diet to determine if there was a baseline difference in the lipids. Matrix Assisted Laser Desorption/Ionization (MALDI) imaging was performed and it was discovered that there were differences in the lipids and the distribution of those lipids between the two types of liver samples.

#### THE EFFECT OF POLLUTANTS ON THE HEALTH AND GROWTH OF DISTICHLIS SPICATA

Philippa Richter  
Heathwood Hall Episcopal School

The purpose of this experiment was to determine which pollutant, out of four common water pollutants (10 g motor oil (11.11 mL), 10 g sediment, 10 g fertilizer, and 1 mL coliphage bacteria), had the greatest negative effect on saltgrass, or *Distichlis spicata*. The hypothesis is that motor oil and fertilizer would have the greatest negative effects on the coloration and height of saltgrass. Each pollutant was added to the soil of a group made up of three groups consisting of four plants each. Another group was left uncontaminated as the control. The height (cm) of the plants was then measured and each plant was rated on a health scale (0-5) over a one month period. The effect of these pollutants on the growth of saltgrass was inconclusive. All plants remained at a relatively constant height throughout the one month period. Only the coliphage plant group changed significantly, but instead of having a negative effect, the plant grew two centimeters. However, the pollutants seemed to have a negative effect on the health of the saltgrass. It was determined that if a plant was rated less than a  $\frac{3}{5}$  on the health scale, a pollutant had a negative effect upon it. All groups except the fertilizer group remained above the  $\frac{3}{5}$  cutoff. The fertilizer group's health degraded early in the experiment, and after a month, its rating was  $2.3/5$ . The results were determined inconclusive because of errors in the procedure of the experiment. However, the results obtained ended up not supporting the hypothesis.

## THE EFFECT OF NITRATE ON THE GROWTH AND DEVELOPMENT OF THE DANIO RERIO

Rachel Rorie and Amelia Wilks  
Dutch Fork High School

To protect the health of the public, the United States Environmental Protection Agency states that the Maximum Contaminant Level for Nitrate concentration is 10 milligrams per Liter (mg/L) or 10 parts per million (ppm). It is known that nitrates are toxic and affect the growth and development and lead to respiratory infections in newborns, but research has not extended to nitrates effect on marine life. The research we will conduct will test the effects of nitrate on marine life using Danio rerio. To test growth and development we will observe the fish and their behavior by documenting the dissolved oxygen level, and specific behaviors of the fish within the tank. Our research should observe that the concentration of nitrate causes issues to the physiological aspect of growth and development in marine life, which says that humans could have drastic physical changes due to nitrate consumption. The correlation between the nitrate concentration found in water samples collected near farmland and the growth and development of Danio rerio (Zebrafish), a South Carolina native fish will be investigated.

## RESPONSES TO MULTIPLE STIMULI IN TOMATO AND ARABIDOPSIS PLANTS

Savannah Ruano  
Governor's School for Science and Math  
Mentor: Dr. Vasquez; Department of Mathematics, University of South Carolina

The goal of this research was to discover the signaling pathways used in plants when stressors were applied to them, particularly tomato and Arabidopsis plants. There was a clear understanding of a plant's response to only one stress, but not more than one at a time. There is, however, no other research that is the same as the research that has been done concerning plants' responses to multiple stimuli, making this research more insightful. The results of the experimental data show that a wounding treatment paired with a salt treatment to the plant subjects may cause a more intense defense response within the plant. The defense response would be heightened in comparison to if the plants were treated with salt or wounding treatments alone. This research is important because these stresses affect crop yields and the long term objective of this research was to create a way of predicting what crop yields would be given certain conditions. The change in the concentration of the salt in the salt treatment, with the salt treatment by itself or paired with another treatment, did not particularly cause the plant to create a stronger defense response. It can be concluded that MAPK6 was directly related to stressors and plant's initiation of a signaling pathway that ultimately invoked a response to the stimulus.

## ATOMIC FORCE MICROSCOPY STUDY OF 4-HEXANGONAL SILICON CARBIDE

Karan Sah  
Governor's School for Science and Math  
Mentor: Dr. Chandrashekar; Department of Electrical Engineering, University of South Carolina

The energy industry is expanding at a rapid pace. However semiconductors able to use power efficiently are lacking. Silicon Carbide (SiC) has the potential of overtaking Silicon (Si) and Gallium Arsenide (GaAs) as a primary semiconductor in devices for high-power, high-frequency, high-temperature applications. Furthermore, SiC is radiation resistant. Despite its high amount of device applications, SiC has a high number of defects in the bulk growth of the crystal. Current methods of growing SiC crystals are producing many defects, making it unreliable for industrial use. Understanding the defects made in the bulk/epitaxy growth of the crystal is necessary to make it more useful. A solution to make SiC industry-ready is cutting the wafers of the crystals at an angle before growth to produce different growth types. Observations of the different off-cut samples were made with the use of an Atomic Force Microscopy Machine (AFM) and optical microscope. Higher angled cuts produced samples with less defects and more efficient epilayers. Where there is a growing industry of high power and more efficient device applications, SiC may enable the industry to grow by providing a more efficient semiconductor for many applications.

## THE EFFECT OF TIME TREATMENT OF PANAX QUINQUEFOLIUS ON NRF2 AND NQO1 LEVELS IN ANA-1 CELLS

Shakthika Saravanan  
Spring Valley High School

The effect of time treatment of Panax quinquefolius on Nrf2 and NQO1 levels in ANA-1 cells / Shakthika Saravanan / Medical Sciences / / Around 93,090 cases and 49,700 deaths, resulting from colorectal cancer, were estimated for 2015 ("Cancer facts and figures 2015," 2015). This study focused on ulcerative colitis induced colon cancer which are promoted through inflammation. The purpose of the study was to increase the Nuclear factor (erythroid-derived 2)-like 2 (Nrf2) and nicotinamide adenine dinucleotide phosphate quinone oxidoreductase 1 (NQO1) production in non-carcinogenic cells to help prevent and protect the cells from inflammation. It was hypothesized that Panax quinquefolius (american ginseng) could accomplish this. ANA-1 cells were treated with 250 ug/mL of american ginseng diluted with Dulbecco's modified Eagle's media (DMEM) with 0.1% fetal bovine serum (FBS) at a two hour interval beginning at 10:00 pm. At 10:00 pm, all the plates were cleansed. Several procedures were completed to prepare the samples for the western blot procedure. The bands of proteins were identified and exposed afterwards. The bands revealed that the Nrf2 increased significantly. NQO1 also increased a significant amount, but decreased after 6 hours of treatment. Hence, it was derived that the Nrf2, if under oxidative stress,

would combat the oxidative species in the cell. However, it was also plausible that the great amount of Nrf2 could not reach the DNA. Thus, the NQO1 and other possible downstream proteins could not be activated. /

#### THE EFFECT OF NEUTRALIZATION ON HEAT CHANGE AND ENTROPY

Jake Sawyer  
Heathwood Hall Episcopal School

Entropy is the amount of energy being released from a system at any given time by way of light or heat. Being one of the many thermodynamic properties of matter, everything in the universe exudes some sort of light or heat at all times, but certain processes and reactions cause a greater change in entropy than others. The purpose of this experiment is to test the effect of a neutralization reaction between Hydrochloric Acid(HCl) and the base, Sodium Hydroxide(NaOH) on the entropy of their surroundings. The manipulated variable was molarity because the difference in pH between 1 molar, 2 molar, and 4 molar bases and acids was negligible. The raw Data was measured in Change in Kelvin(or celsius). The data in terms of temperature change showed an upward trend as the molarity of the acids and bases were increased, but the Hydrochloric acid seemed to have a much larger effect on the change in temp than the sodium hydroxide. The heat energy released(and therefore the change in entropy) was much greater as the molarity rose showing that neutralization did in fact have a measurable effect on entropy.

#### EFFECTIVENESS OF BEHAVIORAL VOICE THERAPY IN PATIENTS WITH DYSPHONIA

Isabelle Schroeder  
Governor's School for Science and Math  
Mentor: Dr. Martin-Harris; Department of Otolaryngology, Medical University of South Carolina

Dysphonia is caused by a variety of conditions; including vocal fold nodules, vocal fold paresis, and scarring. Treatment options for patients with dysphonia include medical or surgical management, specifically medication, injection, or excision, as well as behavioral voice therapy. Previous studies have shown that voice therapy is an effective treatment for improving voice function and reducing the recurrence of laryngeal pathology. In the age of healthcare reform, healthcare professionals must provide objective evidence of improvement in a patient's status for insurance reimbursement purposes. This study assesses treatment outcomes in patients with dysphonia treated with voice therapy by a Speech-Language Pathologist at an outpatient facility. Necessary data was gathered by accessing electronic medical records of patients who had completed voice therapy within a six-month period. Data from three different voice assessment tests were collected; the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V), acoustic measures, and voice related quality of life (V-RQOL). The project goal was to determine the effectiveness of voice therapy using standardized perceptual, acoustic and quality-of-life measures in patients with various underlying vocal pathologies. This study provides further evidence to healthcare providers regarding the effectiveness of voice therapy in patients with dysphonia. Statistically significant improvement in patient scores was only found in the CAPE-V categories of overall severity, breathiness, strain, and loudness. Although no statistically significant findings were shown for acoustic or quality of life measures, trend analysis did reveal individual patient improvement in most cases. Therefore, behavioral voice therapy is an effective form of treatment for patients with dysphonia.

#### THE EFFECT OF A SMALL MOLECULE INHIBITOR IN COMBINATION WITH EVE ON GROWTH OF CANCER CELLS

Erin Scott  
Governor's School for Science and Math  
Mentor: Dr. Sakuntala Warshamana-Greene; Department of Biological and Physical Sciences, South Carolina State University

The IGF-1/IGF-1R pathway is an intracellular signaling pathway involved with cancer. Deactivation of this pathway leads to decreased cell proliferation. The pathway is typically inhibited at a key protein kinase in the pathway, the mammalian target of rapamycin (mTOR), using everolimus (EVE). A negative feedback loop involving the IGF-1/IGF1R pathway has been shown to bypass this inhibition. We sought to determine whether deactivating the pathway at two points was more effective than deactivating it at only one. We treated cells with AEW, a small molecule inhibitor of IGF-1R, and EVE. Alone, neither of the two drugs significantly decreased cell growth. In combination, they did significantly decrease cell growth. We found evidence of apoptosis in cells treated with the drugs individually and in combination based on levels of caspase, cleaved caspase, PARP, and cleaved PARP measured using a Western Blot, but that the apoptotic markers did not correspond to the decrease in cell growth. EVE and AEW used in combination more effectively decrease cell growth than when used singly, but this increased effectiveness cannot be explained by apoptosis alone.

#### THE EFFECTIVENESS OF ELECTRODE PLACEMENT DURING PAIRED ASSOCIATIVE STIMULATION

Samuel Seigler  
Governor's School for Science and Math  
Mentor: Dr. Li; Institute of Psychiatry, Medical University of South Carolina

Paired Associative Stimulation (PAS) is a relatively new technique in which a peripheral stimulation is paired with centrally applied transcranial magnetic stimulation (TMS), which produces plasticity, as measured by TMS motor evoked potential (MEPs). During standard PAS treatment, TMS is timed with median nerve stimulation (a pulse sent to two electrodes placed

one centimeter apart on the median nerve) to produce an increased excitability in parts of the brain. The hypothesis that higher levels of excitability in the brain can be seen after PAS is performed with an electrode placed on an acupuncture point (Hegu) instead of the two median nerve electrodes was tested. Multiple subjects were put through standard PAS and acupoint-PAS in order to observe the levels of excitability created by both types of PAS treatment. It was found that the hypothesis was not supported and acupoint-PAS is less effective at exciting the brain than standard-PAS treatment.

#### THE EFFECT OF DIFFERENT OBJECTS ON WIFI STRENGTH

Tanner Senn and William Scouten  
Heathwood Hall Episcopal School

In this project, there were multiple objects put over a certain WiFi router at Heathwood Hall Episcopal School to test which objects had the most negative effect on WiFi strength. Those objects used were, a cardboard box, cling wrap, a water bottle with water in it, an aluminum pan, and a human body. The technique used to gather the data involved measuring WiFi router signal strength with a computer, while standing off to the side so that the person's body did not affect the WiFi strength. For this study the independent variable was the objects that covered the WiFi router. The dependent variable was the strength of the WiFi signal. The hypothesis was, if the cardboard box was placed over the WiFi router, then the WiFi strength would decrease the most. The null hypothesis was if the cardboard box was placed over the WiFi router, then the WiFi strength wouldn't change. The results suggest that the cling wrap had the most negative effect and the cardboard box had the least negative effect. Another big factor on the WiFi strength was the human body. When this project was first run, the person holding the objects up to the WiFi router was in the way, and this very likely caused the results of percentages in the low 40s and the normal percentage in the 60s.

#### EFFECTS OF ETHANOL ON LIGHT-ACTIVATED CURRENT FLOW IN HEK293 CELLS EXPRESSING CHANNELRHODOPSIN-2

Julia Sequerth  
Governor's School for Science and Math  
Mentor: Dr. Woodward; Department of Psychiatry, Medical University of South Carolina

Optogenetics is a novel technique used in research to understand the function of the brain. It can be theorized to aid in mapping neural circuitry and understanding human brain disorders such as addiction. ChR2 is a light-activated, nonspecific cation channel from the algae *Chlamydomonas reinhardtii*. When neurons expressing ChR2 are subjected to blue light stimulus, the neurons are activated. Currently optogenetics uses Channelrhodopsin-2 (ChR2) DNA transfection in neurons of mice. Past research has demonstrated that neuron channels, such as the GABA and NMDA receptors, exhibit channel inhibition under high concentrations of alcohol. The aim of this research is to test if ChR2 channels are affected in the presence of alcohol so they may be cleared for future use in alcohol addicts by optogenetics. The hypothesis is that ChR2 channels are not affected by blue light in the presence of alcohol. This will be achieved by transfecting HEK293 cells with ChR2-GFP plasmid DNA, treating the cells with 100mMol and 300mMol ethanol (EtOH), followed by patch clamping in two blue light stimulant protocols, each for a duration of ten seconds. Results by Evos microscopy indicated that the transfected HEK293 cells had higher than 60% expression of ChR2 channels. Patch clamping results of the HEK293 cells showed inhibited negative current in the presence of EtOH under light-activation. However, the results of inhibition in 300mMol EtOH might be due to damage to HEK293 cells. ChR2 channel is not affected in the presence of alcohol so they can be used to treat alcohol addiction.

#### EXPRESSION AND LOCALIZATION OF ERBB RECEPTOR BIOMARKERS IN BREAST CANCER CELL LINES

Shreya Shankar  
Governor's School for Science and Math  
Mentor: Dr. Korf; Molecular Genome Analysis, German Cancer Research Center

Breast cancer occurs when cell cycle genes in mammary cells malfunction and lead to unregulated growth. It is the second most prominent cancer worldwide and first in women. Malfunctions of cell cycle surface receptors and the initiation of downstream signaling lead to cancer. Extracellular ligands bind to these receptors to activate them if cellular growth is required. However, mutations, over-expression, or hetero/homo-dimerization of these receptors can cause tumorigenesis. The receptors in this study are the ErbB family which has four members: ErbB1/EGFR, ErbB2/HER2, ErbB3/HER3, and ErbB4. The first three show involvement in breast cancer. The aim of this research was to get preliminary data on the expression of these receptor and other cell cycle genes as biomarkers in starved conditions in five breast cancer cell lines. This aim was achieved by performing Western Blot Analysis to determine the expression levels of various proteins in these cell lines. Immunofluorescence microscopy was also performed on one cell line, HCC1954 for ErbB1 and ErbB2 to determine the location of these receptors. The results from the Western Blot analysis indicated that the five cell lines expressed these proteins in different amounts, but in most cases, was higher in starved cells than cells treated with Fetal Bovine Serum (FBS). The immunofluorescence microscopy showed that ErbB1 and ErbB2 receptors were located in the membrane ruffles and co-localized upon stimulation with FBS. Further testing must be done to classify these proteins as biomarkers so that drugs can be generated. Therapies can also be identified to target co-localization.

THE EFFECT OF VARIOUS HYDROPONIC FERTILIZERS ON THE EMISSION OF GAS IN BRASSICA RAPA  
NIPPOSINICA PLANTS  
Emma Shealy and Alyce Petit  
Heathwood Hall Episcopal School

The purpose of this experiment was to determine whether changing the solution in which plants were grown would change the amount of oxygen that was emitted and the amount of carbon dioxide absorbed. The plant used was mizuna lettuce. The plants were grown in an ebb and flow hydroponic system and fertilized by two different solutions. Once the plants matured, they were put into a sealed chamber with both a oxygen and carbon dioxide sensor attached. These sensors were then attached to a computer showing the amounts oxygen and carbon dioxide inside the chamber. The change in carbon dioxide and oxygen was observed over a period of time. The results indicated that neither solution changed the amount of oxygen emitted or carbon dioxide absorbed. Thus it can be conclude that changing the two solutions in which plants are grown in this experiment does not affect the amount of oxygen emitted or carbon dioxide absorbed.

INTERLEUKIN-2 AND INTERLEUKIN-15 DIFFERENTIALLY IMPACT THE TRANSITION OF EFFECTOR CD8+ T  
CELLS INTO EFFECTOR- AND CENTRAL- MEMORY PHENOTYPE CELLS  
Brittany Shook  
Governor's School for Science and Math  
Mentor: Dr. Rubinstein; Department of Surgery, Medical University of South Carolina

With one in three women and one in two men diagnosed for cancer worldwide, cancer is becoming an increasing problem. More and more people are seeking unconventional treatment methods, including adoptive cell T cell transfer therapy. For this therapy to be most effective, effector-memory cytotoxic T cells are needed. In this experiment, cytokines are used to culture specific cell phenotypes. It was hypothesized that the addition of IL-2 will lead to effector memory phenotype T cells, while IL-15 will lead to more central memory phenotype cells. Using a male B6 mouse, the spleen was removed and the splenocytes were processed, the cells were stimulated using plate-bound anti-CD3 and soluble anti-CD28, and the cells were primed with cytokines IL-2 and IL-15. Flow cytometry was conducted at two time points: three and seven days after stimulation. The flow cytometry data showed that by day seven after activation, cells primed with IL-2 exhibited low levels of CD62L and was positive for the expression of CD44. Cells primed with IL-15, on the other hand, exhibited high levels of CD62L and were also positive for the expression of CD44. The data supported the hypothesis and it was concluded that IL-2 induced proliferation and differentiation of effector-memory phenotype cells, CD62L low CD44+, and IL-15 induced proliferation and differentiation of central-memory phenotype cells, CD62L high CD44+.

REMOVAL OF HAZARDOUS WASTES FROM AQUEOUS SOLUTIONS VIA ADSORPTION USING THE COMMON  
DANDELION /  
Rakib Siddique  
Spring Valley High School

Copper and cadmium are two commonly released pollutants that pose serious health hazards if ingested. An inexpensive and renewable adsorbent is needed for replacing activated carbon as an effective means of removing such pollutants from wastewater. In this experiment, crushed dandelions were used to agitate aqueous solutions containing these toxins for the purpose of evaluating the extent at which they are capable of removing them from water. It was hypothesized that pollutant concentration would be inversely proportional to adsorbent dosage and agitation time.. Experimentation was accomplished by mixing the processed dandelions with the solutions for 30 minute periods. All pollutant concentrations decreased drastically after 5 minutes of agitation. Final pollutant concentrations of copper and cadmium after 30 minutes were shown to be significantly less than initial pollutant concentrations by two-sample t-tests for all dosages of both types of adsorbents;  $t(2) \geq 8.0905$ ,  $p < 0.007$ . Moreover, the highest removal rates achieved by both dandelion adsorbents after thirty minutes of agitation were greater than eighty-five percent for both copper and cadmium. Such results provide hope and encouragement for further studies dedicated to the use of the common dandelion as a cheap and renewable alternative to activated carbon. Future studies would aim to test the ability of such novel adsorbents to remove cadmium, chromium, nickel, and copper from aqueous solutions.

INCREASING THE LIFE SPAN OF DONOR ORGANS  
Shreya Sidhu  
Center for Advanced Technical Studies

When donor organs are removed and transported to other patients, they are preserved in cold ischemia that allows them to be usable when needed. However, with this method, there is fast paced deterioration of the donor organs' cells and tissues that decrease their ability to be transported farther distances which would ultimately help more patients. The method of cold ischemic preservation that has been used for years has allowed the donor organs to remain in hypothermia. So far, it is the most effective method for preserving the organs because it is simple, does not require sophisticated expensive equipment, and allows ease of transport. Making an invention that is able to deal with this issue from a different angle would allow for an increase of the radius to where donor organs can be transported, which would be able to help more patients in need of a transplant. With this project, I hope to be able to create an invention that will allow the donor organs to remain healthy and

alive during transport time instead of being in a hypothermic state/"dead". This would be effective as it would help more people in the medical field.

#### EFFECT OF BATTERY MEMORY ON DIFFERENT TYPES OF ELECTRIC VEHICLE BATTERIES

Lee Sightler

Center for Advanced Technical Studies

Electric vehicles will be needed in the future because of the decline of availability of oil. In the future, more people will be moving towards using electric vehicles instead of normal internal combustion engine vehicles but the thought of range anxiety deters most people from buying one. An important factor to battery life is charging and discharging the battery correctly and avoiding the effects of battery memory. If the battery is only discharged half way and put back on the charger, then the battery will start charging it only that much, leading to a weaker battery over time. For this research project the hypothesis is if a battery is properly charged and discharged, then the battery life will increase and range anxiety will decrease. The results anticipated in this project are that the lead acid batteries will be most affected by battery memory and that lithium batteries are more efficient and are capable of a longer battery life with proper charging techniques. The tests will be conducted in a test vehicle and proper and improper charging will be done for each kind of battery. Once the data needed is collected, then it will be used to determine where the most appropriate locations will be at for new electric vehicle charging infrastructure. The data will represent how far the batteries can go on a full charge and that will give the range for how spread apart new charging stations should be located.

#### THE EFFECTS OF TEMPERATURE ON THE BIODEGRADATION OF POLYSTYRENE FOAM BY WOOD ROTTING FUNGI

Jasdeep Singh

Spring Valley High School

Plastic's properties tend to result in the polymer being resilient towards environmental degradation factors. This results in the accumulation of plastics in the habitats of biological communities, which leads to pollution. The purpose of this study was to discover the efficiency of alternative methods in catalyzing the biodegradation of polystyrene. One of these alternative methods includes increasing the temperature in order to improve the efficiency of the biodegradation of polystyrene. It was hypothesized that increasing the temperature of polystyrene to 30 degrees C would cause the biodegradation of polystyrene by wood-rotting fungi, measured by change of mass, to increase beyond the polystyrene biodegradation at room temperature (23 degrees C). In the experiment, pieces of polystyrene foam were placed into a beaker with samples of wood rotting fungi for 50 days. Each set of 6 beakers incubated at a different temperature. These temperatures ranged from 23oC, 30oC, and 15oC. The pieces were measured prior to experimentation and after in order to determine the amount of mass lost. Results showed an increase of mass instead of a decrease. This was tested for significance using a One-Way ANOVA with  $\alpha=0.05$ , and the treatments had significant variance ( $F(2,87)=31.14$ ,  $p<.001$ ). A Post Hoc Tukey Test showed that the differences between 23oC-30oC and 23oC-15oC were significant. This leads to the conclusion that wood rotting fungi were colonizing on and preparing to degrade the pieces of polystyrene foam.

#### DETERMINATION OF TARGET GEORGRAPHIC AREAS FOR MARKETING KIDS CAN GIVE TOO

Samuel Sisney

Governor's School for Science and Math

Mentor: Dr. Royal; Co-Founder, Kids Can Give Too

This research focuses on the ideal market areas for the company Kids Can Give Too (KCGT) in their upcoming scaling efforts. The purpose of this research is to determine a list of counties for the company to target during the first round of marketing in these efforts. The research seeks areas in the South East and North East regions for the company to pursue. The list of the counties is based off the income in the locations, the number of families, and the ease of access and desire of the company to market there. The information was ranked by gathering census data the desired regions, with some external ranking sources based on census data. The research resulted in a list of counties, some with specified locations of focus, recommended for the company to first target.

#### THE EFFECT OF THE DURATION OF LAVENDER AROMATHERAPY ON LEVEL OF STRESS /

Aniruth Sivakumar

Spring Valley High School

The purpose of this experiment was to see if lavender essential oils could stimulate olfactory sensors enough, to release some stress of the stimulated individual. It was hypothesized that if the subjects were exposed to 12 minutes of lavender essential oils, then their blood pressure (BP) and stress temperature (ST) would decrease greatly compared to the other given time intervals (0, 8 minutes). Three drops of lavender essential oil were placed into a pot and diluted with 200 mL of water. The water was mixed and simmered for 12 minutes. Subjects were asked to lie down on a bed, 1 meter away from the pot. BP was taken by slipping the subject's wrist through a BP cuff. The ST was taken by the subject holding the stress thermometer's sensor between their index finger and thumb. This was done before exposure to the oil, after 8, and after 12 minutes of exposure to oil. It was found that the aromatherapy decreased the mean ST from 0-8 minutes, but it increased from 8-12

minutes. An ANOVA calculated at  $\alpha = 0.05$  (for BP and Stress temperature), was used to find the statistical significance of the difference between 0 and 12 minutes for BP. The p-value found was 0.017. The p-value value was less than the alpha ( $0.017 < 0.05$ ). The data was significant. The difference between 0 and 12 minutes for the ST at  $\alpha = 0.05$ . The p-value found was 0.823. The reduction in ST was not significant. /

#### AFRICAN AMERICAN TOURISM PATTERNS AND MARKETING ETHNICALLY FOCUSED TOURISM IN SOUTH CAROLINA

Jeffrey Sizemore

Governor's School for Science and Math

Mentor: Dr. Hudson; SC SmartState Center for Economic Excellence, University of South Carolina

The African American population in the United States has grown significantly over the past decade. This has led to a larger concern over African Americans in the marketplace. In the past, and still today, most marketing is focused on the majority population and larger-niche population groups. This creates a void of untouched resources to be had. Even with the rising median income and rising total buying power, there is still a gap between the total number of African Americans and the dollars put towards targeting them specifically. The number one worldwide revenue generating industry is tourism, which creates an avenue on which to focus African American marketing. Two of the largest tourism interests among African Americans are coastal, warm-weather areas and heritage tourism. South Carolina fits this mold. Effective marketing strategies differ from general population marketing in that the most-watched television channels and most-visited websites differ from other population groups. African Americans also respond significantly better to advertisements made with particular characteristics. This research found that there is a large untapped market of African Americans, and found also that South Carolina tourism is a good way to fill this void. Future research would need to be conducted to gauge the feasibility of this project, and surveys would need to be conducted to determine the perspective of those affected. Should practicality and support turn out to be positive, a trial run could then be done to determine the effectiveness of this marketing strategy and its possibility of future use.

#### THE EFFECT OF THE THICKNESS OF A LAYERED COMPOST ON THE RATE OF DECOMPOSITION AND TEMPERATURE CHANGE

Carter Smith

Heathwood Hall Episcopal School

This study investigated the possible relationship between the thickness of a layered compost system and the systems internal temperature on its rate of decomposition. The independent variable in this experiment are the amounts of each natural biodegradable materials in the compost such as: leaves, fruit, soil and the dependent variable is the rate of decomposition of the total compost pile. From this study, farmers, gardeners, etc. will be able to infer whether a thicker layered compost or one that is less thick is more effective, in the sense that it will decompose at a faster rate, with respect to the temperature. The problem being investigated was whether the thickness of a layered compost was related to either the temperature and or the rate of decomposition. In this experiment 12 compost bins were created 4 bins with 1 layering of compost, 4 bins with 2 layerings of compost, 4 bins with 3 layerings of compost. One to two times a week, measurements of the change in temperature and change in height over time were recorded. The hypothesis of this experiment was that if the compost bin that had more heat trapped in its compost box, then it will decompose faster. Thus, the null hypothesis is that the thickest of the layered compost bins which has the most heat trapped in its compost box will not have an effect on its rate of decomposition. The results suggest that there was not a statistically significant association between the change in temperature and rate of decomposition of the compost bins.

#### THE STORYTELLER'S AIDE: AN INDEX OF COMPOSITIONAL PROPERTIES IN CINEMA

Justin Smith

Governor's School for Science and Math

Mentor: Dr. Bares; Department of Computer Science, College of Charleston

This project aims to create a program that can effectively instruct novice filmmakers on the compositional properties best suited for a particular scene, the effect one particular composition may have on the viewer, and different ways compositions can be used to convey desired messages to the audience. Current filmmaking programs lack the capability to understand why a particular composition should be used over another. Instead, programs generally considered to be the "state-of-the-art" in pre-professional filmmaking, such as Adobe Premiere, Final Cut Pro, and iMovie, are only able to make suggestions based on the composition, not the impact the composition can make with the audience. This program gains its unique characteristics from the use of a K-means clustering algorithm and a hand-built indexing structure, which served as the basis for classification of shots based on compositional properties and then grouping them according to high-level storytelling goals, which allows the program to make suggestions with an intuitive knowledge of the emotions of the viewer. The project's goal is to develop a program that not only is able to make intelligent suggestions based on common storytelling goals and desired emotional impacts, but to also be highly adaptable to new influxes of techniques and composition styles within the film industry. The intelligent assistant will provide novice filmmakers with an effective video and shot editing tool that will not be limited to one platform.

## GEOTHERMAL HEATING AND COOLING IN K-12 SCHOOLS

Hayden Spencer  
Center for Advanced Technical Studies

Geothermal heating and cooling is an alternative HVAC (Heating, Ventilation, and Air Conditioning) method that uses the stable temperature of the earth to heat and cool rather than using electricity or natural gas. The benefits of geothermal heating and cooling include being cost-effective and being a renewable method of heating and cooling. The purpose of the experiment being conducted is to show that k-12 schools, as well as other buildings in South Carolina, are good candidates for geothermal heating and cooling. This experiment will be carried out by constructing a scale model school with a corresponding scale model geothermal system using local soil from South Carolina. The model will be put in an enclosed container where the geothermal system will be producing either hot or cold air inside the model. The ambient temperature inside the container will correspond to the average temperatures of South Carolina in the summer and winter. The data gathered will be the temperature produced inside the model school by the geothermal system, showing whether or not geothermal heating and cooling can be as effect as more traditional HVAC methods. It is anticipated that the results of the experiment will in fact show that South Carolina schools are good candidates for geothermal heating and cooling.

## THE DIFFERENCE BETWEEN RUSSIAN & AMERICAN MEDIA FRAMING TECHNIQUES ON THE RUSSIAN CRIMEAN ANNEXATION

Michael Spicer  
Spring Valley High School

/ This paper explores the effect of media framing on national media reports toward the 2014 Russian annexation of the Crimea, a region that previously belonged to the Ukraine. 23 Russian news articles and 23 American news articles were coded to develop measures that captured different framing techniques between the two country samples. Each article was coded for two types of issue-specific frames: 1) the extent to which an article discussed the role of history in explaining why Russia annexed the Crimea; and 2) the extent to which it discussed the role that international law played, or should have played, in the annexation process. Based on a review of the media framing literature, three additional general framing techniques were coded: 1) self and other referential frames; 2) gain-based and loss-based frames; and 3) the use of direct quotations. The results find general support for the hypothesis that the way that newspaper articles report on an event, and therefore the information that members of a single country receive, depend strongly on the point of view of the general political attitude that resides in a national settings. The evidence in this case supports a general finding found across media framing studies: newspaper reports do not challenge existing political opinions, but instead act mainly to reinforce them.

## THE REDESIGN OF AN ADHESIVE BANDAGE FOR THE PALM

Hunter Stalker  
Center for Advanced Technical Studies

It is nearly impossible to get a bandage to stick when a person gets a cut, scrape or burn on a area like the palm unless the whole hand is wrapped. The purpose of this research assignment is to create a bandage that is more successful in sticking to the palm, meaning it will stick for a longer amount of time with out falling off. If an adhesive that is more hydrophobic and has a greater strength is used in the bandage, then it will stick to the palm for a greater amount of time. The criteria the bandage needs to have is that it is safe to wear, it needs to be able to stick for 12 hours, and it needs to leave minimal residue. To test this first a baseline test is done on multiple types of bandages already in the market these are to be done on pig skin so that when the new bandage is created safety can be tested before being used on humans. The first experiment tests the strength of the bandages, or the force of the bond between a pig skin and the bandage. The test uses a pasco force sensor to measure the force required to remove the bandage from the palm. The results from the base line will be used to create a more successful bandage that will undergo the same tests. Then the bandages will move to testing on humans. The first experiment involves putting bandages on the palm and moving it in a series of four motions while timing the length of time it takes for the bandage to fall off. The second experiment times how long it takes for the bandage to fall off during the subjects normal daily activities. The bandage that sticks for the longest amount of time and leaves the least amount of residue will be deemed most successful.

## THE EFFECT OF MACULAR PIGMENT ON COLOR DIFFERENTIATION IN HEALTHY ADOLESCENTS /

Allison Stanek  
Spring Valley High School

The purpose of this experiment was to collect data on the Farnsworth-Munsell 100-Hue test (FM-100) scores of adolescent participants and to relate this information to their macular pigmentation. If the data supported a relationship, the goal was to use this relationship to quantify an exact correlation between FM-100 score and macular pigmentation value on the scale by Franssen et al. It was hypothesized that the group with the least macular pigmentation would score lowest on the FM-100 test. Test subjects had their irises scored on a scale from 0 to 25, with 0 being the lightest possible and 25 being the darkest possible. They were then given the FM-100 and their scores were examined in relation to their macular pigmentation scores. Test subjects were separated by gender due to the fact that women tend to have more accurate color vision than men. The male participants had a mean of 112.25, and the female participants had a mean of 94.5. The differences between average scores of macular pigmentation groups in male participants were found insignificant by ANOVA,  $F(5,23)=1.106$ ,  $p>0.05$ . The



differences between average scores of macular pigmentation groups in female participants were found insignificant by ANOVA,  $F(5,12)=1.379$ ,  $p>0.05$ . These ANOVA values do not support the given hypothesis, meaning that significant error was likely to have taken place during experimentation. / /

#### THE EFFECT OF SIGNALING FACTORS ON THE DIFFERENTIATION OF PROGENITOR CELLS

Amanda Steel

Governor's School for Science and Math

Mentor: Dr. Jabbari; Department of Chemical Engineering, University of South Carolina

Tissue Engineering is an interdisciplinary field that applies engineering and life sciences to the development of biological substitutes that restore biological tissue function. The three main aspects are cells, scaffolds and growth signals. This experiment dealt with the cell aspect. Progenitor cells have the ability to differentiate into many different cells. Mesenchymal Stem Cells (MSCs) have the potency to differentiate to bone, cartilage, muscle, and fat. Endothelial Colony Forming Cells (ECFCs) have the potency to differentiate to endothelial cells. While scaffolds help cells differentiate, there are also biological signals which accelerate differentiation. Growth factors are what initiate this signaling and designate the lineage. In our experiment, hMSCs and ECFCs were cultured at the bottom of well plates in 2D environments and encapsulated inside hydrogels for 3D culture. Hydrogels are cross-linked polymeric structures, which mimic the extra cellular matrix of cells. Basic and differentiation media was added to both cell types. The growth and differentiation of the cells were observed at different time points. For results, Alkaline phosphatase (ALP) expression and calcium content of the hMSC were measured as markers of osteogenic differentiation. After fourteen days, there was a significantly higher expression of ALP in hMSCs in osteogenic media. For 3D samples, using PCR, the upregulation of expression of the genes were measured by markers ALP and PECAM-1. Further research will apply these results to making scaffolds to use in bone repair.

#### ANALYSIS OF TENNIS WINNING SHOTS

Hannah Stewart

Chapin High School

This project examined four different types of tennis shots at the 2015 US Open Men's Finals and if any of these shots was more effective than another in being a point winner. A shot was considered more effective if the opponent was unable to return it, ending the point. This is significant to tennis players because if a shot is found to be more effective, then using that shot more often than any other would ideally result in a higher chance of winning a match. In this study, the number of times a cross court volley, crosscourt ground stroke, down the line volley, and down the line ground stroke resulted in a winner in a tennis match was tallied in a chart, and a chi square test and a Marascuillo test were done in order to determine if there was statistical backing that a certain shot was more effective. In this study, both the chi square test and Marascuillo test determined that there was no shot in this study that was proven to be more effective in winning the point than any other tested. Data will also be analyzed to see if a specific shot is more effective against a certain player. A next step for this project will be to gather data to analyze matches at different levels of playing- beginner or high school players, for example- to see if there is a more effective shot for different skill levels.

#### INCREASING INDEPENDENCE FOR THE VISUALLY IMPAIRED: DEVELOPMENT OF A SONAR EQUIPPED CANE

Sofia StMarie

Center for Advanced Technical Studies

It has been shown through different types of research that shows that the visually images feel as if they need extra assistance on a daily basis but they do not want it. The visually impaired want to be independent just like everyone else. The development of a SONAR equipped cane will allow for the visually impaired to be fully independent, they will have the option of moving freely through a space with lots of objects that have no bottoms, which are not noticed with regular canes. With SONAR capabilities in both the x and y direction, objects missed with the regular white cane can be avoided, thus increasing the independence of the visually impaired on a daily basis.

#### THE USE AND REDESIGN OF DATA ACQUISITION SOFTWARE IN PYTHON

Elaina Stuckey

Governor's School for Science and Math

Mentor: Dr. Caicedo; Department of Civil and Environmental Engineering, University of South Carolina

Many fields use data acquisition systems to collect data from sensors. However, using the software for these systems can be difficult for users because the program may not have the needed flexibility for a project, especially if the program uses a drag and drop interface for coding. Not only does the lack of flexibility cause problems but many interfaces hide the code for a test, keeping the user from fixing a problem or increasing the flexibility of the interface. The solution to this problem is to create a new version of data acquisition software that allows for more flexibility while making the user interface user friendly. This new program needs to collect data after sensors are triggered, store that data for analysis and allow users with little experience to use the software easily. It should also pull parameters for each sensor from a database and store data automatically, making it easier for the operator. My research deals with designing and implementing this program for use in various projects. Existing Matlab code and a user guide for the Data Acquisition hardware were used to give both a general

structure and the specific syntax for different features. To create this program, two vertical sensors and one horizontal sensor were triggered to collect data. The code was developed using Git, allowing other users to continue to develop the program for their own purposes.

#### THE EFFECT OF DECREASED CHAOS IN MELODY GENERATION ON ITS CONFORMITY TO COMMON CHORD PROGRESSIONS

Rishi Suresh  
Spring Valley High School

The purpose of this project and experiment was to determine the effect of increasing and decreasing randomness on the conformity of a randomly generated melody to known chord progressions. This project was developed in Jython, a java-based implementation of Python created to be cross-platform compatible. It was hypothesized that decreasing randomness in the computer-generation of melodies would lead to increased conformity to chord progressions. The rationale behind this hypothesis was the fact that less chaos implies more order, meaning that these melodies would tend to stick to patterns which are known to be pleasing to human ears, and thus, to pleasing and therefore known chord progressions. The project's procedure involved only the coding of the program, and the sampling of data. The code will be provided in Appendix A. The sampling of data was quite straightforward, the program was run at each 'independent variable value', which corresponds to a set of Boolean parameters in the code, and the value returned by the program as the chord conformity score was taken. The score is an average score produced by the score for each note interval in the melody divided by the total number of intervals per melody. For each step up, randomness decreases. Results showed inconclusive numbers, with the average values for each IV as follows: 10.406 for the lowest, 9.9895, 10.0143, 10.5066, 10.363 for the highest. A one-way ANOVA with  $\alpha = 0.05$  returned a p-value of 0.002265, which is sufficient to reject the null hypothesis. A post-hoc Tukey test confirmed that of all group combinations, only RemainOctave vs StartOnTonic, RemainOctave vs StepWise, and MiddleOctave vs StartOnTonic were significantly different at  $\alpha = 0.05$ . This suggests that while there may not be an easily noticeable difference in the chord conformity, certain levels of randomness did account for a significantly different amount of chord conformity.

#### POLYMER DERIVED SiOC CERAMIC VIA THERMOLYSIS OF PHOTOCROSSLINKED POLYMETHYLHYDROSILOXANE (PMHS)

Jack Tabb  
Governor's School for Science and Math  
Mentor: Dr. Pilla; Department of Automotive Engineering, Clemson University

Ceramics are a class of materials that possess high thermal stability, chemical inertness, and high hardness. However, processing of ceramics is energy intensive, with temperatures above 1500 °C. Due to their ease of processing at lower temperatures, ceramics processed from a polymeric precursor, known as polymer derived ceramics (PDC), have received wide attention for more than four decades. These ceramics also allow fine tuning of the microstructure because of their bottom-up synthesis with a good control over chemistry. However, the porosity generated during both thermal crosslinking of polymers and the thermolysis is the major drawback that limits these materials from widespread application. In this regard, this work aims at producing highly dense, crack-free ceramics via thermolysis of photocured polymers. Polymethylhydrosiloxane (PMHS) was chosen as a precursor to obtain a SiOC ceramic. PMHS was cured under UV using Irgacure as a photocatalyst to obtain a highly dense polymer. The crosslinked polymer was characterized using thermogravimetric analysis to determine the thermolysis temperature and the ceramic yield. The crosslinked polymer was thermolyzed by being heated at a rate of 5 °C per minute and held at 1000°C, for one hour in an inert atmosphere. The as-thermolyzed ceramic was observed with scanning electron microscopy to determine the presence of porosity, the amount of free carbon was determined using Raman spectra, and the crystalline nature of the ceramic was determined using X-ray diffraction (XRD).

#### THE PSYCHOLOGICAL EFFECTS OF ELIMINATING SOCIAL MEDIA ON EVERYDAY LIFE

Caleb Taylor and Cooper Woodham  
Chapin High School

Students spend at least two to three hours on social media per day. The question is What is the effect of eliminating social media on the everyday life of these students. It was hypothesized that there would be significant positive effects on the subjects following the elimination of social media. The study was completed using intensive case studies of six students over the course of two weeks. The study examined changes in emotional behavior, social interactions, and psychological effect. Results showed no significant evidence of the effect of eliminating social media on these subjects. Upon reflection, the lurking variable that may have prevented significance was that subjects that eliminated social media were willing to eliminate it and therefore had volunteer bias.

## THE EFFECT OF THE NUMBER OF HOURS HORSES ARE KEPT STALLED PER DAY ON THE NUMBER OF STRONGYLE TYPE EGGS AND LARVAE PRESENT IN MANURE

Julia Tenhover  
Heathwood Hall Episcopal School

The purpose of this research project was to investigate the effect that the number of hours kept stalled per day had on the number of strongyle type eggs and larvae in equine manure samples. The independent variable was the number of hours horses were kept stalled per day. Horses were either stalled 0 hours per day (control group) or 8 hours per day. The dependent variable was the number of strongyle type eggs and larvae present in manure samples from these horses. It was hypothesized that the manure of horses stalled 8 hours per day would contain more strongyle type eggs and larvae than that of horses stalled 0 hours per day. The null hypothesis stated that there would be no difference between the two groups. The manure samples were collected, mixed with a sodium nitrate solution, then syringed into two chamber McMaster slides. The eggs and larvae were counted under a light microscope and the eggs per gram was calculated. A two tailed T-test ( $\alpha=0.05$ ) was completed to determine if there were statistically significant differences between the tested groups. The results suggested that these groups were not quite different enough for statistical significance to be considered.

## THEORETICALLY REPRODUCING EXPERIMENTALLY DRAWN PHASE DIAGRAMS OF DOPC-PSM-CHOLESTEROL

Jacqueline Tobin  
Governor's School for Science and Math  
Mentor: Dr. Uline; Department of Chemical Engineering, University of South Carolina

In our research we recreated an experimentally drawn phase diagram of the cell membrane components DOPC-PSM-Cholesterol using the Putzel and Schick mathematical model. We used data from an experiment completed by Sarah Keller and Sarah Veatch at the University of Michigan to help form our model diagram. We created a simpler ternary diagram of this phase separation and determined if there was a relation between the shape formation of the ternary phase diagram and the presence of the three components in the membrane. We found that the mathematical model created accurately represented the experiment's graph. The model created a similarly shaped closed phase boundary. This indicates that the lipid rafts may form due to phase separation. We need to reevaluate the thermodynamic consistency in further models.

## THE EFFECTS AND CHEMISTRY OF NATURAL REPELLANTS VERSUS CHEMICALLY FORMULATED REPELLENTS ON MELITTOBIA DIGITATA

Paris Tomlin and Sonali Patel  
Heathwood Hall Episcopal School

In this experiment, the purpose was to determine if chemically formulated repellants or natural-based repellents have a greater effect when tested on Wow Bugs; *Melittobia digitata*. The independent variable used in this experiment was the repellents used on the *Melittobia digitata*, which were lemongrass oil and OFF insect repellant. The dependent variable was how the *Melittobia digitata* reacted to the various repellants. The hypothesis for this study was if the chemically formulated repellant DEET and a natural repellant are used, then more *Melittobia digitata* will be repelled by DEET. The researchers found that the DEET based repellant was the most effective. An ANOVA test showed the data to not be statistically significant because there was not enough variation between data sets. Therefore, the results of this study does support the hypothesis.

## SUPER RESOLUTION NANOSCOPY FOR BIO-IMAGING BASED ON CW LASER STED MICROSCOPY

Kiara Tompkins  
Governor's School for Science and Math  
Mentor: Dr. Wang; Department of Biomedical Engineering, University of South Carolina

Optical resolution has always been restricted by the Ernst diffraction limit, which states that lens-based optical microscopes are unable to discern details that are closer together than half the wavelength of light. Until about 20 years ago, it was deemed impossible to see particles, such as proteins, that are less than 100 nanometers apart. However, with advancements in fluorescence microscopy, particularly Stimulated Emission Depletion (STED) microscopy, it is now possible to see such structures at the sub organelle level. Although difficult, the end result is an easy to read STED image. The purpose of this experiment was to determine the position at which the best STED image could be captured, allowing for the clearest possible image. In order to find this ideal position, several stimulation trials were run, and with each trial the piezo scanning stage was only moved a few nanometers. The position of the particle in all three coordinate directions (x, y, z) was recorded and the strength of the UV and green laser was recorded as well. In order to best determine the ideal position, several computer programs were used that produced graphs and images that helped determine the most efficient location for the particle. This experiment resulted in images and graphs that allowed the particle to be seen on the nanoscale level with greater clarity than had been obtained previously. The results for this experiment can be used for a wider variety of applications in bio-imaging and could further enable identification of specific proteins in cells.

THE EFFECT OF IMPLEMENTING HONEYCOMB STRUCTURES IN A PHONE CASE AND ANALYZING THEIR INTEGRITY /

Edoardo Tremolada  
Spring Valley High School

Honeycomb structures of hexagonal arrays are naturally occurring structures that occur in many organisms, such as the venation of a leaf (Liu, H., Zou, M., Wang, D., Yang, S. & Liang, M., 2014). This special structure is vital in various applications. Specifically for venation, it is the optimal support structure for the leaf and distributes the veins equally throughout it. The purpose of this experiment was to test a honeycomb's structural integrity by using a Structural Stress Analyzer. Young's modulus of each structure was analyzed with phone cases. A simple iPhone 6 Plus case was chosen from a variety of pre-designed cases online and then printed using the 3-D printer, Z-18, from Makerbot. Two settings were used when printing: no infill and 15% infill. Since the printer automatically infills an object with a hexagonal structure, the 15% infill provided as the honeycomb structure and the 0% infill served as the control. The hypothesis of the control group having a Young's modulus less than the phone cases with honeycomb structures was supported. At  $\alpha = 0.10$ , the Young's modulus in cases with 15% infill was significantly larger than the control,  $t(3) = -1.66$ ,  $p = 0.086$ . In conclusion, the idea of implementing biomimicry in everyday inventions or innovations are beneficial and efficient.

AN ANALYSIS OF THE ECONOMIC IMPACTS OF ACCESS MANAGEMENT STRATEGIES ALONG SELECT CORRIDORS

Joshua Trill

Governor's School for Science and Math

Mentor: Dr. Huynh; Department of Civil and Environmental Engineering Department, University of South Carolina

The purpose of this project is to analyze the economic effect of access management strategies (AMSs) on businesses around South Carolina along select corridors. AMSs include constructing raised medians and other physical barriers along roads such as right in right out turn lanes. These types of AMSs are meant to improve roadway safety, decrease travel time, and lower congestion along major corridors by controlling where and how vehicles are allowed to turn. One of the perceived downsides of AMSs is that business owners believe that it lowers their profits by making it more difficult for customers to access their businesses. The focus of our study has been to analyze both the perceived and the actual economic impacts of common AMSs on businesses so that the Department of Transportation (DOT) will be able to have a definitive and objective analysis of their effects on business profits and operations. Similar studies have been completed in other states and have shown positive results. These states include North Carolina, Washington, and Texas. Each state completed an analysis that consisted of an operational study while only Washington completed an economic study. This study was performed for the same reason as ours, to be able to give empirical evidence to businesses that outlined the effects of AMSs. During the period in which I worked on the project we focused on a section of Two Notch Road in Columbia. Our goal in this area is to focus on a raised median installed in 2013 and 2014.

THE EFFECTS OF A THUNDERBOLT 3 BASED LAN ON THE JAIN'S FAIRNESS INDEX OF THE NETWORK

Vijay Tripathi

Spring Valley High School

As computing systems, cinematography, networks, workflows, the internet, cloud services, and various network-based technologies advance, they offer more power and capabilities. However, as these systems grow, they require more resources. Computer networks are defined as a communication method between two or more computers via a wireless or wired connection that offers file transfer, remote connections, and other utilities. The purpose of this research was to compare an Ethernet and Thunderbolt based network to test their fairness and reliability. To evaluate the network fairness, Jain's equation, which yields an index between 0 and 1. The higher the index, the better the network is at sharing resources. It was hypothesized that the Thunderbolt based network will yield a higher index than the Ethernet network. A brief overview of methods of conducting the experiment is as follows. Two identical computers completed various network based tasks, which included file transfer and video editing. For file transfer, computer A transferred a one terabyte file to computer B. Instantaneous write speeds, transfer time, and CPU usage were recorded. This was repeated for both network types fifty times. For video editing, computer A had various 4K video clips. Computer B used these clips in real time, as opposed to importing, to render a video. The final rendered video was uploaded to computer A in real time. Scrubbing time (in milliseconds), import time (in seconds), and render time (in minutes) were recorded. Data was then substituted into Jain's equation. Statistical tests were taken and conclusions were drawn from the data.

THE EFFECTS OF VITAMIN E AND VITAMIN B (THIAMINE) ON THE GROWTH RATE AND FINAL WEIGHT OF TENEBRIO MOLITOR LARVAE

Nina Valenti

Dutch Fork High School

Tenebrio molitor larvae have the potential to be a highly significant source of food for the human population. This is critical because 2012 and 2050, the need for animal proteins is expected to increase by 70 to 80%. Many countries consume mealworms including Thailand, Mexico, The Netherlands, China, and Brazil this shows that a large percentage of the world is open to the idea of consuming mealworms. Although research has been conducted on the effects of vitamins on growth rate of

mammals and fish, little is known about vitamin's effects on holometabolous insects such as the mealworm. Yellow mealworms typically take 3-4 months to reach the maximum size before they pupate into their adult form, the darkling beetle, so the objective of this study is to determine if thiamine or vitamin E directly increases growth rate so that production of mealworms is more time efficient. In this study, the amount of days that each group of mealworms take to pupate will be measured were a smaller amount of days corresponds with a faster growth rate. The average weight will also be calculated twice every month to determine net growth. This study will demonstrate that dietary supplementation of thiamine and vitamin E increases the growth rate and net growth of *Tenebrio molitor* larvae.

#### THE EFFECT OF COPPER AND SILVER NANOPARTICLES ON ESCHERICHIA COLI K-12

Sreeja Varanasi  
Spring Valley High School

The effect of copper and silver nanoparticles on *Escherichia coli* K-12 / Sreeja Varanasi / Environmental Science / / Almost 783 million people do not have access to clean drinking water. Many of these third world residents who do not have clean drinking water, resort to drinking any water that is available. *Escherichia coli* (*E. coli*), a harmful bacteria that harm and even kill humans, is found in the unsanitary waters of most third world countries. The purpose of this study was to find the most effective element in the form of nanoparticles so that new and improved water filters are made to be more efficient and are distributed around the world faster. It was hypothesized that a silver nanoparticle-coated polyurethane foam piece would inhibit more bacteria than a copper nanoparticle-coated polyurethane foam piece, because silver exhibited properties that could modify and destroy bacterial cells. Polyurethane foam pieces were soaked in colloidal silver and copper, which contained silver and copper nanoparticles respectively. These coated polyurethane foam pieces were exposed to bacterial water, and the absorbance as a function of the concentration of bacteria water was recorded before and after the polyurethane foam piece was introduced. The hypothesis was supported. The silver nanoparticle trials did inhibit more *E. coli* K-12 than the copper nanoparticle trials. An ANOVA test ( $F(2,57) = 148.1327, p < 0.0001$ ) was run. It showed that the means were statistically different ( $p = < 0.0001 < \alpha = 0.05$ ). A two sample t-test determined that there was also significant difference between the copper and silver nanoparticle trials. In conclusion, silver nanoparticles were more effective than copper nanoparticles.

#### RELATIONSHIP BETWEEN GROWTH PLATE DEVELOPMENT AND POINTE RELATED INJURIES

Angelica Walker and Stephanie Hals  
Chapin High School

This observational study was completed to find the correlation between growth plate development and pointe ballet related injuries of adolescent females from ages 12-18 who dance ballet en pointe. Pointe is a classical ballet, in which a ballet dancer supports all body weight on the tips of fully extended feet. According to a study done by the Journal of Dance Medicine, a total of 82% of dancers had suffered between one and seven injuries consisting mostly of foot and ankle injuries. Dance related injuries among children and adolescents increased 37% between 1991 and 2007, according to a new study from Nationwide Children's Hospital. For this study we hypothesize there will be a correlation in low development of growth plates and ankle injuries. The survey asks questions to determine the extent of each dancer's development and type of injury. This survey was administered to pointe dancers in Irmo, SC from Dance Department and Southern Strutt in November 2015. The study shows a connection between growing growth plates and a higher percentage of injuries, 17% girls with ankle injuries and 60% of those dancers whose growth plates are still developing. Conclusions were relayed to current ballet/pointe teachers to aid them in determining if students physically ready for pointe.

#### CONNECTIONS BETWEEN INHIBITION OF ATP PRODUCTION AND FATTY ACID UPTAKE IN PROCYCLIC TRYPANOSOMA BRUCEI BRUCEI

Olivia Walkowiak  
Governor's School for Science and Math  
Mentor: Dr. Paul; Department of Genetics and Biochemistry, Clemson University

*Trypanosoma brucei* spp. are blood-borne parasites transmitted by the bite of a tsetse fly that cause Human African Trypanosomiasis (HAT), also known as African Sleeping Sickness, in humans and a wasting disease called Nagana in cattle. HAT is a major problem in over twenty-four countries in West and Central Africa. Of all infected individuals, less than 10% received any treatment. These parasites are dependent on acquiring fatty acids from their hosts. In order to better understand fatty acid uptake in *T. brucei*, we examined the energy requirements for this process using the tsetse fly midgut procyclic form of *T. brucei brucei*, the sub-species that infects cattle. Energy for endocytosis comes from ATP production. We investigated the relationship between ATP levels and fatty acid uptake. We developed a luminescence-based assay using Cell Titer GLO (Promega) to record intracellular ATP levels, which were normalized to cell number using a Coomassie-based Protein Assay (Bio-Rad). This assay was validated using a serial dilution of cells. ATP production was limited using a mixture of the metabolic inhibitors sodium azide and 2-deoxy glucose. Fatty acid uptake was measured using a BODIPY C-12 fluorescence assay. Inhibition of ATP production caused no difference in fatty acid uptake. Fatty acid uptake in *T. brucei brucei* does not appear to be solely dependent on high ATP levels. These results suggest that the primary mechanism of fatty acid uptake in *T. brucei brucei* is diffusion. This research may help identify and evaluate novel methods to treat HAT and Nagana.

## MOLECULAR DYNAMICS ON OLIGOPEPTIDES TO ASSOCIATE VIBRATIONAL DENSITY OF STATES WITH RAMAN SPECTRA

Albert Wang

Dutch Fork High School

Mentor: Tristan Giesa; Massachusetts Institute of Technology

Raman spectra provides unique information on the conformation, ionization, hydrogen bonding, and hydrophobic interactions of peptide main chains and amino-acid side chains of proteins. However, obtaining Raman spectra through experimentation presents a challenge due to irradiation. During irradiation, the spectrum of the scattered radiation is measured at a definite angle with a suitable spectrometer, causing the intensity of the Raman lines to be one-millionth the intensity of the source. In our study, we develop simple peptide models and perform molecular dynamics simulations to calculate Vibrational Density of States (VDOS), specifically focusing on mid-range frequencies between 600-1800  $\text{cm}^{-1}$ . VDOS calculations in the Groningen Machine for Chemical Simulations (GROMACS) molecular dynamics package are presented and compared with Raman spectra generated from experimental measurement. Characteristic peaks of VDOS and Raman spectra are confirmed using Density Functional Theory and then mathematically modelled for correlation. In this study, we present an analytic model for our approximation relating VDOS to Raman spectra. From the uniqueness of Raman spectra, we investigate a mathematical model to predict the Raman spectra of complex protein structures from VDOS, with the objective of developing new computational methods to expedite the measurement of Raman spectra for protein analysis.

## CTLA-4'S ROLE IN THE DYSREGULATION OF T-CELL FUNCTION IN SARCOIDOSIS

Rebecca Wang

Governor's School for Science and Math

Mentor: Dr. Drake; Infectious Diseases Department, Vanderbilt University

Sarcoidosis is an autoimmune disease with an unknown cause. In Sarcoidosis, the T-cells are activated to destroy harmful substances, but then do not deactivate and subside. The result is the formation of lumps, or granulomas, in the organs of the body, most commonly in the lungs and lymph glands in the chest. There is no cure; however drug treatment is often used to reduce inflammation. CTLA-4 is a glycoprotein of the Ig superfamily that acts as an immune checkpoint which regulates T-cell activation in T-cell-dependent immune responses. CTLA-4 signals lead to the down regulation of T-cell proliferation and activation. Since Sarcoidosis is caused by T-cells being activated and then staying activated, and CTLA-4 is an inhibitor of this activation, CTLA-4 can interfere with TCR-derived signals and block early signaling events. Finding a way to enhance the effects of CTLA-4 could potentially stop cell proliferation so the T-cells do not stay activated. However, researchers do not know which interactions or regions of CTLA-4 need to be targeted in order to enhance CTLA-4's inhibitory functions. In this experiment, CD4+ and CD8+ T-cells taken from Sarcoidosis cells and controls were isolated. cDNA synthesis, using iScript, was conducted and Real-Time PCR was set up to target CTLA-4. It was found that there is a decreased CTLA-4 expression in Sarcoidosis that trends toward significance and a higher CTLA-4 expression in Sarcoidosis CD4 vs. CD8 T-cells. Even though the results showed no statistical significance, they were trending towards significance.

## THE EFFECT OF CARBARYL, PERMETHRIN, AND BIFENTHRIN ON THE GROWTH OF BRASSICA RAPA

Matt Watford

Heathwood Hall Episcopal School

The purpose of this test was to determine the effect of various pesticides on the Brassica rapa plant. The pesticides used were Carbaryl, Permethrin, Bifenthrin. The hypothesis was that if Brassica rapa is exposed to Carbaryl, the impact will be worst than the rest of the pesticides. The null hypothesis was that no pesticides will have any effect on Brassica rapa. The project was carried out in the greenhouse at Heathwood Hall with a controlled environment. The seeds were subjected to each treatment the day they were planted. The pesticides came in powder form, so they were sprinkled on top then watered. The mean growth for the control group was 29.05 cm, 26.05 cm for Carbaryl, 28.25 cm for Permethrin, and 29.35 for Bifenthrin. An ANOVA Single Variable test was used and it showed that there was no statistically significant difference in the treatments.

## THE EFFECT OF MAGNETISM ON THE REGENERATION RATE OF DUGESIA TIGRINA /

Noah Wells

Spring Valley High School

Dugesia tigrina (Brown Planaria) are known for their species' ability to regenerate any part of their bodies after any injury, no matter how severe. Due to their small stature, planaria are very susceptible to outside stimulus, like temperature. In this experiment, brown planaria were exposed to different types of magnets while undergoing the regeneration process to test the effect such stimulus could have on this process. It was hypothesized that the effect of the neodymium magnet would cause the regeneration rate of the planaria to increase the most. The experiment was carried out by equally separating 30 into three separate petri dishes. One petri dish had a 2 in x 1/2 in x 1/2 in rectangular neodymium placed inside of it. Another had a 2 in x 1/2 in x 1/2 in rectangular samarium cobalt magnet inside it, while the last dish had no magnet inside. All planaria in the dishes were cut horizontally along their bodies and observed and measured each day for 10 days. An ANOVA test was run. The hypothesis that the neodymium magnet would increase the regeneration rate was rejected. At  $\alpha = 0.05$ ,  $F(2,6) = 1.703$  and  $p = 0.2596$ . The regeneration rate, when stimulated by the neodymium or samarium cobalt magnet, had no significant difference. In summary, magnetism did not appear to affect the regeneration rate of Dugesia tigrina in any substantial way. /

## THE EFFECT OF SOCIALIZATION AND ISOLATION ON BINGE DRINKING IN C57 MICE

Taylor Widener

Governor's School for Science and Math

Mentor: Dr. Rice; Department of Psychology, Furman University

Dopamine D3 receptor antagonists have been shown to significantly decrease alcoholism related to stress, but stress is not the only factor contributing to alcoholism. Many people binge drink because of social isolation or facilitation and the area of the brain that governs social drinking may be different from the area controlling stress drinking. Because of this, we do not know if a D3 antagonist will help a social drinker. To demonstrate the difference between social drinking and stress drinking, a Drinking in the Dark paradigm was used with 30 female C57 mice. The mice were split into three groups of 10. The first group lived in cages alone for two weeks to acclimate to the isolation before drinking. They served as a baseline to measure against. The second group lived in cages of two at all times, even when drinking. The third group lived in cages of two until 5 pm the day before the drinking paradigm so that they would still show the impact of isolation. In general there does not seem to be a difference between the amount of alcohol consumed by the social mice and the recently isolated mice. In the future, these results can be used to determine whether or not a D3 antagonist would help those who binge drink due to social facilitation.

## THE EFFECT OF DIFFERENT CONFIGURATIONS OF NEODYMIUM MAGNETS ON THE AMOUNT OF MILLIVOLTS(MV) PRODUCED IN A KINETIC GENERATOR. /

Thomas Wigley

Spring Valley High School

The race to build a better energy source other than fossil fuels have been a big goal for science for many years. Many different types of alternate energy sources have already been produced including wind, water, etc. However kinetic energy is an energy that has only recently been thought and/or able to be harvested. It can be harvested through a kinetic generator that uses Faraday's law of induction to create energy by using a magnetic field coming in contact with a coil of conductive wire. This can be used to gather kinetic energy from everyday life. The purpose of this experiment is to create a better kinetic generator by changing the magnet configurations in order to create more electricity therefore a more efficient kinetic generator. It was hypothesized that a magnet in the configuration of south to south without a gap would create the most electricity. The tests were conducted by first making the coil and magnet configuration. Then the voltmeter was hooked to the coil and the magnet configurations were passed through the coil. The results were recorded from the readout of the voltmeter. The results concluded that the north to south with a gap created the most electricity and that it is significant with a 95% confidence interval. An ANOVA test was used to compare the four means of the north to south with gap, north to south with no gap, south to south with gap, and south to south with no gap. In conclusion the north to south with a gap seemed to be the most efficient in producing the most electricity and the hypothesis was not supported. /

## THE EFFECT OF PHOTOVOLTAIC CELLS ON ELECTRICITY COSTS

Allen Wilbur

Dutch Fork High School

In the field of energy production, the cost effectiveness of solar energy systems are affected by certain factors which influence their ability to produce consistently high amounts of electrical power. Insufficient research has been done to determine whether solar power provides enough energy to power a house in real world conditions over a long period of time, or whether the solar power system provides a valuable enough economic incentive to justify their purchase, since costs remain a major barrier to the widespread use of solar power. In this project, it will be examined whether solar power provides enough of a real benefit to electricity costs for a household to justify their use in home electrical systems. This will be done by determining the output of a solar system and comparing it to the electricity needs of a house over a period of time. The solar systems will likely provide some benefit to the cost of electricity, but initial costs will likely hold the systems back from being an extremely beneficial investment. Through this study, it will be determined whether photovoltaic systems are viable sources of electricity cost reduction under real-world conditions.

## A COMPARISON OF PHOSPHATE AND TOTAL DISSOLVED SOLID LEVELS IN CITY WATER AND WELL WATER IN SOUTH CAROLINA

Kate Willhide

Heathwood Hall Episcopal School

The purpose of this experiment was to compare levels of phosphorus and total dissolved solids (TDS) in city water and well water. It was hypothesized that well water would have higher levels of phosphorus and TDS, because well water is not treated but is pumped directly from the ground to pipes. Water samples were collected from city sources and well sources from the Columbia SC area in 40 mL vials. The phosphorus test relied on color to determine the amount present in the water sample, while TDS were measured using a digital tester. The data partially rejected the hypothesis, with the statistical analysis showing a statistically significant difference in phosphorus levels and a very slight significant difference in TDS levels, with city water having higher levels of both.

## PLANAR HALL EFFECT IN THIN FERROMAGNETIC FILM'S DEPENDENCE UPON EXTERNAL MAGNETIC FIELD ANGLES

Wesley Williams

Governor's School for Science and Math

Mentor: Dr. Crittenden; Department of Physics and Astronomy, University of South Carolina

When a thin ferromagnetic film is exposed to an altering external magnetic field and a current is run through it, a Hall voltage will be present, leading to the existence of the normal Hall Effect. Due to the internal magnetic field being influenced by the altering external magnetic field, the planar Hall Effect will also come into being, seen when the internal magnetic field “snaps back” to the easy axis of the film. This experiment begins to search for the relationship between the angles at which the external magnetic field that is altered hits the film to the locations of the “peaks” created when reading the Hall voltage due to the “snap back”. Using thin layers of gold and cobalt in Hall triplets hooked into a simple sample holder and placed in the testing platform, a constant current is applied through the Hall triplets, and the Hall voltage is collected. An external magnet above the platform is fed a current that oscillates to cause the change in the Hall voltage. These results could go on to improve extremely sensitive magnetic field detectors that use the planar Hall Effect, and increase ease for scientists who work with the planar Hall Effect.

## G418 TREATMENT OF PATIENTS WITH A NONSENSE MUTATION IN THE X-LINKED CUL4B GENE

Madison Williamson

Governor's School for Science and Math

Mentor: Dr. Srivastava; Center for Molecular Studies, Greenwood Genetics Center

A nonsense mutation changes a sense codon into a premature stop codon that terminates the polypeptide chain prior to its completion. This creates a shortened protein that is ineffective. For patients with a nonsense mutation in the CUL4B gene, this creates moderate to severe intellectual disability as well as prominent phenotypes such as truncal obesity, short stature, and small feet. Previous studies found that nonsense mutations can be suppressed through the introduction of small molecular compounds, and more specifically, through the use of aminoglycosides, which bind to the proofreading centers of the ribosomal complex and allow for misincorporations of sense codons at the site. Aminoglycoside suppression therapy is a possible treatment option for nonsense mutations. However, it has not been widely tested against genetic disorders. This research explored the effects of aminoglycoside treatment for nonsense mutations in X-linked genes that resulted in intellectual disability. We tested the effects of G418 on the metabolic rates and ability to produce full-length protein in patient samples with nonsense mutations in the CUL4B gene, a commonly mutated gene resulting in intellectual disability. G418 was able to increase the amount of full-length CUL4B protein produced based on Western Blots, and increased the metabolism of patient cells. However, further studies are needed to reduce toxicity levels and improve the read through.

## HEARING COLOR AND SEEING SOUNDS: TO WHAT EXTENT DOES COLOR REPETITION OCCUR IN SONG SELECTION INVOLVING MALES AND FEMALES

Allison Wilson and Sarah Hudson

Heathwood Hall Episcopal School

Throughout the year, a test has been constructed to find a correlation between color selection in males and female while listening to music. The purpose of this study is to examine any repetition that may occur in color selection when listening to five specific songs. In order to test this hypothesis, forty 7th and 8th grade students took a hearing colors test that required them to listen to five song and select three colors that they felt best represented the song. After all data was collected, each result was examined and inferred into data charts. Throughout the testing there were three noticeable colors that were selected multiple times by multiple people: red, orange, and yellow. To conclude the research, there is not a specific interrelation in the results that were collected, however there were certain repetitions that did occur between the forty students. Therefore, these results did support our hypothesis.

## MTF-1 AS AN ACTIVATOR OF HEAVY METAL HOMEOSTASIS IN SCHISTOSOMA MANSONI

Johnny Wood

Governor's School for Science and Math

Mentor: Dr. Jolly; Department of Biology, Case Western Reserve University

Schistosomiasis is a parasitic disease affecting over 200 million people caused by platyhelminths of the genus Schistosoma. Schistosomes have started to develop resistance to the most common treatment, praziquantel. So, new methods of combating the disease need to be found. Copper has been found to induce lethality in the schistosomula parasite. To better understand how schistosomes respond to copper, we studied the role of Metal Responsive Transcription Factor 1 (MTF-1) as a transcriptional activator. MTF-1 is a transcription factor that functions in heavy metal homeostasis in many organisms. Schistosome MTF-1 was fused to the GAL4 binding domain to test whether it could activate transcription in a yeast one hybrid assay. The MTF-1 construct did not activate transcription in either the absence or presence of copper. MTF-1 does not appear to activate transcription in response to heavy metal stress in schistosomes. This suggests that copper lethality is not mediated by MTF-1 activity in schistosomes.



## OPTIMIZING UNDERWATER TURBINE BLADES TO IMPROVE THE EFFICIENCY OF OCEAN ENERGY GENERATION

Tyler Wrenn  
Center for Advanced Technical Studies

This study's goal was to determine if there is an optimal blade design, from biomimicry, for an underwater turbine that allows for an improved efficiency. For this project, the null hypothesis is the efficiency of all biomimicry blades will be less than or equal to nonbiomimic blades. The alternate hypothesis is the efficiency of one biomimicry blade is greater than a nonbiomimicry blade. For this project, research on various aquatic species was conducted to determine how the fins of the aquatic animals help the animals move through the water. Then the blades were mimicked in Solidworks and were fabricated using a 3D printer. After printing, the blades were tested in a controlled environment and the resulting data was analyzed. After static analysis, the blades were categorized and the null hypothesis was rejected or accepted for each individual blade design. Results to date have shown that there is great potential for biomimicry blades. So far the optimal blade design is that of a hump-back whale, producing a max of 18 DC volts. The whale fin was the only blade design that was able to completely reject the null hypothesis. This finding is not surprising because of the inclusion of this design in commercial wind turbine blades. From these findings further research will be conducted on different aquatic animal designs that will have tubercles in various places. In addition to animal fin research, further research will be conducted to find the optimal pitch of the blade.

## THE EFFECT OF IN VITRO SILICA TREATMENT ON LUNG FIBROBLASTS

Nicole Wyman  
Governor's School for Science and Math  
Mentor: Dr. LaRue; Department of Pathology and Laboratory Medicine, Medical University of South Carolina

Pulmonary fibrosis is a debilitating lung disease that is caused by an over proliferation of fibroblasts, which scars the lung tissue. Currently, the disease is regularly modeled by an in vivo approach, which does not allow for the molecular level examination that an in vitro model would. Silica is often used as a stimulus for pulmonary fibrosis, with in vivo experiments, so it was used in this in vitro experiment. To test the impact of silica on lung fibroblasts, lung samples were extracted from an Ly5.1 mouse, the type of mouse for basic research, and plated to allow for fibroblast proliferation. The fibroblasts were treated with varying doses of silica and then tested for alpha-smooth muscle actin ( $\alpha$ -SMA) and collagen I (Col I) protein levels. TGF-beta (TGF- $\beta$ ) treatment was used as a positive control as it has been shown in previous to induce activation in NIH3T3 fibroblast cells. The TGF- $\beta$  treatment resulted in an increase of both alpha-smooth muscle actin and collagen I levels, demonstrating the activation of fibroblasts. The silica treatment resulted in an increase of collagen I levels in the lower dose, but a decrease in the higher doses. Fibroblast death may have caused this decrease in collagen I levels. Silica treatment did not affect the alpha-smooth muscle actin levels. The constant alpha-smooth muscle actin levels and decrease in collagen I levels suggests that the untreated fibroblasts were activated, creating a successful in vitro model of pulmonary fibrosis.

## THE EFFECT OF HYDROGEN CONSUMED AS FUEL ON THE ENERGY OUTPUT FROM A MODEL HYDROGEN FUEL CELL CAR

Jim Xue  
Heathwood Hall Episcopal School

This experiment determined the relationship between hydrogen used and the distance travelled by a working model of a Hydrogen Fuel Cell Car. This study also determined the efficiency of the Hydrogen Fuel Cell by determining the relationship between the time interval and distance travelled. The distance the car travelled on each volume of hydrogen measured, and the distance the car traveled in a certain time interval was also determined. The results suggest that there is a direct relationship between the volume of hydrogen gas used and the distance travelled as well as the time interval. The independent variable was the amount of hydrogen used, and the dependent variable was the distance travelled, time used, and the electrical power produced by the same amount of hydrogen gas. The results of this study can help determine if Hydrogen Fuel Cells should be used as a future power source for cars.

## ESTROGENICITY OF PERSONAL CARE PRODUCTS AS MEASURED IN A YEAST ESTROGEN SCREEN

Lauren Yam  
Governor's School for Science and Math  
Mentor: Dr. Roark; Department of Biology, Furman University

Endocrine disruptors are chemicals that have the potential to interfere with hormone pathways in the body. Estradiol is a naturally occurring hormone that interacts with nuclear estrogen receptors. Multiple endocrine disruptors can also bind to estrogen receptors and elicit estrogenic effects. The yeast, *Saccharomyces cerevisiae*, serves as a model to measure the estrogenicity of these endocrine-disrupting chemicals. Recombinant yeast that expresses human estrogen receptor genes, and a reporter gene, LacZ, turns yellow when exposed to estrogenic chemicals. The yellowness of the yeast, quantified using a spectrophotometer, corresponds to the estrogenicity of the chemicals tested. Some common estrogenic chemicals and endocrine disruptors, like bisphenol A (BPA), phthalates, and parabens, are often found in personal care products. The purpose of this study was to expose recombinant yeast to these personal care products in order to determine how estrogenic the products are by measuring the yellowness of the yeast. The estrogenicities of each personal care product tested are reported as estradiol equivalents as predicted from estradiol dilution curves and LacZ values that were analyzed in JMP software. Implications of long-term use of these estrogenic products are discussed as potential dangers in terms of consumer health.

#### DEVELOPMENT OF MOLECULAR MARKERS IN REDBAY

Kenneth Yarborough

Governor's School for Science and Math

Mentor: Dr. Liyang; Department Of Genetics and Biochemistry, Clemson University

Woody plant redbay (*Persea borbonia*) is a native species in South Carolina whose fine-grained wood is industrially valuable and whose fruits are a valuable food source for animals. However, laurel wilt disease has caused high levels of redbay death, threatening the sustainability of this economically and ecologically important woody plant species. Planting resistant clones of trees is the most promising approach to combat the disease. Large-scale development of molecular markers is imperative in molecular breeding for crop improvement. This project aimed to initiate a small-scale analysis of approximately 200 markers obtained from a shallow genome sequencing project of redbay. The markers that were being used targeted microsatellites, small tandem repeats of DNA that are highly mutable. Of the 213 markers being tested, polymerase chain reaction (PCR) amplification success rate was 94% among the 8 individuals that were used. A total of 160 markers had amplicons that were at least 100 base pairs in length. When fully characterized, these markers will be valuable in linkage map construction, molecular characterization of germplasm collections, and analysis of genetic diversity in redbay.

#### THE EFFECT OF VARIOUS VIDEO GAME GENRES ON THE AGGRESSION LEVELS OF ADOLESCENTS

Zachary Young

Spring Valley High School

Video games, specifically in the first person shooter genre, have been known to cause aggression in adolescents. The purpose of this experiment was to see what kind of effect other video game genres such as platformers, racing games, etc. could have on the aggression levels of adolescents. It was hypothesized that the platformer genre would cause the highest aggression levels in the adolescents who had played them than the other two genres and control. A group of 24 randomly selected adolescents were chosen to play either no game, Peggle, Battleblock Theatre, or Forza 4 for 15 minutes, then take the Buss and Perry Aggression Questionnaire in two minutes. The results had shown that the highest mean aggression score in adolescents were found with no video game, followed by Battleblock Theatre, Peggle, and Forza 4. An analysis of variance showed that the effect of the genres on aggression was not significant,  $F(7,16) = 1.9$ ,  $p = 0.136$ .

**END**

**SC Junior Academy of Science Abstracts**

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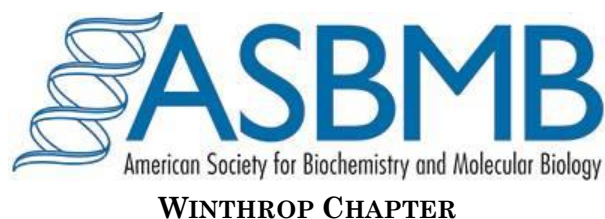
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